

Geological Survey of Illinois, A. H. Worthen, director.

Illinois.

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CHAPTER XIII.

COOK COUNTY.

BY HENRY M. BANNISTER.

Cook county is bounded on the north by Lake county, by Lake Michigan and the State of Indiana on the east, by Will county on the south, and on the west by Kane and DuPage counties. It embraces a superficial area of nearly twenty-five townships, or about eight hundred and ninety square miles. It is of an irregular shape, the main body extending north and south along the shore of Lake Michigan, but having at its northern extremity an area projecting westward, including townships 41 and 42, in ranges 9, 10 and 11 east of the third principal meridian. That portion of township 37, range 11, lying south of the Des Plaines river, forms another less extensive westerly projection.

The principal streams in this county are the Des Plaines, which traverses it in a general north and south direction, and the Chicago and Calumet rivers, emptying into Lake Michigan. These, with their tributaries, and one or two minor streams in the north-western part, emptying into Fox river, drain every portion of the county.

The proportion of prairie to wooded land in this county is a little greater than two to one. The timber is distributed in belts, of varying width, along the water-courses and on the shore of the lake, with frequent groves or timber islands in the open prairie. In many places, however, much of the original forest has been cleared away, and the process of denudation of timber is still going on.

The surface of the country is generally level or gently undulating, the latter character prevailing in the northern and south-western portions of the county, becoming more broken and even hilly in the extreme north-western and south-western parts. The hollows between the undulations are often marshy, and occasionally contain deposits of peat of greater or less extent. The central and south-eastern portions of the county are mostly level, consisting of nearly flat, and in some cases marshy, prairies, with occasional groves and belts of timber.

The soil of the prairies is usually a black or dark brown mould, varying from one to four feet in depth, and is underlaid by a lighter colored sandy or gravelly clay subsoil. In the dry timbered tracts this subsoil comes very nearly to the surface, and generally throughout the county supports a growth of black, white and red oak, butternut, black walnut, bitternut and shell-bark hickory, cottonwood, etc., with an undergrowth chiefly of hazel. In the damp woodlands of the central portion of the county, we find, in addition to the above species, burr-oak, elm, black ash, and locally sassafras, forming a considerable proportion of the timber. On the sandy ridges which skirt the shores of Lake Michigan, the timber is almost entirely composed of the different species of oak, black, white, yellow, red and burr, with an occasional clump of red cedar or white pine, with cottonwood on the edges of the narrow sloughs which separate the ridges. The soil of these ridges is probably the poorest for agricultural purposes in the county, for, though warm and quick, it is light and easily exhausted, and from its sandy nature is most quickly affected by drought.

The surface deposits in Cook county consist of the Drift proper and subsequent alluvial and lacustrine deposits. The former, consisting of blue clay and hardpan, becoming locally brown and yellow, with numerous boulders, covers most portions of the county to the depth of from ten to eighty feet, or even more, and is overlaid at various points by the more recent lacustrine deposits of the Terrace epoch. Of the more ancient geological formations, we find in this county only the outcrops of the limestones of the Niagara group, which attains here, as well as we can estimate, a thickness of nearly three hundred feet.

Surface Geology.

It is evident, with very little observation, that at a comparatively recent period, subsequent to the Glacial epoch, a considerable portion of Cook county was under the waters of Lake Michigan, which at that time found an outlet into the Mississippi valley through the present channel of the Des Plaines. The deposits of this period consist of beds of stratified sand and gravel in the central and eastern portions of the county, either underlying the flat prairies or arranged in the form of ridges, skirting the shores of the lake, and in one or two cases trending westward away from it to a distance of several miles. One of these ridges, which runs in a general east and west direction, is well seen on the road between Thornton station and the village of Old Thornton, in the southern portion of the county. It extends through the whole southern tier of sections in township 36, ranges 14 and 15 east, beyond the limits of the county and State, crossing the State line at Lansing station, on the Chicago and Great Eastern railroad. Another westward spur from the lake ridge is seen on the road running westward from the village of Grosse Point, in the southern tier of sections, towns 41, ranges 12 and 13 east. Still other sand ridges may be observed running in a general north and south direction, but at a distance of even seven

and nine miles from Lake Michigan. These latter are not generally very prominent, and are better recognized by the change in the nature of the soil and vegetation than by their elevation above the surrounding surface. The westernmost of these passes through the village of Oak-Ridge, and running in a direction west of south, crosses the Chicago, Burlington and Quincy railroad a few rods west of the depot at Lyons, and is lost in the slightly rolling country, after crossing the Des Plaines river.

These ridges seem to me to indicate the shores of the ancient bay, which with these boundaries, would require the level of Lake Michigan to be nearly forty feet higher than at the present time. The outlet was evidently near the summit, where the Illinois and Michigan canal passes, and where at the present time an alteration of the level for a very few feet would send the waters of the Chicago river into the Des Plaines. Another very evident outlet, to the south of this, was through the channel now utilized by the Calumet feeder, joining the Des Plaines at the Sag, about four miles north of Athens village. The mound, or ridge, at Blue Island may probably be referred to this level of the waters. The evidences of a powerful stream are numerous on the rocks at Athens, in the shape of water-worn surfaces, pot-holes, etc. The nearer ridges, running parallel to the present coast line, would appear to indicate a very gradual recession of the waters of the lake, before reaching its present limits.

The structure of these ridges is similar to that of beach deposits, generally consisting of irregularly stratified sand and gravel beds, with sometimes a thin seam of vegetable mould. This structure is well displayed on the lake shore, north of the University grove, at Evanston, where the wearing action of the lake storms upon the shore has cut down one of the ridges upon which the town is built. The following section, with which I am favored by Prof. MARCY, of that place, was taken with great care, and is of especial interest as showing evidences of changes in the relative levels of land and water during this period:

| | |
|--|----------|
| 1. Surface soil..... | 1½ feet. |
| 2. Fine sand..... | 2½ " |
| 3. Coarse sand..... | 2½ " |
| 4. Fine sand..... | 2 " |
| 5. Gravel..... | 1½ " |
| 6. Fine sand, containing tree trunks, etc..... | 1½ " |
| 7. Dark colored marly bed, the lower part peaty..... | 1½ " |
| 8. Fine sand..... | 3½ " |
| 9. Blue clay, (drift) | 3½ " |

In addition to the beds given in this section, there may be seen at one or two points, a thin seam of vegetable mould, resting immediately on the blue clays of the drift, and at the base of the true lacustrine deposits. In this seam there have been found many pieces of wood and stems of small trees, apparently cedar, and, in one instance at least, the stump with the roots penetrating the clay below to a depth of two or three feet, evidently in the position of its natural

growth, thus showing that the land was at that time sufficiently elevated to support trees. Water-worn pieces of wood, also apparently cedar, are quite frequent in the stratum of sand above the clay, (No. 8 of the section).

The bed No. 7 of the section, may be followed for upward of half a mile along the beach, and is also frequently met with in digging wells in the town. An occasional fragment of bone, and a great abundance of fossil fresh-water shells are found in this bed. The shells are all of existing species of *Unio*, *Pisidium*, *Physa*, *Lymnea*, *Planorbis*, *Valvata*, *Amnicola*, *Melantho*, *Ancylus*, etc. Immediately above this bed, and generally resting upon it, in the stratum of sand No. 6, we find many stems of large trees, chiefly oak, which seem to have drifted to their present resting place as the waters of the lake gradually encroached upon the marsh.

In the eastern part of the county, along the lake shore, we often find the black surface soil of the small wet prairies underlaid by a bed of quick-sand, containing fresh-water shells of the genera *Melania*, *Unio*, etc., which belong to the same period as the lake ridges. Instances of this kind of prairie may be observed along the lines of most of the railroads running southwestwardly from Chicago, and on the Milwaukee railroad running north. Indeed, such prairies may be seen at the present time, in the process of formation, at various points along the lake shore in this county and elsewhere. The bed No. 7 of the section was probably deposited under conditions very similar to those of the formation of these prairies, in the bottom of a shallow lagoon or marsh, and serves to show how gradual was the process of submergence or emergence, during which it was formed.

The ridges which are cut off by the lake strike the shore at a small angle, and from their direction we are able to judge of the trend of the coast in former times, and it appears that a large territory, probably many square miles in extent, has been washed away by the wearing action of the lake waves. At the present rate of wear, which at the greatest estimate, and at the most exposed points, is but a very few feet annually, it must have taken many hundreds and even thousands of years to wear away this territory, the lake being at or very near its present level.

The deposits of the drift in this county consist, as has been already stated, of blue clays, becoming locally brown and yellow, and hard-pan containing frequent boulders, with now and then a thin seam or irregular stratum of sand or gravel. They probably at one time covered the country to a much more uniform depth than at present, but subsequent eroding agencies have so modified the surface that it now ranges from twenty to eighty or a hundred feet in thickness in different parts of the county. Outside of the city of Chicago we have hardly any data for ascertaining the exact thickness of this formation, as wells seldom penetrate it to any considerable depth, and there is rarely any journal or record kept of the digging. It is probably thinnest west and south of Chicago, as the

rocks appear to be nearest the surface in those directions. In boring the artesian well at the Union stock yards, south of the city, it was found to be only about forty-five feet in thickness, and at the rolling mills in the northern part of the city, seventy-six feet of the clays of this formation were passed through. At Athens and vicinity the bluffs will average near eighty feet, or even more, above the uppermost exposures of the Niagara limestone, which is probably not far from the real thickness of the drift in that region. In the northern part of the county, though wells have been dug forty, fifty, and even seventy feet, I am not aware that any have passed through the drift to the formations below.

In the upper part of the drift there is often an appearance of stratification, especially in the vicinity of the larger streams. In the northwestern part of the county, in townships 41 and 42, range 9 east, lying near the Fox river, a very noticeable feature is a stratum of water-worn boulders and pebbles, chiefly of limestone, but with an occasional hard-head (boulder) of granite, hornblende rock, etc., which crop out on nearly all the hillsides, in some places strongly resembling a natural outcrop of a limestone bed. In the clays and hard-pan of the older drift, we often find in this county the finer and more homogeneous stratum in the upper portion. In the section afforded by the above shaft of the Chicago lake tunnel, after passing through the more recent beds of stratified sand and gravel, we find some thirty feet of fine blue clay, underlaid by what is described as "greenish hard-pan," containing numerous boulders and angular fragments of rock. The same arrangement of finer clays, underlaid by coarser hard-pan, is to be seen in various sections afforded by the lake-shore bluffs, at and near Wynecka, in the northern part of the county, but the line of division between the two is not generally very distinct.

An interesting feature, which has been noticed by Dr. ANDREWS, in the American Journal of Science, and by Dr. JEWELL, in his report to the Chicago Academy of Sciences, on the lake tunnel, is the presence of pockets, or irregular beds of sand and gravel, sometimes stratified, occurring here and there, without any regularity, in the clays and hard-pan of the drift. These masses of gravel and sand were accounted for as having been taken up from beach or bar deposits, while in a frozen state, by moving bodies of ice, during the glacial epoch, and deposited in their present resting-places with the finer sediment which formed the clay. However, as these gravel beds form the channels by which water traverses the otherwise almost impervious clays, it is possible that, in some cases, they may be due to its action, or, at least, have been considerably modified by this agency.

With the exception of such as may be found in fragments of rock derived from the older formations, these lower clays, in this county, appear to be almost entirely destitute of organic remains. In one or two instances only has there been observed what appeared to be fragments of decayed wood.

Scratches, such as are usually referred to glacial action, occur on the surface of the underlying rocks, at several places in this county. I have observed them

on the limestone beds in the vicinity of Blue Island, and at the village of Old Thornton, on pieces of the rock which had been quarried out. In the former place their direction was due north and south (magnetic), and at the latter, as nearly as could be learned of the position of the pieces *in situ*, from north by north-east to south by south-west. In most places, however, the exposures of rock are not such as will show the striae well.

Some peculiar surface-markings, which are found on some of the upper layers in the Athens quarries, are deserving of mention here. They consist of parallel grooves, sometimes extending over a considerable surface, and generally trending in a direction parallel to the course of the river (Des Plaines) valley, from north-east to south-west. They have been enlarged by the action of running water, and are very irregular in their outline. These have been referred to glacier action, which, however, seems hardly probable, when their position in the bottom of the river valley is considered. It seems to me more probable that the river channel and bottom have been excavated subsequent to the drift epoch proper.

Although, as has been already stated, only the limestones of the Niagara group appear in the surface outcrops in this county, we yet have a complete section of the underlying rocks, afforded by the artesian wells which have been bored in the city of Chicago and its immediate vicinity. Of these the deepest, and in some other respects most satisfactory for geological information, is the boring at the Union stock yards, south-west of the city, which passes through all the strata from the upper portion of the Niagara group to the lower magnesian limestone. The record was kept by Mr. JOHNSTON ROSS, who superintended the boring. The whole depth penetrated was eleven hundred and five feet, and after about forty-six feet of drift and surface deposits, the strata were passed through in the following order :

Niagara Group—254 Feet.

1. Bluish-gray limestone..... 16 feet.
2. Light-gray limestone, slightly varying in shade of color at different depths..138 "
3. Limestone (nearly white)..... 20 "
4. Limestone (buff or drab)..... 80 "

Cincinnati Group—250 Feet.

5. Shale (soft and fine).....104 feet.
6. Limestone (light-gray)..... 20 "
7. Shale (coarser and arenaceous).....128 "

Trenton Group—330 Feet.

8. Brownish ferruginous limestone..... 25 feet.
9. Grayish limestone (more or less dark).....305 "

St. Peters.

10. Whitish-brown sandstone.....155 feet.

Lower Magnesian Limestone—70 Feet.

11. Light-colored limestone (very hard)..... 60 feet.
12. Gray limestone..... 10 "

The strata are most probably horizontal, or nearly so, and the section, therefore, gives very nearly the true thickness of each bed. The thickness here given of the Cincinnati group, two hundred and fifty feet, is greater than is generally allowed, but this, perhaps, is only a local difference.

Niagara Group.—This formation, as far as can be ascertained from the outcrops of rock, underlies the whole surface of the county. In the northern part, however, exposures of rock are scarcely met with; indeed, all of the outcrops in the county, with, perhaps, one exception, are included in that portion lying south of the north line of township 39, ranges 12, 13 and 14 east. To the northward of this limit the country is covered with a heavy deposit of drift; but this is, in all probability, underlain by the same beds of Niagara limestone as farther south. The nearest outcrops in the adjoining counties are of that age.

We find the study of the Niagara group, as it is developed in this county, somewhat difficult, not only on account of the infrequency of exposures, but also because of the lack of good natural sections. By means of the artesian well section, however, we learn that its thickness in the vicinity of Chicago is not far from two hundred and fifty feet. There are also certain strata occurring in the southern and south-eastern portions of the county, which do not appear to have been passed through by the Chicago borings, and which are probably still higher in the formation. Add from thirty to fifty feet for the thickness of these to the amount afforded by the artificial section, and we have an aggregate thickness of this group in the county of from two hundred and eighty to three hundred feet. The exposed thickness, however, is somewhat less, as the lowermost beds do not come to the surface within the limits of the county. The dip of the strata appears to be mainly to the south and east, thus bringing the uppermost beds to the surface in the southern and eastern portions of the county. The principal outcrops, commencing at the (supposed) upper beds, are as follows:

About a mile and a half 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 semi-liquid condition, though, in the rock itself, the more volatile part appears to have mostly 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 half a mile. The rock is exposed, however, at but a few points, being else-

where covered with soil to the depth of a foot or more. The most southerly outcrop lies about a quarter of a mile south of the railroad, and is of very limited extent.

Somewhat more than a mile north-east of the first-mentioned locality, in the north-west part of section 23, at Miller's lime-kiln, the same beds are quarried for lime, and present a precisely similar appearance. The bituminous character of the rock is evidenced by a very perceptible odor during the process of burning the stone in the kiln. Just north of the kiln, at the bottom of one of the excavations, there appears an impure buff-colored stratum, with a little of a bluish tinge where it is least weathered, and having somewhat the appearance of a hydraulic rock. The exposure, however, is too limited for a thorough examination, and nothing could be learned of any practical test as to its qualities, excepting the statement that it would not slake after burning in the kiln.

Immediately north of this locality, the ledge disappears under the drift, and no exposures of rock are met with within several miles of this point. The nearest occurs in the south-eastern quarter of section 4, in the same township, where the bed of Thorn creek, for a few feet, is composed of an impure bluish limestone, containing what are apparently traces of fucoids.

In the quarries at Old Thornton, the strata have a strong dip, varying from ten to twenty degrees, to the south-east, and by this a considerable thickness of the strata is exposed. The exposures, however, are not continuous, and it is not easy to ascertain the exact amount, but perhaps about seventy-five feet will be a sufficiently low estimate. The uppermost beds exposed here, appear on the west bank of Thorn creek, about two hundred yards above the bridge, and are probably equivalent to the beds exposed at Miller's, though differing somewhat, lithologically. The rock is a massive gray limestone, rather dark in color, and more compact than the rock in the above mentioned locality, but like it in being highly fossiliferous, and bearing identical species of *Pentamerus*, *Favosites*, etc. In the quarries nearest the bridge, the rock is a yellowish limestone, showing a light gray color on freshly-fractured surfaces, and, with the exception of silicified corals, the cavities of which are frequently filled with bitumen, apparently destitute of fossils. From the direction of the dip at these two exposures, about south 40° east, it is evident that there is a considerable thickness of intermediate strata which is not exposed.

In the quarries in the village, the rock is similar to that at the bridge, the lowest beds, perhaps, rather darker colored, but are much fuller of traces of organisms, though well preserved fossils are not abundant. Bitumen stains are abundant throughout the rock, and masses of this mineral, in color and consistency resembling cold pitch, are occasionally met with. At Leavitt's quarry, the easternmost of the excavations at this point, the rock changes to a blue, or bluish gray, impure limestone, probably identical with that before mentioned as occurring in the bed of Thorn creek, in section 4, township 35, range 14.

When weathered, its color changes to buff, the change not limited to the surface, as in ordinary cases of weathering, but extending inward, often for two or three inches or more, according to the length of time that it has been exposed. About ten feet of this bed is exposed in the quarry. It is underlaid by strata similar to those worked in the excavations to the west, which are also beneath it in position. It is probably intermediate between them and the gray fossiliferous limestone, which outcrops on the creek a little farther east. In the lower part of this bed, near its junction with the strata beneath, we find many fine silicified corals, such as *Favosites*, etc.

Throughout the village, and for a mile or more in the directions north and north-west, the rock appears to be very near the surface, covered for the most part with only a thin stratum of surface soil. The finer materials of the drift deposits, which once covered this tract, have been washed away, leaving the surface strewn here and there with the larger boulders of granite, quartzite, etc. The whole extent of territory thus underlaid is between one and two square miles, and occupies portions of sections 27, 28, 33 and 34, in township 36, north, range 14, east. It is slightly elevated above the adjoining prairie, and on its northern slope, near the section line between sections 27 and 28, and farther west, the rock again appears at the surface. It is here a light gray limestone, apparently of a somewhat concretionary structure, and at one point, close to the road from Thornton to Blue Island, there appeared to be a strong dip, nearly 20° to the north-east.

The nearest locality to this place, where any rocks occur which can be identified with the Thornton beds, is in the north-western part of section 1, township 36, range 13, about a mile south-west of Blue Island, and distant from Thornton, in a north-westerly direction, about seven miles. Here, a bed of bluish, impure limestone, to all appearances identical with that occurring at Thornton, is worked as a hydraulic rock. Only the bluish strata are uncovered at this point, but some of the uppermost layers have been so changed by weathering as to present an entirely different appearance from the more recently worked beds below. A few fossil shells, *Orthocerata*, etc., have been obtained here, and fucoidal (?) traces are especially abundant. The dip here is very slight, 2° to 4° to the south-east; indeed, the prairie for more than a mile to the south-west of this point, appears to be underlaid by this rock very near the surface; but in this case, the strata being very nearly horizontal, there is no very apparent elevation above the surrounding country.

One mile farther to the south-west, at the place of Mr. HENRY SCHWARTZ, in the south-east part of section 2, this bed is again quarried, and presents a similar appearance. About three miles west of this place, in the south-east quarter of section 5, on the land of Mr. SMITH, there occurs an outcrop of limestone, on the banks and bed of a small stream. The rock here is regularly bedded limestone, of a light gray color, where not weathered, and is very fossil-

iferous, although the fossils, for the most part, are only casts, and quite imperfect. At the eastern end of the outcrop, the layers have a slight dip to the south-east, but a few rods farther back are horizontal. This rock is probably underlaid by the bluish hydraulic limestone, which outcrops farther east, and, in this case, would be the equivalent of the upper strata at Thornton, and those exposed farther south, at Miller's. The fossils are identical in each case, and one species, the *Pentamerus Knightii*, especially abundant in, and common to, all these localities, has not been found by me in any outcrops throughout the county. It seems to occur only in the beds overlying the bluish hydraulic rocks, which, as they do not appear to have been passed through by the Chicago borings, I have assumed to be the upper portion of the Niagara Group, as developed in this county.

Along the eastern border of the county, north of the points already mentioned, the county is generally low, and exposures of rock are not numerous. The southernmost point where rock appears at the surface, is in the southern portion of section 1, township 37, range 14, where a bed of gray, fossiliferous limestone has been quarried. An area, equal to nearly half a section, is here underlaid by this limestone, covered only by a slight thickness of surface soil. Still farther north, in the eastern part of section 30 (fractional), township 38, range 15, the same rock occurs, but is here completely saturated with petroleum. The exposure is on the edge of one of the sand ridges bordering the lake shore, and consists of excavations of limited extent, made in former times, when the rock was quarried for the manufacture of lime. It is reported, also, that rock occurs in the bottom of the lake, near the mouth of the Calumet. I had no means of ascertaining the truth of this myself, but if so, it is probably a part of the same bed which appears in these nearest outcrops on land. North of this point, no exposures are met with until within the limits of the city of Chicago.

In the southern part of the city, in the quarter known as Bridgeport, a gray fossiliferous limestone is extensively quarried for the manufacture of lime. It here presents some peculiar features, being a massive concretionary rock, showing very little appearance of stratification, and varying in structure from a loosely compacted clayey rock to a solid bluish-gray limestone. This locality is especially rich in organic remains, and has yielded very many species of the fossils of this formation. The same beds occur again at a point near the track of the Chicago, Burlington and Quincy railroad, about a mile and a half north-west of this locality, where they are likewise extensively quarried, and present similar characters. There is, however, a little more appearance of stratification, and the beds appear to have a slight and very irregular dip to the north-east. North of this, at the western terminus of Chicago avenue, are the artesian well quarries, where the limestone is completely saturated with petroleum. The presence of petroleum in such quantity in this outcrop, may be only a local peculiarity, and in other respects its lithological characters are similar to those of the previously mentioned exposures in this vicinity; but there is, nevertheless,

some doubt as to whether it can properly be identified with them. The scarcity and almost total lack of good fossils in this quarry is in striking contrast to their abundance in the other localities. If it is not the same bed it is most likely either immediately below or immediately above; the latter seems most probable, from the direction of the apparent dip.

West of Chicago, the nearest exposure occurs at Swagey's lime-kiln, in the south-west quarter of section 27, township 39, range 18, nearly on the line between sections 27 and 28, and four miles, in a direction about north 8° east, from Lyons station, on the Chicago, Burlington and Quincy railroad. The rock in the quarry here is a regularly-bedded gray limestone, weathering yellow—a little darker in color than the average of the Chicago rock. The strata here dip strongly in the direction south 50° east, the angle varying from ten to thirty degrees. By means of this strong dip, nearly forty feet in natural thickness of the strata is exposed. As is usually the case in the limestones of this group, some portions of the rock appear to be entirely made up of organic remains in almost undistinguishable fragments; nevertheless, well preserved fossils are extremely rare.

West of this point, for some distance, the indications on the surface are that the rock is not far below; but it does not appear above ground till we reach the Des Plaines river at Lyons, distant about four miles, in a nearly west by south-west direction. It seems probable that there is here a low anticlinal, with its steeper slope on the southern sides, and with a strike at first about west of south-west, but after the crossing of the Des Plaines, bending more to the southward, until it is lost under the accumulations of drift in that direction. The course of the Des Plaines is abruptly changed by this obstruction, when, coming from the north, through the Quaternary deposits, it first strikes the limestone of this ridge and bends suddenly to the north-east for about three-fourths of a mile; then, taking another sharp angle, runs about south of south-east for a mile and a half; after which it continues in a general south-westerly direction, through the ancient river channel by which the waters of Lake Michigan were discharged into the Mississippi valley. This disturbance of the strata may be traced by means of scattering exposures and surface indications, for about four miles beyond the crossing of the Des Plaines at Lyons. Beyond this, the surface appearances cease, and outcrops are scarcely met with.

On the western bank of the Des Plaines, at Lyons, near the crossing of the wagon-road from Chicago, a disused quarry shows beds of gray limestone, apparently the same rock as that which occurs farther east, dipping irregularly to the south-east and east south-east, at an angle of from ten to fifteen degrees. As, in the before-mentioned locality, good fossils seem to be rare, though the rock on weathered surfaces often shows an abundance of fragments of crinoidal stems, etc. At the two other quarries in the village the rock differs from that at this point. About half a mile nearly west of this place, and also near to

the river, a light-gray or grayish-white porous limestone is quarried for the manufacture of lime. No fossils were found in this quarry, nor was any regular dip observable. About a quarter of a mile south-east of this point the rock is again exposed in an abandoned excavation. It is here apparently a coarse yellowish limestone, showing scarcely any stratification whatever, and is very fossiliferous. The fossils collected here were of two or three species of *Pentamerus*, *Pleurotomaria*, etc. These three exposures in the village are entirely disconnected, and it is not possible to exactly ascertain their relative positions. On the banks, and in the bed of the stream also, the river debris has so covered the rock that the particulars of dip, strike, etc., can not well be obtained.

In the south-eastern quarter of section 11, township 38, range 12, a massive gray limestone, in many respects strongly resembling some of the Lyons rock, is quarried. No regular dip was observed here, and the limestone appeared to be altogether barren of fossils. The whole thickness exposed is only about six feet, about two feet in thickness of the upper portion appearing of a buff or pale-yellow color, most probably from weathering. About a mile south-west of this, in the north-eastern part of section 15, on the open prairie, gray limestone appears in the bottom of ditches and natural water-courses, and also upon the surface of the ground. In one place, where the rocks had been slightly excavated so that the dip could be taken, it was found to be between east and south-east, and amounting to from ten to fifteen degrees. The rock at this point is quite fossiliferous, the species mostly identical with those from the quarries in the city of Chicago. The species collected at this locality were *Acidaspis Danæ*, *Ilænus insignis*, *Meristella nitida*, *Atrypa reticularis*, *Stroph. rhomboidalis*, *Stroph. Niagarensis* (?), *Leptæna transversalis*, *Caryocrinus ornatus*, *Eucalyptocrinus*, probably *E. decorus*, fragments of a *trilobite*, apparently *Calymene*, and others. About a quarter of a mile farther to the southward, in an adjoining field, is another excavation of limited extent, which has yielded some large *Orthocerata* and *Lituites*.

At Mr. HARRISON's place, still farther to the south-west, and about three miles from Lyons village, is a more extensive quarry. The limestone here is regularly bedded, the layers horizontal or nearly so, of a yellowish-gray color, and showing on weathered surfaces a great abundance of undetermined crinoidal remains. Complete and well preserved fossils, however, are not abundant. This rock appears quite suitable for building purposes, though the layers do not generally appear to be very thick. Mr. HARRISON's house and barn are built of it. The only prominent outcrop to the south-west of this place, till we reach the county line, occurs on the land of Mr. THOMAS COOK, in the south-east quarter of section 19, township 38, range 12, where a ledge of yellowish-gray limestone is to be seen, in the field on the south-east side of the road. It is also said to occur in the bottom of a hollow in a field on the opposite side of the road, but was covered up at that point at the time of my visit.

It is possible that what has been called an anticlinal in the foregoing pages may prove to be an upheaval, with a fault, or a sudden drop to the southward, in the strata. None of the exposures on the line of disturbance show any decided dip to the north-west; the beds, wherever stratification is apparent, either dipping to the south-eastward or apparently horizontal. On the western side of the Des Plaines, however, in some places, surface appearances seem to favor the theory of an anticlinal. Throughout its whole extent this disturbance borders, on the north-west, the least elevated portion of the county, the ancient river channel of the Terrace epoch, and its western limits are generally hidden under the accumulations of drift material, to which the elevation of the surface to the northward and westward is mainly due.

North of this line of disturbance outcrops of rock are few and scattering. One of these occurs near the residence of Mr. FRANK COVELL, in the north-east quarter of section 17, township 39, range 12. The outcrop is of a grayish limestone, weathering to a dark-buff or brown color, the upper portion apparently somewhat decomposed and crumbling. No fossils, except imperfect crinoidal remains, were discovered. Another outcrop occurs about a quarter of a mile south-west of this point, and it is probable that the slight eminence above the surrounding prairie, on which these outcrops occur, is due to limestone strata lying not far below the surface. Nearly three miles due south of this, on the south line of section 29, limestone again appears, on the banks of Salt creek. The rock is, as usual, of a light-gray color on freshly fractured surfaces, but turns yellow after weathering. It has been quarried here to a very limited extent, and furnishes some fossils, among them very large specimens of *Pentamerus oblongus*, and a few corals and crinoids. The same rock, apparently, occurs in the bed of the creek as it enters the county, in the north-west corner of section 31.

A doubtful locality of rock is in the western part of section —, township 42, range 12, on the land of Mr. MILO WINCHELL. Here it is reported that, in the years 1856 and 1857, limestone for the manufacture of lime was obtained; but, that on account of the supply failing, the work was afterwards given up. The excavation is of very limited extent, and, at the time of my visit, was so filled up with mud and water, that no rock was visible. It is highly probable that this was a mere isolated mass, or boulder, of limestone, of large size, and not a bed of rock *in situ*.

The principal exposures of rock which remain to be mentioned in Cook county, occur in that portion of township 37, range 11, which is included within its limits, and comprise the quarries and outcrops at Athens, and above, on the Des Plaines river and the canal. The upper beds at Athens are cherty, the chert distributed in nodules, between the thin layers of buff-colored rock; the nodules sometimes coalescing, so as to form a thin seam, or stratum, for a considerable distance, breaking off and renewing itself at intervals. These cherty strata can be seen at the foot of the bluffs, on the eastern side of the railroad

(Chicago and Alton), in the village, and are also well exposed, in their lower portion, in the upper part of the Illinois Stone Company's quarry. Though its whole thickness is not to be seen at any one point, yet the whole vertical depth of this stratum, from its uppermost exposures to where it joins the beds below, may be estimated as between fifteen and twenty feet. Below this, we find a compact, even-textured light-drab, or nearly white limestone, in regular beds or layers, the same material which, under the name of "Athens marble," is so extensively known and used as a building material in the city of Chicago and elsewhere. It is exposed in the quarries here to the depth of ten feet or more, and also forms the bed of the river and canal, at this place, for some distance above, and below to beyond the limits of the county. It also occurs at "the Sag," nearly four miles above, where there is also a quarry. This, at the time of my visit, was abandoned, and filled with water; but such of the stone as could be seen, appeared identical with that at Athens.

It is stated that the pot-holes, which have been already mentioned as occurring in the water-worn surfaces of the upper layers in the Athens quarries, when of sufficient depth to penetrate one layer and enter another, are occasionally found to be dislocated—that is, one layer has slipped upon the other, so that the upper and lower portions of the pot-hole are, in some cases, entirely separated from each other. I was not myself so fortunate as to observe a case of this kind, but the fact of their occurrence seems to be well attested. It would appear to indicate a slight disturbance of the strata, at a comparatively very recent period, subsequent even to the Terrace epoch, during which these holes were probably formed. The dip here is hardly perceptible, not more than one or two degrees to the south-east, in Singer and Talcott's quarries, where these appearances have been most observed—the disturbance is, therefore, very slight, and it is quite probable that it was also very gradual.

From only the scattered outcrops which have been enumerated in the foregoing pages, separated as they are by stretches of country more or less heavily covered with drift, it is impossible to, in all cases, ascertain exactly their relative positions to each other, or the vertical range of the exposures in the formation. Sections taken beyond the limits of the county, however, seem to prove that the Athens rock is in the lower part of the series, probably within eighty or a hundred feet of the bottom, or even lower. It is probably the equivalent of the upper part of No. 4, of the Artesian well section, which has been given before. The only outcrops in the county which appear to me, by any possibility, to belong to a lower bed, are those occurring near its western border, in township 39, range 12, and, leaving these altogether out of the account, as doubtful, we have from one hundred and seventy to two hundred feet of vertical thickness between the uppermost and lowermost exposures. This, when we take into consideration the varied characters, both lithological and paleontological, presented by the different exposures, in many cases, at least, indicating entirely different strata, seems a sufficient low estimate.

Fossils are not equally abundant in all the beds of the Niagara group, and in many places the nature of the rock, a concretionary magnesian limestone, is unfavorable to their preservation. In some localities, indeed, well preserved fossils, or even tolerable casts, are very rarely met with, though the rock itself be entirely made up of undeterminable organic remains. Other localities, however, have yielded abundantly, and enough is given to show that in the variety and abundance of its remains of animal life, this formation is second to none of the subdivisions of the Silurian, which occur in this State. Of the species which have been discovered in this county, the following may be enumerated as occurring at Chicago, and other localities where the upper portion of the formation is exposed: *Favosites*, *Gothlandica*, *Diphyphyllum caespitosum*, *Halysites catenularia*, *Caryocrinus ornatus*, *Atrypa reticularis*, *Meristella nitida*, *Spirifer radiatus*, *Pentamerus Knightii* (?), *Strophomena rhomboidalis*, *Pleurotamaria gonopleura*, *Holopea Niagarensis*, *Cyrtoceras Fosteri*, *Iliaenus insignis*, etc., etc. Over eighty species have been enumerated by Professors WINCHELL and MARCY, from the Bridgeport locality alone, and there are other localities in the county which would probably yield nearly as well, were they as extensively worked. The lower beds, at Athens and vicinity, contain comparatively few fossils, and *Pentamerus oblongus*, which is so characteristic of the lower part of this formation, has been positively identified from but one locality in the county.

Economical Geology.

Building Stone.—The supply of stone for building purposes is ample in Cook county, although its distribution is somewhat unequal. For this, however, there is a partial compensation, as by means of the numerous railroads centering in Chicago, the best materials in the county are easily accessible to all its parts. It is the lack of cheap material, for the rougher kinds of mason-work, that is chiefly felt in those parts of the county most distant from available stone quarries.

The lower division of the Niagra group affords, in the Athens quarries, one of the best building stones in the State. The rock is a fine-grained, even-textured limestone, of an agreeable, light-drab color, when first taken from the quarry, and rubs well, though not capable of receiving a very fine polish. It is regularly bedded, the layers ranging from six inches to nearly three feet in thickness, thus affording dimension and flagging stone of almost any required size. By exposure to the air, it changes to a pale yellow, or buff color, which appears to be deepened by the smoky atmosphere of a city; in some cases, so much as to materially injure its appearance. Its accessibility to Chicago, and its general excellence as an ornamental stone, have made it almost the only material used, at the present time, in that city, for facing outer-walls, and for general outside decorative architecture. From its adaptability to these uses, it has fitly received the name of "Athens marble," by which it is known wherever it is used.

The limestones occurring on the western banks of the Des Plaines, south-west of Lyons, furnish a good material for rough walls, and, when the beds are of sufficient thickness, answer well for general building purposes. The dark-colored bituminous limestone, which is quarried just west of the city limits at Chicago, is likewise used for the same purposes, for rough masonry, etc., in the city. The Second Presbyterian church is also built of this stone, which imparts to the edifice a peculiarly venerable appearance.

The upper beds of the Niagara group, which are found in the south-eastern part of the county, afford a good material for rough walls, culverts and flagging, and are somewhat used for buildings. The quarries at Thornton have furnished a considerable part of the stone used in the culverts, etc., of the Illinois Central Railroad in this county. The rock in most of these quarries is regularly bedded, the layers from six inches to a foot or more in thickness, and appears well adapted to the purposes for which it is used. The bluish, impure limestone, which has been mentioned as occurring in Leavitt's quarry at this place, cracks and breaks up under the influence of the frost, when first taken from the quarry, and needs to undergo the process of weathering before being used as a building or foundation stone. The same bed is quarried near Blue Island, and exhibits the same qualities; but there it is worked less as a building stone than as a cement rock.

Lime and Cement.—The beds of limestone outcropping in the southern half of Cook county afford an inexhaustible supply of material suitable for the manufacture of a good quality of quick-lime. The gray limestones of the upper part of the Niagara group, at Chicago and in its vicinity, are most extensively used for this purpose. In the lighter-colored limestones of this group, some selection must be made among the beds to obtain the material for the manufacture of good lime. In the extreme north-western portion of the county, where a band or stratum of worn fragments of limestone occurs in the drift deposits, lime-kilns are supplied with stone for burning by simply digging the boulders out of the hills. Mention has already been made of a bluish earthy limestone, which is quarried in the neighborhood of Blue Island for the manufacture of cement. The same rock is again met with in the village of Thornton, and at one or two points in township 35, range 14.*

Clay, Sand, etc.—The sub-soils and drift-clays of various parts of this county afford a good material for the manufacture of brick, and are extensively used for that purpose. In many cases, however, the bluish clays of the drift are too calcareous, or contain too many small limestone pebbles, disseminated through the mass, to be suited for the manufacture of good brick. This difficulty was met with in the construction of the Chicago lake tunnel, the clay taken from the excavation of which it had been intended to make the bricks for the lining of the tunnel, proving entirely unfit for the purpose. The finer

* For an analysis of this hydraulic limestone, see the appendix to this volume.

kinds of clay, suitable for pottery or a superior quality of drain-tile, seem to be entirely wanting. Sand, for building purposes, is sufficiently abundant in all parts of the county.

Peat.—In various portions of the county deposits of peat are known to exist, and have, in some cases, been worked to a limited extent. None of the beds yet discovered occupy any large surface of country; they are, in most cases, of only a few acres in extent, and when of greater area are generally of very inconsiderable depth. The surface-soil of the more recently formed wet prairies, or sloughs, of the eastern part of the county, is often peaty, and occasionally a deposit of true peat, of a considerable depth, is found in these situations. Such a deposit may be seen at Rose Hill Cemetery, seven miles north of Chicago, on the Milwaukee division of the Northwestern Railway, in the south-eastern corner of which a bed of peat has been excavated to a depth of four or five feet. The whole extent of this deposit has not been ascertained, but in many places on the adjoining prairie this substance forms the bottom and sides of ditches, one or two feet in depth. Other deposits of peat occur in similar situations on the eastern border of the county, and in the small prairie sloughs of the interior, but have as yet received very little attention. It is highly probable that, when this article becomes of more economic value, very many more localities of it will be discovered in all parts of the county.

Deposits of fresh-water marl are sometimes met with in connection with peat-beds, or in very many similar situations. One such deposit occurs near the western border of Cook county, in the southern part of section 6, township 38, range 12, in a marsh which apparently was at one time a shallow lake. The marl here is covered by a thin layer of peat, and was discovered while making the track of the Chicago, Burlington and Quincy Railroad. The whole extent of this deposit is not known.

Bitumens.—The presence of petroleum and mineral pitch, in some of the beds of the Niagara group in this county, has been already mentioned. In two localities only the true petroleum has been observed, impregnating the rock and filling its cavities. These are, respectively, the western limits of the city of Chicago, and in the eastern part of section 30, township 38, range 15. Farther to the south still, on the eastern border of the county, we find bituminous limestones; but here the more volatile matters have escaped, leaving only nodules of mineral pitch, or, in some cases, merely dark stains upon the rock. The cavities of the large corals (*Favosites*, etc.), found in the limestone, are also often filled with bitumen.

It is only in the upper part of the Niagara group that these bitumens occur; the lower beds yield scarcely a trace of them. At Chicago the bituminous limestone was found to be only thirty-five feet in thickness, and below it hardly any traces of oil were met with till the boring entered the shales of the Cincinnati group, where the indications again appeared. Neither in the surface rock, nor in the shales, were there indications of oil in sufficient quantity to be

of any economic value; nor does it seem probable, either from the lithological character of the bituminous limestones of the Niagara group, or from their position as the uppermost rock in the county, that oil, in paying quantity, will ever be obtained from them. It is hardly possible, moreover, that oil, in larger quantities than have heretofore been discovered, will yet be met with in the lower formations, and the indications certainly do not warrant any expenditure in this direction.

The water-gas, or light carburetted hydrogen, which was met with in great abundance in the drift clays, during the construction of the lake tunnel at Chicago, may perhaps have been derived from underlying beds of this bituminous limestone.

Minerals.—The metallic minerals which are met with in this county chiefly occur in the materials of the drift, and are derived from more northern deposits. The only exceptions to this are, the iron pyrites, which is sometimes formed, in small quantities, in the limestones of the Niagara group, and bog-iron ore, deposits of which will probably be yet discovered in some of the marshes and peat-bogs, though whether it will be found in sufficient quantity to be of any economic value, is very doubtful. Another of the ores of iron which is found in the county is the black magnetic oxyd, or magnetites, small patches of which are frequently to be seen on the beach of Lake Michigan. As in other parts of the State, a piece of copper or galena is occasionally found in the surface deposits of this county, the latter, at least, probably brought to the place where it is found by human agency.

The soil of the upland prairies in this county agree, in general character and agricultural products, with that of other portions of north-eastern Illinois, and requires no especial mention in this report. We will only say in regard to it, that when thoroughly and properly cultivated, it is always productive. In many portions of the county, however, where the land is comparatively level, attention must first be given to a proper surface drainage. The narrow belt along the eastern border of the county, near the shore of the lake, where the surface is alternately sand-ridge and low prairie, is of course inferior, but has acquired in many places a much greater value from its availability for residence sites.

Before closing this report, mention must be made of the water supply afforded by the artesian wells in the city of Chicago. These wells range in depth from seven hundred to eleven hundred feet, and generally furnish an abundant supply of water for the local needs which caused them to be bored. The geological horizon from which the water comes is somewhat variable, as will be seen from the range in depth, including, probably, all the beds from the lower Trenton to the upper part of the Calcareous, or Lower Magnesian.

I must also here express my indebtedness to the Chicago Academy of Science, and to its Secretary, Dr. STIMPSON, for valuable assistance afforded while I was engaged in the field work of the Geological survey of this county.

