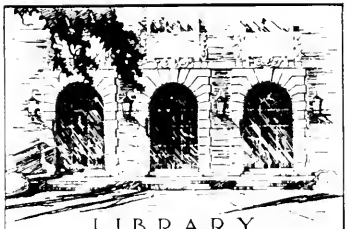

ECONOMICAL

GEOLOGY OF ILLINOIS.

REPRINTED FROM THE ORIGINAL REPORTS OF THE
GEOLOGICAL SURVEY, WITH ADDITIONS
AND EMENDATIONS

BY

A. H. WORTHEN,

STATE GEOLOGIST.

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GEOLOGY OF NORTHWESTERN ILLINOIS.

That part of the State of Illinois embracing the valley of Rock river, and thence north and west of the same, and more minutely described in the following detailed county reports, is, geologically, agriculturally, and in a manufacturing point of view, one of the most interesting portions of our great State. The valley of Rock river, if indeed the high rolling prairie on either side can be called a valley, in fertility and beauty of prairie land is perhaps unequalled in the West. The river itself—swift flowing, broad, clear as crystal—affords one of the most magnificent water powers in the world. At Camden, Sterling, Dixon, Grand DeTour, Oregon, Rockford, Rockton and Beloit, excellent dams are already built and extensively used for milling and manufacturing purposes. Others will be built in due course of time. Almost every half dozen miles contains one or more of these heavy water powers. At one end of the stream are the lumber regions of Wisconsin; at the other, the coal fields of Rock Island. On either side is the richest agricultural region in the State. Along the banks and in the bed of the river are many kinds of stone from the best Silurian formations. A railroad up the valley, joining the coal and lumber, will be built at no distant day.

In addition to this, the Government survey of Rock river, made under charge of General Wilson, and submitted in the form of a report to the War Department some four years ago, shows that the improvement of Rock river navigation by slackwater dams from Rock Island to Lake Horicon, thence across to Lake Winnebago, and thence down Fox river in Wisconsin to Lake Michigan, is not only a feasible project, but is full of interest to the people of this valley and to the whole Northwest. It will thus be seen that Rock river and its valley, in their present and prospective resources, salubrity of climate and beauty of location, have not their equal in the State,

or perhaps in the Nation. The geological formations along this stream are also of an interesting character. The section of the river bluffs herewith presented, and the following county reports, contain detailed descriptions of these formations.

At Beloit and Rockton the dull, yellowish, earth-colored, buff limestone, with its bands of dark-blue, is the surface rock; half way to Rockford this formation sinks below the upper division of the Trenton; three miles above Rockford, and at the city, the warm cream-colored Galena limestone outcrops in the river bluffs to the height of one hundred feet; lower down the Galena gradually thins out, until the buff again comes to the surface in a low axis at Byron. From Oregon to Grand DeTour the castellated hills of the St. Peters sandstone, shining white, brown, and flame-colored in the sunlight, and rising to an elevation of nearly two hundred feet, form striking and picturesque objects in the landscape; below these the solid lower Magnesian limestone probably forms the floor of the glancing river. At Dixon two divisions of the Trenton may be examined almost side by side for some distance; at Sterling the green and blue shales of the Cincinnati group, and the chert-banded and dendrite-speckled Niagara limestone outcrop heavily in the same quarry; from Sterling to Erie, and even lower down, the Niagara continues in the bed of the river and in its banks, a low outcrop, changing before it runs under the Coal Measures into a softer, whiter, finer-grained stone, formerly called the LeClaire limestone; from a few miles below Erie to Camden, the gently rounded hills and black limestones of the productive Coal Measures rise to varying elevations; from Camden to the Mississippi the river rushes over a smooth floor of solid, dove-colored Hamilton limestone of Devonian age.

That part of the State between Rock river and the Mississippi, except JoDaviess and a part of Carroll counties, is mostly high, rolling prairie land, dotted with beautiful groves of timber, and abounding in many small streams, which afford good mill seats and light water powers. The soil is dryer than the flat prairies of Central Illinois. The portion above excepted, being within the productive lead basin, is more abrupt and broken.

The agricultural and horticultural productions, kinds of timber, mineral wealth, superficial extent of geological formations, soils and their capabilities and adaptations, and other matters of scientific and economical interest, will be found set out in detail in the county reports following this article, but need not be again repeated in this place.

The Mississippi river on the west exposes a fine section of its rocks from Dunleith to Rock Island. At the latter place the Hamilton limestones and Coal Measures both outcrop and are the prevailing rocks as far up as Moline; from thence to the south line of Carroll county massive walls of Niagara limestone in places appear like vast mural escarpments, bounding the broad Mississippi bottoms on the east; about Bluffville the Cincinnati shales and clayey limestones are the predominating rocks; at Savanna the same Cincinnati group is capped with more than a hundred feet of coarse, reddish-brown Niagara limestone; and as we ascend towards the north line of the State, massive, solid Galena outcrops occur, the famous lead-producing rocks of the Northwest.

Leaving these rocky formations for the present, it may be well to discuss some questions connected with the superficial deposits covering them.

If all the soils, clays, sands, and gravels, and other loose materials spread over the face of the country were removed, the probability is that the rocky surface thus displayed would present valleys of erosion and elevated ridges; but these inequalities would not perhaps be greater than those now appearing on the surface.

The glacial Drift period, and the tremendous forces acting through it, are not well understood by geologists, but they had much to do with the deposition and present arrangement of loose materials, covering the rocks concealed beneath them.

Clays, sands, and various mixtures, are originally derived from the decomposition of the primitive rocks. The silent processes of nature, to-day, as in past geological time, are grinding rocks into clays and sands, and re-cementing clays and sands into rocks. The affinities of rocky matter can be destroyed by atmospheric and chemical agencies, but the elements will still remain.

There are two theories as to the deposition of the loose materials covering the rocks in this part of the State. One is, that they are derived from the slow decay of the underlying rocks, leaving the clay *in situ* in the exact places where the rocks rotted away. The other is, that the drift forces mingled, mixed, and deposited these loose materials, having gathered them from long distances, and from many and widely separated sources.

In the part of the State now under consideration, evidences of the truth of both these theories can readily be found. In the productive lead region it is now conceded that the drift forces did not act at all or acted in a modified form. The productive lead rocks are covered by a peculiar reddish clay, derived in a large part, I

think, from the decay of the upper strata of the rocks. It bears little evidences of mixing or transporting agencies. The top is enriched by vegetable and atmospheric influences, and has become a thin, poor soil. As it is penetrated, it becomes a reddish clay; pieces of float mineral are found, sometimes in considerable quantities, and before the solid strata are found, apparently lying *in situ*, unworn by water, and becoming more numerous, until the solid rock is reached, as if they were harder fragments of the original rocks, which have withstood the general decay of the mass.

Fragmentary patches of the lead region are undoubtedly driftless regions, but in many places the drift has invaded the lead regions. In the northwestern portions of Carroll county, where the indications are strong that the soils and clay are derived from the decomposition of the underlying rocks, fragmentary boulders are often found on the surface of the ground and in the ravines, showing, as it seems, that even these driftless lead regions have been submerged, perhaps many times, since their uplift from the Silurian seas.

The finely comminuted, greenish and creamy yellow colored clays, forming the subsoil over small extents of Northwestern Illinois underlaid by the Cincinnati shales, would seem to indicate an origin from the decomposition of the earthy shales below.

But in many places and over large extents of this part of the State, the transportation of soils and clays, and a universal mingling and mixing of the surface materials of the earth, is a fact patent to the most casual observer. The gravel hills of Ogle county, and the long gravel beds of Winnebago and Boone counties, mingled with white sand; the stratified and partially stratified clays and sands to be met with almost everywhere; the boulders scattered over the prairies—all owe their present arrangement to the Drift forces. Over these places the underlying rocks are hidden by the concealing Drift. Laminated clays cover the indurated rocks. These clays are in some cases nothing but the sediments and precipitates of peaceful, shallow seas; but the boulder and gravel beds indicate mightier forces and belong to the true glacial Drift. That vast glaciers of ice once extended over large portions of North America is now universally conceded. Their slow, crawling motion and irresistible force ground the rocks to powder, as wheat is ground to flour between the upper and nether millstones; not only ground them to powder, but rounded and polished the boulders and the gravel, planed and grooved the rocky surface of the earth, and moved the vast masses of Drift materials from place to place in a slow procession. Direct evidences of the ice forces of the glacial

period are not met with so frequently, as a modified form of these forces. Along the ridges and gravel hills north of Foreston, in Ogle county, the great accumulation of gravel, sand and boulders presents the appearance of glacial moraines, as if two glaciers had met and deposited their accumulated loads of dirt, sand, gravel and boulders, much of which seems to have been torn from rocky formations of the Silurian age, at no great distance from the place of final deposit. But the great mixing and transporting agency which arranged, assorted and deposited most of our Northern Illinois Drift deposits, was evidently the mixed action of ice and water.

When the temperature of the glacial winter began to grow warmer, and the great moving fields of ice began to melt, streams of turbid water would rush out and form shallow seas and lakes. The glaciers on the more elevated portions of the land, still fed by perpetual snows, would creep into the neighboring bodies of water, break off and float away in the form of icebergs and floes, bearing with them the boulders, gravel and dirt, torn from the hills and outcropping rocks along their passage. As this floating ice melted, either by an increase of the earth's temperature, or by being borne into a warmer atmosphere further south, the materials with which it was freighted would sink to the bottom, and become subject to the action of a new force, the assorting and transporting force of currents of flowing water. The contraction and expansion of the ice over these shallow lakes or seas, caused by alternate freezing and thawing, also exerted a powerful influence in tearing loose stones from the neighboring banks and piling them into long heaps and gravel beds. In some of the lakes in Northwestern Iowa the frost power is producing wonderful phenomena, giving rise to the popular error of walled lakes.

Thus it will be seen that the first and greatest of the Drift forces was the glacier; then the floating iceberg and ice field produced their results, carrying the large boulders from place to place, and dropping them over the ice cold seas; and last the wave and current forces of water, after the ice had in part, or altogether melted, left the loose clays, sands and subsoils substantially as we find them now.

Arctic travelers have made us somewhat familiar with the desolations and savage beauty of the North polar regions—home of the ice-bergs, land of the glaciers, and realm of enduring frost. The phenomena there witnessed at the present day are exactly similar to the ancient forces acting over these prairies, as I have above attempted to describe them, except in so far as they were modified

by the leveler nature of this country as compared with snow-bound, ice-locked Greenland.

The icebergs rise cathedral and sphinx-like from the bosom of the fiords and inland seas, making an ice forest in places over the watery wastes. They impinge upon each other with the crash of parks of artillery, and float away on gulf streams and melt in warmer latitudes, strewing the floor of the ocean with their adhering earth and stones. The blaze of the Arctic summer sun lights them up into brilliant colors. Peaks of flame, columns of emerald, sapphire and blue, move slowly over the green waters, and the play of prismatic colors is indeed beautiful in all the reflected and refracted changes of the bergs. Glaciers are creeping slowly down from the neighboring mountains; fed at their upper ends with perpetual snows; their lower ends constantly breaking off in the waters, and sending away fields of ice and icebergs, loaded with the debris and stones collected in the downward journey.

Similar phenomena, perhaps in a modified form, were once displayed over all the regions traversed by the Drift. The ice gradually melted away, commencing south and disappearing up to the Arctic regions. In process of time the waters gave place to the dry land, and our northern prairies remain, moulded into gentle undulations by the process of the retiring waves.

The startling theory of the Ice Period in North America, announced by Professor Agassiz in the "Atlantic Monthly" for July, 1864, at that time was almost too much for the faith or credulity of scientific men. Now, a large portion of the scientific world accepts the theory then announced. In his recent expedition to Brazil and up the Amazon, the traces of a great glacier, filling the whole valley of that large river, were discovered. When such a sea of ice existed under the very tropic skies, this world must indeed have been in the midst of a glacial winter, where snows, and frost, and ice, held supreme sway. We wonder if, then, the progenitors of the mound-builders and ancient copper-miners and workers built their snow and ice huts, and moved about in their light kiyaks, as the Esquimaux of to-day do in frigid Greenland!

The influence of these glacial drift-forces upon soils is worthy of a passing thought. They changed the surface of the earth from its conditions during the Carboniferous ages, and made soils, by the processes above enumerated, fit to produce grasses, grains, fruits, and hard-wood trees. They prepared the earth for civilized man.

In this part of the State, in attempting to classify soils and earths thus mingled and made, there is no end to the distinctions and

classifications. Soils are light or heavy, warm or cold, dry or wet, compact or porous, fine or coarse, hungry, leachy, loamy, sour, sweet, clayey, sandy, limey, marshy, peaty, and various combinations of these, too numerous to mention. Silica, or the earth of flints, alumina, lime, magnesia, potash, and various salts and metalloid compounds, unite in chemical or mechanical combinations to make up these soils. The humus, or geine, which gives richness and fatness to the land and blackness of color, is chiefly derived from successive growths and decays of grasses and other vegetation.

The productiveness of these soils depends not alone on the nature of the soils themselves, but also upon climatic and atmospheric influences, and the nature and properties of the subsoils and underlying drift materials. If the subsoil is gravelly, marly, leachy or porous, so as not to retain too much moisture, fruits and cereals will flourish. If a hard-pan or impervious clay lies under the soil, so as to retain the surplus moisture, corn and grasses will perhaps do better. The practical agriculturist will knock the bottom out of such a soil if he can, by deep plowing or underdraining, so as to let the surplus water leak out, and permit the sunbeams and kissing winds to penetrate and sweeten the land.

Not only the agriculturist, but the horticulturist may learn a lesson from this. In the first place, let him select one of nature's orchard spots, if that be possible, on which to plant his trees and vines. A light soil, porous subsoil, sheltered, sunny exposure, and well-drained slope or hillside, is the favored spot. Then let him plant, in proper season, of the best and hardiest varieties, in holes big as little cellars. Take care of the young trees, feed them with fertilizers and good cultivation, wage war with their insect foes, and in due time an abundant fruitage, even in this climate, will be the result.

If nature has not given him an orchard site, then he must make one. Do artificially what nature has failed to do. Drain and underdrain, plow and subsoil plow, manure and feed with fertilizers, plant shelter-belts to modify and sift the blistering winds, and in this way an orchard or vineyard may be made to grow, whose generous fruitage will more than repay the expense and toil.

But, leaving these topics, which belong rather to practical agriculture and horticulture than to geology, I pass to notice some phenomena more particularly discernible along the small streams between the Mississippi and Rock rivers. There are a number of these large creeks and small rivers, referred to in the county reports. Those crossing the face of the country in an eastern or western direction generally

have the strata along the north side of the stream elevated higher than those on the south side. In some instances the stream is the dividing line between an older and more recent formation. The Cincinnati shales and limestones often underlie the level prairies on the south side, up to the very water's edge; while the country on the north side rises in rather bold outcrops of the Galena limestone. I think the streams are oftener than otherwise the dividing line between different groups and formations.

Closely connected with this phenomenon is another. The streams often seem to flow in fissures or cracks of the underlying rocks. Slow upheavals, and slight contractions in the cooling earth perhaps, made these fissures. In time they filled partially, making the narrow bottoms and the beds of the present streams. Slight faults were thus left, which seem to be bounded by the streams, and fully account for the difference of elevation on different sides of east and west streams.

While speaking of the surface geology of the region between the two rivers, a few words as to the origin and formation of the prairies may not be out of place.

The largest portion of this part of the State is prairie land. In it all kinds of prairies may be seen—such as the high, upland prairies, the river bottoms or alluvial prairies, and the low, wet swamp lands.

There is quite a diversity of opinion as to the origin and formation of these treeless and grass-covered regions of the Northwest. One theory attributes them to annual fires sweeping through the grass, and killing every tree, germ and young tree, almost before they could take root. In some places the fires are supposed to have encroached year by year upon the forests; in other places, as, for instance, along the streams, in the deep hollows, or in wet places, where the fires would be checked, the timber would spring up and displace the prairies. Another theory accounts for the treeless character of these plains from the lacustrine origin and nature of the prairie soils and subsoils. Trees will not naturally grow in this sedimentary, finely comminuted prairie soil, according to this theory. Others attempt to explain prairie phenomena by atmospheric and climatic influences, marking out certain zones of moisture and dryness. They bound forests and prairies by certain isothermal lines. Another theory, advocated with force and plausibility by Professor Lesquereux, in the first volume, page 187 *et seq.*, finds all our prairies to originate from causes similar to those which form peat-beds, and are in fact incipient peat-beds, drained before completed. In

his own clear language, he finds "that all the prairies of the Mississippi valley have been formed by the slow recession of sheets of water of various extent, first transformed into swamps, and by-and-by drained and dried. The high, rolling prairies, the prairies around the lakes, those of the bottoms along the rivers, are all the result of the same causes, and form a whole in an individual system."

No one of these theories is sufficient to explain all the phenomena noticed in making an examination of the prairies. As in most such cases in theoretical geology, all of them perhaps contain some truth, and may be applicable to localities more or less extended. The burning of the forests, in a few cases doubtless, has changed timber into prairie land, and prevented the timber from invading small tracts of the prairies. But the sweeping, consuming autumnal prairie fires are not sufficient to account for the origin of our wide prairies, else prairies would be found scattered through all the timbered regions of the continent. Neither is atmospheric causes sufficient, for the observations of meteorologists show the annual precipitation of moisture in the form of rains, over our northwestern prairies, quite as evenly and extensively as in the timbered regions of the eastern and northern parts of the continent. The chief causes of the treeless character of our prairies are undoubtedly found in the soil itself.

It is very true that trees, even those whose native habitats seem to be the damp alluvial soils of our river banks, will flourish and grow when planted upon the prairies; but the artificial process of planting seems to fit the soil for their reception. Even vines, Indian corn, and many other sorts of vegetation, will flourish when thus artificially planted, but never would grow naturally and of their own accord upon the grass-bound prairie sod. The prairie soil is naturally adapted to the growth of prairie grasses; and the prairie grasses not only resist the growth of trees, but actually kill them out. By destroying the grasses and sods and cultivating the trees, they will grow vigorously. The prairie soil has certain antiseptic properties, and ulmic and other acids, which give it a sourness. The prairie grasses naturally flourish in such a soil. These properties in the soil, and these grasses, are all unfavorable to the growth of trees; and it is only when their influences are counteracted by cultivation or other local causes, that trees will grow in health and vigor. Cultivation does destroy this sourness in the soil; and I believe if all the cultivated prairies of the State were suffered to relapse into uncultivated wastes, instead of going back to their

prairie condition, they would become eventually covered with brambles, thickets and growths of timber.

In this part of the State, along the Mississippi, Rock river, and other streams, much of the alluvial bottom subject to annual overflow, is covered with timber. There are, however, alluvial prairies along these streams, timberless, and for the most part sandy and coarse-grained, and entirely different in composition and texture from the usual Illinois upland prairies.

The swamp lands of Whiteside, Lee and Carroll counties afford a fine illustration of Professor LESQUEREUX'S theory of the gradual transformation of swampy, boggy ponds, marshes and swales, into the black, spongy moulds of our richest prairies. Aquatic vegetation, the gradual encroachment of the land into ponds, the slow drying of our wet lands, and the gradual filling up of the ponds by successive growths and decays of aquatic vegetation, is building up, rapidly, sour-soiled, treeless prairies. The processes are similar to those forming the peat beds. The results of the processes are curtailed and modified, and a peaty-soiled prairie is formed, instead of a bog or bed of peat.

But the high, rolling prairies of Carroll, Stephenson, Winnebago, and parts of Ogle and Whiteside counties, with, in many instances, but thin soils covering the coarser drift materials below, do not show so plainly the same sort of originating causes. They are interspersed with numerous small groves of timber. These grow along the alluvial mixed soil of the streams, and upon the ridges and patches thrown up and beat together by the waves and currents of the broad lake-like expanse of water, which covered this part of the State immediately subsequent to the glacial Ice period. A few of these drift ridges, as in northwestern Ogle county, are treeless, owing perhaps to fires, or other local causes.

Excessive humidity of these high, rolling, somewhat sandy prairies does not exist, and cannot satisfactorily account for their treeless character. Neither do they bear in their soils and subsoils the evidences of having once been swampy, marshy plains.

When the waters of the broad shallow fresh-water sea, once extending south and west of Lake Michigan, were slowly drained off, either by the breaking away of southern water barriers, or the slow upheaval of this whole region, parts of the bottom were undoubtedly left as broad marshes, swales, and bogs, which assumed in due course of time a peaty character; but other parts must have been left comparatively dry, and covered with the fine, impalpable sediment, constituting the basis of our present prairie soils. The swamp

and peat lands of Lee, Whiteside and Carroll counties, afford fine examples of the former condition of things; the rolling, dryer, sandier prairies of Stephenson, Winnebago, and parts of Carroll and Ogle counties, afford just as fine illustrations of the latter condition of things, while Boone county exhibits very plainly both.

The treeless nature of the marshes is very satisfactorily accounted for upon Professor LESQUEREUX's theory of the origin of the prairies. The treeless character of the high prairies must be accounted for by the nature of the soil itself; the natural tendency of an herbaceous, rather than of an arboreal vegetation, to gain and keep possession of the prairie soil, aided perhaps by fires and other local causes.

These views of mine may contain erroneous suggestions. I have had no special means to examine soils, or compare wide extents of prairie regions with each other. I arrive at my conclusions from simple observations of the prairies in this part of the State. I am satisfied that no one theory yet advanced, as to the origin and formation of the prairies, will account for all their phenomena, even in this limited portion of the State. Combined causes, operating with different degrees of force in different parts of the great prairie regions of the country—sometimes one cause predominating, sometimes another, and sometimes all together—are more in harmony, it seems to me, with the effects left for our observation.

Geological Formations.

Leaving the surface geology and turning our attention to the rocky strata beneath, we find the following formations in descending order: The Niagara limestone, Cincinnati group, Galena limestone, Blue limestone, Buff limestone, St. Peters sandstone, and the upper surface of the Calciferous sandstone or lower Magnesian limestone. The Galena, Blue and Buff limestones are now classed as divisions of the Trenton limestone. The Calciferous sandstone can hardly be named among the exposed and outcropping formations of Northwestern Illinois. It is the floor of Rock river, at a point where the St. Peters sandstone outcrops in high bluffs along the shores of that stream. The local outcrops, superficial extent, characteristic fossils, and weathered appearances and exposures, are referred to in detail in the county reports, following. In this place I shall simply speak of their general characteristics and lithological appearances.

The Niagara Limestone.—This is a heavily-bedded, dolomitic, magnesian limestone, without any appearance of shaly or arenaceous

beds, so far as I have noticed. In color, it ranges from a grayish-white to a brown or brownish-red, often finely speckled with minute dendritic-looking spots. In texture it is soft and fine-grained, like the LeClaire limestone; tough, and of a horn-stone texture, like the Cordova lime-burning quarries; crumbling, coarse-grained and brecciated, like the quarries at Fulton City. And yet, with all this diversity, there is a similarity of structure and appearance which makes it difficult to mistake the Niagara limestone for any of the other formations. From the north part of Carroll county to Port Byron, in Rock Island county, it caps the river bluffs, presenting that splendid castellated brown-red appearance so familiar to travelers on the Upper Mississippi river. It reaches a maximum thickness of one hundred and seventy-five to two hundred feet. It caps the mounds further north, and is called "the Mound limestone" by PERCIVAL and other of the earlier geologists. By Dr. OWEN it was named "the Corraline and Pentamerus beds of the upper Magnesian limestone," referring, doubtless, to the prevailing fossils. The *Pentamerus oblongus* is met with in great abundance in its upper beds, and its corals are so numerous and finely preserved in the form of silicified casts as to show us that the Niagara seas were the coral-paved seas of the Silurian age.

The Cincinnati Group.—Next in the descending order comes that group of clayey, unctious, fine-grained shales, formerly called the Hudson river shales by most of our Western geologists, but now more appropriately named by our own State geologist. The upper parts of the quarries show thin-bedded stratifications, but towards the bottoms of the quarries the strata become thick-bedded and solid. The thin shales are light-yellow, buff or green colored, soft, sometimes unctious to the feel, often giving a creamy color to the water, as it trickles down from the quarries, and crumbling and melting into clays when exposed to atmospheric influences. Some of the massive strata near the bottom of the formation are intensely hard and very blue.

The maximum thickness of this formation reaches perhaps a hundred feet. Above Savanna the outcrop is eighty feet in thickness, and at Bluffville a like thickness is exposed; and a well, thirty feet deep, near by, exposes to the bottom the shales and clays of this formation. In a few places the thin, cream-colored strata break into rhomboidal, diamond-shaped blocks of great regularity.

In a few localities the shales are almost black, and have so much carbon in their composition as to burn with a bright flame, giving

out considerable heat and resembling cannel coal. The flame resembles that of burning petroleum.

The fossils are mostly *Brachiopoda*, and exist in great abundance in some of the strata.

The stone, even the best of the hard blue, except in certain localities, is utterly unreliable as a building stone. It disintegrates and crumbles on exposure to atmospheric influences. On this account natural exposures are rare. In the high bluffs it often presents this appearance. The elevation is capped by the castellated Niagara; then comes a gentle grass-covered slope, succeeded by the rough outlined, underlying Galena limestone, with numerous springs flowing out near the base of the shales. This group is the upper division of the lower Silurian, the Niagara being the lower division of the upper Silurian.

The Galena Limestone.—This limestone, in lithological character and general appearance, closely resembles the Niagara. It presents the same bold, castellated appearance. The color is more uniform, being generally a light-creamy, warm color, with shades of ashy-yellow and dirty-white. The structure is more homogeneous and uniform, having generally a sort of crystalline or sub-crystalline appearance, except when the lower beds sometimes assume, in their passage into the underlying Blue, the characteristics of the latter. The upper beds sometimes have a crumbling, sandy nature. The stone is massive, thick-bedded, solid, and becomes more enduring as it seasons. Its rich warm color and enduring nature make it a desirable material for heavy masonry.

The characteristic coral, the *Receptaculites Oweni*, "the sun-flower coral" or "lead fossil" of the miners, or "honeycomb" of the common quarryman, is known to almost every one.

This is the famous "lead-bearing" limestone of the Galena lead basin. It is heavily developed over the whole lead region or lead basin of the Northwest, a basin occupying an area, according to Professor WHITNEY, of about 4,000 square miles, and comprising portions of the States of Iowa, Wisconsin and Illinois. It reaches a maximum thickness of two hundred and fifty or three hundred feet. It is unnecessary at this time to speak of its mineral treasures in the shape of rich deposits of lead ore found so abundantly in its caverns, crevices and decayed and superincumbent clays, as in the first volume of these Reports this subject has already been discussed at some length. The Wisconsin and Iowa State Geological Reports both devote considerable space to the discussion of the causes of

the deposit of lead, its modes of occurrence, and various other interesting thoughts and questions connected therewith.

A brief reference to our present knowledge upon this interesting subject of inquiry is all that will be attempted at the present time. If deemed necessary, it will be more fully treated of in the report upon the geology of JoDaviess county.

The origin of the lead and other minerals of this district is one of the vexed questions. At least four theories have been advanced and argued. These are as follows:

1. That the waters of the Silurian ocean held the minerals, or their salts, in solution. At the time of the deposition of the lead bearing rocks, or at least before the deposition of the next overlying formation, the mineral matter was precipitated, in the form of sulphurets, in the crevices of the rocks.

2. The injection from below of the mineral matter in a melted state up through the crevices of the rocky mass. Many dykes, lodes and true mineral veins, thrown up by volcanic or other igneous agency, doubtless owe their origin to this source; but it does not satisfactorily explain the origin of the Galena lead.

3. The theory of sublimation supposes the metal to have existed in hot vapor or steam. As this cooled, crystallization took place, and the mineral matter adhered to the sides of the fissures in the rocks, as frost crystallizes upon the window-panes. Craters of volcanoes, flues of furnaces and bloomaries also furnish familiar examples.

4. Another theory supposes that electro-chemical action caused a segregation of minerals into crystals in the soil, as geodes are formed.

The first of these theories is the most universally received, so far as the origin of lead and its associated minerals, in the Galena lead district, is concerned. The injection of melted matter from below into the fissures of the rocks accounts for the origin of many true mineral veins in a satisfactory manner; but in the lead region of the Northwest the vast bodies of unfissured sandstones and other unmetallic formations below the lead-bearing rocks, make it almost impossible to trace the lead to this source. Professor WHITNEY, who is perhaps our best authority upon the geology of the lead region and the modes of occurrence of its mineral deposits, in his articles in the Iowa, Illinois and Wisconsin Geological Reports, has well nigh settled the question in favor of the deposition of the ore in the crevices of the rocks by aqueous solution. He believes that the minerals were held in solution by the waters of the ocean, which

deposited the lead-bearing rocks, and afterwards precipitated or deposited in the fissures, and that the development of life in the ocean produced chemical combinations in the sea water, which caused the precipitation of the sulphurets. In this way sulphurets alone were deposited, but the oxidized combinations of the sulphurets would form the few other accidental minerals found among these sulphurets.

The surface arrangement and systems of parallelism of the veins or lodes of productive mineral is a subject of interest in the mining district. East and west veins usually carry the mineral. North and south veins are unproductive, except in a few instances, where the general rule seems to be reversed. In connection with this, it may be well to remark that Dr. White, the State Geologist of Iowa, has just announced that there is a well marked physical difference between the lead ore of the east and west, and north and south lodes: and also, that they have found in Iowa lead ore with small adhering crystals of native copper. Both these announcements are interesting discoveries.

Lead occurs in the form of float mineral, sheet mineral, and crystallized masses in openings and caverns. The float mineral is found in the red clay overlaying the lead-bearing strata, and results from the decomposition of the upper part of the lead-bearing rock, permitting the mineral to settle down into the clays thus formed. The sheet mineral exists in the form of thin veins in the solid rocks. The crystallized masses are found adhering to the tops and sides of caverns, or buried in the debris at their bottoms. The granular and fibrous structure is almost wanting in this lead region; the crystalline is the only structure generally noticed.

The causes of the fissures in these lead rocks is supposed to have been slow upheavals in the lead basin in past geological ages, and the dynamical agencies operating by reason of the contractions and expansions of whole geological formations.

The historic sketch of mining for lead, found in the published reports of the Illinois Geological Survey, although far more indefinite than we could desire, is perhaps as perfect as we can make it. Many facts and statistics have been lost; many items of interest were never preserved at all.

At the present time lead mining is in a tolerably flourishing condition. The amount of mineral raised is not so great as formerly, but the price is better.

Two practical conclusions seem to have been arrived at as a result of geological examinations in the lead region. First, that no

system of deep mining will ever be generally adopted, simply because deep-buried bodies of mineral do not exist. Second, that a much better and cheaper way to prospect for lead is to drift into and across the veins by adit levels, instead of sinking vertical shafts.

In speaking of the Galena limestone, I have thus been tempted to speak of the treasures lying away in its dark vaults. These vast bodies of metallic wealth have given an interest and a name to this interesting formation. The fortunes torn from its hidden fissures, and those yet to be torn from fissures more hidden still, will always, and in all time to come, dazzle the eye and mind, while the more modest merits—the rich, warm cream color, its enduring qualities as a building material, the good lime easily burned from it—are almost forgotten or overlooked.

The Blne Limestone.—Next succeeding in the descending order comes the Blue limestone, or Trenton limestone proper, of the earlier Western geologists. It is now regarded as the middle division of the Trenton group, the Galena above and the Buff below both being now regarded as members of the Trenton. The upper strata are thin-bedded, and of an ashy-white or dirty-buff color. The lower strata or layers are thicker-bedded, and of an intense ultramarine-blue, when first quarried, but afterwards bleach out to a paler or whiter blue. The whole of this division has a more or less conchoidal or glassy fracture when broken; some of the bluer strata are exceedingly conchoidal in their fracture, and have been characterized in the common speech, all over the lead mines, as the "glass-rock." The Blue limestone reaches a thickness in this part of the State of from forty-five to sixty feet. It makes an excellent, and, when properly dressed and mingled in its shades of color, a beautiful building material. The Union school building in the town of Polo, a very handsome and tasteful structure, is built of this Blue limestone. An excellent article of common lime may be burned from it. All around the lead region, and where the streams cut through the Galena limestone, the Blue limestone appears.

It is one of the most fossiliferous deposits in this part of the State. A large species of *Orthoceras*, sometimes six or eight inches in diameter, and eight or ten feet long, is often found. A large shell, in a fossil state, related to the Nautilus, perhaps the *Lituites undatus* of Hall, is not uncommon. Corals, trilobites, and many species of shells, and some encrinites, are found in abundance, especially on Rock river, in the neighborhood of Dixon.

The Buff Limestone.—Between the Blue limestone and the St. Peters, or upper sandstone, there exists a thin formation known as

the Buff limestone, not recognized at all by the early Western geologists. The learned PERCIVAL mentions buff-colored strata or bands, noticed by him in his examinations of the Wisconsin lead regions. WHITNEY, in his geology of the lead regions of Wisconsin, gives it a thickness at Beloit of some forty-five feet, and at Winslow a thickness of some thirty feet. Following the section of WHITNEY at Beloit, I have called the similar section at Rockton the buff limestone, and found its thickness to be some forty feet. But most of the sections and outcrops through this part of the State are thinner, averaging perhaps not over eighteen or twenty feet in thickness. This limestone is a heavy-bedded dull-colored rock, giving a dull heavy thud or sound when struck by the hammer, as if the sound came from striking a lump of frozen earth. Some of the shaly divisions are very fossiliferous, being covered with shells and fragments of shells. In some quarries near Dixon the strata are massive and solid, and give out almost a metallic ring when struck by the hammer. In a few instances, as on Pine creek, where the buff and St. Peters sandstone meet, the line of junction between the two is hard to determine. Hand specimens obtained there seemed to be a mixture of both sandstone and limestone. At other quarries some greenish shales and clays intervened between the two rocks. Some of the layers are a compact, semi-crystalline magnesian limestone, one or two feet in thickness.

The upper portions of this formation or division are thin-bedded, and of a dull ashy-buff color. They break up into small fragments near the top, and greatly resemble some of the outcrops of the Blue limestone above.

The rock forms a good building material, but the superficial area underlaid by it is quite limited in this part of the State. It outcrops around the St. Peters sandstone in narrow bands, and is recognized at Winslow, Rockton, Byron, and a few other places between the two rivers.

A few fine fossils, mostly a species of *Pleurotomaria*, were observed; but, as a general thing, the outcrops examined were almost devoid of fossils.

The St. Peters Sandstone.—This is the most interesting formation in the series of Illinois strata developed in this part of the State. Its only outcrop is along Rock river, from two to three miles above Oregon to about the same distance below Grand DeTour; and up the streams that fall into Rock river along this part of it, it also outcrops for a few miles; and a few disconnected fragments have

been noticed projecting from a hill-side in Chambers' Grove, a few miles north of Polo. On Rock river the heaviest development, perhaps, in the State may be found. It reaches a thickness here of nearly two hundred feet. Fantastic shaped bluffs of white, brown and ferruginous stained sandstone rise along the river banks, and display the coloring, shapes and castellated appearances of the icebergs in an Arctic zone.

It is composed of pellucid, limpid, regular rounded grains of pure quartz, and is white almost as snow, when unstained by the oxide of iron percolating through the mass as a watery solution. The slightest cohesion holds these grains together. Indeed, in some instances the mass is almost as friable as densely packed sand, and can be penetrated by a blow of the pick, or dug out with a sharp spade. The rock has a saccharoidal or sugary consistence, that would seem to indicate its rapid decay under rains and other atmospheric influences; yet, strange to say, these perpendicular, spire-capped hills resist these influences with great tenacity and success.

In some places in Lee county a sort of calcareous cement is intermixed, making the rock so hard and semi-crystalline that it is used with success as a building stone. In the softer portions of the rock there are many thin bands of a dark, hard, iron-looking consistence. These weather out in places, giving the appearance of pictured rocks. They are caused by thin crusts of the sandstone having become impregnated with a strong solution of the oxide of iron at various times while the rock was in course of deposition. Many of these broken crusts resemble pieces of old cast-iron pots.

Some of them are beautifully marked with what I have been accustomed to consider wave or ripple marks. Prof. WHITNEY could find no evidences of the action of water, in his examinations of this rock further south. I have lately come to think, however, that these beautiful markings, instead of being ripple marks, may be wind marks. In examining some sand blows and dunes lately, I found them about their bases in sheltered positions, marked with the same wave-like etchings.

However that may be, it is evident that some unusual conditions must have existed when the St. Peters sandstone was deposited. It underlies the whole lead basin, and outcrops heavily for a considerable distance around it, reaching on the south into Missouri; but nothing like it, so far as I know, is found anywhere else on the continent. Its origin is not well understood. The conditions of its deposition are involved in mystery.

This is the lowest rock in the series which outcrops in Northwestern Illinois. The floor of Rock river, I think, is made up of the top of the Calciferous sandstone, at several places between Oregon and Grand DeTour, but the formation outcrops nowhere at the surface, so far as I am informed.

The economical geology of this region will be found fully treated of in the detailed county reports, to which this chapter is but an introduction. The ores of lead and zinc, clays, sands, rock for lime and for building purposes, peat, and many ores and minerals of scientific interest, abound, and are fully described in their appropriate places.

CHAPTER II.

JoDAVIESS COUNTY.

This large and important county is situated in the extreme northwest corner of the State, It is bounded on the north by the State of Wisconsin, on the east by Stephenson county, in the State of Illinois, on the south by Carroll county, and on the west by the Mississippi river. From north to south it extends twenty-one miles; from east to west, along the south line twenty miles, and along the north line thirty-six miles. It is divided into twenty-one political townships, not always corresponding in size or shape with government surveyed townships. These are named respectively, commencing and following the order in which the sections of a regular township are numbered, as follows: Courtland, Apple River, Scales' Mound, Council Hill, Vinegar Hill, Menomone, Dunleith, West Galena, East Galena, Guilford, Thompson, Rush, Nora, Ward's Grove, Stockton, Woodbine, Elizabeth, Rice, Hanover, Derinda, Pleasant Valley, and Berreman. These contain, in all, about five hundred and eighty-nine square miles or sections of land.

Physical Features and Configuration.

These are more diversified and interesting than are to be met with in any other county in this part of our State. The whole county is a part of the side of an extensive water-shed, with a slope to the southwest. The county is excellently well watered. All the streams flow in nearly the same direction: from the northeast to the southwest. The principal of these streams, commencing at the eastern part of the county and going westward, are: Plum river, Camp creek, Rush creek, Apple river, Small-pox creek, Galena or Fever river, Sinsinnewa river, Little Menomone and Big Menomone rivers.

Apple river and Fever river are considerable streams; the latter, in high stages of water in the Mississippi river, will float the largest steamers from that river to the city of Galena. Most of the others afford abundant mill-sites for light mills and manufactories. At Hanover, on Apple river, there is quite a heavy power used, for the purpose of driving the machinery in an extensive woolen mill. Along the southwest part of the county there is some alluvial bottom land, made up of deep, black Mississippi mud bottoms and sand prairies; but these are not extensive. Some of the smaller streams have narrow and fertile alluvial bottoms. These are walled in, in most cases, with bluff ranges, more or less precipitous and rocky. The trend of the bluff line along the Mississippi river winds and bends with the general course of that stream. These bluffs are high and gently rounded along the northwestern part of the county, but assume a more picturesque and castellated appearance as they enter Carroll county on the south.

It is almost impossible to give a correct description of the surface of JoDaviess county, without a minute reference to almost every township in it. In general terms, there are all varieties of surface found in the northern part of the State. Level prairie, rolling and undulating prairie and oak openings, uneven, hilly, rocky and bluffy timbered and farm-land tracts, may all be found in almost any portion of the county. The eastern and northeastern townships are generally prairie; soil rich, warm and deep; some of it regular level Illinois prairie land; some of it, towards the center and south of the county, undulating, uneven, partly covered with scattering and scrubby timber. The southern tier of townships is uneven, sometimes hilly, sometimes rocky, with some prairie in Berreman, Pleasant Valley and Hanover. The western and northwestern townships are generally timbered, hilly, rocky, and even bluffy. The central townships are generally uneven and partly timbered.

The prairies of JoDaviess county are not excelled in fertility by any upland prairie in the State. The soil of the rough, uneven and hilly land, when cleared of its timber and underbrush, and laid open to the genial influences of good cultivation, is quick and fertile, being composed of a clayey, somewhat marly base. Numerous farms, some of them quite large, opened in the rough lands in every part of the county, attest the truth of this statement, and amply repay their owners for the labor of putting them under cultivation. Some of these reddish clayey soils might not look fertile to the husbandman used to the blacker prairie soils; but the large yield of cereal grains and grasses would soon convince him that their producing powers

were almost equal to the vegetable moulds and humus-charged soils of the leveler portions of the State. Indian corn, of course, is not so heavy a staple crop here as in other portions of the State farther south; still, good crops are raised with reasonable certainty.

Stock-raising is also an important element of wealth in the county. The range is good, and sheltered situations for the winter are abundant. The citizens of the county, many of them, are largely engaged in this very remunerative business.

The agricultural resources, stock raising capabilities, and mineral wealth hidden away in the underlying rocks, are all leading elements of wealth in this county.

The county has an abundant supply of timber, for its own consumption, for many years to come. The oak family is largely represented among its trees; basswood, hickory, walnut, and, in short, all the trees, wild fruits and shrubs catalogued for this part of the State may be found in the bottom timber, barrens and groves.

Fruit-growing and vine-raising may both be carried on successfully. The hills about Galena, and in many other portions of the county, produce the hardy fruits and grapes in great abundance. The business has not been gone into extensively, but there is no reason why wine-making might not be made to pay in favored localities. On the Galena hills I have seen grape-vines purple with thick hanging clusters, while apple trees near by bent beneath their ripened fruit. The garden fruits attain also to great perfection.

A prominent feature in the landscape of portions of the county is a number of natural mounds rising to a considerable height above the general surface.

Pilot Knob is the most conspicuous of these. It is about three miles south of the city of Galena, and about two miles from the Mississippi river. It is a conspicuous landmark to tourists and river men passing up and down that stream. Towering above the surrounding high bluffs, it reaches an altitude of 429 feet above ordinary water mark in Fever river, according to barometrical measurements made by WHITNEY.

There is a chain of some half dozen of these mounds, running northeast of Pilot Knob four or five miles, among them Waddel's and Jackson's mounds, well known local elevations. Around the city of Galena there are several mound-like elevations and ridges, the most conspicuous of which terminates in a group of castellated rocks near the residence of Mr. Hallet. These rocks overlook the city, and the crooked valley of Fever river, for some distance.

Charles' Mound, near the north line of the county, is supposed to be the highest point of land in the State. Its ridge-like, rocky backbone is 295 feet above the Illinois Central Railroad track, at Scales' Mound station, 951 feet above low-water mark in the Mississippi river, at Cairo; and 1,226 feet above low-tide in the Gulf of Mexico. These are the figures given by Whitney.

Scales' Mound, about a mile south of the last, is a well known locality. Around this latter, and within a radius of two or three miles, there are several other similar but smaller mounds.

East and southeast are Woods' Mounds, in the south part of Apple River township; Bean's Mound, near Apple river; Powers' Mound, in the northwest corner of Rush township; Paige's Mound, near the south line of Courtland township; Simmons' Mound, near the northeast corner of the township of Stockton; Benton's and Rice's Mounds, a little north and west of the latter; one or two mounds or mound-like elevations east of Elizabeth, whose names I did not ascertain; an elevated, mound-like plateau of several miles in extent, commencing about two miles north of the village of Elizabeth; and several other such plateaus in various parts of the county.

The geological structure of these mounds gives them the appearance of gently sloping hills for a part of the distance up their sides, crowned by abrupt, fancifully weathered, castellated rocks, of a reddish-brown or whitish-yellow appearance. Some of these views, from a distance, have a great resemblance to old mural walls and baronial towers, and vividly recall to memory the wild architectural structures of the middle ages. Their geology is quite interesting, and will be more fully dwelt upon in a subsequent part of this report.

These same Niagara rocks outcrop in long mural escarpments along the Mississippi and Apple river bluffs, and along many of the smaller streams in those portions of the county where this geological formation is heavily developed. The ledges and exposures, and some of the abrupt outliers of the Galena rocks, also present the same picturesque, wild appearance. Some of them present scenes almost as attractive as any in Jackson county, about the Devil's Backbone and the Mississippi Bakeoven.

It will thus be seen that the topography and physical features of this county are well marked and attractive in the extreme.

Surface Geology.

Alluvium.—The small water courses of the county have the usual narrow alluvial bottoms. In some places these spread out wide enough for small farms. Pleasant valley, along the north branch of Plum river, extends from Morseville to the Carroll county line, a distance of some ten miles; it is from a quarter of a mile to almost a mile in width, and contains some of the very best farming lands in the county. These narrow alluvial bottoms are composed of a rich brown marly soil, made up in great part from the wash and detritus from the hills on either side. In but few places can there be noticed the black silt or mud or washed sand of river alluvium. The valleys are all ancient valleys of erosion, floored or built up by recent detritus from the hills, not transported to great distances nor greatly mixed, and belonging to very recent Quaternary deposits.

The Mississippi river bottom, in the upper part of its course along this county, is very narrow—in fact, that stream almost washes the rocky base of the bluffs for many miles. There is, however, a chain of sloughs opposite Galena, and along the mouths of Fever river and Small-pox creek, where there is a low alluvial bottom, timber-grown, and made up of Mississippi mud and sand. This is the flood-plain or flood-bed of the stream, over which the annual overflows of high water extend. Farther down the river this bottom spreads out to several miles in extent. In the western part of the township of Hanover, bottom timber land, alluvial grass land, and a table land high and dry and susceptible of cultivation—peopled by a considerable settlement about Huntsville landing—exhibit all the characteristics of the ordinary Mississippi alluvial bottoms. Farther down, in Carroll county, this bottom changes into the broad, well known sand prairie—an old, broad, extended, glittering Mississippi sand bar.

Loess and Modified Drift.—The regular marly Loess of the Mississippi bluffs, such as is found opposite Fulton City, at Warsaw, and at other localities further down, is not a marked feature along the western limits of JoDaviess county. Its bluffs are mostly composed of massive rocky formations. The bald bluffs, composed of whitish, partially stratified sands and clays, were not observed; but there are mound-like elevations, and masses of brown, marly, sandy clays along, among and over-capping some of these chains of bluffs, which undoubtedly owe their origin to the same agencies which deposited the Loess of the bluffs, lower down the stream.

These brown deposits are Loess marls and clays, slightly modified by local conditions. Within the limits of the city of Galena, and at other points in Fever River valley, and forty or fifty feet above ordinary water level of Fever river, there are heavy outcrops of a well marked, distinctly stratified clayey deposit, which shows every characteristic of the most marked and well defined Loess of the lower Mississippi bluffs. Thin seams of reddish clayey marls alternate regularly with thin seams of a whitish, tough, unctious-feeling clay. The seams are from one to four inches thick; the stratification is complete; the lithological character seems to be identical; the thickness is from ten to eighteen feet; and the extent into the hills indefinite, but probably limited. In the marly seams I found great quantities of a fluviatile shell, in a fair state of preservation. These shells are quite small, running from the size of a wheat grain to that of a large barley corn. I have several times, within a few years, noticed the same shell, or a closely allied species, strewn thick over the silt and mud after the floods of the Mississippi had subsided, and the flood bed had become overgrown with a dense growth of grass. Beneath the shadow of the grass the damp ground looked as if it had been thickly sown with large wheat kernels. Subsequent overflows no doubt embedded these, and where antiseptic properties mingled with the silt, they will no doubt be preserved, and present an appearance exactly identical with those picked out of the outcrop near the Illinois Central railroad depot in Galena. It will thus be seen, I think, that the evidences of the disposition of Loess deposits in this county are incontestible.

In the Fever River valley, within the city of Galena, a mile or two above the city, and at several places between the city and its confluence with the Mississippi river, there are well defined river terraces of modified or river Drift. These are about twenty feet above ordinary water mark in that stream. Similar traces were observed by Professor WORTHEN at the mouth, and up the valley of the Small-pox creek; and a broad, distinctly marked river terrace may be observed in the lower part of the Mississippi bottom, extending down into Carroll county.

Drift Proper.—The productive lead field has been written down as "a driftless region;" and to some extent this is true of that part of it within JoDaviess county. But in attempting to account for this supposed absence of the Drift in the lead region, eminent geologists have fallen into a controversy, or difference of opinion.

WHITNEY contends that when the lead region was uplifted from the Silurian seas, no subsequent submergence ever took place; and

that all the changes which have since taken place on its surface, have been produced by agencies, such as we now see producing dynamical results upon dry land. When the broadly extended Drift forces—whether broad-creeping and grinding glaciers, or broad-water currents, or icebergs and water acting together—moved the Drift on its southwest course, according to this theory, the lead region rose as an island in the midst of the moving forces, and the Drift stream was divided—thrown to the east and west—and united again after passing the obstruction. Such being the case, the lead basin, supposed then to have been elevated above the surrounding country, escaped the action of the Drift forces. During all this time, more peaceful geological causes are supposed to have been at work over the uplifted island, whose action has produced all the geological changes supposed to have taken place. Atmospheric and chemical agencies disintegrated the hard Silurian rocks. The surface rocks changed slowly into the clays now overlying the bed rocks, except so far as rains and winds may have transported these clays and subjected them to a mixing process. This being true, the superficial deposits of the driftless lead regions are substantially *in situ*, at the very places where they were formed by the decay of the parent rock.

Percival believed that the high-water shed, extending from the mouth of the Wisconsin eastward, rose as a reef in the Drift epoch waters, and turned the drift to the west through Iowa, and to the east round the lead region. This reef may have permitted a sheet of shallow water to flow over it, and submerge the lead basin. In this way the action of the Drift forces would be greatly modified.

My own observations upon the Drift phenomena in this county have not been altogether satisfactory. In the first place I do not think it a "driftless" region. In addition to the drift pebbles and copper nugget referred to, by Professor Worthen, as having been found at the California lead diggings, I have observed numbers of large boulders lying over the prairie land in the eastern and southeastern portions of the county; and I am credibly informed that, on the high upland some three miles north of Galena, many boulders of a sort of buhrstone, whose parent outcrop is far north in Wisconsin, are strewn over the ground. Many of the clay deposits covering the very lead veins themselves, do not differ materially from the buff and yellow clays treated and recognized everywhere else in the northwest as true Drift clays. The river terraces and stratified Loess deposits above spoken of; the lithological character of the clays just referred to; the few "nigger heads" and lost rocks found in

several places in the county, show unmistakably, I think, that the Drift forces, especially towards the close of the Drift epoch, had much to do in cutting down, carrying away, and arranging the great rocky formations which once existed, but which have now disappeared over large portions of the county. Over more than half its area, perhaps, the whole thickness of the Niagara limestone and the Cincinnati shales have disappeared, except the mounds left standing as sentries, at long intervals; and the very Galena bed rocks below where they used to stand, have had their surfaces denuded, to a considerable extent, in the operation. To one standing upon one of these mounds, and looking over the valley-like expanses between them, with the eye of a geologist, the conviction that he is standing upon the old Silurian level of the country, grows into a certainty. Eroding and denuding influences have removed from three hundred to three hundred and fifty feet of Magnesian limestone and shales. It is impossible to suppose that simple atmospheric or chemical causes, acting no matter how long, could produce such gigantic results. Many submergencies and upheavals may have taken place; the dynamical powers of the heavy bodies of water and water currents, and other Drift forces, must have acted long and powerfully in bringing them about.

While these things all appear to be true, it cannot be denied that the superficial deposits covering the bed-rocks, are, in part, derived from their disintegration, by rains, frosts and other atmospheric and chemical agencies. I have examined many clay banks through the lead mine region, which bore unmistakable evidences of this. Those peculiar red clays, characteristic of the lead region, if dug into, show, first, the clays and hard-pan, without rocks of any description, but as the deposits are penetrated, rocks begin to appear in detached pieces, becoming more abundant at a greater depth, until the regular strata of the bed-rocks are reached. Now, these pieces are unworn by atmospheric influences; they lie in horizontal beds, parallel to the strata below, and are evidently the harder portions of the mass which resisted the influences that changed the rock bed into a clay bed. Nearly all the float mineral or clay bed mineral now found is, also, nothing but the ore which has settled down from the decayed rocks in which it was once held in veins and mineral-bearing lodes.

This is also true of the clays covering some of the Niagara and Cincinnati outcrops or bed-rocks, for they partake largely of the underlying rocks, from which they have probably been derived. I

think a chemical analysis of these clays would show a great similarity or exact identity with the rocks under them.

Professor WHITNEY's theory of atmospheric agencies, and no submergence of the lead basin since its upheaval from the Silurian ocean, explains well these unmixed clays, *in situ* apparently, at the very places where formed; but it does not explain the great erosion and denudation which has taken place through the productive part of the lead basin, and is utterly inconsistent with the terraces, Loess and Drift phenomena, plainly manifest in almost every part of this county. If we knew exactly what the Drift forces were, and how they acted, we would probably have no difficulty in seeing what influences modified their force in the lead basin. That such a modification did take place in some way, there can be no doubt.

The blue plastic clays, which lie near the bottom of the Drift in other parts of the State, are sparingly developed here, so far as I have been able to observe. The boulder drift, and coarse gravel drift, which lie near the top of the true Drift, except the few loose boulders already noticed, are, also, substantially wanting in this region.

The yellowish brown clays, red clays, and hard-pan, are developed here to a considerable extent; but the average depth of the superficial deposits covering the rocks in JoDaviess county, is a good deal less than in portions of the State farther east and south. The great denudation which took place here, seems to have been followed by transporting agencies, which bore away a large portion of the materials thus disengaged, to other regions.

The phenomena here observed are probably best explained by supposing two epochs, when causes somewhat different in their results were at work. The first was the epoch of Erosion and Denudition, accompanied by vast transporting agencies of some kind, probably flowing water or modified drift forces. During this epoch the Niagara limestone was worn down, and the Cincinnati shales suffered disintegration, and most of the detritus thus formed was removed. The second epoch was one in which the waters or modified drift forces had partially or wholly subsided; chemical and atmospheric agencies worked upon the comparatively naked rocks; and the lead basin clays settled down in the places where the underlying rocks had decayed. Such a condition of things would, I think, explain all the phenomena observed in the lead region of this county. How far it might apply to other portions of the northwest lead region, I am unable to state.

The Niagara Limestone.—All the mounds, mound-like ridges and plateaus mentioned in speaking of the topography of the county, are

capped by massive irregularly-bedded dolomitic Niagara limestone, ranging in thickness from about fifty to one hundred and seventy-five feet. The castellated appearance of these outliers of this great formation, as they cap these mounds, has already been mentioned. Tapestried with lichens and mosses, of a dull brown or red color, with castellated and fantastic forms, these rocks at once attract the attention of the most careless observer. In addition to the mounds, they cover other portions of the county in the south and southwest; and their ledges and exposures all round the edges, along the bluffs, and where the streams have cut deep channels into their midst, show the same massive, ragged and picturesque appearance observable on the mounds; except that they resemble more, long, irregularly-shaped reddish-brown mural escarpments or walls, carpeted with soft green mosses and feathery ferns.

The superficial area of the county, covered by these rocks, is about as follows, in a general and approximately correct boundary statement:

The high bluff range, about Pilot Knob, is capped by this rock. It commences a short distance north of the knob; the knob itself is a high pile of Niagara limestone, resting upon the Cincinnati shales; and the bluffs from thence to Small-pox creek continue to show it along their summits. From this latter stream to the Carroll county line, near the point where it crosses Apple river, the upper part of the bluffs are composed of the same rock, and some grand outcrops of almost beetling crags may be seen here. These outcrops extend far back from the brow of the bluffs, and are the bed rock over all that high plateau between the Small-pox creek and Apple river, extending in a strip several miles in width to the northeast, to about the township line, between ranges 2 and 3 east. Still farther to the northeast, and separated from this large field by some narrow belts of Galena rocks, about the head waters of Apple river, is a mound-like plateau or table, about four miles long and two and a half wide, and grouped round it are a number of the mounds heretofore named. As already observed, these are all Niagara limestone structures, built upon the underlying Cincinnati shales.

Terrapin Ridge, about two miles south of Elizabeth, is the northern projection of another high table land of exactly similar character, extending south and a little west, between Apple river and Rush creek, nearly or quite to the Carroll county line; but this table land does not approach close to either of these streams.

About two and one-half townships in the southeast corner of the county, are underlaid by this rock. This field extends from the

east and south county lines to the Rush Creek valley, on the west, and nearly to Morseville on the north. Plum River valley and Dutch Hollow, in this field, cut down to the galena, in places, and show the gentle talus-covered slopes and outcrops of the Cincinnati group at many places along their sides.

The probable extent of the county covered by this formation, is a little less than one-third. There are many places throughout this extent where the eroding streams have cut down through the Niagara, into the Cincinnati shales, and even reached the Galena limestone below both.

Such is the superficial area covered by this rock, stated approximately. Its lithological character has been so often written that it seems superfluous to speak of it here. The rock is generally massive, irregularly bedded; tough; of a yellowish color on fresh fracture, but weathering to a reddish-brown. It is full of chert bands; and some of the Niagara hills are macadamized with a thick floor of finely broken, dendrite-speckled flints, which remain from the decay of the strata formerly enclosing them. These flint hills, or flint covered hills, are characteristic of the Niagara limestone formation. The maximum thickness of the Niagara limestone in this county cannot be accurately stated. The denudation which has taken place on its top, and the difficulty of ascertaining the bottom, make it almost impossible to measure its thickness correctly. Its heaviest outcrop is probably along Small-pox creek, where it reaches a thickness of over two hundred feet. As developed in this county, it is exceedingly homogeneous in character—the varieties observed at Racine, LeClaire and Cordova, being wanting. In chemical analysis, lithological character, and general appearance, it is very similar to the Galena limestone. If a difference can be detected, it is less sandy and crystalline, and tougher than the latter formation. Its type or characteristic fossils are also different.

These are chiefly *Pentamerus oblongus; Favosites favosa; Halysites catenularia; Astroerium venustum;* and one or two species of *Stromatopora* formed corals. The *Pentameri* are the traditional "petrified hickory nuts," so often spoken of by the miners and well diggers. Huge blocks of the stone, in places, are sticking full of them. On the silex-sown hills, bushels of rough weather-stained specimens of the *Favosites* can be collected. These old Niagara seas swarmed with the coral builders; and many of the Niagara beds of rock were little else than coral reefs.

The Cincinnati Group.—The green and blue shales and limestones of the Cincinnati group underlie the Niagara limestone wherever the

latter is developed in the county. There are not many natural outcrops of these shales, and they never stand out in ledges or rocky exposures, unless where quarries are opened into the covered rocks. Even where quarries are opened into this formation, and then abandoned for a few years, the rapid disintegration soon covers up the rocks with a gently sloping talus.

The parts of the county underlaid by this formation can be told at a glance. All around the mounds and mound-like elevations, all around the outer boundary lines of the Niagara formation, up either side of all the valleys of erosion which have cut through it, the gentle slopes extending from the general level of the country up to the base of the bold Niagara exposures, are underlaid by rocks and shales of the Cincinnati group. These slopes may be represented by a narrow band two or three hundred yards more or less in width, encompassing all the Niagara fields and outliers, in the county, and running up either side of all the valleys that are cut through it. When this is said, the superficial area underlaid by the Cincinnati group is as well indicated as it could be by many pages of description. One or two localities, however, deserve a passing notice.

At the northern terminus of Terrapin Ridge, near Elizabeth, the milky looking clays and shales are washed and furrowed out by the rains, exposing many fine specimens of the hemispherical-shaped coral *Chætetes petropolitanus*. I have found dozens of good specimens of this coral in the clay-washed road at this locality.

East of Scales' Mound the track of the Illinois Central railroad is laid for several miles almost upon the top the Galena limestone. Several rather heavy cuts in that locality show good exposures of the overlying Cincinnati shales. These beds contain in certain layers a very great abundance of minute fossils, principally a small *Nucula*.

The general character of this group in Jo Daviess and Carroll counties is almost identical. The upper layers are thin-bedded argillaceous and siliceous shales, of a light-buff or creamy color. Where thick-bedded enough to quarry, the stones have a kiln-dried, dusty appearance. Lower down, the shales become blue or greenish in color, sometimes separated by thin bands of green, marly clay; still lower, some massive strata of a deep ultra-marine blue color may be found, exceedingly hard, and giving out a clear, ringing sound when struck with a steel hammer; below these there is found in some localities a black carbonaceous shale, so highly charged with carbon as to burn with a bright flame as though impregnated with oil, and the bottom of the deposit is made up of thinner strata of

alternating yellow, blue and green shales and clays. Wherever the rain cuts through the soil into these shales, or the little streams wash them, the wet clays have a greasy look, and the trickling waters a creamy and greenish color. There are no gradual beds of passage into the overlying Niagara or the underlying Galena limestones, but the formation preserves well its distinctive characteristics. The beginnings of its foundation stones and its cap-rocks are always easily recognized.

The thickness of the deposit cannot be accurately stated. A true section, as developed in the Mississippi river bluffs, from Bluffville, in Carroll county, to the mouth of Fever river, would run from eighty to one hundred and twenty feet. In the interior of this county it nowhere, perhaps, reaches to one hundred feet, and in some places it is only from forty to sixty feet.

The deposit is full of well-preserved fossils. The *Orthoceratite* beds in Dubuque county, Iowa, have long been famous for the number of well-preserved *Orthoceratites* with which they are crowded.

The *Chætetes petropolitanus* is a characteristic fossil, and is found in great abundance at Elizabeth, and in the washes and ravines at other places. Fragments of a branching coral, and the small, bud-like heads of an *encrinite*, are generally found in the same localities. In a few places I observed immense numbers of the fragments of *Isotelus gigas;* also several species of *Orthis*, among them *Orthis lynx;* associated with *Ambonychia radiata, Strophomena alternata,* fragments of two or three species of *Orthocera,* and one or two of the new fossils described in the third volume of the Illinois Geological Reports; *Strophomena unicostata* and *Tentaculites Sterlingensis* were also observed.

The Galena Limestone.—This is the great bed-rock of the county. From Dunlieth to about the mouth of Small-pox creek it forms the rocky bluffs on the Mississippi river. All the northwestern, northern and northeastern part of the county, except a few of the mounds heretofore named, is underlaid by it. The eastern part of the county, extending a short distance south of Morseville, is also underlaid by the same rock. All the larger streams in the county, including Sinsinnewa, Fever and Apple rivers, Rush, Small-pox and Plum creeks, with their principal tributaries, flow along the surface or cut into this formation. It immediately underlies the surface deposits of something like two-thirds of the county.

The maximum thickness of the Galena rocks in this county is not known. It is probably not far from three hundred and fifty feet. At Elizabeth shafts are sunk one hundred and fifty feet deep, and what

is known as the flint strata, among miners, was not reached. At the places of these shafts the Galena had been considerably denuded. The flinty strata generally is characteristic of the middle of the formation. It may be, however, that the estimate from this basis is too great. No outcrop observed was over about two hundred feet thick.

Its lithological and stratigraphical character is too well known, and has been too often given in these reports, to require an extended notice here, as all into whose hands this report will be likely to fall will probably have access to those descriptions. The rock is a thick-bedded, sub-crystalline, compact, cream or chrome-colored dolomitic or magnesian limestone. It weathers out into forms almost as fantastic and picturesque as the Niagara above it. Along the streams its weathered-out ledges present the same castellated and mural appearances, and some of its outliers rise into towers and chimneyed shapes of the most striking outlines. At Dubuque, or rather opposite Dubuque, at Dunleith, a curving tunnel has been cut through the solid rocky bluff, some eight hundred feet in length, for the purpose of permitting railroad trains to pass over the new bridge across the Mississippi river at this locality. This tunnel is about twenty-five feet above the Trenton or Blue limestone. The base of the Galena, here, is not far from the water-level of the river. The rock removed from the tunnel is not so yellow in color or granular in structure as that obtained from the upper parts of the deposit. It shows the beginning of the beds of passage into the underlying Blue limestone of the Trenton. The rock removed from the shafts and mines at Morseville and Elizabeth has a granular appearance, and a color peculiar and difficult to describe—a color between a cream-yellow and a cerulean-blue, if such a color can be imagined. There is also, mingled with this, a greenish rock, corresponding with the rock found at the green rock openings about Mineral Point.

Other peculiarities of this limestone will be noticed when I come to speak of the lead deposits, under the head of "Economical Geology."

Fossils are not so numerous in the Galena limestone of this county as in that of Carroll, Stephenson or Winnebago. At Morseville, among the stones and debris thrown out from the lead diggings, I obtained several fine specimens of *Bellerophon*, the only fossil there observed. *Illænus crassicanda* and *I. taurus* have both been found at Galena; a large species of *Cypricardites* is also frequently found, especially in the quarries in Carroll county. *Murchisonia bellicincta* and

Receptaculites Oweni, two of the most characteristic Galena fossils, are found less frequently here than in any other portion of the formation in neighboring counties. A section of the largest *Orthoceras* ever discovered in the lead region, perhaps, was found in the Galena limestone at Morseville, some two years ago, by some of the miners. It was eighteen or twenty inches long; a siphuncle nearly three inches in diameter, projected about four inches at one end; the septa, somewhat loose, looked somewhat like a ribbed human body with a projecting neck. Of course, those who saw it supposed that a petrified human trunk and neck had been discovered.

Trenton Limestone.—This limestone is only met with in two localities in the county. At Dunleith, and a little above it, there is a low outcrop along the banks of the Mississippi river. It is here a light bluish-gray rock, regularly and rather thinly-bedded, with shaly partings, showing many of its characteristic fossils. These layers are near the top of the formation, and have some of the characteristics of the superincumbent Galena. They, in fact, begin to partake of the nature of the beds of passage into that rock.

At Dubuque splendid specimens of *Graptolites* have been found in the Trenton; also very finely preserved eyes of *Trilobites.*

Other exposures of this limestone may be seen along the north branch of Fever river, commencing about three miles northeast of Galena, and continuing until the Wisconsin line is reached. The outcrop attains a thickness of about twenty-six feet at its heaviest exposure, at Tuttle's mill. It is made up of thin-bedded limestone, a rather thick-bedded strata of glass rock, and grayish heavier-bedded limestones. Near the forks of Fever river a cut of the Illinois Central railroad shows a similar but thinner section. Many of the well known fossils of this formation are said to have been found at these outcrops. But the conditions were not favorable for obtaining fossils at the time I was there.

This is the lowest formation anywhere outcropping in the county, or that can be regarded as belonging to a section of JoDaviess county rocks. We are now prepared to give that section, naming the approximate average thickness of the formation:

Section of JoDaviess County Rocks.

	Feet.
Quaternary Deposits. Alluvium, Loess, river terraces, clays, sands and hard-pan,	20 to 75
Niagara Limestone. Heavy-bedded, reddish-brown, dolomitic limestone, weathering into cliffs and castellated exposures, similar in lithological character and appearance to the Galena limestone	40 to 200
Cincinnati Group. Green and blue and buff-colored shales; thin-bedded gray limestone, and hard, thick-bedded, glassy rocks	42 to 80

	Feet.
Galena Limestone. Heavy-bedded, cream-yellow, dolomitic limestone, the lead rock of the Northwest; somewhat granular and crystalline, and showing beds of passage into Trenton below	100 to 275
Blue Limestone. Thin-bedded gray limestone and shales and glass-rock of miners	10 to 26

Economical Geology.

Building Stone.—There is the greatest abundance of good building stone in this county, so distributed as to make it of easy access to all its citizens. All the formations are quarried. In Pleasant Valley a number of good quarries are opened in the Cincinnati group of rocks. These quarries are in the brows of the hills, on either side. The stone obtained is sufficiently thick-bedded and compact to make a good building stone. It has a dry, dusty, kiln-dried appearance. Several farm houses are built of this material in the valley. So far it seems to answer well for farm uses, without exhibiting a tendency to disintegrate. The best of it would, I think, be unsafe for massive and long enduring masonry, but for light masonry it seems to answer well; and its convenience of access, and the ease with which it can be quarried, will always cause its outcrops to be kept open and worked. The abundance of better building material in most parts of the county doubtless prevents its extensive use in other places where it could be easily obtained.

The Blue limestone outcrops, along the north branch of Fever river, afford some good building stone. This is a light-gray limestone, rather thin-bedded, and of enduring properties. The outcrop at Dunleith also splits into a conveniently handled stone, and is used extensively for economical purposes.

The massive ledges, exposures and natural outcrops of the Niagara and Galena limestone along nearly all the streams, in the brows of all the bluffs and hills, and in all those parts of the county where these heavy deposits are the bed-rocks, furnish an unexhaustible supply of a coarse, enduring, valuable stone, suitable for all sorts of heavy masonry, such as bridge piers and abutments, foundations, cellar walls, and even public buildings and private residences. They require considerable dressing for these latter purposes, but when dressed into good shape their rich, warm, brown and cream colors, and the fact that they season into almost the hardness of a granite, and have an enduring, solid, substantial appearance, makes them prominent among the materials of economical value in the county.

Lime.—We know not to what extent lime is burned in the county. The abundance of timber and the abundance of good magnesian

limestone afford all the facilities for manufacturing large quantities of a good, coarse, strong lime.

Clays and Sand.—The clays associated with the Cincinnati shales are sufficiently pure to furnish a potters' clay good for the manufacture of common crockery ware.

At Elizabeth I noticed several outcrops of this potters' clay in some of the streets and lots of the village. Four or five miles south of Elizabeth, on the Mount Carroll and Galena road, the Jenkins pottery is located. This establishment has been in operation for quite a number of years, and has built up quite a remunerative business. The clay is obtained near by. It is not altogether pure and free from foreign substances, but these difficulties seem to be mostly overcome by the processes through which it is put in manufacturing. The result is a ware largely used in this part of the State, as the Jenkins pottery wagons are well known in all the neighboring towns, villages and cities.

Common yellow and red clays, for ordinary brick, exist everywhere in the greatest abundance. Sand, suitable for building purposes, is not so universally distributed, neither is it so scarce as to be a matter of serious inconvenience.

The Associate Minerals.—Associated with the galena, and deserving a passing notice before that important mineral deposit is referred to, are several other mineral substances well known in the lead region. The most important of these is the sulphuret of zinc, blende or "black jack" of the miners. This is a useful ore of zinc, but is quite difficult to reduce. In the lead region it is not considered of economical value. The carbonate of zinc, smithsonite or "dry bone" of the miners, is considered a more valuable mineral. A furnace for its reduction has been in operation for some years at LaSalle, and has proved a financial success. Iron pyrites also occur in connection with these minerals in considerable abundance. At the celebrated Marsden lead all these associate minerals may be seen associated with each other and with the galena, with the Galena limestone, and with spar and other substances. This mine has afforded the best cabinet specimens of these minerals in combination to be found anywhere in the lead regions. Brown hematite, and several other mineral substances, occur in occasional small quantities, but they are not of interest in an economical point of view. None of these associate minerals have become articles of commerce, except, perhaps, the carbonate of zinc; and it is doubtful if even that exists in sufficient quantities to make it an article of value in the economical resources of this county.

Galena or Lead Ore.—The great mineral interest of the county, as every one knows, is lead. Indeed, it is second to no mineral interest in the State, except that of coal. The leading ore of this metal has given its name to the great and important rocky formation in which it is chiefly found in this part of the country, to an important city in the midst of its heaviest deposits, and to the township in which that city is located.

The scope of this county report does not embrace a very extended essay upon the mining or metallurgy of lead, or a topographical survey or description of the crevices, leads, lodes and diggings, nor a scientific discussion of the modes of occurrence and phenomena observed in its workings. It is rather the province of this report to present the geological formations of the county, and some general remarks upon the extent of its mineral and other resources. The "Lead Region" has been closely examined and ably written upon by Prof. J. D. WHITNEY, for the three States of Illinois, Wisconsin, and Iowa. It will be unnecessary to repeat here what he has presented so well in the first volume of the Reports of the Illinois Geological Survey. That volume will be as accessible to the common reader as this, and to that volume we refer the reader for surveys, and descriptions of the crevices and leads, and a detailed account of the different diggings, their positions, peculiarities of form, extent of working, amount of ore produced, and facts collected in regard to them. It would be useless to write these things over again; and if it was not, my knowledge of the lead region and opportunities of investigating its facts and phenomena have been far too limited to undertake the task. A brief *résumé* of some of the facts and history of lead and the lead region may not, however, be out of place.

Galena, or the sulphuret of lead, called in the common speech of the lead region "mineral," when pure, is composed of 86.55 pure lead and 13.45 sulphur. It crystallizes in the form of the cube and its secondaries, has a perfect and easily obtained cleavage, and a bright, silvery, metallic luster on fresh fracture. The lead ore obtained in this county is nearly pure galena. It sometimes contains faint traces of silver.

The discovery of this lead was made in an early period. There can be no doubt, I think, that the early voyaguer, trader and explorer, LE SUEUR, on the 25th day of August, A. D. 1700, discovered and described Fever river under the name of "The River of the Mines." From this, and the description of a mine found, in his journal, he is generally considered the discoverer of the Galena lead mines. Subsequently to this, and prior to the workings of these mines by

white men, they were undoubtedly worked to some extent by the Indians, in their rude way. These primitive miners—or rather their squaws, perhaps—rudely drifted into the hills, and loosened the mineral by building fires against the rocks and then throwing water on them, as ancient mining was once carried on in the copper mines of the Lake Superior region. Some eighty years after this the wife of an Indian chief, Peosta by name, struck a lead just below the city of Dubuque, which was worked by Julien Dubuque, under permission from the Indian tribes. In 1819 the present city of Galena was first settled, by a man named Bouthillier. In 1820 several others joined him, and a trading house was opened by Jesse W. Shull and Dr. Muir. The adjoining country was a wilderness. By this time the Galena mines had begun to attract attention. In 1823 emigration was pouring in lively. The government had reserved all its mineral lands in this part of the country. In this same year Lieutenant Thomas was sent here by the United States to look after these mineral lands. He granted leases, collected rents, and looked after the mines generally. In 1827 population had so increased that a village was laid off on the present site of Galena, and named from the mineral found on its site and around it. There is a dispute as to whether Lieutenant Thomas or Dr. Muir named the village. The authorities differ on this proposition. In this year permits were given by the government to occupy and improve lots. The possessors of the permits were liable to surrender them to the government upon thirty days' notice. These permits were poor titles; but the people had no better up to 1836, at which time Congress confirmed the titles of those in actual possession of the town of Galena, laid off into lots by act of Congress, in 1829. Previous to 1827 the leasing policy of the government had substantially failed, and the miners were working wherever they could obtain mineral, without regard to the claims or ownership of the government.

The mineral lands, shortly after the first settlement of Galena, had been turned over to the War Department, and the leasing or permit system was continued up to 1846, every year running the government into debt. In this year a law was passed by Congress, throwing the mineral lands into market, and in 1847 the mineral lands in JoDaviess county were brought into market and sold to actual purchasers. During all this time other settlements had sprung up, the most important of which was the trading post called "The Portage," just below the present site of the city of Galena. The Indians swarmed over the lead region at the time of its first settlement. Their squaws discovered many mines, worked them to

some extent, and traded the mineral to the white settlers. Among these early mines was the "Buck Lead," near the present site of Galena, discovered about the time of its first settlement.

From 1827 the mines rapidly grew in importance and multiplied in number. From 1840 to 1850 the greatest degree of prosperity was reached in the mines, about midway between those years being the very acme of mining prosperity. Galena became the mining metropolis of the Northwest. Thousands of rough miners swarmed through her streets. All sorts of moving vehicles were seen in her thoroughfares, and every language was spoken, every costume worn. The miner generally spent all he made, was poor, and held his own remarkably well. And that reckless spirit, bred of all uncertain pursuits, was abundantly manifested among the miners who assembled in the lead region. Card-playing and whisky-drinking, quarreling, and that rough, desperate life developed among adventurers of all classes gathered about Galena, was characteristic of those as of all other mines. But in the midst of it all, the city of Galena grew to unexampled prosperity and wealth, and for hundreds of miles round was the center of commerce and trade for the whole country. Treasures came up out of the ground, flowed into the city, and there remained and built it up. The discovery of the California gold mines swept from the lead mines all that floating part of its population, ready for a new excitement, and also much that was of a more permanent nature. The lead mining interest rapidly decreased in importance, until the financial troubles of 1857 drove many back to mining as a matter of necessity. At the present time considerable attention is paid to mining, and it is probably a fact that mining labor is better and more uniformly paid now than at any other period in the history of the mines. With all the vast amounts of mineral found, it is also a fact that but a very small proportion of the ground has been proved.

We cannot arrive at even an approximately accurate amount of the mineral mined in JoDaviess county. According to Mr. WHITNEY, the amount of lead received at Chicago and St. Louis, as per records of the Chamber of Commerce and Board of Trade, from 1853 to 1859, including both years, was about 181,000,000 pounds. This was from all sources. Of this amount he thinks about one-sixth was derived from mines in Illinois, almost exclusively in this county. This would give about 30,000,000 for this county for that period, which period was the least prosperous time for mining known to exist for many years. From the detailed descriptions given of particular leads and ranges, by the same gentleman, in the first volume of the geological

report of Illinois, we find that he gives the produce of certain enumerated mines up to that time at about 64,000,000 pounds. The Apple River diggings are supposed to have produced from one-half to one million of pounds. The Elizabeth group of mines are stated, by Henry Green, Esq., an old miner and smelter, to have produced from 60,000,000 to 75,000,000 pounds. Mr. Green is probably below the amount actually produced. The Vinegar Hill diggings, being a group of about forty lodes or mines, are supposed to have produced 100,000,000 pounds. This statement is made upon the authority of Mr. HOUGHTON'S pamphlet upon the Marsden lead. From the same authority we learn that the maximum production of the JoDaviess county mines, in 1846, was 56,000,000 pounds. The Council Hill mines are supposed, by D. Wilmot Scott, Esq., to have produced 19,000,000 pounds. The Morseville mines are stated to have produced from one-quarter to one-half million pounds. Captain BEEBE stated a few years ago that five furnaces were in operation in the county, smelting annually 8,750,000 pounds of pure lead, some of which was obtained outside of the county. The Marsden lead is said to have produced 3,000,000 pounds of mineral. A writer in *Harper*, for May, 1866, states that the amount of lead shipped from the Galena mines from 1821 to 1858 was 820,622,839 pounds, and the value of lead shipped from 1821 to 1865 was not less than $40,000,000. The New California diggings, a few miles south of the Marsden lead, has been yielding a great deal of mineral since their discovery, but I have no means of knowing the amount. These are but a few of the figures and statistics. Hundreds of small ranges, mines and leads have not been mentioned. Multitudes of surface diggings have been carried on, for the purpose obtaining "float mineral," none of which were very extensive, but the sum total of which aggregated a great deal of lead.

From these figures—and they are imperfect enough—it can be seen that the mineral interest of this county in the past has been a matter of great magnitude. Together with Shullsburgh, Mineral Point and Dubuque, this Northwestern lead basin has been, and yet is, one of the greatest mining localities in the world.

The superficial area of the county underlaid by productive lead deposits, so far as known at the present time, is limited, embracing but a small fraction of the area of the Galena limestone. The lodes or ranges are principally located in groups. The diggings, mines or workings are in patches, but seem to have many features in common. The most southern productive mines in the county are on the great east and west range of mineral passing through and just north of

Elizabeth. This mineral range commences at the mouth of Yellow creek, a few miles southeast of Freeport, in Stephenson county, where an old shaft exists, which used to be heavily worked a good many years ago. The next group of mines on this range to the west is at Morseville, in the southeastern part of JoDaviess county. Here lead has been mined more or less for many years. Several men have accumulated a competence, especially the former proprietors of the old Price lead. The workings are shallow, and the water strong at twenty-five or thirty feet deep. Prospect holes cover the hill sides, and piles of red clay indicate them along many of the ravines. The following ranges or leads are worked at the present time: the Blair range, about one-fourth of a mile west of the village, near the road; the Company lead, a little south of the village; Clevinger & Mitchell's range, just south of Mr. Morse's house; Mumma & Livingston's lead, west of the village, which is the old Price mine; and a lead called the Lyons lead. No one seems to know the amount of mineral produced from these mines. One gentleman informed me that it had been about one-half million of pounds. At the present time one or two of the leads are furnishing a considerable quantity of excellent looking heavy lead; some of it is in large cubes. The stone thrown out from these leads has a granular, greenish-blue look, resembling what is called the green openings of the Wisconsin lead-bearing rocks, but probably higher up in the series.

The next heavy mines westward, on this same mineral range, are the groups at Elizabeth and Weston. About 2,500 acres here are prospected over and mined in. It is an irregularly shaped tract of land, about six miles long from east to west. The village of Elizabeth is located upon its southern edge, a little east of its center.

The most extensive lead now worked is the Wishou diggings, discovered some two years ago in a cultivated field, about a mile north of the village. During the last year this mine has turned out nearly forty thousand dollars' worth of mineral. The mine is now worked by a company, under the superintendence of Dr. Little, of Elizabeth. A strong steam engine runs night and day, and gangs of men relieve each other every eight hours. The workings have reached thirty-five feet below the water level. The shaft is about one hundred and fifty feet deep, and still going deeper. The mineral is found principally in vertical openings, in some places several feet wide, and full of clay, loose stones and chunk mineral. The company are driving their drifts in several directions, and at several different levels. The object now seems to be to develop the mine, and not simply to obtain

mineral. Many heavy deposits are passed and left for future working. The prospect of a rich future yield in this mine is very encouraging. I spent about two hours in the bowels of the earth here, and then explored but a few of the horizontal drifts. The old Haggerty diggings, the Van Meter range, Stone's field and Kilpatrick's field have all furnished abundance of mineral, and some of them have been worked for 35 years. The oblong tract of ground above mentioned has been prospected over and mined in extensively. Deep crooked holes, red clay and stone piles, and timbered shafts might be counted by the score. It would be impossible to give the names of all these.

The Elizabeth mines were discovered at a very early day, and worked to some extent. In 1846 more than 800 miners are said to have been engaged in mining about Elizabeth and Weston. At this time one-ninth of all the mineral raised in the lead region is supposed to have been obtained here. Elizabeth and Weston were both swarming, active towns. Lead mining, in its glory, was actively engaging all classes of citizens, and the highest financial prosperity was enjoyed by all who depended upon the trade of mining and the products of the mines. The working out of some of the heaviest superficial deposits, and the discovery of the California gold mines, caused mining to rapidly decline. These mines soon, therefore, fell into disuse and neglect; but they are again assuming something of their former importance. At the present time labor in these mines is better paid than at any other period since their discovery. We mean by this that the general mining labor of all the mines, taken together, will pay a greater average remuneration than in former days, when the few made fortunes and the many only ordinary mining wages.

There is from twenty to thirty-five feet of the "flint-rock" above the water level. The flint, on the higher levels, is from 130 to 150 feet below the surface. The crevices gradually close before reaching the flint rock. The easily worked perpendicular crevices above the flint strata were first worked out, and then the mine was generally abandoned. Another observation worthy of notice is, the local elevations and dips in this group of lead mines. The flint strata outcrop at the side of the Galena road, in a ravine about two miles northwest of Elizabeth. This outcrop is a few feet above the water level of the brook near by. At Wishou's shaft, a short distance east of the outcrop, and near the top of the hill, the miners are working thirty-five feet below the water level of the mines, and still the flint is not reached. The water level in the mines rises slowly as the

hill is penetrated; but this rising of the level could make but a few inches or feet difference at most, while the fact seems to be that there is more than forty feet difference between the bottom of the shaft and the flint outcrop on the road, and no flint is yet reached in the shaft. In other localities the same thing has been noticed. In prospecting for deep mining in this region, this fact may aid in coming to a correct conclusion as to the probable location of lead deposits.

Leaving the Elizabeth lead fields, the next heavy mines are found a few miles west, on the east and west slopes of the bluff range, bordering the Mississippi river. These are the New California mines, discovered accidentally, only a few years ago, by a fisherman, who resided in a wild glen on the Mississippi river. At this point the rocky bluffs rise abruptly. The ranges are found by drifting into them a little above the water level, going in where a crevice is noticed rising vertically through the rocks. The mineral found is heavy mineral, existing in large cubes or cogs in some instances. It resembles the large bodies of mineral found in the Marsden lead. On the east slope of the bluff range, where the hills fall away gradually to the level of the interior, several lodes are struck by sinking shafts down to the ranges. The following ranges have been struck in these mines, and perhaps a few others, the names of which I did not learn: Wise range, McKenda & Graham, Davis & Brownell, Bernard & Co., Lester, Sanders & Hony, Felt & Clymo, Wakefield & Co., Marble & Young, Dye & Co., Samuel Taylor. Other valuable ranges will doubtless be discovered when all the crevices are examined.

West of the Mississippi river, in the Iowa bluffs, the same great mineral east and west range has been found. We have thus followed it almost entirely across the lead basin, and shall now leave it in the Iowa bluffs:

Five or six miles north of the New California diggings, the celebrated Marsden lead may be found. The discovery and history of this great mine was truly wonderful. Some light float mineral had been found in shallow diggings. Thirteen or fourteen years ago the proprietor of the rough farm, which had been purchased by him for stock and dairy purposes, had occasion to drive a stake into a spring, and in so doing heavy mineral was struck. Mr. Stephen Marsden was then the owner of the farm. By following up the discovery, he soon found himself the possessor of a fortune. A succession of openings in the rock, each deeper than the other, were found to be filled with strong mineral. These openings have been followed to the

depth of about 95 feet, and I am informed that nearly 7,000,000 pounds of excellent mineral have already been taken out. Only about one acre of ground has been worked over in obtaining all this mineral, and the prospects of other heavy bodies of lead being found, both below the present level worked, and on other parts of this farm, are said to be very promising. This farm and mine has recently been sold by Mr. Marsden to an eastern gentleman, and a company organized to work this mine on the most approved and extensive plan.

This range is celebrated not only for the amount, but for the variety and beauty of its mineral deposits. Large cubes and diamond-shaped masses of lead ore have been found here, perfectly coated with a beautiful covering of iron pyrites. Galena, black-jack, spar, and iron pyrites are found in wonderful combination, furnishing the finest cabinet specimens found any where in the lead region.

The Marsden lead, the New California diggings, the Ambruster & Co. lode, recently discovered, and most of the mineral found along the western limits of the lead field in this county, have certain resemblances, both in the character of the lead ore and its associated minerals, not observed in the mines in the eastern part of the county.

The next important group of ranges to be noticed, is within and immediately around the city of Galena. The following are the names by which some of these ranges are known. There are many others whose local designations are not now accessible. Some of these are not now worked. They are mostly comparatively shallow diggings: Buck, Doe, Harris Leads, Kringle, Gaffner, Hog Range, Tomlin & Burrichter, Frysinger, Crombacker, Tomlin, Evans & Adams, A. C. Davis, Ambruster & Co., Ottawa Diggings, Drum, Rare & Co., Bennenger & Co., Graves, Comstock & Rosemeyer, Wallon & Quick, Sanders & Co., Muldore, Bolton, Stephen Marsden, Allenrath, Eagan, J. E. Comstock, P. Smith & Co., Hostetter & Co., Duer & Co., Allendorf & Co., Tom Evans, Britton & Wilkins, Cady Range, Roberts Range, Wm. Richards, Wilcox & Co.

In addition to the above named ranges, Mr. WHITNEY, in the first volume of the Geological Survey of Illinois, gives the names of some others not included in that list. These are the Kloepfer Range, Barrow Lot, the Morrelli & Monti group of east and west, the Binsemer Diggings, the groups of small diggings on Furnace creek, the Beber Diggings, the Gaffner and Shuster ranges, in the same group with the Gaffner; the Whitham range; the Brendel, Eberhart, Widmer & Nolt, Monti, and Leonhardt, is another well

known group of mines; the Wallis, Leonhardt and Klein crevices on the Morehead Lot, the Wallis Diggings, and the Mannett & Bassett Diggings, the Tourlin Lot, the DeToya Lot, and the Flege Diggings, the Lowe Diggings, and the Marfield Diggings.

These ranges and diggings are situated within a circle of about three miles in diameter, of which the city of Galena would be the center. They are principally on the west half of section 21, the northwest quarter of section 16, the west half of section 9, the northwest quarter of section 28, east fractional section 8—all in township 28, range 1 east, 4th P. M.; and on the east half of section 12, the east half of section 26, the south half of section 14, the north half of section 26, and the east part of section 27—all in township 28, range 1 west, 4th P. M.

The Vinegar Hill Diggings are about five miles north and a little east of Galena. The following ranges are known by the following designations: Baily, Gear, Meighen, H. Mann, Indian Feehan, Blood, Campbell & Reppy, Furlong & Fechen, Talbot, Kennedy, Rogers, Hogan, Gray, Leekley, Beedle, Briggs, Manley, Myers, Bruno, Cottle, O'Mara, K. Orwick, Whim Range, Hawkin Hart, Trover, Dugan, Liddme, Hoskin, Sidemer, Shattluck, Smelt, 15 Strike, Foley, H. H. Gear, Cooney & Ryan, Cox, Wylram, and Richards. These are located principally on fractional sections 14, 15 and 16, on fractional sections 20 and 29, on sections 21, 22 and 23—all in township 29, range 1 east, 4th P. M.; and on the east part of sections 24 and 25, township 29, range 1 west, 4th P. M. On the west part of the last section named, on the northeast corner of section 35, and on the north half of section 23, in the township and range last aforesaid, there are also groups of diggings not enumerated in the foregoing ranges. The Vinegar Hill mines are among the heaviest in the lead region, if we consider the amount of mineral they have furnished, but they are not now worked to a great extent. These diggings extend in a somewhat northeast and southwest direction, over a tract of ground about three miles long, and not to exceed a mile in width. The shafts are sunk from about 50 to 90 feet deep, and penetrate in many instances the flint beds of the Galena limestone.

About three miles east and a little south of Vinegar Hill Diggings, the Council Hill ranges are located. The heaviest ones are situated on the north half of section 25, and the south half of section 24, township 29, range 1 east. They are known as the North Diggings, and cover a tract of about forty-seven acres, on which is over one hundred veins running northeast and southwest. The prin-

cipal, medium, and smaller shafts, number nearly one thousand. The South Diggings, on the south of the Hill, are of small importance. The east half of section 36, township 29, range 1 east, and the west half of section 31, and the south half of section 30, township 29, range 2 east, have upon them diggings, the most important of which is the Rocky Point and Bolt's Lots.

Two or three lots and diggings along Fever river, between Council Hill and Galena, have yielded considerable mineral. The Burton, the Beeler, the Allan Rea, the Witmer, and the Wright lots, are the most important of these.

The Apple River Diggings, near the station of that name, on the Illinois Central railroad, have yielded heavy bodies of ore. It is generally found in east and west shallow crevices, which did not hold their richness to any considerable depth.

A few scattered and unimportant diggings around Warren, complete the list of diggings or sub-districts into which the lead fields of this county may be divided. It will now readily be seen how small an area of the Galena rocks are productive lead-bearing rocks. All grouped together, would make perhaps less than a township of land.

Price.—The following table shows the price of mineral per thousand pounds, for the last sixteen years, as delivered by the miner to the purchaser, at the mouth of the shaft. The ore was always paid for in gold, until the greenback era drove gold out of circulation:

1853	$37	1861	$28
1854	38	1862	40
1855	32	1863	55
1856	35	1864	75
1857	34	1865	65
1858	29	1866	60
1859	30	1867	60
1860	32	1868	55

Modes of Occurrence.—The crevices, veins and caverns in which the lead ore is found, are all, perhaps, cracks of shrinkage, into which the lead subsequently became deposited. The most common and widely disseminated form in which lead ore occurs, is known among miners as "float mineral." In many places the beds of red ferruginous and ochery clay have scattered through them galena in considerable quantities. It is generally found in small, irregularly-shaped pieces; sometimes in small grains, and sometimes in good sized crystals and chunks. Although widespread in its occurrence, no heavy bodies of mineral are found as float mineral. This form of mineral deposit results from the decomposition of the overlying

Galena limestone, and in many cases it has settled down almost in the exact spot where the rock containing it once existed.

The mineral in the rocks occurs in what is known as "gash veins," and takes the forms of cog, dice, chunk, sheet, float, or fibrous mineral, as modified by circumstances. The predominant forms of deposit are the vertical crevices, and their modifications into the flat sheet and flat sheet openings. A crevice is a perpendicular or nearly perpendicular opening in the rocks, of varying width and depth. When filled with galena, the deposit is called "sheet mineral." The sheet varies in thickness, from a mere seam the thickness of a knife blade, up to three inches or more in thickness. The vertical crevices have a certain well-marked parallelism to each other, and an approximate north and south and east and west direction. The east and west are, by far, the most fully developed, and contain, by far, the largest deposits of mineral. These crevices are known by the various names of "leads," "lodes," "cracks," "veins," "ranges," and "diggings." The predominant form of mining in this county is that of the working of the vertical crevices. These are, by far, the most productive, and are characteristic of the upper and middle of the Galena limestone. The modifications of the vertical crevice are the crevice opening, pocket opening, chimney opening, and cave opening. They are all produced by the same causes. The crevice opening is an expansion of the crevice to the width of several feet in some instances; the cavity is often filled with red ocher and ferruginous clays, intermixed with loose stones and heavy masses of galena. The pocket openings are a succession of irregularly-shaped small openings in the crevices; the chimney opening is a rather large expansion of the crevice, extending upward to a point resembling a chimney; and the cave opening is a large crevice opening, widening out into cave-like proportions, floored often with stratified clays. In these openings the galena is found lying over the bottom, mixed with the materials with which they are filled, crystallized in blocks or cubes over the walls, and hanging pendant from the roof. Some of the masses of mineral weigh thousands of pounds, and it is said one mass was found in the mines of Captain Harris, weighing half a million of pounds, and worth thirty-five thousand dollars.

These various openings are caused by the decay or disintegration of the rock on the sides of the crevices, owing to chemical agencies working round the mineral deposits. If the dirt remains where it was formed, the mineral and nodular masses of the rock will be found embedded in it; sometimes the dirt has been removed and the lead alone remains. Sometimes these openings extend to the surface

clays; sometimes they are covered by a cap rock. They often extend into the flint strata, characteristic of the middle and lower portions of the Galena limestone. There is often several crevices, or sets of these various openings, one over the other; often three; sometimes as many as five; but one opening or set of openings is usually larger than the others, and contains the heaviest bodies of mineral.

The flat sheets or flat sheet openings are similar to the vertical, both as to themselves and their modifications, except that they lay flat in the rocks, parallel to their stratification, instead of standing upright. The saddle-shaped openings and pitching openings are but the transition openings from the vertical to the flat. These flat openings are characteristic of the lower parts of the Galena limestone and of the underlying Blue and Buff limestones, and are not found extensively developed in JoDaviess county. The "green" or "calico" rock, below the flint beds; the "brown rock," and the "glass rock," are characteristic of the lower Galena limestone, their beds of passage into the Blue, and the Blue itself. In these occur the pipe clay openings; and in the Buff limestone the "lower pipe clay opening" is found. These are flat openings, filled with shaly limestone and a peculiar clay, from which they take their name. These lower flat openings are also peculiar in having more of the associate mineral deposits, such as tiff, blende, the ores of zinc, etc., than the upper vertical openings.

In this connection I do not intend to say much as to the origin of the lead ore in the Northwest, nor to speak of the various theories as to the origin and deposition of mineral deposits in general. The question as to the origin of our lead is unsettled, perhaps. J. D. Whitney, the best living authority on the Galena lead basin, believes the galena and its associate minerals were deposited in the aqueous or humid way in the crevices of the rocks, and that the veins were filled from above downwards. This theory supposes that the metals were held in solution in the waters of the primal ocean, in the form of sulphates, and were deposited in crystalline forms in the shape of the sulphurets. The decomposition of organic vegetable or animal matter throws off a sulphuretted hydrogen gas, which, acting upon solutions containing sulphates, is supposed to cause a reduction and precipitation of the metals in the form of sulphurets. The decay of sea plants and the abundance of organic life in the Trenton Period, is thought to have been sufficient to produce the great precipitation of lead ore found in these rocks. The writer argues his theory with ability, and it may now be considered as the one generally received. I hazard the suggestion, however,

that electrical action may have had much to do with the precipitation, crystallization and arrangement of these minerals.

Early and Recent Mining Processes.—The primitive mining processes in the Galena lead basin were of a very simple character. Two men selected the spot where they wished to try their fortunes. They were generally guided by certain signs in making the selection, such as depressions in the ground, unusual luxuriance in the growth of vegetation, color of the clay, or ravines supposed to indicate crevices in the rocks below. A shaft was sunk through the clay, and cribbed by building up timber, until the rock was struck. A rude windlass, bucket and rope, a few shovels, picks and pieces of tallow candle, constituted all the tools needed, to which was sometimes added a few blasting tools. If a crevice was struck it was followed down, and drifts were driven from it in various directions. The man at the top laboriously hoisted with his windlass the material necessary to be removed. The digging was abandoned when worked down to the water, or a pump is put on driven by horse-power. The mineral is brought to the bottom of the shaft or rude car, running on wooden rails. Instead of sinking a shaft, an inclined plane or drift is run into the hill, in case the outcrops of the rock show lead crevices. If a heavy body of mineral is found at any considerable depth, a whim is put on. This is a large wooden wheel, or barrel, revolving at some height above the ground, propelled by horse-power, and containing coils of a strong rope, to which is attached rude cars or tubs, so arranged in many instances that one goes down as the other comes up. With the whim and horse-power pump, a range can be worked considerably below the water level. Most of the prospecting and much of the mining has been done over the lead district in this rude way. It has proved very effective, and will be resorted to for a long time to come, both for prospecting and shallow mining. Gradually, however, more advanced and scientific processes of mining were resorted to. Costly *plants* of machinery, including steam engines and expensive pumps and mining tools, were put to work in the heavier mines, especially where it was desirable to work below the water level. Prospecting is also now done to some extent by driving adit levels, so as to cut and prove all the parallel ranges in a hill or group of diggings by one level. The level also sometimes drains a large group of mines to a lower depth than could have been worked before the level was carried into the hill.

The first attempts at smelting were also quite rude. The Indian squaws smelted the ore by roasting it in a rude stone furnace, in which they were able to melt out but a small portion of the lead. The log furnace succeeded this when the white men began to work the mines. In these some large logs were rolled into an area inclosed on three sides by low stone walls. Upon the logs fuel and ore was piled alternately to the top of the walls. The fuel was kindled and the "charge" melted, the flowing molten lead finding its way in fiery streams to some place prepared for its reception. It took nearly a whole day to melt one of these charges, and not much more than half the lead contained in the ore was smelted out. A "reverberatory furnace," in which the ore was melted in an oven, where the blaze passed over and through the charge, was next tried, and was a great improvement in smelting processes.

But they have all been superseded of late years by the Scotch Hearth, or Blast Furnace, now universally used throughout the lead region. It consists of a cast-iron box, shallow and open at top, and about two feet long and less than two feet wide. In the side and near the bottom of this box is a hole into which the nozzle of a strong bellows is placed. The bellows is generally run by water-power. A huge chimney is built over the hearth, resembling a cooper's chimney. The following detailed description of the Scotch Hearth is taken from an article in "Harper's Magazine," and is understood to be the production of a lady of Galena, whose name I do not know:

The hearth "consists of a box of cast-iron, two feet square, one foot high, open at top, with the sides and bottom two inches thick. To the top of the front edge is affixed a sloping shelf or hearth called the work stone, used for spreading the materials of the 'charge' upon, as occasionally becomes necessary during smelting, and also for the excess of molten lead to flow down. For the latter purpose, a groove one-half an inch deep and an inch wide runs diagonally across the work stone. A ledge, one inch in thickness and height, surrounds the workstone on all sides except that towards the sole of the furnace. The hearth slopes from behind forward, and immediately below the front edge of it is placed the receptacle or 'melting pot.' An inch from the bottom, in the posterior side of the box, is a hole two inches in diameter, through which the current or 'blast' of air is blown from the bellows.

"The furnace is built under an immense chimney thirty to thirty-five feet high, and ten feet wide at its base. Behind the base of the chimney is the bellows, which is propelled by a water-wheel, the

tuyere, or point of the bellows, entering at the hole in the back of the box. The fuel, which consists of light wood, coke and charcoal, is thrown in against the tuyere and kindled, and the ore is placed upon the fuel to the top of the box. The blast of air in the rear keeps the fire burning, and as the reservoir or box is filled with molten lead the excess flows down the grooved hearth into the 'melting pot,' under which a gentle fire is kept, and the lead is ladled from it into the molds as is convenient. Before adding a new 'charge' the blast is turned off, the 'charge' already in is turned forward upon the work stone, more fuel is cast in, and the 'charge' is thrown back with the addition of fresh ore upon the wood. The combustion of the sulphur in the ore produces a large amount of the heat required for smelting. The furnace is thus kept in operation sixteen hours out of the twenty-four.

"The ore is of different degrees of purity, but the purest galena does not yield on an average over sixty-eight per cent. of lead from the first process of smelting. The gray slag is very valuable, though the lead procured from it is harder than that of the first smelting. There is left about 75,000 of gray slag from each 1,000,000 pounds of ore. The slag furnace is erected under the same roof with the Scotch Hearth, and has a chimney of its own a few feet from that of the hearth, and the 'blast' is secured from the same water-power by an additional blast-pipe driven by the same wheel. It consists of a much larger reservoir, built of limestone, cemented and lined with clay, with a cast-iron door in front, heavily barred with iron. It will burn out so as to require repairs in about three months. Open at the top, the slag and fuel are thrown in promiscuously. Under the iron door is an escape for the lead and 'black slag.' In front of this escape and below it is the 'slag-pot.' It is an oblong iron basin about a foot in depth, with about one-third of its length partitioned off to receive the lead, which sinks as it escapes, while the slag, being lighter, flows in a flame-colored stream forward, and falls into a reservoir that is partly filled with water, which cools the slag as it is plunged therein. As the reservoir fills, a workman shovels the scoriæ into a hand-barrow and wheels it off. This scoriæ is black slag, and worthless, the lead having now been entirely extracted. The smelter now and then throws a shovel-full of gray slag into the furnace, which casts up beautiful parti-colored flames, while the strong sulphurous odor, the red-hot stream of slag, with the vapor arising from the tub wherein the hissing slag is plunged, the sooty smelters, and the hot air of the furnace-room, suggest a thought of the infernal regions. Outside, the wealth of 'pigs,' not in the least

porcine, gives one a sort of covetous desire that, if indulged in, we are taught leads directly to said regions. The Scotch Hearth requires less fuel than any other furnace. It 'blows out' in from six to twelve hours, while the Drummond furnace was kept in operation night and day."

After examining the process of smelting, I concluded the above description could hardly be improved on, and hence give it a place in this report.

The Future.—The future of the lead region deserves a passing thought. It is an interesting inquiry as to how extensively the mines will be worked hereafter, and how nearly the supply of lead ore is now from becoming exhausted. That the present mines are far from being exhausted is well known. Many are temporarily abandoned on account of water. These will doubtless be worked extensively hereafter by heavy capitalists and companies, who will be able to put steam pumps on, and thus conquer the difficulties in the way of making them remunerative. Deeper and more scientific mining will be carried on in the future, and new mines and heavy bodies of mineral will yet be discovered. It is a fact, that not much over a tenth of the supposed productive lead district has yet been prospected. In all human probability, when these unexplored lead regions have been thoroughly and scientifically examined, other heavy bodies of mineral will be discovered. Science has already done an important work in the lead basin, and made many valuable suggestions, which the practical miner is now willing to avail himself of. Science has yet a great work to do, taking capital by the hand and exploring this lead field in search of hidden treasures yet locked in the bosom of the earth. It is the opinion of many practical miners and amateur geologists, that labor in the lead field will now pay more uniformly and better than in any past period of its history, and that an intelligent expenditure of capital in this direction is one of the very best investments.

The Romance of Mining.—Lead mining, like all other mining, is attended with hazard and uncertainty. The instances are numerous where poor, hard-working miners have suddenly found themselves in possession of a vast fortune. Indeed this phase of lead mining is so common that it hardly excites comment in the localities where it occurs. The case of the purchase and discovery of the Marsden mine is an illustration in point. The history of Mr. Champion's twenty-five years of persevering labor in running a certain adit level until he had bankrupted himself and almost bankrupted some of his generous friends, to be at last rewarded with a magnificent for-

tune, is one example of a numerous class of cases. The instances where workmen have slowly and laboriously sunk their shafts and run their drifts through the solid rock and finally abandoned the enterprise into the hands of some new man, whose very first efforts struck the "discovery" which the former proprietor had just missed, are by no means rare. Instances of hope long deferred until the heart was made sick, to be at last elated with the looked-for discovery, are numerous enough to make a book.

The hazards, the expectations, the disappointments, the perseverance, if fully written out, would contain much that is wonderful and even romantic. The unwritten history of almost every great mine in the lead region would have in it some chapter of romance, some story illustrating some phase of human character. Gold mining has its wonders and wonderful effects on the human mind; the finding of wonderful oil deposits has been the cause of some curious chapters in human history; lead mining, where sudden fortunes have been poured into the laps of those unused to fortunes, or where steady, persevering toil, with its high faith in its own unyielding endeavors, has at last been rewarded in the most ample manner, has its curious chapters bordering upon the romantic. The story of unrequited labor must sometimes be written in writing the history of the mines; but far oftener the historian of the lead mines may record that steady persevering effort hardly ever fails at last in obtaining its rich reward.

In addition to my own observations upon the geology of this county, I take pleasure in acknowledging valuable aid derived from Mr. Houghton's pamphlet on the Marsden Mine, D. Wilmot Scott's little business directory of the county, the copy of "Harper's Monthly" above referred to, and suggestions obtained from Captain E. H. Beebe, of Galena, and Dr. Little and Henry Green, Esq., of Elizabeth.

CHAPTER III.

STEPHENSON COUNTY.

This county is bounded on the east by Winnebago, on the south by Ogle and Carroll, on the West by JoDaviess, and on the north by Green county in the State of Wisconsin. It thus lies in the northern tier of counties in the State, and is the second county eastward from the Mississippi river. It is twenty-seven miles wide, from east to west, and about twenty-one and a quarter miles from its northern to its southern boundary line; and contains about five hundred and seventy-three square miles. The northern part of the county, according to surveys made by the Illinois Central Railroad Company, averages about seven hundred and twenty-three feet above the level of the Mississippi river at Cairo, about four hundred and fifteen feet above the level of Lake Michigan, and about one thousand feet above the level of the sea. The southern part of the county averages some two hundred and fifty feet lower than these figures. The general level of the county, it will thus be seen, presents a gentle slope to southern, sunny skies. The general surface or face of the county is composed of gently undulating and rather rolling prairie land, interspersed with small groves, and narrow belts of timber land skirting the streams. A small portion of the county is made up of barrens and oak orchards or openings. The prairie soil is of unsurpassed fertility, and under a high state of cultivation and improvement. It is not so black and deep as the prairie soil further south; but is drier, sandier; lighter or more chocolate-colored, producing in great perfection all the staple crops of the northern part of the State. The oak openings and other poorer portions of the county produce the best wheat and other cereal grains, the best potatoes raised in the State, very excellent apples, and pears of the hardier varieties, and with proper care and cultivation will nourish

the vine and ripen its fruitage to a greater extent than is now dreamed of by the grape growers and wine makers of the West. Indeed, the day is coming, in our opinion, when its gravelly hills and Loess clays will not only blush with the purple clusters of such vines as best endure our cold climate, but will also become sources of profit to their cultivators and sources of exquisite pleasure to those who delight in using healthful, invigorating, pure wines. The soil of this county, as of all these northern counties, also produces and ripens in great perfection, the currant, gooseberry, strawberry, raspberry and other garden fruits.

The county is reasonably well watered with streams, which flow in various directions over its surface. Of these, the Pecatonica river is the largest and most important. It enters the county about seven miles from its northwest corner, flows in a course a little south of east to Freeport, bends round to the westward at this latter place, and enters the county of Winnebago, not far from the center of its western boundary line. Its waters are turbid, and muddy as the "Yellow Tiber;" its course is serpentine and crooked beyond comparison, winding and doubling upon itself in the most capricious manner; its current slow flowing, treacherous and silent, notwithstanding the general difference in level between the northern and southern portions of the county, affording few water powers, and they of limited fall, but heavy and constant in their action. This is pre-eminently true of the six feet fall at Freeport, but hardly so true of the power at Martin's mill, just across the northern line of the county. Indeed, so far as a description of the stream is concerned, the dispute as to the Indian significance of the name Pecatonica—"muddy water" and "crooked stream"—might be well reconciled by adopting both meanings and applying them with much truth to this tortuous body of flowing mud. Along portions of its course, its oozy banks and stagnant waters might breed miasms and fevers, were its influences not counteracted by the general healthfulness and salubrity of the climate of Northern Illinois. Yellow creek enters the county almost at the center of the western boundary line, and flows into the Pecatonica two or three miles below and east of Freeport, its general course being a little south of east. Its waters have a yellowish, somewhat creamy color, and are slow flowing like the Pecatonica. The color of its water is derived from the Cincinnati shales, along its banks, which dissolve and mingle with the water like yellow cream with muddy coffee. Its course is not so crooked as the stream with which we are comparing it. It wanders about in long undulating curves, instead of short, abrupt

doublings. It affords few water powers, and they of limited extent. Cedar and Richland creeks rise almost entirely within the county towards its northern and central parts, flow southward, mingle their waters together within a few miles of the Pecatonica, and empty into the latter stream a few miles above Freeport. Both these streams afford light, but rather constant water powers. The mills of the Hon. John H. Addams are located upon the former, at the romantic little village of Cedarville; the Sciota mills are located upon the latter, after its union with the former. Both these streams have bright, clear waters. They are not mountain born, but are fed by prairie and woodland springs, almost entirely within the boundaries of the county lines. Rock run enters the county, about four miles from its northeast corner, and empties, after running about twelve miles on an air line, into the Pecatonica about one and a half miles west of where it crosses the western line of Winnebago county. This is a beautiful little stream, affording a very few light, and not very valuable water powers. It goes babbling and murmuring along through rich prairie farms and woodland groves, until within a dozen miles of its mouth. Here the banks rise to a precipitous, brush-covered, timber-crowned hill, and in a few miles further the low alluvial bottom of the Pecatonica is entered, through which it seeks its way with less haste into the dirty waters of the latter stream. Crane's creek is a small and short prairie stream or brook, flowing into the Yellow creek, nearly south of Freeport, coming in from near the center of the southern boundary line of the county. Besides these there are many brooks, rivulets and little streams in various parts of the county, watering it reasonably well both for agricultural and stock raising purposes. Nor should we omit to mention, in this place, the bright, flashing, singing little Silver creek, which runs northward through the town of the same name, and finds its way into Yellow creek, not far from its mouth.

In comparison with most of our northern counties, Stephenson might be said to be well timbered. The Pecatonica is skirted, more especially along its eastern bank, with a body of rather heavy timber, spreading out northward into the town of Oneco for a considerable distance. Yellow creek is fringed, for a part of its course, with a scattering growth of white oak groves and clumps, spreading across from Mill Grove towards Eleroy and the Sciota mills into oak openings and a somewhat rough soil. Part of the town of Loran, in the southwest part of the county, is a regular white oak barren, with scattering trees and some brushwood. Crane's grove, lying south of Freeport, is about three miles long and more than a mile

wide. Lynn and walnut groves dot the broad expanse of prairie in the northeastern part of the county, with a grateful change in the monotony of the prairie view. Cedar creek has some good timber along its course. Richland creek is shadowed by the heaviest body of good timber perhaps in the whole county.

The prevailing timber consists of white, black and burr oak, sugar maple, black walnut, butternut, pignut, shell-bark and common hickory, slippery and water elm, yellow poplar, with occasional laurel, red cedar, white pine, paw-paw, and some of the rarer oaks, interspersed. Sumach and hazel also abound in and around all the groves. Wild cherry, honey locust, linden or basswood, ash, cottonwood, sycamore, and some other varieties of timber, are more or less to be noticed, and in some particular localities are found in considerable abundance.

Such, in brief, are the topographical features of Stephenson county—a county whose agricultural resources are not surpassed by those of any county in Northern Illinois. Indeed, it would be hard to find an equal area anywhere in the State whose soil is so universally good, productive and teeming in every bountiful gift to the industrious tillers of the earth. No mineral wealth or peculiar manufacturing facilities will attract to this county the attention of the adventurous; but for those resources which are derived from a rich soil and abundant agricultural capabilities, this favored county may well claim a lastimg pre-eminence.

Geological Formations.

The geology of Stephenson county is of very simple character. After leaving the surface geology, the first formation met in a descending order is the Niagara limestone, succeeded in regular order by the Cincinnati shales, and the three divisions of the Trenton period, namely, the Galena, Blue and Buff limestones of the old Trenton seas. The following section shows the actual worked exposures of these rocks as measured in the quarries by the writer of this article. In no instance, perhaps, do the measurements exhibit the maximum thickness of the formations. At some points where measurements were made the rocks of the formations measured undoubtedly extended downwards to an indefinite extent, and in a few particular instances, where the bottom of a formation was distinctly identified, denuding agencies had carried away much of the superincumbent mass. A section thus constructed might be

styled a surface section of the formations indicated, and in a level country, where no borings had been made, would be the only attainable one to be had.

Section of Worked Outcrops.

	Feet.
Quaternary deposits, consisting of clays, sands, gravels, surface soils, etc...	10 to 65
Niagara limestone	23
Cincinnati group	40
Galena limestone	75
Blue limestone	38
Buff limestone	40

Each of these groups or formations outcrops at some place or places in the county. Some of them are the immediate underlying rocks over large portions of the same.

As further illustrating the geological formations of this county, and more especially those which lie deep down in the earth, we now give an imperfect section, obtained from the borings of the rocky farm oil well. This well was commenced, we believe, in 1864, and continued on through a greater part of the year 1865. At that time the oil fever was prevailing extensively. Some surface indications were noticed in a small brook running through the north part of section 6, in the town of Lancaster. A company was formed, an engine was obtained, and a hole six inches in diameter drilled into the earth for over eight hundred feet. No oil was obtained, and no indications of oil noticed after leaving the surface, and the enterprise was finally abandoned. Although very unprofitable to the company, this boring was not devoid of scientific interest. After boring about eight feet through the overlying soil and clays, the Galena limestone was struck. No very accurate record of the material passed through for the first one hundred and twenty feet was kept, but from the fact that the Galena limestone outcrops heavily at Cedarville, only a mile or two distant, being there seventy-five or eighty feet thick in the exposure on Cedar creek, we believe the well, in this one hundred and twenty feet, passed out of the Galena limestone, and reached perhaps a considerable distance into the Blue limestones, immediately underlying. Commencing at one hundred and twenty feet beneath the surface, we give a section of strata and materials bored through, until the depth of six hundred and eight feet was reached, as indicated by the detritus brought to the surface by the auger. No record of the last two hundred and fifty feet seems to have been kept.

Section of Oil Well on Rocky Farm.

Feet.	Feet.
120 to 130, blue limestone and mud veins	10
130 to 146, gray limestone, containing crevices	16
146 to 168, shales of various kinds	22
168 to 375, St. Peters sandstone, soft, very white	207
375 to 484, red sandstone, with tough, paint-like mud veins	109
484 to 487, yellow sand, like surface sand	3
487 to 491, quicksand and salty water	4
491 to 494, bright-yellow, fine, salty sand	3
494 to 501, slate of chalky color and nature	7
501 to 520, snuff-colored, slaty rocks	19
520 to 532, sharp, slate-colored sand	12
532 to 564, dark-red stone, like soapstone, with thin, flinty strata and iron pyrites	32
564 to 586, bright-red stone, slightly oily	22
586 to 608, dark, reddish slate, with iron pyrites	22

At the depth of about sixty feet from the surface some dark-colored carboniferous shales were struck. These must have belonged to the Blue limestones underlying the Galena, and perhaps are near the dividing line between the two. From thence, to the depth of one hundred and sixty-eight feet, the Blue and Buff limestones of the Trenton period were undoubtedly the rocks passed through. The next two hundred and seven feet was the St. Peters sandstone. There could be no mistake as to this; the auger brought it up, pure, crumbly and white. The next one hundred and nine feet, although it strongly resembles the St. Peters sandstone when stained by water holding iron in solution, belongs, perhaps, to the Calciferous sandstone, or lower Magnesian limestone of the Northwest. The next one hundred and twenty-four feet almost loses its identity, but perhaps belongs to the lower Calciferous sandstone and to the Potsdam sandstone. Chemical analysis of the materials brought to the surface, aided by a strong magnifying glass, may show these surmises to be partially untrue. We admit they are little better than scientific guesses after studying the above section, and examining with the naked eye and the touch specimens of the abraded materials, preserved as brought up by the drill.

We have attached some importance to the above section, because it is a matter of much interest to the citizens of Stephenson county, and because it afforded to the writer the only opportunity he had, in all the country examined the past summer, of making even a partial examination of the deep, underlying formations. It also settled another question then agitating the public mind in this part of the State. Before this experiment, geological science had foretold that no productive oil deposits would or could be found in this part of the country. It had predicted this from knowledge of the underlying strata, and their inability to collect and preserve the oily treasures of the earth. But capitalists lacked faith in the teachings

of science, and acquired in the school of experience the lessons which they would nowhere else learn. The experiment of this well had a wonderful influence in allaying the oil fever in this region.

We cannot leave this subject without rendering our acknowledgments to F. E. Dakin, Esq., of Freeport, to whom we are indebted for the figures in the above section, and also for small and carefully labeled specimens of the materials brought to the surface, during every ten feet of the distance to which the well was sunk.

We shall now proceed to describe, in detail, these outcropping geological formations.

Quaternary Deposits.—These deposits cover unconformably the underlying rocks to a varying depth. At some places they are five or ten feet thick; at others they perhaps extend in thickness to sixty or seventy feet. To say that they average twenty-five or thirty feet all over the county, would, perhaps, be placing the figures safely within the bounds of truth. If all this accumulation of deposited materials could be removed, the surface of the underlying rocks would present a very rough, uneven surface. Scooped out depressions, extending through overlying formations and over large portions of the country, presenting, if filled with water, the phenomena of broad, shallow lakes, would be seen. The mounds, rising like watch towers over these prairies (resisting, on account of some local cause or hardness, the denuding agencies that carried away the rest of the formation), would appear like islands in the surrounding waste of waters. The rocky surface thus left, so far as we can judge from the limited examinations we are now able to give that surface, would be unsmoothed by water current and unscratched by glacier, but would be everywhere uneven, rough, and covered with unworn fragments of stone.

Along the narrow bottoms of the Pecatonica may be noticed a strip of Alluvium proper. At some places it is very narrow, at others it extends to one or two miles in width. The same deposit may be observed at a few localities along the Yellow creek bottom, and also along the narrow bottoms of some of the smaller streams. The deposit, however, is of limited extent; it is rich, fat, and heavy as an agricultural and timber soil. Along some of these streams the low, bald hills are found to be composed of the Loess marls and clays; but this deposit is also of quite limited extent in the county. All the rest of these superficial deposits belong to the sands, clays and gravels of the Drift proper. These clays and clayey sands, however, do not furnish very strongly the evidences of deposition or transportation. They seem to partake, in part at least, of the nature

and character of the rock formations lying immediately below them. In every instance examined, this seemed to be true. Where the Galena limestone is the underlying rock, the appearance was somewhat as follows: First, there was the prairie soil and clayey subsoil, at most only a few feet in thickness; this was succeeded by a reddish-brown clay, mixed with flints and pieces of cherty Galena limestone; then came the clay and pieces of the limestone preserving their regular stratification, the limestone becoming more abundant in the descent, until the solid rocky strata was reached. In a few instances this overlying clay is creamy in color, and almost limey in texture; but the prevailing color is reddish-brown or red, and in many cases it is more or less mixed with sand. The clays overlying the Cincinnati shales also bear a resemblance to this formation, from which they are doubtless in part derived. They are of creamy or more chocolate color, finer in texture and freer from sand. These superficial clays and loams certainly have the appearance of being the residuum left after frost and water had pulverized, and, by percolation, removed the more soluble portions of the uppermost parts of the formations below.

But, aside from these deposits, the gravel beds and boulders of the true Drift period are not wanting in this county. That part lying west of the Illinois Central railroad and south of Yellow creek—being mostly low, level prairie, underlaid mostly by the Cincinnati shales, and also that low, rich, level part between Waddam's Mound and the range of mounds running from the neighborhood of Warren towards the southwest, and underlaid by the Galena limestone—may almost be denominated a driftless region. Few boulders are seen over it, and few or no real gravel deposits can be found. The prairies north and east of Waddam's Grove have strewed over them numberless boulders, some black, some flame-colored, and some combining the various colors of the metamorphic rocks. At one place, about half way between Waddam's Grove and Winslow, they are rolled into wind-rows along the road, and used in part for the lane fences. Many of these are exceedingly beautiful, and many colored. They are the real "lost rocks," and must have been dropped from the slow-moving icebergs, as they drifted along towards the southwest. All that part of the county north and east of the Pecatonica is characterized by these boulders, and by many deposits of gravel and gravelly clays, to be met in almost any of the low ridges of land. The same may be said of the eastern portion of the county, excepting that the deposits are not so extensive.

Some other formations belonging to the surface geology, such as fire-clay, peat, bog-iron ore, muck, and the like, will be referred to when we come to speak of the economical geology of the county.

The Niagara Limestone.—The superficial extent of the county covered by this formation is quite small. Waddam's Grove, quite a high elevation of land, two or three miles long and a mile or two wide, and located a little northwest of the town of Lena, is capped by the Niagara limestone. At French's quarry, near the top end of this elevation, facing towards Lena, there is an exposure worked to the depth of about fifteen feet. French's well, near the same spot, is forty-five feet deep, the upper twenty feet being sunk through this formation, and the lower twenty-five feet sinking into the underlying Cincinnati shales. At Blakesley's quarry, twenty-five feet of the same formation is worked into. This is about one mile west of French's, on the north face of the hill. Here they have worked down to the Cincinnati shales. The bottom layers in both these quarries are compact and solid; the top layers are thick, irregular, speckled and porous. A species of slender, rotten *Cyathophyllum* was the only fossil observed in these quarries. From the latter quarry the prospect towards the north and west is beautiful beyond description. The low, level, rich prairie, with its fields and meadows, barns and farm houses, skirted in the distance by the range of mounds, bending around like a distant amphitheatre into JoDaviess county, presents as fine a prospect, beneath a glowing June sun, as we ever beheld in any State.

Leaving this elevation, we next find the Niagara outcropping in the southwestern part of the county. We would indicate its extent by a line, which should enter the county from the west in the town of Kent, some three miles south of Simmons' Mound, and then follow the general course of Yellow creek, keeping distant from that stream from two to five miles, until nearly opposite to Crane's Grove, then carried southward until the south boundary line of the county was reached, near its bisection by the Illinois Central railroad track. This line would cut off that part of the county underlaid by the Niagara rocks. And even in this, some of the small streams which come into Yellow creek through this section cut into the Cincinnati group, and a band of the Cincinnati group, along Lashell's Hollow, where the little village of Loran is located, also discloses the shales and quarries of this group. We would change Professor WHITNEY's map of this part of Stephenson county, to be found in the first volume of the original Reports, so as to make the green ribbon or band south of Yellow creek, denoting the Cincinnati

rocks, very much broader, and the color denoting the Niagara rocks very much less. This formation is not much quarried in this part of the county. At Big Springs, in Lashell Hollow, quite a quantity of stone have been taken out. Few fossils were observed, except that great quantities of some of the rougher Niagara corals lie strewn over the hills about Loran, consisting of two or three species of *Favosites*, and some imperfect *Halysites*.

Cincinnati Group.—The rocks and shales of this group cover but a limited extent of this county. All that part of Waddam's Grove between the level of the surrounding prairie and the capping Niagara, is composed of the shales and rocks of this group. The gentle slopes of the ascent, and the creamy-colored waters from the springs, are an unfailing index of this formation. No quarries are opened in it, but it is here, perhaps, forty feet thick. The broad belt south of Yellow creek, crossing this stream in the township of Kent, extending up into the southwest corner of the township of West Point, as indicated on the general map, has been referred to sufficiently, perhaps, in speaking of the previous formation. About the village of Loran, the hills on either side of the creek, to their top, are composed of the Cincinnati rocks and shales. Many quarries are opened in the face of the hills, and fair building stone are obtained. The worked outcrops here are fifteen or twenty feet thick. As we follow the creek to the northward from here a few miles, the Cincinnati formation runs under, and the Niagara takes its place. In the half township of Erin, just west of the village of Eleroy, there is quite an elevation of land, covering several sections, and crowned with a scattering grove, which is made up exclusively of the Cincinnati formation. On the west end, at the little village of New Dublin, there is a quarried outcrop some forty feet deep. A Catholic chapel is built out of stones from this quarry. It seems to be enduring the influences of the weather reasonably well. Although quite as high as Waddam's Grove, we did not detect any overcapping Niagara on this elevation. A bold and steep escarpment on the north side, caused by extensive quarrying, can be discerned from a long distance off, and is a marked feature in the landscape. The rocks here present a dry and baked appearance. Hardly a trace of a fossil could be seen. An accident here, to our pocket level, prevented an accurate measurement of this interesting mound. Crane's Grove, commencing about one mile north of Baileyville, and extending over several sections towards the northwest, is another of those elevations, left standing when the surrounding formation of the Cincinnati group was eroded and carried away. The worked outcrop near Baileyville,

furnishes stone fit for ordinary foundation purposes, but entirely unfossiliferous. East of the Illinois Central railroad track, in the township of Silver Creek, some isolated patches of the Cincinnati shales and clays may be noticed, but the formation in this direction soon gives place to the Galena limestone.

These quarries of the Cincinnati group afforded few fossils. In the little streams and on the hills about Loran, the *Orthis testudinaria* and *Orthis occidentalis* may be found in some abundance; but we have yet to find a Cincinnati quarry, except along the Mississippi river, abounding in even characteristic fossils.

The Trenton Limestone.—This formation, as now recognized by geologists, embraces the Galena, the Trenton proper or Blue, and the Buff limestone. These divisions are well marked and easily distinguishable, and in these reports we shall describe and refer to them by these well-known names.

The Galena Limestone.—Nearly three-fourths of Stephenson county is underlaid by this well-known division of the Trenton rocks. And inasmuch as the railroad cuts and the streams afford the best facilities to study the geologic formations of these counties, we shall first pass along them in our description of this wide extended member of the group. The Illinois Central railroad enters the county at Warren, near its northwestern corner. It passes over a low, smooth prairie, without outcrop or stone quarry, to Lena. Waddam's Grove, which stands in this prairie, shows that the Galena limestone underlies it. At Lena there is a quarry and a lime-kiln within a short distance of the town, exposing some fifteen feet in thickness. In about two miles further there is another. Both are on a little stream towards the north. Passing on towards the southeast the railroad exhibits several small sections in the top of the Galena beds, but does not afford any heavy section, until Freeport is reached. Just west of the city, along the track of the railroad, and near the banks of the Pecatonica river, in a low range of hills, three extensive quarries are worked, furnishing stone for lime, and for the large amount of building material needed. The first, nearest the city, is worked about eighteen feet deep. The rock obtained here is very soft, yellow, sandy, and full of cavities the size of a walnut. Where heaps of it have been removed, a considerable amount of sand is left scattered on the ground. The top layers of this quarry are so friable and crumbling, that hand specimens will hardly remain in shape. The second quarry exposes an outcrop of about twenty-four feet. The third is exactly similar to the second. Both of them are somewhat shaly towards the top, but rapidly grow massive and

solid as they are worked into. These three quarries are within a short distance of each other. A few feet of reddish clay, with small stones intermingled, covers the strata where these quarries are opened. These are the last outcrops upon the Illinois Central railroad. The Western Union railroad enters the county on a line almost exactly south of Freeport, and passes out of it about four miles south of its northeast corner. Three miles southwest of Freeport it cuts through the top of the rock under consideration, exposing the usual red-clay, and over this a gravelly subsoil. This cut is a small one. About three miles northwest of Freeport there is an exactly similar cut. About a mile further on towards the northwest is another, which measured one thousand feet long and twenty-four feet deep in the middle. Further on, and a little over a mile west of Rock City, is another cut three hundred and fifty yards long, and fifteen feet deep in the solid stone at the deepest place, and the stone covered by about ten feet of the usual gravelly clay. Here the stone is hard, glassy, conchoidal in fracture, and begins to assume the characteristics of the Blue or Trenton proper. One-half mile further on and nearer Rock City there is a cut about twelve feet deep, the lowest part exposing the real Blue limestone. Further on, and one mile east of Dakota, there is another cut into the Yellow Galena. The cut is not a large or important one. Further on, at the railroad bridge, over Rock run, there is a cut about twenty-two feet deep. The first five feet is the usual reddish clay; the next twelve feet is Galena limestone, assuming characteristics of the Blue, and the last five feet is into the real Blue iself. The union of the Galena and Blue, passing into each other almost imperceptibly, may be satisfactorily examined here. The next and last cut is about one-fourth of a mile east of Davis, almost on the county line. It is over one thousand feet long and about thirty-one feet deep; the upper seven feet is the usual clay, with some gravel in it; the lower twenty-four feet is Galena limestone, solid, a little bluish in color, and of a somewhat conchoidal fracture. In fact, all these exposures along the eastern part of the county, in their blue color, conchoidal fracture, and hardness, differ considerably from the Freeport quarries. They are lower down in the series, and assimilate somewhat into the character of the Blue below. So true is this, that in some of the exposures it is hard to fix upon the line of separation between the two.

From Freeport south, along this railroad track, no other exposures of the Galena limestone are visible.

Leaving the railroad cuts, the streams present the next best opportunities to trace the superficial area, thickness and phenomena of this deposit. The Pecatonica river, about four or five miles after entering the county, strikes the Galena limestone, and for its whole distance in the county exposes this formation where any rocks are exposed along its banks. There are no very good exposures, however on this stream, except those at Freeport, already referred to. At Bobtown, or New Pennsylvania, an outcrop is worked near the river; and at or near the mouth of Yellow creek the formation is dug into in an old crevice lead mine. Richland creek and Cedar creek both expose the Galena rocks for their entire length. Both these streams have cut deep into the solid rocks, and at many places along their banks heavy outcrops and escarpments stand out in bold relief. At Buena Vista, on the former stream, there is an outcrop of twenty feet, quarried into for its whole depth. At Cedarville, on the latter stream, the outcrop is seventy-five feet thick. A large quarry is here opened, out of which the stone in Addam's mill-dam have been taken. This is one of the most romantic little places in the county. The high, rocky hills, with their green crowns of evergreen cedars, the more than Cyclopean walls of solid rock, rising along the banks of the clear, shady stream, and the neat little village, all make it a point not soon to be forgotten. At the Sciota mills, below the confluence of the two streams, and in many places in that neighborhood, the same rocks are exposed and quarried. Crane's creek, where it washes the west end of Crane's Grove, exposes the Galena limestone. It is here quarried for the surrounding prairie to a considerable extent. The same limestone is worked into at Rosenstiel's quarry, near Freeport, to a depth of about twenty-two feet. A hard, gravelly, red clay covers this quarry to the depth of eight feet. Bands of chert also exist in the clay and in the top layers of the stone.

Leaving now the streams, we will mention some localities examined in other parts of the county. Burr-oak Grove, half way between Lena and Winslow, has near its eastern limits an interesting outcrop. About two and a half miles west of the latter place, almost every little prairie hilltop is dug into, and several small quarries opened. An exposure of twenty-four feet was also examined at the lime-kiln, a little southeast of Rock City. The top of this quarry is Galena limestone, but it gradually changes into the Blue before the bottom is reached. In the township of Ridott the Galena is the underlying stone, changing into Blue towards its eastern and southeastern part. In the township of Oneco the formation is heavily

developed. In short, the outcrops of this well-known formation, or division, of the Trenton rocks, are so numerous that we do not deem it necessary to particularize them more fully, but shall briefly give the superficial boundaries and area, as marked upon our map of this region.

All that part of the county between the Pecatonica river and Yellow creek, except a small strip east and south of Winslow, and except the development of the Cincinnati group at Waddam's Grove, New Dublin, Kent and along the banks of the Yellow creek, is underlaid by the Galena rocks. All that part of the county north and east of the Pecatonica river, except a strip in the bed of, and along either side of Rock run, is underlaid by the same. The southeastern part of the county, nearly up to the Pecatonica river, and nearly to the track of the Illinois Central railroad, with the exception of a strip along the southeastern corner, and a few isolated patches in the eastern part of the township of Silver Creek, is also underlaid by these same rocks.

Fossils.—Few fossils are found in the Galena limestone in Stephenson county. The characteristic *Receptaculites Oweni*, called by the miners and quarrymen "lead blossom," and "sunflower coral," is found at Freeport and Cedarville in great abundance, but good specimens are hard to obtain, on account of the friable nature of the stone in which it is found. At the former place a specimen of *Receptaculites orbicularis* was noticed. Two or three species of *Murchisonia*, fragments of several species of *Orthocera*, one or two well known *Orthis*, two species of *Pleurotomaria*, a small *Bellerophon*, and a rather well defined *Ambonychia*, were the fossils most usually observed. They all exist in the form of casts, and perfect cabinet specimens are hard to find.

The Blue Limestone.—This, the middle division of the Trenton, is of limited extent in this county. Of course, in many places marked on the map, with the color indicating the Galena, a shaft sunk down a short distance would strike the Blue limestone; but we now describe it as the surface rock, and only speak of it, where developed, as a surface rock. Rock run cuts into the Blue limestone soon after entering the county, and all along its banks, on both sides, until within a mile or two of its confluence with the Pecatonica, this rock outcrops and shows itself. Some of the high, rocky banks are overcapped with the Galena, but the usual rock is the Blue. At the railroad bridge of the Western Union Railroad Company, over Rock run, the railroad track is about six feet below the junction of the Galena and Blue. Stepping west, out of the railroad cut, there is

a perpendicular descent of thirty-three feet, from the track down to the water level, making the whole thickness of the Blue at this place about thirty-nine feet. The lower part of this outcrop is very blue, the upper part yellowish, with thin strata, and gradually changing in lithological character, until the overlying Galena just east of the bridge is reached. This is a very interesting section. One and a half miles below this locality is another quarry, opened in the west bluff of the stream. The outcrop is twenty-five feet thick. The top part is shaly and yellowish; the bottom becomes heavier and bluer in color. Some of the thin shaly strata are full of a small sized *Orthis*. These two outcrops are fair representatives of all the others along this stream. Leaving this stream, we find no other outcrop in the county. Some indications of underlying Blue limestones prophecy its existence in the southeastern part of the county, and we have so marked it on the map.

Some slabs, with fossils similar to those found in the Dixon marble, were picked up; these, with the fragmentary stems of encrinites, were the only fossils found. A small specimen of "sunflower coral" was found in the Blue limestone, at Rock Run railroad bridge, the only one ever found by us in this rock.

The Buff Limestone.—The only place where this, the lower division of the Trenton, is developed in this county, is at Winslow. It is doubtless the underlying rock for a few miles below this place, and on both sides of the Pecatonica river, for this distance. Here it presents very much the appearance of a quarry in the Blue. The top is shaly, thin-bedded, and of a yellowish-chocolate color. At Martin's mill, in Wisconsin, one mile above, the outcrop is much heavier, the bottom layers more massive and very blue. Professor WHITNEY pronounces these exposures outcrops of the Buff, and the fossils seem to indicate that he is correct in this. The lithological character of the quarries would indicate the same thing, but in a less satisfactory manner. On either side of this strip of Buff and within a short distance of its outcrops, the Galena limestone comes to the surface, so that the latter seems to rest unconformably upon the former; but in following the stream to the northward, a few miles above the mill, the St. Peters sandstone begins to show its outliers. The quarry at Winslow is worked twenty-three feet deep, and at Martin's mill thirty-five feet, and at both places it is some ten feet from the bottom of the quarries to the surface of the water. Geologically, the locality is one of the most interesting in this part of the State.

Fossils.—We found here many well preserved casts of fossils. Among them the most characteristic were *Pleurotomaria subconica;* a large *Orthoceras* five or six inches in diameter, and some six feet long, with a part of the shell still wanting; a *Cypricardites niota? Oncoceras pandion;* some two species of *Tellinomya;* and some other fossils, which will be mentioned in our catalogue of the fossils of this part of the State, in the prefatory chapter to these county reports.

Economical Geology.

The chief sources of wealth in Stephenson county are to be found in the richness and productiveness of its soil, and in its abundant agricultural resources. So far as our examinations go, this is the best agricultural county of its size in the State. It has less waste land than any other we know of. It has a larger number of acres under successful cultivation than any of its neighbors; and from this cultivation labor reaps a richer reward than California's golden mines can bestow, and as a result, unexampled prosperity attends the tillers of the soil, and through them smiles upon all other pursuits and avocations which wait upon successful agriculture. In her fat rich soil, therefore, is contained the first and chiefest source of wealth in this county, the one which is nourishing all the rest, and fostering and building the city of Freeport in a wonderfully rapid manner. But aside from this there are other sources of wealth and industry demanding our attention.

Clays and Sands.—Almost anywhere beneath the soils and subsoils may be found clay beds, out of which an excellent article of common red brick can be manufactured. This is more especially true of the reddish clays overlying the Galena limestone. Beds of sand are also found, sufficiently pure for mortars and plastering purposes, but they are far less numerous than the clay beds. A tough, tenacious dark-colored fire-clay also underlies some of the peat marshes, which has been dried and baked into a tenacious light-colored brick, as an experiment, but this is not, perhaps, of much economic value.

Quicklime.—The more solid portions of the Galena limestone burn into a quicklime of excellent quality, and there are many lime kilns in the county. Certain portions of the Blue limestone also burn into a good lime, and at Martin's mill certain portions of the Buff are being successfully made into lime of fair quality.

Building Stone.—All the rocks hitherto described furnish building stone of better or worse qualities. The Niagara is quarried in several

places. It furnishes a handsome colored enduring building material, but is unshapely and unmanageable on account of its irregular stratification. The Cincinnati group, although considered an unreliable building material, is much quarried about New Dublin, and in that region. It comes out of the quarry in good shape for light work, and does not crumble and decay when exposed to the weather, as we have seen it do farther to the west. Barn foundations, houses, bridge abutments and other such work may be seen built out of the Cincinnati group at many places in the western part of the county. The Catholic chapel, before alluded to, is built out of this material, and does not, as yet, exhibit much signs of decay. Indeed, some of the bottom strata are massive, very blue, and excessively hard; but yet the Cincinnati group would not furnish stone suitable for massive and solid masonry, or for long continued resistance to the action of the elements. The Galena limestone furnishes a good material for the heavier kinds of masonry. It is a rough unshapely stone, requiring much labor to lay it, but when well dressed and laid, it seasons into great hardness, and takes a beautiful cream or chocolate color. Nearly all the stone work in the city of Freeport is built of this stone. The new Gothic Presbyterian church, just completed, at great expense, is a noble, imposing structure, whose walls were taken from the Freeport quarries. For heavy pier work this stone is unequaled. The Blue and Buff both afford a good stone for building purposes. The upper strata are too thin and irregular, but the lower blue strata afford the most beautiful building stone to be found in this part of the State. The only difficulty seems to be, the great labor in quarrying, on account of the great amount of worthless materials to be removed before reaching the handsome and valuable portions of the quarries.

Minerals.—Some bog iron ore may be found in some of the marshes, but it is of little value and limited extent. Pieces of float copper have been found in the gravel beds, but they are of rare occurrence, and come from regions far remote. Galena, or common lead ore, is and has been mined for, to some extent. There is an old crevice mine near the mouth of Yellow creek, that has often engaged attention in years past, but no heavy amounts of mineral have ever been taken from it. From the quarries near Lena, "chunks" as large as the fist have been taken. In the township of Oneco a company of Freeport men prospected to a considerable extent, and obtained several hundred pounds of mineral. Near Wetzell's mill some "prospecting" has been carried on. Along the banks of Yellow creek, some "float mineral" has been picked up; and in almost any of the

quarries, small bits of the ore may be detected. But none of these localities have shown heavy bodies of lead. Indeed, the Galena limestone, notwithstanding its general prevalence in this county, seems to be very unproductive of rich bodies of mineral wealth. The probabilities are that no rich, or even good paying, diggings will ever be discovered, for the simple reason that they do not exist within the borders of the county. Small deposits undoubtedly do exist, and will occasionally create some excitement, and invite the expenditure of mining capital, but, in our opinion, capital thus spent will never make remunerative returns.

Peat.—At several localities peat beds of some value have been discovered. On the farm of a Mr. White, in township 26, range 9, a bed of about fifty acres exists. It is from three to six feet deep, and is underlaid by a tough, tenacious, dark-colored fire-clay; the peat is of a rather poor quality, and with our present knowledge of preparing fuel from this substance, is, perhaps, of no great value as a fuel. Near Lena and Burr Oak Grove, very small beds were examined. On the low, level prairies south of Yellow creek, and ranging between Florence and Crane's Grove, almost every swale and marsh has in it more or less peat. One of these beds is quite extensive, and will become valuable as soon as the peat experiment succeeds. It is found in the township of Florence, between sections 25 and 26, the section line running along near its middle. It is from forty to fifty rods wide, and about one hundred and sixty rods long, containing well nigh fifty acres. About one-half of it is owned by G. Purington; the other half is owned by parties whose names we did not obtain. So far as we could obtain the depth of peat, it ran from six to about nine feet. Careful borings would, perhaps, show a greater depth. Through its center, a small stream of pure water runs in a little ditch dug to drain the marsh. The current of the water is rapid, on account of the great fall along the ditch. At the lower end of the marsh, large bodies of the peat have broken off, turned over, and slidden down the declivity for several rods along the declining, underlying, slippery clay, resembling the action of ice blocks sliding away from the lower end of an Alpine glacier. The peat is somewhat fibrous in texture. When cut in square, brick-shaped blocks and dried, it is light and porous, but burns with a light, white-colored flame, making little smoke, and leaving a light, chocolate-colored ash. On account of its lightness, fires made from this fuel would have to be often replenished. No peat machines have yet been tried in this marsh, but there is no reason why this peat could not be manufactured into a valuable and pleasant fuel, by the aid of a good con-

densing machine. The ease with which this bog can be drained, and its proximity to one of the depots of the Western Union railroad, afford peculiar facilities for manufacturing the fuel, and transporting it when so manufactured.

In addition to being used as an article of fuel, peat might be extensively employed as a fertilizer of the soil. If dug out of its native bed, slightly dried to reduce the labor of handling, and mixed with a small amount of wood ashes or quicklime, it makes a fertilizer equal to the best barn-yard compost. The mucks and poorer qualities of peat answer this purpose about as well as the finer qualities. The ashes or lime correct the natural acidity of the peat itself, and sweeten what would otherwise be too sour for an application to the soil. Lime can readily be burned from any of the neighboring quarries. The wood used would not only change the kiln into the lime required, but would leave a large amount of ashes to be used for the same purposes for which the stone was burned into lime.

We have much faith in the future economic uses of peat; and although we would advise due caution in the expenditure of money in experimenting with it, nevertheless we would like to see some of the Stephenson county people expend some capital in developing what we believe to be a source of material wealth. The peat experiment is not yet, perhaps, fully solved, but whoever does fully solve it will not only enrich himself, but will confer a great blessing upon the inhabitants of these northern prairie counties.

CHAPTER IV.

CARROLL COUNTY.

Physical Geology.—Carroll county is situated in the northwestern part of the State of Illinois, and is bounded north by JoDaviess, east by Stephenson, south by Ogle, Lee and Whiteside, and west by the Mississippi river. It contains an area of about 450 square miles. By surveys of the Illinois Central railroad, its elevation above Lake Michigan is about 400 feet, and above the mouth of the Ohio river at Cairo about 800 feet. About one-third of the county, the northwestern, is somewhat rough, being mineral, or "lead-bearing" land. The surface of this is hilly, and sparsely timbered, but in the valleys, along the streams of this part of the county, many excellent farms have been opened. The usual alluvial bottom skirts the Mississippi, being from half a mile to four miles in width. Immediately adjoining the river there is a belt of heavy timber; but the rest of this bottom is composed of drifted sand banks, marshy swamps, and rich tracts of the best pasture and farming lands. The southern and eastern parts of the county are composed of gently rolling prairies, with here and there an island-like grove, as if the fingers of the retiring ocean had stroked the soft surface into swelling undulations. The agricultural portions of the county are perfect garden spots—rich in their almost virgin soil and manifold resources of wealth. Nor is the county wanting in picturesque scenery. Carroll creek, flowing west through its center, and Plum river, running through its mineral land, have each cut channels deep into the underlying rocks. These are piled about in massive grandeur—are crowned with evergreens; and are, in many cases, the abodes of wonderful echoes. Above Savanna, along the Mississippi river, the huge towering Niagara rocks lift their heads like a Cyclopean wall.

Geological position.—We are deep down in the geologic world—almost in the line of union between the upper and lower Silurian

systems. Three distinctly marked groups of the rocks outcrop in Carroll county. These are the Galena limestone, Cincinnati group and Niagara group. Above these are the usual deposits belonging to the Quaternary system.

The Galena Limestone.—This is a massive, grayish, yellowish or brownish-drab colored Magnesian limestone—friable and coarse-grained near its union with the clays, but very solid in its lower stratification. In JoDaviess county it is estimated to be about 250 feet thick; in this county it has never been accurately measured, but is perhaps somewhat thinner, as we are on the edge of the lead basin. Its heaviest outcrop commences near the geographical center of the county. Thence westward heavy ledges of it outcrop along the banks of Carroll creek almost to Savanna. North of this little stream similar outcrops may be found along the banks of Plum river. The former of these streams especially, has cut its channel deep into this rock. Along this stream an anticlinal axis seems to run, as the rocks dip slightly in both directions from the creek, and a slight upheaval must have once taken place here. Along the ridge of elevation thus formed a fissure naturally would be left. The frost, the rains, and the tooth of old Father Time disintegrated, wore down and gnawed away the rocks until the fissure became partially filled. This, in process of time, formed the little valley in which Carroll creek now runs.

This is the famous "lead-bearing rock" of the Northwest. The ore occurs in fissures and caverns running through the rock, in the form of what the miners call "sheet" and "cog," or crystallized mineral—the common sulphuret of lead. In the reddish clay overlying the rock, and formed by the decomposition of its upper beds, "float" ore is found; never, however, in very large quantities. Mining operations have never been carried on on a large scale, or on scientific principles. The "diggings" extend for several miles north and west of the town of Mt. Carroll. The pick, spade, common windlass and bucket, are the only machinery in use. Little more than a livelihood has ever been made by these primitive miners. For a long time it was thought a system of deep mining would reveal heavy deposits of the ore. In two instances companies were formed, and a considerable amount of capital invested. In one instance water compelled the abandonment of the mine, and in the other nothing was ever found to repay a tithe of the expenses of the company.

This surface mining will still go on as a temporary employment for those whose other employments are not steady; but no one will

probably be found willing to spend money enough to thoroughly test a system of deep mining. The deepest section of this rock, measured by me, is one hundred and fifty feet, but the bottom was not exposed, and extended down indefinitely.

The early writers have been treating the Galena limestone as a separate system. We believe it is now coming to be regarded as a member of the Trenton limestone, none of which latter rock outcrops in this county, although it is reached in sinking deep wells in the southeastern part; and one quarry of the real blue Trenton limestone is now worked in Ogle county, two or three miles from the county line.

Of the characteristic fossils, the *Receptaculites Oweni*, or "sunflower coral" of the miners, is the most usually observed, and very perfect specimens are sometimes found. *Orthocera*, several feet long; several species of the *Orthis;* corals of a number of species also abound. A very interesting species of trilobite has left its remains in these rocks; and we firmly believe that many new fossils will be found, when the quarries in this rock are carefully and scientifically examined. Of the economic value of this rock we will speak again. It is the underlying rock in perhaps two-thirds of the county, embracing the central, northern and eastern parts, being our chief building stone.

The Cincinnati Group.—The gentle slopes from the Mississippi bottom lands up to where the bluffs are capped with the castellated crags of the Niagara rocks, if exposed, would reveal outcrops of this group. Some of the small streams have cut down into this formation through the overlying Niagara. Johnson creek, winding in a sinuous course from the central to the southwestern portion of the county, shows the same rocks, sometimes near the surface. One-half of the southern part of the county has this as the immediate underlying formation. About one mile below Savanna there is a fine outcrop, where the county road cuts the side of the hills. About one mile above Savanna there are considerable quarries opened in this formation, on the side of the bluffs. Here the formation, as near as we can measure, is 80 feet thick. This is the best place in the county to make a section. At some large springs, just at the level of the Mississippi, in a full stage of water, the group begins, resting solidly on the Galena limestone as a foundation. Far up the hillside, the overlying Niagara rocks are just as distinctly marked. In the railroad cut, on the Tomlinson farm, some four miles southwest of Mt. Carroll, may be found another, and perhaps the finest exposure in the county. At Bluffville, also, it is

exposed by quarries. There are, however, few natural exposures of this rock. It soon disintegrates and crumbles away. Gentle hills and slopes, and graceful undulations are characteristic of its physical geography. Many springs burst out from the bases of these hills, and marshes and swampy places are not unfrequent. Shales and shaly limestones compose a large part of the rocks of this group; but its lower beds are sometimes solid and massive enough for a building stone, and even contain lead in small quantities. These shales are of a bluish-white color. Their particles are finely comminuted, as if deposited in deep, peaceful seas.

A vast amount of carbon is contained in the black shales of this group. Specimens taken from near Savanna and from the Beers Tomlinson farm are almost as black as cannel coal, and burn with an oily bright flame for a considerable time. Misled by this, some capital has been expended at the latter place in boring for coal, and nothing but experience will convince those engaged that such a search is useless.

One of our citizens also succeeded in extracting some oil, which he pronounced petroleum, out of similar specimens. When the great oil excitement arose in the country, an oil company was formed here, and but for the advice of the geologists, this company would now be spending its money in a vain effort to strike oil. The geologist of Iowa, Prof. WHITNEY, estimates that the carbon of these rock, if gathered into one strata, would form a bed twenty-five feet thick.

Whence came this mass of combustible matter in these old Silurian rocks? No geologist, to my knowledge, has undertaken to answer this question. Is it of organic origin, the remains of an ancient vegetation? Is it the result of animate life, the coral? HALL'S Iowa report states that no trace of vegetation has as yet been observed in the widely distributed shales of this group, except a few traces of fucoids in the Utica slates of New York. This makes him doubt the vegetable origin of this bituminous matter. In this county, however, we have discovered fucoids woven all over the tops of some of the strata in this formation. May it not be that a condition of things similar to that in the Carboniferous eras existed over the broad basin in which these shales were deposited? The vegetation consisted of the lowest orders, such as would decay and leave few traces of their existence. The disorganized remains would alone remain in the form of carbon or coaly shale. The day may come when this substance, whatever it is, will be of economic value, for

light or even fuel. With this brief notice, we must dismiss for the present this very interesting question.

This formation is prolific of fossils. Countless remains, with an occasional perfect specimen of the splendid large trilobite, the *Asaphus gigas*, are the most noticeable. *Orthis occidentalis* and *O. testudinaria* abound. Some of these shales are covered with beautifully marked dendrites. Fucoids are also found. *Orthoceratites* and a large *Lituites* have been found in it, together with numerous other fossils.

The Niagara Limestone.—This is OWEN'S "pentamerus beds" of the upper Magnesian limestone. It is next in order above the group just considered. The traveler on the Upper Mississippi must have been struck with its bold and picturesque appearance as he passed between Fulton City and Dubuque. Now the bluffs sweep down to the water's edge; now they trend off in a semi-circular direction, as if for the site of a colossal amphitheater. Their bases indicate the gentle slopes of the Cincinnati shales, but their summits are capped with the Niagara rocks. Like vast mural structures they rise along the highest elevations, weather-worn into all kinds of fantastic shapes—now displaying in their escarped cliffs resemblances to old forts and ruined cathedrals, time-worn castellated battlements, or distant spires and minarets of some old town. Such is the appearance of these rocks along the river bluffs above Savanna and towards the southern line of the county. The beholder, especially if he be a geologist, feels a strange spell stealing over him. Mighty visions of the old geologic ages enrapture his soul. A leaf from the old stone book is upturned before him, and he reads in the great Bible of Nature her sublime truths. He has discovered *hard sense*, common sense in the rocks.

But enough of dream and fancy sketching. Leaving the river, we do not find exposures of this limestone. Over the northern and northwestern portions of the county, all the highest portions are covered with it, in broken, fragmentary masses. Once it doubtless covered a large part of the county, but it has been denuded and carried off, leaving chert beds, corals and fragments of the rock itself as memorials of where it once existed as the surface rock. The frost, the rain and the atmosphere pulverize the Niagara rocks, and the chert beds in them being harder, settle down, like a crop of white flints sown over farm, field and hill. These chert beds show that the water of the old Niagara seas contained much silica in solution.

The Niagara limestone abounds in fossils. The most common and characteristic is the beautiful *Pentamerus oblongus*, or "petrified

hickory nuts" of the miners. But the old Niagara seas were particularly the homes of the coral builders, and these minute animals swarmed in countless myriads everywhere, leaving their fossil monuments. Among the most characteristic are the *Favosites favosa, F. Niagarensis, Stromatopora concentrica, Halysites catenulatus,* and many other species and genera, containing, doubtless, new and undescribed corals.

This brings us through the Illinois rocks as developed in this county. Sometimes traces of the Trenton proper are found in the southern part, but they hardly deserve a place in the surface geology of Carroll county.

The rocks of all three of these formations possess value as building stone. The Galena ranks first, and the Cincinnati group last in economic value.

THE QUATERNARY SYSTEM.—*Alluvium.*—The Mississippi bottom, from Savanna to the south line of the county, in width averaging nearly five miles, is composed of this recent river deposit. The same deposit also exists north of Savanna, on the Mississippi, and along some of the small streams in the interior. Some of it is a rich, deep, black and rather wet soil; much of it consists of sandy deposits, while a portion forms our very best agricultural lands.

The Loess or Bluff formation does not exist to a great extent in Carroll county, unless the soil and subsoil of our productive prairies belongs to this deposit. Some of our bluffs, as for instance where Johnson creek breaks through to the Mississippi bottom, are composed of the Loess clays.

The Drift formation is also manifest in our county to a considerable extent, although some seem to argue that it is undetected in the Galena lead basin. Deposits of Drift in our county can be found resting immediately on the Galena rocks. All our little streams almost have cut down into deposits of boulder and gravel beds.

The following section, made in a well in the town of Mt. Carroll. might be taken as a fair type of the superficial deposit resting upon our rocks, beginning at the top and measuring downwards:

	Feet.
Black prairie mold	2
Yellow, fine-grained clay	13
Common blue clay	2
Reddish clay and gravel	15
Tough blue clay	2
Coarse, stratified gravel bed	3
Pure yellow sand bed	11
Black, mucky clay	5
	53

Another well, some three miles distant, passed through a second soil some fifteen feet below the surface, and immediately thereafter a deposition of timber or wood, two or three feet in thickness, many of the pieces having tenacity enough to hold together for months after exposure to the atmosphere. This well is on the farm of Felix O'Neal, and at the time of its opening was considered an object of much interest.

We cannot leave this part of our subject without again adverting to the boulders. For us they have a peculiar charm and interest. These "nigger-heads," "hard-heads," or lost rocks, abound in many places, where the streams and rains have carried the soils away. Oftentimes they are associated with gravel beds of the transported drift. Among them have been found several nuggets of copper, one of which was found lodged in a crevice of one of our Galena quarries. Some of these boulders are striated and furrowed by the glacier or the iceberg. Quartz, feldspar, granite, gneiss, hornblende, porphyry, syenite, and various combinations of these and other minerals, make up these traveled rocks.

Would that we could have the true history of one of these lost rocks—real old cosmopolitans in a primal world. What a wonderful interest would cling around its wanderings from the time when it left its home among the Plutonic rocks of Lake Superior, until some iceberg dropped it into its present bed, through gently-moving currents towards the southwest. Ocean streams rolled these uncouth stones for ages at the bottom of the "vasty deep;" frozen into glaciers, they have been pushed along their snail-like pace; adhering to icebergs and ice-fields and ice-floes, they floated hither and thither through Northern seas, until the ice dissolved in the genial warmth. Could we know their true history, the "masquerade of the elements," the lost history of the world, would be made plain as a well-conned lesson.

The associated pieces of water-worn copper are "finger-boards" telling from whence they both came, and the direction of the ocean currents which deposited our Drift.

CHAPTER V.

WINNEBAGO COUNTY.

Winnebago county derives its name from a powerful tribe of Indians of that name who once roamed over its fertile prairies, which then formed a part of their hunting grounds. It is bounded on the east by Boone county, on the south by Ogle county, on the west by Stephenson county, and on the north by the State line between the States of Wisconsin and Illinois. It is twenty-four miles wide from east to west, and twenty-two and one-half miles long on an average from north to south. It therefore contains about five hundred and forty sections of land. The townships, as named, are not all bounded by township lines, but in part by streams and imaginary lines, making the townships thus different in size and shape. Its general level is perhaps somewhat higher than that of Stephenson county, although we have no information of the actual figures. The face of the county is high, dry, somewhat more sandy, rolling and undulating than Stephenson, with which we are now comparing it. A considerable portion of its surface is covered with timber of various qualities.

In the northwestern part of the county, along Sugar river and its tributaries, and along portions of the north bank of the Pecatonica, there is much scattering timber and brush land, interspersed with occasional swampy tracts. A few miles below Rockford, along the north bank of Rock river and extending north and west from the same, there is a tract of barrens covered with brushwood and a rather light growth of white oak and black-jack timber. In the southeastern portion of the county, along and near the Kishwaukee creeks, the face of the county is rough, hilly, barren, brushy and covered with an occasional growth of fair timber. The rest of the county is chiefly prairie, interspersed with many beautiful but small groves.

It is well watered with many fine streams. Rock river enters it about six miles from its northeast corner, at Beloit, runs nearly due south some eighteen miles to Rockford, then bears off gradually to the west and enters Ogle county some fifteen miles south and west of the latter city. This noble and beautiful stream, and its broad, rich valley, fills the mind of the beholder with admiration. The waters of this stream are silvery and clear beyond any other river in the State; its bottom, for the most part rocky and sandy, its current swift and strong, its flow and volume constant. Heavy water powers at Beloit, Rockton and Rockford afford splendid manufacturing facilities; and all along the stream, every few miles, dams might be constructed which would cause thousands of busy wheels to toil in the service of man. At these three places scores of founderies, factories, machine shops, manufacturing establishments, paper mills, grain mills, and other similar enterprises, attest the capabilities and power of this magnificent river.

The next stream in size is the Pecatonica river. It enters the county on the west, some eight miles from its southwestern corner, and flows in a general east and north course, about twenty miles, to near the town of Rockton, where it mingles its turbid waters with the bright, flashing current of Rock river. If possible, its course is more tortuous and its waters more muddy in Winnebago than in Stephenson county. Sugar river comes in from the northwest, and enters the Pecatonica near the village of Shirland. Both these streams have bottoms of rich, deep alluvium, from one to perhaps three miles wide. Neither of them afford any water-power. Both of them, we believe, are dammed, in the water-mill sense of the term; but such lazy rivers will never make whirling wheels hum the songs of busy labor. The two branches of the Kishwaukee unite near the southeastern corner of the county, and flow on, a considerable stream, until their commingled waters fall into Rock river, in the township of New Milford. Killbuck creek, in the southeast; Kent creek, coming in at Rockford; the Kinnikinick creeks, in the neighborhood of Roscoe; and another considerable stream, a tributary of Sugar river, in the northwest, are the most important of the smaller streams, and with their little feeding tributaries afford plenty of water for agricultural purposes, together with a number of light water-powers.

Some of the Indian names of these streams have a very descriptive significance. Pecatonica, as before mentioned, means "crooked stream," or "muddy waters," and so far as the stream is descriptive

of the name, it ought to mean them both. Sinissippi, the Indian name of Rock river, signifies "the rocky river." Kishwaukee means "clear waters," a name reasonably descriptive of the streams. Winnebago means "the fish-eaters."

Taking, therefore, all things into consideration, Winnebago county is hardly so good a county for agricultural purposes as its western neighbor, Stephenson. The soil is hardly so fat; the amount of poor land is proportionally greater. But taking into account its manufacturing interests and facilities, the unexampled fertility and Rhine-like beauty of its Rock River Valley, and the enterprise and wealth of its grove-besprinkled city of Rockford, it would puzzle a jury to decide which is the most desirable county.

Geological Formations.

The geology of Winnebago county is of the simplest character. First, there is the usual Quaternary deposits, consisting of sand, clays, gravels, boulders, subsoils and alluvium. After these, the three well known divisions of the Trenton limestone outcrop along the streams and hills, and show themselves in the railroad cuts, wells and quarries in different parts of the county. These are the Galena, Blue and Buff limestones of the Western geologists. A perpendicular section, as near as we can construct it, exhibits the following strata:

	Feet.
Quaternary deposits. Average depth, about	15
Galena limestone	96
Blue limestone	35
Buff limestone	45

The measurements of the limestones are made at actual worked outcrops. At no place could we discover the St. Peters sandstone, although it must come well towards the surface about Beloit and Rockton. Neither could we discern remains of the Cincinnati group, although the thickness of the Galena would indicate that patches of it might exist. We believe, however, that the Trenton limestones are the only ones at any place exposed or dug into in the county.

Surface Geology.

Alluvial Deposits.—The usual alluvial bottoms exist along the Rock, Pecatonica and Sugar rivers. These are from one to five miles wide. On the two latter the deposit is deep, black, fat and rich, supporting in places a heavy growth of timber, and where cultivated affording the usual superior Indian corn land of flat river

bottoms. The deposit along Rock river is not so rich, being composed more of sands and clays, with occasional patches and strips of the fatter soils.

Loess.—Some of the bluffs along Rock river are in part composed of Loess clays, in which no fluvatile shells were noticed. This formation, however, is of quite limited extent.

The Drift Proper.—The Drift, now the subject of grave discussion among the geologists, is very largely developed in Winnebago county. It is composed of loose detrital matter, often of considerable thickness, brought from long distances and deposited over large areas of the county. The materials making up this loose mass were not derived, to any great extent, from the underlying Trenton rocks, but came from the metamorphic regions of the north. Whether brought by the currents and flow of waters, or transported adhering to the sides of those slow moving, pale-green mountains, the ice-bergs; or ground and pushed and moved along by creeping, all-powerful glaciers, we shall never perhaps positively know. All of these causes may have contributed to these results, but the appearance of the gravel beds themselves indicate the long-continued action of water. This is much more evident in the Winnebago than in the Stephenson county gravel beds. The railroad track from Beloit to Caledonia, every few miles, cuts through the top of long undulating swells of land. These swells are pure, unmodified, unstratified Drift. They are made up of assorted and well rounded gravel of all sizes, from that of a pistol bullet to that of a goose egg, intermingled with a white or yellowish-white sand, and occasional small boulders, and are sometimes ten or fifteen feet in thickness. All the railroads exhibit the same beds along their tracks, though in a less marked degree. Every township in the county has more or less of these gravel beds, and their underlying associate deposits of clay and sand. Along some of the prairies, and in the little streams, huge boulders, the size of a haycock, are sometimes seen, partially sunk into the soil by their great weight. Two of these particularly attracted our attention. One was black as night, but bisected through the middle by a vein of flesh-colored granite three-fourths of an inch in thickness. We once saw one precisely like it, and evidently from the same locality, in Clark county, Missouri. The other was flame-colored and planed smooth on two sides, nearly at right-angles, evidently by glacial action. These lost or transported rocks, the story of whose journey from the north is wrapped in so deep mystery—clay and sand-banks, with faint lines of stratification in some instances, assorted gravel beds, nuggets and boulders of

copper, rounded to smoothness by erosion of the waters; all these, left in their present positions, by the fingers of the retiring seas, slightly modified, in some cases, by subsequent agencies—make the study of the Drift in this county attractive, and are full of lessons of thought to the contemplative mind.

A more particular description of the materials in these and similar gravel beds will be reserved until our report upon Ogle county is written.

The Trenton Formation.

The Galena Limestone.—Two-thirds of this county is underlaid by this rock. It is a heavy-bedded, yellowish, cream-colored, dolomitic limestone, compact, irregular, somewhat crystalline towards the middle and bottom strata, light-colored, porous, crumbling, and full of sand in little cavities toward the top. In some localities the bottom layers pass gradually into the blue shaly parts of the Blue division, so that it is difficult to place the line of demarcation between the two. An imaginary line entering the county about the southeast corner of the township of Roscoe, drawn thence in a southeast course until Rock river was reached; thence extended round in a slight bend towards the northwest, until within a short distance of the Pecatonica river, at a point about four miles west of its mouth; thence meandering along the Pecatonica from one to two miles south of the thread of that stream, until the western boundary line of the county was reached; thence starting south and keeping around the boundary line to the place of beginning, and embracing about two-thirds of the county, would indicate the superficial extent of this division, to which would have to be added a narrow strip, extending from the village of Pecatonica, up towards and nearly to the northwestern corner of the county. The most notable quarries and outcrops within these boundaries were the following. The first heavy outcrop of the Galena limestone exposed on Rock river, after it flows upon the same, is about three miles above Rockford. A high bluff on the north bank of the river presents a bold escarpment, some seventy-five feet in height. At this place a large quarry is opened. The stones are hard, compact and subcrystalline, and burn into the very best quicklime. A little steamer, towing a couple of stone boats, makes daily trips in the summer season from this point to the perpetual New York limekiln in the city of Rockford, transporting thither the large quantities of stone daily burned into lime at this greedy stone-devouring

kiln. Drifting down to the city we find the next heavy outcrops. One mile east of Rockford, along a prairie ridge, there is an exposure about forty feet thick, where a light-colored, whitish, friable stone is quarried to a considerable extent. In the timber ridge, about one mile north of the Fair grounds, is another, about ninety-six feet in thickness, where the workmen have penetrated entirely through the Galena limestone, and about five feet into the Blue limestone below it. The line of demarcation is strongly defined. No brick wall builded upon a stone foundation ever presented a more marked contrast. Three miles below the city, in a bluff on the west bank of the river, is a worked outcrop thirty-five feet thick. The bluffs here present a bold and picturesque front. Clambering vines festoon their face. A crown of timber sits along their brow. A narrow strip of greensward runs along their base, on which the shadows of some graceful elms delight to lie. The river, broad and many-voiced, goes careering by. There are few more refreshing spots than this, of a hot summer day, when the fierce sun is beating down on cliff and terrace, dusty road, and murmuring river.

Some half dozen miles below this, and not far from the Ogle county line, is an exposure in the timber, about six feet deep. Thus the valley of Rock river, for two-thirds of its extent in Winnebago county, is hollowed out of the Galena limestone.

The Galena division of the Northwestern railroad enters the county near the village of Pecatonica, on the west, and leaves it at the village of Cherry Valley, on the east line. In all its cuts and excavations it shows the lead-bearing rocks. It passes nearly over the center of that part of the county colored to represent them. At Cherry Valley a heavy quarry of these cream-colored limestones has been worked, out of which the massive stone for the railroad bridge and piers at this place were taken. Out of a crevice in this quarry several nuggets of pure copper were taken, the larger of which were sold to the tinners, or found their way into eastern museums. Between Rockford and Winnebago station there exist several light exposures, where excavations are made through the low hills.

Two miles and a half below Cherry Valley, down the Kishwaukee, is a lime-kiln, where we found a man asleep, and all our hammering in the quarry did not wake him. A good lime is here burned out of the Galena. A mile further down, at Trink's quarry, an exposure of fifteen or twenty feet is laid bare, and many cords of stone have been taken away. In the bottom of this quarry we found a curious genius, boring away with a horse-power drill for a deposit of copper, on the faith of some witch-hazel and some pieces of float-

copper found, according to neighborhood tradition, in the quarry years ago. The Kishwaukees, before and after their confluence, cut into the Galena for the whole distance of the county, and all their hills and banks show its unworked and weather-stained outcrops.

One of the heaviest outcrops in the county is a little east of the station of Harlem, on the railroad leading from Rockford to Caledonia. The cut passes through a rocky hill, several hundred yards in length and about eighty feet in depth, at the comb of the elevation. A side-track passes through the great ditch, on which cars are switched and left to be loaded. Derricks on either side lift the massive stones, and gently lower them on the cars. The strata here are massive and solid. They furnish splendid material for heavy railroad masonry, and many hands are kept constantly employed blasting them from their adamantine foundations. We know of no quarry in Northern Illinois so valuable as this for railroad purposes and convenience. The top of the hill is covered with a fine, limey, white clay. Gravel and boulders also abound in the neighborhood. About Winnebago, Argyle and along south of Harrison, are many light quarries worked into the Galena. In fact, without further particularizing, all that part of the county bounded by our imaginary line circumscribing the Galena, is underlaid, at no great depth, by this famous lead-bearing rock.

The only fossil found in abundance, is the characteristic *Receptaculites Oweni*. The quarrymen and miners speak of it as the "honeycomb," "sunflower coral," or "lead fossil." About Rockford specimens are exceedingly numerous, but generally break to pieces before finding their way into the cabinet, on account of the friable nature of the upper strata, in which they are mostly found. Judge Miller has a specimen almost as round as an apple. This specimen, when we were in Rockford, was borrowed by an enthusiastic geologist, and we did not see it. But few other fossils were found.

The Blue Limestone.—The Blue limestone, or Trenton proper of the older Western geologists, next succeeds the Galena in the descending order. It is largely developed in the northern and northwestern part of the county. It is here a thin-bedded, bluish-gray limestone, calcareous, or with a lime base, but some of the shaly partings have a clayey base. In the bottom of the deeper quarries a very blue strata always exists. This is massive, and conchoidal or glassy in fracture, and in the mining region is known as the "glass rock." A line drawn from a point in the western boundary line of the county, some two or three miles north of where the Pecatonica river enters it, along the north edge of the alluvial bot-

tom of this stream to a locality about midway between Shirland and Rockton; thence east of north to the northern boundary line of the county; thence west round the county line to the place of beginning, would bound the superficial area underlaid by this deposit, except that the extreme western part occasionally shows beds of passage into the overlying Galena, and except that a considerable patch of the Blue rocks exist in the extreme northeastern part of the county.

The first and second railroad cuts, east of Shirland, made by the Western Union railroad in excavating for their track, afford the best exposures examined for investigating the Blue limestones of the Trenton series. The first is about eight hundred feet long and thirty feet deep; the second is about four hundred and fifty feet long and fifteen feet deep. The rocks are of a whitish-gray color, with conchoidal fracture, becoming darker colored as the lower strata of the quarries are reached. Further west, about Durant, the stone shows a nearer approximation, in lithological characters, to the Galena. The elevations here are capped with the latter rock. The Sugar river hills are rock-ribbed with the division of the Trenton now under consideration.

The fossils noticed in the railroad cuts near Shirland were so numerous as to make their description at this time too tedious. They were mostly small and fragmentary. Some of the thinner and more shaly strata are covered with shells, fragments of trilobites, stems of the encrinites, and pieces of corals, so thick as to resemble masses of fossils stuck together by some adhesive paste. The same limestones at Dixon are exactly similar in appearance.

The Buff Limestone.—This is an unevenly-bedded, somewhat argillaceous or clayey dolomite. It is, for the most part, of a light-yellowish or brownish color, shading into blue towards the bottom of the quarries; is not very homogeneous in composition or stratification, presenting in some of its layers an earthy and in some a crystalline appearance. In every outcrop, worked to any considerable extent, the lower layers become quite massive, and of a dark-blue color. When first taken out, this blue stone presents a beautiful appearance, and no materials make handsomer mason work; but when exposed to the weather for some length of time, the dark, rich, blue color fades into a dirty, whitish-blue, not so beautiful as the original color. This rock, however, makes a good building stone, but, on account of its earthy base, does not burn into a good lime. But a limited portion of the county is underlaid by this formation. If from two points in the boundary line between Wisconsin and Illi-

nois, distant from Rock river on each side three or four miles, we extend two lines southward, following the general course of the river, but drawing gradually nearer together until a point in the center thread of the stream was reached one or two miles south of the north line of Harlem township, the tongue of land thus inclosed would represent this portion. The chief outcrops of the formation, and in fact the only ones where it can be satisfactorily examined, are at Beloit, a short distance within the State of Wisconsin, and at Rockton, about the middle of our tongue-shaped strip of land. The quarry at this latter place is opened on the north face of a low range of hills, ranging along the south bank of Rock river, and distant one mile from the village. The outcrop, as here worked, is forty-five feet thick, and answers well to the above description, except that the upper ten or fifteen feet resemble beds of passage into the overlying division. This outcrop, together with its closely resembling ones at Beloit, in Wisconsin, and at Winslow, in Stephenson county, and at Martin's Mill, in Wisconsin, exhibits about the following section:

	Feet.
1. Light-colored, chocolate-brown clay, covered with a thin soil, full of large, unworn gravel, not apparently transported, but the undecomposed parts of shaly strata or layers formerly decayed or rotted into clays..... about	5
2. Thin-bedded, bluish-yellowish strata or layers, breaking with a more or less glassy fracture, and in some cases having a vitreous appearance, and in all cases resembling corresponding layers in the overlying limestone.....	15
3. A layer resembling the last, but heavier-bedded and duller colors.....	6
4. One, and sometimes two, layers, separated by clayey shales and loose clays, of heavy-bedded, massive, very blue limestone, with less conchoidal fracture than corresponding layer in Blue limestone.....	4
5. Heavy-bedded, massive, dull sand-colored limestone, very impure, breaks into irregular masses, and to the tongue has both a sandy and clayey taste.....	7
6. Clays, and clayey and sandy shales.....	3

The upper part of all these outcrops, in our judgment, differs in but a slight degree from quarries in the Blue limestone of the same thickness. The lower part of the quarries, for four or five feet above and below the blue strata, has a more marked difference. But inasmuch as Professor WHITNEY, and other eminent geologists, class these quarries as the Buff limestone, and inasmuch as the types of characteristic fossils are somewhat different, we shall describe and map them in these reports as belonging to this division of the Trenton formation.

Fossils.—The characteristic fossils of the Buff limestone, observed at Rockton, consist of fragments and indistinct traces of fucoids: *Cephalopoda*, of the genus *Orthoceras*, *Cyrtoceras* and *Lituites; Gasteropoda*, of the genera *Pleurotomaria* and *Murchisonia; Brachiopoda*, of the genera *Orthis* and *Strophomena; Lamellibranchiata*, of the genera *Tellinomya* and *Ambonychia;* and zoophytes or corals in fragments.

The *Pleurotomaria subconica, Oncoceras pandion, Tellinomya cuneata, Ormoceras tenuifilum, Tellinomya ventricosa,* and species of *Orthocera* and *Ambonychia,* are the fossils occurring in the greatest abundance. The casts of some of these come out in great perfection.

Economical Geology.

Building Stone.—All three of the above described formations or divisions of the Trenton rocks furnish stone adapted for building and ordinary mason work. Especially is this true of the Galena limestone. The quarries at Harlem and Cherry Valley furnish excellent materials for solid and massive railroad masonry. The public school building in the city of Rockford is a model of architectural beauty and solid imposing grandeur. No painter's art could improve its present rich, warm color. The beautiful cream-colored residences scattered about the city present an equally striking appearance. When dressed and laid up of equal thickness, nothing can excel the effect of these stone residences. We have heard much said of the beauty and aristocratic appearance of brown-stone fronts in other wealthy cities; but no stone ever quarried, unless it be the marbles or the flesh-colored granites, present a more striking, solid, home-like appearance than these same cream-colored limestones of the Forest City. When built up as these people know how to build them, they are an architectural miracle of stone and mortar. The rich, warm, soft, cream-color attains its richest, warmest and softest hues in the stones taken from the Rockford quarries. It bathes them with a tint beautiful as Nature uses, when, with a brush of sunbeams, she lays her golden-yellow upon the ripe ears of corn. And not only is the material beautiful, but it is lasting, seasoning, when long exposed, into almost the hardness of granite itself. Let wealthy builders hereafter, instead of sending for Milwaukee brick to put into their palatial residences, go to the rich outcrops of the Galena limestone, and dig from thence a building material every way more durable, more beautiful, and more simply grand.

The Buff and the Blue also furnish stone of good quality for all ordinary mason work, and it is easily quarried and easily worked. The dark blue strata, when handsomely dressed and laid up, either by itself or alternating with the lighter-colored, presents a picturesque and quaint appearance: but the colors are not fixed and fast like that of the Galena.

Lime.—The Buff limestone of Rockton will not burn a good quicklime, but would doubtless, if properly managed, make a fair hydraulic

lime. Some of the Blue limestones will make a fair quicklime; but the Galena limestone excels all others in the quality of this useful material, which can be obtained in inexhaustible quantities from its convenient quarries. The New York perpetual patent limekiln in the city of Rockford, before referred to, turns out thousands of bushels, every summer month, of an excellent building and whitewashing lime. It is a high structure, perhaps ten feet in diameter within its circular walls. Perpetual fires burn away at the bottom; the sinking, glowing mass is constantly replenished at the top with cart-loads of stones the size of a man's fist; and daily from the lime-pot below, the hot, dusty, crumbly stones, soon to be transformed by the hissing touch of water into white floury lime, are shoveled into a convenient storehouse.

Sands and Clays.—Sands for all economical purposes are found almost anywhere along the river banks, or may be dug from thickly strewn Drift deposits. Clay, to burn into a good common red brick, may be had in almost any of the underlying subsoils. The subsoil clays just above the soldiers' old camping grounds, a mile or two above Rockford, are of excellent quality for brick-making purposes. While there last summer, a powerful compressing machine, called "The Little Giant," we believe, operated by a steam engine, was at work pressing dry dust into bricks solid enough to be handled. These, when burned, came out a beautiful cherry color, rivaling in appearance and richness of coloring the far-famed Philadelphia cherry-colored brick. If the experiment then being tried proves a success, another branch of manufacturing industry will be added to the many already possessed by this energetic little city.

Mineral wealth.—Of this the county possesses very little. Although covered to so large an extent by the real lead-bearing rocks, no bodies of mineral have ever been found in the county. Traces of lead are found in many of the worked exposures, and bits of float mineral are often picked up in the gravel-beds; but these are simply matters of curiosity, and denote no workable bodies of the lead ore. The modes of occurrence of the galena or lead ore over the lead-basin are very peculiar. A few well-known centres of deposit exist. A radius of a few miles around these seems to be productive. All outside, even where the conditions would seem to be favorable, is unproductive.

Bog iron ore exists about many of the springs, but for economical purposes the deposit is worthless. Copper, in its pure state, is often met with. No deposit of the metal exists. It is all float material, found in connection with the drift, and comes originally from the

Lake Superior copper deposits. A crevice in the Galena rocks at Cherry Valley had a considerable quantity of float copper deposited in it. It has all been removed. A railroad laborer found, in a gravel bed in the southeastern part of the county, a boulder or nugget weighing fourteen pounds. He sold it to a tinner, who shipped it to Chicago, and it found its way into the general copper trade. Hon. Anson S. Miller, of Rockford, has in his cabinet of minerals a handsome specimen of several pounds weight, found in digging a well some thirty feet below the surface. But all these are rather matters of interesting speculation, and are not of much economical value to the county.

Peat.—No peat beds of value were noticed in the examinations of this county. The land is too well drained to afford favorable conditions for the growth of this useful material. In the region of Sugar river, in the sloughs, swales and marshes there existing to a limited extent, and about the rise of some of the small streams south of Rock river, some small beds of imperfect peat and black muck doubtless do exist; but they will never be of value as a fuel, and are only adapted for use as a fertilizer of the soil.

Fruit.—Apples and pears of the hardy varieties succeed well, and more than enough for home consumption is raised. The garden fruits produce large crops. The somewhat sandy nature of the soil is well adapted to the strawberry. We saw, when there, patches of ground blushing red with this delicious fruit. The crop of leaves was not heavy, but the berries lay thick in tempting bunches over the ground. Boys and women, with red-stained hands, were gathering them into baskets for the Rockford market. Orchards planted in unexposed situations, or properly protected by timber belts, bear well, and the crop is remunerative and reasonably sure. Hardy vines, with winter protection, bear bountifully, and may be made a source of profit. The strawberry, currant and gooseberry may be raised in great abundance without protection. The strawberry, however, does better with a covering of coarse straw during the winter, which need not be removed in the spring.

As to the grape growing and wine producing facilities of this part of the State, we refer those desirous of further information to our report upon Whiteside county, where this subject has received more attention from the horticulturists.

Indian Antiquities.

The Indian race is fast fading away before the resistless march of Anglo-Saxon civilization. At his present rapid decrease, the Indian will soon be a historic man. But he has left memorials which will last when the proudest builded monuments of his all-conquering foes have crumbled into oblivion. The geography and significance of our Indian names is a very wonderful subject. Flint arrow-points and spear-heads are frequently picked up, while stone axes, and smooth oblong instruments, sharp at one end, and used for skinning animals, are of not unfrequent occurrence.

But the most common objects of interest to the antiquarian are the mounds, in common speech, thought to be of Indian origin. The mound-builders, whoever they were, once swarmed in the valleys and woodlands, sat down upon every picturesque spot along the streams, and left their mound-builded structures as memorial monuments of their busy lives. We shall not, in this place, discuss their age or their origin, but simply describe some of the most prominent ones noticed in this county. They do not belong to its geology, but they are matters of great interest to thoughtful men. The antiquarian and archæologist, if not geologists, are laboring in a field close bordering upon the domain of that earth-delving science.

Three classes of these mounds were noticed and examined. There was the common round mound, from ten to fifteen feet in diameter, and from two and a half to five feet high. Mounds of this description are very numerous. There is a large group of them on the banks of Rock river, six or seven miles below Rockford. At many other places along this stream they exist in scattered groups. On the north bank of the river, within the city limits of Rockford, and a short distance above the bridge on Main street, several very large ones are preserved in the private grounds of citizens. But the locality where they are met with in the greatest numbers is on the banks of the Kishwaukee, in the southeastern part of the county, near the confluence of the two streams of that name. Scores of them are scattered about here, and scores more have been nearly obliterated by the sacrilegious ploughshare of the white man. The oldest inhabitants recall many occasions where bands of Indians, pilgrim-like, returned to these silent mounds, and held over them for days their mystic pow-wows.

The oblong-shaped mound is of much rarer occurrence. At the locality in Rockford already alluded to there is a very remarkable

one. It is one hundred and thirty feet long, about twelve feet wide at the base, and three or four feet high.

Near by this one is a mound of the third class, or those having a fanciful resemblance to some form of animal life. In Rockford it is known as the "Turtle mound." But it resembles an alligator with its head cut off more than it does a turtle. We give its dimensions: Whole length, one hundred and fifty feet; width, opposite fore-legs, fifty feet; width, opposite hind-legs, thirty-nine feet; length of tail, from a point opposite hind-legs to end of tail, one hundred and two feet; length, from a point opposite hind to a point opposite fore-legs, thirty-three feet; distance from opposite fore-legs to where neck should begin, fifteen feet.

These measurements were not made with exactness, but are simply paced-off guesses. The figure lies up and down the river, on a line almost north and south, the tail extending northward. The body rises into a mound as high as a standing man. The feet and tail gradually extend into a greensward, growing less distinct and undefinable, until they cannot be distinguished from the surrounding sod. The measurements across the body at the legs include those appendages, which are only a few feet long.

The effigy, whether of alligator, lizard or turtle, seems to be headless, and no depression in the surrounding soil would indicate that the materials out of which it is constructed were obtained in its immediate vicinity.

It is a curious structure, and one would like to know its true history as he looks upon its partially defaced form. What were its uses, and who builded its uncouth animal proportions, may be better answered by the researches of the antiquarian than by the speculations of the geologist.

CHAPTER VI.

BOONE COUNTY.

This is, perhaps, the smallest county in the State, comprising only eight townships of land. It is twenty-four miles long from north to south, and twelve miles wide from east to west, and consequently contains only two hundred and eighty-eight square mile. It is situated in the north tier of counties of the State, a little east of the center of the same. Its boundaries are as follows: on the east McHenry county, on the south DeKalb county, on the west Winnebago county, and on the north, the State of Wisconsin.

Its physical geography is not remarkable, and the general face of its surface not dissimilar to that of surrounding counties.

The townships of Spring and Flora, and in fact all that part of the county south of the Kishwaukee, may be called a treeless prairie, characterized by long, low, undulating rolls, and low ranges of hills and ridges. In some places it is flat, with swales and sloughs of unlimited extent, between moist marshes and black, fat meadow lands. A few trees skirt along Coon creek in the southwest, and scattered patches of timber in one or two other places relieve the level landscape. A broad, rich, comparatively level Illinois prairie, these hundred noble sections preserve yet some of that primitive beauty, which gave two townships their names. Before the busy teeming millions of the sons of toil swarmed over the fertile West, prairie flowers, in spring-like beauty and autumnal glory, bloomed, where now the glancing plow-share turns the spring furrow, and the golden-ripened wheat fields dally with the fugitive winds. The purple and golden clouds of flowers, that used to lay on these prairies, are now no more; but in their place the tasselled Indian corn waves its head, and men are growing rich from the cultivation in useful crops of these old flower-beds of nature.

But leaving these prairies, the county changes its appearance north of the Kishwaukee. It becomes rougher and more rolling. Although still good for agricultural purposes, the soil becomes thinner and lighter-colored. More streams are met with. These are margined with hills to some extent, and hilly barrens. Wide stretches of rather light timber and brushwood extend for miles along the streams and over the intervening highlands. Here and there a grove of better timber may be seen. Small prairies, prairie openings, and long stretches of prairie still exist in every direction, but it soon becomes difficult to tell whether the rather poor timber or the irregular prairie land predominates, especially after passing nearly into the northern third of the county.

The same general remarks apply to this third of the county, except that considerable wet and swampy land is noticed. Many of the streams of the county take their origin in these low lands. The northwestern part of the county has considerable prairie, and much wet land; the northeastern has more timber, is higher and dryer, and on towards the "Big Foot" prairie, in Wisconsin, contains good farming lands.

The timber consists mostly of black, white, burr, red, yellow, and some rare varieties of the oak, black walnut and butternut, shellbark and common hickory, cottonwood, sugar-maple, honey-locust, sycamore, water and slippery elm, haw, dogwood, common poplar, white and red ash, red cedar, white pine, linden or basswood, common swamp willow, and a few other shrubs and plants. Many of these are seldom met with, and indeed the groves in this part of the country are made up principally of the common black and white oaks to be met with in the poorer timbered regions of Northern Illinois. The alluvial lands skirting the larger streams are the only places where many of the above species of trees can be noticed at all.

Boone county, for the most part, is well watered. The Kishwaukee, here called a river, enters it on the east, not far from the center of the eastern line of the township of Bonus, and crosses in long, easy flowing curves, entering Winnebago at the village of Cherry Valley. It is a stream of considerable size, not very swift current, reasonably clear waters; and affords fair water powers at Cherry Valley and Belvidere. Coon creek comes in from the southeast, and falls into it near the center of the township of Bonus. This is the only tributary worth naming on the south side, within the county limits. On the north, the Piscasaw creek comes in almost exactly on the center of the eastern boundary line of the town-

ship of Boone, and flows in a southwest direction until it is lost in the Kishwaukee at Belvidere. It is a light stream—too light for available water powers. Beaver creek comes in at the northeastern corner of the county, flows in a direction west of south, and joins the Kishwaukee a short distance above the town of Cherry Valley. It is similar to the Piscasaw, and not valuable for water powers. Some small streams in the township of Manchester, in the northwest part of the county, flow over towards Rock river, but they are small and insignificant. These water-courses and their small tributaries abundantly water the county, and adapt it to stock-raising and agricultural purposes.

Geological Formations.

The Cincinnati group and the upper division of the Trenton limestones are the only rocks which outcrop, or in any manner show themselves, in this county. About its northwestern corner, extending to even some distance within its borders, the middle and lower Trenton limestones doubtless are the underlying rocks; but they nowhere outcrop that I could notice. The deposits of the Quaternary system are extensive in the county, covering it over in many places to a great depth. It will thus be seen that the geological formations of Boone county are few, and its geology comparatively simple. The following section of the rocks exposed and the superficial deposits, is comparatively correct; although nothing but an approximation to the thickness of the latter can be given:

Section of Formations in Boone County.

	Feet.
Alluvium, principally partially stratified clays, sands and fine gravels, along the Kishwaukee with loams and surface soils	20
Light-colored, velvety, tough, tenaceous, impervious potters' clay	30
Ordinary drift deposits, consisting of the usual sands, gravels, hard-pan and clays	35
Cincinnati shales; the formation much deeper, but worked to a depth of	18
The Galena limestone, worked	35
Lower Trenton limestones	Unknown

Surface Geology.

The surface geology consists of the usual Quaternary deposits, except that the Loess is perhaps entirely wanting. The Alluvial deposits along the small streams are narrow, rich and black. On the Kishwaukee they are wider and deeper, intermingled with sands and fine gravels, and bear, in places, a heavy growth of bottom timber. The usual thin prairie soil, swamp mucks and peats of various degrees of purity and ripeness, make up the rest.

The Drift proper is a heavy body of abraded and transported materials. Over that part of the county underlaid by the Cincinnati shales there is a thinner superficial deposit of a fine, laminated, comminuted clay, of a light ashy or blue color; bearing mingled evidence of deposition in still waters and the dissolving *in situ* of the underlying clayey shale rocks. No extensive gravel beds exist; but occasional large boulders may be noticed, more especially lying about the low springy places.

But leaving the gently rolling prairies, and going northward to the region underlaid by the Galena limestone, the reddish clays, hard-pan and coarse gravel beds of the upper members of the Drift largely predominate. A few miles west of Capron are localities where boulders, of the average size of a man's head, lay thickly strewn over the ground. These were noticed to lie thickest where boggy and springy places were met with, surrounded by rougher and more rolling land. The boulders are all from the metamorphic regions of the north, and consist of granite, gneiss, hornblende, trap, and some other varieties, with their various combinations. Across the whole northern part of the county these boulders were noticed in a greater or less abundance, associated with clays and sometimes clayey sands. Across the central part of the county the coarse gravel beds, unstratified hard-pan, and partially stratified clays make up the surface covering of the rocks. Under these, all over this region, laminated clays rest upon the indurated rocks below. Some of the gravel beds northwest of Caledonia are almost a mile long, and several feet deep. They are made up of materials very much rounded and abraided; are partially stratified; the gravel is of all sizes, intermingled with clean sand. A low drift hill of gravelly clay lies close to Belvidere, on which the Court House stands. In the banks of the Kishwaukee, a short distance below the bridge between the north and south parts of the city, on the north side of the stream, are outcrops of the bank of tenacious potters' clay, before referred to. It runs under at least a part of the city, and in one place borings for some public work showed it to be some seventy feet in thickness. At another locality some workmen were sinking a well. After going through this deposit, which there was much thinner, water rushed into the well so fast that the men could hardly get out in safety.

In many places I heard of the traditional nuggets of copper that previously had been found among the gravel and boulders, but I

could not succeed in finding any myself. Over this whole region, in connection with my observations upon the Drift, I watched closely in order that I might detect indications of glacial action; but I am forced somewhat reluctantly to admit that atmospheric and chemical agencies and aqueous forces probably explain most of the phenomena connected with these superficial deposits. In the morraine-like hillocks of Ogle county glacial action, I think, is more manifest.

The Cincinnati Shales.—As already intimated, the shaly rocks of this deposit underlie nearly all that part of the county south of the Kishwaukee. Coon creek doubtless cuts down to Galena; but all the prairie ridges show the outcroppings of the former rocks, although worked exposures are rare. In fact there are but two good stone quarries in Boone county: one in the Cincinnati shales, five or six miles south of Belvidere, and one in the Galena limestone three or four miles northwest of the city. The former of these is opened in the brow of a low hill. A few feet of clay and subsoil is stripped from the surface of the shingly rocks. The formation is quarried into about eighteen feet in depth, and great quantities of stone have been removed and hauled for many miles over the surrounding country, and into the city of Belvidere. The quarry, or rather series of quarries, is a source of profit, not so much on account of the valuable properties of the stone, as on account of the ease with which they can be quarried and the scarceness of all kinds of stone in the county. We noticed here flagging stones twelve by twenty-one feet, and three or four inches thick, without an apparent crack.

On some parts of the rocky walls here exposed to the air, the "tooth of time" has made a marked impression. The rock is crumbling and decaying rapidly. Draw the finger over it and a shower of small fragments fall to the rocky floor.

About Garden Prairie, near the line between this and McHenry county, this formation is quarried and hauled north and northwest over the county for seven or eight miles, for purposes of ordinary stone masonry.

At no other place in the county is it worked. No natural outcrops exist, on account of the ease with which it disintegrates and covers up its natural outcrops; but it is not difficult to trace its boundaries by the gently undulating elevations, the marshy springs along their base, the color of the waters that trickle down the slopes, and the nature of the overlying clays themselves.

The formation here is unfossiliferous to a high degree. Nothing but a few indistinct tracings of fucoids or sea-weeds were noticed.

The Galena Limestone.—Two-thirds of this county perhaps is underlaid by the lead-bearing rocks of the Trenton limestone. And yet in all this extent of superficial area there is but one good outcrop, and one place where the Galena is worked to any extent or advantage. This is at the exposure on Beaver creek, about three and a half miles northwest of Belvidere. Here the quarry is worked to the depth of thirty-five feet. The stone is massive and solid. Some of the bottom layers are from six to eight feet in thickness. Much stone has been quarried here for the construction of the railroad bridge at Belvidere and for building purposes in the surrounding country.

The country round the quarry is barrens and oak openings, with brushwood and a thin whitish soil. The upper strata of this outcrop are thin enough to be readily removed with pick and wedge and crowbar; but the lower ones can only be displaced by patient blasting.

I found here many of the characteristic fossils, such as *Receptaculites Oweni, Marchisonia gracilis, M. gigas, Pleurotomaria angulata, Ambonychia, Bellerophon,* and fragments of *Orthocera.*

Leaving this quarry my examinations indicate that both Beaver creek and the Piscasaw, for their whole length in this county, are underlaid by the Galena limestone. From Belvidere, on a line east of north, through the townships of Bonus, Boone and Leroy, to Capron, and on nearly to the State line; thence west a few miles; thence south along the center township line of the county, through Shermanville, to the starting point; thence northwest to Caledonia, and a few miles north of the same; thence back on any convenient road to the starting point; thence west on the north Rockford road to the county line, and on all this extent of country gone over, I only saw indications of this limestone. Only a few imperfect, crumbly outcrops were seen in the faces of some of the little hills; not such as would pay to work.

On the Upper Beaver and round the feeding springs of one of the Kinnikinniks, some poor specimens of stone are quarried, such as are used for the foundations of houses about Capron and in that part of the county.

Blue Limestone.—On the map I have marked the northwestern part of Boone county with the colors indicating the lower divisions of the Trenton formation. Its close proximity to Roscoe and Beloit, with some surface indications, led me to believe that these would

be the surface rocks, if the superincumbent clays were removed. No outcrops, however, were noticed, and the matter is of little general or economical interest.

Economical Geology.

Building Stone.—Building stones are scarce in Boone county. They are worth about five dollars per cord in the quarries, after being dug and prepared for loading.

The quarry on Beaver creek furnishes a solid, massive, hard stone, very suitable for bridge piers, culverts, and other railroad masonry, or any solid enduring masonic work. It requires, however, a good deal of labor to adapt it to the lighter kinds of masonry. The stone is in active demand, owing to the scarcity of other quarries in the surrounding country. Most of the heavy building stones used in Belvidere, such as church foundations and other like work, are obtained at this place.

The quarry in the Cincinnati shales south of Belvidere, already referred to, furnishes most of the stone used in that city for the lighter kinds of work, such as foundations for ordinary houses, ordinary cellar walls, walling wells, and light kinds of masonry generally. It also furnishes stone for a large extent of country over the surrounding prairies.

The ease with which they can be quarried and broken into blocks of any required superficial area, makes them well adapted for these purposes. The layers are from two to four or five inches thick, and break with ease in any required direction.

In many places the Cincinnati shales are useless as a building stone, owing to the ease with which they disintegrate and crumble away. But here they seem to answer a fair purpose for the uses to which they are devoted. At Gen. Hurlbut's residence, in Belvidere, we were shown some of them which had been in use twenty years, and yet they seemed little gnawed into by the tooth of time. For flagging-stones they can be obtained of any desired size and shape, and when so used in Belvidere they seem to be answering quite well for this purpose.

We would not advise the use of stone from the Cincinnati group for solid work, or in structures which are to stand the test of ages. Some of it will season so far as to become enduring; but occasionally stones will be found, in the most carefully constructed work that can be built, which, after a few years' exposure to the rains and frosts, will begin to crumble and melt into their kindred clay.

Lime.—At the Galena quarry, above referred to, a lime-kiln is in successful operation, and a good quality of common quicklime is burned. We believe, however, the city of Belvidere finds it more economical to use lime shipped on the railroad from other places. A good perpetual lime-kiln at the Beaver creek quarry would furnish abundance of good lime, and would pay well.

Minerals.—No mineral wealth exists in the county. Bog iron ore in some of the bogs and marshes west of Capron was noticed in considerable abundance. Pieces of float copper are frequently picked up in the gravels of the drift. Traces of lead are sometimes found in the Galena limestone. Springs of chalybeate water exist in places. But all these are matters of curiosity and interest, rather than sources of economical value.

Sands and Clays.—From the ordinary clay and sand banks almost everywhere abounding in more or less purity, sand for building purposes, and clay for ordinary red brick, may be obtained in great abundance. The subsoil over most of the Galena rocks makes a good common brick.

The bed of potters' clay, before alluded to, deserves more than a passing notice. When ground and mixed with sand, it makes a hard, handsome, cream-colored brick, quite as beautiful, and perhaps more enduring, than the far-famed Milwaukee brick. The front of the large new church in Belvidere is built of this material. For this purpose alone this bed of clay is valuable. And there is no reason why an article of common crockery might not be manufactured out of it in unlimited quantities. Even a queensware of fair quality might be made from this deposit.

When first dug the clay is tough and tenacious. The spade is forced into it with difficulty. The color is between a milk-white and chocolate-brown. When dry it breaks with a somewhat conchoidal fracture; has a fat, unctious feel to the fingers, and becomes lighter in color. We do not know its chemical composition.

Peat.—In the township of Bonus, near the residence of a Mr. Chapman, and partly owned by him, is a peat bog of about twenty acres in extent. A Mr. Brown and Mr. Dana also own peat land in the same slough. Perhaps the bog contains in all forty acres. It is in a swale or slough running down into the Piscasaw creek in an east and west direction. It is susceptible of easy drainage. I spent some time in examining this peat bed. It was covered with a dense growth of sedgy grass; quaked and shook as we walked over it; had the usual carpet of the sphagnum mosses spread over its moist floor, and permitted us almost anywhere readily to force a

common pole down seven or eight feet. The deposit is undoubtedly nine or ten feet thick at many places. The quality of the peat is a little fibrous. It is grass peat rather than moss peat, although grass and moss both enter into its composition. The bed is in a splendid formation stage; the peat is unripe peat. It might be successfully used as a fertilizer; but in the present stage of the peat experiment would hardly make a successful fuel. When properly prepared and condensed it will make a good fuel, and it will only be a few years, we hope, when peat machines will be brought to such perfection that this, and all equally good peat deposits, will become sources of material wealth and blessings to whole communities.

In the township of Manchester I also heard of the existence of peat of good quality, but did not succeed in finding the bed. Doubtless about the little feeding streams of the Kinnikinnicks many beds of value exist, and will be brought to light when peat becomes of greater economical value.

Indian Antiquities.

The Kishwaukee was a favorite stream with the aboriginal inhabitants of this part of the country. No very conspicuous mounds were noticed, but the usual arrow-points and stone implements are often picked up. Within a few feet of the northwest corner of the court house in Belvidere the spot is yet pointed out where "Big Thunder," a renowned Potawattamie chief, was buried. His grave was surrounded with ash palisades, the bottom of which may yet be traced in the ground. He was buried in a sitting posture overlooking the beautiful plain to the west. He had prophesied that a final great battle would take place between his people and their pale-faced enemies, in which the latter would be perfectly defeated; and he caused himself to be buried thus that he might view the bloody conflict, and with his voice of thunder cheer on his fierce warriors, as in life he was wont to cheer them. The first settlers speak of seeing his huge skeleton sitting in its place of sepulture, waiting in vain for the great battle. By-and-by his skull disappeared, and its disappearance became associated in the public mind with the visit of the wandering phrenologist. But the rolling years passed on. Bone by bone was spirited away. The palisades themselves mouldered into dust. The voice of the chief and prophet was forever stilled in death. The great Indian battle remains unfought. The seat of the Indian tribe is covered with a busy little city, and the plain is alive with the pale-faced race, and full of the roar of their industry.

Agriculture and Fruit Growing.

I would speak of the fruit-growing and agricultural capabilities of this county, but the remarks made in the geology of Winnebago county, upon these topics, apply to Boone county nearly as well as they do to that county, and we refer the reader to that report for remarks upon these subjects.

CHAPTER VII.

OGLE COUNTY.

This large and excellent county is bounded on the north by parts of Stephenson and Winnebago counties, on the east by DeKalb county, on the south by Lee county, and on the west by Carroll county, and a small portion of Whiteside county, just touching it on the southwest corner. It is thirty-nine miles from east to west, and about twenty-one miles from north to south, containing eighteen full townships of land, and about seven half townships. It, therefore, contains about seven hundred and seventy-three sections, or square miles.

Rock river, here a broad-flowing, swift, bubble-dancing stream, flows in a diagonal direction across the county, entering it about twelve miles from its northeast corner, and making its exit about eight miles east of its southeast corner. For most of this distance the stream sweeps along in long, undulating curves, except at Grand DeTour, where it doubles upon itself in short, abrupt crooks. The river valley here is unlike itself further north and south. The face of the county along the river is abrupt, rough, broken and timbered. In only a few places do the prairie vistas open down to the water's edge, affording glimpses of the broad undulating plains, which open so wide beyond, that the blue of the sky and the green of the rolling sward seem to mingle in a far-off blending. The little streams on either side have cut down through the hill, leaving bold outcrops of Trenton limestone and St. Peters sandstone.

To one familiar with the sublimity and grandeur of mountain scenery as displayed in Alpine regions, or among the canons and wonders of our own Sierra Nevada or Rocky Mountain chains, where the slow-moving glacier creeps among eternal rocks down to the evergreen forests and the smiling valleys; where the mountain-born

torrent leaps in foam along its rocky channel; where gorge and precipice and adamantine rocks, in wild confusion piled, fill the soul with awe—to one, I say, familiar with such scenes as these, the scenery along Rock river, in Ogle county, may seem tame; but to the inhabitant of the prairies, accustomed only to the grassy plains and green slopes of his native State, bedecked though they be in their native wildness with flowers of gayest hue, to him there is a charm in such scenery as a ride along the river bank from Byron to Dixon discloses.

The resemblance to the old feudal castles of England, as, half-ruined, moss-covered and ivy-draped, they are preserved to us in picture galleries, is constant and recurring. The limestone bluffs, covered half way up their steep sides with the accumulated talus of ages, look like mural escarpments and Cyclopean walls among the wild hills. The sandstone cliffs of various hues, now glancing like snow hills in the sunshine, or glowing like hills of flame or yellow, when stained with the red oxide of iron, are weathered into all sorts of fantastic shapes. The rounded, tower-like, casemated masses, which stand out in bold relief at the Indian Pulpit, three or four miles below Oregon, and at other places along this heavy outcrop of the St. Peters sandstone, need not the aid of imagination or fancy to shape themselves into dome and minaret, spire or cupola, or the graceful flutings, carvings, mouldings and columns of Gothic, Doric or Corinthian architecture. If well painted in oil, some of the more striking scenes would illustrate Illinois landscapes of no mean order of beauty.

These bold, perpendicular bluffs of rock and deep ravines cut into them by the little streams, afford excellent opportunities for an examination of the geology of this county, and will be again referred to in another part of this report.

At Oregon and Grand DeTour good dams are built across the river, and a part of the magnificent powers thus obtained are made available for milling and manufacturing purposes. Dams might be constructed at many other points on the river within this county, and a supply of water-power be put into use unlimited in extent. Indeed, such a stream as Rock river, for water powers, is hard to find; and some day it will enrich all this part of the State with its mills, manufactories, factories, founderies and machine shops. Other but smaller streams run through different parts of the county.

On the north side of Rock river, and tributary thereto, is Leaf river and Pine creek. The former rises about Adeline, and among the gravel hills in the northwest part of the county, and flowing in

a southeast course, mingles its waters with those of the larger river, a few miles below Byron. It is a considerable stream, and affords some fair water powers for light work. Pine creek runs into Rock river a short distance below Grand DeTour. It comes down from the north, making a sweeping bend towards the east. It is not a large stream, but, geologically, is one of the most interesting water courses we ever examined.

On the south side of Rock river, the two streams of most note are Stillman's run and Kite river. The former is a small stream, rising in the eastern prairie townships, and terminating in Rock river a mile or two above Byron. Those familiar with the history of the Black Hawk war need not be told that this stream took its name from the retreat of a detachment of white soldiers under Major Stillman, after it had been ambushed and defeated by a band of Black Hawk's warriors. Those slain in crossing the stream were buried on a high point of land, near the residence of Joshua White, Esq. So long as the little stream flows, its historic name will preserve the name of that disgraceful scare and wild retreat from an almost imaginary danger. The latter is a more considerable body of water, originating mostly in the county, and coming in from a southeast direction. Its mouth is near the little village of Daysville. It is a slow, lazy stream.

The country is rough, and more or less rolling, in close proximity to all these streams, except Stillman's run. The rough, hilly part of the county, along the streams, is covered with a fair growth of the usual white and black oak timber. None of it could be called heavy timber, and some of it is brushy barrens. Still, all these streams, with a few isolated groves, furnish a fair supply for fuel and other economical uses.

The timber soil is thin and white, but under proper cultivation, returns good crops of potatoes, fruit, cereal grains, and garden products.

By far the largest portion of the county, however, is rich, undulating prairie land. All the eastern and southeastern part, all the western and northwestern part, together with much of the northern part, is prairie, as rich and beautiful as the State can produce. Whole townships are treeless. These prairies are covered with a soil composed of the fattest prairie loam. In a part of the State where all the counties are prosperous, Ogle will rank among the foremost in agricultural resources and in the elements of material wealth. The amount of farm products annually raised and sold are enormous, while the real resources of the soil are not yet half developed.

When these resources shall be more fully developed, and the vast untouched water powers of Rock river and its tributaries shall be utilized, this county will attain a degree of prosperity which will place it foremost in that richest portion of the Prairie State lying between Rock river and the Mississippi.

Geological Formations.

The geology of Ogle county is of a highly interesting character. Besides the usual surface deposits, the Galena, Blue and Buff limestones of the Trenton series, and the Cincinnati group, are all developed and outcrop; while the St. Peters sandstone for about fourteen miles along the river rises in bold outcrops of from twenty-five to two hundred feet in thickness. The only other outcrops of this interesting formation in the northern part of the State is at Starved Rock and Deer Park, on the Illinois river, and a few other points in LaSalle county.

The following section will show the measured outcrops. They are all thicker, perhaps, than these figures indicate, except the St. Peters sandstone. The bottom of that formation and its full outcrop, we think, was reached. The floor of Rock river, three or four miles below Oregon, where its thickest development is reached, is the top of the Calciferous sandstone or Lower Magnesian limestone:

Section of Ogle County Formations.

Usual surface deposits, consisting of sands, clays, soils and gravel beds, aggregate, perhaps	125	feet.
Cincinnati group, green and blue shales	25	"
Galena limestone	35	"
Blue Trenton limestone	44	"
Buff Trenton limestone	36	"
St. Peters sandstone, white, soft	200	"
Lower Magnesian limestone	—	"

The above figures indicate the maximum thickness of the surface deposits, the St. Peters sandstone, and perhaps the Buff limestone. The other members of the section I think are thicker than the above measurements indicate. Nowhere could I find exposures where the full thickness could be determined. Commencing at the top, we will describe these formations in their descending order.

Surface Geology.

The usual "river bottoms" exist along the streams to a limited extent. This, together with the common prairie soil, a vegetable mold, covering most of the county, comprises the extent of the Allu-

vial deposits. The Drift formation is much more heavily developed. Over the southern and eastern portion of the county, and along the lower Rock river bluffs, it thins out to a considerable extent; but over the northern and northwestern parts of the county the true Drift, in the form of drift-hills and coarse gravel-beds, is very heavily deposited, reaching a thickness, as we have above indicated, of one hundred and twenty-five feet. Over the parts first mentioned fine-grained clay, sometimes marly and sometimes sandy, cover the nether rocks. These clays are almost uniformly of a light-yellowish color. Few gravel beds and little coarse gravel can be noticed in passing over them. Boulders are of rarer occurrence than in any other portion of this part of the State. It is not a driftless region, but the drift forces have acted peacefully here, and nothing but the finer sediments and precipitates of the water were here deposited or accumulated under the action of the chemical, atmospheric and aqueous agencies. But in the parts of the county last mentioned vast accumulations of coarse gravel, commingled with fine white sand, have been deposited, indicating that the drift forces and agencies acted here on a large scale. Around the head-waters of Leaf river these gravel hills are a marked feature in the landscape. About three miles and a half north of Forreston the Illinois Central railroad passes through a range of these hills. The company have there opened many gravel pits and quarries, and are constantly loading trains for the purpose of ballasting their road. The appear ance of that chain of hills is so remarkable that few travelers on the swiftly-flying passenger trains fail to notice and remark upon it. East of the track, a backbone of hills stretch away toward Adeline, broadening and widening in the distance, until they resemble great ocean waves fixed and solid. Our pocket-level showed that the highest hump on this backbone, measuring from the base, was about one hundred and three feet, while to the level of the water in the brooks, some distance off, the descent was probably twenty feet. The railroad track is cut through these gravel hills to the depth of about forty feet. For that depth the material is composed of gravel, from the size of pebbles to that of small boulders, mixed with a large quantity of white sand. The sand is almost as white as the St. Peters sandstone, except where stained yellow by the oxide of iron. The gravel is very much rounded and water-worn. The deposit has marks of partial stratification in a few places. At one place, close to the railroad track, a bed of gravel, almost free from sand, is cemented so strongly together by some calcareous substance that it has to be quarried like ordinary stone. It looks like a coarse

conglomerate, or pudding stone, and will resist, without breaking, a smart blow from a heavy hammer. Such is the internal structure of these gravel hills. On the surface they are covered with a thin soil, full of gravel and whitish boulders of small size, in which a spade could not be sunk. Toward the east the hills preserve their outlines for a distance of some eight miles before they sink down into the ordinary gravel beds, extending for a long distance across the northern part of the county. Toward the west they extend three or four miles before losing themselves in the general roll of the prairies. The direction of the main chain is exactly east and west; the western part, as indicated by a very good pocket compass, bears west southwest by east northeast.

A little brook runs toward the east on either side of the gravel hills, being, perhaps, a quarter to a half mile apart. About the middle of the range, the brook on the north side breaks through an abrupt gap, and joins its sister on the south, and together they seek Leaf river, skirting along the south side of the gravel beds. To the north and south of the small valleys, through which these little streams flow, the prairie gradually rises until it attains almost the elevation of the gravel hills themselves.

These hills resemble strongly the central moraines of a vast glacier, or where two glaciers meet and mingle in one; but they also give evidences of the shifting and assorting agencies of water. They are, doubtless, "moraine hillocks," such as are found in many parts of Northern Wisconsin. If the surface of the underlying Trenton rocks could be examined over a dozen miles in extent in this locality, they would, we think, in many places be found plowed, grooved and scratched, or planed smooth by the slow, silent force of the irresistible glacier or iceberg.

If the phenomena in this interesting locality indicate glacial action, and we think they most unmistakably do, it was probably combined with aqueous forces, and the two causes contributed to the results observed. We have sought for the manifestations of the glacial action in many places, while examining the drift through these counties; but while evidences of the floating iceberg and ice-floe, with their freight of boulders, of peaceful atmospheric and strong aqueous forces, are constant and recurring, this is the only locality where we could find phenomena that looked like the work of the glaciers.

I examined with care the materials of which these gravel beds are made up. Much of it is composed of metamorphic rocks, brought from the regions of Lake Superior. But a large portion, from one-

third to one-half perhaps, is derived from the Niagara, Galena, and such other limestones as are found in the Lead Basin. They are much rounded and water-worn, but are not transported from the great distances from whence came the granites, syenites, and other boulders and gravels. *Tentaculites*, from the Niagara; fragments of *Orthocera* and *Orthis*, from the Blue; *Pleurotomarias* and pieces of *Trilobite* shields, from the Galena, were noticed among these piles of gravel—imperfect as fossils, of course, but sure indications of the neighboring formations from which they were derived.

A mixed mass of gravel, like the one under consideration, would seem to indicate that forces from a distance and forces near at hand, operating in every conceivable direction, with great force and over long periods of time, all contributed to gather together these heaps of abraided materials, some from the distant regions of the granite and the traps, and some from the neighboring limestones of a by-gone geological age; but all equally worn smooth by the grinding of the waters and ice.

But, leaving this interesting accumulation, we still find evidence of the Drift gravels all over the northern part of the county; but the beds become comparatively thin, and are underlaid by the usual clays of this part of the State. The blue clay, belonging to the base of the Drift, we failed to detect through Ogle county. It doubtless exists if proper excavations were made, but the common light-colored yellowish clay is by far the most common.

Remains of the *Mastodon* have been found closely connected with this formation. In 1858, the tooth of one of these animals was found in a little tributary of Stillman's run. The locality is low—somewhat marshy. The stream has cut a channel through the black alluvium of the low prairie. The tooth was washed out and lodged against a clump of willows when found. It is a ponderous grinder, weighs seven and one-half pounds, is covered with a black shining enamel, and is a fine fossil in a high state of preservation. The fortunate finder carefully preserves it, and cannot be induced to part with his treasure.

Other Mastodon remains doubtless exist about the marshy springs of Stillman's run.

Some years ago a large bone, supposed to be from the fore-leg of one of these animals, was found two or three miles above Byron. The bank of Rock river had caved down for some distance back from the stream; some five feet below the surface of the highland coming up to the river, and perhaps fifteen feet above ordinary water-level, the bone was found sticking in the bank. The bank

seems to be a sort of a modified drift, made up of somewhat marly, dark-colored alluvial clay, intermixed with river sand and a considerable quantity of gravel. The formation is hardly alluvium, but seems to be a kind of a river drift. The fossil is light, porous, and whitish in color, in a rather poor state of preservation. We obtained it through the courtesy of Mr. Mix, and sent it to the State Geological Cabinet.

Among the mineral substances found in the Drift of this county, bits of lead and pieces of pure Lake Superior copper are occasionally met with.

The Cincinnati Group.

This formation is but lightly developed in Ogle county. No exposed outcrop, that we are aware of, exists at all. The high prairie, however, east and northeast of Polo, lying between Pine creek and the Illinois Central railroad, extending a few miles north towards Adeline, is underlaid by the shales of the Cincinnati group. At several recently dug wells, piles of these cream-colored and blue shales and clays attracted our attention. They are generally struck at a depth of fifteen or twenty feet, and soon crumble to pieces when exposed to the rains and frosts, and other atmospheric influences. The exact thickness of this group I am unable to state, but think it exceeds rather than falls below twenty-five feet. The area indicated is covered by the usual light-colored, finely comminuted clays, which nearly always rest upon the rocks of this group. It generally forms the subsoil of a good agricultural region, but sometimes it is inclined to be a little too sticky and wet. Ever-living wells of reasonably pure water are found without difficulty wherever the Cincinnati shales lie near the surface. In some cases, masses of sticks and decayed drift-wood lie between the shales and superimposed clays, separated from the former by only a few feet of marly, blackish clay. In such cases the water of the wells is neither sweet nor pure.

The Trenton Group.

The Galena Limestone.—Next in the descending series comes the upper division of the Trenton group, known generally in the books as the Galena limestone. It underlies a considerable portion of the county, emerging along the face of the ravines from beneath the concealing Drift, and even rising like mural walls along some of the streams. The line of demarkation between this and the nether Blue

limestone is not always easily distinguished. Layers, partaking of the characteristics of each of these divisions, are often found intermingled for some distance, although the characteristics of the mass of the two formations are very distinct. This peculiarity is not so marked in this county as in the eastern part of Stephenson.

The rock here usually preserves its usual coarse-grained porous nature towards the top of the quarries, changing into a denser subcrystalline mass towards the bottom of the formation. It preserves its usual dull, greyish, cream-colored, chrome-yellow tints. No outcrop of it appears along the banks of Rock river, unless it may be near the Winnebago county line. But as we go back from the river the older formations sink down and run under, and this becomes the prevailing surface rock.

It is an important member of the series of Illinois strata, both on account of its many economical uses, its historic interest, and the lead-bearing character of certain portions of its basin.

The superficial area underlaid by the Galena limestone in this county is quite large. South of Rock river the older formations come to the surface a few miles back from the stream, and outcrop along the ravines cut down into this belt of rough rolling country. But the Galena runs on almost as soon as the level prairie is struck; and all the eastern and southeastern townships are underlaid by it. and would show it, could the concealing drift clay be removed. The township of White Rock takes its name from a low outcrop of light-colored Galena about the headwaters of Stillman's run, near the center of the township. It is quarried to some extent, and hauled over the surrounding prairie. The stone is rather soft and crumbly, but is used extensively by the farmers for cellar walls, foundations and other similar uses. Kilbuck creek running north through the southeastern portion of the county, cuts into the same rock and even touches the Blue limestone, but no good outcrop is shown. About Payne's Point, in the township of Pine Rock, along a little timber ravine, stones are quarried whose conchoidal fracture and ash-color show beds of passage between the Galena and the Blue.

North of Rock river the same phenomenon is observed, only on a more extensive scale. The older formations sink as the distance from the stream increases, until the Galena runs on, forming surface rock where the river enters the county, but, before reaching Byron, it strikes these older formations. Leaf river and Pine creek cut deep into the surface deposits, and show outcrops of the St. Peters sandstone, the Buff and Blue limestones respectively for some distance after the Galena becomes the underlying rock of the sur-

rounding country; but even along the banks of these streams, the Galena outcrops long before their sources are reached. All round the headwaters of Leaf river the gravel beds rest directly upon the Galena limestone. The road from Polo to Mt. Morris crosses Pine creek about the middle of its course. At the crossing, Galena escarpments, crowned with the white pine and red cedar, overhang the creek as it washes their base. In going down stream the Blue Trenton is soon struck; but in going up stream, even to its very sources, massive time-worn outcrops of the real lead-bearing rocks add picturesqueness to the scenery. At the forks of Pine creek, a few miles northwest of the residence of Hon. D. J. Pinckney, there is an outcrop thirty-six feet thick, the upper half of which is quarried into. A lime-kiln is here in successful operation; and stone is quarried for common building purposes.

The western part of the county, between the Illinois Central railroad track and the county line, is principally underlaid by the limestone under consideration. Elkhorn creek, which just touches the county about Brookville, and Buffalo creek, a small stream west of Polo, both cut into the Blue limestone as the exceptions to the above statement. At the quarry one mile west of Polo, on the Mt. Carroll road, the Galena composes the top layers; the middle is beds of passage, and the bottom is the Trenton Blue. Following the creek down past the large Blue limestone quarries southwest of Polo, the Galena is again struck before the county line is reached, and at Sanfordsville, a short distance beyond the county line in Whiteside county, displays itself in a massive quarry, worked extensively in former days. The same rock prevails about Woosung.

At White Rock and at the forks of Pine creek a few characteristic fossils were to be seen; but the rock is not worked enough in this county to afford many fossils or good specimens. Where a Galena quarry is extensively worked for months at a time, and carefully examined during all its working, fossils worth gathering may be found; but a visit of a few hours to outcrops little worked at the time, cannot be very satisfactory so far as the acquisition of fossils is concerned.

The Blue Limestone.—This, the Blue limestone of the Western geologists, or the Trenton limestone of the New York survey, is, under present classification, the Blue or Middle Division of the Trenton proper. In a descending order it next succeeds the Magnesian beds of the Galena division. It is variable in appearance. The upper parts of its outcrops are thin-bedded, almost shaly, and of a

buff or lead-white color, often breaking into fragments when quarried. The lower layers are compact and thick enough to make a good building stone. They break with a glassy fracture; and some of the layers near the bottom are of a deep ultra-marine blue-color. This fine color fades a shade or two lighter when the stones have been quarried and exposed to the weather.

In the region of country underlaid by this rock, pit-holes, or sink-holes, are of frequent occurrence. These curious depressions in the face of the country are from one to three rods in diameter, and run to a point in a funnel-shape, at a depth of from six to fifteen or twenty feet. The rock also contains vertical crevices, through which subterranean streams of water often rush after heavy rains or springy thaws.

Along Buffalo creek, west of Polo, for three or four miles, there is an upheaval of the Blue limestone. The top of the first quarry, the one on the Mt. Carroll road, as already stated, is composed of Galena limestone, shading down into beds of passage into the underlying division; but the bottom is the genuine blue "glass-rock" of the Trenton. Two miles below this, on the creek, several other quarries are opened and heavily worked. They, and in fact all worked exposures of this rock examined in this county, show substantially the following section:

	Feet.
Chocolate-colored clays and subsoils, with fragments of rock and some gravel.....	5
Thin-bedded, buff-colored, fragmentary limestone, sometimes light lead-colored....	14
Heavy-bedded, blue, glassy layers, breaking with a cloudy, conchoidal fracture.....	6

These Polo quarries are worked to a depth of about twenty-five feet. The blue layers in the bottom are sometimes a foot thick. When lifted from their watery bed, they look as if dyed in blue ink. A large public school house is now building in Polo from stone obtained at this locality. The blue color is conspicuous, and the effect striking and beautiful.

This limestone also outcrops about Brookville and west of Forreston a short distance, where it is quarried on some of the small feeding streams of Elkhorn creek.

On the map of Ogle county I have marked, in colors, several long narrow strips on either side of Rock river. They extend diagonally nearly across the county, preserving the general course of the stream. The broad blue band represents the part of the county along the stream underlaid by the Blue limestone. All the small streams falling into Rock river from both sides, so far as I examined them, present the following succession of the rocks. At their mouths, especially from three miles above Oregon to Grand de Tour, the St.

Peters sandstone comes to the surface; a short distance up stream the Buff limestone outcrops along the banks and on the sides of the ravines; farther up, the limestone under consideration is met and continues to outcrop for two, three or four miles; then the Galena rises like a rocky wall along the waters' edge, and continues the surface rock until the headwaters of the streams are reached. Some of the hillsides show all three of these resting conformably upon each other, as in the ravines about Oregon, and along the lower part of Pine creek. Kite river and the next stream below it south of Rock river, Leaf river, Pine creek, and almost any of the small brooks, present the same succession of the rocks.

On Pine creek, from a mile below the crossing of the highway leading directly east of Polo, to about Sharp's mill, the upper thin-bedded layers of the limestone under consideration outcrops in rocky-faced abrupt bluffs, reaching a thickness of forty or fifty feet. The heavier blue layers of the Polo beds were not here observed. They resemble the outcrops of the same rocks above Dixon, except that fossils are rare, and the rocks have a dry, baked appearance. At Sharp's mill, the St. Peters sandstone and the Buff limestone begin to outcrop along the base of the hills. Above Byron the river hills are capped with the Blue, changing into the Buff towards their bases.

The Blue limestone at Dixon and many other places is full of fossils. Slabs of thin stones are there found covered so thickly with fragments of small trilobites, corals, stems of encrinites, and mollusca of various genera and species, that one cannot help wondering at the great abundance of the lower forms of animal life which swarmed in the ocean of the lower Silurian era. These thin fossiliferous strata are compact and solid, and when dressed and polished look like a beautiful variegated marble. Dr. Everett, of Dixon, has in his cabinet specimens of this polished marble, which will compare in beauty with any marble we ever saw. In Ogle county, however, we could nowhere find in the Blue limestone the same abundance of fossils. At Polo, a large chambered shell, known there as an *Ammonite*, but probably the *Lituites undatus* of Hall, is occasionally found; also an *Orthoceras*, which sometimes reached the great size of nine inches in diameter and eight or ten feet in length. But the thin fossiliferous layers, such as are found at Dixon, were not found. A heavier working of the outcrops along Pine creek might disclose them. A barrenness of good fossils seems to characterize all the formations in Ogle county.

The Buff Limestone.—The lower division of the Trenton, or the Buff limestone of OWEN, next succeeds in the descending order. It crops out in many places in close proximity to the St. Peters sandstone. In some places it is separated from the overlying division by a few feet of shale and blue clay; in others the transition from the one to the other is not easily distinguished In the former, it is thick-bedded, compact, and the heavy layers are divided by thin fossiliferous layers and thin blue bands of clay; in the latter it is shaly, shingly, yellowish-buff-colored, resembling much certain parts of the Blue division.

Dr. Everett's description of this rock corresponds with my own observations, so far as outcrops in close proximity to the St. Peters sandstone were examined. In the ravines above and opposite Oregon; at Sharp's mill, on Pine creek; at Moore's quarry, in Lee county; on Kite river, and in one or two other places, this is true. At Sharp's mill and near Oregon, the lower layers are of a dull earthy-color and fracture, with considerable sand in their composition, and, on being struck with the hammer, give a heavy dead sound or thud, as if striking a mass of frozen earth.

This description would hardly apply, however, to the outcrop at Byron. This corresponds exactly with WHITNEY's description of the Buff limestone outcrops at Winslow and Beloit; and these are exactly like many outcrops of the Blue division, except that the fossils do not seem to be identical.

Fossils.—At Moore's farm, in Lee county, many fossils were observed, mostly imperfect casts on the thin layers of shaly matter, separating the massive layers, and also on the surface of some of the massive layers. But in the Ogle county outcrops we could hardly detect a fossil, except at Byron. There we found a part of a large *Orthoceras*, six inches in diameter, perhaps. The animal to which it belonged must have been six or seven feet long.

The St. Peters Sandstone.

This very interesting formation outcrops heavily in this county. It is the prevailing rock along Rock river, from about two and one-half miles above Oregon to three miles below Grand De Tour, a distance of about fifteen and one half miles. Where the bluffs and high land come up to the river, this rock nowhere outcrops more than a mile or two back from the stream. Even the river bluffs, along the sandstone region, in places, are capped by the limestones of the upper Blue and Buff. But up the tributary streams low out-

crops may be noticed extending miles back from Rock river. Up Pine creek it may be traced as high as Sharp's mill, some five miles from the river. Up Kite river, for perhaps as great a distance, it shows itself along the base of the bluffs and hills, often just above the water's edge. Up the smaller streams it can be traced lesser distances. Many of these hills I have found capped with the Blue limestone lying upon the sandstone unconformably; many others exhibit the Buff and Blue lying upon each other conformably; some are capped by the Buff alone; some are nothing but hills of sandstone, uncapped by even the overlying drift, weathered into shapes resembling the pictured icebergs of the Arctic seas. The high bluffs, at the base of which the town of Oregon stands, with the exception of a light limestone cap on the top, are composed of light-colored St. Peters sandstone. At this locality it is about one hundred feet thick. It rapidly dips for two miles and a half up the river, and finally runs out of sight, the last outcrop observed being half a mile up a little stream, and about twelve feet thick. As we go down the river, the thickness increases. About four miles below Oregon, at the fantastic shaped "Indian pulpit," the sandstone peaks rise higher than at Oregon, and before the mouth of Pine creek is reached, the elevations measure from one hundred and seventy-five to two hundred feet. After reaching the mouth of Pine creek, the formation dips rapidly, and soon runs under the overlying formations.

Two or three miles above Oregon, on the other side of Rock river, the bluffs rise in a long line along the stream to a height of, perhaps, one hundred feet. The debris and talus of these hills present an abrupt, grass-covered slope to within twenty feet of the top. The rest of the height is a long, low, beetling mural escarpment of frowning Buff and Blue limestone. The talus covers the St. Peters sandstone, which doubtless forms the base of the hills. Opposite Oregon, in a low hill, a sandstone quarry and a Buff limestone quarry exist within a few rods of each other.

Peculiarities noticed while examining this interesting sandstone suggest a few observations.

In many instances hard metallic-looking layers, or bands, like the red carnelian bands in the trappean rocks of Lake Superior in their modes of occurrence, are found running in somewhat parallel planes through the softer material of which this sand-rock is composed. These are from one-half an inch to two inches in thickness, and are often within a few inches of each other. As the softer material crumbles away these remain projecting, giving the rocky face of the outcrop a pictured or horizontally veined appearance. The frost

breaks these off, and they accumulate in the ravines. They give a hard and ringing sound when struck with the hammer, and almost resemble pieces of old castings in both color and hardness. These layers are ferruginous in texture, and were formed by the oxide of iron cementing together and hardening thin layers of the sandstone while in course of being deposited. At a little ravine between Oregon and Mt. Morris they lay in piles, as if an old pot foundry had once existed there. At the crossing of a small stream between Dixon and Daysville, where an old mill-dam had once been built, and a low outcrop of red St. Peters sandstone may be noticed at the right of the crossing, they lay over the hillside and in the road in great abundance. On many of them, ripple-marks, as perfect as when made in the soft sand of the old Silurian beach, still exist. They are the eddies and ripples of the Silurian seas turned to fossils, and preserved in the embrace of iron and sand.

Again, these sandstone hills resist atmospheric agencies in a wonderful degree, considering the soft and friable nature of their composition. Oftentimes, where they are most abrupt, one can pick holes in their perpendicular sides with his knife, or strike his pick into the solid-looking mass. One would expect that such masses would crumble to pieces and sink into low white sandbanks, but such is not the case. They preserve their forms as well as the limestones, and have quite as little debris and talus piled about their bases.

The color of this sandstone is of all shades, from the whiteness of crushed sugar to chrome yellow, and the many tints of brown and red. The color is a stain produced by the oxide of iron held in solution in the waters, which have at various times percolated through the sandstone mass. Where this dye was absent in the percolating water, a sandstone as white as granulated snow was the result; as the dye was present in the water, in that proportion are the sandstones colored and stained.

In consistence this sandstone is saccharoidal, or sugary, and much of it is held together by the slightest cohesive attraction. In many places, especially where the sandstone was very white, I found difficulty in obtaining cabinet specimens. Every blow of the hammer would shiver the block to pieces. But this is not always true. I saw houses built from this material which seemed to be hardening into a fair building stone; and Dr. Everett gives an account of an arched railroad bridge built over Franklin creek, in Lee county, from the same sandstone. In a few places it seems to have become hard and crystalline; in a few more it has cohesion enough to make

an indifferent building stone; but its general character is soft, friable and uncohesive.

Under a strong microscope the grains of the white variety appear limpid and semi-translucent, those of the darker varieties as if coated over by rust. All the grains are round, similarly formed, and similar in size. The grains are quite small, and the mass is remarkably pure and homogeneous in character. These incoherent, crystalline grains of transparent quartz owe their darker colors, where colored, to a solution of the coloring matter held in chemical combination; but in most cases the color is caused by a formation over the surface of the siliceous grains of sand.

Distinct stratification exists in most of the outcrops, and even lines of cross stratification are not rare. WHITNEY failed to notice wave marks in the Wisconsin outcrops; but there can be no mistake as to the wave and ripple marks on the ferruginous layers of the Rock river outcrops. Some of the large masses present abrupt and strong dips; but these are owing to local causes. No trace of organic life, either plant or animal, has yet been observed in these sandstones. The era of their deposition seems to have been a peculiar one. Great changes must have taken place as it was ushered in and as it went out.

A high axis of elevation runs along this heavy deposit. In either direction from the river it dips away rapidly, and the overlying deposits come on in quick succession. Rock river runs along this anticlinal axis, having cut down almost or entirely through the formation.

The heaviest outcrop of the deposit now under consideration, in the whole area over which it is known, is the one along Rock river in Ogle county. The formation is thin and wide-extended, embracing a superficial extent in the northwest alone of more than four hundred miles in length by over a hundred in width. At Starved Rock, on the Illinois river, it is about one hundred and fifty feet thick. In Calhoun county it outcrops in the Cap-au-Gres Bluffs to a thickness of perhaps eighty feet. In Wisconsin and Minnesota its heaviest outcrops do not much exceed one hundred feet in thickness. In Ogle county, however, we think it reaches fully two hundred feet, and at the artesian well in Stephenson county it is perhaps considerably thicker. It is the identical same rock known in the Missouri Reports as the Saccharoidal sandstone, so extensively used in the manufacture of glass at Pittsburg. As observed in Missouri, however, it is oftener of a light buff or brown color, and has less of

the white, pure siliceous sand in its composition than the same rock has in Illinois and further north.

Geologists seem to be greatly in the dark as to the origin of this curious, interesting formation.

The Lower Magnesian Limestone.

The lower Magnesian limestone, or Calciferous sandstone of the New York geologists, or its Western equivalent, comes, I think, to the surface at several places in the bed of Rock river, between Oregon and Grand DeTour. The floor of the river in many places along these high sandstone bluffs, I am quite sure, is a harder, solider, and altogether different rock. When doing field-work in that part of the ground gone over by me, I had poor facilities for examining the river bed; but at one locality on the north bank of the stream, five or six miles below Oregon, and just at the edge of rather low water, I found a stratum of stone, apparently *in situ*, which I believe to be the top of this formation. I confess, however, that my judgment as to the existence of the lower Magnesian limestone along the river-bed in this county is formed, at least partly, from analogy, appearances, and the natural belief that the bottom of the St. Peters sandstone is here reached. A proper examination of the river-bed, or some shallow borings along its shores, would satisfactorily test the matter, and settle any existing doubt.

Economical and Agricultural Geology.

Most of my remarks upon the economical and agricultural geology of counties north of this one would apply with equal correctness to Ogle. In physical features, geological formations, and agricultural capabilities, they have much in common. There are some points of difference, however.

Stone for Economical Uses.—All the limestones afford a good building stone. The seminary building at Mt. Morris, and the new public school at Polo, are fine examples of the building materials furnished by the Blue limestone quarries. The rock is not only strong, easily worked, convenient to obtain, but when properly laid up of blue, or mingled buff and blue colors, the architectural effect is beautiful. The thin-bedded top layers furnish a good stone for the lighter industrial uses. The heavy-bedded, dull-colored buff is more used for the heavier kinds of masonry. The Galena in this county is a rough, thick-bedded stone, used in cellar walls, bridge foundations, and the common stone work necessary on the farms about its out-

crops. In a few places the St. Peters sandstone has crystalline layers of sufficient tenacity to cut into window and door caps, build into cellar walls and dwelling houses; and in one instance, at least, is used for the culverts in a small railroad bridge. It is easily hewn into shape, and seasons into great hardness and tenacity.

Certain layers of the Blue limestone also burn an excellent common lime. The kilns above Dixon, in Lee county, turn out an abundance of as good lime for ordinary building purposes as need be desired. The sub-crystalline layers of the Galena are well adapted for lime production, and are much used for that purpose. On Pine creek, timber is abundant; stone from both these divisions is easily obtained, and of good quality; and lime can be made in any desired quantity.

It is generally believed that some layers of the Buff might be burned into a good hydraulic lime; but this is not known by the test of experiment.

Peat.—On the Kilbuck creek, on section 30, in the township of Monroe, there is a long, narrow, irregularly shaped peat bed, containing about fifty acres. In the deepest parts the deposit is, perhaps, twelve feet thick. The peat is the result of the decay of the usual grasses, sedges and mosses, but is rather grass-peat than moss-peat. Compared with the Cattail beds of Whiteside county, it is more porous, fibrous and unripe. It is available already as a fertilizer, and like the rest of our small, prairie, unripe beds, will some day be used largely for that purpose. Its value, as a fuel, depends upon the success of the peat experiments now being tried in many places. For a fuller discussion of Northern Illinois peat, its eccnomical uses, its value, and its future prospects, I refer the reader to the report upon the economical geology of Whiteside county.

Clays and Sands.—Banks of common yellow sand, suitable for mortar making and plastering, may be found almost anywhere in the banks and sand-bars of Rock river. The subsoil clays under the thin oak soils, and in fact most of the sandy subsoil, may be molded into a good article of common red brick.

According to all our Western geologists, the white rocks of the St. Peters sandstone furnish the very best material for the manufacture of glassware. The Pittsburg glass manufactories obtain tons of their sand from the saccharoidal deposits of Missouri, a rock identical with our St. Peters sandstone. Our sandstone, however, is white, pure, limpid, and free from foreign matter; theirs consist more of the yellow and brown-stained varieties. The sugary, white

sandstone of the upper Mississippi is a pure silica. If the statements of the learned Dr. OWEN are true, only about two-tenths of one per cent. of extraneous matter, as shown by chemical analysis, enters into the composition of the snow-white sands of this formation.

Thousands of tons of the sand could be cheaply transported down the river to the Rock Island coal fields; or, when the contemplated railroad up the Rock River valley is completed, for the purpose of connecting the lumber regions of the north with the prairies of Iowa and the coal fields of Illinois, the coal could be easily run up from Rock Island to the Oregon or Grand DeTour sand cliffs, and glassware for the whole Northwest be cheaply and successfully manufactured. These facilities for moving the coal and sand together will exist at no distant day. It will then remain for capital to invest in this remunerative branch of manufacturing industry.

Soils and their Products.—The dark-colored loams are underlaid by a light-colored, clayey or gravelly subsoil. The loam is largely composed of vegetable elements. If not made up of, it is at least greatly enriched by the successive growth and decay, for ages, of our common prairie grasses. This is the soil of our prairies. The timber soils are the usual clayey deposits of the oak ridges, underlaid by a close, compact, yellow subsoil. Hungry, sandy soils are seldom met with. Leachy, loamy, fat soils, well adapted for the best farming lands, cover most of the county. The soils in this portion of the State are composed of silica, or the earth of flints; alumina, or fine impalpable clays; carbonate of lime, or calcareous materials, making marly soils; and various other materials, such as the oxide of iron, organic matter and the like. The two first are the basis of all our soils. The last gives them fertility. No soil is composed of a single one of these elements; but the mixture or chemical combination of all these, and sometimes many other elements, exist in the same soil, making clay soils, clay loams, loamy soils, sandy soils, vegetable molds, marly clays or sands, and many other kinds of soils, well known to agricultural chemistry.

I think the general proposition is true, that where large tracts of country are underlaid by the same or closely related geological formations, the soils will have some resemblance to those formations. They are undoubtedly, in part, derived from them; and in many cases in this part of the State, as I have already intimated, the soils and subsoils seem to show their origin from these subjacent rocks. But this remark must be received with considerable allowance. The transporting, sorting, and sifting agency of water, the

ice action of glaciers and icebergs, and the evidences that other geological forces have been at work all over this region, leads us to greatly modify the statement just made, and to believe that our soils are, in part at least, derived from many sources—some of them remote from their present localities. The same is true, I think, of the subsoils, and finer materials of the drift. These, originally perhaps, were all alike; but chemical and atmospheric agencies and the growth of vegetation changed the surface clays into rich fat soils; the subsoils received less of these influences, but still felt them, and were further changed by the percolating, saturating surface waters; but the deep lying clay and sandbeds received no change from these agencies. Even the acids of the air could not penetrate to them, and they remain unchanged.

Ogle county shows more evidences of a transported soil than western Stephenson or Carroll county.

Geology, engaged in investigating these phenomena, is thus the handmaiden of agriculture, and ought to be encouraged and studied by the farmer. He should not be slow to learn that all branches of human knowledge are bound together like the links of a chain; all the arts of life sustain to each other dependent relations, and all cultivators of soil or science ought to be bound together by the bonds of a common interest.

But, however derived or made up, the soils of this county are generous and fertile in a high degree. Indian corn, wheat, oats, hay, potatoes, barley, rye, the products of the kitchen garden, the hardier fruits of garden and orchard, are here raised in bountiful profusion. Vine culture has not yet attracted much attention, not for the want of suitable localities in which to try the experiment, but simply because attention has not yet been directed to this branch of horticultural industry.

In speaking of these noble soils—the Edens of agriculture in these Western States—I may as well make some remarks here, which apply with equal force to the agricultural policy of this and all the neighboring counties, and to the practices of prairie farming generally. I mean the unscientific, slovenly, and wasteful modes of cultivating the virgin soils of our broad prairies. The unripe peat and muck remain undisturbed in their beds; trenching and subsoil plowing are never resorted to; annual fires consume the surplus stubble and stalks left from the last year's crop; ashes, bones, lime, the barn-yard and stable manures, if disturbed at all, are raked into some convenient out of the way place; and the farmer generally cultivates so much that he cannot half cultivate anything at all.

Geology and chemistry, and the experience of older countries, all cry out against this wrong done to our generous soils. In the first place, the farmer ought to study his soil, ascertain what element is wanting or what it has in excess, and intelligently supply the one or counteract the other. Instead of scratching over a large amount of soil, if he would go deeper and throw up a little subsoil, the kiss of the roving winds, the rain and the sunshine would enrich these, and his soil would grow deeper instead of becoming hungry and exhausted. Composts should yearly be made of every available substance, and scattered with a profuse hand over his meadows and grain-producing fields. Perhaps some water-soaked bog and some unproductive ridge, lying side by side, and both worthless, have in them the complements of the best producing soils, and only need a little mingling to make them the most valuable tracts in the field or on the farm. A little mind employed in cultivating the earth is better than much manual labor, aided though it be with all forms of labor-saving machinery.

Against this wasteful system of farming every industrial interest should cry out. Our soils, when new, used to return average crops of forty bushels to the acre; now fifteen is a good crop on the older cultivated lands. In the corn field, seventy, eighty, and one hundred bushels to the acre was not an unusual yield; now thirty-five or forty is oftener the exception than the rule. At this rate our land will rapidly become exhausted. Good husbandry, good farming, if not able to keep the soil up to its primitive fertility, ought, at least, to prevent its rapid deterioration.

CHAPTER VIII.

LEE COUNTY.

Lee county is bounded on the north by Ogle, on the east by DeKalb, on the south by LaSalle and Bureau, and on the west by Whiteside. It is a large county. Its longest extent from west to east is thirty-six miles, and from south to north is twenty-two miles. It contains eighteen full townships of land, and a little over four half townships, embracing in all about seven hundred and twenty-eight sections of square miles.

The face of the country is diversified, and is made up of rough, hilly land, broad and level prairies, and extensive swamps and marshes. The Winnebago swamps, in the southwest corner, and the Inlet swamps east of the center of the county, are peculiar features in its topography, and will receive a farther notice in a subsequent part of this report. The northwestern part of the county, where Rock river cuts across the corner, is rough, hilly and in places picturesque, especially in the vicinity of that stream. The hills and ravines in this locality are partially covered with dense underbrush and scattering timber. The rest of the county, with the exception of an occasional grove, is a broad, level, fertile prairie, inclining in some places to be rather low and wet. Such is the character of the prairie land in places in the eastern part of the county, and also along its western and southwestern borders. The agricultural resources and grain-producing capabilities are very great, owing to the large amount of excellent farm land in the county, while the wet lands afford good grazing, pasture and meadow farms, and make stock-raising a very successful and remunerative business.

Timber is scarce. Sugar Grove, Lee Center Grove, Melugin's Grove, Pawpaw Grove and a few smaller groves, and the scattering bodies of timber along Rock river, afford about the only supply. The oaks,

walnuts, sugar-maple, linden or basswood, and hickory, are the prevailing kinds of timber, although almost every kind in the catalogues for Northern Illinois may be found in the groves. Rock river and the railroads make the pine lumber of the north of easy access to the people of this county, and they do not feel this want of timber as do some of the neighboring counties. Hedges are also grown to considerable extent, and dispense with much fencing lumber. The osage orange here makes an excellent fence when properly planted and taken care of. The history of this plant is peculiar. Many years ago it was extensively introduced in Northern Illinois. Miles of it were planted in hedges. There was great faith that it would prove an excellent fencing material, but the hedges were poorly planted and suffered to take care of themselves. As a natural consequence, poor cultivation and several hard winters caused the hedges to fail as fences. For several years the osage orange attracted little attention as a fencing material; but in the course of time, a few hedges that had been properly cultivated grew into beautiful and successful fences, and public attention was again turned to the osage orange. Miles of excellent fence may now be seen in these northern counties, and hundreds of miles are planted every spring. Instead of the few rows of straggling, ragged, unevenly-grown bushes which used to deform the landscape, long lines of well-grown, compact, green, shining walls of the hedge plants may now be seen, which would defy a buffalo to break through them.

Hedge-growing and timber-growing are not geological questions, but they are great material interests, which are now attracting much attention.

Rock and Green Rivers, and the upper portion of Big Bureau creek, are the only streams of consequence in the county. All these flow in the same general direction, and almost parallel to each other. The general course of these streams is from northeast to southwest. Rock river strikes the county at Grand DeTour, about twelve miles east of the northwestern corner of the same, and cuts off about two townships from the northwest corner. From Grand DeTour to Dixon the bluffs approach closely to the river—are bold, rocky and precipitous, cut up with ravines, and show excellent outcrops of the several formation of Silurian rocks. Below Dixon the bluffs gradually recede and grow lower, and finally swell away into undulating prairies of great beauty and fertility.

Green river is not a river, or even a stream, for a portion of its course across the county. It takes its rise in the swampy land in the eastern part of the county, and in the Inlet swamps between

the eastern and central parts of the county. The surplus waters of this Inlet swamp, two or three miles southeast of Lee Center, are gathered into the first well-defined stream or current of Green river. For ten or twelve miles the stream flows southwestward, and again becomes lost in the interminable Winnebago swamps, in the southwest part of the county. Along its whole course there are no bold bluffs, no distinctive river valley, and no outcropping rocky formations, except about Lee Center, where some low outcrops of the Galena limestone are quarried.

Big Bureau creek, in the southeastern part of the county, is a prairie brook, with no marked peculiarities.

Several small creeks and brooks, such as Sugar creek, in the township of Palmyra, and Franklin creek, east of Dixon, are worthy of notice. The latter is one of the most interesting little streams in the county. It exhibits in its short course a fine section of the geological formations in this part of the county.

Geological Formations.

These are varied and interesting. Below the superficial deposits, we commence with the Niagara limestone, and go all the way down to the St. Peters sandstone. A section of the geological formations of the county, in the order of their sequence, would be represented by about the following figures:

	Feet.
1. Drift deposits	10 to 75
2. Niagara limestone	?
3. Cincinnati group	30?
4. Galena limestone	25 to 70
5. Blue, or Old Trenton	20 to 75
6. Buff limestone	18
7. St. Peters sandstone	150

Reversing this order, I propose to commence at the bottom, and describe these formations in the ascending order.

The St. Peters Sandstone.—This very interesting rock underlies a very considerable portion of the county, and outcrops heavily on Rock river and Franklin creek. The heaviest outcrop in the county is opposite Grand DeTour, just across the river. The base of the bluff, for thirty or forty feet upwards, shows this rock. Here it has a solid, unstratified look, and rusty-brown color. On the Ogle county side of the river the sandstone is whiter, and the outcrop is over one hundred feet in thickness. For two or three miles the bluffs are mostly composed of this material. Just below the mouth of Pine creek the formation on Rock river sinks rapidly out of sight, and is succeeded by the Trenton limestones. On the Lee

county side of the river the sandstone soon disappears, after leaving the outcrop opposite Grand DeTour. Between the latter place and Dixon fine outcrops of Trenton limestone occur. The St. Peters sandstone on Rock river, as will be seen by a reference to my report upon the goology of Ogle county, is chiefly developed in the latter county. For a distance of about fourteen miles, commencing about two miles above Oregon city and terminating a short distance below the mouth of Pine creek, it is a very marked feature of the Rock river bluffs. The outcrop extends back but a short distance from the bluffs. In some of the ravines and intersecting streams it can be traced for one, two or three miles. On the east, north and west of these sandstone bluffs the formation terminates abruptly, sinks out of sight rapidly, and seems like an abrupt, anti-clinal axis pushed boldly up into the air. On these sides the overlying formations are piled as it were against the sides of this sandstone uplift. But on the south side it sinks away more gradually, and doubtless is the underlying rock for most of the distance in a southeast direction to the great upheaval at Deer Park and Starved Rock, on the Illinois river. A line drawn from the mouth of Franklin creek up that stream, thence on a southeast course to the southeast corner of Lee county, and thence to the Illinois river through LaSalle county, for most or all of that distance, would pass over this deposit, lying almost or immediately under the Drift deposits. A line from Oregon City to the same point, or lines from intermediate points on Rock river to the same point, would pass over formations almost identical. From the uplift on Rock river to that on the Illinois river, there is probably a low axis of elevation somewhere in the section of country bounded by the above imaginary lines. I have no doubt but that a broad strip of Lee county, extending from Grand DeTour to the northwest corner of LaSalle county, is underlaid by the St. Peters sandstone. About Franklin, and even south of that, this strip may be covered with fragmentary patches and fields of overlying Silurian formations; but artesian wells for all this distance would soon strike the St. Peters sandstone, after passing through the overlying drift.

The next visible outcrops of this formation in Lee county may be seen on Franklin creek. Several of these may be noticed, commencing about two miles below the village of Franklin, and showing themselves in the base of the creek bluffs all the way down to Rock river. The outcrops are low, and are sometimes capped by Buff and Trenton limestones.

These are the natural outcrops of the St. Peters sandstone in Lee county. Along the northern line of the county, and east of Franklin creek for a few miles, other low-lying outcrops may exist. If so, I did not notice them, and they possess no peculiar interest.

This sandstone has often been described. Its varying shades of color, from white to dirty brown, rusty, and almost flame-red, are well known to all observers in its vicinity. Its want of cohesion, saccharoid, almost crumbling appearance, would seem to indicate that atmospheric and chemical agencies, such as the rain, the winds, the frost, and the tooth of time, would speedily level its piled-up sands and strew them far and wide; but this is contradicted by its remarkable property to weather into sugar-loaf shaped hills, ragged pinnacles, and gracefully rounded bluffs, able to preserve their form and shape through the rolling years.

Where unstained by the oxide of iron, the grains of which it is made up are round and limpid in color, and are a pure quartz. The mystery of its deposition does not seem to be well understood. No fossils, no lines of stratification, have written on it and in it the story of its creation. Horizontal bands or layers, thin and dark iron-colored, weather out on some of the outcrops, and give the same a pictured appearance, at a little distance. On the point of one hill a pile of these fragments lay, detached from the outcrop, resembling a pile of old, broken, iron pots. On some of these ferruginous fragments I noticed the ripple marks spoken of by Dr. Everett, of Dixon, in his description of this rock. These ripple and eddy marks sometimes resemble the forms of organic life in a remarkable degree.

Its uses will be spoken of under the head of the Economical Geology of the county. Ascending the scale, we next come to the lower division of the Trenton.

The Buff Limestone.—Where *in situ* and fully developed, this limestone is separated from the St. Peters sandstone by two or three feet of thin shales, intermingled with a blue and greenish laminated clay. This is especially observable in one or two of the Pine creek outcrops in Ogle county. The best outcrop perhaps in Lee county is in a ravine two or three miles east of Dixon, near the Oregon road. The outcrop is about half way down a hill sloping to the south. In the bottom of the ravine some large detached masses of the St. Peters sandstone are laying in the bed of the little trickling stream. The top of this formation is probably just below them. The buff outcrop above and in the hill-side, formerly quarried largely,

shows a compact, heavy-bedded, crystalline or semi-crystalline limestone. The massive layers are about a foot in thickness, and separated by thin fossiliferous shales and loose clay. These layers belong to the upper part of the division. The lower part, as examined *in situ* in Ogle county, is of a dull color, and gives out a dull earthy sound on being struck with the hammer, while these layers ring out a sharper and more metallic sound. Up Franklin creek in one or two places I detected the Buff limestone above and in close proximity to the underlying sandstone. These are all the outcrops noticed in the county. This Buff limestone underlies but a limited area, and that in close proximity to the sandstone outcrops. The base of the bluffs, from the Blue limestone quarries above Dixon to the sandstone bluff opposite Grand De Tour, contain good sections of this rock; but the outcrops are deeply covered by the talus along the bluff line.

The Blue Limestone, or Trenton proper.—This is very heavily developed, both on Rock river and Franklin creek. About three miles and a half above Dixon, high, perpendicular outcrops begin to appear along the bluffs on the south side of the river; and from thence almost to the city limits of that city the bluffs are mostly composed of this rock. Extensive quarries and lime-kilns are seen at many places in this distance. The greatest thickness developed along these quarries is from sixty to seventy-five feet. The small ravines leading down through the hill, show this rock in their channels, sometimes, for several miles. In these localities it resembles the white Hamilton limestone about Rock Island. North of Rock river its area is more circumscribed. Following up Franklin creek this rock soon shows itself in the hill-side, even before the St. Peters sandstone has disappeared below the surface. In one instance a detached sort of a tower rock stands in the valley of the small stream, entirely disconnected with the hills on either side. All the way up the rocky exposures may be seen. Near the village of Franklin, where the Dixon air line division of the Northwestern railroad crosses that stream, a series of large quarries, extensively worked in past years, line both sides of the creek banks for a considerable distance. A large hotel and other buildings in the village were constructed with the material taken from these quarries. Franklin grove, a fair size body of timber, is underlaid by these beds, which outcrop in the creek. A section of Franklin creek would show the overlying Drift clays of varied thickness; about forty feet of this Blue limestone; and about twenty-five feet of the St. Peters sandstone. These localities, and a few others in this part of the county,

are the only places in the county where natural outcrops of the Blue or lower Trenton may be seen. In the south and southwestern part of the county this rock may exist to a limited extent, but there are no natural outcrops, and it is hard to tell what formations lay under these level prairies.

Where best developed in Lee county, the Trenton limestone at the top of the quarries is thin-bedded, broken up, and of a light-buff color. Towards the bottom the layers become heavier, intersected occasionally with upright clay seams; and in the bottom several massive layers of blue stone are found. On fresh fractures the color is a dark-blue; but it soon weathers to a bright sky-blue.

Some of the layers are full of fossils, the remains of organic life. When highly polished, these make a handsome marble, covered with the delicate tracings of the embedded fossils and casts.

In many instances I noticed the "pot-holes" spoken of by Dr. Everett, over the high surface of the country underlaid by this rock. They are a characteristic feature in the face of the country east of Dixon, and excite the curiosity of the most superficial observer.

The Galena Limestone.—I prefer to retain this name in speaking of this member of the Trenton limestone. Descending Rock river from the locality of the Blue limestone quarries above Dixon, the Galena limestone is first noticed on the south side of the river, in the fine outcrop just above the Dixon mills. The rock has been quarried here, making room for buildings and to obtain building material, until it presents a perpendicular wall of stone, perhaps forty feet high. The top of this outcrop is real Galena limestone; the middle has somewhat changed in character; the bottom presents real beds of transition into the underlaying blue beds of the Trenton proper.

At Dement's quarry, one mile below this place, and on the north side of the river, and also in a hill at the north end of the Illinois Central railroad iron bridge, bold outcrops of massive, heavy-bedded, cream-colored and yellow Galena limestone are largely worked. Thence down the river on the north side for about six miles, to Lawrence's quarry, almost every hill shows a Galena outcrop. Dement's quarry, and a bold stone bluff, projecting over the edge of the river current, about three miles below Dixon, each expose a thickness of nearly seventy-five feet of solid stone escarpment. In this distance there is one heavy exposure in the south bank of the river. At Lawrence's quarry the rock presents a sort of a metamorphic appearance; and some of the layers are covered with a white incrustation of carbonate of lime, resembling the frosting on a

cake. From this last outcrop the banks of the river run low, and show no more rocks until the west line of the county is passed.

South of Rock river, along these Galena outcrops, the country spreads away in a dead level towards the Winnebago swamps. No rocky outcrops are seen, between this section of the river and the south line of the county; but this long parallellogram is probably underlaid by deep-laying Galena limestone, and patches of Cincinnati shales, which are shingled over it along the west line of the county.

North of Rock river the country rolls away in undulating prairie and sparsely wooded stretches, and is all, with the exception, perhaps, of a small corner below the mouth of Pine creek, underlaid by the Galena limestone. The physical features of the country show this at a glance. The Illinois Central railroad, in winding out of the low Rock river bluffs towards Woosung, makes several long but not deep cuts in the Galena limestone. Several wells in the township of Palmyra disclose it at their bottoms. Along the banks of a little prairie stream northwest of Sugar Grove, at a locality called the Big Springs, two or three excellent quarries are opened and extensively worked to supply the surrounding farms with building stone.

The outcrops of this formation south of Rock river are not numerous, but still a considerable area is underlaid by it. Commencing at Mount Carroll, in Carroll county, a low, anticlinal axis of the Galena limestone may be traced southeast through Milledgeville and Wilson's Mill to Rock river, just west of Dixon; thence on the same general course to Lee Center; thence bending south and west towards and near Sublette, and on to Lamoille in Bureau county. At Lee Center, in a grove of timber southeast of the village, there is a good exposure, where abundance of fine building stone is quarried. The stone is somewhat thin-bedded here. At Sublette, or its vicinity, there is another quarried exposure, and in northeastern Bureau county, if I mistake not, some low outcrops exist. The Galena limestone also comes in from Ogle county in the northeast corner of Lee, and underlies two or three townships there, extending down perhaps to the head waters of Spring creek and the Inlet marshes. It is almost impossible to trace or bound the underlying rocky formations in the level prairies of central and southern Lee county; but I feel quite sure the Galena limestone extends back for a considerable distance on either side of the anticlinal axis above referred to, and so continues until it runs under the coal fields of Bureau county, or thins out and disappears from among the underlying rocks.

An extended lithological description of this rock is hardly necessary in this place. It has been many times described in the reports of our Western geologists, and also in my reports upon Carroll, Stephenson and other counties in the northwestern part of the State. As developed in Lee county it is more massive and solid than in some localities further north, belonging as it does to the lower part of the formation. It has that rich, warm, cream-color so characteristic of this stone.

The many economical uses to which this rock is put: its great thickness and local development, being only found in the lead basin of the Northwest; the rich stores of galena contained in its crevices and resulting clays, and the geological questions and phenomena suggested by an examination into its deposition and the origin of its metallic wealth, will always make it a very interesting member in the series of Illinois rocks. Neither is it devoid of organic remains, as will be seen when I come to notice the fossils characteristic of these Lee county formations. The casts of fossils therein entombed are of more than usual interest.

The Cincinnati Group.—No regular outcrops of this formation, I think, exist in the county. I have intimated, in speaking of the Galena limestone, that nearly all that part of the county north and west of Rock river is underlaid by that formation. This is not fully correct. Linn Grove, near Rock river, and almost on the western line of the county, and a small strip of land surrounding it, has a thin deposit of the peculiar shales and clays of this group underlying the superficial deposits and overlying the Galena rocks. The materials excavated from wells in that vicinity show this.

In one other locality north of Rock river I suspect the existence of this formation. The base of "The Mounds," about two miles north and a little west of the west end of Sugar Grove, is composed, I think, of the shales and clays of this formation. There are no outcrops around these elevated and beautifully rounded hills. The gentle slopes leading up to their summits cover such outcrops with a talus, which has slowly accumulated around their bases.

South of Rock river a narrow strip of the Cincinnati group comes into the county a few miles south of its northeast corner, but soon thins out and disappears over the underlying Galena. In the western part of the county, about and running south of the station of Nelson, on the railroad, fragmentary patches and a limited extent of that part of the county is likewise underlaid by the Cincinnati group.

The local extent of this formation being small, and there being no outcrops to attract attention, I do not deem it necessary to dwell further upon it.

These are all the formations developed upon Rock river in this county. In reviewing what I have said about them, it will be very evident that the geological position of Dixon, and the rocks developed in the short distance between Grand De Tour and the west line of the county, are of quite an interesting character. Geologists always spend the time occupied in their examination with interest and pleasure.

The Niagara Limestone.—"The Mounds," referred to above in speaking of the Cincinnati group, are capped, I think, with a light-bedded, broken-up Niagara limestone. The outcrop, however, rather suggests than shows this formation. All this portion of the country once undoubtedly was covered by the Niagara limestone underlaid by the Cincinnati shales and rocks. But these have been removed by denudation, leaving these mounds as conspicuous landmarks, standing upon the underlying, level Galena limestone.

This is the only Niagara outcrop, such as it is, that I detected in the county. I suspect that a considerable area in the eastern part of the county is underlaid by this formation. A strip six or eight miles wide comes in from De Kalb county, about the middle of the eastern end, and extends westward nearly to the low land of the Inlet swamp, where it thins out and disappears. The only evidence of this is the existence of Niagara rocks in De Kalb county, in such a position as to favor this supposition. The general topography of the face of the country also makes this look probable.

The formation is not of sufficient importance in Lee county, either on account of its economical uses, its extent, or its geological interest, to call for a more extended description.

Fossil Remains.—Three of the above formations—the Buff, the Trenton, or Blue, and the Galena—are characterized by an abundance of fossil remains, in a very fine state of preservation.

The characteristic fossils of the Galena limestone is the *Receptaculites Oweni*, or old *Coscinopora sulcata*, of the earlier geologists. In the common speech of the people it is known by various names, such as "lead fossil," "honey-comb," and "sunflower coral." A good specimen, with its central depression and folding-over edges, resembles the latter flower very much. In addition to this, of which good specimens have been found around Dixon, other casts of characteristic fossils are numerous, such as *Lingula quadrata; Murchisonia bellacincta; M. gracilis;* fragments of *Orthoceras; Ambonychia inter-*

media; Receptaculites globularis, rare; *Chætetes petropolitanus*, very rare in this rock; *Calymene senaria*, rare; *Orthoceras anellum*, a species of *Cypricardites*, rather abundant; *Murchisonia bicincta; Illænus taurus*, rare; *Raphistoma lenticularis*, common; *Bellerophon platystoma*, common; *Ophileta Oweni*, common; *Illænus crassicanda*, fragments and shields common; *Trochonema umbilicata*, common; specimens of *Orthis, Ormoceras*, and *Maclurea*, rather common; a large species of *Columnaria*, rather rare; a species of *Petraia?* very abundant; and some other less common fossils, whose names I do not now recall.

In the Blue or Trenton, of the old Western geologists, fossils are so abundant that it would be tedious to enumerate them. In some of the thin, shaly, blue slabs found above Dixon, fragments of corals and stems of Encrinites, Trilobites, Leptæna, Strophomena, Orthis, and other shells and fragments are embedded and stuck over them as close as they can be packed. A species of *Orthoceras*, sometimes attaining from six to eight inches in diameter, and from eight to ten feet long, is often found. Sections and fragments of this huge animal are of very frequent occurrence. A large chambered shell, probably the *Lituites undatus* of Hall, is very characteristic. *Ormoceras tenuifilum; Gonioceras anceps; Orthis testudinaria; O. occidentalis; Strophomena alternata; S. filitexta; Leptæna sericea;* a new fossil named the *Vanuxemia Dixonensis*, by Meek and Worthen; and many others, too numerous to mention, are found in the outcrops along Rock river, in Lee county. The Trenton seas must have swarmed with these lower orders of life.

In the lower earthy and sandy layers of the Buff limestone I have not noticed many fossils. The Buff limestone, of Rockton, in Winnebago county, and of Winslow, in Stephenson county, is full of fossil remains—of species and genera almost identical with those found in the Trenton quarries at Dixon. The thick layers of the outcrop east of Dixon are separated by thin layers, an inch or two in thickness, abounding with fossils and impressions. The species here are not numerous, but the individuals are clustered together in multitudes. They are mostly casts of shells in a poor state of preservation. The *Lituites undatus*, and the large *Orthoceras*, spoken of as found in the Trenton, are also characteristic of the Buff limestone.

The Silurian fauna, disclosed in the geological horizon represented by these Dixon formations, was truly wonderful. The soft mud of these Silurian seas became the sarcophagi of extinct species and generations. We tread reverently among these old stones, marked with forms of life now fossilized; for a great chapter of the history

of the earth—of the story of creation—lies half revealed before us. The entombed relics of millions of years—cycles in which man had no part—Sibyline mysteries, almost too great for the finite mind to grasp—the story of undefinable epochs, written by the infinite finger of the Creator, in strong traces—these and kindred thoughts come over us, when gathering the fossils. No wonder Shakspeare could find "sermons in stones." The stones are full of sermons; full of an inspired revelation; they are the great Bible of Creation—the Stone Book, whose solid leaves are pictured over with sublime truths.

Surface Geology.

The surface geology of Lee county is also interesting. The Drift beds or gravel banks—the boulders or lost rocks—the clays and the sand—the alluvial deposits of the river and the swamps—these form instructive chapters in a subsequent ancient history of the county.

Alluvial Deposits.—Rock river spreads out into a bottom land of limited extent, below Grand DeTour. This bottom land is composed partly of the Black river alluvium characteristic of river bottoms generally, and partly of banks and ridges of river sand; but before reaching Dixon the rocky bluffs on either side have drawn close to the river's shore, and for several miles below Dixon no alluvial deposits exist, except the shifting sand bars and gravel beds in the stream. Before leaving the county, the bottom again spreads out, and occasional small flat expanses are covered by crumbling, marly sands and clays more recent than the true Drift. Even the extensive gravel beds worked by the railroad company, just below Nelson Depot, are river gravel beds belonging to this division of the Quaternary system.

The common prairie soil covering the county, composed largely of humus and the vegetable mold left by the successive growths and decays of the prairie grasses, of course belongs to these recent deposits and is found all over the county. But the most marked of the recent deposits to be found in the county are the swampy lands of the Green river bottoms. The struggle between water and land over these affords one of the finest illustrations of the origin and formation of the prairies to be met with in this part of the State. The land can almost be seen slowly encroaching upon the miry waters, and a real prairie taking the place of a water-logged swamp.

A large part of the township of Viola, and parts of the townships of Reynolds, Bradford and Lee Center, are taken up by the Inlet or Upper Green river swamps. This body of low land is about ten miles

long, and from two to five miles wide. It is mostly covered with a dense prairie grass, among whose roots is concealed, in the wet seasons of the year, a thin sheet of water. Towards its center the water is deeper, and patches of cat-tails and rushes abound. On the south, the country slopes up gradually to the water-shed between this stream and Bureau creek; on the north, to the dividing ridge between Green and Rock rivers. The southern slope is sandy prairie; the northern is a rich, productive one. The soil in the swamp is a black, miry muck, carpeted with a prairie sod strong enough to bear the fowler's tread. The dryer portions of these swamps afford unlimited quantities of coarse prairie hay, much used in wintering stock. They also afford grazing for large droves of cattle in the summer season.

The Winnebago swamps are even larger than the Inlet swamps, and have about them several new features. Hills of almost indurated sand rise in chains and clusters and groups from the midst of some of the swamps. These sand mounds and sand dunes were originally heaped up by the winds from materials brought from neighboring sand ridges, or at least partially formed in this way. Some of them are forty or fifty feet high, and are covered with scattering but stunted trees. The sloughs and swamps wind through them in many places, dark bands of green vegetation and glancing patches of water amid sand deserts and oak barrens. The intervening swamps are fringed with a band of thick-growing swamp grass, on a miry, mucky soil; then comes an inner fringe of dense, cane-like rushes and cat-tails, growing so thick and tall that it is almost impossible to penetrate it; then come stretches of clear water, with hard, sand bottoms, over which one can wade easily without miring. No habitations are near these watery jungles. A spirit of desolation seems to brood over them. The tall, purple-caned reeds bend their light feathery tops in the wind; triangular-shaped rushes cut the bare legs of the wader with their sickle edges. Innumerable water fowls congregate here in the spring and fall months, and the evening and morning hours witness a babel of bird voices, nowhere else to be heard to an equal extent in the State; and when the adventurous duck-hunter discharges his gun, the roar of myriads of wings, and an uprising cloud of the whole web-footed tribe, disclose the fact that even these desolate spots have their uses.

Of course this description of the Winnebago swamps applies to only a part of them. The rest are similar to the Inlet swamps, being more grassy and less wild. Some of these statements may not seem like the utterances of practical science. They are true, nevertheless.

I have spoken of them at some length, because they are very marked features in the surface geology of part of this and the adjoining counties, and are known as remarkable places over all this part of the State.

The Drift Proper.—This county is covered with the usual drift clays of this part of the State. If these superficial deposits were stripped off, the surface of the underlying rocky formations would probably present quite as level an appearance as the present face of the county. The depth of these drift clays is hard to ascertain, being quite variable. Over the township of Palmyra wells are put down from thirty to fifty feet before striking the rock. One of these wells gave the following section, as given to me by the person who dug it:

	Feet.
1. Black mold and subsoil	6
2. Finely comminuted buff-yellow clay	12
3. Blue, compact, laminated clay	10
4. Black, oozy, marly mud, full of sticks, etc	5

At this point an abundance of rather brackish and not very sweet and pure water was struck, and the well up to the present time is never failing, and the water growing sweeter and purer. At other localities in this township wells are put down to the rock, and then drilled fifty or sixty feet in the Galena formation below, before water is found.

Over the southern part of the county the drift clays are probably thicker than in the vicinity of Rock river. Where thickest, the blue clay is usually much the heaviest deposit, and is often underlaid by the black mud of the above section, No. 5, or by a bed of gravel and dirt of variable thickness. In the eastern and central portions of the county beds of sand often cover the surface and alternate with the clays below the surface.

This blue clay and the black deposit containing the decayed remains of timber, and the gravel beds on which the blue clay often rests, lies at and near the base of the true Drift in this part of the State. Clay deposits covered the Silurian rocks before the Drift forces acted. These deposits were then undoubtedly very much thinner than now, and were derived from the slow decomposition of the underlaying rocks and partook of their characters. The ice and waters of the Drift period, the transporting, grinding and abraiding agencies then acting with so much power, increased these deposits very greatly; mingled them up; assorted them, and left them in their present forms as beds of sand, different colored clays, gravel and bowlder beds, and other deposits as we now find them, modified somewhat by subsequent surface influences. Since the Drift epoch

there has been a constant struggle, with varying results, between the ravines and the level lands. Rains and water currents constantly struggle to cut out ravines in the crumbling clays. Rains and other atmospheric agencies constantly struggle to fill up these ravines, and reduce the surface of the ground to a water level. These forces, thus acting in antagonism, nearly balance each other in their effects, and keep the general face of the country about the same.

No extensive gravel beds of the Drift period were noticed in Lee county. Occasional nuggets of copper and galena are picked up in the surface clays and ravines. Scattering boulders are also often noticed in the ravines about Rock river and lying on the surface of the prairies even in the region of the swampy land. One remarkable flame-colored boulder, of several tons weight, lies on the side of the road a few miles southeast of Dixon; another, of still deeper color, lies two or three miles east of Dixon. Either of them would attract the attention of the most casual observer, and he would find himself wondering as to their history and origin.

Economical Geology.

Building Stone.—Plenty of good building stone is quarried in the outcrops of Trenton and Galena limestone along Rock river. These supply the country for some distance away from the river. The Galena quarry at Big Springs is extensively worked; so is the one directly southeast of Lee Center. In the vicinity of Franklin the Trenton outcrop along the creek of the same name has been extensively worked, and the materials thus obtained used over the surrounding country and in the village for building and farm purposes. The sandstones of the St. Peters formation in some of the outcrops of Franklin creek are hard enough to be handled and hewn into shape, and are used to some extent for ordinary mason work. An old culvert bridge, one mile west of Franklin, is built out of this rock. In Ogle county, just across the line from Lee, we noticed one or two houses built of this material. But the rock is hardly hard enough to be handled well, and makes poor stone work.

The Trenton limestone, for rough, ordinary mason work, furnishes a good material. It is very lasting, but very difficult to make handsome work out of. The large mills at Dixon are mostly built out of this limestone; so are the buildings for some large manufacturing establishments located at Dixon. The stone is so easily quarried and so readily obtained, that it has added much to the building facilities of the city of Dixon.

The Galena limestone, for heavy masonry, such as culverts, piers and the like, is the best in the county. The city of Dixon is now engaged (1868) in constructing a splendid iron bridge across Rock river to unite its north and south divisions. Two heavy abutments and a number of high, sólid, and heavy piers were necessary to support the great weight of iron in the structure, and to resist the crushing weight of ice which sometimes impinges against them in the spring floods. After an unsuccessful attempt to contract for Joliet or Athens limestone, the persons having the work in charge made arrangements to build the heavy work necessary to be constructed out of the layers of massive Galena near the city. To this end Dement's quarry, about a mile northwest of the bridge, has been heavily worked during the past summer. Massive stones have been quarried in great quantities and dressed into proper shape. The result is highly satisfactory. It would be hard to find mason work anywhere which, for warmth and softness of color, massive strength, and the quality to season harder as the work grows older, can excel that now being completed for the iron bridge at Dixon. Not only does this stone answer well for marine masonry, but for building private residences, whether dressed or bush-hammered, it is all that could be desired. For foundations, wells, and the many other uses for which a stone is required, it also answers well.

Lime.—Both the Trenton and Galena limestone burn into an excellent article of common lime. The kilns below Dixon, along the Trenton outcrops, some years ago seemed to prefer this latter limestone. At that time and now they turned out a good article of this very necessary material. But at the present time the quarry near the mills in Dixon seems to be preferred, and a large kiln here is in constant operation. The top of the quarry is mostly used at the present time. The quarrymen take up the stone nearly on a level with the top of the kiln. This is a compact limestone, and makes both a strong and a white lime. The lower layers, the harder, subcrystalline layers between the Galena in the top and the Trenton in the bottom of the quarry, a sort of transition rock between the two, are equally good for the same purpose.

Great quantities of lime can here be easily manufactured. It might be produced for the home market and for shipment, and ought to become a source of material wealth, and one of the elements of the city's prosperity. Coal, lime, and clay for brick and pottery-ware, are great resources for the production of wealth and the enlargement of human happiness.

Common Clays and Sands.—These exist in abundance in every part of the county. From them a good article of common red brick and mortar for building purposes may be obtained. Fine gravel exists in the bed and banks of Rock river, and can easily be obtained in any quantity desired for economical purposes.

Other Deposits.—The softer and whiter limpid quartz sands obtained from the St. Peters sandstone would furnish a good glass sand, and will be in demand some day for such uses. The subcrystalline strata of the Buff limestone would probably burn into a fair hydraulic lime, and, if so, would add materially to the resources of the county.

Plenty of muck beds and half formed peat deposits of mud exist in the sloughs and swamps. These might be made valuable as fertilizers and amendments to the soil; but in the present state of prairie agriculture they are not in demand for this purpose. Good beds of peat ought to, and do probably exist in the swamps; but none fit to work have attracted attention, so far as I know.

Nuggets of copper are found in the drift clays, but are rather matters of curiosity than of economical value. Pieces of galena have been found in the rocks in the northwestern part of the county; but no valuable deposits of this metal probably exist in the Galena rocks of Lee county.

The agricultural and horticultural resources of the county are about the same as those of the surrounding counties, and have been fully described in the reports upon some of these counties.

CHAPTER IX.

WHITESIDE COUNTY.

The geology and physical geography of Whiteside county are of a most interesting character.

The county is bounded on the north by Carroll county, on the east by Lee county, except the northeast corner, which is touched by Ogle county, on the south by parts of Bureau and McHenry counties, and on the west by Rock Island county, the Mississippi river, and the Marais d'Ogee slough. It is twenty-four miles long from north to south, and about thirty-two miles wide from east to west. It contains sixteen full townships, and four parts of townships on the western side. The number of square miles or sections of land embraced in all these is about six hundred and seventy-six.

The surface of the county is greatly diversified. The northern, northeastern, eastern, central and southeastern parts are chiefly composed of high, level, rich prairie land, as well adapted for agricultural purposes as any of our Northwestern prairie lands. That part south of Rock river, except a strip west of Prophetstown; that part along the Marais d'Ogee slough on the west and southwest; the region of the Cat-tail slough, opening above into the broad Mississippi bottom, and below into the Rock creek bottoms—these parts are level, low, and characterized by marshy, swampy, grass-covered sloughs and boggy and broad expanses of wet lands. In some of the western townships sand prairies of hungry, poor soil exist. The same may also be seen along portions of Rock river.

Along the western bluffs, and through the township of Ustick, the surface is rough and covered with oak barrens. An alluvial band of heavy timber fringes the lower part of Rock river. The high prairies are diversified with a number of beautiful groves. Among these, Genesee Grove, Union Grove, Round Grove and Kingsley's

Grove are the most conspicuous. Rock creek, Elkhorn creek and Buffalo creek have more or less timber, thinly scattered along their devious windings. The county, however, is rather scantily supplied with timber.

The principal streams are Rock river, Otter, Rock, Elkhorn, Buffalo and Sugar creeks, and some few smaller tributaries of these.

Rock river enters the county at the center of its eastern boundary line, and takes its exit in its southwestern corner. Its general course is straight, its deviations crooked and many; its current is broad and swift-flowing; its banks are high, except in a few places where alluvial bottoms spread out. Otter creek comes in from Carroll county and soon almost loses itself in the swamps of Willow Island lake, a few miles above Fulton City. Rock creek comes into the county about the center of its northern boundary line, flows in long undulating curves almost southwest, and enters Rock river at Erie. Elkhorn creek comes in near the northeastern corner, runs in the same general course, and enters Rock river at Como, a few miles below Sterling. Buffalo and Sugar creeks are tributaries to Elkhorn, coming in on the east side.

Rock creek has three or four good water-powers in operation. The mills at Sterling are driven by one of the heaviest powers in the State. On Elkhorn creek two or three mills are in operation. On Buffalo creek one mill has been running since the days of the first settlements in that part of the State. Many other seats for fine water-powers exist on all these streams. Rock river, at many localities in the county, would furnish water-powers almost as heavy as the one at Sterling. At these localities the stream always flows over a floor of solid rock. By constructing coffer-dams and partially turning the river out of its channel while the work is going on, materials for the most enduring dams may be quarried at the places where needed.

It will thus be seen that, altogether, Whiteside county is rather sparsely timbered. It is well watered and well supplied with water-powers; has abundant agricultural and manufacturing resources; has a diversified surface; and I am now to describe its interesting and varied geological formations.

Geological Formations.

These consist of Quaternary deposits of more than usual interest; unproductive Carboniferous rocks of the true coal horizon; sandstones belonging to the Conglomerates, or "Millstone grits," lying at

the base of the true Coal Measures; heavy developments of the Niagara limestone; widely extended outcrops or the Cincinnati rocks and shales, and considerable exposures of the Lead rocks of Galena limestone. Building them into a vertical section, the examined outcrops measure about as follows:

Sections of Whiteside County Rocks.

The usual Quaternary deposits	from 10 to 80 feet
Carboniferous rocks, shales, etc	from 10 to 40 "
Conglomerate sandstone	from 12 to 25 "
Niagara limestone	from 24 to 175 "
Cincinnati group	from 10 to 37 "
Galena limestone	from 15 to 30 "

In most of these outcrops the maximum thickness at some places in the formation was reached. This was not true, however, of the Galena limestone. That deposit runs low, and its outcrops susceptible of measurement are much below its full thickness. I shall describe these formations in the descending order, commencing at the top.

The Quaternary System.—All the divisions of this system are recognized in this county. One of them, at least, is now attracting the attention of the capitalists and scientific men in a marked degree. I allude to the Cat-tail peat beds, the heaviest and best deposit of peat perhaps in the State or in the Northwest.

Alluvium.—An alluvial bottom extends along the Mississippi river, from Savanna, in Carroll county, to a few miles below Fulton City, in Whiteside county. It is from four to seven miles wide. It is naturally divided into two parts, nearly equal in extent. There is the high table lands not subject to overflow by the spring floods of the river, consisting of sand prairies, sand-banks, and occasional tracts of the richest alluvial farm lands. The other half is that low, wet, marshy bottom next to the river, and a chain of sloughs and marshes along the bluffs, subject to overflow at every period of high water. Upon it grows an enormous yearly crop of sedges and grasses, and the heavy alluvial timber belt of the Mississippi river. The sand-beds are finely stratified and contain occasional boulders, and beds of well worn, unassorted gravel. In one of these gravel beds, recently worked by the Western Union Railroad Company, a mass of transported rock of several tons weight was unearthed. It lies at least four miles from the bluff on either side of the river. The sand-ridge in which it was embedded is evidently an old Mississippi sand-bar, of more recent deposition than the Drift proper. How the great boulder came there, is a mystery. Perhaps when the

great river extended from the Illinois to the Iowa bluffs, and the vast fields of ice came floating down in the colder springs of a former geological epoch, some of them were freighted with bowlders, which, as the ice fields went to pieces, dropped to the sandy bottom of the river. The lower water-soaked bottoms sometimes approach in character imperfect peat marshes. The black vegetable mold covering them is often many feet in thickness. It is comparatively free from sand, and when reclaimed from the water is rich and fat, but too cold and sour for general cultivation, until sweetened by tilling and drying. Below Fulton City and on almost to Albany, and from the Maredosia slough to Cordova the alluvium rises into a high, buff colored sand prairie, fertile enough to produce fair crops, except in hot dry seasons, when every green crop is parched and withers beneath the blaze of an August sun. These sand prairies are old Mississippi sand-bars, resting against the bluffs extending east from these two towns, and running north many miles. Near the northeast corner of Garden Plain, the low alluvial bottom strikes off towards the southeast; leaves the Mississippi river altogether; makes a junction with the alluvial bottom of Rock creek in the township of Trenton; and thence extends itself to the alluvial bottom of Rock river near the village of Erie. It contracts to an average width of half a mile. Low, abrupt, oak-covered hills rise from its edges. This is the Cat-tail slough, so famous for its magnificent deposit of peat, of which more will be said in another part of this report.

Three distinct river beds are easily recognized at the present time. First, there is its present bed, about one mile wide on an average; second, the low wet alluvial above referred to, and now subject to periodic overflows. When the waters filled this, the river averaged two or three miles in width. Lastly, the river once flowed a broad stream from bluff to bluff, and averaged six or seven miles in width. Then a heavy body of water flowed lazily through the Cat-tail, but as the great stream went down, this branch of it ceased to flow, and in its water-soaked bed gradually grew a great thickness of the best peat.

The Marais d'Ogee or Maredosia slough, as it is usually called, or Dosia, as it is called in the common speech of the people, is another broad marsh, spreading out along the line between this and Rock Island county, and extending in a nearly north and south direction, connecting Rock river with the Mississippi. Cat-tail slough is similar to the Maredosia, runs nearly parellel to it, and is distant some five or six miles from it. When the Mississippi river is high,

the water runs south through these sloughs into Rock river; when Rock river is high, the water runs the other way. The highest point between low-water mark in the two rivers along the Maredosia is thirteen feet; along the Cat-tail, it is twenty-six. These figures are obtained from actual surveys made along the sloughs in winter. I am indebted to the courtesy of Mr. J. Abbott, an accomplished engineer and surveyor of Cordova, for this interesting information.

There can be but little doubt that the Mississippi river itself once flowed through the Marais d'Ogee. The evidence seems conclusive to any one making an examination of these localities. The broad bottom, several miles in width, looks like the Mississippi bottom. Then the mouth of Rock river was a mile or two below Erie. The same broad bottom runs along Rock river from Erie to Rock Island. Round this channel the distance to Rock Island is twenty miles greater than along the present course of the river. If flowing round this way at the present time, this increased distance would give the usual fall of six inches to the mile; but along the present channel of the river from Albany to Rock Island the distance is twenty miles less, and the fall eighteen inches to the mile. Besides this the abrupt, rocky hills approach closer to either bank of the river as it now runs; and there is nothing about it between these two points, having any resemblance to the usual alluvial bottom now under consideration. For some cause the Father of Waters left its old channel and broke through the rocky hills, gaining twenty miles in distance and leaving the upper rapids as the result.

But leaving this interesting question, I will refer to the other parts of the county, where the alluvium is prominent. In the south-eastern part of the county the townships of Montgomery, Hahnaman, Tampico, Hume and Prophetstown, are largely made up of wet or swampy lands. Peaty marshes and sloughs intersect the level face of the country. The soil is deep, black, and water-soaked. The famous Green river Winnebago swamp extends across the town of Hahnaman in a somewhat diagonal direction. This swamp is a wilderness of reeds, sedges, and miry sloughs, in which countless thousands of wild geese, ducks, swans, and other aquatic birds, in proper seasons congregate and find an almost Arctic isolation.

At almost any of these localities the origin and formation of the prairies is well illustrated. The highland round the swamps, aided by a vast yearly decaying vegetation, is encroaching upon the marshes and building them up into dryer prairie land. But the county of Whiteside is reclaiming her swamp lands, by an efficient system of ditching, faster than Nature ever dreamed of doing. Thirteen miles

of big ditch are now finished and under contract. Already, hundreds of acres of land, after being drained, have advanced in value from a few cents to many dollars per acre in value. The scheme promises to add greatly to the material wealth of the county.

The usual dark surface, organic, geine soils of the prairies, the leaf molds of the groves, the sands and gravels recently deposited by Rock river, and the white soils of the barrens and oak timber tracks, may be said to make up the rest of the alluvial deposits.

Loess.—When the Mississippi occupied the higher of the three beds above referred to, and extended from its eastern to its western line of bluffs, and in many places spread out over the level prairies, the term river was hardly a proper designation for the great sheet of water. It approached more nearly the character of a great lake or inland sea of fresh water, with its surplus water falling over the mountain chain of its southern boundary, like some Niagara, pouring out the overflow of the great lakes of the North. This barrier over which the water rushed, crossed the river, like a great dam, where the "Devil's Bake-oven" is now pointed out to the traveler. As this was worn down and the bed of the Mississippi lowered, the water assumed more and more the form of a river, draining the great basin thus exposed. The action of the low running waves and other aqueous agencies threw up and arranged in part the bluffs around its shores, while the great basin was full of comparatively currentless water. This deposit is the Loess. It is composed of light-colored, finely comminuted clays, white and yellow sands and sandy marls, all generally partially stratified, and containing lacustrine and fluviatile shells and other fossils. The Loess bluffs are generally bald knobs, covered with short tufts of grass. A good example of the Loess may be seen where the Northwestern railroad strikes the bluffs east of Fulton City. The bluffs here are made up nearly altogether of the Loess. South of this, along the Cat-tail, the bluffs are in part capped by the same deposit; but in going north they soon rise into the rocky walls and high mural escarpments of the Niagara limestone. The low hill north and west of Morrison is partly composed of Loess clays. Rock river and the smaller interior streams did not present favorable conditions for this deposit to take place, and we seldom find it away from the bluffs of the Mississippi river.

Drift.—There is a marked distinction between the Drift in this and counties farther east. The coarse gravel beds of its upper division are almost entirely wanting. The recent gravels of Rock river were the only real gravel deposits I observed. The usual blue-colored

and yellow plastic clays of the lower Drift cover the underlying rocks in many places to a considerable thickness. At one locality a well was sunk twelve or fifteen feet through yellow unctious clay; then blue clay was struck, and in about fifteen feet more a great quantity of sticks and wood, apparently cedar and pine, was found. The water in the well, of course, had a brackish taste. This woody deposit was about the base of the true Drift. Occasional bowlders are found in the ravines, but they are nowhere abundant. Over the northern parts of the county, and especially that portion underlaid by the Galena limestone, the reddish clays or hard-pan of the lead region exists to a considerable depth. These Drift clays, however, as developed in this county, have in them nothing of peculiar or marked interest, except that they bear evidences of peaceful forces rather than that tremendous power which strewed the bowlders and yield up the gravel beds in many places in the neighboring counties Whether the floating iceberg, or the slow-crawling glacier, or the strong water currents, or all these combined, transported the coarser materials of the Drift, the force of the powerful agents were much modified in their action here. In the spring of the year the ice in Rock river sometimes, impelled by the strong current, gorges, until it rises to the height of fifteen or twenty feet, and then with a cracking roar it tears rocks from their beds and trees from its banks, grinds them in its strong jaws, and throws them high on the land or strews them along its bottom. But away from the river the clays of the Drift appear as if deposited and arranged in peaceful waters.

The Carboniferous System.—While making the examinations at Sterling, I was repeatedly told that coal had been found three or four miles below the town. The supposed outcrop was stated to be a thin seam in a bend of the river, not far from the edge of the water. The same statement is made, I think, in Dr. J. G. Norwood's small report on the coal-fields of Illinois. I sought out the locality, examined the river, and made inquiries of an intelligent farmer, who has resided near the spot for many years. With him the existence of coal in the neighborhood was a faint tradition, nineteen or twenty years old. An examination of the river showed that its bed or floor consisted of the soft, white, dendrite-speckled upper division of the Niagara limestone. Gravelly banks of river drift rose on one side some twenty-five feet from the water's edge; a low alluvial bottom lay between the river and the high prairie on the other. No sign of any outcropping rock exists, except in the bed of the river. This is the general character of Rock river from Sterling to about seven miles below Erie. No coal seam or outcrop of coal, in my judgment,

exists at the point designated. Some one digging along the banks of the stream at an early day, doubtless came upon a small deposit of float or drift coal. Tradition has kept the circumstance alive, and it grows with the passing years.

The edge of the Coal Measures, however, extends thinly into Whiteside county, at its southwestern corner. Opposite Erie, the south bank of Rock river begins to assume the character of a low bluff-line. In descending the stream these bluffs rise in altitude, become more abrupt and broken; and such are their general characters until the Mississippi range of bluffs is reached, several miles below Rock Island. For most of the distance the glancing waters of Rock river hug their bases. On the north side of the stream the low alluvial bottom spreads out, widening in proportion as the range of hills rise in height. A hundred feet is perhaps the highest altitude attained by these bluffs. A short distance below the western line of the county, coal begins to outcrop in the sides of these bluffs. Still lower down, at Aldrich's coal mine, the seam is some four feet thick, and is extensively worked. Cannel coal, soapstone, fire-clay, black slate, and a stratum of black limestone are associated with the coal. The outcrop is in the side of the hill, at a considerable elevation above the waters of Rock river. Below this mine, and in close proximity to it, several Sterling capitalists own land, and have opened drifts into the hill. Still lower down, at Cleveland, coal is extensively mined; and lower down, Coal Valley is pouring its black treasures into Rock Island, and from thence is distributing in every direction the old imprisoned heat and blaze of the Carboniferous ages, to warm our prairie homes through the bleak winters. My field-work, however, did not extend into these rich coal regions, and I refrain from further description of them.

These coal bluffs extend for a few miles into Whiteside county. But no productive coal seam has yet been found in them, within its limits. The bluffs run too low, by the time the county line is reached, to indicate a workable coal vein. A thin seam and light outcrops may be discovered, but so far as the economical geology of this county is concerned, the Coal Measures may be set down as unproductive. No workable beds extend within its boundaries.

The Unionville Sandstones.—In the northern part of the township of Hopkins, I unexpectedly found a low outcrop of sandstone in a ravine. The stone was soft and friable; in color it varied from a dirty-white to a clouded or yellowish-red; it easily crumbled beneath a blow of the hammer, and could be cut or hewn readily with a common ax. It resembles the St. Peters sandstone, and at first

surprised me not a little. Other outcrops, however, indicated its true geological horizon. The outcrop may be found on the land of a Mr. Johnson, on section 13, if I mistake not. A well, sunk higher up on the side of the ravine, or near its head, penetrated the sandstone about thirty-three feet, when the bottom of the bed was probably reached. This locality is about eight miles east and a little south of Morrison. A line drawn from Johnson's nearly west to Unionville, and thence southwest to Mineral Springs, in the southwestern part of the county, would pass through six or seven localities where this sandstone outcrops, or has been dug into. About three miles west of our first outcrop, and not far north of the village of Round Grove is the locality of the famous walled well of Whiteside county. Some ten years ago an article went the rounds of the papers, stating that in digging a well at this locality, after a depth of twenty-five feet was reached, the top of an old walled well was discovered, which showed unmistakably that it was the work of human hands. The old well was filled with debris. After removing this to a depth of several feet, sweet waters rose, until the wall of the old well was covered.

The supposed discovery, at the time, excited general and even scientific interest. I sought out the old well, and tried to learn its history. It is now filled up. The porch of a farm house extends over it. Its wonderful story was freshly told to me, in the truth of which the narrator seemed to have full faith.

Something like a walled well was, no doubt, actually discovered; but from all the light I could obtain on the subject, I think it was only a rounded excavation in the underlying sandstone—a pot-hole, perhaps—worn out by an eddy and moving pebbles revolving in a circular motion. In sandstone, with broken and thin-bedded strata, the inside of such an excavation would present exactly the appearance of an artificial well. And thus, this supposed wonder, like the walled lakes of Iowa, and other supposed works of art, is susceptible of a simple and satisfactory explanation.

To me the chief interest in the well consisted in the fact that its walls were built of my newly-discovered sandstone, enabling me to trace the general course of its deposit.

The next outcrop is in the grove about one mile east of Unionville. Here it is quarried to a considerable extent.

But the most characteristic outcrop is at Unionville, one mile north of Morrison. Here a heavy quarry is largely worked. A section of this quarry shows about nine feet of light marly clay, resembling Loess, about three feet of alternating clays and soapstone, and

twelve feet of massive, heavy-bedded sandstone. Three strata or layers of the latter outcrop, each from two to three feet thick, separated by layers of soapstone embedded in thin seams of clay. One of these soapstone layers is six inches thick. It is of a blue-white color, greasy and unctious to the touch and feel. The sandstone layers are soft, light-colored, finely-grained arenaceous rocks. They can be hewn into any shape with an old ax, but when seasoned and dried they harden into a fair building stone. The surface of some of the larger blocks is beautifully covered with very distinct ripple and wave marks.

About seven miles southeast of Unionville, on the Poor farm, is another outcrop. It is in the face of the east bluff of the Cat-tail. This quarried outcrop is similar to the one just mentioned. The bluffs on both sides of the Cat-tail, in this vicinity, show signs of this sandstone.

At Mineral Springs, on Kingsley's Grove, still further to the southwest, the borings of a small artesian well showed it to be the underlying rock. This well was put down in oil-fever times. Some indications of oil still exist about these chalybeate springs; but after prospecting awhile, the enterprise was abandoned.

Following the same general course, we next find outcropping sandstones in the Mississippi bluffs, near Hampton, in Rock Island county. The rock has a resemblance to the Unionville sandstones, but probably belongs to the true Coal Measures, a little higher in the geological scale.

The sandstone deposit rests unconformably upon the Niagara limestone. At one time it was thicker, and covered a larger extent of the county, but the erosive and denuding forces of past geological ages have worn it down and carried it away, until nothing but small patches and basins remain.

Its place in the strata of Illinois rocks is at the base of the Coal Measures. It belongs, I think, to the Conglomerate, which, in the West, is often only a fine-grained, arenaceous rock; but in other localities is made up of coarse sandstones, pebbly conglomerates, and grits.

Fossils.—The Unionville quarry has afforded a considerable number of impressions and casts of fossil plants. The most conspicuous among these is a Calamite, the *Calamites cannæformis*, I think. The casts of this plant are from one and a half to four inches in diameter, the joints from three to about eight inches in length, the surface finely marked with longitudinal lines. The friable nature of the rock makes it difficult to obtain specimens. A species of *Lepi-*

dodendron has also left some well-defined impressions. It seems to have been as thick as a man's arm, and the impressions have a rough, shark-skin, rattlesnake-like appearance. I could not obtain a good specimen, and am unable to give it a specific name. Some other sections of what appeared to be a plant were observed; but the impressions were too indefinite for identification.

The Niagara Limestone.—A large extent of this county is underlaid by this formation. Probably all that part of the county south of Rock river is underlaid by the Niagara, except a little strip along the Sterling dam, and the Carboniferous bluffs below Prophetstown. In all this extent of territory there is not an outcrop or quarry, however, of any kind, except those in and along the bank of Rock river. The surface is low, and the underlying rock runs low. The river, from Sterling to its exit out of the county, every few miles, runs over rocky beds of porous, dendrite-specked, yellow Niagara limestone. Just below the dam at Sterling, at Lyndon, at Erie, seven miles below Erie, and at many other intermediate localities, quarries are opened at the water's edge, or in the floor of the river; and judging from the appearance of the low wet prairies south of the river, the Niagara runs back nearly level, perhaps, beyond the southern limits of the county, before running under the Bureau and Henry county Coal Measures.

About a mile above Sterling, on the north bank of the river, a series of Niagara quarries are extensively worked. The formation here is worked down about thirty-five feet, and the rock is full of chert bands, and is speckled with dendrite markings. The layers, although thin-bedded, are so uncouth and rough that no mason could build them into a handsome wall. The bottom layers are of a dull green color, and soon pass into the underlying Cincinnati shales.

Quarries of the Niagara are also worked near Empire and Como, one of them in the bottom of a little tributary of Elkhorn creek. The outcrops here are low and not very heavy.

Westward of these latter places and in all that tract of country bounded by the railroad track, Rock creek and Rock river there is scarcely an exposure of any kind; but this irregular-shaped triangle is nearly all underlaid by the Niagara limestone.

Rock creek, from the north line of the county to Morrison, and in fact to its mouth above Erie, cuts into the underlying rock and exposes it at numerous places. All these exposures belong to this formation, except the sandstone at Unionville and Mineral Springs. At Brothwell's mill the exposure is sixty feet thick, presenting a

perpendicular bluff, cavernous, and light-colored on a recent fracture. Just above Jacobs' mill an extensive quarry is opened in the same limestone. In the hill north of Morrison it is again quarried. At this latter place a lime kiln is in successful operation. Some of the layers here have in them many small, curiously shaped cavities, lined with a velvety-looking, lead-colored metallic substance.

The bluffs along both banks of the Cat-tail, with the exception of a few sandstone outcrops, show the Niagara limestone.

That high plateau of land bounded by the Cat-tail, the Maredosia and the Mississippi, and consisting of the townships of Newton, Albany and Garden Plain, is underlaid by the same rock. At Albany a high rocky hill, with an old shore line of the Mississippi, fifty feet above present low-water mark, rises a short distance back from the river.

The hill north of Fulton City, and on which it is partly built, is an outcrop of Niagara limestone. At one time it was a small rocky island in the midst of a broader and mightier stream than the present Mississippi river.

But the grandest development of this formation, perhaps, in this part of the State, may be seen along the Mississippi bluffs, near the north line of the county. After viewing these beetling cliffs, the appropriateness of the old name, "Cliff Limestone," becomes apparent. This bold exposure rises at its highest altitude to the heighth of one hundred and seventy-five feet above the level of the bluff road, and this is but the upper portion of the formation at this place. The talus and debris of ages have accumulated along the base, rising in slopes half-way up the steep aclivity. Loose stones, sometimes weighing tons, loosened by the frosts and other atmospheric agencies, have rolled down, and thickly strew the roadside. Sweet, sparkling, deliciously cool water gushes in strong springs from little ravines. Wild grape vines, dense thickets and old monarch oaks cover these talus slopes for the most part; but sometimes the scene is varied by a slope covered with short tufts of prairie grass, or the richer and softer blue grass. The upper part of the exposure resembles dilapidated Cyclopean walls of the mystic times. A long mural escarpment rises from the top of the slopes, and presents its castellated face to the broad Mississippi Valley, whose lacustrine waves in older geologic epochs beat against the rocky barrier and wore it into fantastic shapes. Many caverns exist, some of them almost inaccessible, out of which issued, the day I spent among them, the half human cries of wild-cats and the growls of a small species of lynx. Some miles of stone wall along

the road are built, by quarrying the material on the tops and sides of these steep rocks, and letting it go plunging down to the very places where it is needed. The little farms thus fenced along the public highway have a fat, rich, sour, cold soil, too wet for very successful cultivation, except in occasional mellow localities. As we recede from this bluff line towards the interior of the county, the Niagara limestones thin out by erosive and denuding agencies, until the Cincinnati shales and the Galena limerock successively come to the surface. This is especially true along the northern part of the county, where the exposure is so much the heaviest.

In the large area of Whiteside county underlaid by this portion of the upper Silurian rocks, I noticed considerable difference in lithological character. The exposure just referred to consists of the upper "Coralline and Pentamerus beds" of the Cliff or Mound limestone of the earlier western geologists. It is compact, homogeneous in structure, full of minute specks of dendrites, of a light straw color on a recent fracture, sometimes taking a reddish tinge, nearly the color of brickdust. At Sterling the lower part of the formation is exposed. This is a thinner-bedded, rougher, uglier stone, and would hardly be recognized as the same rock just referred to. At Fulton City the upper part of the quarry, at least, is a friable yellow-colored or ochreous limestone, sometimes porous or sponge-like, and sometimes of a tough crystalline texture. Sometimes the color approaches an almost white cream-color. It is identical with the Racine limestone of Mr. Lapham, referred to in the Wisconsin geological survey. At Lyndon the rock is porous and full of the stems of *encrinites*. Below Erie, near the point where Rock river leaves the county, the color is still lighter and more delicate, the texture more compact and finer-grained, and the stone is in every respect, I think, identical with the LeClaire limestone, now recognized as a member of the Niagara formation.

Organic Remains.—The characteristic fossil of the upper beds, perhaps, is the *Pentamerus oblongus*. In the speech of the people, masses of it are commonly called "petrified hickory-nuts." At Brothwell's mill many of them are sticking through the rocks; but at the heavy exposure along the bluffs huge stones are covered over so thickly with the casts that they seem to be an aggregated mass solidified with a calcareo-magnesian cement. In the old Niagara seas they must have grown in countless millions, like oysters in a modern oyster bed. Some of these vast slabs would make attractive specimens for the geologist's yard; but good cabinet specimens are hard to obtain. Along the Niagara ridges, and in the ravines, casts of corals turned

to silex may be picked up in great quantities. Among the most common is the well known chain coral, the *Halysites catenularia. Favosites Gothlandica, F. favosa, F. Niagarensis, Stromatopora concentrica, S. rugosa, Astrocerium venustum,* one or two species of *Cyathophyllum,* stems of *Encrinites,* and fragments of *Orthoceras* of at least two species, are all very abundant.

From the abundance of these silicified corals, coral reefs must have existed in the old Niagara seas, where countless millions of these little animals lived and built, as the modern coral-builders raise up, from the modern ocean's floor, reefs, atols and islands.

In these clear coral-growing seas, sea weeds or fucoids abounded, and in the Sterling quarries are woven over some of the layers in a perfect net-work.

Cincinnati Shales.—The rocks of this formation, formerly designated as the Hudson River shales, but now known as the Cincinnati group, show surface exposures over a considerable portion of the county. Along the rapids at Sterling, on the banks of the river and at the base of the bluffs under the Niagara quarries already referred to, the various rocks, shales and clayey and bituminous deposits of this formation may be seen. The rapids in the river are to some extent produced by the wearing away of these deposits. They rise at a considerable angle from beneath the Niagara rocks just below the dam. On the south side of the river the formation can hardly be distinguished, but on the north side, a mile above town, it attains a thickness of thirty-seven feet, from the surface of the water to the base of the Niagara limestone. From thence it runs round east and north of Sterling, three or four miles distant from the city, striking off into the large Cincinnati surface exposures in the neighborhood of Dr. Pennington's residence. In this circular belt there are no surface exposures after leaving Rock river, but the wells dug indicate the existence of these shales and shaly limestones. The inevitable blue clay and creamy-colored water, oozing from some small ravines above Sterling, are unfailing indications of this deposit, even where no outcrop is visible.

That high plateau of level prairie between Elkhorn and Rock creeks, and extending from the railroad track to a mile within the limits of Carroll county, except a small portion of the southwest corner, is underlaid by the rocks of this group. This elevated water shed contains large portions of four or five townships. Round its eastern and northern edges, and in many ravines inside of its boundary lines, good exposures and artificial outcrops may be examined. Rock creek cuts into the Niagara, and Elkhorn creek cuts into the

Galena limestone, but the Cincinnati rocks and shales run over the one and come from under the other, in less than one mile from either stream. Along its northern limits it rises to the altitude of almost a hill, overlooking the low-lying Galena deposits of Carroll county. Three or four quarries are opened along the face of this elevation. The average thickness of these exposures is about twenty feet. The stone is thin-bedded, easily broken, close in texture and light in color, having a dry or baked appearance. The bottom layers are thicker-bedded, and have a faint green or blue tinge. It is an argillaceous shaly limestone. At Bressler's mill, on the east side of the ridge, there is a low outcrop just above the water's edge. Here the rocks are stained by iron-impregnated waters, flowing from some springs just above them. Nearly a mile northwest of this is Dr. L. S. Pennington's large quarry, opened at a considerable distance from and elevation above Elkhorn creek. The exposure is stripped of the overlying clay and worked into about thirty feet. A drain is constructed to lead off the water. The upper portion of the quarry is thin-bedded, but the layers can be lifted in immense slabs. No better flagging-stone can be obtained anywhere. The lower portions of the quarry are thicker-bedded, compact, and very blue. On section three, in the town of Hopkins, there is another splendid quarry of this stone. The part worked is about twelve feet thick. It is covered by a few feet of finely-comminuted light-colored clay. A circular pool of sweet, clear, cold water, fed by some large springs, lies in placid tranquillity almost in the quarry, and throws off a laughing stream. The stone here is a hard, thicker-bedded, compact, argillaceous limestone, unlike the usual crumbling shales of the Cincinnati group. Two or three of the bottom layers are of a deep ultramarine blue color, with shaly and clayey partings of a few inches thickness between them. The locality is known as Hecker's quarry. It is now owned by Dr. Pennington.

There is another quarried exposure nearly a mile north of this, at Harvey's. The stones here are soft, shaly and crumbling. The tooth of time makes sad havoc with them. When exposed to the atmosphere they soon begin to decay.

Here I noticed some disturbances in this usually quiet formation. Over a few sections it seems to be thrown out of shape. Not far off some Niagara rocks are found where they do not belong, according to outcrops and the signs in the surrounding hills. These lost Niagara rocks are evidently not *in situ*, but have been moved probably by the drift forces.

The lithological character of the Cincinnati rocks examined in this county deserves a passing thought. The carbonaceous and bituminous shales found further north, which are there a very marked feature, are here almost entirely wanting, or are at least not distinguishable by ordinary observation. The stone is compacter, and less liable to decay, than that examined in many other localities. It approaches nearer an ordinary limestone in structure and in uses. And altogether it is a valuable deposit, as I shall show in speaking of the economic geology of the county.

Organic Remains.—These are not very abundant. Most of the heavily worked outcrops are barren of fossils. In the ravines cutting the formation on the north the *Chætetes petropolitanus, Orthis testudinaria, O. occidentalis, O. lynx,* and a small *Brachiopod,* probably a *Leptæna,* are often picked up, weathered out in great perfection. The spines and shields of a characteristic trilobite, the *Asaphus gigas,* are not rare, but perfect specimens are seldom found. At Sterling some of the thin layers are exceedingly hard, almost flinty, and are thickly covered with fossils. Conspicuous among these is the *Strophomena alternata,* and among other shells common to this and the Trenton period.

The Galena Limestone.—This becomes the surface rock to some extent along the northern and northeastern part of the county. That irregularly shaped parallelogram in the latter locality, north of Sugar creek and east of Elkhorn creek, is all underlaid by the Galena limestone. Buffalo creek cuts this piece of land in a diagonal shape. For two or three miles west of Polo this creek runs over and shows exposures of the Blue limestone; but at Sanfordsville, near the line between this and Ogle county, this rock outcrops heavily just below the dam for the saw mill. The outcrop has been worked to the depth of twenty-four feet. The layers are massive, solid, and subcrystalline. At the present time the quarry is not much worked. Following the creek down a few miles, the next exposure of consequence is at Wilson's mill. Here there is a quarry worked to the depth of about twenty feet. The stone is similar to that at Sanfordsville. Other small outcrops may be seen in this locality in some small ravines in a white oak grove of some extent.

On Elkhorn creek, at Allison's mill, just across the line in Carroll county, there is a worked exposure some eighteen or twenty feet thick. The stone here is of a white cream color, and quite handsome in appearance. From this locality nearly to Bressler's mill, just east of the residence of Dr. Pennington, the Galena is

the surface rock. It runs low, however, and soon disappears below the overlying Cincinnati group.

The central part of that broad stretch of prairie and rough land north of Morrison, and lying between the Mississippi bluffs and Rock creek, is also underlaid by this rock. There is no conspicuous outcrop anywhere over it; but some of the ravines, especially near the Carroll county line, show its peculiar gravels, red hard-pan, and low-lying, crumbling outcrops.

There is nothing noteworthy connected with this limestone as a surface rock in this county. Its superficial area is limited, its outcrops are few, and the only scientific interest attached to it is the knowledge of its existence among the other interesting formations of the county, and the fact that it may become of economical interest for the manufacture of quick-lime.

It is almost barren of fossils. I only noticed fragments of a few characteristic species. Near the northern part of the county I found a rather poor specimen of *Receptaculites* and fragments of *Bellerophon*, *Pleurotomaria*, and *Murchisonia*.

Economical and Agricultural Geology.

This department of Whiteside county geology is of more than usual importance, both in a scientific and economical point of view. The variety of rocks; the new interest awakened in the cultivation of the vine; rich and varied agricultural resources; the great beds of excellent peat existing in hitherto useless bogs, and the fat lands now being successfully reclaimed from the swamps—all these are matters of wider interest than usually appertains to a single county.

Building Stone and Lime.—All the outcropping formations above described furnish materials for ordinary mason work, such as cellar and well walls, foundations, and public buildings. The Galena requires much labor to quarry and work it into good shape; but it lasts like granite, has an attractive, warm, fashionable cream or straw color, and for heavy massive masonry has no superior. Its limited outcrop prevents is general use for economical purposes. It burns into a good article of quick-lime. There is a lime-kiln in successful operation at Wilson's mill. While at Sterling I observed some capitalists, who were intending to manufacture a quantity of lime, figuring whether they could haul stone to the fuel or fuel to the stone the cheapest, the one being in Sterling and the other on Buffalo creek. I did not learn the result.

For common rough mason work the Niagara limestone is much used. Some of its layers make a good quick-lime, as may be seen on the ridge north of Morrison.

The sandstones of Unionville and the county farm are also extensively used for building purposes. The mill between Unionville and Morrison is built of this soft gray stone. It is a handsome and substantial structure. The jail and court house foundations, and the public offices in Morrison belonging to the county, are of the same material. When first quarried it is so soft that it can be hewn into any shape with an old ax. It then appears unfit for building into any structure. But when laid up in a wall it dries, seasons, and attains a firm texture. The ease with which it can be worked recommends it, where dressed stone is desirable.

In some places the shales and rocks of the Cincinnati group are considered unfit for permanent mason work. It is supposed that atmospheric agencies will eventually destroy their beauty and injure their durability. But so far as tested, the quarries of the Cincinnati group in this county furnish a lasting and desirable material for economic uses. The layers are of convenient thickness, and break into any desired size. The flag stones raised at Dr. Pennington's home quarry are as large as need be wished for. This gentleman, with his accustomed energy and a large expenditure of money, has two large quarries in operation. He has also a stone yard in Sterling, where he can furnish stone from his quarries in any quantity, and dressed into any desired shape. He supplies this stone yard from the quarry near his residence, and from the Hecker quarry in the township of Hopkins, already referred to in this report. A handsomer looking lot of stone than those quarried and corded up at the latter locality last fall, one seldom ever sees. I hope merited success will crown Dr. Pennington's efforts to develop this branch of the material wealth and industry of the county.

As pertinent to this part of our subject, I here insert a table showing the tests and properties of many samples of stone. Some of them are from the quarries of the Cincinnati group just referred to. Others are from the Niagara limestone from different localities in Northern Illinois. The table is given entire, on account of the interesting nature of its contents, and as furnishing a basis of comparison between our Northern Illinois and some other rocks. It was furnished to myself and Dr. Pennington by the government officials on Rock Island. I regretted that no specimens of the Galena limestone were present to be subjected to the same trying ordeal. It will be seen from the table that the samples of stone

from Dr. Pennington's Cincinnati quarries were in many respects superior to the LeClaire limestone, out of which the United States Arsenal at Rock Island is built, and were almost equal to the Joliet marble, out of which the United States Armory is being constructed:

Table showing Properties of Stone.

Kinds of Stone.	Dimensions in Inches.		No. Samples.	Specific gravity	Crushing force, in lbs.	Crushing force, in lbs. per sq. re inch	Began to spawl	Breaking w'ght for transverse strain	Transverse strength—*L W 2. S=4 b d.
Athens marble (Illinois Stone Co.), Magnesian limestone.	Transverse,	3.75×7.9×20	1	2.5154	65,700	16,420	65,700	16,900	=361.5
		3.9×7.05×20	2	2.5132	49,000	16,255	49,000	18,580	=377.4
		4×8×20	3	.....	64,800	16,700	64,000	16,600	=324
	Crushing,	2×2×4	..	.....	.....	.....	.....	.....	.....
				2.5143	60,500	15,125	59,567	17,360	=354.3
Athens marble (Walker), Magnesian limestone.	Transverse,	4×7.5×20	1	2.6629	34,500	8,625	28,000	12,100	=172
		4×8×20	2	2.5271	43,700	10,950	39,000	16,800	=328
		3.8×8×20	3	2.5246	38,000	9,500	38,000	14,300	=294
	Crushing,	2×2×4	..	.....	.....	.....	.....	.....	.....
				2.4051	38,733	9,692	35,000	14,400	=264.5
Joliet (State Prison) Magnesian limestone.	Transverse,	4×8×20	1	2.6123	40,000	10,000	20,000	13,800	=269
		4×8×20	2	2.6086	31,270	7,817	18,000	15,000	=293
		4×8×20	3	.....	33,000	8,150	19,000	18,800	=267
	Crushing,	2×2×4	..	.....	.....	.....	.....	.....	.....
				1.6105	34,757	8,656	19,000	15,867	=276.5
Magnesian limestone.	Transverse,	4×8×20	1	2.6526	64,000	16,000	64,000	15,309	=298.7
		4×8×20	2	2.6354	47,000	11,750	44,000	16,400	=220.3
		4×8×20	3	.....	65,500	16,375	65,000	.....	=248
	Crushing,	2×2×4	..	.....	.....	.....	.....	.....	.....
				2.6440	58,883	14,708	57,833	15,850	=283
Nauvoo, Pure limestone.	Transverse,	4×8×20	1	2.6378	31,400	7,850	.....	14,600	=285
		4×8×20	2	2.7028	36,200	9,150	.....	14,400	=273
		4×8×20	3	.....	35,000	8,950	.....	14,600	=285
	Crushing,	2×2×4	..	.....	.....	.....	.....	.....	.....
				2.6703	34,200	8,583	.....	14,300	=281
Blue stone (New York), or North river flag-stone.	Transverse,	30×4×3	1	2.7249	84,600	21,150	.....	4,000	=623
		30×4×4	2	2.7242	95,300	23,825	.....	5,680	=665
		30×4×5	3	.....	89,500	22,375	.....	8,890	=616.75
		30×4×6	4	.....	.....	.....	.....	10,000	=520.8
	Crushing,	2×2×4	..	.....	.....	.....	.....	.....	.....
				2.7245	89,800	22,450	.....	7,142	=609
Le Claire (Old Quarry) Magnesian limestone, very impure.	Transverse,	4×8×20	1	2.3354	13,000	3,250	11,000	6,590	=127.7
		4×8×20	2	2.3379	13,800	4,700	18,800	6,880	=130.5
	Crushing,	2×2×4	..	.....	20,000	5,000	20,000	.....	.....
				2.3366	15,600	4,317	16,600	6,695	=129.6
Le Claire (New Quarry) Magnesian limestone.	Transverse,	4×8×20	1	2.3712	24,900	6,225	24,900	7,000	=136.6
		4×8×20	2	2.3033	29,800	7,450	25,000	9,100	=177
	Crushing,	2×2×4	..	.....	21,500	5,375	15,000	.....	.....
				2 3372	25,400	6,350	21,633	8,050	=156.8
Andalusia Magnesian limestone (very impure).	Transverse,	3.8×7.95×20	1	2.3790	24,200	6,050	.....	5,900	=112
		3.7×8×20	2	2.4067	28,100	7,025	.....	5,000	=105
		4×8×20	3	2.3812	20,000	5,000	.....	3,600	=103
	Crushing,	2×2×4	..	.....	.....	.....	.....	.....	.....
				2.3389	24,100	6,025	.....	4,833	=107

*NOTE.—The product of the length and width divided by 4 times the breadth and depth gives the transverse strength. †Defective.

Table showing Properties of Stone—Continued.

Kinds of Stone.	Dimensions in Inches.	No. samples	Specific gravity	Crushing force, in lbs.	Crushing force, in lbs. per sq. re inch	Began to spawl	Breaking weight for transverse strain	Transverse strength— $\frac{L W}{S=4} \frac{2}{b} \frac{}{d}$
Sterling, Ill. (Pennington), Magnesian limestone.	Crushing, 2×2×4 from top	..	.....	27,540	6,885	5,250	.....	.....
	" 2×2×4 from bot.	..	.....	40,000	10,000	3,250	.....	.....
Hopkins, Ill. (Pennington).	Crushing, 2×2×4	..	.....	34,000	8,500	6,000	.....	.....
Wills Quarry, Hancock, Illinois.	Crushing, 2×2×4 from top	..	2.468	32,100	8,025	25,000	.....	.....
Wills Quarry, Hancock, Illinois (Magnesian limestone).	" 2×2×4 from bot.	..	2.387	16,000	4,150	9,000	.....	.....
Rickey's Quarry, Lee Co., Iowa (Sandstone).	Crushing, 2×2×4	..	2.180	15,700	3,925	15,700	.....	.....

To determine the absorptive properties of different stones, the following varieties of different stone were placed in the boiler of a steam engine, and remained for sixteen (16) days. They were then weighed, and then placed in water, where they remained three (3) days and nights, and were again weighed, with the following results:

Kinds of Stone.	No. of specimens	Weight before steeping — Grains.	Weight after steeping — Grains.	Increase in weight, — Grains.	Increase per cent.
Athens (Illinois Stone Company)	1	5554	5755.5	201.5	3.6
" " "	2	5421	5593.5	172.5	3.1
Athens (Walker)	1	5020	5184	164	3.26
" "	2	5140	5309	169	3.28
" "	3	5230	5300	171	3.26
Joliet (State Prison)	1	5293.5	5495.3	101.8	1.8
" "	2	5306.3	5432.5	126.2	2.3
Joliet (Sanger)	1	6211.8	6382	170.2	2.73
" "	2	6640.5	5800	159.5	2.8
Nauvoo	1	5498	5513.5	15.5	.33
"	2	5578.7	5599.5	20.8	.39
Blue stone, New York	1	5685	5661.5	26.5	.47
"	2	4479	5498.5	19.5	.45
LeClaire, new quarry	1	4999.7	5361.2	361.5	7.23
" old quarry	2	4333	4674	341	7.8
Andalusia	1	4611	4874	263	5.7
"	2	4902	5181	279	5.68
Wills quarry, from top	1	4798	4924	126	2.5
" " from bottom	2	4425	4701	276	6
Rickey's quarry	1	4029	4230	201	5

The soils, clays and sands have been sufficiently referred to in speaking of the surface geology of the county. They furnish the usual materials for economical purposes and uses, and need not now be more specifically referred to.

Vine Culture.—The cultivation of the vine in some parts of the county is awakening deserved attention. The experiment, so far as tried, has been eminently successful. Several amateur grape-growers in the city of Sterling are devoting some attention to this interesting branch of industry. Their success has been most flattering, and there is a well-grounded belief springing up that both grape-growing and wine-making, in favorable localities in Northern Illinois, may be made a source of profit to the cultivator. The soil in and about Sterling seems well adapted to vine-growing,

At Morrison, the soil partakes somewhat of the nature of the Loess clays. The vine flourishes in it in the greatest luxuriance. I observed, last fall, one little vineyard just below the town, on a southern slope of the hill, which seemed, from the highway, nothing but a mass of purple grapes. I have since been furnished with some statements as to the amount of fruit raised, mode of culture, and other facts of interest to vine-growers.

The vineyard belongs to Canfield Blodgett, Esq. He has 140 bearing vines, of which 90 are Concords, 24 Hartford Prolific, 6 Delawares, 6 Crevelings, 6 Taylor White or Bullitt, 6 Maxitawna, and 2 Cuyahoga. The vines were planted three years ago last spring, on soil heavily manured and subsoiled. The crop of 1867 was as follows: 3,018 pounds, sold at an average of 16 cents per pound; about 500 pounds were used by the family and friends of Mr. Blodgett; 20 gallons of wine, the pure juice or blood of the grape, were made; layers were sold to the amount of $100; layers yet on hand, about $40 worth; net profits on 140 vines, three and a half years after planting, on a single crop, at least $500. He has since planted 320 vines, not yet in bearing, varieties as follows: 115 Concord, 50 Iowas, 40 Israelas, 50 Delawares, 13 Adirondacks, 13 Ives' Seedling, 13 Clintons, and 26 Hartford Prolifics. The ground for these was trenched two feet deep, and a load of well-rotted manure to every five vines, well mixed with the earth. He takes down and trims in the fall, and covers with earth, and takes up about the middle of May. It takes ten or twelve pounds of grapes to make a gallon of wine—pure juice—and two pounds of sugar. Where one-third water is used it takes more sugar, and the wine is of inferior quality.

The above statement can be relied on, I think, as correct. It shows what may be accomplished on a small scale. It is true, vines would not bear every year as they did in 1867, but they would produce with as much certainty as our most staple products of the farm.

The Loess hills along the Mississippi, with their marly clays and sands, may be made to do even better than this. Proper care in planting, and a generous after-culture, would produce this delicious fruit and a generous, invigorating wine in the greatest profusion.

Grape-growing and wine-making in this country is rapidly rising to a prominent position among industrial pursuits. In California, it is now the leading interest of the State, surpassing in importance the production of gold. In a few years it will, even now perhaps it does, surpass all other interests combined. Our California wines are becoming as familiar as the products of the vintages of the Old World. Cincinnati wines establish the fact that the Ohio valley is eminently well adapted to vine-culture. The hills of the Missouri river are attracting to them the wine-making Germans from the best vine lands of the Rhine, and of other famous wine-producing countries.

The Loess bluffs of the Mississippi, about Warsaw, Nauvoo, Fort Madison, and in that locality, are surprising horticulturists by the adaptability of their soil and climate for the growth of the vine and its abundant yield of grapes. In this latter locality, the Catawba is the favorite wine-grape. It has stood the test of a severe trial, and the wine-growers have faith in it. In Whiteside, Carroll, and counties farther north, the Concord is the favorite grape. It is found to be hardy, prolific, reasonably sure of a crop, and comparatively free from mildew and insect foes. All over the district where the Galena and Niagara limestones outcrop, the deep, loose, red soil, intermixed with loose stones, ought to, and will produce grapes that will make a wine of high excellence and great durability, although it may not attain the richness and ripeness of flavor of that grown in sunnier climates. In the latitude of Nebraska, the Concord, Hartford Prolific, Taylor's Bullitt, Ives' and Norton's Virginia, and Clinton, have all, after a thorough test, proved successful. Some of them never show mildew, or a diseased berry, and are not subject to the ravages of insects.

If we could produce grapes for the table and for wine, even as abundantly as we produce apples for the cellar and for cider, how much would be added to our material wealth, our social enjoyment, and the healthfulness of our people. A new and profitable industrial interest would spring into existence; a blow would be struck at the

consumption of poisoned and adulterated liquors; and a pure, healthful and invigorating beverage would be furnished, which would do much for the destruction of a perverted taste for alcoholic stimulants. I have a deep and abiding faith, that the awakening interest of our people in the cultivation of the vine, and the making of wine, will do much towards the accomplishment of this result.

Peat.—In Whiteside county peat exists in inexhaustible quantities and of first rate quality. It has become not only a subject of widespread scientific interest, but an element of material wealth, and one of the industrial and economical resources of the county.

The most valuable deposit is found in the Cat-tail slough, a low swale running through the highlands from the Mississippi to the Rock River bottoms, in the western part of the county. In width this slough varries from one-half to three-fourths of a mile. From Bluff station to Rock creek, the Cat-tail proper is about ten miles long. A heavy vegetation of sphagnous mosses, sedge grasses, cat-tail rushes, and other aquatic plants cover it. In approaching it from either side over the rolling prairie, no indications of its existence are discovered, until the low bluffs running along either side are reached. The broad, water-soaked swale then opens upon the sight, gray at the touch of October frosts, except where blackened by the sweeping march of recent prairie fires; dotted with haystacks; a creeping stream of antiseptic peat water, shining like a thread of silver in the shallow black ditch, opened to drain the surplus waters of the bog—thus it appeared when I first went there to pursue my investigations of the peat-beds of the county.

Much and various qualities of young, growing and unripe peat exists all along the slough. But the great bed of fat, ripe peat, which has made the name of Whiteside county peat prominent in connection with the peat deposits of the Northwest, lies near the middle of the Cat-tail, and not far from the water-shed or dividing ridge between Rock and the Mississippi rivers. Mr. Nathaniel Dodge, who resides in the vicinity, about twelve years ago had his attention attracted to the valuable character of this peat deposit. At first it was cut into convenient sized blocks with a common spade, and dried in the summer sun. Neighboring farmers began to use it for fuel and heating purposes. It was used for burning lime from the Niagara limestone, in the adjoining bluffs. It was hauled to Morrison in small quantities and burned in offices and dwellings. At length, stimulated by the experiments and successes of Eastern peat companies, and the reported examinations of geologists and practical men, a peat fever sprung up in Whiteside county, a steam

engine was placed in the swamp, and two peat machines were operated by Messrs. Townsend & Dodge, during the summer of 1867. Three hundred tons of dry, hard peat fuel were manufactured. The experiment was a success. The manufactured fuel became popular and valuable. Peat lands, hitherto considered almost a drug in the market, rapidly increased in value, doubling and quadrupling in a few months. The Union Grove Peat Manufacturing Company, of Whiteside county, with a cash capital of one hundred thousand dollars, has just been organized, and its articles of association filed with the Secretary of State. During the summer of 1868 extensive works will be put in operation, and large quantities of peat fuel manufactured.

The bed of peat is in all about six miles long, averaging in width about three-fourths of a mile. It contains, altogether, some three thousand acres of peat lands. These land do not all contain valuable workable peat, but the greater part of them do.

The amount of peat contained in such a deposit is almost beyond belief. It is considered a reasonable estimate that one acre of drained peat will produce two hundred and fifty tons of dry fuel for every foot in depth. If the Cat-tail would average ten feet thick of workable peat, and this estimate is perhaps below the truth, then an acre would furnish twenty-five hundred tons of dry fuel. The blocks made last summer were almost as dense as bituminous coal, and readily sold for seven dollars per ton or cord. Five dollars could be realized for all that can be manufactured. The price of manufacturing the fuel need not, I think, exceed two dollars and fifty cents per ton. This leaves a net profit of over six thousand dollars to every acre of ten foot peat. At these figures a hundred acres of this best peat land would be worth, as an element to convert into material wealth, over six hundred thousand dollars.

Some geologists reckon a ton of well manufactured peat fuel as equal to a cord of dry hickory wood. If this is true, the Cat-tail is indeed a valuable deposit. I sat by a peat fire several frosty evenings, while making my investigations in this part of the county. The fuel certainly made a cheerful fire. It was burnt in a grate; made little smoke; left little ash, and that light and white; there was no unpleasant smell, and a bright flame was given out. It consumed, however, rather rapidly, and as a generator of heat is not equal to the better varieties of coal, or the harder varieties of dry wood.

And yet, after all this apparent fair showing, some caution ought to be exercised in the investment of money in this new enterprise.

The great labor of handling the raw material must ever make the cost of manufacturing peat bricks a considerable item of expense. The Rock Island coal-fields are at no great distance, and for many years will cheaply furnish a good article of Illinois coal. The cost of peat machines is quite an item, and experience may encounter unexpected difficulties as further progress is made in the work. I simply throw this out as a doubt in my well-grounded faith in the final and complete success of manufacturing crude peat into a cheap and valuable fuel. For coking purposes, and for the working of iron and steel, it is said to furnish a heating material more valuable than any now in use.

The principle of manufacturing the fuel, now being applied in the Cat-tail mills, is essentially that of Weber. The crude peat is ground by cutting arms, revolving in a strong box, between fixed arms. When the texture or fiber is destroyed, it is molded into convenient sized blocks; some of the water is squeezed out; it is then dried a few days or weeks in the sun, and eventually is cribbed like Indian corn in covered narrow plank cribs. Condensation is chiefly effected by a destruction of the fibrous texture, permitting the peat, when it dries, to contract into a more solid form. Compressed peat, or peat made by an attempt to press or squeeze the water out, no matter how powerfully the pressure is applied, will not succeed in making the pressed material either dry or solid. Good peat is very elastic. When the pressure is removed it returns to nearly its original volume. The partial closeness of texture given to the outside hinders the drying process. Actual experiments have taught the manufacturers this truth, and they have abandoned the idea of pressing the water out by mechanical means.

A cord of wet peat, by the natural process of drying, shrinks to one-third or one-fourth its original size. Condensed into the solidity of ordinary coal it shrinks much more. This loss of bulk and weight is caused by the evaporation or loss of the water contained in the peat. The great desideratum is to get rid of this large amount of water as economically and with as little handling as possible. New processes of manufacture, new applications of labor-saving machinery, and cautious but liberal outlays of capital, will yet overcome every difficulty now in the way; and as the wants of the human family require new supplies of fuel, the bogs and marshes will furnish it, as the barren hills now spout forth their treasures of oil.

The peat furnished by the Cat-tail deposit is of excellent quality. It contains few veins of sand, mud, or other impurities. When first dug the blocks have a dark, almost black color, and unctious

or greasy feel. When dry it becomes comparatively light, has a fine, spongy, fibrous structure, and compares favorably with dry peat blocks from the heather-clad moors and heaths of Scotland or the Emerald Isle. The Sphagnum mosses are the true peat producers; but in our western sloughs, swales, marshes and bogs, grasses, sedges, and other species of aquatic vegetation, contribute largely in making up the beds. Grass peat, when old, thick, and subjected to pressure, makes a solid, lusterless, dark-colored peat; moss peat, under the same circumstances, is a little more fibrous in texture; both growing together make a modified peat. In the Cat-tail and other similar sloughs the ground is covered with a short, thick, velvety moss, out of which rises a dense vegetation of grasses, sedges and rushes. The ground has a quaking tread; is saturated with water; and the heavy vegetation, as it settles down, becomes perfectly soaked and even covered with water. The mosses keep drying at the roots and growing at the tops. The antiseptic peat water arrests rapid decay. From this slow decay, by chemical action, solid compounds are formed able to resist decay. The mass grows, and a peat bed is the result. Pile a mountain upon this highly concentrated vegetable matter, sink it beneath the ocean's level, and cook it, or season it for a few millions of years, and a bed of coal would be the result.

It will thus be seen that moisture and a low temperature are essential to furnish favorable conditions for the growth of peat. In the dry sandy soil of Winnebago county, for instance, little peat can be found; in the swamps and marshes of Whiteside county it is found in all stages of growth and ripeness. The Cat-tail is a ripe, fat and old deposit. I will now pass to some of the younger and more unripe beds.

In the Maredosia slough I heard of some peaty deposits, but did not examine them. They are probably not of much value as a fuel.

Southwest of Prophetstown there is a peat marsh known as "The Big Slough," extending from near Rock river in a southeast direction until it loses itself in the Winnebago swamps. Its average width is nearly half a mile. I spent a day boring in this great deposit with the peat augur. In thickness the peat is from four to nine feet. A foot or two of fibrous turf covers the top of the marsh. Alternating layers of a coarse, red, unripe peat, and veins of mud and sand and other earthy substances, were observed at every boring. Silver-shining threads and fibers show themselves in the good peat. They result from the partial decomposition of coarse, wirey grasses. The deposit, in several stages of its growth, seems

to have been overflowed by water. At each flooding earthy matter and sand was swept over the slough and deposited as a sediment. At present a heavy growth of Sphagnous mosses is flourishing in the greatest profusion over the whole slough.

This great slough, for the reason stated, is not so valuable for fuel making as the Cat-tail; but for fertilizing purposes it is perhaps better.

Many less valuable deposits of peat exist in the lowlands towards the Winnebago swamps; but I deem a minute description of them unnecessary at this time. I cannot leave this swampy region, however, without noticing a curious phenomenon often seen among them. I refer to the sand-hills, sand-dunes, sand-blows, or "blow-outs," as they are called in the common speech of the people. The wind has built the sand into curious-shaped, ever-changing hills. The "blow-out," about twelve miles south of Sterling, is a circular range of low sand hills, inclosing a small lake. It looks like the extinct crater of some old volcano, but owes its peculiar shape simply to the action of prairie winds.

The Sphagnous mosses and the highly concentrated cooked vegetable matter of these peat beds, in chemical composition, are similar to the woods of our forest trees. Where pure, ripe and fat, this peat can readily be converted into a cheap and valuable fuel—valuable as a clean, healthful fuel; valuable, on account of its strong flame and freedom from ash and clinker, as a steam generator and locomotive driver; valuable, on account of its freedom from sulphur and other metallic impurities, for working iron and steel; valuable, for its fine coke producing qualities, and the many other economic uses to which it can be put on account of its fine heating properties; and cheap, because the supply of raw material out of which the fuel can be manufactured is inexhaustible.

The youngest, unripe qualities may be put to use as a fertilizer and a valuable addition to the poorer prairie and hill soils. For this use it is almost invaluable. Geine or humus is the fertile element in all soils. It is also the life of stable and barn-yard manures. This is so well understood in New England States, under the scientific investigations of their agricultural chemists and geologists, that peat, and even the pond mucks and muds, are every year composted in large quantities, and spread over the thin soils, with the happiest results.

Agricultural chemistry has demonstrated that the salts and geine of a cord of wet, raw peat are equal to the manure of one cow for three months. Practical agriculture has also demonstrated that

crude peat, in a raw state, is too acid and sour to be immediately beneficial to the soil. By composting for a few months with wood ashes, lime, potash, or common manure, the whole mass becomes sweetened, and one of the best and strongest fertilizers for farm crops is produced. The orchard, the vine and the garden fruits feed greedily upon this compound, and bear abundant crops.

When necessity compels our prairie farmers to turn their attention to fertilizers, these unripe peat beds will become the most valuable spots on every farm. Tracts of sterile land in Maryland, worth but four or five dollars an acre, suddenly increased in value to forty dollars an acre, upon the discovery in their neighborhood of the wonderful fertilizer, the green marls of Maryland and New Jersey. A peat bed is not only valuable itself, but will eventually confer a new value upon all adjoining lands, if properly used.

Clays, Sands and Soils.—Further remarks upon the clays, sands and soils of this county, and their products, seem hardly necessary. The discussion upon these topics in the Ogle county report might be applied with nearly equal truth to this county.

Antiquities.

I cannot close this report without referring briefly to the antiquities left by the mound builders. Near the Niagara limestone quarries above the city of Sterling, on a high table land overlooking Rock river from the north bank, is a large congregation of these mounds. Along the south bank of the river, below the city, many large ones are scattered along. Most of these Sterling mounds are the common round ones. Their size is a little larger than the average. A few oblong ones were noticed, but none of the strange effigies and mystic representations observed at some other localities. Mounds also exist about Portland, and many other places along Rock river.

Many of these mounds have been partially excavated, and some trinkets and pieces of charcoal taken therefrom.

These are commonly believed to be burial mounds; but there is reason to think that many of them are house mounds, or hut mounds, made by covering some sort of supporting structures with sods or surface earth, for winter residences of extinct races of men. The charcoal found in them would indicate the fires once kindled, perhaps, in the center of these low, earth-covered huts. The fact that these mounds are composed of surface soil, with no depression

near them, indicates that the materials of which they are composed were gathered from the surface of the earth. Later generations have doubtless used these structures as places of interment for their dead. Whether used as human habitations, burial mounds, memorial or sacrificial monuments; whether built by the Indian tribes, or races of men older than they, may remain a mooted question. The researches of antiquarians and archæologists may yet throw a flood of light upon these interesting investigations. The red man was doubtless a mound builder, but I think more primitive men than he built many of our mounds. In these structures he may have buried his dead, but older and higher civilizations than the red man built earth-works for defense, boundaries and national purposes long before the Indian roamed over these hunting grounds.

The usual flint arrow-heads, stone axes, and other stone implements, though not abundant, are sometimes picked up.

One relic was found a few years ago, in the banks of the river at Sterling, which deserves more than a passing notice. The implement is, I believe, of pure copper, fashioned into the form of a long, heavy knife. The broad end has a hole through it, and is turned over from the edges towards the center, making a place or socket for a wooden handle or spear-shaft. The blade is eleven inches long; it is nearly an inch and a half wide near the heel of the cutting side; from thence it tapers on both sides to a blunt point. It has a vein-like appearance over it, caused by the unequal decay and eating of the copper rust. It was found some seven feet below the surface of the earth, sticking out of an embankment which had caved into Rock river. The formation was a dark-colored diluvial, or river drift, made up of black or dark-colored deposits, containing chert and considerable river gravel. The spot where found is seven or eight feet above ordinary water-mark. If found where indicated, this relic is older than the historic period, and is in some way doubtless connected with the ancient mining of the Lake Superior copper mines.

Prior to the wearing away of the Cincinnati shales, where the Sterling rapids are now located, the bed of the river was higher, and the rapids further down the stream. At that time the stream might have formed the embankment where this primitive knife or spear-head was found; but even that view of the case makes it almost of pre-Indian origin.*

* NOTE.—This knife has been figured in the Transactions of the Chicago Academy of Science, Vol. I, plate 23, fig. 3. A. H. W.

The bone from the fore leg of the Mastodon found in Ogle county, and referred to in the report of that county, was found in the same river gravel or drift, and at the same depth below the surface. This fact seems to indicate that the Mastodon and the maker of this copper knife existed at the same time in the Rock River valley.

CHAPTER X.

BUREAU COUNTY.

This large county is located in one of the finest agricultural portions of the State. It is bounded on the north by Whiteside and Lee counties, on the east by LaSalle, on the south by the Illinois river, and parts of Putnam and Stark counties, and on the west by Henry county. The Illinois river also touches the southeastern boundary line for four or five miles, and the south side of the township of Milo joins upon the north side of Marshall county. The county is longest from east to west, being six townships, or thirty-six miles. It is four townships, or twenty-four miles from north to south, except where the township of Milo extends south of what ought to be the southern line. There, of course, the distance is six miles more. The county thus contains about twenty-three and one-half townships, or eight hundred and forty-six square miles or sections of land.

The general configuration of the face of the county: its groves, streams, soil and other characteristics, are similar to those of Henry county, with the exception of some peculiarities along the Illinois river. The prairies are not quite so rolling as those of Henry county. The timber skirts the streams more in belts, and fewer groves stand like islands over the expanse of the prairies. The surface of the ground rises and falls in long, swelling undulations, separated in places by level stretches of country. The streams wind in long curves. The soil is light and warm. Corn and the grains, grasses, fruits, potatoes and the other staple products of Northern Illinois grow luxuriously, and are almost never failing.

Streams.—Green river enters the county about twelve miles from its northwest corner, flows south with very crooked windings through the township of Greenfield; then turns westward through the north

part of the township of Gold to the west county line, cutting off from this corner of the county the township of Fairfield and parts of the two townships just mentioned. Green river has here its usual characteristics. These three townships have in them large bodies of genuine Green river swamp lands. Big Bureau creek comes in from Lee county near the northeast corner of Bureau. It flows in a general southwest direction to a point a short distance west of the city of Princeton; from thence it takes a south course for ten or twelve miles, and then turns nearly due east and falls into the Illinois river some five miles from where the south boundary line of the county strikes that river. This stream has very little alluvial bottom land along its course. The prairie rises in rather abrupt swells from the banks of the stream. About Tiskilwa and on to the Illinois river there is an alluvial bottom, covered with a dense growth of timber.

West of Little Bureau creek is a tributary of the former, rising in the northern part of the county and forming a junction with the larger stream a few miles southwest of Princeton. It is a smaller stream, but of the same general character.

Brush creek and Coal creek are small prairie streams, the latter flowing near Sheffield, and losing itself in the Green river swamp land.

On the southeast corner of the county, the Illinois river forms the boundary line for a distance of some fifteen or sixteen miles. There is a broad alluvial bottom along the river on the Bureau county side. The lowest bottom is mostly a swampy, grassy plain, interspersed with sloughs, and ridges of river sand, and subject to inundations when the Illinois river sends out its floods over the low banks. One of these sloughs assumes the character of a lake, communicating with the Illinois river at its southern terminus. The town of Trenton is built upon the west side of this lake, half a mile or more from its outlet into the river. At ordinary or high stages of water steamboats enter this lake slough, and make their regular landings at Trenton. I shall have more to say of this valley when describing the geological formations of the county.

Timber.—Along Green river there are a few scattering bunches of rather scrubby timber. Big Bureau has a scattering belt along its margin for a considerable portion of its course above Princeton. Below that city it enters a timbered region. The townships of Princeton, Indian Town, Arispe, Lepertown, Selby, and Hall, in the south and east portions of the county, all have considerable tracts of timber. Those below Tiskilwa, and bordering the Illinois river,

are bluffy, and mostly covered with a scattering growth of such trees and brush as may be found in similar localities in the northern part of the State.

Big Bureau Grove, in the western part of the county, has a considerable body of timber.

Crow Creek, in the township of Milo, and Pond creek, west of Tiskilwa, two small streams not named above, have each some scattering trees along their courses.

"Dad Joe's Grove," in the northwestern part of the county, is a small grove on a very high elevation, and is a conspicuous landmark for a long distance over the prairies.

These groves and timber belts furnish a fair supply of timber, and add variety to the landscape.

The rest of the county is prairie land, some of it level and some undulating and rolling. The two northern tier of townships, the western and southwestern townships, and the north parts of Hall, Princeton and Selby, are such prairie lands.

The water sheds between these streams rise to a considerable height in places, but I had no means of ascertaining how high. The dip of these water sheds and the elevation of the different parts of the county above some given point, as for instance the waters of the Illinois river, would aid materially in fixing the true horizon of some of the coal seams to be spoken of hereafter.

Geological Formations.

No county in this part of the State presents so poor an opportunity for the investigation of its geological formations. With the exception of the Illinois river bluffs from Trenton towards Peru, in LaSalle county, and a small ravine or two near Tiskilwa, there is hardly an outcrop of a single rocky formation in the county. The Chicago, Burlington and Quincy railroad traverses the entire county diagonally from the northwest to the southeast corner, a distance of about forty-five miles. With the exception of a few gravel beds and clay banks, its excavations present no sections of interest to the geological examiner. The Rock Island and Chicago railroad traverses the southern part of the county through its roughest portions, from the west to the east line, and the same may be said of it. Green river, in this county, has no sign of an outcrop in its low, swampy banks. Big Bureau, West Bureau, and their tributary brooks, with but a few exceptions, cut into no rocky formations. When the railroads and streams, which traverse and cut a county in all direc-

tions, show no natural sections of the rocks, the difficulty of correctly describing the underlying formations will at once be seen. The following section of the Bureau county rocks and Drift deposits is approximately correct. The reasons for giving it thus will appear in subsequent parts of this report:

Ideal Section of Bureau County Formations.

1. Quaternary deposits, such as Drift clays and gravels, Loess, and alluvial clays and sands	150 to 250	feet.
2. Coal Measures, such as sandstones, shales, limestones, soapstone and hard clay	250 to 400	"
3. Cincinnati group of shales	?	?
4. Galena limestone	?	?
5. Trenton proper, or Blue limestone	?	?

Commencing with the top, I will describe these formations in the order of their succession. The descriptions are made from the best examinations I was able to make.

Quaternary Deposits—*Alluvium.*—The Illinois river bottom, on the west side of the river, lies in the county of Bureau from three miles below Peru to the south line of the county, a distance of from fifteen to eighteen miles in length. At its upper end it is not much over a quarter of a mile wide; at its lower, it gradually spreads out to a mile or mile and a quarter. For most of this distance there are two bottoms. The first and widest is a low flat expanse, composed of sloughs, river sand beds, finely comminuted black mud banks, boggy and mucky meadows, covered with a dense growth of wild grasses, and green scum-covered ponds, starred with water lilies. Most of this first bottom is subject to the annual overflows of the Illinois river. Very little of it is susceptible of cultivation, but where dry and high enough to be cultivated, it yields immense crops of Indian corn. The slough or lake on which the village of Trenton stands, runs up along the west side of this bottom for several miles. For part of this distance a heavy belt of bottom timber skirts the Illinois river. Some of the bogs, morasses, and sloughs in this low bottom, covered with green scum and almost seething beneath a summer sun, have a Stygian smell, and must be prolific breeding places for agues and intermittent fevers. The name Lepertown, applied to the part township lying along the Illinois river, is no misnomer.

I do not know the depth of this black, alluvial deposit of river mud and sand, but it is quite deep, perhaps thirty or forty feet in many places.

From forty to fifty feet above this first bottom of the Illinois river, and lying along its western bluff range, is another or second

river bottom or terrace. This one is from a few hundred yards to half a mile or more in width. It seems to be composed of sandy and marly clays, intermixed in places with marly-mixed gravels. It is a regular river terrace. Its eastern line is the old shore of the Illinois river. The railroad track is built along this river shelf or terrace, and the traveler, from the car window, obtains a fine view of the valley of the river, stretching away with its dark serpentine belt of timber, and glimpses of the slow-moving, shining water. In the diluvial epoch, when the water spread all over the low bottom, the Illinois river, lake-like in its expanse and slowness of current, must have presented a body of water larger than the Mississippi in its ordinary or even high stages of water.

The lower valley of Big Bureau creek has also a narrow alluvial bottom, back a few miles from its confluence with the Illinois river. This bottom is narrow, crooked, and covered with timber. The deposit is a rich, fat, marly one. A few small farms are opened in it below Tiskilwa. These farms are immensely productive.

The swamp lands of Green river are also alluvial deposits. They are grassy marshes and imperfect peat moors and bogs, containing great beds of black mud, muck, and impure peat.

The Loess.—The Illinois river bluffs, already referred to, are partially made up of an imperfect Loess deposit. These bluffs rise to a height of nearly one hundred and fifty feet, and display some of the characteristics of the bluff or Loess formation. The deposit is not as plainly marked, however, as the marly, partially stratified clays and sands along the Mississippi bluffs, about Fulton. Some of the steeper bluffs present bald knobs, and light-colored marly clays exist along their sides. Between Bureau Junction and Peru there are several places where landslides have taken place, and the formation is more easily recognizable. One of these is a marked feature in the landscape. At a distance, it presents the appearance of a heavy outcrop of a white sandstone. A closer examination shows it to be a heavy bed of sliding, crawling sand. It is a white, yellow-banded sand, marly in its composition, and exhibits the most marked lines and bands of stratification. The outcrop is about thirty feet in thickness. It may be found in the side of the bluffs, near the railroad track, some three miles east of Trenton. The caving sands have crawled down the hill almost to the railroad track.

This Loess formation thins out rapidly as it recedes from the bluffs, and soon loses itself among the drift clays, with which it is closely associated. These bluffs, for a part of the distance, in this

county, show no rocky outcrops along their bases or up their ravines, but are mostly made up of Loess and Drift-clays, and sands.

Drift.—The usual yellow and blue clays of this part of the State lay over this county in a thick deposit. The artesian well, at Princeton, shows them to be about seventy-nine feet thick there, before rock was struck. The record of that well shows that a thin bed of rock was then struck, only three feet thick, and then a hard-pan clay was penetrated to the farther depth of one hundred and fourteen feet. There may, however, be some mistake about this; the record was poorly kept. It is more likely that the thin bed of rock was some detached mass sticking in the Drift clay, and that the real depth of these clays here is about one hundred and ninety-three, instead of seventy-nine feet.

Some of the higher ridges of the prairies contain finely assorted gravel beds. This is true of that portion of the county between Sheffield and Tiskilwa. Some fair gravel beds are also opened along the railroad northeast of Princeton. But these gravels are full of marly clays and hard-pan. No coarse gravel beds and fields of bowlders were noticed. Some detached bowlders of black and flesh-colored granite were noticed at a number of places on the surface of the prairie. No beds of heavy coarse gravel were observed. The regular Drift deposits of the county belong to the lower and older Drift clays. I could observe nothing like glacial action, and the only evidences of the ice forces are the bowlders dropped from the icebergs floating over the submerged prairies.

Coal Measures.

On all the old geological maps of the State which I have seen, the northern line of the Illinois coal-field is marked too far south, both in this county and Henry. According to these maps, about one-half of this county—the north half—is underlaid by Silurian rocks. The north boundary line of the Illinois coal-field should commence at a point in the east line of Bureau county, ten miles south of the northeast corner of the county, nearly due west of Homer Station, on the Illinois Central railroad. Thence it should be drawn nearly due west, but curving or bellying a little to the south, until it crosses the track of the Chicago, Burlington and Quincy railroad, a little southwest of the village of Malden; thence it should bear off a little north of west until it intersects Green river at the northeast corner of the township of Gold; thence down Green river

to a point north of Geneseo, in Henry county; thence northwest until Rock river is reached, a few miles above Aldrich's mine, touching and taking off a small corner of Whiteside county. All of Bureau and Henry counties south of this line are underlaid by lower Coal Measure deposits.

A line passing through the points where coal is actually worked along the north margin of the Illinois coal-field, would pass across the State from Rock river, to the Illinois, as follows: Commencing at Aldrich's mine, on Rock river; thence southeast to Anawan, on the Chicago and Rock Island railroad; thence nearly east on the same road to Sheffield; thence to the shaft of Robinson, Dinke & Co., near the crossing of the railroads between Wyanet and Buda; thence north of east to Biernan's shaft, five miles east of Princeton; thence to the shafts and outcrops about LaSalle and Peru. Coal may yet be worked north of this last line, but at all events, the coal deposits extend as far north as the first described line.

It will thus be seen that over two-thirds of the county is underlaid by the Coal Measures. Having given their superficial extent, let us next obtain as good a vertical section as we can. Two artesian wells, one put down at Princeton and one at Tiskilwa, afford the best opportunities of making such a section. These wells are not always reliable, but they furnish the best data that can be obtained in this county:

Section of Artesian Well at Princeton.

		Feet.
1.	Soil, and yellow and blue clays	53
2.	Sand	20
3.	Clay, indurated hard-pan	3
4.	Stone—quality not given	3
5.	Clay, called hard-pan in record	114
6.	Quicksand	13
7.	Hard-pan and stone	10
8.	Gray sandstone, bottom hard	58
9.	Soapstone, bluish-buff color	12
10.	Thin mud vein	about 1
11.	Sandstone	12
12.	Hard rock, which cut tools	14
13.	Soapstone, of light color	?

The bed of soapstone at the bottom had been penetrated to a considerable depth, and the work had then been suspended. Contrary to general expectation, this well penetrated no coal seam. The boring is to be resumed for the purpose of trying to obtain a supply of water for the city.

Section of Artesian Well at Tiskilwa.

		Feet.
1.	Earth and soil	6
2.	Hard sandstone	40
3.	Brown clay	25

		Feet.
4.	Vein of sulphur	½
5.	Light-colored slate	2
6.	Black slate	1½
7.	White limestone	4
8.	Clayey soapstone	4
9.	Hard flinty rock	4
10.	White and black slate	1
11.	Soapstone	8
12.	Limestone	6
13.	Sandstone	7
14.	Alternating soapstone, sandstone, slate and clay	40
15.	Flinty vein	½
16.	Alternating sandstone and greasy clay	6
17.	Black slate and flinty vein	3½
18.	Fine white clay	2½
19.	Coal	1½
20.	Fire-clay	1
21.	Clayey soapstone	5½
22.	Light-colored limestone	6
23.	Hard clay and sulphuret of iron	5
24.	Yellow soapstone	6
25.	Shale, color not kept	3
26.	Alternating shale, slate, etc	16
27.	Clay seam	1
28.	Strata of flint ?	⅓
29.	Clay soapstone, etc	2½
30.	Hard clayey sandstone	12
31.	Softer sandstone deposit	13
32.	Brown stone	4
33.	White soft sandstone	?

This well was bored for oil, at a time when the oil fever was at its height. Some indications of oil in a spring near by caused the enterprise to be undertaken. Of course, the hoped-for petroleum was never struck. The general similarity between this and the Princeton section will at once be seen, after the rock formations are reached. The heavy, hard sandstone, where the similarity commenced, is, however, struck six feet below the surface at Tiskilwa, and nearly two hundred and sixteen below the surface at Princeton. The latter well, however, was commenced on the upland prairie; the other in the bottom of a deep ravine, with the Tiskilwa coal mines in the sides of the bluffs above the level of its mouth.

Outcrops of the Coal Rocks.—Natural outcrops of the rocky formations are very rare in this county. No county yet examined by me shows so few.

Coal valley is a little valley coming in from among the Big Bureau bluffs from the south, just above Tiskilwa. A ravine about two miles in length comes into this little valley from the west, about one mile and a half from its mouth. This ravine is known by the name of Rocky Run. A little stream tumbles down among the rocks and bowlders with a very rapid descent. The only stone quarry in this part of the county is in the bed of this tumbling stream. Huge masses of a hard, sub-crystalline quartzose sandstone block the

ravine in places. Considerable stone, for foundations and other economical uses, has been quarried and blasted from these masses. They are not *in situ*, and are not the natural outcrop of the formation to which they belong, but seem to be outliers detached from the parent strata, which are undoubtedly *in situ* under the clay bluffs on either side. These large outliers are somewhat water-worn. Among them are many large erratic bowlders of granite, trap, hornblende and quartz. One or two of the granite bowlders are very micaceous. A coal seam, one foot thick, outcrops in the midst of these large detached stones, underlaid by a heavy bed of blue plastic soapstone.

A section made in this little run showed the following approximate figures:

Section half-way up Rocky Run.

	Feet.
1. Bluff clays, yellow and buff	40 to 60
2. Gravelly clay, full of bowlders and blocks of sandstone	15
3. Coal, stained with iron	1
4. Blue, silvery, unctious soapstone	10

The bottom of this soapstone is still a good many feet above the mouth of the artesian oil-well, whose section has already been given. I have called this outcrop a sandstone; but some of its outliers, especially farther up the ravine towards the barn of Mr. Whiting, present the character of a limestone. The rock is entirely unfossiliferous, so far as I could see. A good specimen of *Lepidodendron* was found in this ravine a few years ago, according to local report. In geological interest and picturesque scenery, this little run is an interesting spot. I shall speak of its coal seam hereafter.

The next outcrops worthy of attention were found in following the Illinois River bluffs from Bureau to Peru. About two and a half miles east of the village of Trenton, along the base of the bluffs, which rise here to a bold height, the outliers of a rocky formation first begin to appear, on the farm of a Mr. Dustin, not far from where Nigger creek comes down through the bluffs. Stone is quarried to some extent for building purposes in Trenton and on adjoining farms. The stone is a hard sub-crystalline rock, similar to that outcropping on Rocky Run. In some places it resembles a quartzose sandstone.

In the Bureau county bluffs, from Nigger creek to the county line below Peru, good quarries could be opened in many places; but the difficulty of access to them, the sparse settlements in this portion of the county, and the great abundance of stone about Peru and LaSalle, have conspired to prevent the opening and working of the outcrops. In some instances the distinction between argillaceous

and quartzose sandstone and argillaceous limestone, is hard to determine, and I may be mistaken in the true character of these outcrops at Rocky Run, and about the mouth of Nigger creek. To me they looked like a sub-crystalline clayey sandstone, if such a rock can be supposed to exist.

These are the most important and almost the only outcrops in the county, except the rock strata found in close proximity to the coal seams.

The coal mines at Sheffield, in the township of Mineral, are the oldest and best known mines in the county. There seems to exist here one of those local coal deposits of limited extent, so common all over the northern part of the State. It is irregularly shaped, but would be found about four miles in diameter. Sections 22, 23, 24, 25, 26, 27, 28, 34, 35 and 36, in the township of Mineral, and several sections adjacent thereto, in the township of Concord, are estimated to contain more or less coal beneath the surface.* The Sheffield Mining and Transportation Company are operating several mines about a mile west of the village, and near the railroad track. A low range of hills, facing north and east, rises from Coal creek to the high prairie lying south. Into this low hill several drifts are extended to the south and west. Some of the drifts are inclined planes extending down to the coal. The drifts are driven into the hill about one-half mile. Twenty-five or thirty feet overhead productive prairie farms are tilled. Black shale, soapstone and irregularly-bedded yellow crystalline sandstone (?) compose the roof, not all found associated together, but some in one place and some in another. Over this slate or stone roof is a body of indurated clay. The coal seam is underlaid by a bed of indurated fire-clay. This under-clay contains some large nodular masses of limestone, some of them kidney-shaped and some of them round, and all flat. Fine impressions of fern leaves have been found in the roof slates, if the statements of the miners are to be relied on.

The coal seam itself ranges from four and one-half to five feet in thickness. A thin seam of light-colored fire-clay runs through the

* These apparently local deposits of coal, occurring along the borders of the Illinois coal field, are not detached outliers, but are localities where the coal seams attain their full thickness, and may be successfully worked, while in adjacent territory they become too thin to work, although they may attain their full thickness again within a distance of a few miles. An area of coal land is often pronounced unproductive, on the evidence obtained, perhaps, by a single boring, where the drill may have struck a "horseback," or some other irregularity in the coal seam, while another boring, but a few feet from the first, would have shown the usual thickness of coal. It is by no means safe to pronounce any considerable area within the confines of the coal field unproductive, on the strength of such evidence as may be obtained by one or two experiments with the drill. A. H. W.

coal seam near its middle; near the bottom some seams of shale also exist in the coal. This fixes the identity of the coal with that mined at Wataga, Galva, Kewanee, and the upper Peru coal. Prof. LESQUEREUX says that the Wataga coal is the same as the middle Peru seam. I have little doubt of the Galva, Kewanee and Sheffield coals being identical with the Wataga seam. The clay and slate partings in the coal are characteristic of this seam. On the general section of the coal seams of the State, this seam would belong to coal No. 6 or 7, according to Prof. WORTHEN'S reconstructed coal section, as published in the first volume of these reports, page 172.

The following description and analysis of this coal is taken from the Report on Illinois Coal, made by Prof. J. G. NORWOOD and his assistants:

Coal bright, hard, compact; fracture inclining to conchoidal; layers thin, and separated with minute seams of carbonaceous clod; contains a few thin seams of carbonate of lime; slacks on exposure to the weather.

Specific gravity	1.1986
Loss in coking	47.5
Total weight of coke	52.5
	100.0

ANALYSIS:

Moisture	7.0
Volatile matters	40.5
Carbon in coke	47.5
Ashes (white)	5.0
	100.00
Carbon in the coal	53.4

As a matter of general interest, I also give the analysis and description of this same coal, made some years ago, by Professors PORTER and B. SILLIMAN, Jr., who occupied the chairs of Analytical and Agricultural, and General and Applied Chemistry, in Yale College, at the time of making the report, from which I take the following extract:

Subjected to a moderate red heat, it yielded, in a hundred parts, as an average of two trials—

Volatile matter	29.32
Fixed carbon	64.90
Ash	5.78
	100.00

The specific gravity of the coal is 1.247, giving 2.103 lbs. to the cubic yard. These results are nearly identical with those obtained from a sample of English bituminous coal (New-Castle) recently analyzed by us. The coke obtained from your coal is of a very superior quality, being firm and of high metallic luster.

The amount of fixed carbon is large. It has been repeatedly demonstrated by experiment that the evaporative power of different coals is in proportion to the quantity of this constituent. Your coal is therefore of superior quality for the production of steam. We

have used the coal for several days in an open grate, and find it adapted for this use. It ignites readily and burns freely, cracking open as it becomes heated. It burns to a comparatively small quantity of ash, without producing clinker. To test thoroughly the effect of a high temperature on the coal, we burned a grate full of it, keeping the blower on, until it was entirely consumed. In this case, even, the quantity of clinker or fused ash was small.

In all our experiments with the coal, burning it in an open grate and otherwise, it has not contaminated the atmosphere of the room with sulphurous or unpleasant gasses in the slightest degree. Neither do we observe in the coal those layers or grains of pyrites or sulphuret of iron, such as are often found in bituminous coals, and are the source of the sulphurous fumes. By this we do not mean to say that your coal contains no sulphur. Sulphur is found in all coals without exception. But we find no reason to believe that it is present in yours in larger quantity than in other Western coals of established reputation.

We have tried your coal in a blacksmith's forge, and have the testimony of practical men to its superior quality for such use. For many purposes it possesses great advantages over more highly bituminous coals. It does not melt and cement, so as to render a frequent stirring of the fire necessary in order to keep up a draft. Neither does it swell objectionably on the fire. This property, and the firmness of the coke yielded, adapt your coal especially to use in founderies and smelting furnaces, for which purpose it may not improbably be used without coking. It is impossible, however, to give a definite opinion as to this without experiments on a larger scale than we have found it possible to make.

From these descriptions it will at once be seen that the Sheffield mines yield a very valuable coal. The analyses differ considerably as made at Springfield and at Yale College; that, however, may be owning to the coal analyzed having been taken from different Drifts of different parts of the seam. The coal sent to the Eastern chemists was, no doubt, the best that could be obtained from the mines.

The next coal mine of interest is near the Chicago, Burlington and Quincy railroad, south of and near the track, and about two and one-half miles northeast of Buda, on section 25, in the township of Concord. A small stream, and a small grove called Bilbenne grove, at this place, give variety to the prairie monotony. Coal has been detected all around this little grove, and there can be no doubt but that there is a productive coal patch of considerable extent to be worked out here. This is but about five miles from the Sheffield digging, in a southeast direction. A shaft is sunk in the bottom of the ravine, and a drift driven into the hill on the principle of an inclined plane. Messrs. Robinson, Dinks & Co. are working these mines, operating a steam engine to raise the coal from the shaft. The shaft is sixty feet deep; the seam of coal from four and a half to five feet thick, and said to resemble the Sheffield seam in appearance and in the quality of the coal. Forty feet above this heavy seam, and twenty feet below the surface of the ground, is another coal seam about two and a half feet thick; but the coal is of inferior quality. The shaft is used in mining coal in the lower seam, the drift for mining the upper one.

Section thirty-two, in the township of Center, is said to show evidences of coal, but as no coal mine is worked there, no examination was made of the place.

Following on southeast in the same general course, the next coal of workable thickness is found in Coal Valley and Rocky Run, near Tiskilwa. These mines have been worked for many years. Two or three drifts have been worked out and abandoned. There seems to be three coal seams at this locality. The lower one has only been found in the boring made for an artesian oil well, at a depth of one hundred and fifty-nine feet below the surface of the ground, at the mouth of the well. It has not been worked, and in the present state of coal mining in this part of the State is of no practical value. The seam is thin; access to it is difficult; its existence was only accidentally disclosed by the oil well boring, of which a section has already been given.

The next seam, called by the miners the middle Tiskilwa seam, is worked in many places. The mines are about half a mile farther up the stream, on the left bank or bluff of Coal creek; the entrances to the drifts are fifteen or twenty feet above the level of the water in the little brook, and still more than that above the mouth of the oil well. I cannot tell the distance between the lower and middle coal seams here, but judge it to be from one hundred and eighty to two hundred feet. The principal drift into this seam has been worked a long time, mostly by Messrs. Churchill & Shaw; the mine is nearly worked out and is abandoned at the present time. At the time I was there Messrs. Jobling, Sleeter & Snowden had just completed a new drift a few hundred yards above the old one; had struck the seam at a distance of one hundred and eighty feet under the hill, if I recollect right, and, so far as could be judged at that time, they were opening a very valuable mine. I have since heard that this mine is turning out an abundance of good coal. The seam is five feet thick. It can be easily drained; there is a fair roof of black-slate; below there is the usual bed of ordinary fire-clay. In some places soapstone takes the place of the black-slate roof.

This is doubtless the seam of coal from which the analysis was made by Mr. PRATTEN, while acting as Assistant in the Illinois Geological Survey. The following is his description and analysis:

This bed is of the same age as the middle (?) workable seam of LaSalle county, and like that bed is frequently interrupted with clay "slips." The portion of the bed examined is on L. D. Whiting's place. Coal very bright, hard, compact; layers generally thick, and separated with carbonaceous clod, sometimes nearly indistinct; frac-

ture conchoidal. Contains a very few thin seams of carbonate of lime, with occasional thin scales of sulphuret of iron. Swells but little in coking.

Specific gravity	1.363
Loss in coking	43.0
Total weight of coke	57.0
	100.0

ANALYSIS.

Moisture	7.5
Volatile matter	35.5
Carbon in coke	48.9
Ashes (white)	8.1
	100.0
Carbon in the coal	57.0

To this I might add that this coal makes a considerable amount of clinker and is inclined to become solid enough to clog the grate. As a steam-making coal it is hardly considered so good as that furnished by the upper seam, the clinker from which easily crumbles and runs through the grate. It is however a good coal for general purposes. Its accessibility and the ease with which it can be worked, make it a valuable coal.

Going up Coal Valley about half a mile, the outcrop of the upper seam is reached. It is well up on the hill side; supposed to be from forty to forty-five feet above the level of the middle seam. It might be possible that this so-called upper seam is but another outcrop of the coal just referred to, and that the difference in level is owing to a local disturbance; but I believe it to be a different seam, identical with and belonging to the same horizon with the upper coal at Robinson, Dinks & Co.'s shaft, near Buda, and Bierman's shaft, east of Princeton. Messrs. Worthington & Marshall are working a drift at the present time at this place. The coal is from one and a half to two feet thick. Black slate and shale are found over the coal; the usual fire clay exists below it. The clay bluff overlies all to the depth of about forty-five feet. The coal is softer than the other seam; has a reddish or rusty appearance, and cannot be worked to very great profit. The one foot exposure of coal, near the barn of Mr. Whiting, in Rocky Run, belongs to this seam, and lies at about the same general level. The following section will give a general idea of the Tiskilwa coal seams, and associate exposures, and underlying deposits.

Section of Coal Seam at Tiskilwa.

	Feet.	In.
Drift clays	40 to 75	
Black shale	2 to 4	
Coal	2	6

	Feet.	In.
Clays and shales	40	
Coal	5	
Alternations of shales, sandstone, etc., passed through in the boring	175 to 200	
Coal	1	6
Fire clay and clay shale	thickness unknown.	

No fossils were observed in and about these coal mines, except sections of a flattened coal plant of some kind, found in the roof slates of the upper seam. These fragments had become completely impregnated with sulphuret of iron; they presented a beautiful irridescent appearance, and readily split with the grain of the plant, showing its fibrous texture.

The next important coal mines are at Bierman's shaft, five miles east of Princeton, on section 17, in the township of Selby. Two seams are reached here. The following section will give an idea of this coal deposit:

Section at Bierman's Shaft.

	Feet.
1. Usual oak land soil and subsoil	4
2. Yellow, hard, ringing sandstone	10
3. Soapstone, clay, shale and other deposits	64
4. Coal—soft, rusty, inferior, No. 7	2½
5. Black shale, clay and sandstone	42
6. Coal—hard, bright, good quality, No. 6	5

The upper sandstone in the above section outcrops along the banks of the creek a few hundred yards below this shaft. This coal seam dips apparently toward the northwest. The shaft is operated by a common two-horse whim. The mine is a very valuable one, and it will pay to put on a steam engine and work it strongly. Another shaft, being sunk a short distance down the creek, had passed through the upper seam, and had reached the lower sandstone at the time I was there. The deposit, I think, is of considerable local extent, and ought to be more fully prospected. The coal is of excellent quality, fully equal to the Sheffield coal. The seams, I think, are identical. The drifts from Bierman's shaft run north and east a few hundred yards. Like the upper Peru seam, this is frequently interrupted by faults, clay slides and horsebacks. These latter are places where the coal gives out for short distances, and is replaced by bowlders, nodules, shales and a conglomerate mass of sulphuret of iron. The mines at Coal Valley, in Rock Island county, at Perry's, in Henry, at Tiskilwa and Sheffield in this county, and the upper working at LaSalle and Peru, all, more or less, have this characteristic feature, but are not therefore necessarily the same coals.

These are the only localities in the county where coal is worked to any extent. There is said to be a thin outcrop of coal on Nigger creek, among the Illinois river bluffs. This would be a few miles east of Bierman's shaft. If coal does exist there, it has as yet attracted no attention. There are several other localities in the county where coal is supposed to exist, but they are not worked, and have not even been thoroughly prospected.

The position to which these seams should be assigned in the general section of the coals of Northern Illinois is not easily fixed. The lower vein at Tiskilwa probably is the same as the lower La-Salle vein, being No. 2 of the section; and this is the only place, so far as I know, where a third vein has been discovered in the county. The seam worked at Sheffield; the lower seam at or near Buda; the middle seam at Tiskilwa, and the lower or worked seam at Bierman's shaft, are all identical with each other, I think, and are identical with the upper Peru and LaSalle coals. This seam, according to the new section for Northern Illinois, would belong to coal No. 6. The upper seam at Tiskilwa, at Bierman's shaft, and at the shaft of Robinson, Dinks & Co., is probably the equivalent of coal No. 7 of the new section of the Illinois coals. These seams are assigned to the horizons of the LaSalle coal seams, not on palæontological evidences; characteristic fossils seem to be scarce at all the localities examined; the coal seams themselves, however, and their associate rocks and shales, seem to justify such classification. The position of the Sheffield coal, near the surface of the ground, and no seam being found above it, would seem to identify it with the upper instead of the middle seam; but its place without doubt, I believe, is with the coals of No. 6 in the section referred to.

The general level of these seams varies greatly. The railroad track at Sheffield is eighty-eight feet above, and at Tiskilwa it is sixty-six below, the level of the surface of Lake Michigan. Estimating from the position of the coal seams, as compared with the railroad track at these places, there must be a difference in the level of the coal of from seventy-five to one hundred feet, in a lineal distance of some twenty miles, showing a dip of about five feet to the mile to the southeastward.

Silurian Formations.

There are no exposures or outcrops of the Silurian rocks in this county; but the northern one-third of it is underlaid by these rocks in about the following order:

The Trenton or Blue Limestone.—These rocks outcrops rather heavily at Homer, about two miles east of the Bureau county line, in LaSalle county. They doubtless continue the underlying rock west, or a little south of west, along the north line of the coal field, until they sink beneath the Coal Measures opposite to Princeton, and extend northward nearly to the C., B. and Q. railroad.

The Galena Limestone.—This limestone outcrops at Lee Center and near Sublette, in Lee county, and is probably the underlying rock in that part of Bureau county about and on both sides of Bureau creek, and between that creek and Green river, and north of the Coal Measures, with the exception of some elevated ground about "Dad Joe's Grove."

The Cincinnati Group.—These shales would doubtless be found underlying the grove just named, and may also underlie small patches in the northwest corner of the county, west of the Green river swamps.

Economical Geology.

Coal.—From what has already been said, in speaking of the coal seams and their outcrops, it will be seen that the coals of Bureau county are an important element of county wealth, and minister largely to the convenience and well-being of its citizens. I have no means of estimating the present amount of coal mined each year in the county. The Sheffield mines have been worked since 1853. Two hundred and fifty thousand tons of coal are supposed to have been mined and sold during that time at these mines. They are being worked extensively at the present time, and their supply is by no means exhausted. Thousands of tons have doubtless been taken out by farmers and land-owners, in small quantities at a time, of which no account has been rendered. The coal-field actually known to exist here has hardly commenced to be worked over, and may be found to extend much farther east, south and west than is now supposed.

The Buda shaft is worked strong enough to employ a steam engine, and is yielding at the present time a large amount of good coal. Other shafts, in course of time, will be put down here. There is evidence that coal underlies several miles in extent of surface around the grove where the present mine is worked. The necessities of the country, and the ease with which shafts reach this good

workable seam, insure more extensive operations at this locality. By the Buda shaft, I refer to the one between that place and Wyanet.

Almost the same can be said of the locality at Bierman's shaft. I am satisfied this is a valuable field of coal, of considerable extent, of easy access. It will be worked extensively at an early day, and will afford a large supply of excellent coal.

The Tiskilwa coal-banks are old banks, having been worked for many years. The amount of coal taken therefrom is not known, but they have at no time been worked as strongly as the mines at Sheffield, and the supply of coal has been much less. I am uncertain as to their future productiveness. For a time they were considered as partially worked out, but the heavy seam found in the new bank of Messrs. Jobling, Sleeter & Snowdon seems to show that the supply of coal is by no means exhausted. This discovery will probably add new impetus to coal mining in this locality.

There are many other localities in the southwestern and southeastern portions of the county, where shafts sunk to a moderate depth would strike coal from four to five feet thick. Along and among the Illinois river bluffs there is no reason why valuable coal deposits may not be found. Borings along the base of these bluffs ought to disclose the middle and even lower Peru coal seams; and if the ravines were carefully traced to their sources, outcrops and exposures of the upper seam would doubtless be detected under the talus and along the little streams.

Bureau county already produces coal enough to supply in great part the home demand, except a considerable amount of transported coal used in the larger railroad towns.

As fuel becomes scarce, and the demand therefor greater, the coal interests of the county will be more fully developed. The hungry maw of the iron horse, the iron stomachs of many steam boilers, a great increase among the people of coal stoves and coal-burning appliances, will constantly increase the demand for coal. These hidden sources of wealth and prosperity will then be looked up more carefully, and the supply will be found adequate to the increased demand for many years to come.

Building Stone.—So far as at present known, stone quarries are few, and the home supply of stone for building and other economic purposes is quite limited. I have already named the localities where stone is quarried, but even at these localities the supply and quality are both of such a nature as to make the quarrying of rock an item of small economic value. Heavy quarries could be opened below

Peru, but access to them would not be easy. The difficulty is largely remedied, however, by the ease with which stone from Peru and LaSalle, and from the marble quarries of Athens and Joliet, can be shipped on the intersecting railroads to convenient and accessible points all over the county. Lime from the banks of the Mississippi, about Rock Island and Port Byron, and from the stone ledges towards Chicago, is also readily obtained.

Clays and Sand.—The heavy Drift deposits over the county contain abundant supplies of sand and the common kinds of clays. Common red brick of good quality can be made at reasonable expense, and sands for mortar dug from almost every township. The facilities for building are thus within the reach of all. No minerals of economical value exist.

Peat.—Several peat beds exist in the Green river swamps in the township of Gold, and in one or two adjoining townships. Some of this peat is of fair quality and of considerable depth. But in the present state of our knowledge as to the manufacture of peat fuel, none of these beds possess very great value for burning and heating purposes. They, together with their associate muck beds, will some day possess a value as a fertilizer of the surrounding prairie soil.

Agricultural and Horticultural Geology.

Enough has already been said about the agricultural resources and capabilities of the county. They do not differ greatly from those of surrounding counties. Perhaps they are better than those of most other counties in this part of the State. The soil seems to have in it a little more fine silt—to be lighter and warmer than that of some of its neighbors. As a consequence of this, it is largely and uniformly productive of the staple products of Northern Illinois.

Fruits, and especially the hardier varieties of the apple, do remarkably well. The orchards about Princeton are among the oldest and best in Northern Illinois. According to the reports of the various *ad interim* committees of the Illinois Horticultural Societies, the apple orchards of Princeton are among the best in the State. I know not to what extent grape culture has been carried on in the county; but the nature and properties of the soil would justify the planting of the vine to a large extent. Some of the Illinois River bluffs on the east side of the county could be turned into profitable vineyards. Wine-making might be made remunerative in many places where

the land is now considered almost worthless. The small garden fruits, such as gooseberry, currant, strawberry, raspberry, etc., do well almost anywhere in this part of the State, and of course flourish luxuriantly in the warm light soil of this county.

EXPLANATORY NOTE.—The geological map of Northwestern Illinois, prepared by Mr. Shaw, to accompany this report, including a section of the formations outcropping on Rock river, was in the hands of the Western Engraving Co., in Chicago, at the time of the great fire, in October, 1872, and was utterly destroyed. The map is often referred to in the preceding pages. A. H. W.

CHAPTER XI.

HENRY COUNTY.

Henry county is bounded on the north by Whiteside county and Rock river, on the west by Rock Island and Mercer counties, on the south by Knox and Stark counties, and on the east by Bureau county. It is a very large county, being thirty miles long and thirty miles broad, and lying in the form of an exact square, with the exception of about two townships cut off from the northwest corner in a sort of triangular-shaped piece, by Rock river. It consequently contains about eight hundred and twenty-five square miles. The surface of the county is made up mostly of a high, rolling, fertile prairie, in places breaking into rough ridges and ravines. For a few miles back from Rock river, in the northwestern part of the county, and about Minersville, the land almost approaches the character of barrens, being interspersed with ravines and elevated ridges, partially covered by a somewhat stunted growth of oak timber. About the northeastern corner, the prairie becomes somewhat sandy, rising occasionally into white hillocks of sand, cut into picturesque shapes by the prairie winds. Across the northern part of the county, the broad valley of Green river is level, and chiefly composed of swamp lands, of which there is estimated to be some fifty thousand acres. This valley is rather a low, wet, swampy prairie, than a regular river valley. Green river enters the county from the east, about eight miles from the northeast corner, and flows almost directly west across the county, through the second tier of townships, until it enters Rock river, a few miles southwest of Colona. For a part of this distance, it is rather a succession of swamps than a river. At other places, it is a broad sheet of stagnant water, almost lost among the reeds, rushes and tall grass; but towards its outlet into Rock river, these waters gather into a stream of considerable

size and depth, with scarcely an appreciable current—a slow, lazy, stagnant stream, oozing along amid a deposit of black, greasy-looking mud—green with its coat of August scum, a very Styx of a stream, on whose filthy, scummy surface intermittent fevers and agues seem to play, like half-concealed, restless ghosts. Such a stream I have never seen before, not even excepting the liquid mud of the Pecatonica, which latter stream has a decent current or flow, when compared with Green river. And yet I would not convey the idea that Henry county is an unhealthy county. The salubrious air of her broad prairies quickly neutralizes any miasmatic influences thrown off by this local nest of fevers. If Pandora's box itself were opened on one of our broad, high prairies, the spirit of Health would drive thence the whole brood of ills and woes and diseases as they swarmed forth. The Edwards river flows across the southern part of the county, in almost the same relative position that Green river occupies in the north. The surface between the two, which is from twelve to fifteen miles wide, is a high, dry, rolling prairie, under a good state of cultivation, the water-shed of the two streams running not far from the middle of it. The Edwards river has a bottom averaging perhaps a mile in width. This is low, but not so wet or swampy as that of Green river. Both streams are almost timberless; the latter almost dries up in the summer season, but when swollen with rains, it is a formidable body of water. The country rises rapidly from the Edwards river bottom, assuming almost the form of a low range of undulating bluffs along its south side. The southern part of the county is of the same general character as that between these two streams, except the southeast corner township of Kewanee, which is somewhat broken, and covered with timber where most broken. Spring creek is a deep little prairie brook, which runs towards the north, and falls into Green river twelve miles from the eastern line of the county. These are the only streams of consequence in Henry county.

In addition to the scattering timber about the northwest and southeast corners of the county, in the townships of Kewanee, Colona and Hanna, the broad expanse of prairie is diversified by a few beautiful groves, many of them sadly marred by the settler's axe. Among these are White Oak Grove, south of the village of Andover; Sugar Tree Grove, east of Cambridge, the county seat; Hickory Grove, not far from Galva; Red Oak Grove, in the township of Weller; a small grove near Council Hill; and several small barren groves, whose names I do not now recollect. These furnish

a fair supply of timber for their immediate neighborhood, but will become exhausted in process of time, unless timber-growing receives more attention on our prairies.

In an agricultural point of view, this county is hard to excel. Such a large proportion of the surface is under cultivation, that its grain-producing powers must be immense. Such being the case, wealth, and a high state of prosperity, are found to characterize its citizens.

Its groves; its rolling fertile prairie lands; its remarkable marshes along Green river, being a continuation of the famed Winnebago swamps; its few sand-hills; and its unequalled Green river, are the most prominent characteristics of its surface topography, and do not differ materially from those of adjoining counties north and east.

Geological Formations.

These consist of the usual Quaternary deposits, the lower Coal Measure series, and some low outcrops of the Hamilton and Niagara limestones. The geology of the county, at first thought, appears quite simple; but the paucity of stone quarries, and workable outcrops, over most of the county, makes the problem more difficult than one would at first imagine. The best section I can construct will give the formations about as follows:

General Section of County.

	Feet.
Alluvial deposits and Drift clays	50 to 100
Lower Coal Measures	250 to 300
Hamilton (Devonian) limestone	20
Niagara or LeClair limestone	15

In this section a very marked hiatus of Illinois rocks will be observed between the Hamilton limestone and the Coal Measures.

Niagara Limestone.—In the bed of Rock river, where it first touches the northwestern boundaries of Henry county, and from thence about half way to Cleveland, the soft, fine-grained, yellowish LeClair limestone shows itself, and is quarried during low stages of the river, at one place to a considerable extent. The Coal Measures at Aldrich's, and Johnson & Kent's coal mines, rest directly upon this member of the Niagara limestone. Except this limited outcrop in the banks and bed of Rock river, this formation cannot be said to be developed in the county. At ordinary stages of water in that stream, the outcrop would hardly be detected. With the exception of a few *encrinite* stems, no fossils were noticed in it.

Hamilton Group.—On descending Rock river from the Niagara outcrops just mentioned, the lower division of the Hamilton limestone is next discovered, commencing in the bed of the river about a mile and a half above Cleveland, and continuing as the river flows to the west line of the county, and thence west at intervals across Rock Island county, A short distance above Cleveland, and two or three times below it, in a distance of three miles, a short axis of upheaval appears to extend from the river almost south across Rock river bottom, which is here three-fourths of a mile in width, and runs under the bluff line. At these places the Hamilton limestone comes to the surface of the ground, where the rains or little streams have removed a few feet of the top soil. These axes, or undulations, rise twenty-five or thirty feet above the low bottom land of Rock river. Between are depressions or troughs, filled with Coal Measure deposits. The heavy seam of coal, worked so extensively at Cleveland, rests in one of these basins, and extends half way across Rock river, resting almost directly on the Hamilton limestone. The top of the axis spoken of above, east and west of the coal basin, is higher by several feet than the coal seam. Southward, however, the Coal Measures continue uninterrupted under the bluffs to Coal Valley and the Minersville mines.

These natural outcrops of the Hamilton limestone are massive and solid in their structure. The stone breaks with a smooth conchoidal fracture, almost resembling polished marble. On fresh fractures the color is a beautiful bluish-white or pale dove color. A semi-transparent, splintery, horny appearance was noticed in some cases on breaking a rock to pieces with smart blows of the hammer. No fossils were observed. Indeed, the lower portion of this rock is almost devoid of organic remains.

While making these observations, parties were engaged in boring an artesian well, two miles above Cleveland. Prospecting for petroleum and coal was the object of the boring. Any practical geologist could have told the proprietors that their hopes would not be realized, and that their labor and money was being foolishly expended. In connection, however, with the geology of this part of the county, they made an interesting hole in the ground, of which the following is the best section I could obtain:

Section of Artesian Well near Cleveland.

	Feet.
1. Black earth, alluvial deposit	12
2. Black and dark-colored shales and slate	18
3. Dark limestone, cap rock of Cleveland coal	3
4. Limestone (probably Hamilton and Niagara)	398
5. Soft shale (probably Cincinnati group)	77

At this depth the drill struck a sharp, hard rock, with sandy grit in it. How much deeper this well was put down I have not ascertained. Another artesian well was put down, just north of Kewanee, to a depth of six hundred feet, in search of water, I believe. No accurate record of strata bored through was kept. Three hundred and fifty or four hundred feet of the bottom penetrated a hard, light-colored limestone, being perhaps the same formations passed through in the lower part of the Cleveland well. This, however, is only conjecture.

Coal Measures.

With the exception of the formations just described, the whole county is underlaid, below the usual drift deposits, by the lower Coal Measures. It is quite difficult to obtain a correct knowledge of the local extent of particular deposits, on account of the scarcity of outcrops. In other counties the railroads and the streams nearly always expose the upper rock formations, and give, in their cuts and banks, well marked outcrops. In Henry county the railroads only afford a few clay cuts, not once exposing any rock formation. The river banks of Green and the Edwards are, if possible, still more unfavorable for geological examinations. Not once, so far as I know, do the banks or bends of these streams afford good outcrops of even the sandstones and limestones of the Coal Measures. Large portions of the county are utterly without stone quarries of any kind. In a few places fragmentary outcrops of rotten sandstone, or defective shaly limestone, occur; and in a very few localities limestone or sandstone is quarried in abundance. I shall first speak of these outcrops, before attempting to describe and trace the coal seam.

Sandstone.—Overlying the lower coal and its roof of black shales and dark limestone is a heavy deposit of coarse-grained sandstone. The rock is gritty, not very hard, of a creamy-brown or dirty-whitish color, and greatly resembles the sandstone deposit north of Morrison, except that the soapstone seams are wanting. Three miles below Cleveland, in the face of the river bluffs, but near their base, and at several places below or farther down the river, the outcrop is conspicuous, and has been quarried for local uses. The outcrops are partly hidden by talus; but the sandstone at these localities seems to be from twenty to thirty feet thick. This same sandstone, on a line westward, outcrops heavily at Camden, at Hampton, and opposite the latter place in Iowa. At the latter place some fine specimens of *Lepidodendron* were found some years ago. The principal outcrops about Cleveland are on sections 20 and 35 of town-

ship 17, range 1 east. At Moline it also outcrops, and at Hampton it covers a thin coal seam or trace of coal.* At Camden the coal seems to be above the heaviest body of sandstone. At Hickory Grove there is a light sandstone outcrop, not very thick; stone poor quality; quarried by neighboring farmers. In the valley of Green river, up the latter valley, and into the bluffs of Mineral creek about Minersville, the same bed of sandstone shows itself in several places. The outcrops here run from seven to twelve and twenty feet thick. On section 3, in the township of Munson, and not far from Cambridge, some poor sandstones are quarried. In the shaft of the Platt Coal Company, just east of Kewanee, thirty feet of heavy sandstone was struck immediately overlying the coal seam at the bottom of the shaft, but this bed is about a hundred feet below the surface.† In the vicinity of Red Oak Grove a thin, rotten, Carboniferous sandstone has been quarried by the farmers, and used for farm purposes. One well was walled with this material. The wall decayed or rotted down, and the well caved in after it had been in use for a series of years. On section 20, on Spring creek, in the township of Atkinson, there is a small stone quarry, but my notes on its characteristics have been misplaced or lost.

These are the best tracings I have been able to make of this bed of sandstone. Its place in the geological section of the county seems to be above the heavy, lower, workable seam of coal, sometimes separated therefrom by shales and limestone, and sometimes appearing to rest almost directly on the coal. Its position is by no means constant, however. It is also almost unfossiliferous. A few tracings of *Calamites* and *Lepidodendron* were the only organic remains I could find in this deposit.

Limestone of the Lower Coal.—The "cap rock" over some of the coal mines is a dark-colored, almost black, and sometimes shaly limestone, in which is frequently found a small and beautiful *Productus*. The coal seam at Aldrich's mine is overlaid by a thin stratum of shale, which is capped by a hard, blue, shelly limestone. This limestone is quarried in small quantities here, and sold at a high price to neighboring farmers. At Cleveland the coal seam is stripped of its superficial covering over several acres in extent. The

* NOTE.—We think Mr. Shaw has here confounded two distinct beds of sandstone that at Camden begin below the main coal seam, instead of above it. The sandstone above the coal is a much more durable, and is generally a harder rock than the bed below.

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† NOTE.—This sandstone overlies coal 5 or 6, and is at least one hundred and fifty feet above either of the beds outcropping in the vicinity of Camden, Moline or Carbon Cliff.

A. H. W.

limestone is more massive here, not quite so dark in color, and rests almost directly upon the coal. Hundreds of cords of it are stripped from the coal. The deposit is from one to two feet thick, and great quantities are sold at remunerative prices. Large numbers of the heavier stones thus quarried are to be used in the railroad bridge to be built across Rock river at this place. Immense slabs, more than a foot in thickness, obtained at the lower opening, are piled over an open space, ready to be transferred to the piers in the river. Some of these show signs of crumbling round the edges, as if the tooth of time had gnawed into their surface. We doubt whether they will prove entirely satisfactory for railroad masonry. Above this massive strata, and separated from it by from four to seven feet of shales and black, hardened carbonaceous mud, is another strata of lighter-colored, thin-bedded, shaly limestone, which is also corded up and sold for lighter masonry. The supply of stone thus obtained at these coal mines is very considerable. About Minersville the same limestone is found in connection with the coal seam, and a section here would be very similar to the Coal Valley section, except the sandstone above spoken of.

Along the banks of Geneseo creek, a little southwest of the city of Geneseo, there is a very curious outcrop of stone, which has been worked to some extent in former years. The top of the stratum is a sandstone for about two feet in depth. It then gradually changes into a blue, compact, or dark-colored limestone, having a nodular or concretionary appearance. The whole rests on several feet of compact, hardened carbonaceous mud. But the most curious deposit in this interesting locality is a thin stratum of "cone in cone," outcropping in the yellow-clay, several feet above the top of the sandstone. The stratum is from two to four inches thick, has a woody or fibrous texture, the grain running vertical to the plane of stratification; on being dug from the ground it falls into small blocks, having the appearance of wood split from a thin section of a large tree. In one or two of the low, rain-washed hills in that vicinity, I noticed this same outcrop, with no signs of the underlying rocks. Large quantities of this "cone in cone" have been gathered up for cabinets. Its resemblance to petrifactions of wood is very complete.

The Coal Seams.—In the northwestern part of the county there is one heavy coal seam, well developed, and worked to a large extent. In the southeastern part of the county, and extending up through its central portion, there are two seams, the lower of which is largely mined. Commencing with the former, and at the outcrop highest up Rock river, within the county limits, we find ourselves at Aldrich's

mine, on section 24, township 18, range 2 east. The coal is here about four feet six inches thick. It is overlaid by a few inches of dark shale, and this is in turn capped by the thin stratum of black limestone, spoken of above. A bed of ordinary fire-clay lies under the coal. The mine is opened into the point of a hill, up a wooded, romantic ravine, about one-half mile from Rock river, which here washes the base of the bluffs. A steam engine pumps out the water and draws the coal-cars up an inclined plane. The drift extends toward the south at a heavy dip near its opening. The mine has been worked for many years. The coal is a bright, moderately hard, thin-seamed coal, with carbonaceous clod between the seams, and vertical markings of carbonate of lime in the perpendicular openings. The following analysis shows its composition:

Specific gravity	1.261
Loss in coking	43.1
Total weight of coke	56.9
	100.0

ANALYSIS:

Moisture	6.0
Volatile matters	37.1
Carbon in coke	49.9
Brown ash	7.0
	100.0

This analysis was made for the State by Mr. PRATTEN, I believe, and gives the general character of the coal in the northwestern part of the county. An approximate section at this coal mine gives about the following figures:

	Feet.	In.
Drift clays of bluffs, light color	50 to 70	
Dark, shelly limestone	2	
Shale and black slate		6
Coal (No. 1)	4	6
Fire-clay	10	

All above the water level of the river.

Half a mile below Aldrich's mine is the drift of Messrs. Johnson & Kent. The upper part and outer edges of the seam here pass into a very solid, shining cannel coal, with smooth surface and conchoidal fracture. Messrs. Johnson & Kent believe the seam is not identical with the one worked at Aldrich's mine. The roof is of soapstone and shale, and there are some indications of two seams, ten or twelve feet apart, but approaching each other under the hill. There is, evidently, some local displacement here, and probably a local separation of the seam, such as is witnessed occasionally in working the Coal Valley seam.

The next important workable locality is at Cleveland. Here, most of the coal is *quarried*, not *mined*. The surface deposits are stripped off, exposing the seam, which is from four and a half to five and a half feet thick. The quality of the coal is similar to that at Coal Valley, except that it is a little better. The ash is not so red, in fact is almost white, and this is probably the better steam coal.

Section at Cleveland, from the top of Rock River Bluffs.

		Feet.
1.	Bluff clays of the drift	50 to 60
2.	Whitish-brown, coarse sandstone	20 to 25
3.	Gravel bed of ochre color	2 to 5
4.	Carbonaceous black shale	3
5.	Black limestone	2
6.	Coal seam	5
7.	Fire-clay	12
8.	Hamilton limestone	Bottom.

Three or four mines are being worked in close proximity to each other. Taylor Williams has a steam engine in operation, and he both strips the seam and runs slanting drifts into it. Mr. Stokes and Mr. Jefferson Taylor also mine to some extent. The basin or hollow, between two uplifts of the Hamilton limestone, in which this Cleveland coal seam is found, is narrow at the place where the mines are worked, being only a few hundred rods wide, and coming to almost a point in the bed of Rock river. The coal seam widens out towards the south, but becomes thin where it runs under the river bluffs. Still farther south, and about two and a half miles from the Cleveland coal quarries, is the Green River valley, which intersects the Rock River valley a few miles below. This Green River valley, for several miles round Colona, is all underlaid by the Cleveland coal seam. The south slope of the bluff range between Rock river and Green river at this place, where prospected by borings, also shows the seam or traces of it, at many places. The same seam outcrops and is mined extensively on Mineral creek farther south, and at Coal Valley, southwest a few miles. On the Green river bottom—the underlying rock—the cap of the coal seam is from seventeen to twenty feet below the surface. The seam at Cleveland furnishes one ton and a half of coal to the superficial square yard of its surface. The section there made will give a general idea of the Coal Measures on Mineral creek, farther south, and for the rest of the northwestern part of the county. No two sections, of course, would be exactly alike; but the resemblance would be very marked.

The superficial extent of coal lands, underlaid by this coal seam, extending from Cleveland around by Mineral creek, Minersville, Coal Valley, and Green River Valley, so far as now prospected, contains perhaps some forty thousand acres. On a railroad and coal land map, made by the chief engineer of the railroad about to be built along Rock river, some fourteen sections and parts of sections are marked as underlaid by coal in township 17, range 2 east; in township 17, range 1 east, some twenty-two sections and parts of sections are similarly marked; in township 17, range 1 west, some ten sections and parts of sections are marked as containing coal underneath; in township 16, range 1 west, five or six sections are similarly marked; in the same township and range east, three sections are coal lands; in township 18, range 2 east, some ten more sections are supposed to be underlaid partially by coal. These east ranges are in Henry county; the west ones are in Rock Island county. The Cleveland mines are in township 18, range 2 east. Other sections will, no doubt, be found containing coal in this vicinity. Of course, all the above marked coal lands are not underlaid by heavy coal deposits. Wherever coal or its traces were detected by the engineer in charge—Mr. J. C. Abbott, to whom I am under many obligations for favors extended—the same was marked coal lands on the map. My own personal examinations confirm the general correctness of this map.

The following worked mines in this coal field should not be passed over without notice. On or between sections 17 and 18, township 17, range 2 east, Mr. Shepherd is successfully operating several shafts; on section 22, township 17, range 1 east, Perry's mine is also now in successful operation; Glen's mine, on section 20, in the same town and range, and some mines on section 21, township 17, range 1 east, now are or have been successfully worked. The seam is from four to six feet thick in this group of mines. It has an easterly dip, and appears to be lower at Shepherd's mines than at the mines of Mr. Perry.

In one of these mines, where a drift is driven into the seam, the coal is separated into two bodies, the upper three feet thick, the lower two feet, separated at the outcrop by seven feet of clay parting. These two parts of the seam approach each other under the hill, and unite in a distance of about six hundred feet.

Shepherd's mines are located about two miles south of Green River Station, on the railroad. He is operating two shafts, and driving one drift mine. The shafts are sunk near the base of Mineral creek bluffs. The roof here is stone, same as at Cleveland.

The shafts are about sixty feet deep. The coal seam is thickest on bottom or low land, and thins when followed under the hills, same as at Cleveland. One shaft is operated by a steam engine, one by a gin; both have what the miners call a "sump" in the bottom, for convenience in lifting water out of the mines. The Drift is an inclined plane, extending from the surface to the level of the coal. The heavy, overlying sandstone is higher above the coal than at Cleveland. The shafts and drifts both extend into the same seam. The coal is supposed to be stronger and duller in color than that mined at Cleveland. In Shepherd's mines there is a black shale in places below the coal.

At Minersville, the mining was all done by driving drifts into the seam from and near its outcrops. These mines are well worked out. Others may be found, when the demand for coal becomes greater. The competition, at the present time, between Cleveland and Minersville coal on the one hand, and Coal Valley coal on the other, is spirited. The latter has a little, and but little advantage, in the item of transportation to market.

Perry's mines, almost adjoining the latter mines, still furnishes coal in paying quantities. This mine is also reached by drifting into the coal seam. The most noticeable feature here is the basins or "horsebacks," filled with a conglomeration of nodular masses of clay and sulphuret of iron, which are characteristic of this mine. Some of them are several yards in extent.

The seam under Green river and its valley, in the townships above named, contains a great deal of coal; but the roof is poor. This has prevented its being strongly worked.

From what has been said, it will now be seen that there is a large supply of coal stored away in the northwestern part of Henry county, for the present and for future generations. The mineral resources of this part of the county will not soon be exhausted, but will, as they now are, continue to be a source of wealth and material prosperity to the county.

Another heavy coal deposit lies in the southeastern part of the county about Galva and Kewanee. Between this and the Cleveland and Mineral creek mines, and over a diagonal strip across the county from the northwest to the southeast corner, which averages from ten to fifteen miles in width, coal has been found in many places. The seams, however, are thinner than at the two corners. Some of the shafts have been abandoned, and some never were worked at all. I propose to briefly notice some of the coal mines discovered

in this portion of the county, before describing the important coal mines about Galva and Kewanee.

About one and a half miles northwest of Geneseo, there is an abandoned shaft, where a coal seam from one and a half to three feet thick was found at a depth of about sixty feet. This, I believe, is the old Allen's mine. Indurated clay, limestone and sandstone were all penetrated in sinking the shaft. The coal was of good quality; bright iridescent in color; hard, even fracture, and rhomboidal cleavage. The seam was considered too thin for profitable working.

At Atkinson, the next station east of Geneseo, on the Rock Island and Chicago railroad, the well dug to supply the large steam mill standing near the depot, passed through a seam of coal three feet thick, and twenty feet below the surface. One-half mile east of this well there is a shaft still worked, out of which has been taken about ten thousand bushels of coal. The seam is here three and one-half feet thick, and twenty-two feet below the surface, and is operated by a horse gin. There is in this locality a good slate roof over the coal, ten feet thick, and it is underlaid by a bed of fire-clay.

About four miles northwest of Cambridge, in the township of Oscoe, Mr. A. A. Crane has put down a coal shaft, striking a seam from thirty-two to thirty-six inches thick, at a depth of eighty-seven feet. The seam appears to thin out towards the north and thicken towards the south.

On the farm of Samuel Dixon, in Munson township, eight miles east of Cambridge, coal is mined to some extent, the seam being the same as at Atkinson, and twenty-four feet below the surface. Two miles south of Cambridge, a shaft was being put down when I was there. A boring previously made was reported to have indicated coal, at a depth which I do not now remember.

Coal is mined in this vicinity about Round Grove, equally distant east from Cambridge and north from Galva, and in considerable quantities. It is hauled in wagons to Cambridge and over the surrounding prairies, and thus finds a ready market at the mines.

In a few more places over this broad strip of country between Cleveland and Kewanee, coal has been discovered; but sufficient has been said to indicate the general character of the seam here mined. I come now to the most extensively worked locality in the county, and perhaps the heaviest deposit of coal within its limits. Galva and Kewanee, both in the southeastern corner of the county, but a few miles apart, are widely known as coal mining localities; but at the latter place the mines are worked to much the greatest

extent. Five or six shafts are put down at Galva, known as the shafts of Messrs. Knox & Co., Cummings, Johnson, Lindsey, and Barnum. The following section, made at one of them, illustrates the character of all. They are in a group, within a radius of a mile or two, and are as much alike as coal shafts usually are, penetrating the same seam, and put down near together through essentially the same formation and superficial deposits.

Section of Galva Coal mines.

		Feet.
1.	Yellowish Drift clay	32
2.	Hard rock, bottom softer and sandy	12
3.	Soapstone, top light-color, bottom dark-color	14
4.	Black or dark-colored slate	2
5.	Coal, with clay seams No. 6	4
6.	Fire clay	about 9

The coal here is of good quality, and similar to the Kewanee coal. The seam is probably identical with coal No. 6, of the general section of the Illinois Coal Measure. At Galva the clay and shale partings are not so well marked as at other points, and at some of the shafts indications of cannel coal may be seen along the top of the seam.

At Kewanee, much capital is employed in the coal mining business. During the past year (1867) fifty-three thousand tons were raised here, of which thirty-two thousand were shipped on the Chicago, Burlington and Quincy railroad to various points, fourteen thousand were used by the railroad company, and seven thousand were used for home consumption in Kewanee and neighborhood. The revenue thence derived amounted, during the year, to over one hundred and forty thousand dollars. The productive mines are within a radius of three miles north and east of the town. Within this small area some eight shafts have been put down, and twenty drifts driven in. The shafts are sunk from the general level or face of the country; the drifts are driven upon the outcrops in some deep ravines, passing up from a good sized brook three or four miles north of the town. The face of the country, among these mines, is rough, and covered with a scattering growth of barren oak timber.

The shafts are operated by the following companies and individuals: The Platt Coal Company, Messrs. Walker & Co., Breckens & King, McCartey & Kirby, K. Murchison, J. C. Bowerman, H. Martin, W. S. Carnly, and one or two others of less note. Of these, the Platt Coal Mining Company, whose mine embraces about one thousand acres of land, located one mile east of the village, does by far the largest business, and by some arrangement handles and markets

all the coal dug in all the mines in this vicinity. Their shaft is near the railroad track, and they have a very convenient mode of loading the coal into the cars. At the depot, there is also a large elevator-shaped building, used for the purpose of feeding passing locomotives with their supplies of coal. A section of these mines, made at the Platt Coal Company's shaft, is as follows:

		Feet.
1.	Soil, subsoil and yellow clay	5
2.	Oily looking quicksand	20
3.	Soapstone, light and dark-color	25
4.	Upper coal seam No. 7	2½
5.	Fire-clay	10
6.	Soapstone	?
7.	Sandstone, same as at Galva	30
8.	Middle coal seam No. 6	4½
9.	Alternating soapstone and sandstone	80
10.	Carbonaceous shales and coal traces (No. 5 ?)	a few inches.

The four and a half foot vein is the same as the Galva seam, and is, probably, identical with the upper seam at LaSalle, and with coal No. 6 of the general section of the State. The upper seam, some forty-two and a half feet above the lower, is perhaps No. 7 of the same section. The lower eighty feet of the foregoing section was prospected by boring an artesian well in the bottom of the Coal Company's shaft, and ought to be regarded with some doubts as to whether it shows correctly the indications of coal in the bottom. The bed of quicksand or shifting sand, No. 2 of above section, was struck near the depot, in a shaft now abandoned.

The supply of coal at Kewanee and vicinity is very large, and will not become exhausted for many years. Newly discovered mines will replace those worked out, and the revenue derived from this deposit of mineral wealth will build Kewanee into a place of consequence.

In Norwood's report upon Illinois Coal, I find a description and analysis of cannel and bituminous coal, taken from the same seam, at a place then called "Serrell's mine," which it may be well to insert, in this place, for convenience of reference:

Serrell's Mine, Kewanee.

Thickness of the bituminous portion of the bed, four feet, underlaid with fire-clay. Coal bright and dull in alternating layers; hard, compact, fracture tolerably even. Contains thick seams of carbonate of lime, which cross each other at right angles, causing the coal to break into slightly irregular cubes. Has sulphuret of iron disposed both horizontally and vertically. The layers of coal are thick and separated with carbonaceous clod. Coke very bright and good, but swells in coking.

Specific gravity	1.232
Loss in coking	42.2
Total weight of coke	57.8
	100.0

ANALYSIS.

Moisture	9.0
Volatile matter	33.2
Carbon in coke	52.8
Ashes (gray)	5.0
	100.0
Carbon in the coal	52.2

Cannel Coal in same Seam.

Thickness of the bed from eight inches to one foot; overlaid with black slate; underlaid with four feet of bituminous coal. No analysis of this coal has yet been made, but, judging from its texture and general appearance, it does not differ from the Wataga cannel coal. The coal is dull, hard, compact; fracture slightly conchoidal; layers thick; contains bright, yellow, vertical plates of sulphuret of iron.

NOTE.—While engaged, during the past spring, in examining the coal deposits of Rock Island, I was induced to extend my examinations into Henry county, in part to confirm observations previously made in adjoining territory, and partly to satisfy myself as to the general development of our workable coal seams along the northwestern confines of the Illinois coal field.

Commencing at the northwest corner of the county, coal No. 1 of the Illinois River section is opened and worked at various points in the bluffs of Rock and Green rivers, as at Cleveland and near Colona, as shown by Mr. Shaw, in the sections given on the preceding pages, and it presents the same general characters here as at Carbon Cliff, Coal Valley and other points in Rock Island county. It is overlaid by a peculiar dark-gray siliceous limestone, and its accompanying band of flint or chert, that enables any one to identify it without difficulty. This seam is worked by the Messrs. Perry, at Briar Bluff, near Green river, in Henry county, by a tunnel driven into the hillside. The coal is somewhat variable in thickness, and is sometimes cut off altogether by what the miners term a "horse-back." About forty feet below the coal the shaly limestones of the Hamilton group outcrop but a short distance to the northward of the mines. A curious phenomenon was observed at these mines, in a remarkable geode-like cavern, or pocket, occurring partly in the coal, and extending into the fire-clay beneath. The cavity was ovate in shape, and about ten feet long by five feet in width, and two or three feet in depth, and surrounded by a solid crust. The inclosed cavity was filled with water and gas, and when the pick broke through the crust an explosion followed like the firing of a blast. On breaking into the cavity it was found to be thickly set with magnificent crystals of dog-tooth calcite, from six to eighteen inches in length, the points all directed towards the center of the cavity, like the crystals on the inner surface of a geode. Unfortunately many of these fine crystals were broken up and destroyed in removing them, but a few were preserved, and I was fortunate in securing some of them for the State cabinet.

On the southwest quarter of section 21, township 17, range 1, coal seam No. 2 has been opened near the top of the bluff and immediately under the bowlder-clay. The coal is eighteen inches thick, and is overlaid by four or five feet of clay shale, forming but a poor roof. This was the first exposure of No. 2 that we met with in Henry county. The coal was underlaid by a few feet of fire-clay and clay shale, and not sufficiently exposed to be accurately measured, which was followed by a bed of bluish-gray septaria two or three feet thick, exactly like that found below the Colchester coal in McDonough county. This coal appears to be from thirty-five to forty feet above coal No. 1 at this point.

At the Mineral Creek mines I found coal No. 1 worked at a shaft sixty feet in depth, and sunk in the valley of a small creek, and about one hundred and fifty yards southeast of the shaft the same coal outcrops seventy-five feet above its level in the shaft. In a boring made at this point below the coal, they reported seven feet of fire-clay and forty feet of shales, partly blue and partly gray, with a streak of coal, from two to four inches thick, about half way to the bottom. Some layers of sandstone, and one or more thin bands of iron ore, were passed through towards the bottom of the boring.

At the Mauch Chunck mines, about six miles west of Geneseo, coal No. 1 is worked just above the level of the creek by tunneling into the hill along its outcrop. It is here much thinner than it usually occurs in this part of the county, being reported as varying in thickness from two feet to three feet six inches. No. 2 is found here outcropping about forty feet above No. 1. A tunnel has been run into it, and considerable coal taken out, though the seam is here only from twelve to fifteen inches in thickness.

At Geneseo coal crops out along the little run on the west side of the town, and is worked by Mr. Maynard in a shaft sunk from a higher level near the outcrop. The beds passed through in this shaft give the following section :

	Feet.	In.
No. 1—Soil and drift clay	20	
No. 2—Hard rock (probably limestone)	1	3
No. 3—Sandstone	5	
No. 4—Blue shale	3	
No. 5—Coal	0	3
No. 6—Hard dark shale	6	
No. 7—Hard rock (concretion ?)	0	4
No. 8—Clay shale, or fire-clay	1	3
No. 9—Blue shale	10	
No. 10—Black shale	0	6
No. 11—Coal	3	8

This seam has a parting of dark shale of variable thickness, and I am inclined to regard it as No. 2, which is frequently separated by a shale parting. The coal is also a rather soft and light coal, more like No. 2 than any other, though it contains more pyrite here than is unsually found in it at more southern localities.

At Atkinson a coal seam about three feet in thickness has been opened on the eastern borders of the town, where it lies about fifteen feet below the surface, and from this point in a southwesterly direction it outcrops along the bluffs of Spring creek for a distance of about seven miles. Mowbray, Weatherspoon, Welch, Morrow, Shearer and Torpenning's mines, are all on this outcrop. The coal averages about three feet in thickness, and has an excellent roof of hard, black slaty shale, passing upward into a blue clay shale containing nodules of ironstone and blue limestone. The roof shales are locally filled with *Aviculopecten rectilaterarius* and *Productus muricatus*. The nodules of limestone and clay ironstone contain *Productus Prattenianus*, *Pleurotomaria percarinata*, *P. Montfortianus*, *Macrocheilus*, and a minute spiral shell like *Polyphemopsis*. I have no hesitation in referring this coal to No. 3 of the Illinois River section, and it shows a regularity in the development of our workable coals along the northwestern borders of the coal field that could hardly have been expected. The coal obtained from this seam has a tendency to split into thin layers, with partings of charcoal, and is a harder coal than that obtained from No. 2, and quite unlike that from either of the lower seams.

On Mud creek, a few miles further east, another coal is said to outcrop, which is probably No. 5 of the general section; and at Sheffield, Kewanee and Galva, No. 6, with its characteristic parting of clay shale, is found, thus completing the range of our most valuable coals, and showing their full development within the limits of Henry county. The general trend of their outcrop is from northeast to southwest, and the dip of the strata is to the southeastward, but at a very slight angle.

In closing these brief notes on Henry county, I desire to acknowledge my obligations to A. W. Perry, Esq., of Geneseo, who placed himself and whatever conveyance was required at my disposal, and kindly acted as both guide and commissary during my stay in the county.

A. H. W.

Superficial Deposits.—The drift clays of Henry county run from ten to fifty or sixty feet in thickness. These are the common yellow and blue clays underlying the soil over most of our northern prairies. No fossils of any note have been discovered in these clays, so far as I know. No beds of coarse gravel were noticed; no drift copper or galena has been picked up in the county, as in some of the counties farther north. Few bowlders were observed lying over the prairies. In the valley of Green river, near its mouth, and in some of the ravines, an occasional bowlder may be found washed out of the denuded soil and clay. Indeed, the Edwards and Green rivers, in much of their courses, hardly show even fine pebbles along their banks.

The alluvial deposits, however, are very marked in the Green River swamp lands, and in certain curious sand ridges and hills in the northeastern part of the county. No regular peat beds seem to exist in these swamps; but the tough sward of many grasses and sedges scarcely prevent one from sinking into the oozy muck and black vegetable mud covering these fresh-water marshes. For some cause the peat mosses have not flourished here as in the Whiteside county sloughs; but a good illustration of the origin of the prairies, according to Professor LESQUEREUX's theory, may be seen almost anywhere along these Green River swamp lands. The sand hills of this swampy region present a more curious phenomenon still. Chains and curious-shaped round hills, fashioned into shapes fantastic, and gathered and piled up by the roving winds, extend in ridges and groups from Rock river to and among the Winnebago swamps proper, in Bureau and Lee counties, and touch the northeastern portion of Henry. In the reports upon these latter counties, more will be said upon these shifting and roving hills and chains of sand.

Economical Geology.

Coal.—From the foregoing pages a good idea will be obtained of the extent, quality and accessibility of the coal deposits in this county. The supply of this useful mineral is not likely to soon become exhausted. As opened mines are worked out, new ones will be discovered. But a small portion of the productive coal seams underlying so large a part of the county, diagonally from its northwest to its southeast corner, has been properly or thoroughly prospected. Sources of wealth hidden away from the eyes of man are yet to be developed, and the coal of Henry county, for a long time

to come, will furnish abundant supplies for home consumption, and a still more abundant supply for neighboring markets. Such minerals as coal, iron, lime and the like, which minister so largely to the economies, utilities and conveniences of life, are not only desirable in and of themselves, but become sources of wealth and the highest material prosperity. Coal is second only to iron in every quality that can make it desirable. Especially in the prairie counties of Illinois, where fuel is scarce, coal, in even ordinary workable quantities, becomes of more than ordinary interest aud value. As a steam producer for the lower Rock River valley, when all its manufacturing and milling facilities shall be developed, these coal fields bordering on the stream will obtain a new value. They will then be sought after eagerly, and developed to their full extent.

Stone.—The supply of building stone, as will have already been surmised, is quite limited. The cap stone over the Cleveland coal seam will furnish plenty of stone for cellars, wells, and ordinary mason work in that part of the county. Stone of a better quality can there also be quarried from the Hamilton limestone in and near the river. The supply of limestone at Aldrich's coal mine is small, but of good quality. The sandstone outcrops below Cleveland, and on Mineral creek can also be made to furnish abundance of a sandstone that will be useful for many purposes. The other outcrops and stone quarries in the county furnish only limited amounts of rather poor building stone. All the railroad towns now draw their supplies of stone from the quarries at Athens, Joliet, and other places in their vicinity, and will continue so to obtain them.

Clays.—Great abundance of the usual drift clays can everywhere be obtained. These, with proper treatment, burn into a good article of common brick.

Agriculture.—But the distinguishing characteristics of this county are its coal deposits and agricultural resources. In the latter respect Henry county ranks among the best counties in the State. Its surface is mostly a high rolling prairie; its soil is good. The staple crops of Northern Illinois give abundant returns. Its population, its wealth, and its material resources are rapidly increasing. As a fruit county it also ranks among the first in this part of the State. The orchards around some of the older settled towns seem to do well; but fruit-growing in the county has not received the attention its importance demands. Fruit-growing and timber-raising should both be looked after by the farmers of Henry county.

CHAPTER XII.

MARSHALL AND PUTNAM COUNTIES.

Marshall county is bounded on the north by Bureau and Putnam counties, on the east by LaSalle and Livingston counties, on the south by Woodford and Peoria counties, and on the west by Stark county. It is twenty-four miles long from east to west, and fifteen miles broad at its broadest part from north to south, and contains, as near as I could estimate, about three hundred and fifty square miles of land.

The Illinois river runs through this county from north to south, bearing towards the west. On the east side of the river are the towns of Evans, Roberts, Hopewell, Bennington, Belle Plain, Richland, and Lacon—all full towns except Evans and Lacon, which are fractional; and on the west of the river are Saratoga, La Prairie, Steuben, Whitefield and Henry—all full townships except Henry and the next one south, which are fractional.

The only streams of importance, besides the Illinois river, are Crow creek, Sandy creek, Mud creek, Spring creek, and Hickory creek. Crow creek flows across the southern tier of towns near their southern limits, east of the Illinois river. Sandy creek flows across the northern tier of towns on the same side of the river. The other three are small streams in that part of the county west of the river.

The general surface of the county is similar to that of Putnam county. First, there is the Illinois river, with its broad and varying bottom; second, there are the bluff ranges on either side of the stream, with the accompanying strips of rough barren land, being the transition lands between the bluffs and upland prairies; and third, there is the level upland prairie land, a few miles away from the bluff ranges on either side. The entire eastern end of the county, embracing almost four entire townships, is level, rather flat prairie land, with a few undulations and gentle swells. This resembles the country of the Grand Prairie in flatness and other characteristics, and is almost devoid of geological interest. The western

end of the county, embracing about three townships, is also prairie, but is more rolling and dryer than that on the eastern side of the river. This is the prevailing characteristic or difference between prairies east and west of the Illinois river. The former are flatter, tougher and blacker; the latter are more rolling, dryer, and lighter. The Illinois river bottoms, through Marshall county, partake of their usual characteristics. On the east side the bluffs, for most of the distance through the county, come close to the river. In some places, as at Lacon, a high terrace or table land runs back; and in one or two bends of the river are the usual sloughs and willow swamps. On the west side there is a broad table land or second bottom, extending from the north line of the county down to Sparland, widening out about Henry to eight or nine miles between the river and the low bluff line on the west. This tract of land is called the "Crow Meadows." It is beyond the reach of the inundations of the river, is of unsurpassed richness and fertility, although inclining slightly to a sandy plain; is thickly settled, and is under the highest state of cultivation. The flourishing town of Henry, on the Illinois river, and also on the railroad between Peoria and Chicago, is built up in great part by this fine agricultural region surrounding it. The rest of the bottom, averaging a mile or two in width, is made up of the usual alluvial deposits—sand banks, mud flats, sloughs and marshes, willow thickets, meadows of coarse grass and pea vines, skirting strips of heavy timber land—the whole subject to frequent overflows, which precipitate over it a fine silt or mud, richer than the Nile ever sifted over its rich valley in Egypt.

Geology of the County.

The three divisions of the Drift deposit are easily recognized in this county. The alluvial bottoms of the Illinois river are the most recent, and have already been sufficiently referred to. They are mostly composed of fine mud and sand and various mixtures of these two substances, with occasional banks of recent river gravel. The Illinois River bottom is composed of two, and perhaps three, different kinds or ages of bottom land. First, there is the present flood plain of the stream, embracing all the low, flat lands liable to inundation by the almost annual overflowing of the river. The difference in this stream between low and extreme high water mark is some twenty-three feet, if we have been correctly informed. When extremely low, the river winds along among expanses of fine, yellowish sand, and black silt-like mud, and is a moderate sized,

slow-flowing body of water. When at extreme high-water mark, it spreads over a vast expanse of low land, almost washing the bluffs and terraces on either side, and becomes a broad amber-colored, muddy expanse of water. Every year this flood deposits over the flood plain, mud, silt, and sand. Cultivation is making the face of the country dryer; the volume of the stream is slightly diminishing in size; the annual deposits are building up the flood plain, and altogether the valley of the river is becoming dryer, notwithstanding the constant rains the past summer have swelled it to one of its most formidable floods. Second, after leaving this low flood plain, a second bottom or river terrace may be noticed, elevated twenty or thirty feet above the flood plain. This is the ancient flood plain of the river. It is composed of loamy clay, with various quantities of sand intermixed, with occasional beds of river gravel. It produces the very best crops, is easily worked, and in an agricultural point of view is of the greatest value. Fresh-water shell deposits and remains are sometimes found in it, and in similar positions in other parts of the northwest shell heaps have been found, supposed to be the remains of human feasts. It is a great deal older than the present flood plain, but geologically is comparatively recent. The Crow meadows, the Lacon prairies, and the second table on which is laid the railroad from Bureau Junction to Sparland, and a few narrow strips on the east side of the river, are about the extent of this river terrace, or ancient flood plain of the Illinois river in this county.

The two bluff ranges on either side of the Illinois River valley contain deposits properly belonging to the Loess formation. They are not pure Loess deposits however. Marly clays and sands intermingled with gravels are the nearest approach to the Loess to be observed. These everywhere exist along the bluffs, and may be noticed in excavations and partial landslides. The eroding influences of the rains have cut them into ravines and hollows, and carried much of the bulk into the valley below. The Loess mixture remains in considerable quantities however, and is well adapted to fruit culture and the growth of the vine. The foundations of the hills however, and most of their matter, is composed of Coal Measure deposits, and the older Drift clays. The upland prairies are covered with the usual Drift clays, of a yellowish or bluish color, similar in kind, in appearance and in depth to the Drift clay deposits covering most of the prairies of the northern part of the State. Away from the river gravels few gravel deposits belonging to the older Drift period exist. Bowlders are not so abundant as in more

northern counties. Some large ones of porphyry, syenite, and flame-colored granite, were observed on the terrace bottoms of the Illinois river.

Coal Measure Deposits.—Except the deposits of the Quaternary system above referred to, the only outcropping formation in the county belongs to the Coal Measures. Outcrops of this formation are not of frequent occurrence. In all that part of the county east of the Illinois river Coal Measure rocks scarcely outcrop at all. The prairies of eastern Marshall county, comprising much the largest portion east of the river, are level. Neither coal, coal shales or coal rocks outcrop or come near the surface. At Rutland, near the eastern line of the county, a shaft has been sunk for coal, traces of which mineral were found at a considerable depth, but no coal in workable quantities could be found, and the shaft is now abandoned. At Minonk, the next station south on the Illinois Central railroad and a few miles within Woodford county, a coal shaft has also been sunk to a depth of over four hundred feet. The company are still at work in the shaft. They have spent over twenty-five thousand dollars in the attempt to find coal at this point, as yet without substantial success. At about one hundred feet below the surface an unproductive seam of coal was discovered. Nearly a hundred feet below this another was detected, and, lower down towards the bottom, traces of a third were observed, but none of them contained sufficient coal to make their working profitable. They do indicate however the existence of coal seams under eastern Marshall county, corresponding to the LaSalle and Peru seams perhaps, but probably not developed to a workable extent.

In the bluffs and ravines along the east side of the Illinois river no coal, so far as I could ascertain, outcrops, or has been worked. Stone quarries and natural outcrops of rock are also extremely rare in these bluffs and hills. In a few localities, a whitish, hard sort of limestone, which rings like an anvil when being struck with the hammer, was observed in partial outcrops. It is the same kind of rock, and belongs to the same geological horizon, as the outcrops above Trenton in Bureau county. It will thus be seen that there is nothing of special interest to the geologist in the eastern part of Marshall county. In the western part of the county the field is more inviting.

In the western bluff range, from the south line of the county to a point considerably north of its center, and in the associated ravines and hollows along this distance, sandstones, shales, black slaty clays, thin bands of limestone, and coal belonging to some three different seams, outcrop, or are mined and quarried.

At Sparland, opposite Lacon, a large number of coal mines may be examined. There are thirty or forty drifts in all within two or three miles of the place, but most of these are now abandoned. A few are still actively worked, and furnish all the coal needed for local consumption, including that burned by several large mills and manufactories in Lacon. "Gimlet Hollow" is a crooked ravine of a few miles in length, widening among the bluffs, having its mouth immediately west of the little village of Sparland, on the Peoria and Chicago railroad. The sides are steep and abrupt. A considerable sized brook of yellow, ochreous water flows in its bottom. Commencing almost in the village, the piles of black earth and shales, indicating the mouths of old coal drifts, may be seen on either side, and some forty feet above the level of the water in the brook. For about two miles up the hollow these old drifts mark a regular black line along the face of the hills. Most of them are not now worked. Some have been abandoned for years. None of them have been worked with any great energy or capital; but the aggregate amount of coal taken from them in past years has been immense. The drifts extend back into the hills from fifty to two hundred yards. The style of mining has been and now is very primitive. The seam of coal is from three to four feet in thickness, and is underlaid with a coarse fire-clay, and overlaid in some places with soapstone; in others with a black shale; and in others still with a massive, dirty-white, heavy sandstone. The same seam of coal is mined at the mouth of Tinsley's Run, about a mile north of Sparland, where it presents the same characteristics, and is found to be about the same altitude on the sides of the bluffs. Following up Tinsley's Run, in its devious windings through the bluffs, outcrops of the same seam are abundant. From three to four and a half or five miles northwest of Sparland is another group of mines, drifted into the hill sides, very similar to the group near Sparland, and all belonging to the same coal seam from two to three miles north of Sparland, between that village and Henry, and in the face of the Illinois river bluffs the coal has also been struck, and presents the same general appearance. Several mines are close to the railroad track in this last locality. A heavy company is running a drift into the bluffs as I write this article. The intention is to fully prove the seam, and if it will justify the outlay, to commence heavy and systematic coal mining on a scale similar to the Coal Valley Company's operations in Rock Island county. Indeed, I believe some of the Rock Island men are largely interested in the enterprise.

Below Sparland, at several places, for a distance of four or five miles, indications of the same seam exist, but as yet it has not been extensively worked in the latter localities. The fact is, this western bluff range, for a distance of six or seven miles, being between a point about three miles north of Sparland and a point about four miles south of the same place, and extending back a few miles into the hills, is all underlaid with coal seams of more or less value.

The quantity of coal already mined, as above stated, has been great. Competition among the small miners brought down prices to the lowest living rates, and caused the abandonment of many drifts, where the show for coal was good. When capitalists and companies commence working this seam on a large scale, many valuable beds, of perhaps limited extent, will be discovered; and the mineral wealth of these Marshall county hills will add largely to the material resources of the county.

The quality of coal found in this seam is fair. The coal is somewhat soft, of a dark or shining black color. It contains a considerable quantity of iron pyrites, or "sulphur" of the miners. In a few places I noticed partial but thin strata of this deleterious substance running through the body of the coal. When properly selected, however, this coal is considered a good steam producer, and is largely used for that purpose.

The miners here call this the upper coal seam. About thirty feet below the upper seam, and a number of feet above the level of the water courses, is another seam, which appears to be nearly as thick. In several places up Gimblet Hollow we noticed the natural outcrops of this seam, about thirty or thirty-five feet below the mouths of the drifts in the other one. The seam, where examined, was about three feet thick. The coal was soft, with a reddish-brown tinge of color; but the coal examined was at the immediate outcrops. Drifts carried into the hill would, I think, disclose coal of a better quality and of a workable thickness. At no place, however, could I find that this seam had been extensively worked, or even fairly tested, and I am of opinion that in some of the hills immediately west of Sparland there is a considerable body of good coal in this seam. It exists also up Tinsley's Run, and in every locality, I believe, where the other is worked. Towards the top of the seam I noticed everywhere two thin, whitish-colored clay partings, each about an inch and a half thick, near each other. The upper one is from six to eight inches from the top of the coal; the other about three inches below the upper one. Partial strata of iron pyrites

also are found in connection with the clay partings. At a point below Sparland, called Minersville by the coal-workers, some attempt has been made to develop this seam and fully test its value; but the attempt has been mostly abandoned, and the experiment, up to the present time, has not proved successful. These clay partings would seem to indicate that this is the Wataga seam of coal, mined so successfully in Knox county, west of this locality, being identical with the Middle Peru and LaSalle seam, or number 5 of the amended coal section of the Illinois river. If so, and I think there can be no doubt of this, the upper seam above referred to doubtless corresponds with the Upper Peru and LaSalle seam, or number 7 of the same section.

At Minersville traces of a still lower seam have been discovered at a considerable depth below the latter. This is probably coal seam number 2, but there is no evidence yet of its development to any large extent in this county. The attempt to make it of economical value will not be seriously undertaken.

What the coal interests of Marshall county need is a more extended and scientific working of her upper coal seam, and a thorough examination and proving of the lower one.

Leaving the coal seams and coming to the associate rocks and deposits, we find nothing worthy of special attention. Both seams of coal have under them, at most places examined, a bed of the usual coarse fire-clay. The roof of the upper seam is composed of the usual dark-colored shales, clay shales and soapstone. The latter was noticed only at certain localities, was of a clay color, greasy feel, and rather massive in appearance. Between the two seams of coal outcropping about Sparland and northwest of that place is a massive, light-colored, coarse, gritty and very soft sandstone, about thirteen feet thick. On being quarried and dried, it seasons and becomes sufficiently hard for economical purposes. A similar bed of sandstone outcrops higher up on the hill sides, especially at some points on Tinsley's Hollow. This is above the upper coal, and, in some instances, it almost forms the roof of that seam. Higher still, and almost crowning these Sparland bluffs, a thin outcrop of a white, hard limestone seems to lie immediately below the small amount of Loess and Drift clays and gravels, making the bald tops of the hills. It is only three or four feet in thickness, but affords a good quarry rock, and is used in a few places for burning into lime, of which more will be said by and by.

The following section gives approximately the Coal Measure deposits of Marshall county. The measurements were not accurately

taken, and all the strata mentioned will not be found at any particular locality. The section is a general average of these Sparland Coal Measure outcrops and bluffs:

Section of Sparland Bluffs.

		Feet.
*No. 1.	Loess and drift-clay capping the bluff	not measured.
No. 2.	Thin band of whitish limestone	4
No. 3.	Clay shale—exposures partial	about 50
No. 4.	Shale and sandstone	13
No. 5.	Coal—(No. 7?)	3½
No. 6.	Fire-clay, shales, etc	about 11
No. 7.	Light-colored, coarse-grained sandstone	14
No. 8.	Clay shales	5
No. 9.	Coal, with clay partings (No. 6?)	3
No. 10.	Fire-clay and shales	20

All the coal-bearing hills west and northwest of Sparland are of exactly similar formation, and would present similar sections. On leaving the river hills and ascending to the high upland prairies, all evidences of these sections disappear, but a deep shaft in most parts of the county over the upland prairies, would disclose traces of many of the strata in the above section, and in some places might develop coal seams of workable thickness.

Economical Geology.

Coal.—Under this head I can add very little to what has already been said about the coal of Marshall county. The seam already worked has produced a large amount of coal, chiefly mined for local purposes; but no statistics were gathered as to the amount of coal already mined. But from the number of banks which have been opened and worked, and the extent to which some of the drifts have been carried, and the number of years the banks have been known, there can be no doubt that the coals of Marshall county have added largely to her material resources. Sparland is almost a mining village, and other localities support many families engaged in mining coal. All this mining, however, has been carried on in primitive style. Few heavy capitalists, and no heavy companies, have engaged systematically and scientifically in the development of these coal seams. Nearly all the mining done has been in the upper seam; and that, I think, has not been exhausted, except at certain spots. The miners believe, and experience will prove, that many local de-

*From our examinations in the vicinity of Chillicothe, in Peoria county, and extending northward to the south line of Marshall county, we have no doubt but the coal seams represented in the above section are Nos. 6 and 7 of our general section of the coal seams in the Illinois Valley. A. H. W.

posits belonging to this seam are richly worth the working. The seam outcropping immediately below this, appears to be thick enough to justify the belief that it, too, will afford a fair supply of the useful mineral. It is high enough to be easily drained, and in other parts of the coal-field not remote it has proved a valuable seam.

Nothing, however, but the actual test of proving these seams at any locality desired can be depended on in making an estimate of the amount and quality of coal in them. They thin out and disappear in some localities, and the productive coal beds in even the best portions of Northern Illinois are somewhat local in their character, so that an examination of the exposures to be met with in this part of the State can not be depended on in predicting results. A few hundred yards, or a few hundred rods, drifting in any direction in our heaviest coal seams, may come to the productive limits of a local coal field in which parties may be at work. Shafts over some of the prairie portion of the State may disclose only traces of the coal seams outcropping in considerable thickness near the Illinois river, just as the shafts at Rutland and Minonk, in and near the eastern limits of the county, have disclosed traces of unproductive coal seams; but it by no means necessarily follows that these unproductive measures extend over any considerable area of the Illinois coal field.

Building Stone.—A limited supply of rather poor building stone may be obtained along the western bluff range of the Illinois river for a few miles above and below Sparland, and in and about all the outcrops of the coal seams. The heavy, soft sandstone about Sparland is quarried in considerable quantities for foundations and ordinary farm and cellar masonry. On first being quarried it is too soft and crumbling; but exposure to the weather seasons it and adapts it to the above purposes. It is not a good building stone, but, for want of a better, is used to some extent. It is very coarse-grained and gritty.

The thin band of outcropping limestone above referred to furnishes a hard, compact building stone, rather unshapely and hard to work as it comes from the quarry. The quality is good and the color is warm and rich; but the trouble of working it into shape will always prevent its use, except for rough masonry. Good stone can be obtained so easily from LaSalle and Joliet that it will not pay to quarry these limestones extensively for building purposes.

Over the upland prairies, and even along the eastern bluff range, stone quarries and outcrops of stone are hardly to be met with. The farm-houses and barns are built upon blocks, bricks, and all sorts of

foundation materials, except good foundation stones. In riding through a country, and observing the foundations of houses and barns, an unfailing indication may be had as to the condition of the country with reference to the outcrop of rocky geological formations. Applying this test to eastern and western Marshall county, we shall not be disappointed. A few of the hills show a gravelly appearance, or limited outcrops of a hard, ringing, light-colored rock, and that is about the extent of the outcrops which present themselves for examination.

Lime.—A few lime-kilns now are or have been in operation in the county. One of these, about one mile above Sparland, on the point of a bluff, makes a considerable quantity of very good lime. The material used is the light-colored, hard limestone from the thin outcrop near the top of the bluff. The lime is very white and rather fine-grained. It is used in the neighborhood quite extensively, but will never, perhaps, become an article of shipment to other counties. All points accessible to railroad depots can be supplied with good lime from other localities so easily and cheaply that these lime-kilns will never obtain anything but a local trade.

Sands and Clays.—All along the Illinois river plenty of good river sand may be obtained fit for various economical purposes. It lies in banks and drift beds, and ranges from a fine-washed to a coarse gritty grain, according to the conditions of the waters which assorted, arranged and deposited it. Its color also varies. In some places it is almost as white as St. Peters sandstone. In others it is of a yellowish and brownish hue.

The clays of the Illinois river bottom are especially suitable for the manufacture of common red brick. They are partially mixed with sand, and burn into a very solid, ringing brick, well adapted for ordinary building purposes.

General Remarks.—Very few fossils were found in this county. In the ravines about Sparland specimens of *Lepidodendron* are sometimes picked up; and I was informed that the associate shales of the coal drifts often contain rather poor specimens of fern leaves. The shales observed by me were too much decayed to afford anything but traces of these ferns, and a few stems of some kind of coal plants. The sandstones and limestones examined seemed almost unfossiliferous. More extensive working of the beds might develop fossiliferous strata.

It will thus be seen that the general geology of the county is comparatively devoid of interest. The Sparland coal banks will always excite more or less attention, and will remain sources of a consid-

erable supply of coal. It will mostly remain a local trade in coal, however, unless some heavy company is fortunate in finding a good mine near the railroad.*

PUTNAM COUNTY.

Putnam county lies on both sides of the Illinois river, a short distance below its great bend at LaSalle. It is bounded on the north by Bureau and LaSalle counties, on the east by LaSalle county, on the south by Marshall county, and on the west by Marshall and Bureau counties. It is one of the smallest counties in the State, and contains four irregularly shaped towns, three of which are east of the Illinois river, and one west of it. These towns are Granville, Hennepin and Magnolia, on the east, and Snatchwine, on the west side of the river. The county contains in all about two hundred and sixty-six square miles, and is, at the longest measurement, about fifteen miles long from north to south, and about twenty-five miles from east to west.

Surface Configuration.—The most marked feature in the surface configuration of the county is the Illinois river and its attendant bluffs and bottoms. The river itself flows along the northern boundary line of the county from the northeast to the northwest corner of the county, at which latter locality it makes its great bend from a western to a southern course. It flows along the western boundary line until it reaches the township of Snatchwine, which township it leaves on the west. The river bottom, within the boundaries of this county, is not so extensive as in other counties in this part of the State. On the eastern side the bluff range keeps near the river through the entire extent of the county. About Hennepin, and imme-

*NOTE.—Since the foregoing report was written a boring was made at Sparland to the depth of 182 feet below the lower seam outcropping in the river bluffs. For the following section of this boring I am indebted to Mr. Chas. Sargent, of Sparland:

Section of Boring.

	Feet.	In.
No. 1—Surface clay	10	
No. 2—Sandstone	2	
No. 3—Shale	40	
No. 4—Black slate or shale	3	
No. 5—Coal (No. 3 ?)	0	6
No. 6—Shale	10	
No. 7—Quartz (sandstone ?)	0	6
No. 8—Sandy shale	91	
No. 9—Black slate or shale	2	
No. 10—Shale	6	
No. 11—Coal (No. 2 ?)	2	8
No. 12—Fire-clay	2	6
	170	2

diately below, it is a sort of high prairie, rising gradually back from the river. This is a sort of medium table-land between the alluvial bottom and the highlands back from the bluff range. It is very fertile, but rather sandy, and is under a high state of cultivation. On the west side of the river, from its entrance into the county to the south line of the same, the river bottom is from one-half to about two miles in width, except at the southern boundary line, where it widens out into the upper extremity of the "Crow Meadows," in Marshall county. This stretch of alluvial bottom land is subject to almost annual inundations from the overflow of the Illinois river. It is one interminable wilderness swamp, penetrated with sloughs and swales, overgrown in places with thickets of water-willow, dense with heavy grasses thickly interwoven with pea-vines, receiving from each overflow a deposit of soft mud silt, with one or two slough-like expanses or lakes during low water; a broad expanse of yellow, thick, cream-colored water at high-flood of the river; a pestilent tract, breeding fevers, frogs and mosquitos; skirted in two or three places with bottoms high and dry enough for cultivation. Such is the character of this bottom. In it there is some heavy timber skirting the river. Banks of sand and fields of mud and silt alternate along the stream.

The bluff ranges on both sides of the river have nothing peculiar about them. They rise to an altitude of from 80 to 125 feet. For the most part they are gently rounded and covered with a light growth of scattering timber. They are composed for the most part of drift clays, and gravels, and Coal Measure deposits, occasionally showing Loess, marly clays, and sands. From the brow of these bluffs, in either direction from the river is a tract of rough or barren land from one to about four miles in width. These strips of land are somewhat rough; are intersected by numerous ravines, and are more or less covered with a scattered growth of oak timber. These rough lands, although not so well adapted to agriculture as the more level portions of the State, will produce fruits in perfection, and the cereals grown upon them have a plumper berry and more weight than those grown upon the flat prairies.

Leaving these intermediate tracts of rough barrens, the rest of the county, both on its eastern and western sides, settles off into the usual level Illinois prairie land. On the east this strip of prairie is from six to twelve miles wide. It is generally quite flat, with a few gently swelling elevations. It is almost devoid of timber, of stone, of coal, and of large streams of water. The soil is black and fat, but in wet seasons much of it is a little too flat. Along the

western part of the county the prairie is more rolling, dryer, and with a lighter, warmer soil.

Streams.—Except the Illinois river, there are no streams of any size in the county. "All Forks" is a considerable sized brook; the rest of the county, and especially the more level prairies, have many small brooks and rivulets, for the most part without steep banks or hills. They are essentially surface streams, dry in dry seasons, and draining off the surface water in wet ones.

Geology.

Quaternary System.—There is nothing of special interest in the geology of this county. Outcrops are few and far between. The variety of formations is very limited. The surface geology is made up of the usual Quaternary deposits. The soil and subsoil of the prairies, the few narrow creek bottoms, and the usual Illinois river bottom, are well-marked alluvial deposits. Of these nothing need be said, except almost to reiterate the statements about the same deposits of Marshall county. Along the Illinois river there is the same low bottom, slightly contracted in width. The present flood plain of the river is composed of the same fine, black, soft-grained mud and silt, very fat and productive when dry enough for cultivation; the same banks and beds of variously-colored sand of different degrees of fineness, according to the condition of the waters which assorted, arranged, and deposited it; the same system of sloughs, willow growths, and meadows of rushes, and water grasses; and the same oozy pools of green scum, pestilent-breeding beds of agues and intermittent fevers.

Along the Hennepin prairie, and in a few other localities, there are considerable strips and stretches of river terrace land, the ancient flood plain of the river, when its waters ran many feet higher than they do now. Some very fine farms, in the vicinity of Hennepin, are made upon this older alluvial deposit. Few traces of the Loess clays and marls were noticed, but the river bluffs are undoubtedly crowned with a clayey deposit, more or less partaking of the nature of this formation. The more level portions of the county are covered with the usual Drift clays, about which nothing need be said. They have been sufficiently described in the published works of the survey, and in many of the detailed county reports. In this county they are similar, both in quality and thickness, to like deposits in neighboring prairie counties. They belong to the older Quaternary, or true Drift deposits. Over the prairies, and especially about some

of the little surface streams, an occasional black or flesh-colored bowlder can be seen, "lost rocks," indeed, in an ocean of prairie clays. Along the shores of the Illinois river, and on a line between the present and ancient flood plains of the stream, a few very large masses of transported rock lie half buried by the debris of ages. One of these masses, near the Putnam and Marshall county lines, would weigh many tons. It is a pale flame-colored granite. Similar masses lie in the waters of the river at several places. In one or two instances, I noticed great rocks of this kind, partially buried by a soft silt-like mud. I did not notice in this county any beds of coarse, transported gravel. On the face of some of the bluffs, and in some of the ravines, there is a rather coarse gravel, but it seems to be composed of water-worn fragments of Carboniferous rocks, similar to the natural bed rock of the county. The ice and water forces, acting in ages past, in and along the Illinois River valley, doubtless smoothed the original rocky projections of the beds, and these are the water-worn fragments of the rocks, abraided, and carried away to short distances only from their original Carboniferous ledges.

Geological Formations.—If the Quaternary deposits be stripped from the bed rocks all over the county, the surface would then present, in all probability, only Coal Measure rocks and associate deposits, representing, perhaps, the same strata that are far better exposed in Marshall and LaSalle counties.

Commencing at the northeast corner of the county, we may reasonably infer that Coal Measure deposits, similar to those existing about LaSalle and Peru, underlie the surface. From this point, it is but five or six miles to the extensive coal shafts at and near Oglesby, just south of the Illinois Central railroad bridge across the Illinois river. The bluff range, on which the south end of the bridge abuts, continues on down the river southwest into and through Putnam county, without any material change in appearance. The Peru coal shafts are even nearer to this corner of the county, but are on the other side of the Illinois river. All the north part of the county east of the Illinois river contains beneath it these same Coal Measure deposits, subject only to local changes; but the coal seams themselves may have thinned out as no valuable deposits of coal have as yet been discovered. The Peru and LaSalle coal seams, as they extend south, on the eastern side of the Illinois river, dip to the southward, and as the superincumbent Drift materials increase to nearly a hundred feet in thickness over the Coal Measures, the coal seams are nowhere exposed above the surface. All the south-

eastern part of the county is underlaid by these same formations, except that they have more and more lost surface indications of the coal seams. Natural outcrops do not exist, and no borings have been made so far as I know, and, of course, our knowledge of things hidden beneath the surface cannot be very definite.

Following the trend of the bluffs from the above starting point to the south line of the county, nothing very definite shows itself. Traces of sandstone along their bases, and of limestone higher up, may sometimes be noticed. The former is the coarse, massive, friable sandstone, and the latter the light-colored limestone, described in the reports upon the geology of Marshall and Bureau counties. The country being rough, and timbered for most of the distance, except the Hennepin prairie, stone is not quarried, and the opportunities to examine outcrops are very scarce. Indeed, I hardly know of a good outcrop in the county, either natural or made by quarrying, and there certainly is no outcrop where a fair section can be made.

These remarks apply more particularly to the large fractional township of Hennepin, lying immediately adjacent to the Illinois river on the east. The two eastern townships of Magnolia and Granville are dead-level prairie land, devoid of outcropping strata of any kind, except towards the river on the north.

West of the Illinois river, the single large township of Snatchwine, which is the only part of the county west of the stream, the geology is similar to that of southeastern Bureau county, except that no productive coal seams have been discovered. There is also a slight sinking or dip of the strata towards the south. At the north line of the county the bluffs are not remote from the river, and the valley on that side is narrower than in some other places. The trend of the bluffs bear gradually away from the river, at the southern limits of this large township, and the northern extremity of the "Crow Meadows" is reached. The bluffs show some unworked outcrops of the hard, semicrystalline limestone, noticed about Trenton, in Bureau county, but they are not quarried, and show no fossils where examined. The western end of the township is prairie, without anything of geological interest.

This is about all that can be said about the geological structure of this little county. On the map it should be marked as underlaid by the Coal Measures, except the valley of the Illinois river, which should indicate alluvial deposits. The county is quite small, and its geology is uninteresting. Its detailed report will consequently be short and somewhat unsatisfactory. Such counties as LaSalle, and

others in that part of the State, afford the geologist a more interesting field for observation.*

Economical Geology.—Although underlaid by the Coal Measures, coal in workable quantities has not yet been discovered in the county. In the northwestern and southwestern portions, coal seams may exist, but their character and extent remain to be proved, but it is likely that valuable beds will yet be discovered. The same might also be said of stone suitable for the purposes of building or other economical uses. The stone quarries, if any good ones exist, lie concealed beneath the surface, and have not yet been opened. Lime, as a natural consequence, is not burned to an extent that would make it a valuable production. The railroad and river facilities for transportation will always enable the citizens of this county to obtain coal, stone, and lime from other places with very great ease. Sands and ordinary clays exist in great abundance. Materials for the manufacture of common red brick can be found in most parts of the county, and in the valley of the Illinois river these materials are of excellent quality. For agricultural purposes, fruit-raising, and wine-growing, this county is very similar to Marshall county.

*NOTE.—The hard, blue limestone which forms the upper bed of the Coal Measures at Sparland, I have no doubt is the same bed outcropping at Jones' Prairie, and at Lonsdale's Quarries, in Peoria county, and usually lies about fifty feet above coal No. 7, and from ninety to one hundred feet above coal No. 6, and one hundred and fifty feet above coal No. 5. As the limestone is mentioned by Mr. Shaw as outcropping in the bluffs of the Illinois, in this county, it may serve as a guide to those in search of coal; and it will indicate the depth to which it would be necessary to go in the vicinity of its outcrop, to reach either or all of the above named coals. A. H. W.

CHAPTER XIII.

ROCK ISLAND COUNTY.

That part of Rock Island county north of Rock river is bounded on the south by Rock river, on the west by the Mississippi river, and on the north and east by the Marais d'Ogee slough and a portion of Whiteside county. It is an irregularly shaped triangular piece of land, some twenty-eight and one-half miles long on its western boundary, about seventeen miles wide across the north end, and gradually tapers to a point at the junction of the two rivers a short distance below Rock Island City.

Its physical features and surface configurations are a good deal diversified. Broad sand prairies, low alluvial bottom lands, abrupt bluffy highlands, and various combinations of these, make up the general face of the country. At Cordova the bluffs rise abruptly from the sandy plain. They follow the trend of the Mississippi river close along its shore, and are abrupt, broken and rough. About Moline and Rock Island they recede a mile or two from the river, but strike Rock river at Camden. Up this latter stream they continue for a few miles, rising high and abrupt from the water's edge. Soon they commence drawing away from this latter river, leaving a low alluvial bottom. They then trend off to the north, leaving the same low bottom between themselves and the Maredosia slough, along the Whiteside county line. Following this course five or six miles, they suddenly bend to the west, and strike the Mississippi near Cordova, the place of beginning. This part of the county has in it six named townships, not bounded by regular township lines, but made up mostly of irregularly-shaped fractional government townships. These contain somewhere near one hundred and seventy-eight square miles or sections of land.

All that portion of the county within the above bluff line boundary is highlands or uplands, from fifty to one hundred feet above the general water level of the Mississippi river. It is abrupt, broken, rolling and rough. Much of it, especially the hills and ravines, is covered with a scattering growth of timber and brush. Pleasant Valley, cutting across this upland region from Hampton, on the Mississippi, to Carbon Cliff, on Rock river, is the only considerable depression in this elevated plateau. This valley, though small, contains some good farm lands. Over this elevated region, especially towards the northeast, many small farms are opened. The soil is thin, but well adapted to the growth of cereals and fruits. The alluvial bottoms, when dry enough to cultivate, make the best and richest corn lands, and the wet portions make good meadow and grass lands.

The agricultural resources of northern Rock Island county are not very rich or varied. Much of the land is unproductive, much of it is too high, or too low, or too sandy; small portions of it are almost unsurpassed for fertility.

As a fruit-growing region it ought to excel. Some of the large apple orchards along the bluffs near Cordova bear abundantly and uniformly, and produce fruit of excellent quality. That whole encircling range of bluffs has hundreds of localities where the hardier varieties of the vine might be raised with great success. There is no reason why grape-growing and wine-making might not be made a producing interest of the county. The few local experiments with the vine, tried by amateurs, certainly give promise of this.

The manufacturing facilities of Rock Island county are among the best in the State. The coal is abundant and cheap, the water-powers are heavy and conveniently located. The well known power at Moline, obtained from an arm of the Mississippi river, has built up a flourishing and wealthy village within sound of its roaring wheels, and sends out its shining steel plows and other manufactured articles over the whole Northwest.

At Camden a vast enterprise has been undertaken. When I was last there (in 1868) Rock river was turned out of its accustomed channel by a series of coffer and other dams, and a little regiment of men and teams were at work in its bed, quarrying rock and building one of the most elegant and solid dams on the whole river. Foundations for mills and other buildings were also being laid. The object is to build up another manufacturing village at this locality, that shall rival or surpass Moline in wealth and importance. The

natural advantages are abundant, men of energy and abundant capital are at the head of the enterprise, and there is no reason to anticipate a failure.

Surface Geology.

The Rock river and Maredosia bottoms, above referred to, belong of course to the alluvial deposit. They are from two to five miles wide. Their character and agricultural capabilities have already been stated.

That part of the county north of the bluff line, made up mostly of the township of Cordova, is a broad, level sand prairie, and at a time when the Mississippi river flowed a mightier stream, both in its present channel and in the Maredosia slough, it was a broad headland sand-bar. The bluff-bounded highlands, above described, then rose as an island from the broad lake-like river. The drifting sands lodged against its upper end, and the sand plain under consideration was gradually formed, just as sand-bars of the present day are formed against the upper end of river islands.

This sand deposit took place during the long ages, while the Mississippi Valley was occupied by a mightier stream than the present river, and a part of its waters found a channel through the Maredosia bottom and the present valley of Rock river below its outlet. I have discussed at length, in the geology of Whiteside county, the proposition that the Mississippi once flowed through this latter bottom, and into Rock river at Erie, and need not now make farther remarks upon that subject.

The narrow bottom from Hampton to Camden is an ancient shore or beach. It is dry, and in some places rocky. But the most curious phenomenon along the Mississippi bluffs is the old shore-line marked along their sides. At Cordova the principal part of the town is built upon this ancient beach or terrace. It is here some fifty feet above the present low-water mark of the Mississippi river. It is distinctly marked all along the bluffs to Camden, but runs lower as it passes from Cordova to the latter place.

The bluffs and hills of Rock Island county are composed in part of the whitish buff clays, sands and marly deposits known as the Loess. Receding back from the bluff lines the Loess thins out, and is succeeded by fine laminated drift clays, such as cover most of our upland barrens and high prairies. Large bowlders are of rare occurrence; so are genuine Drift gravel beds. Beds of recent river gravel mark the present shore lines of the streams, but these are of very recent formation.

Coal Measures.

In that portion of the county lying west of Rock river, the Coal Measures are found as outliers, overlying and resting unconformably upon the Devonian and upper Silurian limestone, as far north as the vicinity of Port Byron, where they finally terminate. The most northerly point where a workable bed of coal has been found on this side of the river is at Rapids City, where the seam, probably the same as that two miles east of Hampton, and at Carbon Cliff, is said to be from four to five feet thick, and overlies the Niagara limestone, with only a few feet in thickness of shales and fire-clay between.

Two miles east of Hampton, several shafts have been recently sunk on a good seam of coal from four to five feet thick. The coal and the associated strata are the same as at Carbon Cliff. The coal here has a tendency to the block character, breaking easily into quadrangular pieces.

It is overlaid by bituminous shales, and argillaceous and siliceous limestone, which is capped with a band of chert from four inches to a foot in thickness, above which we find siliceous shales and sandstone. The dip of the coal is very irregular here, sometimes rising nearly to the surface level and then sinking to the depth of sixty to seventy feet; probably conforming to the irregular surface of the underlying limestones. The coal at this point appears to occupy a limited basin, that has been proved by borings to extend for about three-quarters of a mile in one direction, by about half a mile in the other, covering a portion of sections 15, 16 and 22, in town 18 north, range 1 east. The Hampton shaft, Ætna Coal Co., Durfee shaft and Davenport & Co.'s shaft are all on this little basin.

The Carbon Cliff mines were located on Sec. 4, T. 17 N., R. 1 E., and were among the earliest mines worked on the west side of Rock river. For many years extensive coal operations, in connection with an establishment for the manufacture of pottery and fire-brick, were carried on at this point under the management of W. S. Thoman, Esq., but the limited supply of coal finally became so nearly exhausted that mining was no longer a profitable investment, and the mines have been abandoned. A section of the Coal Measures at this point, the upper part obtained by surface exposures, and the lower part furnished from the records of a boring made by Mr. Thomas, will give a general idea of the measures as they are developed in this part of the county:

		Feet.
No. 1.	Streak of bituminous shale, probably indicating the horizon of coal No. 2	1
No. 2	Siliceous shale and sandstone	18
No. 3.	Blue argillaceous shale and limestone, with a band of chert	15
No. 4.	Bituminous shale	1
No. 5.	Coal	3 to 4
No. 6.	Fire-clay	2 to 3
No. 7.	Sandstone, dark-blue clay shales, with bands of iron ore, and thin coal, or bituminous shales, passed through in the boring	70
No. 8.	Gray Devonian and upper Silurian limestone penetrated to the depth of two or three hundred feet.	

The band of chert in the shales over this coal forms a reliable guide to the identification of the strata both in this county and in Henry. It varies in thickness from four inches to two feet, and in color from a light-gray to black. It has the conchoidal fracture of a true flint, and was used by the Indians for the manufacture of their implements of war and of the chase. The limestone over the coal contains but few fossils at this locality, but the *Spirifer cameratus* and *Athyris subtilita* seemed to be the most common, and *Productus longispinus*, *P. Prattenianus*, *Chonetes mesoloba*, and a minute *Trematopora* were also observed, but more rarely.

An analysis of this coal, by Mr. HENRY PRATTEN, former chemist of the Survey, gave the following results:

Moisture	7.0
Volatile matter	36.7
Carbon in coke	52.8
Ash (white)	3.5
	100.0
Carbon in coke	55.3

In the vicinity of Camden, on the western shore of Rock river, the lower beds between the Devonian limestone and the Carbon Cliff coal are well exposed, showing an outcrop of a thin seam of coal just above the river level. Above this thin seam there is a bed of coarse sandstone that sometimes passes into a sandy shale, above which is another coal seam two feet in thickness. The exposure here gives the following section:

		Feet.
No. 1.	Sandy shale	30 to 35
No. 2.	Bituminous shale	4
No. 3.	Coal	2
No. 4.	Fire-clay	1 to 2
No. 5.	Sandstone and sandy shale	20 to 25
No. 6.	Thin coal	1 to 2
No. 7.	Shale	1 to 3
No. 8.	Devonian limestone.	

It is possible the upper seam in the foregoing section may be the equivalent of the Carbon Cliff coal, but I am inclined to regard both these thin seams as intercalated beds underlying the main coal of this county. The seam at Carbon Cliff and Coal Valley I consider as identical with the Seaville coal in Fulton county, and as No. 1

of the Illinois river section, published on page 174 of the first volume of these Reports. If this conclusion is correct, then the two thin coals in the above section are the representatives of the sub Conglomerate coal of Southern Illinois. The fact that they have nowhere been found in this portion of the State thick enough to be of any economical value, except for local use, seems to favor this conclusion. The seam of so-called cannel coal opened at the foot of the bluff near Colona, in Henry county, and similar beds of highly bituminized shales that occur at some other points in Rock Island county, may probably be referred to the same horizon. In the bituminous shale overlying the two-foot coal seam in the above section, we obtained a few plants, among which the *Lepidodendron clypeatum* was the most abundant.

The Hamilton Limestone.

About a mile and a half below Hampton the upper and more shaly beds of the Hamilton limestone first begin to outcrop along the Mississippi river. About Moline still heavier outcrops exist. These are thicker-bedded, are of a brownish color, and are full of fossils. At Rock Island City, and about Camden, it becomes more massive; the stratification is irregular; the color a bluish-white or brown upon recent fractures, and the stone hard and tenacious. At Camden the bed of the river is a solid floor of these irregularly-shaped rocks. They are worn smooth by the flow of the heavy, swift-running waters, rushing over them for ages, and stained a mud color by the sediment. It underlies all that narrow bottom reaching from Moline to Camden, and attains a thickness in its outcrops of perhaps thirty feet. Rock Island, in the Mississippi river, is a vast pile of this Hamilton limestone, rising in the midst of the stream, overlaid by a thin soil, and covered by a magnificent young forest.

The Devonian limestones, as they are developed in this county, may be readily separated on lithological grounds into three divisions. The uppermost division consists of gray and brown limestones, the lower layers rather coarse-grained and completely filled with the shells and corals peculiar to the Hamilton beds. This may be estimated at from twenty-five to thirty feet in thickness, and is well exposed near Andalusia, and on the opposite side of the river near New Buffalo. The middle division consists of brown argillaceous limestones and calcareous shales, full of the characteristic shells of this group, and from 30 to 40 feet in thickness. This division is well seen between Rock Island and Moline, where a perpendicular

face of thirty feet or more in thickness is exposed in the quarries. These shaly limestones are underlaid by a fine-grained, gray or dove-colored, compact limestone, the upper part tolerably massive, but becoming thinner-bedded below. It extends below the river level, and is said to have been penetrated in some borings made here, several years since, to the depth of more than a hundred feet. This would make the aggregate thickness of the Devonian limestones at this point from one hundred and fifty to one hundred and seventy-five feet.

Fossils are quite rare in the lower division of this formation, but we found in its upper beds *Atrypa reticularis, Alveolites Goldfussii,* and a *Phillipsastrea* of the same species as that common in the upper division. The shaly limestones of the middle division contain *Spirifer pinnatas, S. Parryana, S. aspera, S. bimesialis, S. subattenuata, S. inutilis, S. fimbriatus, Cyrtia umbonata, Productus subalatus, Strophomena demissa, S. perplana, S. lepida, Orthis Iowensis, O. suborbicularis, O. Vanuxemi, Megistocrinus latus, Synbathocrinus matutinus, Taxocrinus interscapularis, T. gracilis, Pentremites subtruncatus, Platyceras ventricosum, Astreospongia Hamiltonensis, Fenestella bifurcata, Polypora Hamiltonensis,* and *Striatopora Iowensis.* There are also to be obtained from this division several species of turbinated corals, and a *Gomphoceras* that have not as yet been specifically determined.

The upper division contains many of the species above named, and in addition many corals belonging to the genera *Phillipsastrea* and *Stromatopora,* associated with *Cystiphyllum Americanum* in great numbers. There are also some brown beds near Andalusia that contain numerous *Gasteropods* and *Orthoceratites,* and a few miles below, these are overlaid by from eight to ten feet of a brown magnesian limestone that contain casts of a large *Spirifer* like *S. Parryanus* and *Strophomena demissa.* These brown beds are directly overlaid near the mouth of Stone-coal creek by the sandstones and shales of the Coal Measures. There can be no doubt that the two upper divisions of this limestone fairly represent the organic forms of the Hamilton group as it appears in New York and Canada, and as no fossils specifically different from these have been obtained from the lower bed, we see no good reason for assigning that division to a lower formation. This group attains a greater thickness here than at any other point in the State, and at the first outcrop of this limestone to the southward, in Calhoun county, its entire thickness scarcely exceeds ten feet.

Niagara Limestone.—From Cordova to Port Byron this formation outcrops heavily. Leaving Port Byron it gradually sinks as we ap-

proach Hampton, and a little south of that place disappears beneath the outliers of the Coal Measures. The stone at Cordova has a tough, hornstone-like consistency and appearance, unlike its outcrop at Fulton and farther north. Some of its top layers break with a splintery fracture, and the lines of stratification and bedding are very irregular. It has some of these characteristics at Port Byron, but is more brecciated in structure and yellow in color. Stems of encrinites, some of them half an inch in diameter, fill some of the large blocks of limestone at this point. Following the bluffs from Cordova eastward and down to Pleasant Valley, this limestone outcrops and is quarried in many places, both in the face of the bluffs, and by digging into the higher bottom land between the bluffs and the Maredosia slough. Its characteristics along this eastern exposure of outcrop change a little. Minute dendritic spots or stars give a speckled appearance on fresh fractures, and the color is a yellow or reddish-brown. The stone is softer, and occasional fragments of *Pentamerus oblongus* are seen. All that upland region north of Pleasant Valley is underlaid by this Niagara formation and a thin outlier of Coal Measures, but the soils and upland clays deeply cover them, except where the small streams cut down through the superficial deposits.

Economical Geology.

The horny, tough, splintery layers of the Niagara limestone burn into an excellent quicklime. It is white, strong, and pure. At Cordova and Port Byron fires almost perpetually glow in extensive lime kilns, and the lime made at these localities has a wide reputation and commands a ready sale, and an extensive business in this line is done here. The Hamilton limestone of Rock Island is a very pure carbonate of lime, and is manufactured into a good article of quicklime. It is extensively used in the government works and buildings, now in process of erection on the Island, and although coarse, it is strong and makes a firm cement for heavy masonry.

Lime enters extensively into all the arts, uses, and utilities of life. Like iron, coal, clay, sand, and many other familiar materials of daily use, we seldom stop to consider its many uses in the economies and conveniences of life, and the localities offering facilities where it can be manufactured cheaply and of superior quality, have elements of material wealth worthy the attention of capitalists and political economists. Such localities exist at Cordova, Port Byron,

Albany, Rock Island, and other places along the Mississippi in this part of the county. Transportation by rail and water is easy, coal and wood are abundant and accessible for fuel, the Niagara cliffs and Devonian beds furnish abundance of the raw limestones, and no better place can be found for making the manufacture of lime a good paying business.

The coal seams north of Rock river, as before stated, are limited. At Carbon Cliff the seam was four or five feet thick, and for a time was worked with profit. But the deposit there seemed to be but an outlier and has now ceased to be mined to any extent. Traces of coal were also discovered in the bluffs opposite Cleveland, in the township of Hampton, and also further towards the east line of the county, in the township of Zuma. At Coaltown, midway between Carbon Cliff and Camden, some old coal banks at the base, or near the base of the bluffs, in former years furnished considerable coal, of a quality similar to that found at Carbon Cliff. It will thus be seen that coal and traces of coal, together with Coal Measure sandstones and shales, are more numerous north of Rock river than has been generally supposed. The northern edge of the great Illinois coal field rests uncomformably upon the Hamilton and Niagara limestones from near Port Byron, on the Mississippi river, to where the bluff line abruptly trends north on striking the bottom of the Maredosia slough, and indeed northeast from thence to the sandstone quarries of Whiteside county on Cat-tail slough and north of Morrison. The triangular piece of elevated land east of Rock Island city, bounded by Pleasant Valley, Rock river, and the Mississippi river, is a mass of Coal Measure materials, resting upon a Devonian or upper Silurian foundation of underlying limestones.

Building Stone.—Good building stone may be obtained from the Niagara and Hamilton limestones, at any of the outcrops of these formations. They both furnish a strong, rough material for common and massive masonry, but are difficult to dress into good shapes. The Le Clair limestone is softer and finer grained than the beds at Port Byron, but is undoubtedly only a variety of the same formation. The Niagara limestone further up the river is somewhat coarser in texture, but is essentially the same rock. The Government arsenal on Rock Island is built of the Le Clair stone, but time has shown that it has not the requisite solidity for such massive work, and its use is now discarded in building the armory and the other public buildings in course of erection by the United States on that beautiful island. Some of the Coal Measure sandstones

would make a fair building material, but as yet they have not been used extensively for that purpose.

The other geological deposits of economical value do not differ materially from those found in adjoining counties, and with the exception of fine potter's clay, may be passed without further comment. Associated with the Coal Measures about Hampton, and Carbon Cliff, and doubtless many other places along these bluffs, is a very fine deposit of this clay.

A fair sized pottery at Hampton is kept running in the manufacture of common pottery ware. The clay is dug from the adjoining bluffs and hauled into the village, and made into crocks and jugs. It is here of a bluish, chocolate-color, and makes a good article of common ware.

But the best establishment of this kind, perhaps, in this part of the State, is located at Carbon Cliff, within a few hundred yards of the railroad station of the same name. Many years ago a company was formed for the purpose of mining coal in the Carbon Cliff bluffs. The company operated the mines, with varying success, until the coal practically became exhausted. The fine strata of potter's clay outcropping all along the exhausted coal seam then attracted attention. A pottery was started; patience, enterprise, energy and money, at last succeeded in building up from a small commencement a large and growing business. The buildings are of brick; the principal one is similar to a large, railroad round house, with a towering smoke-stack in the center. Around this has sprung up a little village, dependent for existence upon this single manufactory. More than eighty hands are constantly employed. The company have their own cars, which they load with their wares and attach to the passing trains; and in this way they supply the railroad towns over large portions of Northern Illinois and Iowa. Not only does this company manufacture the more ordinary crockery and pottery ware, but they devote much attention to making drain tiles, coarse table ware, terra cotta ware, garden ornaments, vases, and all similar articles. The company has met a marked and deserved success, and well illustrates what energy, skill and capital can make out of a bank of clay at one time supposed to possess no great value. The associate clays of the Carbon Cliff Coal Measures are likely to possess a value far higher than the four feet of coal worked in former years.*

* NOTE.—Since the above report was written, this establishment has been changed from a common pottery to the manufacture of drain tile; and the material used is obtained

Rock Island County South of Rock River.

That part of the county lying south of Rock river contains five full townships and six pieces or fractions of regular townships, with an area of perhaps two hundred and sixty square miles. It is bounded north by Rock and the Mississippi rivers, west by the Mississippi, south by Mercer county, and east by Henry county. It has an average width of about nine miles from north to south, and a length from east to west of about thirty-three miles. The Mississippi river at Rock Island makes an abrupt bend to the west, and continues to flow in that direction for some twenty miles, where it turns south again, and thus almost washes the entire north and west sides of this part of the county.

The surface is diversified, and is made up of alluvial bottom land, hilly barrens, fertile and somewhat rolling upland prairies; the southern townships and large portions of Coal Valley, Bowling, Edgington and Buffalo Prairie, are made up of the latter, under a higher degree of cultivation. These prairies are the handsomest part of the county, and gently roll away to the south and east, to the borders of Mercer and Henry counties. On the south side of Rock river, from the Henry county line to its confluence with the Mississippi below Rock Island city, is a strip of alluvial or bottom land, from one to two miles in width. Portions of this are swampy and boggy; others are sandy, with ridges of fine gravel and sand blows; and still others are rich farming lands, which yield heavy crops of Indian corn, grass and grains. Along the south side of this Rock River bottom the range of bluffs rise abruptly to an average of more than a hundred feet. At Andalusia the bluffs approach the Mississippi river, and this latter stream washes their base almost to the southern line of the county, except in a few places, where an uncultivated, low bottom intervenes, seamed with running sloughs. This range of bluffs is cut up with hollows and ravines; is covered with a moderate growth of timber, principally the oaks; the rough land, extending back into the highlands from two to five or six miles, has a thin, white soil, such as is found in

from the siliceous shale that overlies the coal at this point. The shale is dug out where it lies immediately under the Drift clays, and has been thoroughly exposed to Drift influences, by which its lithological characters have been changed from a light-gray shale to a siliceous clay. The material used at Hampton, and formerly used here for pottery, is the under clay of the coal seam formerly worked at this locality. Several other beds of fire-clay, apparently of good quality, occur in the lower Coal Measures in this county, and are mentioned in the local sections made at different points.

the timber barrens of other portions of the State, and is altogether the least valuable portion of the county for agricultural purposes.

Geological Formations.

The geological formations consist of the drift clays and usual superficial deposits, the Coal Measures, including productive coal seams and associated shales, sandstones and limestones, and the Hamilton limestones.

The Hamilton Group.—The floor of Rock river from Camden almost to the Mississippi is composed of this rock. These massive paving stones as seen in the bottom of the river are irregular in size and contour, but are all worn smooth by the ceaseless flow of the strong, swift-running river. Their thickness at this place is unknown; the massive solidity, conchoidal fracture, and white dove-color of the stone, indicate that it belongs to the lower part of the formation. At Lear's new mill, almost in the bed of Rock river, the workmen quarried into the solid stone floor of the river fifteen or twenty feet, with no signs of the bottom. Rock river runs over the same rocky floor of Hamilton limestone at and below Cleveland, near the eastern line of Rock Island county; also at its confluence with the Mississippi, below Camden. Between these points the river bottom shows a mud deposit, under which this same formation still probably might be found. Few fossils are found in the rock quarried from this river floor, either in Rock river or in the Rock Island rapids of the Mississippi.

The Mississippi river has a similar rocky floor from Port Byron almost to Muscatine. Horse-backs, hog-backs, and great rocky chains, characterize the rapids proper, but the lower part, from Rock Island city down, shows alternating stretches of mud, sand and rocky bottom. At some of the latter places navigation is rendered difficult at low stages of water. The Mississippi river bed from Rock Island to a few miles below Andalusia is composed of the lower member of the Hamilton group, being the same as the floor of Rock river at Camden. At Andalusia, in the edge of one of the Mississippi sloughs, just between high and low water mark, an excellent stone quarry is opened in this formation. The character of the stone quarried indicates that the quarry is opened in the upper division of the formation. The layers are not so massive as those found in the river; some of them are of a dove, and even light-blue color, and fossils are abundant. Some large, thin slabs of flagging stone lying at this quarry were beautifully marked over the surface

with groups and clusters of white encrinite stems, partially weathered out but firmly embedded in the stone. At New Buffalo, the opposite steamboat landing in Iowa, a similar stone quarry is extensively worked. Some of the pieces of stone thrown out of the bottom of these quarries presented a milky-white, and faintly bluish clouded color, and smooth conchoidal fracture; very unusual in stone thrown roughly from the quarry. The middle division of this formation, which outcrops between Moline and Rock Island in several places, was not observed south of Rock river. At the latter localities the color is a dirty brown; the strata thin and broken up; many thin, shelly layers run through the mass, which disintegrate on exposure to the weather, leaving in the shaly clay thus formed a great abundance of fossil shells and corals. The little spring run, extending up from the stone quarry at Andalusia towards the residence of Dr. Bowman, runs over the top of the Hamilton limestone until it rises into the Coal Measures of the adjoining bluffs. In this little ravine finely preserved fossil shells and many cup-shaped corals may be obtained.

While speaking of the Hamilton group of this county and its development along the upper rapids of the Mississippi river, it might seem appropriate to notice the great amount of work now being done between Rock Island and Port Byron by the Government in the bed of the river, and to inquire as to its probable effect upon the depth of water in the Upper Mississippi. Large coffer-dams are built in the stream, and a heavy force is employed at low stages of water in drilling, chiseling and blasting the rocky obstructions in the steamboat channel, and removing them. Steam and the best improved machinery are freely employed, and the work is making rapid progress. Some rivermen fear the effects of any deepening of the channel upon the supply of water above. This fear in all probability is ungrounded. The removal of obstructions, and the construction of wing dams with the material removed, will deepen the channel, by concentrating and raising the current, and will have no perceptible effect upon the waters of the upper river.

Coal Measures.

All that part of Rock Island county south and east of the Mississippi and Rock river ranges of bluffs is underlaid by the Coal Measures, which, as we have seen, rest near the two rivers, and for several miles back into the interior, upon the solid strata of the Hamilton limestone. The Coal Measures all over the county are

covered with a deep deposit of drift-clays. At Camden, Carbon Cliff, and east of Rock Island city, this drift-clay is from forty to seventy-five feet thick.

A section made at the Coal Valley coal mines, south of Rock river, and seven or eight miles in the interior of the county, gives the following section:

		Feet.
No. 1.	Reddish and yellowish drift-clays	30
No. 2.	Siliceous shale	10
No. 3.	Band of chert	2
No. 4.	Dark bluish gray, siliceous limestone, shaly at the top and massive at the bottom	10 to 18
No. 5.	Bituminous shale	1 to 3
No. 6.	Coal No. 1, average thickness	4½
No. 7.	Fire-clay, passing downward into shale	12

Up a ravine in the bluffs, midway between Camden and Andalusia, a dark-colored massive sandstone is quarried to some extent. The outcrop is about ten feet thick, and the stone is clouded and stained with iron. Below Andalusia, near the mouth of Coal creek, a little stream which comes down from the bluffs, is an outcrop about twenty feet thick, of a massive, close-grained, umber-colored magnesian limestone, which has been quarried to a considerable extent. From thence down the bluff line to Drury's Landing, both sandstones and limestones show themselves low in the hills, but none of these outcrops have been worked to any extent. Opposite Muscatine, a somewhat massive sandstone outcrops, which has been worked, and in which has been found several fine specimens of *Lepidodendron*. Near Copperas creek, in the eastern part of the township of Drury, there is also a sandstone quarry worked to some extent.

South of Rock river, the Coal Measures are more regular and more extensively developed than in the northern part of the county, and at least three of the lower seams were recognized. At Coal Valley, and near the base of the hills in the vicinity of Andalusia, coal No. 1 may be seen with its black shale and limestone roof, and its characteristic band of chert; and further back in the hills of Coal creek, Walnut creek, and on Big run, coals Nos. 2 and 3 were identified, and have both been opened, and are now worked for the supply of the local market. Nevertheless, more than nine-tenths of all the coal mined at the present time in this county comes from the lower seam. The Coal Valley mines are among the oldest worked in this portion of the State, and to the present time they have furnished the largest portion of the coal used at Rock Island and Moline, and the country further north. Where fully developed

as a single seam, its thickness is about five feet, but it is sometimes divided by a shaly parting, and the two divisions become too widely separated to be worked together. It has an excellent roof of black shale and hard blue arenaceous limestone, overlaid by a band of chert, which at one point attains a thickness of about two feet. This is succeeded by siliceous shale and sandstone, extending upward to the fire-clay or septaria-like limestone below coal No. 2.

The limestone over this coal splits into irregular conchoidal fragments on exposure to atmospheric influences, and at Coal Valley, and at some other points, is filled with a peculiar fucoid resembling the *Cauda Galli* of the Devonian rocks. The black shales over the coal afford some fossils, among which the *Productus muricatus* and *Chonetes mesoloba* were common, and associated with them we obtained *Discina nitida, Rhynchonella Eatoniæformis, Lima retifera, Petrodus occidentalis* and *Listracanthus hystrix.* Undetermined species of *Nautilus, Orthoceras, Aviculopecten* and *Pleurophorus* were also obtained here.

An analysis of this coal, from a specimen taken from the Carbon Cliff mines, is given on a preceding page, and shows about the average quality of this seam in the vicinity of Rock river.

About three miles northeast of Coal Valley, and just over the line in Henry county, on the S. W. qr. of Sec. 19, T. 17 N., R. 1 E., this seam has been opened and is now worked at what is known as the Parks mines. The coal is here about five feet thick and of excellent quality, breaking into regular quadrangular pieces. The chert band over the coal is a foot or more in thickness at this point, and the beds of the little runs are full of its broken fragments.

On Walnut creek, which empties into the Mississippi just below Andalusia, about one hundred feet in thickness of Coal Measures may be seen directly overlaying the Devonian limestone. The beds exposed here show the following succession:

		Feet.
No. 1.	Clay shales passing upward into sandy shales, the lowest layers bituminous	8 to 10
No. 2.	Coal No. 2	1½
No. 3.	Fire-clay	2 to 3
No. 4.	Sandy shales and sandstone	20 to 30
No. 5.	Dark-blue siliceous limestone	1 to 3
No. 6.	Bituminous shale	4 to 8
No. 7.	Coal No. 1	3
No. 8.	Fire-clay	2 to 3
No. 9.	Shales, argillaceous, siliceous and partly bituminous, with a thin seam of coal	50 to 60
No. 10.	Devonian limestone	exposed 10

The upper coal seam in the above section had been opened at one point in the bluffs of the creek, but proved to be too thin to be profitably worked, and was subsequently abandoned.

On Coal creek, another small stream still further south, there are about two hundred feet of Coal Measures to be seen, which probably include the horizon of the three lower seams of coal. The section here shows about the following order:

		Feet.
No. 1.	Sandy shales	30 to 40
No. 2.	Bituminous shale, with about one foot of coal near the middle of the bed (No. 3?)	8 to 10
No. 3.	Sandstone, thin-bedded in the upper part and thicker below	30 to 40
No. 4.	Bituminous shale (Coal No. 2?)	3 to 4
No. 5.	Fire-clay	2 to 4
No. 6.	Sandy, argillaceous and bituminous shale	50
No. 7.	Bituminous shale	3
No. 8.	Coal	
No. 9.	Sandstone, filled with *Stigmaria* } No. 1	6 to 8
No. 10.	Coal	
No. 11.	Sandy shales and thin-bedded sandstones partially exposed	60 to 70
No. 12.	Brown magnesian limestone, Devonian	10

Neither of the coal seams appear to be well developed on this creek. No. 1 is divided, and the divisions are so widely separated that they cannot be worked together, and are both too thin to be profitably worked as separate seams. No. 2 is represented by a bed of bituminous shale, and No. 3, if represented at all in this section, is only about a foot thick, and intercalated in a bed of bituminous shale. I am rather inclined to the opinion, however, that No. 2 of the foregoing section is only a local development, and that No. 3 coal lies above the sandy shales forming the top of the section, and if found at all on this creek will be immediately below the Drift.

On Big run, near Brownsville, a coal has been opened near the top of the hill, which I believe to be No. 3 of the Illinois River section. The seam is here about three feet in thickness, and is overlaid by a few inches of bituminous shale, passing upward into a brown sandy shale. The slope of the hill below this seam for a distance of nearly a hundred feet was so completely covered that no section of the underlying beds could be made here. The coal afforded by this seam was rather hard and slaty, and inferior in quality to that usually obtained from either of the lower seams. About half a mile up the creek from this coal bank, the following beds outcrop below the drift clays that cap the hill:

		Feet.
No. 1.	Shale, sandy	3
No. 2.	Hard quartzose sandstone	3 to 4
No. 3.	Fire-clay	4
No. 4.	Shales, partly argillaceous and partly sandy	30 to 40

The sandstone No. 2 of the above section is an excellent and durable stone for heavy masonry, and the creek bed is full of large blocks of it, on which the elements seem to have no effect. The Brownsville coal probably overlies the beds in the foregoing section. The beds in this vicinity are the highest Coal Measure strata that we found exposed in this county, and as the distance from No. 3 up to No. 5 is usually from 75 to 100 feet, it is hardly probable that any coal above No. 3 will be found in the county.

From the preceding section it will be seen that the coal seams of this county are very irregular in their developments, and, with the exception of No. 1, do not promise to be of much value in the production of coal. However, it is quite possible that at some localities remote from the river bluffs, or away from the principal streams, the upper seams may be found more fully developed, and this may be tested at any point in the county where the demand for coal may seem to justify the experiment, by boring down to the Devonian limestones, which will be reached anywhere in the county at a depth probably not exceeding 300 feet.

About seven miles below Andalusia, and in the neighborhood of Illinois City, coal is worked by a Mr. Arnold, by drifting into the Mississippi river bluffs. Here the seam is almost four feet thick, and the quality of coal about the same as at the mine worked by Mr. Smith, east of Andalusia. On Copperas creek, in township 16, range 5, the same seam, I think, is reached by a shaft of moderate depth.

The Coal Valley mines have been worked for many years and have made their present proprietors wealthy. Some ten years ago a railroad was built from Coal Valley to Rock Island City, with depots and all the appurtenances of a first-class road. A village of eighteen hundred inhabitants has sprung up round the mines. From sixty to one hundred miners find constant employment, and two hundred and fifty tons per day are sent to Rock Island when the mines are worked with the latter number of hands. This coal is sent into Iowa and Northern Illinois, but is used principally for making steam on the Mississippi river, for which purpose it seems well adapted. The working of these mines, the transportation of the coal to the river, and the capital or ownership of the mines, is all under a sort of a triune arrangement, which, under the energetic supervision of the Messrs. Cable, seem to work admirably. The coal company, the railroad company, and the miners each receive one-third of the coal mined, or profits realized. A perfect community of interests is thus kept up, and strikes and dissatisfaction are comparatively unknown.

The coal seam is from four to four and a half feet thick. It is subject to local dips and elevations, sometimes dipping below the water level. Faults or "horsebacks" are struck when the drifts extend far into the hills. Beyond these so-called faults, sometimes only black shales are found, and sometimes the coal seam becomes too thin to work. The roof is composed of black shales, in places rotten, and is succeeded by dark, irregularly-bedded limestone, of slaty cleavage and conchoidal fracture. In one or two instances, for short distances the seam is double, being separated by several feet of dark shales and other foreign matter. The floor of the seam sometimes consists of an impure fire-clay, and in other places of a black slate, with some resemblance to cannel coal. Wooden railways are laid in the drifts, and the coal is hauled out by mules and wooden cars, and dumped directly into the railroad cars at the station. Some of the hills are tunneled pretty thoroughly, and the supply of coal well nigh exhausted in them, but new drifts, and farther extensions of old drifts, will doubtless afford profitable mining for some years to come. The deposit, however, is quite local in extent, and will some day become exhausted. In 1867, sixty-eight thousand tons of coal were mined and sent to market; in 1868 the amount was probably larger. This, in time, will exhaust any small coal field.

The coal itself is a fair, soft coal, tolerably free from sulphur, and stained red in places with the rust of iron from the percolating waters. It is well adapted to making steam, for which purpose it is extensively used.

The seam nowhere perhaps rests directly upon the Devonian rocks, as in Henry county, near Cleveland, but is separated therefrom by sandstones and shales, some twenty to sixty feet and upwards in thickness.

The coal seams of Rock Island and adjoining counties along the northern boundaries of the Illinois coal fields belong to the lower Coal Measures of the State. The Silurian rocks dip very gradually, the angle being almost imperceptible, beneath the Coal Measures. At the southwest corner of Rock Island county the sub-Carboniferous limestone probably underlies the Coal Measures; at the mouth of Rock river the Hamilton limestone does the same; farther up the river, at Aldrich's, the Niagara limestone is the underlying rock; and along the northeastern part of Bureau county the Galena limestone may be detected in the same position.

Drift Deposits.—The usual Quaternary deposits are found in this part of Rock Island county. In the southwest corner there is a

strip of alluvial bottom along the Mississippi river. On the south side of Rock river the usual alluvial river bottoms extend across the whole county, intersected with some low ridges of sand. Both these strips are inclined to be swampy, except some portions of the latter, which are dry enough to make excellent farming lands. The Loess of the bluffs is not very distinctly marked. A heavy deposit of light-colored Drift clays overlays the Coal Measures, attaining a thickness of fifty or sixty feet. Occasional bowlders are seen on the surface, or in the ravines. Gravel beds and coarse gravel are not met with. No very marked drift phenomena were noticed, and the Drift deposits of the southern part of Rock Island county present no peculiar or marked characteristics.

Economical Geology.—Of coal, the extent of its mining and its probable supply, we have spoken already in a former part of this report. The importance of the coal traffic in the future history of this county can hardly be over-estimated. The facilities for distribution from Rock Island into Northern Illinois and Iowa, and the great demand and easy access to the Rock Island coal field for fuel to make steam on the Mississippi river, create a steady demand for large quantities of coal. The construction of a railroad up the valley of Rock river, and eventually into the lumber regions of Wisconsin,—a work now actively agitated, and in part commenced and under contract,—will greatly add to this demand.

The other economical deposits do not differ materially from those of the northern part of the county. Abundance of good stone are found along the two rivers, for building purposes. The Drift clays burn into a good common brick. The purer strata of the Hamilton limestones make an excellent and very white article of common lime. The rougher portions of the surface are well adapted to the cultivation of the cereals, the vine, and other varieties of Illinois fruits. The county, as a whole, has many sources of material prosperity, although its agricultural resources are far from being equal to those of some of the neighboring counties.

Mineral Springs.—I should not close this report without speaking of a very remarkable group of mineral springs just below the village of Andalusia. They are known as the "Rinnah Wells Springs." Two or three of them are curbed with stone. The water flows out of the top, and leaves a whitish incrustation on the curb-stones. It has a strong, rather pleasant, soda taste, and is said to contain marked medicinal and health-giving properties. The water is far more pleasant to the taste than that afforded by the springs at Saratoga and other fashionable resorts in the Eastern States; but

the probability is that there are no better or more health-giving mineral waters to be found in our country than those welling up from these "White Sulphur," or "Soda," springs. Andalusia has a musical name, is surrounded with varied and picturesque scenery, and as a pleasant resort during portions of the year would prove attractive. A little wealth and a little advertising would make this a desirable stopping place for pleasure-seekers on the great thoroughfare of the Mississippi, and would attract invalids from this and neighboring States.

NOTE.—In closing our report on this county, we desire to acknowledge our obligations to Wm. S. Thomas, of Carbon Cliff, and to Mr. Buffum, of Andalusia, for the hospitable entertainment which they so freely extended to us while at work in the county; and to Mr. Rinnah Buffum, Mr. S. C. Bowman, J. H. Southwell, and Dr. Cozad, of Andalusia, for their valuable contributions of the interesting fossils of this region, and their earnest coöperation and assistance while at work in the southern part of the county.

A. H. W.

CHAPTER XIV.

PEORIA COUNTY.

Peoria county lies about seventy-five miles north of the center of the State, and is bounded on the north by Stark and Marshall counties, on the east by the Illinois river, on the south by the Illinois river and Fulton county, and on the west by Fulton and Knox counties. It embraces an area of fourteen full townships and seven fractional townships bordering the Illinois river, or about six hundred and thirty square miles. The Illinois river extends for about fifty miles along its eastern and southeastern borders; Kickapoo creek and its several affluents traverse the central portion of the county; while Spoon river intersects the northwestern townships for a distance of ten or twelve miles.

The surface of the county was originally nearly equally divided into timber and prairie. The prairies are usually small, the most extensive ones being those in the western and northern portions of the county, and extending over the highest lands between the watercourses. There is also a narrow strip of prairie extending along the river from the northeast corner of the county to the outlet of the Kickapoo, having a variable width of from one to three miles. This belt of prairie covers a sandy terrace below the river bluffs, and is elevated from thirty to fifty feet above low-water level.

Surface Geology.

Four subdivisions of the Quaternary are found in this county: Alluvium, Loess, modified Drift, and the true Drift or bowlder clay. The alluvial deposits are of limited extent, and confined to the borders of the principal streams. The terrace lands, on the southern extremity of which the city of Peoria is built, and which extend thence to the northeastern extremity of the county, may be considered as belonging to the modified Drift deposits rather than the Alluvium. Their surface is entirely above the high-water level of the river, and they consist largely of sand and gravel, which was deposited during what was termed the Terrace epoch, when the waters

in the valley of the Illinois stood at a level of fifty feet or more above the highest point attained by the waters of the existing streams, but still subsequent to the accumulations of modified Drift that form the main portion of the bluff at Peoria, and along the north bank of the Kickapoo for some distance beyond Edwards station. These sandy terraces, occurring at about the same level, are a characteristic feature of the Illinois River valley, and most of the towns from Naples to Peru are built upon them. We were not able to obtain any reliable section of the beds constituting this terrace; but, so far as could be seen from partial exposures of the strata on the small streams that cut through it, the upper portion, at least, is composed mainly of sand and gravel.

The modified Drift deposits, which form the main portion of the bluff at Peoria, are about seventy-five or eighty feet in thickness; and for the following section, made in sinking a well from the top of the bluff in that city, I am indebted to my friend, E. G. Johnson, Esq. The well was four feet in diameter, and was carried down ninety-seven feet, and then a boring was made eight feet more. The section is as follows:

		Feet.
No. 1.	Brown prairie clay and soil	12
No. 2.	Coarse gravel and sand, with bowlders	35
No. 3.	Clay and sand, forming seven or eight distinct beds, some containing coarse gravel and bowlders	48
No. 4.	Black, mucky soil, with limbs of trees, etc	2
No. 5.	Bowlder clay	8

Nos. 2 and 3 constitute the modified Drift deposits of this section, and their aggregate thickness is eighty-three feet. Mr. Johnson remarks, in his letter transmitting this section to me, that "at the depth of about eighty feet from the surface we found a considerable heap of charcoal: evidently such as would be left by a fire made of branches of trees from a half inch to an inch in diameter; a small fire, big enough to have boiled a kettle or cooked a venison steak." This indicates the existence of man in this region anterior to the epoch of the modified Drift, and we may reasonable expect that evidence will yet be found to prove his existence here anterior to the deposit of the bowlder clay. No. 2 of the foregoing section contains bowlders of all the varieties of metamorphic rocks usually occurring in our Drift deposits, and of all sizes up to a diameter of three or four feet. The full extent of this deposit inland from the river bluffs we were unable to determine, but it extends westward to the valley of the Kickapoo, and northwardly it is exposed on all the branches intersecting the bluffs for several miles. The ancient valley, now in part occupied by the Illinois river, was apparently at one time fully twice its present width from the outlet of the Snacht-

wine to the Kickapoo, and its western portion has been subsequently filled with these drift accumulations. In the northeastern portion of the county the Drift beds presented no decided indications of having been subjected to the modifying influences observed further south, and they attain a greater thickness here than in any other portion of the county. In the bluffs west of Mossville they are fully two hundred feet thick, as shown by measurement where the road leading out to the prairie ascends the bluff, and consist of brown and dark-bluish colored clays, with gravel and bowlders. The upper portion of this deposit here is a brown clay, comparatively free from gravel, and thirty to forty feet thick. Striking the prairie road about three miles west of Mossville, and turning south to Peoria, no indications of the presence of any stratified rocks were seen in any of the gulches intersecting the bluffs, although careful examinations were made. Hence we may safely conclude that the western borders of the old valley in this vicinity were at least three miles to the westward of the present line of bluffs.

On the south side of the Kickapoo, and in the central and northwestern portions of the county, the stratified rocks of the Coal Measures outcrop on all the streams, and the overlying Drift beds are comparatively thin, ranging all the way from four to sixty feet. At Chase's quarries, three miles northeast of Princeville, the Drift clays are only from three to four feet thick, with about a foot in thickness of sand resting directly upon the limestone; and at several other points in this vicinity the bed-rock was seen outcropping within a few feet of the surface. It is probable that this limestone formed a barrier reef during the accumulation of the drift, and the transported material was thus diverted into the deeper channels on either side. South of Kickapoo the uplands are covered with Drift clays that are generally from forty to fifty feet in thickness and spread quite uniformly over the surface. Along the river bluffs the marly, buff-colored beds of the Loess cap the highest point, but north of the Kickapoo we did not meet any beds that could be properly referred to this age, unless the brown clay immediately below the soil may be so referred.

The only fossils of this age that have come under my notice from this county are the remains of a mammoth, consisting of two molar teeth, with a portion of the jaw, which was found by Captain Smith in the gravel bed No. 2 of the foregoing section, in the Peoria bluff. A portion of one of these teeth, with a part of the jaw, now belongs to the State cabinet, as a contribution from its discoverer. In a boring made near Chillicothe, a few years since, an ancient copper

coin was reported to have been found at a depth of 122 feet, but it might have been dropped in from the surface for the purpose of deception, or fallen down accidentally from some layer near the surface. This coin has been figured and described in the Transactions of the American Philosophical Society of Philadelphia, Vol. xii, p. 224. Although it is by no means improbable that primeval man existed before the valley drift of this region was deposited, yet we have no evidence going to show that he was then so far civilized as to be able to work the native metals, or to have acquired any knowledge of the use of money.

Stratigraphical Geology.

All the stratified rocks that appear above the lowest water levels in this county belong to the Coal Measures, and comprise an aggregate thickness of about 175 feet, including the horizons of coals Nos. 5 to 7, inclusive. Three of these seams, Nos. 5, 6 and 7, are worked extensively in various portions of the county, and have an aggregate thickness of about twelve feet.

The following section, constructed from the outcrops of the strata along the Kickapoo creek and its branches, will illustrate the thickness and relative position of the various coals in the county, and the rocks with which they are associated:

		Feet.
No. 1.	Seam of smut, indicating a thin coal, or black shale	1
No. 2.	Soft, brown sandstone, partly exposed	15 to 18
No. 3.	Gray limestone, upper portion nodular and impure	15 to 20
No. 4.	Sandy and argillaceous shales	45
No. 5.	Bituminous shales	3 to 5
No. 6.	Coal No. 7	1½ to 3½
No. 7.	Sandy shales	30 to 35
No. 8.	Light-gray limestone, with *fusulina*	2 to 4
No. 9.	Bituminous slate and shale	1 to 2
No. 10.	Coal No. 6	3 to 5
No. 11.	Shales, argillaceous and sandy	20 to 35
No. 12.	Sandstone, partly ferruginous, passing upward into shale	28 to 30
No. 13.	Bituminous and arg. shale, with ironstone concretions	5 to 8
No. 14.	Coal No. 5	4 to 5
No. 15.	Fire-clay and septaria	2 to 3
No. 16.	Argillaceous and sandy shales	15 to 20

The three upper beds in the foregoing section, especially the limestone, is well exposed at Mr. John Lonsdale's quarries, on the south side of the Kickapoo valley, on section 14, town 8 north, range 7 east (Limestone township). The lower layers of this limestone are quarried here both for building stone and for burning into lime. This part of the bed affords tolerably even layers, from four to eight inches thick, of fine-grained, compact, light bluish-gray limestone, that makes a very good building stone and also a quicklime of fair quality. The upper portion of the bed is in very uneven, nodular layers of an inch or two in thickness, and, on weathering,

becomes a loose mass of limestone pebbles of about the proper size for macadamizing material. *Spirifer lineatus* and *Athyris subtilita* were the most common fossils found in these upper layers, and these, with *Spirifer cameratus*, *Retzia Mormoni* and *Platyostoma Peoriense*, were obtained from the lower beds. William Gifford, Esq., obtained here a magnificent specimen of *Chætetes milleporaceous*, about two feet in diameter, by far the largest specimen of the kind yet found in this State. It came from the lower part of the limestone, or perhaps from the clay shales which underlie it.

The beds overlying the limestone we found but partially exposed in the vicinity of St. John's church, where a quarry had been opened showing a face of about five or six feet of thin-bedded soft brown sandstone, and above this some partial outcrops of sandy shale. In the side of the road nearly opposite the church, the seam of smut was found which we have placed at the top of this section, but whether it was derived from a rotten coal or a bituminous shale, could not be determined without further exploration. It lay immediately under the bowlder clay, and had probably been for a long time subjected to atmospheric influences before the Drift clays were deposited upon it. It is not probable that it represents a coal seam of any considerable thickness; otherwise it would have been discovered in sinking wells in this vicinity, as the outcrop was not far below the general level of the prairie. The bed No. 4 of the foregoing section is usually an arenaceous shale, but locally it becomes partly argillaceous, and affords some fine specimens of siliceous wood, that are found in the beds of the small streams that cut through it, and probably come from the argillaceous layers of this bed. On one of the branches of the north fork of the Kickapoo creek, on section 4, in Jubilee township, there is an imperfect exposure of the following beds, all of which seem to belong above the horizon of coal No. 7:

	Feet.
No. 1. Brownish-gray limestone	2 to 3
No. 2. Green and yellow argillaceous shales	20 to 30
No. 3. Limestone conglomerate	2
No. 4. Sandy shales partially exposed	15 to 20

The ravine where this section was made abounds with fossil wood, all of it completely silicified, and many of the specimens representing sections of what were once large trees; many of the fragments are now from two to three feet in length, and so large as to require the strength of two stout men to load them into a wagon. Several wagon-loads of this siliceous wood could have been obtained from

this ravine in a distance of two or three hundred yards. Although not found *in situ*, it no doubt came from the argillaceous shales represented by No. 2 of the above section, as it seemed to be most abundant along the outcrop of this bed. We found one fine specimen on the south side of the Kickapoo at about the same horizon, but the shales are there more arenaceous, and the specimens of fossil wood comparatively rare. The limestone conglomerate, No. 3 of the above section, was not seen on the south side of the Kickapoo, but it seems to correspond very nearly in position to a band of sparry limestone at the top of the section at Kingston, given on a following page.

On section 18, in Radnor township, we found a single layer of fine-grained gray limestone about thirty inches thick, traversed by thin veins of spar, which may be the equivalent of No. 3 of the above section; but as there was no exposure of the underlying strata, its position could not be positively determined. Below it we only saw a few inches of pebbly clay resembling a fire-clay.

Coal No. 7 is quite variable in thickness in this county, ranging from one and a half or two feet on the waters of the Kickapoo, to three and three and a half feet in the northeastern portion of the county. On the Kickapoo but few attempts have been made to work it in competition with the thicker seams which underlie it and outcrop in nearly every hillside, but in the northern part of the county this coal ranges from three to three and a half feet in thickness, and as the lower seams are there below the surface, this is mainly relied upon for a local supply of coal. Armet and Dukes mines, two and a half miles northwest of Chillicothe, are on this seam, and the coal is there thirty inches thick, overlaid by a rather soft bituminous shale about two feet in thickness. The beds exposed at this point give the following section :

		Feet.
No. 1.	Sandy ferruginous shales	35
No. 2.	Bituminous shale	2
No. 3.	Coal No. 7	2½
No. 4.	Sandy shales and sandstone	20 to 25
No. 5.	Arenaceous limestone	2
No. 6.	Bituminous shale	1 to 3
No. 7.	Coal No. 6	below the level of the creek.

On Mr. Hunter's land, a little farther to the westward on the same branch, the coal is three feet thick, with about the same thickness of bituminous shale above it. It is also worked on the Snatchwine and at Hallock's hollow five miles west of Chillicothe, but I did not visit these localities. The shales overlying the coal on Hunter's land contains numerous ironstone concretions very similar in

appearance to those found on Mazon creek in Grundy county, but they contain no fossils here so far as I could discover. Coal No. 6 is reported to be very irregular in its development in this vicinity, and hence no systematic attempt has been made to work it here.

Coals No. 5 and 6 outcrop in the river bluff below the valley of the Kickapoo and also in the bluffs on either side of that stream nearly to Edwards station, where No. 6 gradually passes underneath the creek valley. At Kingston, in the extreme southeastern portion of the county, both seams have been worked since the earliest settlement of the county, and the mines here were among the first opened for supplying coal to the river steamers. When we first visited this locality in 1859 the upper seam (No. 6) was worked by Mr. John D. Jones, in a tunnel driven horizontally into the bluff on the outcrop of the seam. The coal averages about four feet in thickness and has a good roof of bituminous shale and limestone.

No. 5 was also worked at this time by the Kingston Coal Company, in a horizontal tunnel driven into the base of the hill. The thickness of the coal in this seam ranges from four to four and a half feet, and the coal is much harder than that in the upper seam and is a good steam coal, but contains more pyrite than No. 6, and is consequently not a favorite coal with the blacksmiths.

At Lancaster landing, one mile and a half below Kingston, both seams have been opened, and the lower one has been constantly worked for several years. Its thickness here is from four and a half to five feet, with a roof of bituminous shale one foot thick, overlaid by shale and sandstone. Below the coal there is from one to two feet of dark-blue fire-clay, underlaid with shale containing bands of septaria. From the roof shales of this seam we obtained the following fossils at the various mines in this part of the county: *Lingula mytiloides, Discina nitida, Athyris subtilita, Aviculopecten rectilaterarius, Petrodus occidentalis, Listracanthus hystrix, Pleurotomaria Grayvillensis,* and joints of *crinoidea,* some of the latter being more than half an inch in diameter.

At Liverpool, No. 6 is mined to supply steamers at that point, as No. 5 is below the level of the bottom lands. The roof of this seam is usually a foot or more of bituminous shale, overlaid by from two to three feet of brownish-gray argillaceous limestone. The characteristic fossil of this limestone is a small *Fusulina,* about the size and form of a grain of wheat, but associated with it we find *Productus longispinus, P. costatus, Hemipronites crassus, Chonetes mesoloba* and joints of *crinoidea.* The coal in this seam is not so persistent in its development as that of No. 5, being more affected by the

irregularities usually termed "horsebacks" by the miners, by which the coal is partly or wholly replaced with shale or fire-clay. This forms the great impediment to the successful mining of this seam at the present time. The following section of the strata outcropping at Kingston was made on my first visit to the locality in 1859:

		Feet.
No. 1.	Sparry brownish-gray limestone	2
No. 2.	Shales, sandy and argillaceous	12 to 15
No. 3.	Coal No. 7	1½
No. 4.	Fire-clay	2
No. 5.	Sandstone and shale	20 to 25
No. 6.	Limestone	2 to 3
No. 7.	Bituminous shale	1 to 3
No. 8.	Coal No. 6	3 to 4½
No. 9.	Fire-clay	2 to 3
No. 10.	Sandstone and sandy shales	35 to 40
No. 11.	Blue clay shales with bands of ironstone	10 to 15
No. 12.	Bituminous shale	3 to 5
No. 13.	Coal No. 5	4 to 4½
No. 14.	Fire-clay with septaria	2 to 3
No. 15.	Shales partially exposed to river level	20

Previous to this time a boring was made here, no accurate record of which was kept, but a coal seam three feet thick was reported at a depth of about one hundred and fifty feet below the lower seam in the above section, and as that is about the depth at which No. 2 would probably be found, the report is by no means improbable. From the careless manner in which borings were made at this time, and the incompetency of those most frequently placed in charge of this kind of work, but little dependence should be put upon the reported results.

At the Mapleton mines, the first now in operation north of Kingston, the coal in No. 5 is somewhat thicker than its general average in this county, being, according to the report of the mining engineer, from five feet to five feet ten inches in thickness. This seam is also less subject to interruptions from "horsebacks" here, than in some of the mines further north, and where they do occur they are usually of limited extent. These mines have been opened in the most substantial way, the entries are spacious and thoroughly secured with heavy timbers, and the work is prosecuted in the most thorough manner.

At the Orchard and Hollis mines, opposite the city of Pekin, the same seam is worked, and the coal is from four feet to four feet ten inches thick, with a very good roof of bituminous shale. A "horseback" has been encountered in these mines so extensive as to lead some of the miners to the conclusion that a true fault or dislocation of the strata occurred here, but from such examinations as I was able to make, both in the mines and the adjacent ravines, where

conclusive evidence of a fault ought to be apparent if one existed, I came to the decided conclusion that no dislocation of the strata had taken place, but that the coal had perhaps been cut away by the action of water currents, and the clay deposited in its place, and that when it was found on the other side of this so-called "fault" it would be found at about the same level with the coal now worked in the mine. On one of the ravines immediately west of these mines we were shown a locality where the rocks had apparently been partially undermined by the erosive agencies that formed the valley, and the strata of sandstone and shale above the coal having partially fallen, dipped to the eastward at a high angle, and this was regarded by some as conclusive evidence of the occurrence of a fault in this vicinity. But if this was the case, and this apparent dip continued to the Orchard mines, it would carry the coal seam far below its present level, and probably even below the level of the Illinois river, while on the contrary the coal in these mines lies nearly horizontal, and is, moreover, on about the same level as in the mines on either side. Hence we feel confident the irregularity in the deposition of the coal here is not due to any dislocation of the strata, but must be accounted for on some other hypothesis. No systematic attempt has yet been made in this neighborhood to work No. 6, but its outcrop is continuous along the face of the bluff, at an elevation of about sixty-five feet above No. 5. The coal afforded by this lower seam is considered to be somewhat softer and freer from pyrite at the mines along the Illinois river bluffs, than on the Kickapoo, which is, perhaps, in part, the reason why the upper coal has been so generally neglected here.

Commencing on the south side of the Kickapoo, we find continuous outcrops of these two seams in the bluffs of that stream for several miles to the westward, until the elevation of the valley towards the head of the stream brings it above the level of these coals, and No. 7 is the only seam remaining above the level of the water courses. On the north side of the creek the outcrops are not continuous, the coal strata being partially removed by erosion, and their place subsequently filled with deposits of modified drift.

Walter Treasure's mine is on the south bluff of the Kickapoo, on the southeast quarter of section 24, township 8 north, range 7 west. No. 5 is the seam worked here, and it ranges from four feet to four feet two inches in thickness, with a roof of bituminous shale passing upward into a blue clay shale with bands of iron ore. The coal is hard and bright, and is not much interrupted by "horsebacks," and is underlaid by a foot or more of gray fire-clay passing downward

into a clay shale with bands of limestone. This mine, like all the others in this part of the county, is worked with a horizontal tunnel driven into the base of the hill on the line of outcrop.

The following section, compiled from the exposures of the strata seen in this vicinity, will, by comparison with those heretofore given, show how uniformly these two coals and the strata associated with them are developed in this part of the county.

		Feet.
No. 1.	Light-gray limestone	2 to 3
No. 2.	Bituminous shale	1 to 2
No. 3.	Coal, No. 6	3 to 5
No. 4.	Clay shale or fire-clay and nodular limestone	3 to 6
No. 5.	Sandy shales	25 to 30
No. 6.	Massive micaceous and ferruginous sandstone	20
No. 7.	Blue shale with iron bands	6 to 8
No. 8.	Bituminous shale	1 to 3
No. 9.	Coal, No. 5	4
No. 10.	Fire-clay	2
No. 11.	Shale with thin bands of limestone	15

At Griswold's mines, on the northwest quarter of section 24, township 8 north, range 7 west, coal No. 5 is from four feet to four feet six inches in thickness, with the same kind of a roof as at Treasure's mines, and the coal is similar in quality.

No. 6 has been opened at many points in this vicinity, but from its uneven development and its greater elevation above the creek valley, it is not mined as systematically as the lower seam. The sandstone No. 6 of the above section is well developed along the Kickapoo bluffs in this vicinity, and some extensive quarries have been opened here. The rock is partly a brown micaceous, and partly a ferruginous sandstone, in massive layers from one to three feet in thickness. The ferruginous layers become quite hard on exposure, and will no doubt resist the disintegrating influences of the atmosphere more effectually than any other portions of the bed, but if carefully selected and the soft and shelly portions of the rock rejected at the quarry, the remaining portion will no doubt sustain a good reputation as a reliable building stone.

On a ravine about half a mile west of Monro's mill, coal No. 7 was found high up in the hill. It is here only about eighteen inches in thickness, and is separated from No. 6 by about thirty-five feet of sandy and argillaceous shales. It was overlaid by bituminous shale and a soft micaceous sandstone.

At Edwards station, on the Peoria branch of the Chicago, Burlington and Quincy railroad, coal No. 5 is some sixty feet below the level of the valley, and No. 6 is worked by a horizontal tunnel into the base of the hill just above the railroad grade. As at the out-

crops of this seam further west, it is quite variable in thickness here, ranging from three to five feet, and, in consequence, it cannot be mined as cheaply as No. 5.

About a mile south of Elmwood, coal No. 6 is reached by a shaft fifty feet in depth. The coal is four feet to four feet and a half in thickness, with a few inches of bituminous shale, and a light-gray sandstone forming the roof. The coal is tolerably soft, light and free burning, and generally free from pyrite. Coal No. 7 outcrops in this vicinity and has been worked in a limited way, but is too thin to be mined successfully in competition with the lower seams. A boring near Elmwood, on the south side of the Kickapoo, struck the bed rock at sixty feet and below the horizon of coal No. 6, and was carried down through the following strata.

		Feet.
No. 1.	Drift clay	60
No. 2.	Clay shale	18
No. 3.	Limestone	2
No. 4.	Bituminous shale	2
No. 5.	Coal, No. 5	3½
No. 6.	Sandy shale	15
No. 7.	Septaria	7
No. 8.	Clay shale	24
No. 9.	Nodular limestone	8
No. 10.	Gray shale	28
No. 11.	Blue limestone	2
No. 12.	Dark shale	12
No. 13.	Bituminous shale	2
No. 14.	Coal, No. 3	3½

This boring was made by the Elmwood Mining and Manufacturing Company, and I am indebted to W. J. Phelps, Esq., of said company, for the details here given. By comparing this section with that of Voris & Co., on the east bank of the Illinois river opposite Peoria, as given in Vol. II, p. 439, it will be seen that the beds below No. 4 coal thicken somewhat to the eastward, as it was found to be about one hundred and thirty-three feet from No. 5 down to No. 3 in that boring, while at Elmwood it is only ninety-eight.

On one of the branches of the north fork of the Kickapoo, on sec. 5, in Jubilee township, coal 6 outcrops in the bed and along the banks of the creek. The coal is very irregular in its development in this vicinity, sometimes thinning out to a mere streak, and then thickening to five or six feet. No 7 was also found here, represented at the outcrop by about a foot in thickness of rotten coal. About twenty feet or more above No. 7 we saw a bed of hard, brownish-gray limestone, some three or four feet in thickness, traversed by thin veins of calcite, and resembling somewhat the band of sparry limestone at the top of the Kingston section.

One mile and a half northeast of Princeville No. 7 is worked on a small branch of Spoon river. The coal varies in thickness here from two and a half to three feet, with a tolerable good roof of bituminous shale. No. 6 has also been found on this branch, and a shallow shaft sunk to it; but it proved so irregular in its development that the working of it has been abandoned, and all the coal mined at the time we visited this locality was obtained from No. 7, and it is probably the only coal that outcrops in the northern tier of townships in this county, except, perhaps, on Spoon river in the northwestern corner of the county, where No. 6 probably again appears above the river level.

Three miles northeast of Princeville a bed of limestone outcrops on the open prairie, and only from three to five feet below the general level of the surface. At Chase's quarries the bed is about twenty feet thick, the lower six feet being a true crinoidal limestone, composed almost entirely of the joints of small crinoids, and containing also a few fossil shells, among which we observed *Spirifer camerata*, *Athyris subtilita*, *Hemipronites crassus*, and some remains of fishes. The middle and upper portion of the bed is nearly destitute of fossils, and is a thin-bedded buff-colored earthy limestone, a portion of which is in thin even layers from two to six inches thick, and is easily quarried in large slabs suitable for flagging. It is extensively quarried and used throughout the neighborhood for foundation walls, for walling wells, and for various other purposes for which a building stone is required. The middle portion of the bed has an earthy texture, and resembles a hydraulic limestone. The quarry can be cheaply worked, from the small amount of stripping required to clear the rock from the overlying Drift clays.

A few feet of blue clay shales were seen below the limestone, but no outcrop was found where a good section from coal No. 7 up to the limestone could be made.

The nearest outcrop of the coal was about a mile and a half distant, and at a somewhat lower level, and I estimated the distance between them at about fifty feet. This would bring the limestone here about on the same stratigraphical level with that at Lonsdale's quarries, on the south side of the Kickapoo; and although the limestone at Chase's quarries differs somewhat in its lithological characters from that at Lonsdale's, I am still disposed to regard them as probably equivalent beds. The distance between the limestone and the coal at Lonsdale's was forty-eight to fifty feet by measurement, while at Chase's quarries, according to the best estimate I could

make, it seemed to be about the same. Furthermore, if this limestone represents a higher bed, then the Lonsdale limestone should be found outcropping between it and the coal, and from the thinness of the Drift clays in this vicinity, its outcrop could hardly be concealed. The color of the rock is very similar at the two localities, and there is also a general similarity between them, in this, that the purest limestones and the thickest layers are at the bottom of the bed, and the thinner impure layers above. But the lower part of the bed at Lonsdale's is a fine-grained compact rock, while here the same portion of the bed is a rather coarsely granular crinoidal limestone, and the upper part of the bed at the one locality is in nodular uneven layers, and weathers on exposure to a heap of limestone pebbles, while at the other it is more evenly-bedded, and can be quarried in slabs of considerable size. If these two exposures are not equivalent beds, then the Lonsdale limestone is not developed here at all, and the limestone north of Princeville is deposited unconformably upon the shales above coal No. 7. This limestone is the uppermost bed of rocks exposed in this part of the county, and its outcrop is on an elevated prairie, apparently one of the highest in this vicinity.

In tracing the various outcrops of the strata in this county, the dip is found to be very slightly to the northeastward, and about three feet to the mile. Hence No. 6 coal, which on the lower course of the Kickapoo ranges from seventy-five to eighty feet above the level of that stream, is found just below the level of the small creeks north of the Snatchwine, while No. 5 is from sixty-five to seventy feet below their beds, and No. 7 is the only seam outcropping above the level of the streams, and it attains here a thickness of about three feet, which is fully double what it will average in the southern part of the county.

Below the level of the Illinois river there are also at least two coal seams, as has been demonstrated by the borings of Voris & Co., opposite Peoria, and the Elmwood Mining and Manufacturing Company, that are of sufficient thickness to be worked successfully, whenever the supply from the higher seams becomes exhausted, making in all five seams underlying nearly the whole of this county, except the valleys of the Kickapoo and the Illinois river.

Economical Geology.

Coal.—There are but few counties in the State where so great an amount of coal can be obtained at a minimum cost of mining as

in this. Coals Nos. 5, 6 and 7 outcrop on all the streams in the southern part of the county, and can be worked in the most economical way by horizontal tunnels driven into the hillsides on the natural outcrop of the seams, while in the central and northern portions of the county, where the two principal seams are below the level of the creek valleys, they may be reached by shafts not exceeding seventy-five to one hundred feet in depth. These three coals have an aggregate thickness of about ten feet, and will yield ten million tons of coal to the square mile. They probably underlie fully one-half of the entire area of the county; and in addition to these there are probably two more, with an aggregate thickness of about seven feet, underlying the whole area of the county, and capable of yielding about seven million tons of coal to the square mile. I know of no other county in the State, except Fulton, where so great an amount of coal can be mined at the same cost as here, and the facilities for transportation over the various railroads centering at Peoria, as well as by the Illinois river, are such as to make this one of the most important coal-producing sections of the State.

The quality of the coal obtained from the three seams now being worked in this county is variable, and even from the same seam the quality varies somewhat at different localities. Most of the coal now mined in the southern part of the county, and on the lower course of the Kickapoo, is from No. 5, and the coal it affords is somewhat harder than that from either of the other seams, and therefore a better coal for transportation. The coal from No. 6 is not only softer, but freer from pyrites and other impurities, and is an excellent coal for the smith's forge. No. 7 also affords a soft coal, generally free from pyrites, but containing a much larger per cent. of ashes than that from No. 6.

The following analysis, by Messrs. Blaney and Mariner, of coals from this county, is extracted from Dr. Blaney's Chemical Report, in Vol. I, page 208. The specimens were collected in 1858 from mines worked at that time, and the owner's name was given instead of the locality where the mines were located. The two first are an average of three analyses of specimens from different parts of the seam at one locality, and the last the result of only a single analysis:

Aiken's Mine—(Coal No. 5.)

Specific gravity	1,3122
Total volatile matters	36.9
Coke	63.1
	100.0

ANALYSIS.

Moisture	10.3
Volatile combustible matters	29.9
Carbon in coke	54.4
Ashes	8.7
	103.3

R. Howard's Mine—(No. 6.)

Specific gravity	1.2571
Total volatile matters	38.3
Coke	61.7
	100.0

ANALYSIS.

Moisture	11.2
Volatile combustible matters	27.1
Carbon in coke	59.5
Ashes	2.2
	100.0

Specimen from Isaac Brown's Land.—(Seam No. 7.)

Specific gravity	1.3228
Total volatile matters	37.2
Coke	62.8
	100.0

ANALYSIS.

Moisture	12.0
Volatile combustible matters	25.2
Carbon in coke	53.2
Ashes	9.06
	100.00

These analyses show that No. 6 contains the largest amount of fixed carbon, and the smallest amount of ashes, while the specimen from No. 7 contained a smaller per cent. of carbon and more ashes than either of the others. However, the actual value of this coal cannot be fairly judged from the result of a single analysis. At least three-quarters of all the coal mined in the county at the present time is taken from No. 5, and the others are only worked in neighborhoods where No. 5 is below the surface, except at some few points where No. 6 is mined in a small way for smiths' coal. No. 6 is more irregular in its development than either of the others, and for this reason it is generally neglected. When fully developed it is quite as thick as No. 5, but the miner who commences drifting into this coal on a promising outcrop from four to five feet in thickness, will frequently, in the distance of a hundred yards or less, find the coal gradually thinning out to one-half or less its original thickness, and he becomes discouraged at the prospect and abandons the mine. But with a good slate and limestone roof, this seam may be profitably worked with an average thickness of no more than two and a half to three feet of coal, especially where it can be done by tunneling into the hillsides along its line of outcrop.

No. 5 is also more or less subject to the interruptions commonly known as "horsebacks," but they are seldom of any considerable extent, and offer no serious impediment to the miner. Outcropping just above the level of the T., P. and W. railroad, and also the Peoria branch of the C., B. and Q. railroad, in the valley of the Kickapoo, it offers the best facilities possible for obtaining a fair quality and an abundant supply of coal at the lowest cost to those roads, for the supply of the less favored regions on the western borders of the State; and the amount of coal now annually transported from these mines is very large, and is constantly increasing. At the Orchard, Kingston, Lancaster and Liverpool mines, located in the western bluff of the Illinois river, large quantities of coal are annually taken out for the supply of steamers, and for transportation by the river to points below.

In the northern portion of the county, No. 7 is the principal coal outcropping above the valleys of the streams, and the lower seams can only be reached by shafts, or by an inclined tunnel carried down to their level. This seam ranges from two and a half to three feet in thickness in this part of the county, and its outcrop may be found on most of the small streams. It is very regular in its development, and affords a coal of fair quality where it is mined beyond the influence of atmospheric agencies.

Building Stone.—Sandstone of good quality may be obtained from the bed overlying coal No. 5, which, at some points on the Kickapoo, is fully twenty feet in thickness, and it outcrops at many points under very favorable conditions for quarrying. The rock is a brown micaceous, and partly ferruginous sandstone, in massive beds, some of which are two feet or more in thickness. It presents a bold escarpment at many points where it outcrops, indicating a capacity for withstanding well the ordinary influences of the atmosphere. The ferruginous layers harden very much on exposure, and would form the best material for bridge abutments, and for all other purposes where a rock was required to withstand well the influences of frost and moisture.

On Aiken and Griswold's land, on the south side of the Kickapoo, on section 24, this sandstone has been somewhat extensively quarried, and the bed presents a perpendicular face of solid sandstone fully twenty feet in thickness. It is rather soft when freshly quarried and can be easily dressed, and splits freely into blocks suitable for building and for foundation walls. These quarries are located just above the level of the railroad grade, and are very conveniently

situated for the transportation of the stone by railroad to the city of Peoria, or wherever else it might be in demand.

At Lonsdale's quarries, on section 14, T. 8 N., R. 7 E., the lower part of the limestone affords a durable building stone, though the layers are not usually more than from four to six inches thick. This rock is in common use in this part of the county for foundation walls, and there are several small buildings in this neighborhood constructed with this material. That portion of the bed which affords a building stone is from four to six feet in thickness.

At Chase's quarries three miles northeast of Princeville, the limestone is nearly twenty feet in thickness, and though for the most part thin-bedded, yet the greater portion of it can be used for foundation walls, flagging, etc., and is the only building stone available in that portion of the county. The thickest layers are at the bottom of the bed here, as well as at Lonsdale, but the middle and upper portion is more evenly-bedded at this point, and may be quarried in thin even slabs of large size.

The limestone over coal No. 6 may answer for rough foundation walls where it can be protected from the atmosphere, but is generally too argillaceous to make a good building stone.

Iron Ore.—Concretionary bands of iron ore occur in the shales overlying coals Nos. 5 and 7, but not in sufficient quantity to be of any economical importance. In the south part of the county, large concretions of iron and clay, the former mostly in the form of the bi-sulphuret, are quite abundant in the roof shales of No. 5 coal. Some of these concretions are two feet or more in diameter.

Clays.—We found no beds of fire or potters' clays in connection with the coal seams in this county, that appeared to be sufficiently free from foreign matters to be of much value, but excellent brick-clays are abundant, the subsoil clays over a large portion of the uplands throughout the county being used for this purpose, and furnishing an abundant supply of brick of good quality at a moderate cost. The best beds of fire and potters' clays known at the present time in this State are associated with coal No. 1 of our general section of the Illinois Valley coals, given on page 166 of Volume I of these reports; and should a shaft be sunk to that horizon in this county, good clays may probably be found here, and mined successfully in connection with these lower coals.

Sand.—The modified Drift deposits, forming the terrace upon which the city of Peoria is mainly built, will furnish an inexhaustible supply of sand of various qualities, adapted to the varied economical uses to which this material is applicable, and it will also afford an

excellent moulders' sand, in quantities sufficient for the supply of all the adjacent region.

Gravel.—An inexhaustible supply of clean gravel may be obtained from the gravel beds forming the bluffs at Peoria, and along the north side of the Kickapoo for a distance of eight or ten miles above the outlet of that stream. All the railroads in the State might obtain here an ample supply of ballast for their road beds, without greatly diminishing the amount of this material to be found in this county.

Timber.—There is an ample supply of timber in this county, the proportion of timber and prairie land being originally about the same. The timbered land is mostly confined to the ridges and valleys of the streams, though occasionally fine groves are met with on the level land adjacent to the prairie. The growth upon the upland is mostly black and white oak, pig-nut and shell-bark hickory, elm, linden, wild cherry, honey locust, wild plum and crab-apple; while on the bottom lands and the slopes of the hills, we find white and sugar maple, black and white walnut, pecan, cotton-wood, sycamore, ash, red birch, coffee-nut, hackberry, mockernut hickory, post, Spanish and swamp white oak, red bud, dogwood, persimmon, mulberry, service-berry, buckthorn, three or four varieties of willow and box elder.

Soil and Agriculture.—As an agricultural region, this county ranks among the best in this portion of the State. The western and northern portions of the county are mostly prairie, and generally level or gently rolling. The soil is a dark chocolate-colored loam, rich in organic matters, and producing abundant crops annually of corn, wheat, rye, oats and barley, and, with judicious cultivation, this kind of soil will retain its fertility for an indefinite period of years, without the application of artificial stimulants. On the more broken lands adjacent to the streams, the soil is of a lighter color, but where it is predicated upon the marly beds of the Loess, it is still productive, and scarcely inferior to the best prairie soils. Where the soil overlies the yellow Drift clays, the timber is mostly white oak and hickory; the soil is thin, and would be greatly improved by an annual application of manure liberally applied. These lands, however, produce fine crops of wheat and oats, and are excellent for fruit orchards and vineyards. The soil on the terrace and bottom lands is a sandy loam, and generally very productive.

In closing my report on this county, I desire to express my obligations to many of its citizens for their earnest coöperation and manifest interest in the work of the Survey, and especially to Mr.

Mark Aiken, Dr. Chapman, Sidney Pulsifer and Wm. Gifford, Esqrs., for much valuable information and assistance, and to E. G. Johnson and family for the enjoyment of a quiet home while at work in the county. The State Cabinet is also indebted to Wm. Gifford, Esq., for several interesting fossils, collected by himself from the Coal Measures of this county, and to Capt. Smith for a tooth and part of the jaw-bone of a mammoth, found by him in the modified drift of the Peoria bluffs.

CHAPTER XV.

McDONOUGH COUNTY.

This county is bounded on the north by Warren and Henderson counties, on the east by Fulton, on the south by Schuyler, and on the west by Hancock. It contains a superficial area of sixteen townships, or about five hundred and seventy-six square miles. The face of the country is generally level or gently rolling, except in the immediate vicinity of the streams, and consists of broad prairies covering the most elevated portions of the county, with belts of timber along the valleys of the streams and the broken land adjacent thereto. The prairies have a general elevation of seventy-five or a hundred feet above the valleys of the streams, and the soil upon them is a dark-chocolate colored, sandy loam, similar in general character to the prairie soils of the adjoining counties, and is admirably adapted to the growth of the cereals usually cultivated in this climate.

Timber is not as abundant in this county as in those adjoining it on the east and south, and covers less than one-third of its entire area. The principal varieties observed here were white, red, post, pin, black and Spanish oak, shell bark and pig nut hickory, red and slippery elm, linden, buckeye, white and sugar maple, cottonwood, sycamore, red birch, hackberry, white and red ash, honey locust, wild plum, crab apple, sassafras, red bud and dogwood.

The principal streams in this county are Crooked creek and its tributaries. The east fork of this stream traverses the county from northeast to southwest, while the main creek intersects diagonally only the southwestern township. In the early settlement of the State several water mills were erected on this creek, and the inhabitants of this and the adjoining counties were largely dependent for many years on the water power it afforded for their milling facili-

ties; but as the country was improved, and a considerable portion of its surface brought under cultivation, the supply of water gradually diminished from year to year, until many of the old mill sites have been abandoned, or else have added steam power to supply the lack of water during the dry season.

Geology.

The geological formations appearing at the surface in this county comprise the Quaternary, including the Loess and Drift; the lower portion of the Coal Measures, including the three lowest seams of coal; and the St. Louis and Keokuk divisions of the Lower Carboniferous limestones.

The entire area of the county, except the valleys of the streams, is covered with beds of Quaternary age, ranging from thirty to a hundred feet or more in thickness, and presenting the same general features that have been given as characteristic of this formation in the reports on the adjoining counties. Good natural exposures of these beds are but rarely found here, and the observer is compelled to rely mainly on such information as can be obtained from the well diggers, or others engaged in surface excavations, as to their thickness and general character. In the railroad cut on the north bank of Crooked creek, just below Colmar, the following section of Quaternary beds was seen:

Soil	1 to 2 feet.
Ash-colored, marly clay (Loess)	8 to 10 "
Reddish-brown clay	5 "
Sand and gravel, partially stratified	15 to 20 "

This exposure is considerably below the general level of the prairie, and the beds seems to have been subjected to some sifting process since its original deposition, giving to it the general characteristics of "modified Drift." In the shafts of Colchester the Drift clays generally range from thirty-five to forty feet in thickness, and consist of buff or brown clays, with gravel and bowlders, passing downward at some points into blue clays, or "hard-pan." Bowlders of metamorphic rocks, of various kinds, and of all sizes up to a diameter of two or three feet, are scattered in considerable numbers in all the gulches and streams that cut through the Drift beds, and are most abundant in the lower part of the Drift deposits. No indication of the presence of an ancient soil, underneath the Loess or the Drift, was seen at any of the points visited in this county; nor did we learn that it had been observed by any one else. The

wells are seldom sunk to the bottom of the Drift, and hence afford no indications of what may underlie the bowlder clays in this county.

At Bushnell a boring for coal passed through 112 feet of these Quaternary deposits before reaching the bed rock, in the following order:

No. 1.	Soil	2 feet.
No. 2.	Yellow clay	12 "
No. 3.	Sand	2 "
No. 4.	Blue bowlder clay	61 "
No. 5.	Blue and yellow sand	35 "
		112

This is probably twice as much as the average thickness of these deposits in this county—the drill having evidently penetrated an old valley, where from sixty to seventy feet of Coal Measure strata had been removed by erosion, and the valley thus formed subsequently filled with the transported material. The average thickness of the Drift deposits in this county probably does not exceed fifty feet.

Coal Measures.—All the uplands in the county are underlaid by the Coal Measures except a limited area on Crooked creek, in the southwestern corner of the county, embracing nearly the whole of township 4 north, range 4 west, and the southwestern portion of township 5 north, range 4 west. The beds composing the lower portion of the Coal Measures, as they are developed in this county, give the following section:

No. 1.	Sandstones and sandy shales, partly ferruginous	20 to 30 feet
No. 2.	Band of calcareous shale, with lenticular masses of dark-blue limestone, containing *Cardiomorpha Missouriensis*	2 to 3 "
No. 3.	Coal No. 3	2 to 3 "
No. 4.	Sandy shales and soft sandstones	35 to 40 "
No. 5.	Bluish clay shale, filled with fossil ferns	½ to 2 "
No. 6.	Coal No. 2	2 to 2½ "
No. 7.	Bituminous fire-clay	2 "
No. 8.	Gray clay shale	6 "
No. 9.	Septaria limestone	3 "
No. 10.	Variegated shales, purple, yellow and blue	18 to 20 "
No. 11.	Sandstone, passing locally into shale	10 to 15 "
No. 12.	Coal No. 1, sometimes replaced with slate or blue shale	1 to 3 "
No. 13.	Fire clay sometimes replaced by a sandy shale	2 to 3 "
No. 14.	Quartzose sandstone (conglomerate)	5 to 20 "

These beds have a maximum thickness of about one hundred and fifty feet, and consequently a boring anywhere in the county, carried down to the depth of two hundred feet from the surface, would pass entirely through the Coal Measures, and determine the amount of coal that could be found at that point. No coal seam is worked at the present time, except No. 2, or the Colchester coal; and it seemed to us quite probable that neither 1 nor 3 is developed in this county so as to be of any value to the industrial interests of its people. In the vicinity of Colchester the limestone and calcareous shale

usually found above Coal No. 3 outcrops in the breaks of ravines west of the town, but no indications of the presence of the coal was seen. The concretionary or lenticular masses of dark-blue limestone were found quite abundant here, and they afforded *Cardiomorpha Missouriensis* in great numbers, associated with *Discina nitida*, *Productus muricatus*, *P. Prattenianus*, *Pleurotomaria sphærulata*, *Aviculopecten rectilaterarius*, two or three species of small *Goniatites*, fossil wood, and the spine of a fish (*Listracanthus hystrix*). We also obtained from one of these limestone concretions, associated with the fossil wood above mentioned, a fossil fruit, shaped somewhat like an elongated pecan nut, the relations of which have not yet been determined. These limestone concretions have been found in Fulton and Schuyler counties overlying coal No. 3, and affording most of the species of fossil shells obtained from it here; so that there seems scarcely a doubt but that it here represents the horizon of that coal. It is quite probable that in the eastern, and especially in the southeastern portion of the county, coal No. 3 may be found sufficiently developed to be worked to advantage. The shale and sandstone above this coal, No. 1 of the foregoing section, we only saw in the vicinity of Colchester, where about ten feet in thickness of sandy, ferruginous shales overlay the limestone concretions above mentioned. No. 4 of the foregoing section is well exposed on the ravines leading into the east fork of Crooked creek, west of Colchester, but is everywhere a sandy shale, with some thin layers of sandstone, but affords no material of any economical value. The calcareous shale associated with the limestone in No. 2 of the above section is, at some points near Colchester, quite full of small fossil shells, among which the *Spirifer plano-convexa* was the most abundant, associated with *S. lineatus*, *Chonetes mesoloba*, *Productus muricatus*, *Pleurotomaria Grayvillensis*, a small *Machrocheilus*, and fragments of a *Nautilus*.

No. 5 of the above section forms the roof of the Colchester coal, and is a true clay shale at the bottom, and locally quite bituminous, becoming sandy higher up, and gradually passes into the sandy shales of No. 4. It contains ironstone concretions similar to those at Mazon creek and Murphysboro, though usually not so perfectly formed, and they contain fossil ferns of the same species found at those localities. The shales also are filled with beautiful ferns, in a remarkably fine state of preservation; and this locality may be reckoned as one among the best in the State for collecting these beautiful relics of an ancient vegetable world. Two specimens of fossil insects and two or three species of shells have been found associated with the fossil

ferns at this locality. The following list comprises all the species of fossil plants that have been identified at Colchester to the present time: *Neuropteris hirsuta, N. tenuifolia, N. rarinervis, Alethopteris aquilina, Callipteris Sullivantii, Pecopteris squamosa, P. villosa, P. plumosa, P. chærophylloides, Sphenopteris irregularis, S. trifoliata, Hymenophyllites alatus, H. spinosus, H. splendens, H. Gutbierianus, H. thallyformis, Cardaites borassifolia, C. angustifolia, Sphenophyllum Schlotheimii, S. emarginatum, S. cornutum, Annularia longifolia, A. sphenophylloides, Asterophyllites equisetiformis, Calamites ramosus, C. approximatus, C. undulatus, Selaginites uncinnatus, S. carifolius, Lepidodendron diplostegioides, L. simplex, L. obovatum, L. gracile, Ulodendron majus, U. ellipticum, Lepidophloios obcordatum, Lepidostrobus princeps, Lepidophyllum auriculatum, Sigillaria monostigma, Stigmaria ficoides, S. umbonata, Pinnularia capillacea, Caulopteris obtecta, C. acanthophora, Carpolithes multi-striatus.* Owing to the thinness of the coal, the roof shales are removed in driving the entries to the mines, thus affording a fine opportunity for collecting the many beautiful fossil plants that they contain. The thickness of the coal at this locality varies from twenty-four to thirty inches, and at the level of the prairie it lies from seventy-five to ninety feet below the surface. On all the branches west of Colchester the coal outcrops, and is worked by tunneling into the hillsides. The city of Quincy, as well as most of the small towns along the Chicago, Burlington and Quincy railroad, south of Bushnell, have for many years derived their supplies of coal mainly from the Colchester mines.

In the vicinity of Macomb the Colchester coal seam has not yet been found of sufficient thickness to be worked. About a mile and a half southwest of the town a thin coal outcrops above the sandstone quarries of Mr. Stewart, which I am inclined to regard as the Colchester seam, though it is here only about one foot in thickness. This may, however, be an outcrop of the lower seam No. 1, but from the appearance of the sandstone I believe it to be No. 2, thinned out here to about one-half its usual thickness. In the vicinity of Colchester a very good sandstone is found below the coal, and from ten to fifteen feet in thickness. It is No. 11 of the foregoing section. This I believe to be the equivalent of the sandstone at Stewart's, and the old McLean quarries near Macomb. A section of the beds exposed in the vicinity of these quarries shows the following succession of strata:

	Feet.
Thin coal	1
Shaly clay	2
Thin-bedded sandstone	1 to 6

	Feet.
Massive sandstone	10 to 12
Bituminous shale—coal No. 1?	4
Carbonate of iron	½
Fire-clay	½
Bituminous slate or shales	⅔
Shale	5

The horizon of coal No. 1 is here occupied by bituminous shales and a six-inch band of carbonate of iron. In the vicinity of Colchester, at most of the outcrops we examined, the same horizon was represented by dark-blue shales (No. 12 of the section previously given), containing nodules of iron ore inclosing crystals of zinc blende. On the southwest quarter of section 24, town 5 north, range 4 west, the following beds were found exposed in connection with coal No. 1:

	Feet.
Shaly sandstone	4
Coal No. 1	2
Fire-clay	not exposed.
Shaly sandstone	16
St. Louis limestone	6

Although we did not find this lower coal developed at any of the exposures examined in the vicinity of Colchester, yet it was found by Mr. Horrocks at his tile and fire-brick kiln, not more than a mile from the town, and was struck in one of the pits sunk for fire-clay. It was found to be about a foot in thickness only, and was associated with an excellent fire-clay, and was here about 45 feet below coal No. 2. Below Horrocks' brick and tile kilns, on the same stream, a band of ferruginous sandstone, or rather a sandy iron ore, was found, about six inches in thickness, filled with fossil shells, among which a large *Discina* was the most abundant, associated with *Hemipronites crenistria*, *Athyris subtilita*, *Spirifer opimus*, *S. Kentuckensis*, and some other undetermined species. This was no doubt a local deposit, and probably represents the band of iron ore occurring in Schuyler and Fulton counties, associated with coal No. 1. This band of iron ore occurs just at the junction of beds numbered 13 and 14 of the general section of the coal-bearing strata, on a preceding page.

On section 24, town 5 north, range 4 west, southwest quarter of the section, a coal seam was opened as early as 1853, when we first visited this county, on land then owned by Mr. Lowry. The coal was from eighteen inches to two feet in thickness, overlaid by a few feet of shaly sandstone. Below the bed of coal there was about sixteen feet of sandstone exposed, and a short distance up the creek the concretionary limestone is exposed underlying the sand-

stone. This, I have no doubt, is the lower coal (No. 1), and it will no doubt be found at many points in the county ranging from one to three feet in thickness.

At this time coal was also dug on Mr. Thompson's place, on the northeast quarter of section 16, town 4 north, range 3 west. The seam at this point was thirty inches thick, but was only exposed in the bed of the creek, with no outcrop of the associated beds. This is also, without doubt, the lower seam, as the concretionary member of the St. Louis limestone was found outcropping on the creek a short distance below where the coal was found. On the northwest quarter of section 33, town 4 north, range 3 west, a coal seam was opened and worked in 1853 on lands then owned by Mr. J. Stoneking. The coal was worked by "stripping" in the bed of a small creek, and the coal ranged from eighteen to twenty inches in thickness, and was overlaid by about two feet of gray shale.

These two lower seams also outcrop on Job's creek, near Blandinsville, and have been worked from the first settlement of the county. They outcrop also on nearly all the tributaries to the east fork of Crooked creek, and probably underlie at least seven-eighths of the entire area of the county. They seldom attain a thickness of three feet, however, in this portion of the State, but they are nowhere more than one hundred to one hundred and seventy-five feet below the surface at the general level of the prairie. No. 3, if developed anywhere in the county, will probably be found in the eastern range of townships, and would be the first seam reached in sinking a shaft or boring from the prairie level.

At Bushnell a boring for coal at the steam mill passed through the following beds, as represented by those in charge of the work:

		Feet.
1.	Soil	2
2.	Yellow clay	12
3.	Sand	2
4.	Blue clay, with bowlders	61
5.	Blue and yellow sand	35
6.	Sandstone	5
7.	Clay shale	1½
8.	Black shale	½
9.	Gray shale	34
10.	Limestone	9
11.	Shale	1
		163

The beds numbered 1 to 5, inclusive, belong to the Drift, and show an aggregate thickness of 112 feet, indicating the existence of an old valley here, in which the Coal Measures have been cut away down to a point below the horizon of the Colchester coal, and which was subsequently filled with Drift deposits, and consequently that

coal which should have been found at a depth of 50 to 70 feet below the surface at this point was not met with at all. The limestone No. 10 of the above section is probably the bed overlying the Seaville coal. The extent and direction of this old valley we have no data for determining at the present time, but it is probably a lateral arm of the Spoon River valley, and most probably trends southeastwardly into the valley of that stream.

At Prairie City a boring was carried down to the depth of 222 feet, passing through the following beds, as reported by Mr. T. L. Magee:

		Feet.
1.	Soil and drift clays	36
2.	Clay shale, or "soapstone"	16
3.	Black shale	½
4.	Coal No. 2	1½
5.	Fire-clay	4
6.	Shale and sandstone	12
7.	Clay shale	38
8.	Hard rock (limestone?)	11
9.	Shale	4
10.	White flint	1
11.	Shale	10
12.	Coal No. 1	3
13.	Fire-clay	6½
14.	Hard rock	5
15.	Clay shale	8
16.	Sandstone	4
17.	Dark-gray shale	8
18.	Clay shale (light-colored)	14
19.	Limestone (St. Louis beds	44½
		222

In the foregoing section the beds numbered from 2 to 18, inclusive, belong to the Coal Measures, and include the two lower coals. No. 19 is undoubtedly the St. Louis limestone which outcrops on Spoon river just below Seaville, about eight miles east of Prairie City. At Lawrence's mound, at an elevation considerably above the surface where the above boring was made, a coal seam three feet in thickness was found in digging a well, which was probably No. 3, occurring here as an outlier left by the denuding forces which swept it away from the surrounding region. It lay immediately below the Drift, with no roof but gravel, and covered but a limited area of ground.

At Macomb a boring, carried to the depth of about 160 feet, failed to find any coal of sufficient thickness to be of any economical value. From these experiments it would seem that the lower coals in this county are not very uniform in their development, and probably neither No. 1 nor No. 3 will be found over any considerable area thick enough to be worked to advantage, while No. 2 is also

too thin to be worked at some points, though it may be considered the most persistent and reliable seam to be found in this county.

St. Louis Limestone.—This division of the lower Carboniferous series is probably nowhere in this county more than fifty feet in thickness, and consists, first, of a bed of light-gray concretionary or brecciated limestone, lying immediately below the lower sandstone of the Coal Measures; and, secondly, of a magnesian limestone and some blue shales or calcareous sandstones, constituting what is sometimes called the "Warsaw limestone." On the east fork of Crooked creek, a little north of west from Colchester, the following section of these limestones may be seen:

	Feet.
No. 1. Brecciated light-gray limestone	5 to 20
No. 2. Calcareous sandstones in regular beds	12
No. 3. Bluish shale	3

The magnesian bed, which usually forms the base of this group, is below the surface here, and generally ranges from eight to ten feet in thickness. The brecciated limestone is very unevenly developed, and often varies in thickness in a short distance from five to twenty feet or more. It rarely affords any fossils except the common corals *Lithostrotion mamillaris* and *L. proliferum*, siliceous specimens of which are often found weathered out along the creeks where this limestone outcrops. No fossils were seen in the calcareous sandstone, but the magnesian limestone that outcrops lower down on the creek, and underlies the blue shales in the above section, usually contains a variety of *Bryozoans*, among which are the *Archimedes Wortheni*, *Polypora Varsouviense*, *Semicoscinium Keyserlingi*, etc.

Keokuk Limestone.—This is the lowest rock exposed in the county, and is only found along the bluffs of Crooked creek, in townships 4 and 5 north, range 4 west. The upper part of this formation is usually a bluish calcareo-argillaceous shale, containing siliceous geodes either filled with a mass of crystalline quartz, or hollow and lined within with quartz crystals, mamillary chalcedony, calcite and dolomite. Below this geode bed there is usually from thirty to forty feet of cherty gray limestone, the layers varying in thickness from a few inches to two feet or more, and separated by partings of shale. The limestone beds consist mainly of the remains of organic beings, the corals, crinoids and mollusca that swarmed in countless numbers in the primeval ocean, and the old quarries in this limestone afford a rich field for the student who desires to become fully acquainted with the varied and peculiar organic forms of this

period. South of Colmar the grade of the C., B. and Q. railroad cuts into the upper part of this limestone to the depth of several feet, and from the material thrown out from this cut we obtained many specimens of the characteristic fossils of this limestone in an excellent state of preservation. The upper layers of the limestone had been freely exposed to the erosive action of the water during the Drift period, and many of the siliceous fossils were found completely weathered out from the shaly limestones, and in a most perfect state of preservation. Among the fossils found at this locality were many specimens of *Zaphrentis dalii, Spirifer Keokuk, S. lineatus, S. sub-orbicularis, Agaricocrinus Americanus, Actinocrinus bi-turbinatus, Barycrinus stellatus, Archimedes Owenana, Hemipronites crenistria, Phillipsia Portlocki*, several species of fish teeth, etc. The lower portion of this limestone is usually below the level of the creek bottoms, but the upper portion is well exposed on the main creek in T. 4 N., R. 4 W., and on the east fork in T. 5 N., R. 4 W. In the region south of Colmar the geodiferous shales and the St. Louis limestones have all been removed by denudation before the deposit of the Drift, and the bowlder clays now rest directly upon the upper part of the Keokuk limestone. A complete section of all the limestones below the Coal Measures in this county would show the following order of succession and thickness:

	Feet.
Light-gray brecciated limestone	5 to 20
Calcareous sandstone	12
Magnesian limestone and shale	10 to 12
Geodiferous shales of the Keokuk beds	20 to 30
Light-gray cherty limestone	30 to 40

Economical Geology.

Coal.—As may be seen from a perusal of the foregoing pages, a large portion of this county is underlaid with coal, and although the seams that are found here are much thinner than some of those that outcrop in Schuyler and Fulton counties, yet they have not only furnished an abundant supply of coal for home consumption, but for many years have furnished many thousands of tons annually for shipment south and west to the adjoining counties. The shipment from Colchester alone for the years 1866 and '67 was about 500,000 tons per annum, and the product of the mines has been constantly on the increase. The coal obtained here is of an excellent quality if taken out at some distance from the outcrop, where it has not been exposed to atmospheric influences. The coal is tolerably hard, bright, and comparatively free from pyrite, and breaks freely into

cubic blocks when mined. An analysis of this coal by Mr. Pratten, as reported in Dr. NORWOOD'S "Analyses of Illinois Coals," gave the following result:

Specific gravity	1.290
Loss in coking	41.2
Total weight of coke	58.8
	100.0

ANALYSIS:

Moisture	5.4
Volatile matters	35.8
Carbon in coke	56.8
Ashes, light-gray	2.0
	100.0
Carbon in coal	60.10

This analysis shows this to be one of the best coals in the State, and its freedom from pyrite has always made it a favorite coal with the blacksmiths of this and the adjoining counties. The coal from the lower seam is usually harder than that from the Colchester seam, and less uniform in quality. Its thickness is also more variable, and frequently the coal is wanting altogether, and its place occupied by bituminous shales. Nevertheless, it sometimes attains a thickness of three feet, as at Seaville, in Fulton county, and the coal obtained there is of a fair quality. It is quite probable that this seam may be found in some of the eastern townships in this county, as thick as it is at Seaville, and if so, it might be worked to advantage, as its depth below the surface would probably nowhere exceed two hundred feet.

No. 3, if found at all in this county, would be met with in the uppermost layers of the bed rock, and immediately underneath the bowlder clays, except at a few points, where it might be overlaid by a few feet of sandstone or sandy shale. It is less persistent in its development, however, than either of those below it, but its proper horizon may be readily recognized by the dark-blue limestone and bituminous shales that are nearly always present, even when there is no development of the coal itself.

A boring carried down to the depth of two hundred feet would probably pass entirely through the Coal Measures in any portion of the county, and in the western part the subordinate limestones would be reached at a depth of one hundred and fifty feet or less. When the light-gray brecciated limestone of the St. Louis group is reached it is useless to bore further in search of coal, and this limestone is so decidedly different in its appearance from any of the limestones in the lower part of the Coal Measures, that an expert would find

no difficulty in identifying it, even by the smallest fragments taken up by the sand-pump. Hence, it forms a reliable guide, both where it outcrops and where it may be reached by the drill, and determines the point below which no coal can be found.

Fire-clay.—The fire-clay under the Colchester coal has been used by Mr. Horrocks, at his kiln west of the town, for the manufacture of drain tile, fire-brick, etc., but recently he has obtained a better quality of fire-clay by sinking a shallow shaft down to the lower or No. 1 coal, which, at his kiln, is about forty-five feet below the Colchester seam. The horizon of this lower coal furnishes an excellent article of fire and potters' clay in various portions of the State, and it may, no doubt, be found at many points in this county besides the one where it is at present worked.

Iron Ore.—There is a band of iron ore, very generally developed in connection with coal No. 1, and indications of its presence were observed at several points in this county, though not in sufficient quantity to justify an attempt to work it at the present time. On the creek below Horrocks' brick kiln it is about six inches thick but too sandy to be of much value, even if the quantity was greater. On the creek west of Macomb, a band of very pure iron ore occurs, about six inches thick, and it is quite probable it may be found somewhere in the county of sufficient thickness to be of some economical importance. In Schuyler county there are two or three bands of ore associated with this same coal, attaining there an aggregate thickness of about two feet, and yielding on analysis about 52 per cent. of protoxide of iron. The ore is an argillaceous carbonate of iron, and compares favorably in quality with the best Pennsylvania ores.

On Mr. D. C. Flint's place, in Mound township, a deposit of bog iron ore of good quality is found, which is reported to be several feet in thickness, but the area covered by it has not been ascertained. Should it prove sufficiently extensive, and as pure as the sample sent to my office, it is a valuable deposit.

Building Stone.—The central and western portions of the county have an abundant supply of freestone from the sandstone bed intervening between coals No. 1 and 2. This is usually from ten to twelve feet in thickness, the upper part thin-bedded and quarrying out in thin, even slabs, suitable for flags, while the lower part is quite massive, and splits evenly. At Stewart's quarries, two miles west of Macomb, there is about twelve feet in thickness exposed in the face of the quarry. The rock is a rather coarse-grained sandstone, nearly white in color, and furnishes a very durable material for

foundation walls, and is also easily cut and may be advantageously used for all ordinary architectural purposes.

At these quarries the rock is very massive, but at the old McLean quarries, about half a mile to the westward of Stewart's, the sandstone is more regularly-bedded, the layers varying from four to twelve inches or more in thickness. This sandstone is the equivalent of that on the T., P. and W. railroad west of Seaville, in Fulton county, and is very similar in quality. Some of the beds seem to be sufficiently even-textured for grindstones. The magnesian and arenaceous beds of the St. Louis group will afford the best material for culverts and bridge abutments that can be found in the State, as they are scarcely at all affected by the action of frost and moisture. The gray limestones of the Keokuk series make a durable building stone if protected from water, but split to fragments on exposure to ordinary atmospheric agencies. The brecciated limestone will make an excellent macadamizing material for the construction of turnpike roads, or for ballasting our railroads.

Limestone for Lime.—Good limestone for burning into quicklime may be obtained from the lower division of the Keokuk, and from the brecciated bed of the St. Louis group. Where the former is used, it should be selected with some care, as a portion of the beds contain too large a per cent. of argillaceous or siliceous matter to slack readily when burned, and would yield only an inferior quality of lime. The light-gray, semi-crystalline layers are the best for this purpose, and will make a quicklime of good quality. The brecciated limestone is, however, in many respects, the best rock in the county for this purpose, as it is usually a nearly pure carbonate of lime in its composition, and can be burned at less expense and makes a quicklime of superior quality. This limestone may be found on most of the tributaries of Crooked creek, and on the east fork as far north as the vicinity of Colchester.

Sand and Clay for Brick.—The subsoil, where it is predicated upon the marly beds of the Loess, supplies these materials in nearly the right proportion for the brickyard; and when deficient in sand, this may be easily supplied either from the creek bottoms or sandy beds interstratified with the Drift clays. These materials are so universally distributed that there is scarcely a neighborhood in the county where they may not be readily found at hand.

Soil and Agriculture.—There is not much variety in the general character of the soils in this county, and there is no considerable portion of its surface that will not bring good crops of the various cereals usually cultivated in this latitude, without other stimulants

than those contained in the soil itself. The prairie soil is a dark, chocolate-colored loam, appearing nearly black when wet, and produces excellent crops of corn, wheat, oats, barley and grass, and where a proper rotation of crops has been the rule, no perceptible decrease in the annual product has been observed, even on lands that have been under constant cultivation for the last twenty-five or thirty years. The timbered lands are generally confined to the creek valleys, and broken ridges adjacent thereto. The soil on these timbered ridges is usually thin, but they are excellent fruit lands, and will produce fair crops of wheat, oats and clover, but they require manuring if subjected to long continued cultivation. These thin soils are predicated upon the bowlder clays, and the timber growth is mainly black and white oak, and hickory; and their uneven surface does not retain the vegetable and animal matters that are annually deposited upon them, but, on the contrary, these are swept away by the annual rains into the adjacent valleys, while on the level prairies they are retained, and add from year to year their fertilizing properties to the soil. The bottom lands on Crooked creek are very limited in extent, and are mostly subject to overflow. They afford some fine timber, the varieties of which have been enumerated on a preceding page.

CHAPTER XVI.

MONROE COUNTY.

The county of Monroe comprises an irregular-shaped triangular area on the southwestern borders of the State, embracing about three hundred and eighty square miles. It is bounded on the north and east by St. Clair and Randolph counties and the Kaskaskia river, and on the south and west by Randolph county and the Mississippi river.

It presents considerable diversity of surface, the region adjacent to the river bluffs being quite hilly and broken, while the eastern portion of the county is comparatively level, and affords a considerable area of excellent farming lands. In that part of the county underlaid by the St. Louis limestone, comprising most of the central and southwestern portions of the uplands, "sink holes" are so numerous as to render the land nearly valueless for agricultural purposes. These "sink holes" are funnel-shaped depressions in the Drift clays overlaying the bed-rock, leading down to crevice or cavern in the limestone below, through which the water that falls upon the surface finds an outlet into the adjacent streams. They are often fifty feet or more in depth, with an open crevice at the bottom leading into a yawning chasm or cavern beneath the surface. Occasionally the crevice at the bottom becomes filled up with the clayey sediment that washes into it, and small ponds of water are formed, some of which, in the vicinity of Waterloo, cover an area of several acres, and are filled with fish.

The principal streams in Monroe county are Fountain creek, which rises in the highlands south of Waterloo, and runs in a northwesterly course until it enters the American bottom, and from thence southwesterly, emptying into the Mississippi near Harrisonville;

Horse creek, which intersects the southern portion of the county; and Prairie du Long creek, which waters the eastern portion, both emptying into the Kaskaskia river.

This county was originally heavily timbered, there being but three or four small prairies in its eastern portion, the largest of which are New Design prairie, Prairie du Long, and Prairie du Rond, none of which exceed an area of three or four square miles in extent. The timber upon the uplands consists mainly of the usual varieties of oak and hickory on the broken lands, with the addition of elm, black walnut, hackberry, wild cherry, honey locust and linden, on the more level portions in the eastern part of the county.

The western portion of the county, embracing nearly one-fourth of its entire area, is included in what is known as the "American Bottom," which extends along the eastern bank of the Mississippi river, from Alton, in Madison county, to the mouth of the Kaskaskia in Randolph county, a distance of about eighty miles. The average width of this alluvial belt in this county is about four miles, and its extent from northwest to southeast something over thirty miles. These bottom lands are exceedingly fertile, and, except for their occasional overflow, would rank among the most valuable lands in the State. There are several fine lakes in this portion of the county, among which are Moredock, Kidd and the Grand Coule lakes, with some others of less note. Some of these are fed mainly by subterranean streams, which find their way through the fissures and caverns of the limestones underlying the adjacent highlands, and the water is quite clear, presenting a pleasing contrast to the turbid waters of the Mississippi. They are filled with fish, and are favorite resorts for the sportsman both for hunting and fishing. These bottom lands are for the most part heavily timbered with cottonwood, ash, elm, sycamore, black and white walnut, hackberry, linden, honey locust, pecan, persimmon, soft maple, water and Spanish oaks, hickory, wild cherry and coffee-nut.

Superficial Deposits.—The highlands in this county are covered with a variable thickness of Drift clays and Loess, usually ranging from ten to sixty feet, and at some few points near the river bluffs attaining a maximum thickness of seventy-five to one hundred feet. The Loess is mostly restricted to the vicinity of the river bluffs, and often forms mound-like elevations on their summits of thirty to fifty feet in height. It consists of a buff-colored sandy loam, often filled with bleached fresh-water and land shells, and is sufficiently coherent to retain its position in perpendicular walls on either side, when an artificial cut is made through it. It forms the bald, tree-

less knobs that constitute a conspicuous feature in the scenery of our principal western rivers. At Salt-lick Point the slope above the limestone measured 125 feet; but it is impossible to say whether the whole of this is formed by superficial deposits, or in part by a hidden nucleus of limestone; but it is quite probable that the Drift clays and Loess are here at least a hundred feet in thickness.

At Mr. Stumpf's place, on the S. W. qr. of Sec. 3, T. 2 S., R. 10 W., on sinking a well near his dwelling about thirty feet of yellow Drift clay was passed through, below which was a black peaty soil with fragments of wood. This was underlaid by seven or eight feet of hard blue clay. This is the only place where a true soil under the Drift clays was reported to me in this county; but it is quite probable the same thing occurs at other points, the interesting fact being overlooked, or not considered worthy of especial attention by those who have had an opportunity of observing it.

Good exposures of Drift were met with along the bluffs of the small creek west of Columbia, where it seems to be fifty feet or more in thickness, and consists of buff or brown clay at the top, with bluish or purple beds at the bottom, the whole containing small pebbles of metamorphic rocks, and occasionally bowlders of the same material of considerable size, but rarely more than two feet in diameter. Where the exposure occurred near the outcrop of the green and purple shales of the Chester group the lower beds of Drift seemed to approximate closely to these shales in color, indicating the source from which they have, in part at least, been derived.

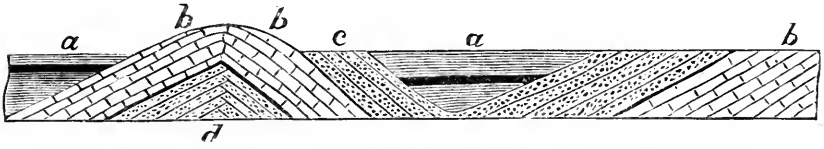
Stratified Rocks.

The Paleozoic formations are largely represented in this county, including all the usual subdivisions of that age, from the lower Coal Measures to the middle of the Trenton limestone, except the Devonian and Upper Silurian, which are wanting at the only locality where they should appear, leaving a hiatus in the sequence of the strata, and allowing the shales and shaly limestones of the Lower Carboniferous series to rest directly upon Lower Silurian strata.

There are two decided axes of disturbance in this county, the most northerly of which intersects the Mississippi bluffs just over the line in St. Clair county, and about three miles northwest of Columbia, and extending thence about south 20 deg. east, passes a little to the eastward of that town, and to the westward of Waterloo, forming the high ridge on which the old stage road runs between

these points. The nucleus of this axis is the Keokuk limestone, which may be seen well exposed on a small creek intersecting this axis about half a mile east of Columbia. There is about fifty feet of this limestone exposed here, the upper forty feet consisting of coarse, thin-bedded, brownish-gray and cherty limestones, containing *Spirifer Keokuk*, *S. neglectus*, and *Archimedes Owenana*, while the lower ten feet of the exposure consists of blue calcareo-argillaceous shales, with small geodes of quartz, the whole probably representing the geodiferous beds of this group at more northern localities.

Immediately west of this outcrop the overlying St. Louis limestone dips west 20 deg. south at an angle varying from 20 to 30 degs., while on the eastern side of the axis the dip in the opposite direction varies from 8 to 12 degs. This axis forms a synclinal trough or valley on its western side, extending from the river bluffs northwest of Columbia to the vicinity of Waterloo, with a varying width of from one to three miles, in which an outlier of coal has been deposited, hereafter to be described. The following wood-cut will give a general idea of the relative position of the beds in this part of the county and the relation of the Coal Measures to the underlying limestones. The section represented by the cut crosses the beds from north to south, and extends from the Coal Measures in the edge of St. Clair county east of Columbia westwardly to the river bluffs, a distance of about three miles:



a, Coal Measures; *b*, St. Louis Limestone; *c*, Chester Group; *d*, Keokuk Group.

From an examination of this section it will be seen that, at its northern extremity, the Coal Measures rest directly upon the St. Louis limestone, while in the synclinal basin the coal holds its normal position, overlying, though unconformably, the Chester group. From these facts we may infer that the disturbance in the underlying limestones took place anterior to the Coal epoch, and that the beds on the northern slope of the axis were subjected to erosive agencies, by which the whole of the Chester group, including a thickness of at least one hundred and fifty or two hundred feet of strata, were entirely removed, so that the subsequently deposited Coal Measures rest directly upon the St. Louis limestone. Evidences of the powerful action of erosive agencies immediately antecedent to the Coal epoch, have been observed in other portions of the State,

but no locality has been noticed where so great a thickness of strata has been removed by such agencies as in this vicinity.

The other axis to which we have referred, crosses the Mississippi in the vicinity of Platin rock, in Missouri, where, according to the section of Dr. Shumard, given in Vol. I of the Missouri report, page 145, the St. Peters sandstone (or Saccharoidal sandstone of that report,) is elevated above the river level, and there forms the nucleus of an anticlinal axis, and although the dip and strike of the beds at that point are not given in the report above referred to, yet it seems quite probable that the elevation of the Trenton limestone above the surface at Salt-lick Point, in this county, is but a continuation of the same axis, which brings up the underlying sandstone on the Missouri shore. This axis does not appear to extend very far to the eastward of the river bluffs in this county, and the Trenton limestone only appears along the base of the bluffs for a mile and a half or two miles, when it sinks rapidly below the surface, and is replaced by the overlying shales and limestones of the Lower Carboniferous series, the Devonian and Upper Silurian systems being both unrepresented at this point.

The following section will show the relative position and comparative thickness of the stratified rocks in this county:

No. 1.	Coal Measures	40 to 50 feet.
No. 2.	Chester group	100 to 350 "
No. 3.	Upper St. Louis limestone	140 to 150 "
No. 4.	Lower St. Louis or Warsaw beds	120 to 130 "
No. 5.	Keokuk limestone	150 "
No. 6.	Burlington limestone	75 to 100 "
No. 7.	Kinderhook group	80 to 100 "
No. 8.	Trenton limestone (in part)	120 "

The aggregate thickness of these rocks may be estimated at about one thousand feet, and they represent a very large portion of the whole Paleozoic series below the Coal Measures, as that series is developed in Southern Illinois.

Coal Measures.

An outlier from the main coal field, in St. Clair county, impinges on the county line immediately north of Columbia, and at some points probably extends a little over the line into this county, following very nearly the trend of the county line. The mines worked at this locality are known as Henckler's mines, being owned and worked by Mr. H. F. Henckler, of Columbia, and are located on sections 13 and 14, township 1 south, range 10 west, and are mostly in St. Clair county. The coal obtained here is a good block coal,

and if on further examination it proves to be sufficiently uniform in its development to admit of successful mining, it will prove, from its proximity to the iron furnaces at south St. Louis, a valuable acquisition to the mineral resources of this portion of the State. The coal rests directly upon the St. Louis limestone, with only a few inches of dark-colored clay shale between, and the coal seems to follow the inequalities of the limestone surface on which it rests, and at one point in the mine it was seen to rise abruptly to the height of about six feet with the elevation of the limestone floor on which it rested, and as suddenly sink again to its former level. The main point to be determined is, whether these inequalities may not be so frequent, and sometimes so great, as to cut off the coal entirely, and thereby greatly increase the cost of mining. The seam is about three feet thick, when fully developed, and ranges usually from two to three feet in thickness. It is quite free from pyrite, and presents all the essential characters of a true block coal. It is overlaid by a few feet of argillaceous limestone, passing locally into calcareous shales, above which we found a stratum of soft porous limestone about two feet thick, that appeared as though it had been subjected to a process of leaching, by which a large portion of the calcareous matter had been removed, the stone now presenting the appearance of a soft porous chert. In contained numerous casts of fossil shells.

This coal has been struck at numerous points in this neighborhood in sinking wells, the general trend of the outcrops being to the southeast. At Mr. Snyder's place, on the southeast quarter, section 27, township 1 south, range 9 west, it outcrops in the bluffs of Prairie du Long creek, and has been worked in a small way for several years. The beds exposed here afford the following section:

		Feet.	In.
No. 1.	Nodular argillaceous limestone	4 to 6	
No. 2.	Slope, with partial outcrops of shale	15 to 20	
No. 3.	Compact bluish-gray limestone	3	
No. 4.	Gray shale	1	3
No. 5.	Argillaceous limestone	2	6
No. 6.	Bituminous shale	2	
No. 7.	Coal	3	
No. 8.	Shales, partly bituminous	2	
No. 9.	Argillaceous and sandy shales	exposed 15	

The lower shales, No. 9 of the above section, probably belong to the Chester group, and these, with some underlying beds belonging to the same formation, are well exposed for some distance down the creek below the outcrop of the coal. The nodular argillaceous limestone, No. 1 of the above section, closely resembles the bed usually found underlying the Belleville coal, in St. Clair and Madison coun-

ties, and contains a similar group of fossils, among which the *Bellerophon nodocarinatus* may be cited as especially characteristic of this horizon. This would seem to identify the coal at this point, and that at Henckler's mines, with the lower seam at the old Pittsburg mines in the bluffs east of St. Louis, and if more extensively explored in that vicinity, it might be found to possess the same characteristics which prevail in it on the southern borders of the county. Hitherto this seam has been almost entirely neglected, in St. Clair county, for the thicker seam lying immediately above it, but if it should prove, on further examination, that it retains its peculiar block character throughout the county, it would prove a valuable addition to the mineral resources of that county.

The principal deposit of coal in Monroe county is found in the long, narrow, synclinal basin already referred to, which extends from the river bluffs, just below the St. Clair county line, in a course of south 20° east, to a point two and a half or three miles northwest of Waterloo, forming a narrow belt of coal lands, varying, as originally deposited, from one to three miles in width.

Gall's coal mines, on the northwest quarter of section 3, township 2 south, range 10 west, have been more extensively worked than any others in this isolated basin, though others have been opened at various points, and after being worked for a short time have been abandoned. The beds exposed in the vicinity of Gall's mines give the following section:

		Feet.
No. 1.	Calcareous shales	6 to 8
No. 2.	Compact argillaceous, dark-blue limestone	3 to 4
No. 3.	Bituminous shale	1 to 3
No. 4.	Coal—Belleville seam	3 to 4
No. 5.	Calcareous shales and nodular limestone	3 to 4
No. 6.	Shale and shaly sandstone	15

The limestone and shales forming Nos. 1 and 2 of the above section closely resemble the beds usually overlying the Belleville coal, in St. Clair county, and contain the same group of fossils, among which are *Spirifer cameratus*, *S. lineatus*, *Athyris subtilita*, *A. Royissii*, *Chonetes mesoloba*, *C. Smithii*, *Productus punctatus*, *P. costatus*, *P. Prattenianus*, *P. longispinus*, and *Trachydoma nodosa*. Hence we have referred this coal to the horizon of the Belleville seam, although the seam is not so thick here as it is in St. Clair county, and the coal it affords is inferior in quality. We saw no indication of the development of the Henckler seam, in this vicinity, though it is not improbable that it may be found in some portion of this isolated basin. On the creek running through Mr. Gall's land we found continuous exposures from this coal, down to the lower Carboniferous limestones,

without any indications of the presence of any underlying seam. A little to the eastward of Gall's old shaft, the St. Louis limestone may be seen in heavy beds, dipping west 20° south, at an angle of about 30°, overlaid by the Chester beds, dipping in the same direction and at a slightly decreased angle, while the beds of the Coal Measures lie nearly horizontal, and rest unconformably upon the subordinate limestones. On the western side of this synclinal the dip of the limestones is much less, varying from 6 to 10° to the eastward.

Over some portion of this synclinal valley the coal has been swept away by denuding forces, and heavy beds of Drift clay now occupy the place of the coal deposits; and it is not probable that any considerable area is now underlaid by coal of sufficient thickness to be profitably mined, in competition with the well-developed coals of St. Clair county. However, the completion of the narrow-gauge railroad from St. Louis, south through this neighborhood, may afford a better market for coal than they have heretofore had, and should stimulate research to develop whatever fuel resources exist in the county.

Chester Group.—This upper group of the lower Carboniferous system, as developed in this county, consists of a heavy bed of sandstone forming its lower division, above which there are two or three beds of limestone, alternating with sandstones and sandy and argillaceous shales, the whole series thinning out to the northward, and scarcely attaining to one-half the thickness in this county that they have in Randolph. We found no exposures where accurate measurements of the whole group could be made, but its thickness may be estimated at from 250 to 300 feet in the southern part of the county, and at something less than 100 feet in the northern part. On sections 9 and 3, in township 2 south, range 10 west, we saw the following section above the top of the St. Louis limestone:

	Feet.
No. 1—Brown ferruginous sandstone	4 to 6
No. 2—Green and purple shales, with plates of limestone	6
No. 3—Gray limestone	5
No. 4—Ferruginous sandstone	3
No. 5—Green, blue and yellow shales	15 to 20
No. 6—Ferruginous sandstone and shale	40 to 50
No. 7—St. Louis limestone	partially exposed.

At this locality the gray limestone, No. 3 of the above section, as well as the plates of limestone intercalated in the shales above it, are filled with the characteristic fossils of this group, among which were *Pentremites Godoni, P. pyriformis, Athyris ambigua, A. Royissii, Spirifer Leidyi, Productus elegans, Archimedes Swallovana,* and numer-

ous plates of *Agassizocrinus*. Between the sandstone at the base of the foregoing section and the underlying St. Louis limestone, there is about three feet of green and purple shales, with a thin ledge of lime conglomerate intercalated in it. The beds at this point all have a decided dip to the eastward.

On section 16, township 3 south, range 9 west, about five miles southeast of Waterloo, the lower limestone of the Chester group is partially exposed, on Mr. H. Druse's place, where about six feet of thin-bedded brownish-gray limestone was found, underlaid by three or four feet of blue clay shale, which directly overlaid the lower sandstone of this group. About a mile north of Mr. Druse's place, on a branch of Prairie du Long creek, the upper portion of the St. Louis limestone is well exposed, forming a perpendicular cliff about twenty feet in height. Following down the creek in an easterly direction for about half a mile, the dip of the beds carries the limestone beneath the surface, and it is immediately succeeded by the sandstone of the Chester series, which forms a perpendicular cliff for some distance along the creek, ranging from forty to fifty feet in height.

On a branch of Stone creek, which heads a little to the northeastward of Waterloo, the Chester sandtone is well exposed, the first outcrops appearing about a mile and a half from the town, and continuing down the creek for a half mile or more, where about thirty feet in thickness of the sandstone may be seen in the bluffs of the stream. The rock is here partly massive and concretionary in structure, and partly thin-bedded, affording layers from two to four inches in thickness. Proceeding northeastwardly from this sandstone outcrop to the main creek, where it is crossed by the road from Waterloo to Belleville, partial outcrops of the lower Chester limestone and the overlying shales are seen on a branch of the creek, and on the main stream the second bed of limestone and the overlying shales are well exposed, and are filled with the characteristic fossils of this group.

Three miles south of Freedom, at the crossing of Prairie du Long creek, the entire bluff is composed of Chester limestone and shales. This exposure is about fifty feet in thickness, consisting of coarse, granular and partly crinoidal limestone, with intercalated bands of shale, containing many of the characteristic fossils of this group. We obtained at this locality the following species, in addition to those mentioned on a previous page, from about the same horizon: *Pentremites sulcatus*, *Zeacrinus maniformis*, and *Z. Wortheni*. The best exposures of these limestones in this county may probably be found

on this creek and its tributaries, and the entire thickness of the group in the southeastern part of the county cannot be less than 250 feet.

These limestones and shales are also partially exposed on the western borders of the synclinal basin already referred to, but the exposures are mostly isolated, and no continuous section of the several divisions of the group can be seen, but fine localities for collecting the fossils of this horizon occur in this part of the county.

St. Louis Limestone.—This limestone occurs in extensive outcrops in the county, and in two well-marked divisions. The upper division consists mainly of light-gray, compact, regularly-bedded limestones, with some thin shaly partings; and the lower, of buff or brown marly and partly magnesian beds, with some very massive layers of a semi-oolitic, nearly white limestone, which are well exposed about a mile east of Columbia, where they constitute the upper beds of this division. This group forms the main portion of the river bluffs from the center of township 1 south, range 10 west, to Eagle Cliff, below which the Keokuk and Burlington beds gradually rise above the surface, and cap the hills in the vicinity of Salt Lick Point, near the south line of township 2 south, range 11 west. Below this point these limestones soon dip again below the surface, and the St. Louis group, with an occasional outcrop of the Keokuk beds, continue to form the main portion of the river bluffs to the south line of the county.

The upper division of this group forms the bed rock over a considerable portion of the county, and wherever this is the case, the surface is covered with sink-holes, which form a sure guide to the extent of its outcrop. All of that portion of the county lying between Fountain creek, west of Waterloo, and the river bluffs, and extending thence in a belt from three to six miles in breadth, in a southeasterly direction, to the Randolph county line, is covered with sink holes, and for agricultural purposes may be regarded as the poorest lands in the county. There is also a limited area northeast of Waterloo where this rock comes to the surface, and where sink holes are abundant, but the strong easterly dip of the strata soon carries it beneath the sandstones of the Chester group, which, with the overlying limestones and shales, form the bed rock thence to the eastern line of the county.

About a mile east of Waterloo the uppermost beds of this group are exposed at their junction with the overlying sandstone. About ten feet in thickness of the limestone may be seen here, the lower three feet of which is a very hard shell breccia, largely composed of

chambered shells belonging to the genera *Nautilus, Goniatites* and *Orthoceras,* and seems to be the exact equivalent of a similar bed occurring at Greencastle, Indiana, where the rock, though similar in character, is not so hard, and its characteristic fossils may be obtained much more easily, and in a better state of preservation. The beds above this brecciated limestone contain *Lithostrotion proliferum, Zaphrentis spinulosa,* etc., and are immediately overlaid by the Chester sandstone.

One mile east of Columbia extensive quarries are opened in the lower portion of the upper division of this limestone, both for a supply of building stone, and for lime burning. The rock is evenly bedded, the layers ranging from an inch to two feet in thickness, and abound in the characteristic fossils of this horizon, especially corals and bryozoans. These quarries show a perpendicular face of about fifteen feet. Quarries have also been opened in the upper portion of this division east of Waterloo, but they are mostly in the beds of the small streams, and show but a few feet in thickness of strata.

Two and a half miles west of Waterloo, on Fountain creek, the upper division of this limestone is well exposed, forming the entire bluffs of the creek for several miles. There is from 75 to 80 feet in thickness of strata exposed here, the lower portion of which is a light-gray, regularly-bedded limestone, similar in appearance to the beds quarried one mile east of Columbia. These are overlaid by from 30 to 40 feet of thin-bedded, semi-oolitic limestone, containing a peculiar group of small fossil shells, among which are *Straparollus similis, S. planus, Dentalium venustum, Nuculana curta, Yoldia? levistriata, Rhynchonella mutata, Terebratula hastata, Hemipronites crenistria* (small variety), and some other undetermined species. These beds are overlaid by about fifteen feet of light-gray or nearly white oolite, in tolerably massive beds, which form the upper portion of the exposure at this locality. The lowest beds seen at this point contain some of the characteristic crinoids of this group, among which are *Poteriocrinus Missouriensis, Forbesiocrinus Shumardianus, Graphiocrinus dactilus,* and spines of *Archæocidaris Wortheni.* These crinoids are associated here with *Athyris ambigua, Spirifer Keokuk? Hemipronites crenistria, Productus scitulus, P. tenuicostatus, P. punctatus, Zaphrentis spinulosa,* and numerous *Bryozoans.*

Four miles southeast of Waterloo there are some old quarries, known as the "Portland quarries," which are in an earthy, buff-colored magnesian limestone, of which only about six feet in thick-

ness is exposed. This rock closely resembles the limestone used at the cement mills north of Columbia, in the edge of St. Clair county, and probably belongs to the same geological horizon, near the base of the Warsaw division of the St. Louis group. The rock exposed here has every appearance of a good hydraulic limestone, and will probably prove to be valuable for the manufacture of hydraulic lime. As no other beds were exposed in connection with this, its stratigraphical position is only inferred from the lithological resemblance of the rock to that used at the cement mill above referred to; but I have little doubt it will prove identical with that, as the exposure is nearly on the line of the anticlinal axis already mentioned as extending from a little east of Columbia to Waterloo, and which must pass in its further extension very near to this locality.

The Warsaw division of the St. Louis group is well exposed in the vicinity of Columbia, where it outcrops on the hillsides east of the town, and quarries have been opened in it at several points. It consists of buff, brown and light-gray limestones, partly thin-bedded and marly, and partly massive; the thin-bedded layers being filled with *Bryozoans* and the small *Brachiopoda* peculiar to this horizon. The old quarries to the left of the Centerville road were partly opened in the marly layers of this rock, and the weathered debris afforded many fine specimens of its peculiar organic forms. We found the *Pentremites conoideus* quite common, and were so fortunate as to find a single perfect specimen of *P. obliquatus* of Rœmer, a very rare species in this State. *Rhynchonella mutata* and *Orthis dubia* were also quite abundant at this locality. Mr. H. F. Henckler found, in one of these old quarries, a crushed specimen of *Melonites*, that closely resembles the *M. multipora* of the upper division of this group.

Above the beds from which these fossils were obtained there is about twenty feet in thickness of massive light-gray limestone, which stands exposure well in the quarry, is free from siliceous matter, and splits evenly, and will afford an excellent building stone. This portion of the bed is nearly destitute of fossils, but from some earthy layers above it we obtained some fine specimens of *Productus ovatus*. In the river bluffs these buff limestones outcrop in the vicinity of Eagle Cliff; also about a mile and a half below Salt Lick Point, where they form a bluff about one hundred and twenty-five feet in height, the whole of which consists of regular-bedded buff and light-gray limestones, that belong to this lower division of the St. Louis group; and from this point to the south line of the county they are well exposed at many points in the river bluffs.

Keokuk group.—The outcrop of the upper portion of this group, where it forms the nucleus of the anticlinal axis passing a half mile east of Columbia, has already been mentioned, but good exposures are rare, and only a few feet in thickness of these beds are to be seen at the various localities examined along the trend of this axis. At Mr. Ditch's place, a half mile north of Waterloo, on the Columbia road, a well was sunk to the depth of about a hundred feet, the first 20 feet being drift clay, and the remainder through the shales and limestones of the Keokuk group. This is evidently near the center of the axis, as a mile and a half northeast of this point the hard gray limestone of the upper division of the St. Louis group outcrop at the surface, dipping eastwardly at an angle of about 5 deg. Two miles and a quarter northwest of Waterloo, on the road leading in the direction of Gall's coal bank, a yellow calcareous shale, with intercalated plates of chert and limestone, are found outcropping on a small creek running to the westward into Fountain creek. This shale contained small quartz geodes and the plates of limestone afforded specimens of *Archimedes Owenana, Spirifer lineatus, S. cuspidatus,* and some other organic forms of the Keokuk group.

One of the best exposures of this group seen in the examination of this county was found on Mr. Prior's place, about a mile and a half to the eastward of Salt Lick Point. The beds at this locality afforded the following section:

		Feet.
1.	Coarse grained gray limestone	25 to 30
2.	Yellow calcareous shale	12
3.	Slope, with partial outcrops of blue shale	35
4.	cherty gray limestone	60
5.	Bedded chert	6
		143

The upper limestone in the above section is a good building stone, and contained the characteristic fossils of this horizon, among which we observed *Spirifer Keokuk, Productus magnus,* and *Terebratula hastata.* The bedded chert at the base of the section may possibly belong more properly to the Burlington, than to the Keokuk series.

In the rivers bluffs two miles west of Glasgow, the lower portion of the bluff consists of the shales and thin-bedded limestones of this group, of which a hundred feet or more in thickness is here exposed. These beds are full of fossils, among which *Spirifer Keokuk, S. cuspidatus, Productus magnus,* and *Chonetes plano-convexa,* are quite abundant, associated with several species of rare crinoids, among which are the *Onycocrinus Monroensis* and *Zeacrinus plano-brachiatus,* figured and described in the second volume of the original

reports, with several other as yet undetermined forms. The lithological character of the rock in this county is quite different from that presented by it at the outcrops along the Illinois river and the upper Mississippi, and two of the most common *Brachiopods* here, the *Productus magnus* and *Chonetes plano-convexa*, we have not met with in any exposures of this formation north of St. Louis. The crinoids also are, for the most part, specifically distinct from those most common at more northern localities, and seems to be more nearly allied in form to those occurring at Crawfordsville, Indiana. The shales forming Nos. 2 and 3 of the above section are most probably the stratigraphical equivalents of the geodiferous shales of the more northern localities, though we found no geodes in this county, except those of very small size, and these seldom well crystalized on their interior surfaces. If we are right in this conclusion, then the overlying regularly-bedded limestone is a local deposit, which seems the more probable from its containing some fossils that are not known to occur at any locality north of this county, such as *Productus magnus*, and *Chonetes plano-convexa*. The fossils of these upper beds have a striking resemblance to those from Crawfordsville, Indiana.

Burlington Limestone.—This limestone is confined in its outcrop to the vicinity of Salt Lick Point, where it forms the upper escarpment of the bluff, and is also well exposed on some of the small streams that intersect the river bluffs in this vicinity. Its thickness here probably does not exceed seventy-five feet, and it consists of alternations of light-gray crinoidal limestone and chert, the latter at some points predominating. A section of the beds forming the bluff at Salt Lick Point shows the following order of succession:

	Feet.
1. Covered slope, apparently composed of Loess	125
2. Burlington limestone	70
3. Ashen-gray shales and chocolate-colored limestone	80 to 90
4. Massive gray Trenton limestone	100 to 120

This is believed to be the highest bluff between St. Louis and Chester on the east side of the river, and the view from its summit is very fine. St. Louis is distinctly visible to the northward; and the valley of the Mississippi, for a distance of at least fifty miles by the meanderings of the river, with a large portion of the American Bottom, dotted with lakes and cultivated farms, may be seen at one view, forming one of the finest landscapes to be seen in the State. This is the most westerly extension of the bluffs in the county, and from this point they trend southeastwardly to the Randolph county line. A half mile below this the Burlington limestone forms the lower escarpment of the bluff, and with a rapid dip to the south-

ward soon disappears below the surface. No exposures of this limestone was met with in the county, except those occurring in this vicinity.

Kinderhook Group.—This group also owes its outcrop in this county to the disturbing influences by which the Trenton limestone has been lifted above the surface at Salt Lick Point, and, in the absence of the Devonian and upper Silurian groups, the shales and chocolate-colored limestones of which this group consists immediately overlie the Trenton limestone, as indicated in the foregoing section. The lower portion of the group consists of ashen-gray shales, which pass upward into chocolate-colored shales and limestones, and these form the slope at Salt Lick Point between the two escarpments of limestone, the Burlington above and the Trenton beneath. A few fossils were obtained here, mostly from the chocolate-colored shales and shaly limestones, among which were *Productus Burlingtonensis*, *Spirifer Grimesi*, or a closely allied species, *Spirifer Vernonense*, *Spirifera Hannibalensis*, *Paleacis enorme*, *Actinocrinus pistiliformis*, *Strophomena analoga*, *Conocardium* and *Zaphrentis* of undetermined species. This group overlies, unconformably, the outcrop of Trenton limestone at this point, and dips rapidly beneath the surface in either direction.

Trenton Limestone.—This is the oldest or lowest formation that appears above the surface in Southern Illinois, and it only outcrops at one other point, in Alexander county, where, as here, it forms the nucleus of an anticlinal axis. The first appearance of this limestone in this county, in tracing the river bluff southward, is about two miles below Eagle Cliff, where it forms a low ledge of massive gray limestone at the base of the bluff, a short distance below the point where the main road from Waterloo to Harrisonville enters the river bottom. From this point it rises rapidly to the southward, and a half mile below where it first makes its appearance it forms a perpendicular cliff nearly a hundred feet in height, which forms the culminating point of the axis. There appears to have been a dislocation and down-throw of the strata at this point, for below the valley of a small creek which intersects the bluffs on the lower side of Salt Lick Point the lower portion of the bluff is formed by an outcrop of Burlington limestone, the Trenton limestone and the Kinderhook group having both been carried down below the surface, and the beds dip rapidly to the southward, or in the opposite direction to the beds at Salt Lick Point. The point where the dislocation of the strata occurs is now occupied by the creek valley, and consequently the amount of the down-throw could not be accu-

rately determined from the poor exposure of the beds; but I inferred that the amount could not be less than two hundred feet, as neither the Trenton nor Kinderhook groups were to be seen on the southern slope of the axis.

That portion of the Trenton limestone outcropping in this county consists, for the most part, of heavy-bedded, yellowish-gray crystalline and sub-crystalline limestones, intersected with vertical fissures or joints, probably resulting from the shrinkage of the material on crystallization. The beds vary in thickness from one to six feet or more, and contain a few of the characteristic fossils of this horizon, among which *Receptaculites Oweni*, *Orthis lynx*, *O. testudinaria*, *O. formosus* and *Rhynchonella capax* were obtained at this point.

Along the western face of this limestone escarpment, where it attains its greatest elevation, tall columns of limestone, locally known as the "Stone Chimneys," stand out entirely isolated from the face of the bluff, from which they are now separated by a space of from ten to twenty feet or more in width, the intervening portions of the limestone having been removed by surface erosion. Originally these columns were probably only separated from the adjacent cliff by one of the narrow fissures already mentioned as common in this limestone; but these have gradually widened, by the long continued action of atmospheric influences, until they are now many feet away from the rock to which they were originally united. These columns, seen from below, when the leaves have fallen from the dense forest in which they stand, present a very grand and picturesque view, and resemble the ruins of some ancient castle. Some of them are from forty to fifty feet or more in height, and others have toppled down, and the huge blocks of limestone of which they were composed now lie scattered along the base of the cliff. There is but one other point in Southern Illinois where this limestone appears above the surface, which is at the "Grand Chain," just below Thebes, in Alexander county, where it forms the nucleus of another anticlinal axis crossing the river at that point. It appears to be stratigraphically equivalent to the "Galena Limestone," the true lead-bearing rock of the Northwest; but we saw no evidences of its being a mineral-bearing rock in this portion of the State, nor does it possess the dolomitic character which prevails in its northwestern outcrops.

This limestone furnishes the celebrated "Glencoe marble," of Glencoe, in Missouri, and inexhaustible supplies of the same marble, equally as good as that from the locality above cited, might be obtained from the Trenton limestone at Salt Lick Point. A railroad

from St. Louis to Chester, down the American Bottom, would render this rock at once available, as well as various other quarries of excellent building stone, that could be opened in every township through which the road would pass in this county. The time is not far distant when the demand for such materials will justify the building of a railroad along the foot of the Mississippi bluffs between the points above named.

Economical Geology.

Building Stone.—There is no county in Southern Illinois more abundantly supplied with building stone of various qualities than this, and it is so generally distributed over all portions of the county as to be easily accessible to every neighborhood. The stratified rocks of this county are something more than a thousand feet in thickness, and fully one-half of this may be considered of economical value for all the ordinary uses for which a building stone is required. We will take the several groups in their descending order, and briefly notice the building material they will afford.

The Coal Measures afford little or no building stone of any value, though in the vicinity of Gall's coal bank the limestone over the coal might be used for rough walls in the absence of a better material from the underlying groups.

The Chester group will furnish an unlimited amount of excellent building stone, especially from the sandstone that forms the base of the group. This sandstone is from 60 to 75 feet thick, and nearly the whole of it, at some points, may be used as a building stone. It is generally pretty evenly bedded, but sometimes shows a concretionary structure; but where this is the case, as at the quarries east of Waterloo, the rock splits evenly and can be readily quarried in blocks of the proper size. It works easily under the chisel, hardens on exposure, and may usually be relied on as a durable stone. This sandstone outcrops at many points on Stone creek and Prairie du Long, also on Horse creek and its tributaries, in the southeastern portion of the county. It is also well exposed on the N. E. qr. of Sec. 6, in T. 2 S., R. 10 W., and at some other points along the synclinal coal basin between this and the river bluffs west of Columbia. The limestones of this group also furnish some very good material suitable for rough walls, especially along the southern course of Prairie du Long creek, in T. 3 S., R. 8 W.

The upper division of the St. Louis group forms the bed rock over a greater surface area than any other formation in this county,

and therefore the building stone it affords is more generally used. The rock is mostly a compact, fine-grained, bluish-gray limestone, weathering to a nearly white color, and generally lying in regular beds, varying from a few inches to two feet in thickness. Extensive quarries are opened on the outcrops of this limestone in the vicinity of Columbia and Waterloo, to supply the demand for rough walls, as well as for curbstones and flagging, to which the thin beds of this group are well adapted. Two miles west of Waterloo the upper layers of this group consist of a light-gray or nearly white oolite, in beds from six inches to two feet thick. The rock is free from chert, and would afford an excellent material for window caps and sills, as it cuts much more easily than the fine-grained limestones below, and is also more uniform both in color and texture. Most of the macadamizing material used in this county is obtained from the hard, bluish-gray limestones of this group.

The lower or Warsaw division of this group is well exposed a half mile east of Columbia, and some portions of it afford an excellent building stone. The upper portion consists of about twenty feet in thickness of a light-gray, granular limestone, entirely free from chert, and in heavy beds, some of which are from three to four feet thick. The rock splits easily, affording dimension stone of any desired form and size. This rock appears to dress well, and is really one of the best building stones in the county. The lower beds of this division are also partly heavy-bedded buff or brown limestone, partly magnesian or dolomitic in structure, and afford a durable building stone. This division of the group is well exposed in the river bluffs about a mile and a half below Salt Lick Point, where it forms a bluff more than a hundred feet in height, nearly the whole of which is a valuable building stone. The Keokuk group is not fully exposed in this county, except along the river bluffs in the southwestern portion, where there has as yet been but little demand for building stone, and no extensive quarries have so far been developed in it. The upper beds seen at Mr. Pryor's place, a mile and a half east of Salt Lick Point, were in tolerably regular beds and comparatively free from chert. The lower sixty feet of the section at the same point consisted of gray limestone, somewhat cherty, but similar to the limestones obtained from this group at more northern localities. The Burlington limestone appears to be more cherty at the outcrops seen in this county than it usually is in the northern portion of the State, and consequently no great amount of good building material may be expected from it.

The entire thickness of the Trenton group might be made available, if it was found at any point where a demand for building stone existed, but as its only outcrop is in the river bluffs, remote from any town, its supplies of useful building material are for the present only of prospective value.

Marble.—The Trenton limestone affords some beds of light-gray crystalline thick-bedded rock, that receives a fine polish, and the thickly embedded organic forms give to the polished surface a slightly mottled appearance that is rather pleasing. This rock is extensively quarried at Glencoe, in Missouri, and is known as the Glencoe marble. It may be obtained at Salt Lick Point, in this county, in inexhaustible quantities, and if railroad facilities were at hand would become a source of considerable revenue to the county.

Coal.—The only coal in this county is that occurring in the small synclinal basin already mentioned, and the area of workable coal is consequently quite limited. At Gall's place the coal is about four feet thick, but it is not very persistent, frequently running down to two feet or less in thickness. The quality of the coal obtained is also inferior to that from the equivalent seam near Centerville, in St. Clair county, and hence the mines here cannot be successfully worked in competition with the thicker beds of the main coal field. We are also inclined to believe, from the examinations made, that over a considerable portion of the northern half of this isolated basin the Coal Measure strata have been partially removed by denudation, and are now replaced by Drift clays. This is indicated by the frequent occurrence of tumbling masses of the compact gray limestone, which overlies the coal, in the Drift clays on the small stream south and southwest of Columbia. The block coal a mile and a half east of Columbia, already described, and which is owned and worked by a citizen of Columbia, Mr. H. F. Henckler, lies mainly beyond the St. Clair county line.

Iron Ore.—A band of iron ore, apparently of good quality, occurs in the vicinity of Henckler's coal mines, at the junction of the Chester and St. Louis groups. At the only point we saw it exposed, it was not above three or four inches thick, but it is quite probable it may be developed somewhere in this county, or in the southern portion of St. Clair, thick enough to become of some economical importance.

Hydraulic Limestone.—The limestone at the Portland quarries, four miles southeast of Waterloo, closely resembles the hydraulic rock often found at the top of the Keokuk group. The bed has been exposed in the quarry to the depth of six feet, and the rock is

an earthy, buff colored dolomite, very similar in appearance to that used at the cement mills in St. Clair county, and also on the Piasa, in Jersey county. If, on experiment, it should be proved to possess hydraulic properties, the manufacture of cement might be successfully carried on here, as the railroad now building through this county would open a good market for all the cement that could be made.

Limestone for Lime.—First in value and importance for the manufacture of quicklime, is the light bluish-gray compact limestones of the upper division of the St. Louis group, which could be readily worked at more than a hundred points in the county. It is one of the purest limestones in the West, and is more extensively used for the lime kiln than any other. The completion of the railroad through this county will open new markets and facilitate the production of this article. The Trenton limestone at Salt Lick Point, as well as the lower beds of the Keokuk group in the same region, will afford an abundant supply of excellent limestone for this purpose, whenever any demand shall arise for its manufacture in this part of the county. This county might easily furnish the whole Mississippi valley with all the quicklime required for centuries, without exhausting the supplies for this material now so abundantly at hand.

Brick Materials.—Sand and clay suitable for the manufacture of common brick abound in almost every neighborhood, and may be readily obtained. The brown clay subsoil on the highlands is generally well adapted for this purpose, and where there is a deficiency of sand it may be readily supplied from the banks of the adjacent streams.

Soil and Agriculture.—The varied character of the surface in different portions of this county must necessarily result in an equally variable soil and its products. On the bottom lands along the river, and also in the valleys of some of the small streams, the soil is a deep, sandy loam, highly charged with humus from the vegetable matters that have been produced and decayed upon its surface; and this soil is exceedingly productive, yielding annually heavy crops of corn and other cereals usually grown in this climate. These are the most productive lands in the county, and where they are elevated above the annual floods in the Mississippi, are also the most valuable. Next in order are the chocolate-colored soils of the small prairies in the eastern portions of the county, and the timbered lands adjacent thereto, where the underlying rocks belong to the Chester group. These lands also produce good crops of corn, wheat, barley and clover, but require a judicious rotation of crops to retain their original fertility. Lastly, we have the oak ridges along the river bluffs, and the

sink-hole region, underlaid by the upper division of the St. Louis limestone. The soil over this portion of the county is very thin, and consists of yellowish or ashen-gray clays, with a yellow clay subsoil. These lands require heavy manuring, if cultivated in corn, but produce fair crops of wheat and other small grains, and clover, where the surface is not too broken for cultivation. These are the best fruit lands, perhaps, in the county, and apple, peach and pear orchards flourish here, and grapes are also extensively cultivated. All the small fruits might be successfully cultivated on these broken lands, and their near proximity to the St. Louis market would make this branch of horticulture exceedingly profitable, if properly conducted. Vineyards have been successfully cultivated here for many years, and this county probably ranks about the third in the State for the value of its wine products. The completion of the railroad through this county will bring it within a half-hour's ride of St. Louis, and will greatly enhance the value of its lands, especially those best adapted to the cultivation of the small fruits.

Before closing my report on Monroe county, I desire to express my obligations to Hon. Henry Talbot, of Waterloo, and his son, and also to Mr. H. F. Henckler, of Columbia, for their earnest coöperation and assistance in the prosecution of my work while in the county. To Mr. Talbot and his amiable lady I am also indebted, for the hospitalities of a quiet home, while engaged in working out the geology of the southern part of the county; and to Mr. Henry Talbot, Jr., I am indebted for several days' personal assistance, and for many fine specimens collected by himself at various localities in this county.

CHAPTER XVII.

MACOUPIN COUNTY.

This county lies a little to the southwestward of the geographical center of the State, and embraces a superficial area of twenty-four townships, or eight hundred and sixty-four square miles. It is bounded on the north by Sangamon and Morgan counties, on the east by Montgomery, on the south by Madison, and on the west by Jersey and Greene counties.

The principal streams in the county are Macoupin creek, and its tributaries, which intersect the central and northern portions of the county, and Cahokia creek, traversing its southeastern townships. Heavy belts of timber occur on either side of these water courses, which furnish an adequate supply for the prairies that occupy all the high lands between the streams, and cover fully two-thirds of its entire area. The prairies are generally nearly level or gently rolling, and are elevated from fifty to one hundred and fifty feet above the beds of the principal streams.

Surface Deposits.—The Quaternary beds of this county consist mainly of Drift clays, with some interstratified beds of sand and gravel, and some local deposits of Loess along the bluffs of the Macoupin. They range in thickness from forty to two hundred feet or more, the greatest development being restricted to the ancient valleys, excavated anterior to, or during the Drift epoch, and subsequently filled with Drift accumulations. The lower course of the Macoupin, south and west of Carlinville, appears to occupy in part one of these valleys, and three miles south of Carlinville a shaft was sunk by Mr. T. L. Loomis, Esq., to the depth of one hundred and sixty feet, without reaching the bed-rock, all but a few feet at the top being through a blue hard-pan. At this point a stream of water broke through, probably from an underlying bed of quicksand, and

filled the shaft in a few hours to the depth of about eighty feet, and the work was consequently abandoned.

At Naylor & McPherson's coal shaft, one mile southeast of Bunker Hill, the superficial deposits were only twenty-eight feet thick, while at Van Horst & Voges' shaft, east of Staunton, they were one hundred and ten feet; at the Virden shaft twenty, and at Girard about seventy feet. These figures illustrate the variable thickness of the Drift deposits in this county, and indicate the irregularity of the original surface of the bed-rock, which seems to have been intersected by valleys of erosion quite as deep, if not as numerous as those which characterize the surface at the present time. The upper thirty or forty feet of the Drift consists of brown or buff gravelly clays, which pass gradually into the blue hard-pan below, which forms the lower division of this deposit. The beds underlying this hard-pan were not passed through at Loomis' shaft, and consequently their characters are not definitely known, but the great amount of water flowing into it in so short a time indicates the presence of a bed of quicksand immediately below the hard-pan; and quite probably other beds, including an original surface soil similar to that met with at the Bloomington shaft, and at various other localities in the State, may also be found to exist here.

Stratified Rocks.

All the stratified rocks of this county belong to the Coal Measures, and include all the strata from the horizon of coal No. 5, which outcrops on Hodge's creek, just on the Greene county line, to coal No. 10, inclusive, embracing an aggregate thickness of about three hundred and fifty feet:

The following section of the coal shaft at Virden, kindly furnished me by G. W. Utt, Esq., one of the proprietors of the mine, will give a general idea of the relative thickness and position of the strata, and includes nearly all the different beds that outcrop in the county, except a few feet in thickness below the coal worked in this mine, which outcrop on the west line of the county, and also a few feet in thickness of beds overlying the highest in this shaft, which outcrop on the upper course of Macoupin creek, east of Carlinville:

	Virden Shaft.	Feet.	In.
	Drift clay	20	0
No. 1.	Sandstone	5	0
No. 2.	Bituminous shale	0	5
No. 3.	Coal	0	2

		Feet.	In.
No. 4.	Fire-clay	5	0
No. 5.	Bituminous shale	4	6
No. 6.	Coal No. 10	0	6
No. 7.	Fire-clay or clay shale	6	0
No. 8.	Hard gray limestone	7	9
No. 9.	Bituminous shale	1	4
No. 10.	Argillaceous shale	5	6
No. 11.	Compact limestone —Carlinville bed	7	0
No. 12.	Bituminous shale, coal No. 9	1	3
No. 13.	Clay shale	6	0
No. 14.	Limestone	0	9
No. 15.	Sandy shale and sandstone	63	0
No. 16.	Soft limestone or calcareous shale	1	4
No. 17.	Bituminous shale	3	10
No. 18.	Coal No. 8	0	10
No. 19.	Sandstone and sandy shale	72	0
No. 20	Shales with ironstone	3	0
No. 21.	Hard calcareous ? sandstone	8	0
No. 22.	Blue clay shale	4	0
No. 23.	Variegated shales—horizon of coal No. 7	22	6
No. 24.	Sandy shales	26	0
No. 25.	Soft bituminous shale	1	6
No. 26.	Limestone	3	0
No. 27.	Bituminous shale	2	6
No. 28.	Coal No. 6.)	2	9
No. 29.	Fire-clay.. |	2	0
No. 30.	Sandstone |	4	0
No. 31.	Coal No. 6.)	1	6
No. 32.	Fire-clay	2	0
No. 33.	Sandstone and shale	10	0
No. 34.	Limestone	7	0
No. 35.	Bituminous shale	0	6
No. 36.	Coal No. 5	7	8
	Total depth to the bottom of the coal	320	1

A shaft has also been sunk at Girard down to this main coal, but as no record was kept of the thickness and character of the beds passed through, we are unable to designate the changes which mark the various strata between these points.

The coal worked at these shafts, as well as all others at present in operation in this county, is, in my opinion, No. 5 of the general section of the Coal Measures of Western Illinois, as given in the first volume of these reports. In the central portions of the county its thickness ranges from six to eight feet, but on Apple creek, in the northwest corner of the county, a coal outcrops that seems to be the equivalent of this, but is much thinner, ranging only from two to three feet, and at Howard's shaft, one mile and a half north of Bunker Hill, its average thickness is about four feet.

At the Virden shaft the main coal (No. 36 of this section) averages about seven feet and a half in thickness, sometimes running up to eight feet, and seldom falling below seven. It is a moderately

soft, free-burning coal, especially that from the upper portion of the seam, from two to three feet in thickness, which is an excellent smith's coal. The seam is divided by a shaly parting about an inch in thickness, which is very persistent, and about one-third the distance from the bottom to the top of the seam. The coal has a tendency to break into cubic blocks, like the Belleville coal, though the partings which separate the coal into several distinct layers are not as decided here as at the mines in St. Clair and Randolph counties. No horsebacks or other impediments to the profitable working of this coal has yet been encountered in this shaft. Salt water in small quantities percolates through some of the sandstones above the coal, especially above Nos. 19 and 33. The roof consists first, of a dark-blue clay shale, sometimes passing into a hard black slaty shale, an inch or two in thickness, resting directly on the coal. This clay shale varies in thickness from two to three inches to as many feet, and above this there is a dark-gray limestone about seven feet thick, which forms an admirable roof to the coal. The shale immediately on the coal is more argillaceous than at the mines in the vicinity of Springfield, and fossils are comparatively rare, even where it becomos hard and slaty. We obtained a few of the common species here, among which were *Discina nitida*, *Productus muricatus*, *Hemipronites crassa*, *Chonetes mesoloba*, some fragments of a *Nautilus*, and *Petrodus occidentalis*. These fossils were generally poorly preserved, and the shells mostly replaced with yellowish pyrites.

This coal seems to be the equivalent of coal No. 5 of the Fulton county section, given on page 347 of the second volume of these reports. It affords a softer coal than that usually obtained from No. 4, and is more regularly stratified, breaking freely into blocks of a cubical form when carefully mined.

No attempt has yet been made to determine the development of No. 4, or either of the lower seams in the central portion of the county, but No. 4 outcrops on Hodge's creek, near the Greene county line.

The shaft at Girard is about three hundred and forty feet in depth, but as no record of it was kept by those in charge of the work, no reliable section could be obtained of the strata passed through. The coal averages about seven feet in thickness, has a shaly parting similar to that at Virden, and the coal presents the same general character. The limestone above the coal is somewhat thicker than at Virden, being about ten feet.

Weir's shaft, at Carlinville, is two hundred and sixty feet to the top of the coal, passing through the following beds:

		Feet.	In.
Drift clays		75	0
No. 1.	Clay shale	28	6
No. 2.	Soft coal, No. 8	0	6
No. 3.	Dark and light fire-clays	5	0
No. 4.	Sandstone and shale	70	0
No. 5.	Clay shale	15	0
No. 6.	Dark shale	6	0
No. 7.	Soft smutty coal, No. 7	5	0
No. 8.	Fire-clay	6	0
No. 9.	Sandstone	8	6
No. 10.	Clay shale	2	0
No. 11.	Limestone	3	0
No. 12.	Clay shale	1	0
No. 13.	Limestone	1	6
No. 14.	Coal	1	6
No. 15.	Shale	6	6
No. 16.	Coal	0	6
No. 17.	Fire-clay	2	6
No. 18.	Hard rock, probably limestone or calc. sandstone	12	0
No. 19.	Shale	5	0
No. 20.	Limestone	5	0
No. 21.	Black shale	0 to 4	0
No. 22.	Coal, No. 5	6	
		266	2

The coal here is similar in quality to that obtained from the shafts at Virden and Girard, and the mine is entirely free from water, and its gangways as dry as though they possessed a waterproof covering.

Bartel's shaft, in the creek valley south of town, was commenced at a much lower level, and the coal was reached at a depth of about 210 feet. The coal in this shaft ranges from six to eight feet in thickness, and has a good roof, composed of five feet of bituminous shale and five feet of limestone.

In the section given above of the Carlinville shaft it will be seen that coal No. 6 is divided by a parting of shale six feet and a half in thickness, while at the Virden shaft the parting consists of sandstone and shale, and is six feet in thickness. In the last named shaft this seam would be thick enough to be profitably worked, the two divisions being in the aggregate four feet three inches in thickness, if united, but owing to the great thickness of the parting the seam is valueless, as too great an amount of labor would be required to remove the material separating the two divisions of the coal. This seam has not yet been found in any of the shafts in this county under such conditions as will permit of its being worked successfully. The next seam, No. 7, although of sufficient thickness, was found to be too soft and inferior in quality, and consequently valueless. Coal No. 8 appears to be the equivalent of the eighteen-

inch coal outcropping on the breaks of Spring creek near Springfield, and on the Sangamon, at Howlett. It seems to be thinner in all the shafts sunk through it in this county than in Sangamon, usually ranging from six to ten inches only. The sandstone intervening between this and No. 7 is partially exposed on the lower courses of Macoupin and Hodge's creeks, and also on some branches of Apple creek in the northwestern portion of the county. The limestone No. 11 of the Virden shaft section is a very hard gray limestone, and outcrops at several points in the vicinity of Carlinville, and is, therefore, locally called the Carlinville limestone. It ranges in thickness from six to twelve feet or more, and is a compact, brownish-gray rock, weathering to a rusty brown color on exposure, the lower portion of the bed being usually in regular layers, while the upper portion becomes locally concretionary, or pebbly, in its structure. This limestone forms the bed-rock over a considerable portion of the county, especially the region between Carlinville and Cummington, and extending from the first named point southeastwardly to Bunker Hill and Staunton. On the road between the two points last named, on the head-waters of Cahokia creek, two miles and a half northwest of Staunton, this limestone is partially exposed, and is here overlaid by about fifteen feet of greenish shale, with a band of impure earthy iron ore intercalated in it about two feet above the limestone. This band of iron ore closely resembles the fossiliferous ore bed on the north fork of Saline river in Gallatin county, twelve miles north of Equality, and contains several of the same species of fossils obtained there. If these ferruginous beds are identical, as seems highly probable, it fixes the geological position of a group of fossils that have hitherto been considered as more decidedly Permian in their aspect than any others occurring in our Coal Measures, and establishes their stratigraphical position at least three or four hundred feet below the uppermost beds of the Coal Measures in this State. The limestone underlying this fossiliferous iron ore is about 210 feet above coal No. 5 in this county, and probably from four hundred to four hundred and fifty feet above the base of the Coal Measures, and therefore this iron ore band is not far above the middle of the Coal Measures. The Carlinville limestone outcrops on Macoupin creek, from the vicinity of Corr's mill, northeast of Carlinville, down to the bridge on the Hillsborough and Carlinville road, forming the bed of the creek for several miles by the meanderings of the stream. At the first outcrop below the mill the limestone forms the bed of the creek, and only the upper por-

tion of it can be seen. It forms a riffle here across the creek, and the pebbly character of the upper portion gives it the appearance of a bed of coarse gravel rather than an outcrop of limestone. Below these pebbly layers the rock becomes quite evenly-bedded in layers from four inches to a foot or more in thickness, and has been quarried for local use as a building stone. In the debris of an old quarry I obtained a few of the most characteristic fossils of this limestone, among which were the following species: *Rhynchonella Uta, Retzia Mormoni, Terebratula bovidens, Spirifer plano-sulcata, S. cameratus, S. Kentuckensis, Athyris subtilita, Productus longispinus, Platyostoma,* and *Platyceras,* of undetermined species, *Pleurotomaria turbiniformis, Nautilus Tcheffkini? Phillipsia scitulus,* and *Campophyllum torquium.* At most localities where this limestone is exposed fossils were exceedingly scarce, and difficult to obtain when found, from the very hard and splintery character of the rock in which they were embedded.

At the coal shaft one mile west of Staunton this limestone is six feet thick, and lies in regular beds, and is quarried for foundation walls and other purposes. The coal at this point lies 210 feet below this limestone, and the seam averages about six feet in thickness. At the coal shaft on the railroad a half mile east of the town, which is located on the prairie a hundred feet above the level of that west of town, in the valley of Cahokia creek, a hundred and ten feet of Drift clays were passed through before reaching the limestone. At the time of my visit to this locality, in September, 1871, the shaft was down to the horizon of coal No. 6, but no accurate record had been kept at either of these shafts of the character and thickness of the strata passed through. The following, given me from recollection by the man in charge of the work in sinking these shafts, is approximately correct. Beginning at the level of the limestone, we have the following:

		Feet.	In.
No. 1.	Limestone	6	
No. 2.	Clay shale	25	
No. 3.	Fire-clay—?	5	
No. 4.	Coal—No. 8	0	3
No. 5.	Shales and sandstone, partly arenaceous, and including the horizon of coal No. 7	110	
No. 6.	Red shale	0	4
No. 7.	Limestone	5	
No. 8.	Blue shale	3	6
No. 9.	Coal—No. 6	2	
No. 10.	Clay shale	9	
No. 11.	Limestone	17	
No. 12.	Bituminous shale	2	
No. 13.	Coal—No. 5	6	

To get the total depth of these shafts we must add ten feet of Drift clays to the top of that west of town, and one hundred and ten feet to the top of the other.

In the vicinity of Bunker Hill there are also two shafts in successful operation, one a half mile southeast of the town, of which Naylor & McPherson are the proprietors; and the other, owned by Mr. Andrew Howard, one mile and a quarter north of town, on a branch of Wood river. The shaft southeast of town is two hundred and fifty-three feet in depth, and, although no record was kept of the beds passed through, the following given me by one of the proprietors, from recollection, is probably approximately correct:

		Feet.	In.
No. 1.	Drift clay	28	4
No. 2.	Blue clay shale	12	
No. 3.	Hard gray limestone (Carlinville bed)	8	4
No. 4.	Blue shale	30	
No. 5.	Limestone (?)	2	
No. 6.	Clay shale	1	4
No. 7.	Coal, No. 8	0	3
No. 8.	Fire clay	2	
No. 9.	Clay shale, with nodules of limestone	8	
No. 10.	Red shale	2	6
No. 11.	Sandstone and shale	55	
No. 12.	Black shale (coal No. 7)	3	
No. 13.	Sandstone (water-bearing)	30	
No. 14.	Shale, with some limestone	15	
No. 15.	Clay shale	3	
No. 16.	Coal	1	8
No. 17.	Nodular limestone and shale } No. 6	10	
No. 18.	Coal	1	6
No. 19.	Limestone	8	
No. 20.	Shale	7	
No. 21.	Limestone	7	
No. 22.	Black shale	2	
No. 23.	Coal, No. 5	6	
		253	7

The coal at this mine varies in thickness from five to seven feet, and is divided below the middle by a shale parting, the coal above the parting being of a better quality than that below it, and having a tendency to the block character. The coal has a bright glistening color on the faces of transverse cleavage, and the layers are separated by thin layers of charcoal or carbonaceous clod.

At Mr. Howard's mine, in the valley of Wood river, the coal was reached at a depth of one hundred and sixty feet, but as we could obtain no section of the shaft, we are unable to say whether the coal mined here is the same with that in the other shafts or not. The seam is only about four feet thick here, and it may be that it is No. 6 instead of No. 5 that is worked at this point.

In the vicinity of Plainview the Carlinville limestone is found outcropping on one of the small tributaries of the Macoupin, and fol-

lowing down the railroad grade as it descends into the creek valley, the following beds may be seen:

		Feet.
No. 1.	Compact brownish-gray limestone	6
No. 2.	Calcareous shale with chonetes, etc	¼
No. 3.	Dark-blue clay shale, with ferns	3
No. 4.	Sandy shales and shaly micaceous sandstones extending below the creek level	50 to 60

The buff-colored calcareous shale immediately beneath the limestone was found at one locality filled with fossil shells, *Chonetes*, *Athyris* and *Productus*, but mostly in a crushed and flattened condition. The dark-blue clay shale, No. 3, is partly bituminous, and contains fragments of fossil ferns of two or three species. It seems probable that the Carlinville limestone, No. 1 of the above section, is the stratigraphical equivalent of the Shoal Creek limestone, mentioned in the reports on Madison, Clinton and Marion counties, in the second volume of these reports, and if so, this bituminous clay shale may represent the thin coal immediately below that limestone, which would be coal No. 9 of the general section, and is from eighteen inches to two feet thick in the vicinity of Highland, in Madison county, where it has been worked for many years in a small way, to supply the local demand for coal.

In the section given above, it will be seen that there is a very decided increase in the thickness of the beds intervening between the Carlinville limestone and coal No. 8. Usually the intervening beds are about thirty to thirty-five feet in thickness, but here we have nearly sixty feet in thickness below the limestone without any indication of coal, and this probably results from a local thickening of the sandstone, a repetition of what may be seen in the section of the Virden shaft, where the sandstone, No. 15 of that section, is sixty-three feet in thickness, and the whole distance from the limestone to coal No. 8 is seventy-six feet and two inches. In the bed of Macoupin creek, about half a mile below Holliday's ford, on section 30, township 9, range 8, we found an outcrop of bituminous shale and thin coal which may probably be considered as representing coal No. 8. The beds exposed here show the following succession:

		Feet.	In.
No. 1.	Clay shale	10 to 12	
No. 2.	Chocolate-colored limestone	1	
No. 3.	Bituminous shale	0	4
No. 4.	Coal	0	2
No. 5.	Fire-clay	2	

We obtained a few fossils from the limestone No. 2 of the above section, and among them *Naticopsis ventricosa*, a small *Macrocheilus* and

Lophophyllum proliferum, all of which are found in the roof of No. 8 coal, in the vicinity of Springfield. If we add to the top of this section the shales and micaceous sandstones of the preceding section, we shall have about the same thickness of strata intervening between coal No. 8 and the Carlinville limestone that occurs in the Virden shaft. Moreover the local thickening of beds of sandstone is by no means uncommon in the Coal Measures, but on the contrary is of frequent occurrence.

There are some excellent exposures of this micaceous sandstone along the creek bluffs just below the railroad bridge. The rock is partly massive, especially the lower portion of the bed, and affords layers two feet or more in thickness, some of which are quite hard and will afford a durable building stone. Silver ore was reported to have been discovered in this sandstone, in a quarry on the southwest quarter of section 20, town 10, range 8 west, a few years since, and an attempt was made to organize a joint stock company for its development. The silvery scales of mica which the rock contained were mistaken by some ignorant persons for silver, and hence the reported discovery of a rich mine of metallic ore at this locality. The only material of economic value this rock contains is building stone of a fair quality, which may be obtained here in abundance.

The best exposures of the beds overlying the Carlinville limestone, that we met with in this county, are on the upper course of Macoupin creek, commencing eight miles northeast of Carlinville in the vicinity of Coop's Mound, and extending down to the bridge on the Hillsborough road. The succession or relative position of the beds is as follows:

		Feet
No. 1.	Light yellowish-gray nodular limestone	5 to 8
No. 2.	Bituminous shale	1
No. 3.	Gray shale	17
No. 4.	Soft coal, No. 11	1
No. 5.	Shale with iron pebbles	7 to 8
No. 6.	Chocolate-colored coarse limestone	2 to 3
No. 7.	Green and yellow shale	2
No. 8.	Black shale and poor coal, No. 10	2
No. 9.	Green and gray shale	3 to 4
No. 10.	Carlinville limestone	6 to 12

At Fullerton's mill, on Macoupin creek, eight miles northeast of Carlinville, on the northeast quarter of section 16, town 10, range 6, there is an outcrop of light-gray, irregularly-bedded limestone in the banks of the creek, that I am inclined to refer to No. 1 of the above section, although none of the underlying beds were exposed at that point. The rock is similar in color and general appearance, and contains the same species of fossils, mostly *Athyris subtilita*,

Productus longispinus, Rhynchonella Uta, Terebratula bovidens, and joints and plates of *Crinoidea.*

Just below Corr's mill, about four miles a little north of east from Carlinville, the lower limestone in the foregoing section appears in the bed of the creek, and between this point and the bridge on the Hillsborough road the beds intervening between these two limestone are partially exposed at several points. The chocolate colored limestone (No. 6) is a coarsely granular rock made up in good part of the joints and plates of *Crinoidea,* but it also contains *Pinna peracuta, Productus Prattenianus P. Nebrascensis,* and the teeth of several species of fossil-fishes, among which we recognized *Petalodus destructor* and *Cladodus mortifer.* In the yellow-clay shale underlying this limestone, specimens of *Syringopora multattenuata* were quite common, and were frequently met with in the rubble of the creek bed. The thickness of the shales Nos. 7, 8 and 9 of the foregoing section seemed to be quite variable in this vicinity, and at some points probably attain an aggregate of fifteen to twenty feet, but at the best exposure we were able to find they only measured about eight feet, and at some points were still less. The chocolate-colored limestone of the above section seems to be identical with that of Sugar creek in Sangamon county, seven miles southeast of Springfield, where the rock for the old State House was obtained. The thin coals Nos. 4 and 8 of the foregoing section are nowhere thick enough at any of the exposures seen to be of any economical value. It is probable these beds underlie the surface deposits over nearly the whole of the eastern tier of townships in this county. Over a large portion of the two central tiers of townships the Carlinville limestone forms the bed-rock, while the western is mainly underlaid by the sandstones overlying No. 7 coal.

One mile and a half southeast of Cummington the Carlinville limestone outcrops on the breaks of the small streams, and only from thirty to forty feet below the general level of the prairie. It was also found on section 7 in the same township, where it was underlaid by eighteen inches of bituminous slate and shale, representing the horizon of No. 9 coal, and by about fifteen feet of sandy shale and sandstone.

The lowest strata exposed in this county are on Apple creek in the northwest corner, and on Hodge's creek in town 10 south, range 9 west, near the Green county line. At the locality last named coal No. 5 or 6 crops out in the bluffs of Hodge's creek, and has been mined to supply the local demand for coal in that vicinity ever since the first settlement of this part of the county.

At Thomas Bielby's mines, in the bluffs of Hodge's creek, on section 29, town 10 north, range 9 west, the coal ranges from five to seven feet in thickness, and is overlaid by from one to three feet of black shale, forming a good roof. A half mile further south, on a small branch of the creek, the coal is overlaid by a foot or more of black shale, then follows eight to ten feet of hard steel-gray limestone, with intercalcations of calcareous shales. Above this is a bed of clay shale, and a second limestone of a lighter color, but weathering to a rusty-brown, and filled with *Fusulina* which would seem to identify it with the limestone usually overlying coal No. 6. The section here is as follows:

		Feet.
No. 1.	Yellow shale, with thin plates of limestone	4 to 6
No. 2.	Yellowish-gray limestone, with *Fusulina*	4
No. 3.	Green shales partly bituminous	6 to 8
No. 4.	Steel-gray limestone and calc. shale	8 to 10
No. 5.	Black shale	1 to 2
No. 6.	Coal No. 5?	5 to 7

I am inclined to the opinion that in the shales and limestone forming Nos. 2 and 3 of the section we have a representation of coal No. 6 and its overlying limestone; and at Mr. Davis' coal-bank, about a mile west by south from this locality, the coal is directly overlaid by about two feet of light-gray fire-clay, above which there was about two feet of yellowish-gray limestone similar to No. 1 of the above section, which led me to suspect the coal here to be a local development of No. 6. The lowest bed of the foregoing section is undoubtedly the same coal worked in the shafts at Virden, Girard and Carlinville, though the coal contains more pyrite (or sulphur as the miners term it) here, on its outcrop, than in the shafts above named, where it lies from three to four hundred feet below the surface. The coal varies however in this respect in the different mines in this county, and indeed in different portions of the same mines, this sulphurous compound being more abundant at some points than others.

At or near the old strip banks on Hodge's creek, coal No. 4 or 5 outcrops at low water, but no exposure was found where its thickness could be accurately determined or its quality ascertained. It was reported to be about two feet thick. Between the main coal and this lower seam there is a bed of nodular argillaceous limestone, which sometimes lies directly under the coal, and at other points is separated from it by a few inches of clay shale or fire-clay, and below the limestone there is from fifteen to twenty feet of sandy shales, extending down to the bituminous shale which forms the roof of No. 4.

The shales and argillaceous limestone immediately below coal No. 5 contains *Chætetes milleporaceous* in abundance, and at this locality a peculiar group of small univalve shells have been obtained, a number of which have been described in the original reports, and will be found illustrated on Pl. 31, Vol. II. These univalves are associated here with *Athyris subtilita*, *Spirifer cameratus*, and some other of the more common forms of the Coal Measures. The upper limestone above the coal at this locality contains *Fusulina*, and joints of *Crinoidea*, which are associated with *Productus Prattenianus* and *P. longispinus*, but fossils are less numerous, both as to species and individuals, in the limestone over the coal here, than in that beneath it. In Fulton county the *Chætetes milleporaceous* is found in the clay shales or fire-clays under coal Nos. 6 and 7, and it is possible that the Hodge's creek bed should be referred to No. 6 of the Fulton county section. The thickness of the limestone over this coal is very variable, and ranges from three to ten feet, and where it attains its greatest development it is usually interstratified with calcareous shale.

On Apple creek, in the northwest corner of the county, the following beds are exposed between Carlin's cannel coal seam, on the northeast quarter of section 3, township 12 north, range 9 west, and the west line of the county, following along the bluffs of the main creek and its tributaries:

		Feet.	In.
No. 1.	Bituminous shale	1	6
No. 2.	Cannel coal—local?	1	6
No. 3.	Shale	10 to 12	
No. 4.	Compact steel-gray limestone	2	
No. 5.	Sandstone and shale	32	
No. 6.	Bituminous shale	1	6
No. 7.	Coal—No. 7?	0	10
No. 8.	Clay shale	6	
No. 9.	Nodular gray limestone	4	
No. 10.	Greenish-colored shale	12	
No. 11.	Brown, coarse-grained limestone	1 to 8	
No. 12.	Sandstone and sandy shale	24	
No. 13.	Brown argillaceous limestone	3	
No. 14.	Shale, mostly argillaceous	1 to 3	
No. 15.	Coal—No. 6?	2 to 3	
No. 16.	Clay shale and nodular limestone	8 to 10	

On a branch of Apple creek, two miles north of Scottsville, the beds of the foregoing section, from 7 to 16 inclusive, are well exposed, and the lower coal seam has been opened at several points by tunnels driven into the hillsides. It ranges in thickness from two to four feet, and is divided near the middle by a parting of shale from one to two inches thick. The coal is overlaid by two

or three feet of clay shale and a bed of argillaceous limestone, which sometimes passes into calcareous shales three or four feet in thickness. The limestone weathers to a rusty-brown color, on exposure, though its color is a light-gray on a freshly broken surface. Where this rock is shaly it afforded some good fossils, among which the *Rhynchonella Uta* and *Productus longispinus* were the most common. This coal is underlaid, first, by from one to two feet of shaly fire-clay, and then a bed of nodular argillaceous limestone, containing numerous joints of large *Crinoidea*, associated with *Productus costatus* and *Spirifer cameratus*.

The cannel coal, No. 2 of the foregoing section, was opened at an early day on land owned by Matthew Newkirk, on section 11, township 12 north, range 9 west, and was worked for several years by Mr. John Carlin, to supply the local demand of the neighborhood. The seam varies in thickness from eighteen inches to two feet, the upper part being a true cannel coal and the lower a common bituminous coal. It has proved to be quite local in its development, and has not as yet been met with at any other locality in the county of sufficient thickness to be of any economical value. This seam may be the equivalent of No. 7 coal in the general section of the lower Coal Measures of Fulton county, but we are not sure it does not hold a still higher position, and is an entirely local seam not represented at all in that section.

The limestone below this coal is also local in its development, not appearing at all on the ravine where the coal was opened, though exposed on another not more than two hundred yards to the northward, and again a mile and a half east of the old Newkirk mine. The coarse brown limestone is also local in its development, and quite variable in thickness, ranging from one to eight feet. Lithologically it resembles a limestone occurring at a much higher level in the vicinity of Virden, and represented by No. 8 of the Virden shaft section.

The sandstone below the coarse-grained limestone, at the locality two miles north of Scottsville, is quite massive and affords a very good building stone. This is also true of the sandstone below the Newkirk coal, No. 5 of the foregoing section, and the upper twenty feet of the bed is a micaceous sandstone impregnated with the oxide of iron, which hardens on exposure, and affords a reliable building stone.

We were unable to determine the exact horizon of the lower coal, No. 15 of the section, but it seems to be more like No. 6 of the general section than like No. 5. No attempts have been made in

this vicinity, by boring or shafting, to ascertain the character of the underlying beds, and assuming this coal to be No. 6, the main coal worked in all the shafts in this county should be found at a depth of some thirty-five to forty feet below. The reasons which may be urged to sustain this view are the following: The thickness of the seam is only about one-half that of No. 5, where it has been identified in other portions of the county, and the limestones, both above and below the coal, differ in their lithological characters, as well as in their fossils, from those associated with coal No. 5. One of the most abundant fossils in the shale over this coal, at its outcrops north of Scottsville, is the *Rhynchonella Uta*, which I have never found abundant with coal No. 5, and the latter has a peculiar group of univalve shells associated with *Chætetes milleporaceous* in the nodular argillaceous limestone, below the coal, none of which were found in the limestone underlying the coal at this point. These reasons have induced the belief that the coal on the branches of Apple creek north of Scottsville is coal No. 6, and that No. 5 will probably be found below it, at the depth of thirty-five to forty feet. At the outcrop on Hodge's creek, near the Greene county line, the coal averages about six feet in thickness, and in the central portions of the county, where it has been penetrated by various shafts, its thickness ranges from six to eight feet, averaging nearly or quite seven feet. There is probably no point in this county where this seam is more than 400 feet below the surface, and its greatest depth will be in the townships of range 6 west, the most easterly range of townships in the county.

From an examination of the sections already given, it will be seen that the lowest beds outcropping in the county are found on Hodge's creek, its extreme western border, where coals Nos. 4 and 5 are found exposed in the bluffs of this stream; and one of them has been worked since the earliest settlement of this portion of the county, to supply the local demand for coal. Going eastward from the west line of the county, the surface level gradually increases in elevation, directing the surface drainage of nearly all the streams to the southwestward, which, with a slight eastwardly dip of the strata, carries the coals outcropping along the western borders of the county from 300 to 400 feet below the surface, in the central and eastern portions, where the Carlinville limestones, and the overlying limestones and shales forming the uppermost thirty-five to forty feet of the stratified rocks in the Virden shaft, are the only beds found exposed on the upper course of the Macoupin and the head waters of Otter creek.

In the extreme southwestern portion of the county, coals Nos. 5 and 6 are found outcropping a mile and a half west of Brighton, just over the line, in Jersey county, and their outcrop has been fully described in the report on that county in Vol. II, p. 28 of these reports. In that vicinity these two coals only average from three to four feet in thickness at the outcrop, but No. 5 evidently thickens to the eastward, in the direction of the dip, as in one of the shafts at Bunker Hill it averages about six feet, and about the same or a little more in the shafts at Staunton. It is probable that Macoupin creek, in its course through township 9 north, range 9 west, may expose some of the shales and sandstones below coal No. 5, but from the wide bottoms and limited exposures of the beds in the creek bluffs, we are unable to decide this point.

In dividing the Coal Measures into an upper and lower division, as seems desirable on many accounts, I am inclined to regard the heavy bed of sandstone and shale, No. 19 of the Virden shaft section, as about the proper horizon where the division should be made, as the beds underlying this sandstone contain all the heavy beds of coal worked at the present time in this State. There is, however, one of the upper seams outcropping in some of the eastern counties of the State, that attains locally a thickness of about three feet, and is some 300 feet higher in the Measures than this sandstone. Nevertheless, there appears to be a decided change in the coal-forming conditions after the deposit of this sandstone, resulting in thin seams of coal interstratified with calcareous shales and numerous beds of limestone, indicating a more general and long continued submergence of the surface below the ocean's level, and comparatively short periods of emergence, and of true plant-producing conditions. This sandstone is probably the equivalent of the Mahoning and Anvil Rock sandstones of Kentucky, the latter being considered in the Kentucky section as the upper boundary of the workable coals of that State. These sandstones, as I have attempted to show in the chapter on the general distribution of the coal in this State, in Vol. III of the original report, p. 7, are most probably one and the same bed, which, at widely separated exposures, were taken to be two distinct sandstones, occupying entirely different stratigraphical positions.

The seven coals underlying this sandstone range from three to eight feet in thickness, except the upper one immediately below it, which, at the exposures seen in this county, is scarcely developed above one foot in thickness, though at other localities, as in Fulton county, it ranges from twenty to thirty inches, and affords a coal of

excellent quality. The coals above the sandstone in this county are Nos. 8, 9, 10 and 11, all of which are too thin to be of any economical value. No. 8, which, in the Virden shaft (No. 18), is only ten inches thick, is probably identical with the eighteen-inch coal outcropping in the vicinity of Springfield, and which, on the Sangamon at Riverton, is two feet in thickness, and affords a coal of very good quality. No. 9 immediately underlies the Carlinville limestone, but in this county seems to be scarcely developed at all, and is usually represented by a thin bed of bituminous shale, locally containing fossil ferns in considerable abundance. No. 10 was found only six inches thick in the Virden shaft, but in the bluffs of the Macoupin, east of Carlinville, it is from twelve to eighteen inches in thickness, but poor in quality where it outcrops. No. 11, in the same vicinity, is only one foot thick at its outcrop, and I could not learn that any attempt had been made to work it in this county. None of these seams are likely to be found thick enough in this portion of the State to be of any economical importance, so long as the vast resources from the lower seams remain unexhausted.

Economical Geology.

Coal.—As may be presumed from the perusal of the preceding pages, coal is by far the most valuable mineral product of this county. Its entire area is underlaid by coal, and the supply from coal seam No. 5 alone is practically inexhaustible; and its resources from this seam, reckoning its average thickness at six feet, which I believe to be a fair estimate, is not less than 5,184,000,000 tons, and will admit of an annual consumption of one million tons per annum for 5,184 years before the coal from this seam alone would be exhausted. The underlying beds which have never yet been penetrated in this county, and probably will not be until No. 5 has been thoroughly worked out along the railroad lines, may be safely set down as capable of affording an amount equally as great as that from No. 5, and hence the entire coal resources of this county may be estimated in round numbers at more than ten billions of tons.

Coal No. 5 may be found anywhere in this county that it may be desirable to inaugurate a coal mining enterprise, as it outcrops at the surface on the principal streams that intersect the western border of the county, and in the central and eastern portions it may be reached in shafts varying from three to four hundred feet in depth. Its depth below the Carlinville limestone varies from two hundred to two hundred and twenty feet in the county, and where this limestone is

exposed, or where it is known to form the bed-rock, the distance to the coal, and the approximate cost of opening a mine in it, can be readily determined.

Coal No. 4 usually lies from thirty to forty feet below No. 5, and the three lower seams, Nos. 1, 2 and 3, will all be found, if developed at all, within one hundred and fifty feet below No. 4, so that a boring or shaft carried two hundred to two hundred and fifty feet below the main coal in this county, would penetrate all the coals to be found here, and determine positively the amount of coal accessible at any given point where the experiment may be made.

Coal seam No. 5 affords a coal of good average quality, tolerably hard, bright, compact, and usually free from pyrite; it has a rather uneven fracture, but inclines to break into cubic forms, the layers rather thick and separated by partings of carbonaceous clod or mineral charcoal, and contains vertical seams of white carbonate of lime. An analysis of this coal from the Hodge's Creek mines, made by the late Mr. Henry Pratten, former chemist of the geological survey, and published in Dr. Norwood's "Abstract of a Report on Illinois Coals," gave the following result:

Specific gravity	1.297
Loss in coking	43.48
Total weight of coke	56.52
	100.00

ANALYSIS.

Moisture	6.50
Volatile matters	36.98
Carbon in coke	48.72
Ashes, white	7.80
	100.00
Carbon in coal	53.8

This coal is about equal in quality to the Belleville seam in St. Clair county; it is a good steam-producing coal, hard enough to bear transportation, and when carefully selected this seam will afford a good smith's coal. In quality it will compare favorably with the average of our western bituminous coals.

Building Stone.—The Coal Measure strata seldom afford a good building stone, except for foundation walls, culverts and the more ordinary uses for which a coarse and homely material may be used. The Carlinville limestone is the most valuable rock of its kind to be found in this county, and it has been freely used through the central and eastern portions of the county for the ordinary uses above named. In the vicinity of Carlinville the bed ranges from five to six feet in thickness, and occurs in quite regular layers from four inches to a foot or more in thickness. The rock is compact,

fine-grained and of a bluish-grey color on a freshly fractured surface, but weathers to a rusty-brown color on exposure. When burned, it slacks freely, and makes a tolerable good but dark-colored quicklime. It appears to stand exposure well and has proved to be a durable stone where used for foundation walls, bridge abutments, etc., and is the most valuable limestone in the county for economical purposes.

The coarse brownish-gray limestone above the Carlinville bed, which is found in the bluffs of the Macoupin, east of Carlinville, is also a durable stone and has been used for bridge abutments and foundation walls in the vicinity of its outcrop, but as the bed is only from two to three feet in thickness, the supply from this source is necessarily limited. This seems to be identical with the rock at the old State House quarries on Sugar creek, in Sangamon county, though the bed is much thinner here than at that point. The limestone over the main coal, on Hodge's creek, is abundant at some points, but is too argillaceous to withstand the influences of frost and moisture, and therefore not reliable.

Among the sandstones of this county there are at least three distinct beds, that will furnish building stone of fair quality if carefully selected. Two of these beds outcrop on Apple creek and its tributaries, in the northwestern corner of the county, and are numbered 5 and 12, in the Apple creek section on page 312. These beds are 24 and 30 feet thick respectively, and are in part composed of a massive brown sandstone that stands exposure well, has an even texture and can be easily quarried in blocks suitable for ordinary building purposes. They are more or less charged with the brown oxide of iron, which gives to the rock a mottled or speckled appearance on a freshly broken surface, and as a cementing material adds much to the durability of the stone. There is also a softer micaceous sandstone outcropping on the Macoupin, below the bridge on the Alton and Chicago railroad, which affords a tolerable good building stone if carefully selected. This bed is No. 15 of the Virden shaft section, and lies from 30 to 40 feet below the Carlinville limestone. These sandstones may probably be found outcropping at other points in the western portion of the county, and, as a general rule, whenever a sandstone is found to present a solid cliff of rock at its outcrop, it may be safely used for all ordinary building purposes.

Limestone for Lime.—The Carlinville limestone has been already mentioned as suitable for lime burning, making a strong but dark-colored quicklime, and it is probably the best material for this pur-

pose to be found in the county; but owing to the proximity of the purer limestones of the Lower Carboniferous series at Alton, and the facility for obtaining the very superior quality of lime manufactured at that point, it is not probable that the Carlinville rock will ever be very extensively used for this purpose.

Iron Ore.—A band of very pure carbonate of iron was observed at two or three points on the Macoupin east of Carlinville, intercalated in the shales overlying the Carlinville limestone, but nowhere in sufficient abundance to be of any economic importance at the present time.

Fire Clay.—The under-clay of Coal No. 4 on Hodge's creek, at the single point where we found it exposed, seemed to possess the qualities of a good fire-clay; but the clays under coals Nos. 5 and 6 seemed to be too shaly and impure to be of value for making either pottery or fire-brick. Neither did the under-clays of the thin coals above the Carlinville limestone, at the several outcrops we examined, seem to be pure enough to form a good fire-clay; but as these under-clays frequently change their local characters, it is by no means improbable that they may be found somewhere in the county in good quality.

Sand and Clay for Brick-Making.—These materials are abundant in all parts of the county, and may usually be obtained from the beds immediately beneath the soil on the uplands, and where there seems to be a deficiency of sand in the subsoil clays, it may be easily supplied from the beds of the streams, or from the sand-beds interstratified with the Drift clays.

Timber.—Fine belts of timber skirt the banks of all the streams in the county, furnishing an adequate supply for fencing the adjacent prairie, and for fuel to those who prefer wood to coal. The principal growth upon the uplands is two or three varieties of oak and hickory on the ridges adjacent to the streams, while on the more level lands skirting the prairies there are fine groves, which, in addition to these varieties, contain elm, linden, wild cherry, honey-locust, black walnut and hackberry, and indicate a soil of excellent quality. On the creek bottoms the cottonwood, sycamore, white and sugar maple, ash, red-bud, dogwood, sassafras, persimmon, paw-paw and white walnut are common. Since the introduction of the Osage orange for hedges, which are now a common fence in this county, and the introduction of coal as a common fuel, it may be safely estimated that the annual growth of the timber is fully equal to the yearly consumption in this county.

Soil and Ayriculture.—This county is situated in the heart of the best corn-producing region in the State, and its prairie lands, which constitute by far the largest part of its area, are unsurpassed among the uplands of this State in fertility, and produce annually large crops of Indian corn, as well as the small grains and grass, without the aid of fertilizers or artificial stimulants of any kind, and with a judicious system of rotation of crops, I believe these lands might be thus cultivated for an indefinite period without any serious deterioration in their productive qualities.

The soil on the level prairies is of a black peaty character, becoming of a chocolate-brown color on the more rolling surfaces, and degenerating into a light ash-gray colored soil on the oak ridges, which are the poorest lands in the county; but these poorer soils upon the broken lands that border the streams are excellent fruit lands, and also produce good crops of wheat and clover, if properly cultivated.

Underdraining would no doubt greatly benefit the prairie soils, as the crops are much injured in excessively wet seasons from the superabundance of moisture absorbed by the soil, and held by the impervious clays of the subsoils beneath until dissipated by surface evaporation.

The bottom lands in this county are restricted to a narrow belt along the lower course of the Macoupin, and some portion of this has been cleared of the heavy growth of timber with which it was originally covered, and brought under cultivation, and in its productive qualities it ranks with the best prairie soils, especially in the growth of corn. We did not find a single tract of land of a hundred acres in extent during our explorations in this county, that would not well reward the labor of the industrious husbandman, if brought under cultivation, with an ample crop of some of the fruits or cereals usually cultivated in this climate.

Natural Mounds.—There are some natural mounds in the eastern portion of the county, among the most conspicuous of which is Coop's Mound, eight miles northeast of Carlinville. This mound covers an area of several square acres, and is about sixty feet in height above the level of the adjacent prairie. It was originally covered with a heavy growth of oak and hickory, and from its summit a beautiful view of the surrounding country may be seen. So far as could be seen from the shallow cuts made by the surface drainage, it seems to be composed entirely of the common yellow gravelly clays that form the upper portion of the Drift in this region, and its formation

is probably due to the erosion of the surrounding surface after the accumulation of the Drift deposits.

In closing my report on this county, I take pleasure in expressing my obligations to Geo. H. Holliday, Esq., and Judge T. L. Loomis, for valuable information and personal assistance, and to the former gentleman for several rare and valuable fossils collected by himself from the Coal Measure limestone and shales of this county. Also to Mr. Utt, of Virden, and Mr. Weir, of Carlinville, for correct sections of the coal shafts at those points.

CHAPTER XVIII.

SANGAMON COUNTY.

Sangamon county lies nearly in the geographical center of the State, and embraces an area of sixteen full and several fractional townships, or about eight hundred and sixty square miles. The surface is generally quite level, or gently rolling; the general prairie level being from fifty to seventy-five feet above the Sangamon river.

It is bounded on the north by Menard and Logan counties, on the east by Macon and Christian counties, on the south by Christian, Montgomery and Macoupin, and on the west by Morgan, Cass and Menard.

The Sangamon river traverses the entire extent of the county from east to west, and with its tributaries furnishes a reasonable supply of water, in ordinary seasons. This stream, as well as its main affluents, are skirted with belts of excellent timber, which makes this one of the best timbered counties in the central portion of the State. About one-third of the county was originally covered with timber, but much of the timbered land has been cleared up and brought under cultivation. The principal varieties of timber observed in this county are the following—and it will be seen that the list embraces nearly every variety of forest tree that is found in the central portion of the State: Sugar and white maple, buckeye, shellbark hickory, swamp hickory, mocher-nut and thick shellbark hickory, hornberry, serviceberry, hackberry, redbud, dogwood, red thorn, black thorn, persimmon, waahoo, white, blue and black ash, coffeenut, black and white walnut, mulberry, sycamore, cottonwood, wild plum, wild cherry, crab apple, white oak, scarlet oak, chestnut oak, laurel oak, red oak, pin oak, swamp white oak, burr oak,

sumac, elder, sassafras, linden, willow, American elm, slippery elm, prickly ash, pawpaw, red birch, hazel, spiceberry and honey locust.

The superficial deposits in this county comprise the three principal divisions of the Quaternary: Alluvium, Loess and Drift. Narrow belts of alluvial bottom skirt the Sangamon through a large part of its course in this county, but they are subject to be annually overflowed by the river floods, and are most valuable for the heavy growth of timber they sustain.

The Loess covers a large part of the uplands to the depth of from six to twenty feet, and is composed of its usual marly beds of buff and gray sands and sandy clays. Underneath the surface soil at Springfield we usually meet the following succession of beds:

		Feet.
No. 1.	Soil	1 to 2
No. 2.	Buff-colored, siliceous clay	2½ to 3
No. 3.	Very fine gray, marly sand	3 to 4
No. 4.	Brown Drift clays, usually extending down to the bed-rock	30 to 40

Nos. 2 and 3 of the above section may properly be referred to the Loess, and at several points in the vicinity of the city it has been found to contain the characteristic shells usually found in it. I am indebted to Mr. Joseph Mitchell, who has dug many wells in the northwest part of Sangamon county, and in the adjoining portion of Menard, for the following section of the beds usually passed through by him:

		Feet.
No. 1.	Soil	1 to 2½
No. 2.	Yellow clay	3
No. 3.	Whitish (gray?) jointed clay, with shells	5 to 8
No. 4.	Black muck, with fragments of wood	3 to 8
No. 5.	Bluish-colored bowlder clay	8 to 10
No. 6.	Gray hard-pan—very hard	2
No. 7.	Soft, blue clay, without bowlders	20 to 40

No. 3 of this section is undoubtedly Loess, and he affirms that this order of succession was invariably observed at many different localities in that portion of the county, the black, mucky soil always appearing immediately below the Loess, and varying from three to eight feet in thickness, and always overlaying the true Drift or bowlder clay. This old soil is probably the equivalent of a chocolate-colored band a foot or more in thickness, which lies at the base of the Loess in the bluffs at Quincy. In my report on Adams county, published in Vol. IV. of the original reports, p. 45, I suggested that the layers of chocolate-colored soil at the base of the Loess observed there, might be the equivalent of the old Post Tertiary soil penetrated in the shaft at Coatsburg, and in consequence of the absence of true Drift deposits at Quincy, it was difficult to

fix the relation which this chocolate-colored soil might hold to the bowlder clays, but the occurrence of a similar deposit at so many different localities in this county, at the base of the Loess, and always above the bowlder clays, seem to indicate pretty conclusively that the stratum at Quincy also belongs above the true Drift, and to a more recent period than that penetrated at Coatsburg. These two ancient soils, the one at the base of the Loess, and the other below the bowlder clay, belong to distinct and widely separated periods, and indicate two distinct emergencies of the surface during the Quaternary period, and the prevalence of conditions suitable for the growth of an arboreal vegetation.

The bowlder clays, or true Drift, consist for the most part of brown, gravelly clay, with small bowlders. Occasionally, a bowlder two feet or more in diameter is met with in the beds of the ravines, but they are not common. In the vicinity of Springfield this division of the Quaternary ranges from twenty to forty feet in thickness, and this is probably not far from its average thickness throughout the county; but at some localities there is a blue clay or hard-pan below the brown clays, which attains about the same thickness as the former, making the aggregate thickness of the Drift, where fully developed, from fifty to eighty feet. No fossils have as yet been obtained from the Drift in this county, so far as I am aware, though the tooth of a mammoth was found some years ago in the bluffs of the Sangamon, and near the surface, and probably came from beds not older than the Loess.

The discovery of the Niantic mastodon, some three years since, between Illiopolis and Niantic, and just over the Macon county line, excited considerable interest when the discovery was first announced, and I visited the locality, and was present when a part of the bones were taken out. The discovery was made on the farm of Wm. F. Correll, in sinking a stock well, in a wet, spongy piece of ground located in a swale or depression of the surface, that had evidently once been a pond of water, and had been filled up by the wash from the surrounding highland, until it formed a morass, or quagmire, in dry weather. The bones were about four feet below the surface, and partially embedded in a light-gray quicksand filled with fresh-water shells, *Planorbis*, *Cyclas*, *Physa*, etc. Above this quicksand there was four feet of black, peaty soil, so soft that a common fence rail could be easily pushed down through it. The quicksand had evidently once formed the bottom of a fresh-water pond, fed probably by springs, and was the resort of the animals whose bones were found here. The first bone met with in sinking the well was

one of the tusks, and supposing it to be a small tree, it was cut in two with an axe before its true character was suspected. The other tusk was taken out whole, and measured nine feet in length around the curve, and about two feet in circumference where it was inserted in the skull. The lower jaw, with the teeth in place, and the teeth of the upper jaw, and some of the small bones, were also found in a good state of preservation. A fine pair of antlers of the elk, with some other bones of the same animal, and bones of the buffalo and deer, were found in the same position as the bones of the mastodon, but the bones of the smaller animals, although embedded at the same depth, were lighter-colored, less decayed, and appeared to have been buried at a more recent period. The depth of the quicksand was not fully ascertained, but it was probed to the depth of two feet or more without reaching a solid bottom.

Stratified Rocks.

The stratified rocks outcropping at the surface in this county all belong to the upper Coal Measures, and overlie all the main coal seams worked in the State. The lowest beds exposed in the county are found on the Sangamon river, near the Menard county line, and on Richland creek, one of the southern affluents of the Sangamon, in the western part of the county. They consist mainly of sandstones and shales, including the horizon of the Rock Creek limestone, although we have not as yet seen any outcrop of this limestone in Sangamon county.

A vertical section of all the beds exposed on the Sangamon and its tributaries, in the central and western portions of the county, would show the following relative position and thickness of the strata:

		Feet.
No. 1.	Sandy shales and soft sandstones	15 to 20
No. 2.	Hard, gray limestone, partly brecciated	10 to 12
No. 3.	Black, slaty shale	2 to 3
No. 4.	Clay shale	4 to 6
No. 5.	Brown, calcareous sandstone, passing into a ferruginous limestone	4 to 5
No. 6.	Clay shale, partly bituminous	4 to 6
No. 7.	Hard, gray limestone—Carlinville limestone	6 to 8
No. 8.	Sandy shales and soft sandstone	30 to 40
No. 9.	Argillaceous limestone and calcareous shales	2 to 3
No. 10.	Bituminous shale	1
No. 11.	Coal No. 8	1 to 2
No. 12.	Fire-clay	2 to 3
No. 13.	Impure limestone—local	4 to 6
No. 14.	Sandy shales and soft sandstones, with local bands of argillaceous and bituminous shales	50 to 60
No. 15.	Hard, gray limestone	2 to 6
No. 16.	Shales—sandy, argillaceous and bituminous, with a thin seam of coal	30 to 40

The beds numbered from one to seven inclusive, of the above section, are well exposed on Sugar creek two miles north of Virden, and thence down the creek to the crossing of the St. Louis, Alton and Chicago railroad, between which points all the beds included in these numbers outcrop in succession, the eastward dip of the strata being somewhat less than the fall of the stream. The upper limestone, No. 2 of the above section, is well exposed near the bridge on the main road north of Virden, and has been quarried both for lime and building stone. The upper part of the bed is a nodular, unevenly-bedded rock, partly brecciated, while the lower portion is more evenly-bedded, affording a tolerably good building stone, in layers from four inches to a foot or more in thickness. A little farther up the creek, the whole mass becomes brecciated and fragmentary, and quarries in pebbly fragments suitable for macadamizing material. The brown ferruginous bed No. 5 of the foregoing section is a hard massive rock, resembling the limestone at Crow's mill, on Sugar creek, six miles south of Springfield, of which it is probably the equivalent. It contains numerous fossils, among which are *Productus costatus*, *P. Nebrascensis*, *P. Prattenianus*, *Spirifer cameratus*, *Athyris subtilita*, *Terebratula bovidens*, *Pinna peracuta* and *Myalina ampla?* The limestone No. 7 of the foregoing section is not fully exposed, but the upper layers outcrop in the bed of the creek just above the railroad bridge in pebbly layers, not unlike the upper layers of No. 2 as they appear above the bridge on the main road north of Virden. This outcrop is very similar in appearance to the upper layers of the Carlinville limestone just below Corr's mill, on Macoupin creek, northeast of Carlinville, and I have no doubt but this limestone on Sugar creek is the equivalent of that. Below the railroad bridge the shales underlying these limestones are the only beds exposed for some distance, but east of Auburn the limestones are again met with, and are found in occasional outcrops from this point to Crow's mill, seven miles south of Springfield, where the rock for the old State House was obtained. At Peddicord's quarries, on Sugar creek, the State House rock is well exposed, affording the following section:

No. 1.	Thin-bedded ferruginous limestone	2 to 3 feet.
No. 2.	Massive coarse-grained limestone	4 "
No. 3.	Clay shale partly bituminous	6 "
No. 4.	Thin-bedded limestone	3 to 4 "
No. 5.	Sandy shale	10 to 12 "

The material for the old State House was obtained mainly from No. 2 of the foregoing section, and there is a nearly continuous outcrop of these beds from this point to Crow's mill, two miles

below, where the old State House quarries were located. This rock is a coarse-grained brownish-gray crinoidal limestone, almost entirely composed of crinoidal joints and the calcareous remains of marine mollusca, cemented together by a calcareous and ferruginous sediment. In addition to the fossils already enumerated as occurring in this limestone at the locality north of Virden, the quarries here afforded numerous specimens of *Syringopora multattenuata*, which seem to belong in the clay shale under the limestone No. 2 of the foregoing section, and so far as I am aware has been found nowhere else but in this shale in Sangamon and Macoupin counties. Some of the masses obtained on Sugar creek are nearly a foot in diameter. This limestone has also afforded fine specimens of *Cladodus mortifer*, *Petalodus destructor*, and *Cyathocrinus Sangamonensis*. This rock possesses the same lithological characters, and affords exactly the same group of fossils as the upper division of the main limestone at LaSalle, and I have no doubt they are stratigraphical equivalents. Below Crow's mill to the outlet of Sugar creek into the Sangamon river, the sandy shales and sandstones intervening between this limestone and the little coal outcropping at Howlett, are the only beds to be seen.

This coal seam, numbered 11 in the general section given on a preceding page, ranges in thickness from eighteen inches to two feet, and is coal No. 8 of our general section of the Coal Measures given in Vol. 1, page 166, of these reports. It outcrops in the bank of the Sangamon river at Howlett, and on Spring creek and its branches north and west of Springfield; and previous to the discovery of the heavy beds below this, it was extensively worked in strip banks, and by tunnels along its line of outcrop. It is overlaid by a calcareous shale, and argillaceous limestone, which are wonderfully rich in fossils, and have afforded more than sixty species of the shells, corals and crinoidea characteristic of the upper Coal Measures. The coal is underlaid with a dark bluish-gray fire-clay two or three feet in depth, below which an impure nodular limestone is sometimes found, but more frequently the fire-clay rests directly upon the sandy shales and sandstones below. At Howlett, the argillaceous limestone overying this coal seam is succeeded by sandy shales, passing upwards into soft micaceous sandstones, which outcrop along the railroad grade just beyond Camp Butler, and contain an intercalated seam of poor coal, only a few inches thick. The limestones of Sugar creek, which properly overlie this sandstone, are not found in the vicinity of Howlett, having been probably removed in the erosion of the Sangamon valley.

Below this coal where it outcrops west of the city, we find a bed of sandy shale and sandstone from thirty to forty feet thick, that locally furnishes some building stone of fair quality, the thick-bedded portions being partly concretionary in structure, the concretions often attaining a diameter of five or six feet or more. They are exceedingly hard, but may be split into blocks of suitable size, and make a very durable building stone.

At Carpenter's mill, five miles north of Springfield, a fine exposure of the sandstone underlying this coal may be seen on the north bank of the Sangamon, where it forms a perpendicular cliff more than fifty feet in height. The upper and lower portions of the formations are thin-bedded and shaly, but the middle portion, nearly twenty-five feet in thickness, is in tolerably heavy and evenly-stratified beds, ranging from six inches to two feet or more in thickness. These thick layers seem to harden on exposure, and afford a very good building stone.

In a ravine a little to the west of the road on the north side of the river, the coal No. 11 of the foregoing section, and overlying argillaceous limestone, were found well up towards the top of the hill, and apparently above the sandstone exposure at the bridge. The limestone here contains the same species of fossils so abundant in the roof of this coal in the vicinity of Springfield. The coal was not well exposed, but does not appear to be more than a few inches in thickness, and this exposure is probably on or near the most westerly outcrop of the seam on the north side of the river.

Among the fossils common in the limestone and shale over this coal the *Lophophyllum proliferum* is very abundant, and is associated with *Astartella vera, Pleurotomaria sphærulata, P. Grayvillensis, P. carbonaria, Bellerophon carbonaria, B. Montfortianus B. percarinatus, B. Stevensianus, Leda bella-rugosa, Nucula ventricosa, Polyphemopsis peracuta, P. nitidula, Soleniscus typicus, Loxonema rugosa, L. cerithiformis, Macrocheilus primigenius, M. ponderosus, M. medialis, M. intercalaris, M. pulchella, M. ventricosus, Euomphalus subrugosus, Productus longispinus, P. Nebrascensis, P. Prattenianus, Spirifer cameratus, S. Kentuckensis, Athyris subtilita,* etc.

The Rock Creek limestone of Menard county, if it extends this far to the eastward, should outcrop on the Sangamon not very far below Carpenter's mill, as its place in the vertical section is between coals Nos. 7 and 8; but all these Coal Measure limestones are somewhat local in their development, and this bed has not been met with, so far as I know, in any of the coal shafts that have been sunk in this vicinity.

The main coal, No. 5 of the general section of the Coal Measures in the central and western portions of the State, lies about one hundred and seventy-five feet below coal No. 8 in the vicinity of Springfield, and from two hundred to two hundred and ten feet below the general surface level. A boring for artesian water was made at Springfield in 1858, and was carried down to the depth of nearly twelve hundred feet without finding water that would rise to the surface, and the parties having the work in charge reported no coal below the small seam thirty or forty feet below the surface, though it was evident, from the character of the material brought up with the sand-pump, that they must have passed through from four to five hundred feet of Coal Measure strata. Subsequently, in a boring at Howlett, a six foot seam of coal was found at a depth of about two hundred feet. A shaft was immediately sunk, and extensive mining operations have been carried on there to the present time. The boring at Springfield not only passed through this seam, but all those underlying it, of which two or three will probably be found of workable thickness, the men in charge of the work being apparently entirely unconscious of the true character of the strata through which their drill passed. If this work had been placed in the hands of competent men, and an accurate journal of the boring kept, we should now know exactly what our coal resources are, whereas nothing was known in regard to the development of the lower coals, except from the examinations of their outcrops along the Illinois river bluffs, until borings at Jacksonville and Chapin showed the existence of a seam at those points between three and four feet in thickness, which is probably coal No. 3 of the Illinois River section. The dip of the strata in the vicinity of Springfield appears to be about six feet to the mile to the eastward, and a boring at Decatur of a little over five hundred feet in depth failed to reach No. 5 coal. At the depth of about three hundred and forty-five feet they found a hard gray limestone eleven feet six inches in thickness, which I believe to be the Carlinville limestone, and if so, the boring would have to be carried from sixty to ninety feet further to reach the coal that is mined in this city and vicinity.

A section of the Howlett shaft, given below, will show the thickness and relative position of the bed to be passed through to reach coal No 5. in the central part of this county, commencing at the bed-rock below the Drift:

		Feet.	In.
No. 1.	Gray sandy shale	20	
No. 2.	Black shale	3	
No. 3.	Coal No. 8	2	
No. 4.	Fire-clay	2	

		Feet.	In.
No. 5.	Impure limestone	3	
No. 6.	Gray sandstone	18	
No. 7.	Sandy shales	49	9
No. 8.	Blue clay shale	16	2
No. 9.	Limestone	3	
No. 10.	Black shale	1	
No. 11.	Coal No. 7	0	2
No. 12.	Fire-clay	4	6
No. 13.	Red and blue shales	11	4
No. 14.	Hard rock (limestone)	3	6
No. 15.	Variegated shales	9	6
No. 16.	Limestone	8	
No. 17.	Reddish shale	2	
No. 18.	Thin coal No. 6	0	5
No. 19.	Fire-clay	7	6
No. 20.	Sandstone and shale	32	
No. 21.	Limestone	1	6
No. 22.	Black shale	2	6
No. 23.	Coal No. 5	6	
		206	10

The next shaft sunk in the vicinity of Springfield was that of Mr. Jacob Loose, two miles south of the city, at the junction of the Toledo, Wabash and Western, and the St. Louis, Alton and Chicago railroads. Beard and Sanderson's shaft is one mile north of the city, and Starne and Shutt's just west of the city limits, on the line of the Springfield and Southeastern railroad. This last named shaft is located in a creek valley, and the coal was reached at the depth of about one hundred and fifty feet. All these shafts are upon the same seam, which averages about six feet in thickness, with an excellent roof of bituminous shale and limestone.

Going west from Springfield, this seam gradually rises towards the surface, and at Pleasant Plains the coal is found at the depth of about one hundred and ten to one hundred and twenty feet below the general surface level. The first shaft sunk there, that of Messrs. Claiborne & Co., is located in the vicinity of a little branch about a mile north of the village, and the coal was reached at the depth of about eighty feet. The following is a section of this shaft.

		eet.	In
No. 1.	Drift clay, with tumbling masses of limestone at the bottom	55	
No. 2.	Hard argillaceous limestone	0	8
No. 3.	Blue shale	21	
No. 4.	Bituminous shale	4	
No. 5.	Coal	6	

At the Pleasant Plains shaft, a half mile east of the village, the coal was found at the depth of about eighty-three feet, passing through a thin seam at the depth of forty-five feet, which probably represents No. 6. The main coal in this shaft averages about six feet in thickness, and has a good roof of bituminous shale and lime-

stone. This shaft, like the one north of the village, is located in a creek valley some thirty or forty feet below the general level of the adjacent prairie. No accurate section of this shaft was preserved, and I was unable to learn whether the Rock Creek limestone was found in it, but it must underlie the western portion of Sangamon county at no great depth below the surface, unless it has been swept away by denuding forces. All the building stone used in the vicinity of Pleasant Plains comes from Rock creek in Menard county, and hence we may conclude that there is no outcrop of the bed in Cartwright township.

At Barclay station, on the Gilman, Clinton and Springfield railroad, a shaft has recently been sunk, and the coal was reached at the depth of about 250 feet. For the following section, furnished by Mr. R. D. Lawrence, superintendent, I am indebted to L. A. Fuller, Esq., of Springfield:

Section of Barclay Coal Shaft.

	Feet.	In.
Yellow clay	17	
Hard-pan	20	
Gray shale	10	
Coal No. 9		8
Fire-clay	1	
Gray shale	70	
Black slate		4
Coal No. 8	2	
Fire-clay	3	
Blue shale	6	
Hard variegated rock	5	6
Black slate	1	8
Coal and rock mixed	1	8
Fire-lay	2	6
Gray shale	26	
Coal (No. 7 ?)		1
Fire-clay	1	6
Soft sandstone	17	
Black slate		2
Coal (No. 6 ?)		2
Fire-clay	4	
Blue shale	16	
Sandstone	10	
Gray shale	14	
Hard limestone	15	
Black slate	4	
Coal No. 5	6	1
Fire-clay	4	
Hard gray rock	8	
	267	4

Coal No. 6, which is usually from thirty-five to forty feet above No. 5, and is generally well developed in Fulton and Peoria counties, has not yet been found in this county of sufficient thickness

to be of any economical value. At Beard & Sanderson's it was found to be three feet thick, on sinking the shaft, but on drifting on it, it soon thinned out; and at the other shafts it was only a few inches in thickness. When well developed, it affords a fine, soft, bright coal, free from pyrite, and an excellent blacksmith's coal. By referring to the report on the Illinois Coal-field, in Vol. I, p. 166, of these reports, the reader may see the continuation of the section from coal No. 5 to the base of the Coal Measures, and the relative position and thickness of the coal seams that probably underlie the main coal now worked in this county. The limestone found in tumbling masses at the base of the Drift clays in Claiborne & Fink's shaft, near Pleasant Plains, seemed to be the same rock as that outcropping on Rock creek, in Menard county, at Cogdale's quarries. This limestone is a fine-grained, compact, bluish-gray rock, susceptible of a fine polish, and makes a beautiful marble, of a mottled-gray color. It burns into an excellent white quicklime, and the quarries furnish an abundant supply of material for lime-burning and for building stone. This limestone is usually from 100 to 115 feet above No. 5 coal, though in Menard county it is only about 85 feet. I regard it as the stratigraphical equivalent of the limestone at Lonsdale's quarries, in Peoria county, and the Collinsville limestone, near Collinsville, in Madison county, where it lies about 115 feet above the coal seam mined at that point, which is probably No. 5. This limestone varies in thickness from five to fifteen feet, is generally even-bedded and in tolerably thick layers in the lower part of the bed, and thin-bedded and nodular in the upper part, where the bed is fully developed. At the outcrop of this limestone about a mile south of the New Salem mills, in Menard county, a huge cyathophylloid coral, sometimes two feet or more in length, and from two to three inches in diameter, is quite common. At the quarries near Collinsville, we have obtained numerous specimens of the *Axophyllum rudis*, of White and St. John, and this is the only locality in the State, so far as I am aware, where this fine species has been found. It is associated with *Bellerophon carbonaria*, *B. nodocarinatus*, *B. Stevensianus*, *Pleurotomaria Grayvillensis*, *Schizodus*, *Platyostoma Peoriensis*, *Pinna peracuta?* and *Petalodus destructor*. This limestone will probably be found in the bed of the Sangamon river somewhere in Springfield township, unless it has been swept away by erosion.

In the eastern portion of the county rock exposures are rarely met with, and the few that are to be seen are mainly shaly sandstones and sandy and argillaceous shales. At the mouth of Clear creek

some beds of shaly sandstone are found, which are probably the equivalent of the soft shaly sandstone forming the top of the bluff on the east side of the Sangamon, near Howlett.

There are probably from seventy-five to a hundred feet of shales and sandstone, belonging above the limestone on Sugar creek, which outcrop along the breaks of the Sangamon between Howlett and the east line of the county, but the exposures are so local and widely separated, that no satisfactory section can be made from surface exposures. They include a thin seam of coal, which, in the boring at Decatur, was twelve to fifteen inches thick, and about 250 feet below the surface.

Commencing at the west line of the county, the main coal worked in the shafts in Sangamon and Macoupin counties, which I believe to be No. 5 of the general section of our Illinois coals, is found at the depth of 120 to 150 feet below the general prairie level, and it dips eastwardly at the rate of about six feet to the mile, and in the central portions of the county it will be found from 200 to 250 feet below the general level, and in the eastern portion, from 300 to 400 feet, to which we may add the additional surface elevation of the eastern part of the county. No borings have yet been made at any of the coal shafts to determine how many of the seams underlying No. 5 are developed in this portion of the State to a sufficient thickness to be profitably mined, but it is probable there are three or four underlying seams, that will range from two to four feet in thickness. The supply from No. 5, however, is so great, that it will probably be many years before any serious attempts will be made to mine the lower seams in this county. At every point in the county where a reliable boring has been made, or a shaft sunk to the horizon of this coal, it has been found well developed, being usually from five to seven feet in thickness, with an excellent roof of bituminous shale and limestone. None of the shafts in this county are troubled with water, and in most of the mines the rooms are as dry as an ordinary underground cellar.

Economical Geology.

Coal.—From what appears on the foregoing pages, it will be seen that coal is by far the most important mineral resource of this county, and is destined hereafter to exert a very important influence upon the industrial interests of its inhabitants. The general development of the industrial interests of a people is more dependent upon its fuel resources than upon any other to be found beneath

the soil, and in all calculations upon the probable future wealth and prosperity of a community, an abundant and cheap supply of coal must form one of the essential elements to be taken into account. More especially is that the case in this Western country, where a comparatively level surface, and consequently sluggish streams, furnish no water power of any value for manufacturing purposes. The value of the coal deposits of this State can hardly be estimated in dollars and cents, and the mighty influence they are destined to exert upon the future wealth and prosperity of its inhabitants can scarcely be overestimated. We have a soil of unsurpassed fertility, producing annually large crops of all the cereals grown in a temperate climate; wonderfully productive in the grasses most conducive to the growth of stock and the production of wool; and beneath the surface we find stored away inexhaustible supplies of fuel, for manufacturing cheaply all the products of our own soil, and also for smelting the iron and other metallic products of adjoining and less favored States.

The coal seam now worked in the shafts in this county will furnish at least five millions of tons of coal to every square mile, or section of land in the county, and that is probably less than one half the full resources of the county in fossil fuel. There are certainly four seams in other portions of the State, which underlie the main coal worked in this county, having an aggregate thickness of about twelve feet of solid coal, and there can be no reasonable doubt but some of them will be found here thick enough to work when the one now mined is exhausted. With such fuel resources at command, there is no reason why Central Illinois should not become a great center of iron manufacturing interests, for it seems to be a well settled proposition that it is cheaper to transport the ores to the fuel, than the fuel to the ores. We have the fuel in almost inexhaustible quantities, and by the improved methods of smelting, our coals are equal in value to the block coals of Indiana, and no good reason can be assigned why this portion of the State should not soon become as noted for the production of iron and steel as it now is for beef and corn. Located, as it were, midway between the great iron ore deposits of Michigan and Wisconsin on the north, and those of Missouri on the south, they must eventually become tributary to Illinois for the means of rendering their vast deposits of iron available as a part of the great industrial resources of the West.

Springfield, with its system of railroads radiating in all directions, is favorably located as a center of important iron and steel manu-

facturing interests, and it only requires that a knowledge of the resources and facilities here existing should be generally disseminated, to concentrate here the capital and skill required for such enterprises.

Building Stone.—The central and western portions of the county are tolerably well supplied with both limestone and sandstone for ordinary building purposes. The limestone on Sugar creek, from which the material for the old State House was obtained, is a durable stone when laid in a dry wall, but splits into thin fragments if subjected to the combined influences of frost and moisture. The bed is from four to six feet in thickness. It outcrops on all the tributaries of the Sangamon in the south part of the county, and on Sugar creek it is met with at intervals from the bridge north of Virden, where the quarries are located, near the Macoupin county line, to Crow's mill six miles southeast of Springfield.

The best sandstone in the county for building material is that underlying the little coal (No. 8) of the general section, but in the section of the formations outcropping in this county, giving on page 335, it is numbered 11. Its entire thickness is about sixty feet, but only the middle portion, some twenty feet or more in thickness, where the layers are from six inches to two feet thick, can be safely used for a building stone.

At Carpenter's mill, and at some of the outcrops west of the city of Springfield, extensive quarries have been opened in this sandstone, and when carefully selected it is a tolerable good building stone. At some of the quarries the rock is partly concretionary, the concretions in some cases being from six to eight feet in diameter, and exceedingly hard. Other beds of sandstone appear in local outcrops at various points in the county, and furnish some material suitable for cellar walls, etc., but are of only local value.

Limestone for Lime.—The best material for lime-burning is to be obtained from the upper bed of limestone on Sugar creek, north of Virden, where a lime-kiln was formerly located. The bed at this point is from ten to twelve feet in thickness, the upper part being nodular and fragmentary, and the lower part even-bedded in layers from four to twelve inches thick. The upper part would furnish an excellent macadamizing material for common roads, fit for immediate use.

Ochre and Iron Ore.—On Mr. David Miller's farm, four miles southeast of Springfield, in a cut on the Springfield and Southeastern railroad, a bed of brown ochre was exposed about fifteen feet below the surface. It proved to be of good quality, and was used by him in

painting some portions of his dwelling house, but appeared to be only a local deposit of no great extent. It probably originated, like the common bog ores, from ferruginous springs, and like them i only a local development.

Sand and Clay.—These materials are abundant, the Loess clays and subsoil furnishing them over nearly all the uplands in the county, and excellent cherry bricks can be manufactured abundantly in every neighborhood in the county.

Soil and Agriculture.—This county ranks among the very best in Central Illinois as an agricultural region. Its surface is largely composed of broad stretches of nearly level, or gently rolling prairies, separated by considerable belts of excellent timber along the streams. There is but little broken land in the county, and that is mostly confined to the bluffs of the Sangamon, along its lower course in this county. East of Howlett, the bluffs are comparatively low, and slope gradually up to the level of the adjacent prairie. The soil upon the prairie is a rich black loam, highly productive, and yields annually large crops of corn and all the cereals adapted to the climate. It is, however, most decidedly a corn producing and stock growing region, and these are the principal agricultural products of this county.

CHAPTER XIX.

CLARK COUNTY.

Clark county is situated on the eastern border of the State, and is bounded on the north by Edgar and Coles counties, on the east by the Indiana line and the Wabash river, on the south by Crawford, and on the west by Cumberland and Coles counties. It contains ten full and eight fractional townships, making a total area of about five hundred and thirteen square miles.

The surface of the country in the western portion of the county is generally rolling, though some of the prairies are rather flat. The eastern portion is more broken, especially in the vicinity of the Wabash bluffs, where it becomes quite hilly, and is often broken into steep ridges along the courses of the small streams. The general level of the surface of the highlands above the railroad at Terre Haute, which is a few feet above the level of high-water in the Wabash, is from one hundred and twenty-five to one hundred and fifty feet. The principal streams in the western part of the county are North Fork, which traverses the western portion of the county from north to south, and empties into the Embarras river in the eastern part of Jasper county; and Hurricane creek, which rises in the south part of Edgar county, and after a general course of south 20° east, discharges its waters into the Wabash river near the southeast corner of the county. In the eastern part of the county, Big creek, and two or three of less note, after a general southeast course in this county, empty into the Wabash river. The North Fork, throughout nearly its whole course, runs throug a broad, flat valley, affording no exposures of the underlying rocks, and the bluffs on either side are composed of Drift clays, and rise from thirty to fifty feet or more above the valley, and at several points where wells have

been sunk these clays and underlying quicksands are found to extend to an equal depth beneath the bed of the stream. The creeks in the eastern portion of the county are skirted by bluffs of rock through some portion of their courses, and afford a better opportunity for determining the geological structure of the county.

The Quaternary system is represented in this county by the Alluvial deposits of the river and creek valleys, the Loess of the Wabash bluffs, the gravelly clays and hard-pan of the true Drift, and the underlying stratified sands that are sometimes found immediately above the bed-rock.

The Drift deposits proper vary in thickness from twenty to seventy-five feet or more, the upper portion being usually a yellow gravelly clay, with local beds or pockets of sand. The lower division is mainly composed of a bluish-gray hard-pan, exceedingly tough and hard to penetrate, usually impervious to water, and from thirty to fifty feet in thickness. This is underlaid by a few feet of sand, from which an abundant supply of water can be had where it cannot be found at a higher level. A common method of obtaining water on the highlands in this county, where a sufficient supply is not found in the upper portion of the Drift, is to sink a well into the hard-pan, and then bore through that deposit to the quicksand below, when an unfailing supply is usually obtained. Bowlders of granite, syenite, trap, porphyry, quartzite, etc., many of them of large size, are abundant in the Drift deposits of this county, and nuggets of native copper and galena are occasionally met with, having been transported along with the more massive bowlders, by the floating ice, which seems to have been the main transporting agency of our Drift deposits.

Coal Measures.

All the rocks found in this county belong to the Coal Measures, and include all the beds from the limestone that lies about 75 feet above coal No. 7, to the sandstone above the Quarry Creek limestone, and possibly coal No. 14 of the general section. These beds are all above the main workable coals, and although they include a total thickness of about 400 feet, and the horizon of five or six coal seams, yet none of them have been found in this county more than from 12 to 18 inches in thickness. The following general section will serve to show the relative position and comparative thickness of the Coal Measures in this county:

		Feet.	In.
No. 1.	Sandstone, nowhere found well exposed	30 to 40?	
No. 2.	Quarry Creek and Martinsville limestone	20 to 30	
No. 3.	Shales, lower part bituminous	10 to 15	
No. 4.	Coal—No. 14?	1	
No. 5.	Shaly fire-clay	2 to 3	
No. 6.	Sandstone and shale, some bands of iron carbonate	18 to 20	
No. 7.	Bituminous shale	1 to 2	
No. 8.	Coal—No. 13?	1 to	1½
No. 9.	Clay shale and fire-clay	4 to 6	
No. 10.	Cinnamon-brown limestone	3	
No. 11.	Coal—local?	0	9
No. 12.	Sandy shales, passing into massive sandstone below	40 to 50	
No. 13.	Dark shales, with nodules of argillaceous and fossiliferous limestone	5 to 8	
No. 14.	Hard black shale, approaching cannel coal	1 to 3	
No. 15.	Evenly-bedded sandstone	20 to 25	
No. 16.	Greenish argillaceous and sandy shales	30 to 40	
No. 17.	Sandstone	8 to 10	
No. 18.	Gray limestone—upper division of Livingston bed	5 to 8	
No. 19.	Shale, enclosing a 6 to 10-inch coal—No. 12?	7 to 8	
No. 20.	Limestone—lower bed at Lvingston	7 to 8	
No. 21.	Argillaceous and sandy shales	30 to 35	
No. 22.	Coal—No. 11?	½ to 1	
No. 23.	Brown and gray sandstones	24	
No. 24.	Shale, lower part bituminous	25	
No. 25.	Coal—local	0	7
No. 26.	White fire-clay	3	6
No. 27.	Green clay shale	3	6
No. 28.	Shale and sandstone	36	
No. 29.	Chocolate-brown impure limestone	3 to 4	
No. 30.	Bituminous shale	3 to 6	
No. 31.	Coal—No. 10	1 to 1	6
No. 32.	Drab-colored shales	30 to 40	
No. 33.	Compact brownish-gray limestone	4 to 5	

This limestone is about 75 to 80 feet above the coal in the shaft just across the river from Terre Haute, which is No. 7 of the Illinois section, and the intervening beds would give the following continuation of the section, if carried down to the horizon of this coal, but they do not come to the surface in Clark county:

No. 34.	Green, blue and red clay shales	10 to 12	
No. 35.	Sandstone	12 to 15	
No. 36.	Argillaceous and sandy shales	45 to 50	
No. 37.	Bituminous shale	1 to 2	
No. 38.	Coal—No. 7	5	

The coal afforded by this seam is a rather soft, fat, caking coal, of fair average quality. The lower part of the seam contains two or three partings of shale. This seam would be the first workable coal that could be reached anywhere in Clark county, and its approximate depth at any point where it was desirable to bore for it may be determined by reference to the foregoing general section. From the horizon of the Quarry Creek limestone to this coal it would be from 350 to 400 feet, and from the horizon of the Livingston limestone from 250 to 300 feet.

In the northwest part of this county several borings were made for oil during the oil excitement, some of which were reported to be over 900 feet in depth; but as no accurate record seems to have been kept, the expenditure resulted in no general benefit further than to determine that no deposit of oil of any value existed in the vicinity at the depth penetrated. The following record of the "Old Well," or "T. R. Young well," was furnished to Prof. Cox by Mr. Lindsey:

	Feet
Soil and drift clay	23
Hard-pan	30
Sandstone	20
Mud stone ?	20
Coal and bituminous shale	3
Sandstone	22
Coal	1
Sandstone	5
Clay shale—soapstone, so-called	23
Black shale	9
Sandstone	12
Coal	1
Sandstone	90
Mud stone ?	2
Hard rock	1
Sandstone	52
	314

The upper part of this boring corresponds very well with our general section, except in the absence of the Quarry Creek limestone, which should have been found where they report 20 feet of "mud stone," but, whatever that may have been, it seems hardly probable that such a term would be used to designate a hard and tolerably pure limestone.

This well was tubed with gas-pipe for some 8 or 10 feet above the surface, and water, gas, and about a half gallon of oil, per day, were discharged. All the wells, so far as I could learn, discharged water at the surface, showing that artesian water could be readily obtained here, but it was all more or less impregnated with mineral matters and oil, sufficient to render it unfit for common use. The 900-foot well must have been carried quite through the Coal Measures, and if an accurate journal had been kept, the information it would have afforded would have been of great value to the people of this as well as the adjacent counties. It would have gone far towards settling the question as to the number and thickness of the workable coals for all this portion of the State, and the depth at which they could be reached from certain specified horizons, as, for instance, from the base of the Quarry Creek or Livingston limestones, or from either one of the thin coals of the upper measures

that were passed through in this boring. As it is, the expenditure was an utter waste of capital, except in so far as it may have taught those directly engaged in the operation the folly of boring for oil where there was no reasonable expectation of finding it in quantities sufficient to justify such an expenditure of time and money.

The beds forming the upper part of the general section in this county are exposed on Quarry creek south of Casey and one mile and a half east of Martinsville, on the upper course of Hurricane creek, and the Blackburn branch southeast of Parker prairie. At the quarry a mile and a half east of Martinsville, the limestone is heavy-bedded, and has been extensively quarried for bridge abutments, culverts, etc., on the old National road. The bed is not fully exposed here, and seems to be somewhat thinner than at Quarry creek, where it probably attains its maximum thickness, but thins out both to the northeast and southwest from that point. The upper part of the bed is generally quite massive, affording beds two feet or more in thickness, while the lower beds are thinner, and at the base it becomes shaly, and locally passes into a green clay shale with thin plates and nodules of limestone. These shaly layers afford many fine fossils in a very perfect state of preservation, though they are neither as numerous nor as well preserved here as at the outcrops of this limestone in Edgar county. The most characteristic fossils of this formation are *Meekella striato-costata*, *Pleurotomaria turbiniformis*, and *Platyceras Nebrascensis*, associated with *Athyris subtilita*, *Spirifer cameratus*, *S. lineatus*, *Spiriferina Kentuckensis*, *Orthis Pecosi*, *Platyostoma Peoriense*, *Terebratula bovidens*, *Chonetes Verneuilianus*, numerous corals like *Heliophyllum*, and large joints of *Crinoidea*. Possibly the apparent thinning out of this limestone to the northward in this county may be due to surface erosion, as we nowhere saw the overlaying sandstone *in situ*, and Prof. Bradley gives the thickness of this bed in Edgar county as about 25 feet, which does not indicate a very decided diminution of its thickness in a northeastwardly direction.

Below this limestone, in the vicinity of Martinsville, there are partial outcrops of shale and thin-bedded sandstone, with a thin coal, probably No. 4 of the preceding section, and southwest of the town, and about three-quarters of a mile from it, there is a partial outcrop of the lower portion of the limestone in the bluff on the east side of the North Fork valley, where we obtained numerous fossils belonging to this horizon.

West and northwest of Martinsville no rocks are exposed in the bluffs of the creek for some distance, but higher up partial outcrops of a sandstone, probably overlaying the Quarry Creek limestone, may be found.

At Quarry creek, about a mile and a half south of Casey, on section 28, township 10, range 14, this limestone appears in full force, and has been extensively quarried both for building stone and the manufacture of quicklime. It is here a mottled-gray, compact limestone, locally brecciated, and partly in regular beds from six inches to two feet or more in thickness. At least 25 to 30 feet of limestone is exposed here, and as the overlying sandstone is not seen, its aggregate thickness may be even more than the above estimate. At its base the limestone becomes thin-bedded and shaly, passing into a greenish calcareous shale with thin plates and nodules of limestone, abounding in the characteristic fossils of this horizon. At one point on this creek a bed of green shale, about two feet in thickness, was found intercalated in the limestone. A large amount of this stone was quarried here for lime, for macadamizing material and for bridge abutments on the old National road, and this locality still furnishes the needed supply of lime and building stone for all the surrounding country.

At the base of the limestone here there is a partial exposure of bituminous shale and a thin coal, probably representing the horizon of No. 4 of the preceding section, below which some ten or twelve feet of sandy shale was seen.

At Wm. Howe's place, on sec. 3, T. 9, R. 14, we found the following beds exposed below the Quarry Creek limestone:

	Feet.
Clay shale	4 to 6
Bituminous shale	2
Coal	1
Soft fire-clay	2
Sandstone and shale with bands of carb. of iron	20
Coal	1½
Clay shale	3 to 6
Compact brownish-gray limestone	3 to 5
Black shale and fire-clay partially exposed	2 to 3
Sandy shale and sandstone	25 to 30

Both the coals in the above section have been worked here, mostly, by stripping in the bed of a small branch. The quality of the coal is good, but, unfortunately the seams are too thin to be successfully worked in a regular way. They are the equivalents of the two upper coals in the general section of the rocks of this county.

At Mrs. Brant's place, on sec. 10 of the same township, we found the following section, which varies but little from that above given:

	Feet.	In.
Blue shale	10	
Bituminous shale	1	3
Coal	1	
Fire-clay	2	
Shale and sandstone	20	
Bituminous shale	1	
Coal	1	3
Clay shale	6	
Brown limestone	3	
Shale and sandstone	25	
Bituminous shale	3 to	4
Coal	0	9
Sandy shale and sandstone	30 to	40

Tumbling masses of the Quarry Creek limestone were found here as well as at Mr. Howe's place, immediately above the blue shale, at the top of the foregoing sections, and there is probably only a few feet of sandy shale or sandstone intervening between the limestone and the upper shales of these sections. Considerable coal has been mined at Mrs. Brant's place, and these two seams formerly furnished the greater portion of the coal used by the neighboring blacksmiths. It is a true splint coal, breaking freely into cuboidal blocks two or three inches in thickness, and free from pyrite. At Mr. Joseph Howe's dwelling house the limestone was found at the bottom of his well, not more than ten to fifteen feet above the upper coal which crops out near by.

On Hurricane branch, commencing on Sec. 14, T. 10, R. 13, and extending down the creek for a distance of two miles or more, there are continuous outcrops of sandstone and sandy shales, No. 12 of the county section. The upper portion is shaly with some thin-bedded sandstone, passing downward into a massive, partly concretionary sandstone that forms bold cliffs along the banks of the stream from 20 to 30 feet in height. At the base of this sandstone there is a band of pebbly Conglomerate from one to three feet in thickness, containing fragments of fossil wood in a partially carbonized condition, and mineral charcoal.

The regularly-bedded layers of this sandstone have been extensively quarried on this creek for the construction of culverts and bridge abutments in this vicinity, and the rock is found to harden on exposure, and proves to be a valuable stone for such uses. Some of the layers are of the proper thickness for flag-stone, and from their even-bedding can be readily quarried of the required size and thickness.

This sandstone is underlaid by an argillaceous shale, and a black slate which, where first observed, was only two or three inches thick, but gradually increased down stream to a thickness of about fifteen

inches. The blue shale above it contains concretions of argillaceous limestone with numerous fossils, among which were *Pleurotomaria sphærulata, P. Grayvillensis, Astartella vera, Nucula ventricosa, Rhynchonella Eatoniæformis, Orthis Pecosi,* and *Lophophyllum proliferum.* These fossils indicate the horizon of No. 13 coal, and in Lawrence, White and Wabash counties we find a well defined coal seam associated with a similar shale containing the same group of fossils, but possibly belonging to a somewhat lower horizon.

On Blackburn branch, commencing on sec. 24 in the same township, and following down the stream for a mile and a half, we have a repetition of the same beds of shale and sandstone seen on Hurricane creek, underlaid by the clay shale and black slate, Nos. 13 and 14 of the county section.

Near the center of Sec. 4, T. 9, R. 12, the following beds were found on Joe's Fork, above the site of the old Anderson mill:

	Feet.
Massive sandstone, the same seen on Hurricane creek	25
Dark shales with nodules of arg. limestone	5 to 8
Black shale	1 to 2
Sandy shale and evenly-bedded sandstone	20 to 25
Greenish colored sandy and arg. shales	35 to 40
Hard concretionary sandstones with softer beds below	8 to 10
Gray sparry limestone	5
Shale with 10-inch seam of coal	8
Brownish-gray, hard, brittle limestone	7 to 8

The above includes Nos. 12 to 20 of the county section. The limestone at the base of the above section are the equivalents of the Livingston limestone hereafter described, and they pass below the bed of the creek here about a mile above the old mill. The sandstone overlaying the upper limestone here, when evenly-bedded, is quarried for building stone, and affords a very good and durable material of this kind for common use. At the mouth of Joe's Fork the lower limestone is partly below the creek bed, the upper 4 feet only being visible, and above it we find clay shale 2 feet, coal 10 inches, shale 5 to 6 feet, succeeded by the upper limestone which is here only three or four feet thick. The upper limestone at the outcrop here is thinly and unevenly-bedded and weathers to a rusty brown color. The lower limestone is more heavily bedded, but splits to fragments on exposure to frost and moisture. It is of a mottled-gray color when freshly broken, but weathers to a yellowish-brown. Fossils were not abundant in either bed, but the lower afforded a few specimens of *Athyris subtilita,* a coral like *Heliophyllum, Productus costatus,* and *Terebratula bovidens.*

At Mr. Spangler's place, on sec. 12, in Melrose township (T. 9, R. 12), a hard, brittle, gray limestone outcrops on a branch of Mill creek. The bed is about eight feet in thickness here, and is underlaid by a few feet of partly bituminous shale and a thin coal from six to eight inches thick. This is probably the same as the upper limestone at the old Anderson mill, or No. 18 of the county section. The rock has been quarried here for lime, and is said to yield a fair article.

On sec. 5, T. 9, R. 10, Prof. Cox reports the following section:

	Feet.
Covered slope	20
Gray shale and shaly sandstone	10
Limestone	4
Gray fossiliferous shale	½
Coal—impure	6 inches to 1
Black fire-clay	½
Gray shale to the bed of the creek	2

The fossils observed here in the shale below the limestone were *Productus Prattenianus, P. semireticulatus? P. punctatus, Chonetes mesoloba, Spirifer cameratus, Athyris subtilita, Lophophyllum proliferum,* and *Myalina pernæformis.* The limestone and coal of this locality probably belong to Nos. 10 and 11 of the county section.

At the railroad bridge northwest of Livingston, the following section may be seen:

	Feet.
Gray sparry limestone	7
Blue shale	6
Gray limestone, heavy-bedded	8
Sandstone and sandy shale	30 to 40
Thin coal—reported	½

This upper bed of limestone (No. 18 of the county section,) is traversed by veins of calcite and brown ferruginous streaks, that give the rock a mottled appearance when freshly broken. The upper layer of the lower bed is about thirty inches thick, and is a tough, compact, gray rock, that breaks with an even surface and has a slightly granular or semi-oolitic appearance. The lower part of this bed is a mottled-gray fine-grained limestone, and breaks with a more or less conchoidal fracture. The fossils found in the limestone here were *Athyris subtilita, Productus costatus, P. Nebrascensis, Pinna peracuta, Spirifer cameratus, S. planoconvexus,* and joints of *Crinoidea.* The upper division of this limestone thins out entirely about a mile above the bridge, and passes into a green shale like that by which the limestones are separated. The following section is seen about one mile above the railroad bridge, in the creek bluffs and adjacent hilltops:

	Feet.
Covered slope, with tumbling masses of Quarry Creek limestone	20
Sandstone, upper part massive, with shaly beds below	40 to 50
Pebbly sandstone	8 to 10
Green clay shales, with a streak of coaly matter	21
Limestone, upper division of Livingston bed	3 to 0
Green shale	3 to 5
Limestone—partial exposure	3

The tumbling masses of limestone that are found in the hilltops hereabout, no doubt, belong to the Quarry creek bed, which is found in partial outcrops not more than half a mile back from the creek, and from 80 to 90 feet above its level. The intervening sandstones and shales which separate these limestones in the northeastern part of Clark county are much thinner than where they outcrop on Hurricane and Mill creeks, in the southern portion, indicating a general thinning out of the strata below the Quarry creek bed to the northward. Sometimes I have been inclined to believe that this upper limestone was unconformable to the beds below, and its disappearance beyond Parker prairie to the southwest, where the apparent trend of its outcrop would naturally carry it, seems to strengthen this conclusion, but the outcrops of the underlying beds are so partial and widely separated that it is difficult to determine this point satisfactorily. At any rate, the thickness of the beds between these limestones north of Livingston does not exceed 75 or 80 feet, while south of Martinsville they are from 125 to 150 feet apart, at least, showing that they thin out rapidly to the northward. The upper division of the Livingston limestone can be seen to thin out entirely about a mile north of the railroad bridge northwest of Livingston, and the other division must also disappear before reaching Edgar county, as Prof. BRADLEY failed to find it there, as will be seen by his report on that county in Vol. 2 of these reports. The Quarry Creek limestone is undoubtedly the same bed described by him as No. 3 of his Edgar county section; and if the Livingston beds extended into that county they would be found not more than 60 to 75 feet below his No. 3. Possibly this lower limestone may be represented there by his No. 11, which is described as a "sandy argillaceous limestone, containing pebbles of black limestone and fragments of fossils," as we have nothing in Clark county that can be correlated with that unless it is one or both divisions of the Livingston limestones. The distance from his No. 3 down to coal No. 7 he makes from 185 to 250 feet, while in Clark county the distance from the limestone on Quarry creek to this coal is from 250 to 400 feet.

At Mr. Murphy's place, near the mouth of Ashmore creek, on section 29, T. 11, R. 10, a bed of shelly, chocolate-colored, impure limestone, is found outcropping by the roadside at the base of the Wabash river bluffs. The section seen here is as follows:

	Feet.	In.
Massive brown sandstone	30 to 40	
Brown earthy limestone	3 to 4	
Bituminous shale	4 to 6	
Coal	1	6
Fire-clay and shale	4	

These beds are equivalent to Nos. 29 to 31 inclusive of the county section, and the coal at this point is No. 10 of the Illinois section. The limestone above the coal here contains a fine *Naticopsis* and a *Macrodon*. It weathers to a rusty-brown color on exposure, but when first broken the color is a chocolate-brown, mottled with dark bluish-gray spots. This limestone resembles the brown arenaceous limestone subsequently found two and one-half miles north of New Haven, near the south line of White county, and also in the bed of the creek at Carmi, and I am inclined to believe it belongs to the same horizon, though fossils are by no means as numerous in it in Clark county as at the localities mentioned in White county. If this conclusion is correct, it would bring the New Haven limestone on a parallel with that numbered 33, and forming the base of the Clark county section, and they agree very well both in their lithological and paleontological characters.

The coal seam at Murphy's averages about eighteen inches in thickness, and affords a coal of fair quality.

Tracing the bluff northeastwardly from this point the beds rise rapidly, and about half a mile from Murphy's place there is about 30 feet of drab-colored shales exposed beneath the limestone which is here found well up in the hill.

At the foot of the bluff on Clear creek, near the State line, a mottled-brown and gray limestone four to five feet in thickness is found, underlaid by ten or twelve feet of variegated shales, which are the lowest beds seen in Clark county. Extensive quarries were opened in this limestone to supply material for building the old National road, and in the debris of these old quarries we obtained numerous fossils from the marly layers thrown off in stripping the solid limestone beds that lay below. The fossils found here comprise the following species: *Athyris subtilita, Retzia Mormoni, Spirifer lineatus, S. Plano-convexus, Terebratula bovidens, Platyostoma Peoriense,* and two or three undetermined corals. The limestone is a tough, fine-grained, mottled, brown and gray rock, in tolerably heavy

beds, which makes an excellent macadamizing material, and also affords a durable stone for culverts, bridge abutments and foundation walls.

The beds intervening between this limestone and coal No. 7 do not make their appearance in this county, but by visiting the shafts now in operation on the west side of the Wabash river, one and a half miles west of Terre Haute, I found a portion of them outcropping at the surface, and the remainder had been penetrated in the shafts and were reported to me by the gentleman in charge of the work. The section from the limestone to the coal would be as follows:

	Feet.
Brownish-gray, compact, fine-grained limestone	4
Green, blue and purple shales	10 to 15
Sandstone, locally in tolerably heavy beds	12
Argillaceous shales, with bands of iron stone	40 to 50
Bituminous shale	1 to 2
Coal No. 7	5

This is undoubtedly the "Danville coal" which has been extensively worked at Danville and at several other points in Vermilion county, where it ranges from four to seven feet in thickness, and is equivalent to No. 7 of the Illinois section. There it is overlaid by a soft black shale filled with fossil shells, in which the calcareous matter is replaced with pyrite, giving to the fossils a beautiful metallic lustre, but unfortunately in many cases the pyrite decomposes if not protected from the atmosphere, and the fossils are soon destroyed. Locally No. 7 is overlaid by a heavy bed of limestone, as at the Equality and Bowlesville mines, in Gallatin county. At the mines opened west of Terre Haute, we found no well preserved marine fossils in the soft shales over this coal, although a careful search was made for them. Fragments of fossil wood, either siliceous or replaced by pyrite, were abundant in the debris taken from the shafts here, as well as at Bowlesville.

In any attempts that may be made in Clark county to mine coal by shafting to the lower coals, this would be the first seam reached, and its approximate depth at any given locality may be determined by the remarks already made, and especially by reference to the county section. In the northern portion of the county the distance from the Livingston or Quarry Creek limestones to this coal would be considerably less than in the southern part, for reasons already stated, namely, the thinning out the intervening beds to the northward, and consequently this variation in the relative thickness of the beds in different parts of the county should be duly considered in estimating the probable cost of any extensive operations for coal mining.

Economical Geology.

Coal.—From what has already been stated in the preceding pages it will be inferred that there is no great amount of coal accessible in this county, except by deep mining. In the thin seams outcropping at Mr. Murphy's place, near the Wabash river, and at Mr. Howe's and Mrs. Brant's, southeast of Casey, the coal varies in thickness from a foot to eighteen inches, and though of fair quality the beds are too thin to justify working them except by stripping the seams along their outcrop in the creek valleys. The coal at Mr. Murphy's place has a good roof of bituminous shale and limestone, and could be worked successfully by the ordinary method of tunnelling if it should be found to thicken anywhere to 24 or 30 inches. The higher seams found at the localities above named, southeast of Casey, are thinner than that at Mr. Murphy's, though one or both of the upper ones are said to have a local thickness of 18 inches. I see no good reason to believe that the main workable seams that are found outcropping in the adjacent portions of Indiana, should not be found by shafting down to their proper horizon in this county, notwithstanding the reported results of the oil well borings in the northwestern portion of the county. I have observed that in borings made for oil or for artesian water, which are expected to come to the surface whenever they are reached by the drill, it is only in exceptional cases in this State that any accurate knowledge was obtained, even by the persons in charge of the work, of the character of the rocks passed through in the boring; and in many cases the work is placed in charge of those who are utterly incompetent to determine the proper characteristics of the strata through which the drill was passing. Hence, when the enterprise was abandoned, the expenditure proved to be utterly valueless, for the want of a correct and reliable record of the strata penetrated, which, if kept and preserved, might have been of great value to the public at large, as well as to those for whose special benefit the work was prosecuted.

Building Stone.—Clark county is well supplied with both freestone and limestone suitable for all ordinary building purposes. The sandstone bed on Hurricane creek, southeast of Martinsville, is partly an even-bedded freestone, that works freely and hardens on exposure, and is a reliable stone for all ordinary uses. The abutments of the bridge over the North Fork on the old National road were con-

structed of this sandstone, which is still sound, although more than thirty years have passed away since they were built. The sandstone bed overlying the limestone at the old Anderson mill, below the mouth of Joe's Fork, also affords a good building stone as well as material for grindstones, and the evenly-bedded sandstone higher up on Joe's Fork, which overlies the green shales, is of a similar character, and affords an excellent building stone. Each of the three limestones in this county furnish an excellent macadamizing material, and the Quarry Creek limestone, as well as the beds near Livingston, furnish dimension stone and material for foundation walls of good quality.

Lime.—A fair quality of quicklime is made from both the limestones above named, and on Quarry creek the kilns are kept in constant operation to supply the demand for this article in the adjacent region.

Potters' Clay.—An excellent article of white clay, suitable for pottery or fire-brick, was found in the shaft near Marshall, about eighty to eighty-five feet below the Livingston limestone, and about fifty feet above the coal in the bottom of the shaft, which was probably the same coal found at Mr. Murphy's. This bed of clay would probably be found outcropping in the Wabash bluffs, not far below Murphy's place.

Soil and Timber.—The soil is generally a chocolate-colored sandy loam, where the surface is rolling, but darker-colored on the flat prairies, and more mucky, from the large per cent. of humus which it contains. The prairies are generally of small size, and the county is well timbered with the following varieties: white oak, red oak, black oak, pin oak, water oak, shell-bark and pig-nut hickory, beech, poplar, black and white walnut, white and sugar maple, slippery and red elm, hackberry, linden, quaking asp, wild cherry, honey locust, red birch, sassafras, pecan, coffee-nut, black gum, white and blue ash, dog-wood, red-bud, sycamore, cottonwood, buckeye, persimmon, willow, etc. The bottom lands along the small streams, and the broken lands in the vicinity of the Wabash bluffs, sustain a very heavy growth of timber, and fine groves are also found skirting all the smaller streams and dotting the upland in the prairie region. As an agricultural region this county ranks among the best on the eastern borders of the State, producing annually fine crops of corn, wheat, oats, grass, and all the fruits and vegetables usually grown in this climate. Market facilities are abundantly supplied by the Wabash river, and the St. Louis, Vandalia and Indianapolis railroad, which passes through the cen-

tral portion of the county, furnishing an easy communication with St. Louis on the west, or the cities of Terre Haute and Indianapolis on the east.

Before closing my report on this county I desire to acknowledge my obligations to John F. Lafferty, Esq., of Martinsville, for valuable information, and personal attention and assistance rendered me, while prosecuting my examinations in this county.

CHAPTER XX.

CRAWFORD AND JASPER COUNTIES.

Crawford county contains seven full and several fractional townships, making an aggregate area of about 438 square miles. It is bounded on the north by Clark county, on the east by the Wabash river, on the south by Lawrence and Richland counties, and on the west by Jasper.

Located on the western side of the Wabash, and traversed by several small streams tributary thereto, the surface is generally rolling, and was originally mostly covered with timber. Subsequently a considerable portion of this timbered area has been cleared and brought under cultivation, though there is still remaining an abundance of timber to supply the present and also the prospective demand for many years. The southwest portion of the county, from the Shaker mills, on the Embarras, nearly to Robinson, is quite broken, and there are also belts of broken land of greater or less extent on all the small streams. The principal water-courses in the county tributary to the Wabash river are, the Embarras, which runs diagonally across the southwestern corner of the county; the North Fork, traversing its western border from north to south; Crooked creek, also in the southwest part; and Brushy fork, Lamotte creek, Sugar creek, and some other smaller streams in the eastern portion of the county.

The prairies are generally small, and are for the most part rolling, and are mainly confined to the northern and western portions of the county, and to the bottom and terrace lands adjacent to the Wabash river. One of the earliest settlements made in the State was on one of these bottom prairies in the vicinity of Palestine, in this county.

Quaternary.—The beds referable to this formation in this county consist of buff or drab marble clays belonging to the Loess, which are found capping the bluffs of the Wabash and attaining a thickness of ten to twenty feet or more, and from twenty to forty feet of brown gravelly clays and hard-pan, the latter resting upon the bed-rock, or separated from it by a thin bed of stratified sand or gravel. If these beds were found in a vertical section they would show the following order of succession:

	Feet.
Buff and drab marly clays or sands	10 to 20
Brown and yellow gravelly clays	15 to 20
Bluish-gray hard-pan	10 to 25
Sand or gravel	0 to 3

Generally, these superficial deposits are thin in this county, and at most places the bed-rock will be found within fifteen or twenty feet of the surface. Small bowlders are frequently met with in the branches, but large ones are quite uncommon, and they are more frequently derived from the limestones and hard sandstones of the adjacent Coal Measure beds than from the metamorphic rocks beyond the confines of the State, though some of the latter were seen.

Coal Measures.

The stratified rocks of this county all belong to the upper Coal Measures, the lowest beds appearing in the bluffs of the Wabash river, and the highest along the western borders of the county, and include the horizon of coals Nos. 11, 12 and 13 of the Illinois section. The only knowledge that we have of the underlying formations is derived from a shaft and boring made at Palestine landing. The shaft passed through the following beds, commencing about six feet above high-water level in the Wabash river:

	Feet.	In.
Soil, gravel and clay	8	0
Loose sand-rock	0	4
Shale	21	8
Coal No. 10?	2 to 3	6
Fire-clay	3	0
Hard limestone	3	6
Sandstone	21	0
Brown shale	6	6
Limestone, with fossils	0	6
Gray sandy shale	2	0
Limestone	0	8
Clay shale	1	4
Limestone	0	6
Sandstone and shale	38	6
Black shale	2	0
Coal No. 9?	0	6
Total	123	6

Fire-clay, not passed through.

This shaft was sunk to reach a coal seam, reported, in a boring previously made, to be four feet thick, and at a depth of 123 feet. The bore was made about a mile and a half northwest of the shaft, and commenced 15 feet below a thin coal which outcrops in the hill above. The bore was made for oil, during the oil fever, and no great reliance can be placed in the reported thickness or character of the strata penetrated.

The shaft mentioned above was sunk to the horizon of a coal seam reported 4 feet thick in the bore, but on reaching it in the shaft, it proved to be 2 feet of bituminous shale and 6 inches of coal.

The report of this bore is as follows:

		Feet.	In.
1.	Soil and clay	4	
2.	Shale	15	
3.	Sandstone	10	
4.	Clay shale	6	
5.	Coal, No. 10	1	
6.	Fire-clay	13	
7.	Limestone	3	
8.	Fire-clay	5	
9.	Limestone	2	6
10.	Shale	8	
11.	Coal, No. 9?	3	6
12.	Fire-clay	4	
13.	Sandstone	43	
14.	Shale	5	
15.	Hard sandstone	4	
16.	Shale	8	
17.	Gray sandstone	8	
18.	Shale	12	
19.	Coal, reported	4	
20.	Fire-clay	5	
21.	Pebbly shale	4	
22.	Dark shale	15	
23.	Gray sandstone	4	
24.	Dark shale	39	
25.	Gray sandstone	17	
26.	Black shale	3	
27.	Rotten coal, No. 8?	3	
28.	Fire-clay	3	
29.	Sandstone	22	
30.	Shale	5	
31.	Sandstone	4	
32.	Soft variegated shale	30	
33.	Shale, with tarry substance and fetid odor	7	
34.	Hard sandstone	4	
		323	

If any reliance can be placed on the reported section of this boring, it must have passed through coals Nos. 10, 9 and 8, of the general section of the Illinois Coal Measures, and it is noticeable

that in the shaft sunk at the landing, they found two thin beds of limestone over the coal at the bottom of the shaft, coal No. 9, showing that although this limestone has thinned out very much from what its outcrop shows in Clark county, it has, nevertheless, not quite disappeared. This coal was reported in the boring at 4 feet, without any recognition of the bituminous shale above it, while in the shaft that was sunk down to this horizon in the anticipation of finding a good seam of coal, the bituminous shale proved to be 2 feet thick and the coal only 6 inches.

The rotten coal, No. 27 of the foregoing section, probably represents coal No. 8, which, in Gallatin county, is from 50 to 75 feet above No. 7, though no trace of the latter was reported in this bore. The coals intervening between No. 8, and 15 are seldom found of sufficient thickness to be worked to advantage except where it can be done by stripping along their outcrops, and hence they are of but little value as a resource for fuel. In the western portion of the county but little coal has been found, and only in a single mine, hereafter to be mentioned, has there been any attempt to mine for coal in a systematic way.

The exposure in the bluffs just below Palestine landing shows the following beds:

		Feet
No. 1.	Covered slope of Loess and Drift	15 to 20
No. 2.	Shelly brown limestone, with fossils	2
No. 3.	Bituminous shale and thin coal—No. 12	1 to 2
No. 4.	Sandy shales and sandstone	45 to 50
No. 5.	Bituminous shale, with numerous fossils	2 to 3
No. 6.	Coal—No. 11	1
No. 7.	Hard, dark-gray bituminous limestone	2 to 3
No. 8.	Shale	16 to 20

The shelly brown limestone, No. 2 of the above section, contains numerous fossils, among which I recognized *Spirifer cameratus, Productus costatus, P. punctatus, P. Prattenianus, P. longispinus, Chonetes Flemingii,* joints and plates of *Crinoids, Orthis Pecosi,* and some undetermined forms of *bryozoa.* Farther west in this county, and in Lawrence also, No. 12 coal is overlaid by a buff, calcareous shale, in which *Orthis Pecosi* and *Lophophyllum proliferum* are conspicuous

The bituminous shale, No. 5 of the above section, I found well exposed at the bridge on Lamotte creek, on the road from Palestine to the landing, and the following group of fossils were obtained from it at this locality: *Pleurotomaria sphærulata, P. tabulata, P. Grayvillensis, Bellerophon carbonarius, B. percarinata,* etc., corresponding with the beds at Lawrenceville and Grayville. Numerous bands of carbonate of iron occur in the shales at the base of the above section, both on Lamotte creek and in the river bank at Palestine landing.

Robinson is located on a sandstone deposit overlaying all the rocks found in the bluffs at Palestine landing, indicating a decided dip of the strata to the westward. The outcrops of sandstone on the small branch of Sugar creek, which drains the section on which the town is built, show from 15 to 20 feet in thickness of soft brown rock, in which a few small quarries have been opened. This portion of the bed affords sandy shales, and thin-bedded, rather soft brown sandstone, with some thicker beds towards the base of the outcrop, which are rather inaccessible, from the amount of stripping required to reach them, as well as from the fact that they are partly below the water level in the branch.

At Mr. Isaac C. Hole's place, north of Robinson, on the N. E. qr. of Sec. 16, T. 7, R. 12, more extensive quarries have been opened in this sandstone, and a much greater thickness of strata is exposed. The quarries are on a branch in the timber, but there is almost a continuous outcrop along the branch, nearly to the prairie level, showing the following succession of strata:

	Feet.
Shaly, micaceous sandstone, becoming thicker-bedded and harder towards the bottom, and containing broken plants	30 to 40
Massive brown sandstone, (main quarry rock)	8 to 10
Ferruginous pebbly bed	3

The massive brown sandstone quarried here is locally concretionary, the concretions being much harder than other portions of the bed, and afford a very durable stone. This sandstone, with the shales usually associated with it, probably attains a maximum thickness of 60 to 80 feet, and fills the intervening space between coals Nos. 12 and 13 of the general section. It has been penetrated in sinking wells on the prairie at many places north and northwest of Robinson.

Law's coal bank, formerly known as Eaton's bank, is on the S. W. of the N. E. qr. of Sec. 12, T. 7, R. 13. The coal is a double seam, about three feet thick, with a parting of bituminous shale from two or three inches to two feet in thickness. It is overlaid here by shale and a hard, dark, ash-gray limestone, destitute of fossils. One mile up the creek from this mine the coal is said to pass into a bituminous shale. The coal obtained here is rather soft, and subject to a good deal of waste in mining; but as the mine was not in operation when I visited the locality, I had no opportunity of judging of its average quality. A section of the creek bluff at the mine shows the following order:

Gravelly clays of the Drift	10 to 15
Hard, dark ash-gray limestone	1 to 1½
Hard, siliceous shales, with nodules	½
Coal, with shale parting—No. 13?	3

A boring was made here by the proprietor, and a thicker seam was reported to have been found some forty feet below; but if this report is correct, the sandstone usually intervening between coals Nos. 12 and 13 is here much below its average thickness, and no such coal is known to outcrop in the county. However, local coals are sometimes developed which only cover very limited areas, and this may be a case of that kind.

Four miles southwest of Robinson, a bed of hard, dark-gray bituminous limestone outcrops in the bed of Turkey creek, and has been quarried for building stone, for which purpose it is but poorly adapted, as it splits to fragments after a limited exposure to the elements. The rock occurs in a single stratum about eighteen inches thick, overlaid by a brown calcareous shale, filled with nodules of argillaceous limestone. The shale contained numerous specimens of *Lophophyllum proliferum*, associated with joints of *Crinoidea*. The foundation stone for the court house at Robinson was obtained here. This limestone may overlay a thin coal, but I could not learn that any seam had been found in this vicinity, and I could find no outcrop of the beds below the limestone in this neighborhood. In the western portion of the county outcrops are rare, and so widely separated that no continuous section could be made.

On section 4, in Hutsonville township, at Mr. W. D. Lamb's place, a bed of limestone is found underlaid by five or six feet of blue shale and a thin coal. In a well sunk here the limestone was found to be five feet in thickness, a tough, fine-grained, dark-grayish rock, containing no well preserved fossils. On Mr. Evans' place, just over the line of Clark county, on Sec. 34, T. 8, R. 12, heavy masses of tumbling limestone are to be seen along the creek valley. It is a massive, gray, brittle rock, and contains *Athyris subtilita*, *Spirifer cameratus* and *Productus longispinus*. A mile and a half further up the creek this limestone is found in place, and is burned for lime by Mr. Drake. I believe these limestones belong below the sandstone which is found at Robinson and at Hole's quarry.

At Lindley's mill, on the N.W. qr. of Sec. 7, T. 8, R. 13, a hard, dark-gray limestone was found in the bed of the creek, only about two feet in thickness of its upper portion being exposed above the creek bed. A quarter of a mile south of the mill, at Mr. Reynolds' place, coal is mined by stripping along the bed of a branch. The coal is from 15 to 18 inches thick, overlaid by 2 or 3 feet of blue shale,

and a gray limestone filled with large *Producti*, *Athyris subtilita*, etc. *Productus costatus*, with its long spines, seemed to be the most abundant species. This limestone and the underlying coal, I am inclined to believe, represent the horizon of the upper coal in the bluff at Palestine landing, and No. 12 of the general section.

Hutsonville is located upon a bench of sandstone, the lower part of which is concretionary, and the upper part, which outcrops in the hills back of the town, is more evenly-bedded, and affords some tolerably good building stone. The sandstone extends below the average water-level of the river, and is probably altogether not less than 50 to 60 feet in thickness here, and is the equivalent of the sandstone at Robinson and vicinity in the central portion of the county.

At Martin's mill, on Brushy Fork, near the south line of the county, the limestone and shale found at the Lamotte creek bridge, and also at Lawrenceville, representing the horizon of coal No. 11, is well exposed, the creek bluff showing the following section:

		Feet.
No. 1.	Brown sandy conglomerate and concretionary sandstone, found a quarter of a mile east of the mill	10 to 15
No. 2.	Space not seen.	
No. 3.	Micaceous sandstone and shale, top of the bluff	6
No. 4.	Brown and bluish-gray micaceous shale	18
No. 5.	Blue shale, partly calcareous, with iron nodules, and numerous fossils	4
No. 6.	Hard bituminous limestone.	

The upper bed in the above section was found about a quarter of a mile from the creek, and at a somewhat higher level apparently than the sandstone, No. 2, forming the top of the bluff; but the intervening space could not be more than 10 or 15 feet. Pockets of coal were found here in the concretionary sandstone; but although dug into for coal, they proved to be of very limited extent. The micaceous sandstone, No. 3 of the section, affords some very good building stone, and some of the thin layers are distinctly ripple-marked.

The calcareous shale afforded numerous fossils of the same species found at the Lamotte bridge.

At Mr. Nettle's place, on the N. E. qr. of Sec. 24, T. 5, R. 12, coal has been mined for several years. The coal is about 18 inches thick, and has a roof of fine black slate, resembling a cannel coal, nearly as thick as the coal itself. The black slate is overlaid by 2 or 3 feet of calcareous shale, containing *Orthis Pecosi*, *Retzia Mormoni*, and joints and plates of *Crinoidea*. This coal I believe to be the same as that near the top of the hill at Palestine landing, and No. 12 of the Illinois section.

Prof. Cox reports the following outcrops in this county, at localities which I did not visit: "In the hill east of the Shaker mill, Sec. 32, T. 5, R. 12, a soft yellowish massive sandstone, forming cliffs along the ravines, and in places weathering into 'rock houses,' or oven-like cavities. Section here as follows:

	Feet.
Soil and covered space	5
Flaggy sandstone in two to eight-inch layers	8
Solid-bedded sandstone	13

Sandy shales, flagstones, and an occasional showing of massive soft sandstone, form the prominent geological features of the southern and western portions of the county. Around Hebron, four miles south of Robinson, massive sandstone forms cliffs 15 to 20 feet high, probably a continuation of the rock seen at the Shaker mill. Two miles and a half southeast of Belair, I found the following section at Gooden's coal bank:

	Feet.
Slope of the hill	20
Hard blue argillaceous shale	10
Coal—breaks in small fragments	1 to 1½

This mine is worked by a shaft. A quarter of a mile below, on Willow creek, the same seam is worked on Mr. Matheny's place by stripping, where the coal is of the same thickness."

This coal must be as high in the series as No. 13 or 14 of the general section, and may be the same as the coal mined near Newton and New Liberty, in Jasper county.

Economical Geology.

Coal.—As we have already stated on a preceding page, all the stratified rocks in this county belong to the upper Coal Measures, extending from coals Nos. 11 to 14, inclusive, and as these seams are usually too thin to be worked in a regular way, no valuable deposit of coal is likely to be found outcropping at the surface in the county. The seam at Mr. Law's place, northwest of Robinson, is said to attain a local thickness of three feet, and may be successfully mined where the coal is good. When the demand for coal shall be such as to justify deep mining, the lower coals may be reached at a depth of four to six hundred feet. Their nearest approach to the surface is along the valley of the Wabash river, and the depth would be increased to the westward by the dip of the strata and the elevation of the surface.

Building Stone.—The best building stone to be found in this county comes from the heavy bed of sandstone above coal No. 12, which

outcrops at various places in the county, and especially at Mr. Hole's quarries north of Robinson. At some localities, a fair article of thin-bedded micaceous sandstone is found between coals 11 and 12, as at Martin's mill, on Brushy Fork, near the south line of the county. These sandstones afford a cheap and durable material for foundation walls, bridge abutments, etc. The limestone four miles west of Robinson, that was used in the foundation walls of the court house, is liable to split when exposed to the action of frost and water, and although seeming hard and solid, when freshly quarried, will not withstand exposure as well as the sandstone, if the latter is carefully selected. The limestone at Reynolds' coal bank, near Lindley's mill, stands exposure well, and will afford a durable building stone.

Lime.—We met with no locality in the county where lime was burned, but just north of the county line of Clark county, at Mr. Drake's place, a fair quality of lime is obtained from a limestone apparently the equivalent of that at Reynolds' coal bank.

Iron Ore.—The shales associated with coal No. 11 usually contain more or less carbonate of iron, and at the locality below the bridge on Lamotte creek, near Palestine landing, the quantity seemed to be sufficient to justify an attempt to utilize it. The shale in the bank of the creek shows a perpendicular face of fifteen to twenty feet, and the bands of ore towards the bottom of the bed would afford from twelve to eighteen inches of good ore in a thickness of about six feet of shale. At the river bank, just below the landing, this shale outcrops again, and the iron nodules are abundant along the river bank, where they have been washed out of the easily decomposed shale.

Sand, Gravel and Clay.—The materials for brick are abundant almost everywhere, and can be had wherever wanted. Good brick clay can be found in the subsoil of the uplands, and sand is found both in the Loess deposits of the river bluffs, and in the beds of the streams. The second bottom or terrace land along the Wabash river, affords an abundance of gravel for road ballast, making cements, etc.

Soil and Timber.—From Hutsonville south there is a belt of alluvial bottom and terrace land, from one to three miles in width, extending to the mouth of Lamotte creek, a distance of about ten miles. This is mostly prairie, and the soil is a deep, sandy loam, and very productive. The upland prairies have a chocolate-colored soil, not so rich in humus as the black prairie soils of Central Illinois, but yielding fair crops of corn, wheat, oats, clover, etc. On the timbered lands the soil is somewhat variable. Where the surface is broken the soil is thin, but on the more level portions, where

the growth is composed in part of black walnut, sugar tree, linden, hackberry and wild cherry, the soil is very productive, and yields annually large crops of all the cereals usually grown in this latitude.

The varieties of timber observed in this county were the common species of oak and hickory, black and white walnut, white and sugar maple, slippery and red elm, honey locust, linden, hackberry, ash, red birch, cottonwood, sycamore, coffeenut, black gum, pecan, persimmon, paw-paw, red thorn, crab apple, wild plum, sassafras, red bud, dogwood, ironwood, etc.

Indian Mounds.—One mile south of Hutsonville, on the gravel terrace, and about 200 yards from the river bank, there is a curious group of mounds, 55 in number, and from eight to ten feet in height. One of the largest mounds is surrounded by a wall of earth raised about three feet above the surface, and from five to six feet in width, inclosing a space of ground about a hundred feet in diameter. This was undoubtedly the site of an ancient village belonging to that mysterious people whom we call the "Mound-builders," for want of some more distinctive appellation, and who once, and probably for a long series of years, inhabited the valleys of the Mississippi and its tributaries, as is proven by their earthworks scattered over the whole area of the Western and Southern States. But little is at present known of the character and habits of this ancient people, whence they came or whither they went, and the study of these ancient works, and the ornaments and implements belonging to those who built them, is perhaps the only available clue to their history.

JASPER COUNTY.

Jasper county contains an area of 484 square miles, and is bounded on the north by Cumberland, on the east by Crawford, on the south by Richland, and on the west by Clay and Effingham counties. The Embarras river traverses the whole extent of the county from northwest to southeast, and drains nearly the whole of its surface except the southwest corner, which is drained by Mud creek, a tributary of the Little Wabash. About one-third of the county was originally timbered land and the remainder prairie, the latter occupying the broad areas of upland between the valleys of the streams, and elevated from sixty to eighty feet above the water courses. From Robinson to New Liberty the country is rather low and comparatively level, seldom rising more than twenty or thirty feet above the beds of the small streams. The Embarras river runs through

a low, flat bottom, from three to five miles in width, with some swampy areas, though generally dry enough to admit of cultivation, but subject to overflow from the high water of the river. Rock exposures are but rarely to be met with in the county, owing, in part, to the soft and yielding character of the sandstones and shales that form the bed-rock over the greater portion of the county, and in part to the wide valleys in which the streams have their courses, seldom impinging upon the bluffs sufficiently to expose the stratified rocks.

The superficial deposits of this county consist mostly of brown, gravelly clays, and a bluish-gray hard-pan, the whole aggregating from twenty to forty feet in thickness, and presenting the same character as in Crawford county. These beds thicken to the westward and are considerably heavier in the western part of the county than in the eastern. Small bowlders of metamorphic rock are frequently met with in the creek beds or on the hillsides, weathered out of these deposits, associated with those derived from the sandstones and limestones of the Coal Measures.

Coal Measures.

From the limited exposures, and the widely separated points where the bed-rock can be seen in this county, no general section of the strata was possible, but enough was seen to indicate their general character, and to determine very nearly their relative position in the Coal Measures. The main water-courses traverse broad alluvial valleys which gradually slope up to the level of the adjacent highlands, rarely impinging upon the bluffs on either side so as to show the character of the underlying formations. The lowest beds in the county are probably the shales and shaly sandstones outcropping on the lower courses of the North Fork, and on the Embarras in the vicinity of St. Marie, which probably belong to the heavy shale deposit passed in the boring at Greenup, and belong between coals Nos. 14 and 16 of the general section. The highest outcrops will be found in the northwest corner of the county, where the *Fusulina* limestone that outcrops at Churchill's place, near the county line in Cumberland county, may be seen.

At the crossing of North Fork, on the old Palestine and Vandalia road, a blue, sandy shale has been penetrated by a shaft to the depth of about thirty feet in search of coal, but without success. The upper part of this shale bed outcrops in the bank of the stream at an old mill just below the bridge. About a mile further down

the creek, a bed of brown, calcareous sandstone is found from 18 to 20 inches thick, which contains *Pinna peracuta*, *Spirifer plano-convexus*, *Productus Prattenianus*, *Orthoceras*, *Myalina*, etc.

In the bank of the Embarras, at St. Marie's, a thin-bedded micaceous sandstone is quarried at low water, but it splits into thin layers on exposure, and is of but little value as a building stone. A well was sunk here at the steam mill, to the depth of ninety feet, through sandy shales and sandstone, without finding either coal or limestone.

Newton, the county seat of this county, is located on the bluff of the Embarras, and the outcropping beds that form the lower portion of the bluff consist of 25 to 30 feet of soft micaceous shales and sandstones, extending below the river bed. About two miles southeast of the town, on Brush creek, a sandstone is found that furnishes most of the building stone used in the vicinity. The quarry rock is from eight to ten feet thick, in layers varying from six to twelve inches or more in thickness. The stone is rather soft when first quarried, but becomes harder on exposure, and makes a very durable rock for ordinary use. Locally it has a coarsely concretionary structure, the concretions being harder than the surrounding rock, a character frequently observed in the heavy-bedded sandstones of the Coal Measures. Below the sandstone there is a variable thickness of shale that becomes bituminous towards the bottom and forms the roof of a coal seam that has been opened and worked to some extent at this locality. The seam was covered up by the falling in of the roof, so that I could not see the quality of the coal or measure its exact thickness, but it is said to be from $2\frac{1}{2}$ to 3 feet thick, and has a shale parting like the seam at the old Eaton mines northwest of Robinson. This is probably coal No. 14 or 15 of the general section. This coal probably underlies the town of Newton at a depth of eight or ten feet below the bed of the Embarras river, and might be easily mined anywhere along the bluff, by driving an inclined tunnel into the base of the hill above high-water mark down to the level of the coal. A mine could be cheaply opened here in this way, and if the quality of the coal should prove to be good, it would no doubt become a profitable investment in supplying the steam mills and other local demands for coal.

Three miles east of Newton, on the road to New Liberty, the same sandstone is met with on the east side of the Embarras valley, outcropping in the base of the low hills bordering the valley, and continuing in occasional outcrops to the coal bank one mile west of New Liberty. This coal is probably the same as that at Brush creek

a mile and a half southeast of Newton. The seam is divided by a bituminous shale varying from six to eighteen inches in thickness, and only the lower division of the seam is mined here, the upper part being too soft and shaly to be of much value. A section of the beds above this coal, as seen between Newton and this point, would be as follows:

	Feet.	In.
Micaceous sandstone, thin-bedded at the top and more massive below	20 to 30	
Sandy shale with local layers of thin sandstone	5 to 10	
Bituminous shale	1 to 3	
Coal, rather soft and poor	1 to 1	6
Shale parting	½ to 1	6
Coal, good	1	6

We found no fossils in the shale overlying this coal on Brush creek, but west of New Liberty we noticed imperfect examples of *Bellerophon carbonarius* and *Spirifer plano-convexus*.

South of Newton a prairie ridge extends for several miles in a southerly direction, along which sandstone is said to be found, and most probably this ridge shows the trend of the sandstone formation in this part of the county.

On Limestone creek, in the southwest corner of the county, there is an outcrop of light-gray limestone, that is quarried for building stone, and is also burned for lime.

The following sections were found by Prof. Cox at localities I did not visit: "In the northwest corner of the county, on Island creek, an outcrop of heavy-bedded sandstone and flagstone commences on Sec. 16, T. 8, R. 8, and may be traced northward to the county line. The sandstone is brownish-colored, and makes a fair building stone. On Mint creek, Sec. 1, T. 7, R. 8, the following section was found:

	Feet.	In.
Siliceous shale	20	
Gray pyritiferous shale, passing into limestone	2	
Jet black bituminous shale, with fish scales and spines		6
Coal, breaking into small cubes		6
Fire-clay		3
Gray siliceous shale and flagstone	3	8

This thin coal was sometimes found split by a hard bituminous shale, leaving only about an inch of coal in each division.

Section on Slate creek, Sec. 9, T. 7, R. 8:

	Feet.	In.
Grayish-buff argillaceous shale	5	
Calcareo-argillaceous shale with fossils	1	6
Brownish-black shales	2	6
Hard black shale	2	
Gray argillaceous shale	6	6

The fossiliferous shale in the above section contained *Euomphalus subrugosus, Pleurotomaria Grayvillensis, Nucula ventricosa, Lophophyllum proliferum, Chonetes mesoloba,* and a leaf of *Neuropteris.*

Section on Embarras river, S. W. qr. of sec. 31, T. 7, R. 10:

		Feet.	In.
1.	Covered slope	10	
2.	Bluish-brown argillaceous shale	10	
3.	Brown and black bituminous shale	3	
4.	Fire-clay		3
5.	Gray fossiliferous limestone		10
6.	Blue argillaceous shale		4
7.	Brownish-black impure limestone	3	
8.	Blue shale	2	
9.	Bluish shaly sandstones	10	

The impure limestone, No. 7, contained *Productus longispinus, Athyris subtilita, Pleurotomaria Grayvillensis, Terebratula bovidens, Chonetes mesoloba,* and *Hemipronites crassus.* The shale under the limestone contained *Myalina subquadrata* (?), *Euomphalus subrugosus, Orthoceras Rushensis,* fragments of *Pinna,* etc. Two miles north of St. Marie, on the west half of sec. 7, T. 6, R. 11, a shaft was sunk twenty feet to the river level, and some fragments of impure limestone were thrown out. About a hundred yards up the river this limestone is just at the water's edge. It is eight or ten inches thick, and contains *Athyris subtilita, Spirifer cameratus,* and fragments of *Pinna.* It is probably the equivalent of the limestone near Newton.

The second bluff or terrace is about forty feet above low water. About thirty feet above low water, in the face of the bluff, there are the remains of an old furnace. It is about three feet in diameter, of a circular form and walled with rock. Around it are pieces of burnt limestone, charcoal and cinders. On the top of the bluff there are a number of Indian mounds, arranged in the form of an oblong square inclosing a court. The peculiar arrangement of the mounds, and the presence of mica in the sandstone and also in the drift bowlders found here, led to the belief that silver existed in the rocks and could be extracted from them, and the existence of the mounds and the furnace led to the sinking of the shaft in pursuit of the same precious metal.

On Crooked creek, a half mile west of Brockville, the following section was found:

	Feet.	In.
Buff-colored limestone, without fossils	4	
Blue argillaceous shale	3	
Rotten limestone, with fossils		6
Black bituminous shale	4	
Blue argillaceous shale	2	

The fossils found in the rotten limestone were: *Athyris subtilita*, *Chonetes mesoloba* (?), and *Productus longispinus*.

One mile and a half southwest of Harrisburg, on Lick creek, I found the following beds:

	Feet.	In.
Bluish argillaceous shale	10	
Black bituminous shale	4	
Impure limestone, with fragmentary fossils		6
Bluish argillaceous shale	2	

The water of the creek is slightly saline, and some prospecting for brine has been done in this vicinity."

All the outcrops given on the preceding pages belong to the upper Coal Measures, and range about the horizon of coals Nos. 14 or 15 of the general section. From the general trend of the strata it may be inferred that the lowest beds that outcrop in the county are those along its eastern border, and the highest those upon the western.

Economical Geology.

Coal.—A limited supply of coal may be obtained from the beds outcropping near Newton and New Liberty, but neither the average thickness of the seams nor the quality of the coal they afford would justify an attempt to work them except in a limited way. The main coals are here from five to six hundred feet or more below the surface, and to reach the bottom of the Coal Measures would require a shaft more than a thousand feet in depth. It will probably be many years before the demand for coal will be such in this county as to warrant the opening of mines at this depth.

Building Stone.—Building stone of good quality is not abundant, the supply being mainly from the sandstone overlying the coal at Newton and in that vicinity. At some points this bed affords a brown sandstone of fair quality, and at others it passes into siliceous shales or shaly sandstones too soft and thin-bedded to be used for building purposes. On Limestone creek, in the southwestern portion of the county, there is a bed of compact gray limestone in layers of a foot to eighteen inches in thickness, that is quarried for foundation walls, etc., for the supply of the adjacent region.

Lime.—The only limestone found in this county that seemed to be at all adapted for the use of the lime-kiln, was that on Limestone creek, in the southwest corner of the county, and a fair quality of lime may be made there for the supply of such portions of the adjacent region as are remote from railroad transportation.

Sand and Clay.—These common and useful materials are abundant, and good brick may be made at almost any point on the uplands where they may be required. Sand for mortar and cement occurs at many places along the bluffs of the Embarras, and may be found in the beds of most of the small streams, and in nearly every portion of the county.

Soil and Timber.—The bottom lands of the Embarras have a rich alluvial soil, and when cleared and brought under cultivation, produce large crops of corn, to which they seem best adapted. The soil of the prairie region is a chocolate-colored clay loam, similar to that of the adjoining counties, and produces fair crops of corn, wheat, oats and grass. The timbered upland is similar to that described in the report on Crawford county, and the varieties of timber noticed here was nearly the same. Although not possessing so large an area of timbered land as Crawford county, it has nevertheless an abundant supply for a much larger population than it contains at the present time.

CHAPTER XXI.

LAWRENCE AND RICHLAND COUNTIES.

Lawrence county embraces an area of about three hundred and sixty-two square miles, and is bounded on the north by Crawford county, on the east by the Wabash river, on the south by Wabash county, and on the west by Richland. The principal water-courses in the county, besides the Wabash river, which forms its eastern boundary, are the Embarras river, which traverses the northeast portion of the county, with its affluents Brushy Fork and Indian creek, which drain the northern and central portions of the county, and Raccoon creek and the eastern fork of the Bonpas, which drain the southern part. East of Lawrenceville, and lying between the Embarras and Wabash rivers, there is an extensive marsh from two to four miles in width and about ten miles in length, called Purgatory swamp. Surrounding this on the east and north, there is a considerable area of bottom prairie, the upper or northern portion being known as Allison's prairie, and the lower portion as the Russelville prairie. In addition to this there are some small prairies in the southern, and also in the northwestern portion of the county, but the greater portion of its area was originally covered with a heavy growth of timber. The surface is generally rolling, but nowhere so broken that the land cannot be cultivated even along the bluffs of the streams. The elevation of the county above the water courses is nowhere very great, and on what may be termed the upland, ranges from fifty to about a hundred feet.

Loess and Drift.—In the vicinity of the Wabash river we find beds of brown clay and buff or yellowish marly sands ranging from ten to twenty feet or more in thickness, which probably represent the age of the Loess. These are underlaid by brown or gravelly clays containing small bowlders ranging in size from an inch or two to a

foot or more in diameter. On the uplands away from the river bluffs there are usually from fifteen to twenty feet of these gravelly clays above the bed rock, and usually in sinking wells, especially in the northern portion of the county, an adequate supply of water can only be obtained by going from ten to forty feet or more below the Drift clays into the underlying shales or sandstones. About Lawrenceville there is usually from five to six feet of brown gravelly clay resting immediately upon the bed-rock, and above that from ten to twelve feet of buff or brown clays that are quite free from gravel.

Stratified Rocks.—All the formations that outcrop in this county below the superficial deposits already described, belong to the upper Coal Measures, and include a vertical thickness of not more than one hundred and fifty to two hundred feet. On the Wabash river, at St. Francisville, there is an outcrop of massive gray sandstone, which I believe to be the same as that found at Hanging-rock bluff, in Wabash county, and the lowest rock seen in this county. The section here is as follows:

	Feet.
Shale	8
Impure iron ore	1
Thin-bedded sandstone and sandy shale	16
Massive gray sandstone	20 to 25
Unexposed to river level	10 to 15

Just below the dam at Lawrenceville, on the Embarras river, we find the following section, which I believe overlies the beds seen at St. Francisville:

	Feet.
Brown and bluish-gray argillaceous shale	10 to 12
Bituminous and partly calcareous shale, with bands of iron ore and numerous fossils	4 to 5
Black slaty shale	3 to 5
Dark gray limestone in the river bed	1

The fossiliferous bed at this locality contains *Lophophyllum proliferum, Pleurotomaria sphærulata, P. tabulata, P. Grayvillensis, P. carbonaria, Polyphemopsis peracuta, Bellerophon Montfortianus B. carbonarius, B. percarinatus, Astartella varica, Productus longispinus, Hemipronites crassus, Macrocheilus primigenius,* and joints and plates of *Crinoidea.*

At the bridge two miles east of Lawrenceville we find a repetition of the foregoing section, but the bluff is much higher and a greater thickness of strata is exposed, giving the following section:

	Feet.
1. Micaceous sandstone and shale, passing downward into argillaceous shale	20 to 25
2. Bluish-gray calcareous shale, with iron bands and fossils	4 to 6
3. Black laminated shale, with concretions of black limestone	4 to 5
4. Brittle dark-gray limestone, weathering to a brown or buff color	1½ to 2
5. Blue and brown shales, partly argillaceous and bituminous	12 to 14

About a hundred yards above the bridge, by an undulation of the strata, the limestone No. 4 of the above section is brought down to and passes under the river bed. This would seem to indicate a rapid dip to the northward, but the reappearance of the fossiliferous shale No. 2 of this section on Lamotte creek, in Crawford county, some twenty miles north of this, shows that the apparent dip here is only an undulation of the strata, such as may frequently be observed in the Coal Measures of this State. Near the upper end of the exposure here a dike of sandstone from six to eighteen inches in width cuts transversely through the lower bed of shale, No. 5 of the above section, having an east and west direction. This would seem to indicate that the undulation in the strata here might be due to some disturbing force acting from below. The calcareous shale No. 2 of this section contains the same group of fossils found at Lawrenceville. The limestone contains *Naticopsis ventricosus, Nautilus sp? Terebratula bovidens, Spirifer planoconvexus, Rhynchonella Uta, Athyris subtilita, Clinopistha radiata, Solenomya radiata*, with several undetermined species of small univalve shells. This is a very marked horizon in the upper Coal Measures, and the outcrops extend along the valley of the Wabash from below Grayville, in White county, to the central or northern part of Crawford county. The black laminated shale above the limestone contains local concretions of black limestone, with fish scales, *Discina nitida*, etc. South of the bridge, on the east side of the Embarras, there is an outcrop of micaceous sandstone that affords some building stone of a fair quality, which has been used for bridge abutments, foundation walls, etc., and is probably the equivalent of the upper part of the foregoing section.

At Mr. F. Plummer's place, on the S. E. qr. of sec. 25, T. 5 N., R. 12 west, two wells were sunk, one near his dwelling house, passing through eighteen inches of coal at a depth of eighteen feet, and the other, about a quarter of a mile to the northward, commencing at a level below the bottom of the first, was carried down forty-three feet, mostly through sandstone and shale, the lower part bituminous, and ending in the calcareous fossiliferous beds of the section at Lawrenceville and the bridge two miles east of that point.

At Mr. Porter's place, adjoining Mr. Plummer's on the south, a well was sunk to the depth of fifty-six feet, through the following beds:

	Feet.
Drift clay, soil, etc	18
Sandstone	11
Blue shales, bituminous at the bottom	27

The water was obtained in the fossiliferous layers over the black, sheety shale No. 3 of the section at the Embarras bridge. The coal passed through in the well at Mr. Plummer's house must lay above the sandstone in the Porter well, which had probably been eroded away at that point by water currents during the Drift epoch.

At Mr. Fritchey's well, a half mile west of Mr. Plummer's, a bed of cellular iron ore occurs in the sandstone near its base, and was passed through in his well about sixteen feet below the surface. The iron ore was reported to be two feet thick in the well, but at the outcrop, a quarter of a mile from the house, its thickness was only about six inches. It appears to be too sandy to be of any value for the production of iron.

At Mr. Warriner's, a mile and a half northwest of Mr. Plummer's, the sandstone was penetrated in a well to the depth of fifty-eight feet without reaching the bottom of the bed, and its entire thickness here cannot be less than from sixty to seventy-five feet. Near its base there is a very hard layer about two feet in thickness, which rings under a blow of the hammer like a compact limestone, probably from a small per cent. of calcareous or ferruginous matter in its composition. A similar hard layer was observed at the base of the sandstone at Hole's quarry, north of Robinson, in Crawford county, of which this is probably the equivalent. The coal under this sandstone is probably No. 12 of the general section, which is somewhat irregular in its development in this county, sometimes affording from eighteen to twenty inches of good coal, while at other places it thins out to a few inches, or is wanting altogether.

At Mr. Emerich's quarry, two miles and a half northeast of Sumner, a heavy bed of sandstone outcrops on a branch of the Embarras, that is probably referable to this same formation. The face of the quarry shows from eighteen to twenty feet of massive sandstone, presenting a concretionary structure at the base of the bed, but becoming thinner bedded and somewhat shaly towards the top. This rock has been extensively quarried here for building culverts and bridge abutments on the O. and M. railroad. One mile north of the town there has also been a small quarry opened higher up in this formation, where the rock is thin bedded and shaly, but

affords some good building stone near the bottom of the quarry, though the overlying beds are shaly and worthless.

In the Embarras bluffs, near Mr. Wm. H. Miles' place, on the N. W. qr. of sec. 33, T. 5, R. 12, there is a massive sandstone exposed forming the lower portion of the bluff in connection with a thin seam of coal. The section here is as follows:

	Feet.	In.
Massive sandstone	8 to 10	
Ferruginous conglomerate	2 to 3	
Coal (probably local)	0	8
Slope covered to the river level	10 to 12	

A hundred yards above where this section was seen, the sandstone continues down to the river level with no indications of coal. This is probably the same thin coal found on Brushy creek, near Martin's mill, just over the line in Crawford county, and as it is there from forty-five to fifty feet above the creek level, it indicates a westerly dip of the strata equal to about six or seven feet to the mile. No rocks are known to outcrop on the Embarras for some distance above this point, and below there is no considerable exposure between this and the dam at Lawrenceville.

Three miles south of Lawrenceville, on Mr. Henderson's place, on the south side of Indian creek, and at several other points in the neighborhood, a coal seam is found which has been opened and worked in a limited way to supply the local demand for coal. It ranges from twelve to eighteen inches in thickness, and is mined only by stripping along its outcrop in the banks of the small streams. The seam at Mr. Henderson's place is from twenty-five to thirty feet above the bed of Indian creek, and partial outcrops of soft shale were seen between the coal seam and the creek level. This coal seems to be identical with that at Mr. Nettle's, near the south line of Crawford county, and the equivalent of No. 12 of the general section. It outcrops also on Mud creek, three or four miles northwest of Lawrenceville, at several places, and has been worked to a limited extent to supply the neighboring blacksmiths previous to the construction of the O. and M. railroad, since which time it has been generally abandoned.

A boring was made some eight or ten years ago at Lawrenceville, to the depth of about four hundred and fifty feet, but no accurate record has been kept of the beds passed through. A thin coal was reported at the depth of three hundred and forty feet, and another seam four feet thick near the bottom of the bore, but it seems probable, from all that can be learned at the present time, that the work was not in charge of a competent person, and hence but little

reliance can be placed on the reported results. A very good brine was said to have been reached near the bottom of the bore.

The following sections and notes are reported by Prof. Cox, from his examinations at localities not visited by myself:

"At John Leed's quarry, on Indian creek, one mile west of the St. Francisville road, I found the following section:

	Ft.	In.
Gray shale	6	
Carbonaceous shale		6
Shale		8
Sandstone, in even beds, from 4 in. to 1 foot thick	3	

This sandstone is a durable building stone, and was used in the bridge abutments on Embarras river. On the north bank of the Embarras river, at the Shaker mill, on Sec. 32, T. 5, R. 12, the following section was found, the massive sandstone being probably the equivalent of that at St. Francisville:

	Ft.
Soil and Drift	5
Thin-bedded sandstone, 2 to 8 inches	8
Massive sanestone	13

Section on Indian creek, three miles south of Lawrenceville:

	Ft.	In.
Soil and Drift	10	
Argillaceous shale, with iron bands	25	
Impure coal		8
Fire-clay and gray shale	5	
Bluish sandstone in the bed of the creek	?	

The 8-inch coal in the above section is below that mentioned on a previous page as occurring on Mr. Henderson's place in this neighborhood, as that is found from 25 to 30 feet or more above the bed of Indian creek, and ranges from 12 to 18 inches in thickness. The following is an approximate section of the rocks outcropping in this county:

	Feet.
Brown and gray sandstone, the lower part in massive beds	60 to 75
Coal—No. 12	1 to 1½
Shales, with bands of argillaceous iron ore	30 to 35
Coal—No. 11	0 to 1
Sandstone, top thin-bedded and shaly, bottom massive	30 to 35

The upper sandstone underlays the northern and western portions of the county, and is penetrated in sinking wells nearly everywhere upon the uplands. At its base there is usually a very hard stratum that is sometimes called limestone on account of its hardness, and also a ferruginous bed, that passes locally into a sandy iron ore. The lower sandstone forms the main portion of the Wabash bluff at St. Francisville, and also appears at the Shaker mill on the Embarras; but its outcrop is restricted to the eastern border of the county.

Economical Geology.

Building Stone.—Both the sandstones in the foregoing section afford more or less building stone of fair quality for ordinary use, and extensive quarries have been opened in the upper one in the vicinity of Sumner, for the use of the O. & M. railroad. Small quarries have been opened in various places in the central and northern portions of the county in this bed to supply the local demand for foundation stone, walling wells, bridge abutments, etc. Leeds' stone quarry on Indian creek, south of Lawrenceville, and one mile west of the St. Francisville road, is probably in the lower bed of sandstone, and the rock obtained there is in thin, even beds, ranging from four inches to a foot in thickness.

The limestone associated with coal No. 11 at Lawrenceville, and at the bridge two miles east on the Embarras, is somewhat argillaceous, and consequently can not be depended on where it is to be subjected to the action of frost and moisture, although it has been used in building the Lawrenceville bridge. This is the only limestone that was met with in the county, and being both argillaceous and siliceous, it is not adapted either for building purposes or for the lime-kiln.

Coal.—The uppermost of the two coal seams that outcrop in this county has been worked in a small way at several points by stripping, and affords a coal of very good quality; but unfortunately it has been nowhere found thick enough to be profitably mined in any other way.

Just north of the county line in the edge of Crawford county, at Mr. Nettle's coal mine, the coal is about 18 inches thick, overlaid by about a foot or more of hard bituminous shale resembling a cannel coal. It has been mined here for several years at intervals, by tunnelling into the bank along the line of outcrop, but no permanent entry was constructed, and when the work stopped the roof caved in and filled the opening so that a new entry was required as often as the work was resumed.

This was the condition of things when I was there, and I was unable to make any satisfactory examination of the quality of the coal, or to determine its exact thickness.

The main coals of the lower measures which are so extensively mined in Gallatin and Saline counties will probably be found here by boring, and if the well bored at Lawrenceville had been in the hands of an expert, and an exact record kept of the thickness and

composition of the various beds passed through, the question would have been settled whether there was any thick seam of coal within four hundred feet of the surface in this county. As it is, nothing has been positively determined by this expenditure of money, further than the fact that two coal seams of uncertain thickness were found in the boring, one at a depth of about 340 and the other at 440 feet below the surface. The depth of the seam, when not exceeding four or five hundred feet, is no serious impediment to the working of the coal, if the demand for this kind of fuel is sufficient to justify the investment, and we already have several shafts in successful operation in the State that are over 500 feet in depth. Deep mining is the only alternative in this county for obtaining an unfailing supply of this kind of fuel, as the surface seams appear to be too thin at every outcrop at present known in this or the adjoining counties, to be successfully worked for the supply of any large demand for coal.

Iron Ore.—The shales intervening between coals 11 and 12 contain numerous bands of argillaceous iron ore, but they are too widely separated at the localities where the shales were met in this county to be of any practical value for the furnace. At the base of the upper sandstone a ferruginous bed is frequently met with, sometimes appearing as a conglomerate of iron nodules in sandstone; but in Mr. Fritchey's well, on sec. 25, T. 5 N., R. 12 W., it was reported to be two feet thick, and consisted partly of a very good quality of brown hematite ore, but other portions were too much mixed with sand to be of any value for the production of metallic iron. It was found in the well at a depth of 16 feet, and outcrops about a quarter of a mile to the westward, where its thickness is only about six inches.

Soil and Timber.—The Wabash and Embarras rivers are skirted with broad alluvial bottoms and level table lands, ranging from two to four miles in width. Some portions of the latter are quite sandy, and constitute the terrace prairies between Purgatory swamp and the Wabash. The bottoms along the Embarras are heavily timbered with all the common varieties of oak, hickory, ash, elm, maple, black and white walnut, coffeenut, persimmon, cottonwood, sycamore, hackberry, red birch, honey-locust, wild cherry, black gum, dogwood, etc. The uplands are generally rolling, and were mostly originally covered with a heavy growth of timber, though much of the surface has been cleared and brought under cultivation since the first settlement of the county. The soil on the rolling

uplands is a chocolate-colored clay loam, usually very productive, bringing good crops of corn, wheat, oats and grass annually.

With a judicious system of cultivation, and a proper rotation of crops, these uplands can be easily kept up to a high standard of fertility. There are some small upland prairies along the western borders of the county, the soil of which does not differ very much from that of the timbered lands adjacent thereto.

RICHLAND COUNTY.

Richland county embraces a superficial area of about three hundred and fifty square miles, and is bounded on the north by Jasper and Crawford counties, on the east by Lawrence, on the south by Wabash, Edwards and Wayne, and on the west by Wayne and Clay counties. There are no large streams in the county, but some of the northern affluents of the Little Wabash drain the western, and the western branch of the Bonpas creek the southeastern portion of the county. The main stream of the Little Wabash also skirts the southwestern border of the county for the distance of about eight miles. The surface of the county is generally rolling, and its area is nearly equally divided into prairie and timbered land, the latter forming belts along the courses of the streams from one to three miles in width, and the prairies occupying the higher or table lands between the main water-courses. The elevation of the prairies above the beds of the principal streams ranges from fifty to about a hundred feet. The southeastern portion of the county on the head waters of the Bonpas is quite broken, and is underlaid by the heavy beds of sandstone and shale intervening between coals 12 and 13, which attain here a thickness of seventy to eighty feet, or more. In the central and western portions the surface is seldom so broken as to render it unfit for cultivation.

The geological formations of this county comprise a moderate thickness of Drift clay, sand and gravel, that is everywhere found immediately beneath the soil, except in the creek valleys, where this superficial material has been removed by eroding agencies; and a series of sandstones, shales, etc., embracing an aggregate thickness of 250 to 300 feet, which belongs to the upper Coal Measures, and includes the horizon of three or four thin seams of coal.

The Drift clays are somewhat thicker in this county than in Lawrence, and the bowlders are more numerous and of larger size. Below the brown gravelly clays that usually form the subsoil on the uplands, and range from ten to twenty feet in thickness, there is in

many places a bed of hard, bluish-gray, gravelly clay, or "hard pan" as it is frequently termed, and below this at some points there is an old soil or muck bed, underlaid by from one to five feet or more of quicksand. Limbs and trunks of trees are frequently found embedded in this old soil in which they probably grew, or in the bluish-gray hard pan immediately above it, but to the present time no authentic specimens of animal remains have been found in them in this State, sufficiently well preserved for identification. Some small fresh-water and land shells have been found in the quicksand in other portions of the State, but they did not prove to be specifically distinct from those now living.

Coal Measures.—From the meager outcrops to be seen on the small streams in this county, it would not be possible to construct a continuous section of all the beds that should be found here, but fortunately a boring has recently been made at Olney, which will aid us materially in ascertaining the general character of the formations that underlie the southern and eastern portions of the county to the depth penetrated by the drill. This boring for coal was made by Mr. Crane, to whom I am indebted for the following report of the beds passed through:

		Feet.	In.
1.	Soil and drift clay	13	
2.	Yellow sandstone	28	
3.	Gray sandstone	2	6
4.	Black shale (horizon of coal No. 13?)	4	
5.	Clay shale	29	
6.	Hard rock (probably sandstone)	48	
7.	Clay shale with black slate	25	
8.	Hard sand rock	3	
9.	Clay shale	28	
10.	Hard rock (probably sandstone)	36	
11.	Clay shale	22	
12.	Black shale and coal (No. 12?)	2	
13.	Clay shale	31	
14.	Limestone	4	
15.	Shale, partly calcareous	23	
16.	Limestone	3	
17.	Hard rock (probably sandstone)	36	
		337	6

Two miles and a half south of Olney, in the vicinity of Boden's mill, located on the S. E. qr. of sec. 15, T. 3, R. 10 E., there is an outcrop of thin coal in the creek bed, overlaid by the following strata:

	Feet.	In.
Brown sandstone	10 to 12	
Black shale with concretions of blue septaria	4 to 6	
Blue clay shale	5	
Hard siliceous limestone with broken plants	2	
Clay shale with concretions of limestone	3	
Coal, No. 13 of general section		6

The black shale in this section is probably identical with No. 4 of the Olney boring, and the thin coal below was wanting there, or else was passed without observation. Some of the limestone concretions contain fossils, among which I identified *Productus Nebrascensis, Bellerophon carbonarius, Aviculopecten*, etc. The band of hard siliceous limestone found at this locality is a very durable stone, and has been quarried for building purposes. It is a refractory stone to work, but may be relied on for culverts and bridge abutments, where an ordinary sandstone would yield to atmospheric influences.

One and a half miles south of Clermont there is an outcrop of the following beds, probably representing the same strata seen at Boden's mill, south of Olney:

	Feet.
1. Shale	1 to 2
2. Hard calcareous sandstone	4 to 8
3. Blue shale, with calcareous nodules	3 to 4
4. Black laminated shale, extending to the creek level	4

The quarry here belongs to the O. and M. railroad, and an immense amount of stone has been quarried from the calcareous sandstone, No. 2 of the above section, to be used in the construction of culverts and bridges on that road. The quarry is near the center of Sec. 16, T. 3, R. 14 E.

On Mr. P. Berry's place, on the S. E. qr. of Sec. 11, T. 2, R. 14 E., coal has been mined for several years in a limited way by stripping the seam along its outcrop in the valley of a small stream, a tributary of the Bonpas. The coal is about 18 inches thick and of good quality, and is overlaid by a few inches of soft bituminous shale and an argillaceous, shelly limestone which contains *Productus costatus, P. punctatus, P. Prattenianus, Spirifer cameratus*, etc. The shale contains *Chonetes variolata, Orthis Pecosi, Lophophillum proliferum, Trematopora*, joints and plates of *Crinoidea*, etc. This coal is also mined by Mr. Stover on the N. E. qr. of the same section. This is probably coal No. 12 of the general section, and must have been passed through in the boring at Olney, and may be represented by No. 12 of the boring at that point.

About five miles northeast of Olney coal has been found on the open prairie at a depth of about 22 feet below the general surface level. It was first discovered in digging a stock well, and subsequently an inclined tunnel has been driven down to the coal and preparations made to work it in a systematic way. If the seam retains an average thickness of three feet, it will prove of great value to the county. The roof consists of clay shale, with some limestone in

bowlder-like masses, though it is possible the limestone masses thrown out in opening the tunnel may belong to the Drift clays, and not to the roof shales of the coal. This tunnel is on Mr. Combs' place, but the coal has also been found on the adjoining place belonging to Mr. Shooks. On another farm a little farther to the west, on Sec. 18, T. 4 N., R. 10 E., a double seam was reported to have been passed through in a bore but a short distance below the surface, the upper one two feet and the lower one three feet in thickness, with a space of about fifteen feet between them. These coals, if there are really two distinct seams here, must be about the horizon of No. 15 of the general section, and this is probably about the southern line of outcrop for these coals, as no indications of their presence was found in the boring at Olney or in sinking wells about the city, and from the topography of the surface I am inclined to believe the surface level where these coals have been found is at least forty or fifty feet above the level at Olney.

Prof. Cox notes the following sections at points I did not visit:

"Section at B. F. Heap's sandstone quarry on Sec. 34, T. 4, R. 10 E.:

	Feet.
Soil and Drift	8
Soft buff sandstone	3
Hard gray building stone	4

The gray sandstone is very hard and takes a good finish, stands well, but is somewhat marred by carbonaceous spots. At Andy Darling's quarry, two miles west of Olney, the quarry rock is overlaid by 8 feet of buff siliceous shale, beneath which is a heavy-bedded buff sandstone that was quarried for the masonry on the O. and M. railroad at the time of its construction.

On Sec. 18, T. 3, R. 10, on Big creek, found the following section:

	Feet.
Covered slope	25
Shaly sandstone	5
Heavy-bedded sandstone	10
Black bituminous shale	3

A quarter of a mile down the creek a soft buff sandstone in heavy beds from four to ten feet thick, alternate with thinner beds of hard bluish sandstone. At Higgins' mill, on Sec. 34, T. 3, R. 14, in his well, located on the slope of a hill rising to the north from Bonpas creek, sixteen feet of sandstone was passed through, and a coal seam below it reported to be twenty inches thick. Shaly sandstone and clay shale were seen overlying the heavy-bedded sandstone a few hundred yards above the mill. The hills along the Bonpas are from twenty to sixty feet high, composed in part of Drift deposits

consisting of yellowish clay with gravel and small bowlders, the latter seldom exceeding five or six inches in diameter.

At Wilson Law's coal bank, on Sec. 16, T. 2, R. 14, the section is as follows:

	Ft.	In.
Soil and Drift	10	
Buff sandstone and shale	5	
Bluish-gray limestone	2	
Shale	0	2
Coal	1	8

The shale over the coal was filled with fossil shells, corals, etc. The limestone over this coal was also seen three miles northwest of Law's place, where it was formerly quarried and burned for lime.

A quarter of a mile below the Big Creek bridge, south of Olney, found the following section:

	Feet.
Soil and Drift	15
Coarse, irregularly-bedded sandstone	15
Black marly shale	13

The lower part of the black shale was slaty, and contained numerous fossils: *Pleurotomaria tabulata, P. Grayvillensis, Bellerophon percarinatus, B. Montfortianus, B. carbonarius, Athyris subtilita, Productus longispinus, Nucula ventricosa, Orthoceras Rushensis* and *Lophophyllum proliferum.* At. James C. Stewart's place, four and a half miles southwest of Olney, a black shale outcrops in the banks of Sugar creek about five feet thick, underlaid by a thin coal. A quarter of a mile below at the bridge saw the same conglomerate sandstone that occurs on Big creek, underlaid by the same black shale, which was sometimes marly and contained the fossils mentioned above. It also contains large nodules of impure limestone."

This bituminous shale and thin coal probably represents coal No. 13 of the general section, and this same group of fossils occurs in connection with this coal on the east fork of Shoal creek, in Montgomery county.

Economical Geology.

Building Stone.—Sandstone of a fair quality for ordinary use is quite abundant, and there is probably not a township in the county where good quarries could not be opened at a moderate expense. Many of these localities have been mentioned in the preceding pages, and but little needs to be said farther in regard to them. The quarries south of Clermont, belonging to the O. and M. railroad, afford a very hard and durable rock, and although the bed is only about six feet in average thickness, it is, fortunately, so situated as

to require no great expenditure in stripping, and the rock has already been removed over a surface of several acres in extent. The rock is a very hard, gray, micaceous sandstone, and seems to be but little affected by long exposure, and hence affords a desirable material for culverts, bridge abutments, etc. The sandstones in the northern and western portions of the county are, for the most part, rather soft, but locally they afford some good building stone, as at Heap's quarry, northeast of Olney, and at Darling's quarry, two miles west of that town. The stratum of hard, siliceous limestone outcropping on Big creek, two miles and a half south of Olney, is a durable stone, but is not to be obtained in sufficient quantity to be of much importance as a building stone.

Coal.—There are two coal seams cropping out in this county that promise to be of some value in supplying the local demand for fuel, and the upper one, if its thickness at the outcrop should be found persistent over any considerable area, will furnish all needed supplies for the county for many years to come. The lower seam, which outcrops on the headwaters of the Bonpas, in the southeastern portion of the county, and has been referred to No. 12 of the general section, ranges from sixteen to twenty inches in thickness, and has only been worked by stripping in the creek valleys where it outcrops. It affords a coal of good quality, but unfortunately is generally too thin to be mined profitably in a systematic way. The other seam, five miles northwest of Olney, is about three feet in thickness, and an inclined tunnel has been carried down to it, and preparations made for working it systematically for the supply of the Olney market. This is probably the Shelbyville seam, No. 15 of the general section, which is the thickest seam in the upper Coal Measures, and usually quite persistent in its development. In Shelby county this seam affords a semi-block coal of fair quality, hard enough to be handled without much waste, and tolerably free from sulphuret of iron, but showing thin partings of selenite on transverse cleavage.

The thickness of the sandstones, shales, etc., intervening between coals 12 and 15 in the valley of the Okaw is about 235 feet, but in this county it is probably somewhat less, though this point could only be determined approximately from the lack of continuous outcrops of the intervening strata. The main coals of the lower Coal Measures are probably from six hundred to a thousand feet below the surface at Olney, and it would require an expenditure of capital to open and work them that the present demand for coal would not justify. If the seam northeast of Olney should be found to retain

an average thickness of three feet over any considerable area, it will furnish an abundant supply for all the present demands for coal in this county.

Lime.—No limestone was seen in this county that seemed well adapted for use in the lime-kiln, though some attempts have been made to use the rock overlying coal No. 12, on the Bonpas, for that purpose. It is usually too argillaceous to slack freely when burned, and at best would only produce a very inferior quality of lime.

Soil and Agriculture.—The agricultural facilities in this county are similar to those of the counties adjoining, and do not require any extended notice in this place. The surface is generally rolling, and pretty equally divided into timber and prairie land. The prairies are usually small, and possess a rich productive clay-loam soil, that will never require manuring if properly cultivated, with a judicious system of rotation of crops. The soil on the timbered lands is less uniform in quality than on the prairies, and its character is generally well indicated by the growth of timber. Where this is mainly composed of two or three varieties of oak and hickory, the soil is thin and poor, and will require frequent applications of manure or other fertilizers to keep it up to the ordinary standard of productiveness for western lands. But where the timber growth is largely interspersed with elm, black walnut, linden, wild cherry, persimmon, honey locust, etc., the soil is good, and will rank favorably with the best prairie lands in its productive qualities. A large portion of the timbered land in the county is of this quality, and when cleared and brought under cultivation, it produces nearly or quite as well as the best prairie land.

I am indebted to Mr. J. B. Wolf, of Olney, former county surveyor, for much valuable information, and for personal attention and assistance while at work in the county.

CHAPTER XXII.

WABASH AND EDWARDS COUNTIES.

Wabash and Edwards are two of the smallest counties in the State, and lying contiguous to each other on its southwestern borders, they may very properly be described together. Their aggregate area is about four hundred and twenty-five square miles, and their boundaries are as follows: Wabash is bounded on the north by Lawrence and Richland counties, on the east and south by the Wabash river, and on the west by the Bonpas creek. Edwards county is bounded on the north by Richland county, on the east by Bonpas creek, on the south by White county, and on the west by Wayne. The only streams of any importance are those forming in part their respective boundaries, the Wabash river, by a southwesterly course, bounding Wabash county on the east and south, and the Bonpas creek, with a course nearly due south, forming the dividing line between them. The latter stream winds its sluggish course through a broad alluvial valley, showing no outcrops of the underlying rock formations except at rare intervals. Along the Wabash, exposures of the rocky strata are more numerous, but as the course of the river is nearly on the trend of the underlying formations, but a limited thickness of strata can be seen along the bluffs of this stream. The surface of the uplands is generally quite rolling, but there are some limited areas of rather flat timbered lands above the level of the river bottoms, and forming what may properly be termed terrace lands.

Both counties are heavily timbered, though there are some small prairies within their limits. A complete list of the trees and shrubs indigenous to Wabash county has been furnished for this report by Dr. J. Schenck, of Mt. Carmel, which will be found further on. It is peculiarly interesting because it shows the presence here of some

species hitherto supposed to belong exclusively to a more southern latitude.

The geological formations to be seen in this county belong to the Quaternary and the upper Coal Measures. The former is more fully developed along the bluffs of the Wabash than elsewhere, and consist of the buff and yellow marly sands and clays of the Loess, and a moderate thickness of the gravelly clays of the Drift formation.

On the lower course of the Bonpas, in the vicinity of Grayville, and in some of the valleys of the smaller streams, stratified clays are found at the lowest levels seen, which may belong to an older deposit than the Drift, and a heavy bed of this kind is reported to have been passed through in the boring southwest of Mount Carmel, but as it was overlaid by sandstone, and no rock of this kind is known in this county of more recent age than the Coal Measures, I am inclined to doubt the correctness of the report. However, it is by no means improbable that there are old valleys along the Wabash, as well as the Mississippi and Ohio, that were filled originally with Tertiary or Cretaceous deposits, some of which still remain, and are now hidden by the subsequent accumulations of Loess and Drift. Indications of the existence of such beds have been found on the Ohio as far north as Louisville, and on the Mississippi for more than two hundred miles above St. Louis, the evidences being well preserved shark's teeth, found at various points within the region specified, some of which are too fragile and delicate to have been transported for long distances by Drift agencies without destruction. The reported sandstone above the clay in the boring is most probably a Coal Measure bed, and the reported clay beneath it may be a soft clay shale of the same age, such as is frequently met with in the coal-bearing formations. At Mount Carmel the Loess and Drift clays are about thirty feet in thickness, which is probably about the average in the vicinity of the river bluffs, while on the uplands, remote from the river, their average thickness is not more than fifteen to twenty feet, and at many points much less.

In Edwards county the Quaternary beds present the same general character, and are considerably thicker in the bluffs on the lower course of the Bonpas than in the central and western portions of the county, where we only find from ten to twenty feet of buff or brownish gravelly clays overlying the bed rock. Near Grayville the creek banks show outcrops of five to ten feet or more of stratified clays, variously colored, and seemingly derived from the decomposition of the clay shales of the Coal Measures, and above these we find

from twenty to thirty feet of Loess, possibly covering a nucleus of gravelly Drift clay. To the north and west the Loess is not conspicuous, and in digging wells the bed-rock is usually reached after passing through ten or fifteen feet of brown Drift clays.

Coal Measures.

In the bluffs of the Wabash river, at Mount Carmel, there is an outcrop of sandstone forming the lower portion of the bluff, underlaid by a blue clay shale but partially exposed.

The following is a section of the bluff at this point:

	Feet.
Loess and Drift clays	30
Soft, shaly, micaceous sandstone	13
Massive sandstone, partly concretionary	20
Blue clay shale—partial exposure of	3 to 6

Springs of water issue from the base of this sandstone, indicating the impervious character of the underlying beds, even where there is no outcrop of the shales. Locally the concretionary sandstone contains geodes of oxide of iron, filled with a greenish or buff-colored clay. The base of the above section is some fifteen or twenty feet above the low-water level of the river, and the intervening beds of which are probably shales, are not exposed. A boring was made here for coal under the direction of Mr. J. Zimmerman, to whom I am indebted for the following section of the beds passed through, and as the work was done with a hollow drill and prosecuted very carefully, the section is probably a very correct one. The bore was commenced just above the low-water level of the river, and something like fifteen feet below the base of the foregoing section, and passed through the following beds:

		Feet.	In.
No. 1.	Shale	2	
No. 2.	Sandstone	2	
No. 3.	Clay shale	4	
No. 4.	Sandstone	35	
No. 5.	Micaceous sandstone	0	10
No. 6.	Hard, fine sandstone	4	
No. 7.	Fire-clay ?	1	
No. 8.	Coal and bituminous shale	0	4
No. 9.	Fire-clay	9	
No. 10.	Argillaceous sandstone	2	
No. 11.	Blue shale	1	4
No. 12.	Fire-clay	3	10
No. 13.	Calc. shale and sandstone	32	
No. 14.	Calc. shale, with black streaks	20	
No. 15.	Blue clay shale	36	
No. 16.	Blue fire-clay	4	2
No. 17.	Coal	0	7

		Feet.	In.
No. 18.	Fire-clay	3	
No. 19.	Argillaceous limestone	5	
No. 20.	Hard sandstone, parting	0	1
No. 21.	Hard gray limestone	2	2
No. 22.	Hard gray limestone	1	8
No. 23.	Very hard llmestone	2	
No. 24.	Calcareous shale	1	8
No. 25.	Band of ironstone	0	3
No. 26.	Variegated shale	2	
No. 27.	Hard gray limestone	1	3
No. 28.	Variegated shale		3
No. 29.	Hard gray limestone	2	4
No. 30.	Variegated shale	0	3
No. 31.	Hard gray limestone	8	8
		180	8

This boring was commenced near the horizon of No. 11 coal, and the beds passed through probably extend very nearly to No. 7. The following is the report of a bore made for oil one mile and a half southwest of the court house, commencing in a creek valley:

		Feet.	In.
No. 1.	Soil, clay, etc	54	
No. 2.	Sandstone	24	
No. 3.	Clay ? (probably clay shale)	45	
No. 4.	Sandstone	2	
No. 5.	Bituminous shale	32	
No. 6.	Sandstone	1	6
No. 7.	Bituminous shale	10	
No. 8.	Sandstone	2	
No. 9.	Bituminous shale	5	
No. 10.	Sandstone	3	
No. 11.	Bituminous shale	4	
No. 12.	Sandstone	1	4
No. 13.	Bituminous shale, showing oily soot	5	
No. 14.	Sandstone	13	
No. 15.	Very hard limestone	24	
No. 16.	Bituminous shale	8	
No. 17.	Sandstone	2	
No. 18.	Coal, No. 9	2	
No. 19.	Limestone	5	
No. 20.	Shale	3	
No. 21.	Sandstone	2	
No. 22.	Mixture of sand and limestone	8	
No. 23.	Yellow shale	4	
No. 24.	Sandstone	12	
No. 25.	Clay shale, with pyrite	12	
No. 26.	Sandstone	15	
No. 27.	Bituminous shale	6	
No. 28.	Sandy shale	70	
No. 29.	Sandstone	60	
No. 30.	Micaceous sandstone	10	
No. 31.	Coal, No. 7 ?	3	
No. 32.	Bituminous shale	12	
No. 34.	Compact limestone	8	
No. 35.	Bituminous shale	7	
No. 39.	Lime and sandstone	2	
No. 40.	Bituminons shale	5	
		482	4

It is hardly possible that the beds reported as bituminous shale in this bore could be anything more than ordinary blue clay shales, and as a rule I believe that but little dependence can be placed in the reported sections of oil well borings made in this State. By comparing this section with that made for coal it will be seen that there is a wide discrepancy in the descriptions given of the strata passed through in each, and although the oil well boring was carried down to the depth of about seven hundred feet, yet no coal was reported below the three foot seam found at the depth of four hundred and fifty-five feet, which probably represents coal No. 7 or 8 of the general section. The sandstone No. 2 of the oil well boring may be the same as No. 4 in the other, but there is very little correspondence in the lower strata, considering that the distance between the points where the borings were made is scarcely two miles in a direct line.

In the bed of the river at low water there is an outcrop of micaceous sandstone No. 2, of the first boring, which contains iron nodules, some of which inclose fossil ferns, and one was found containing *Leaia tricarinata*. In the bed of the river, a little further down, an impure argillaceous limestone has been found below the river level.

At Hanging-rock bluff, about three miles northeast of Mt. Carmel, there is an outcrop of massive sandstone similar to that at the town, which projects into the bed of the river at low water, and rises above it to the height of 30 to 35 feet. Three-quarters of a mile nearly west of Hanging-rock, at Mr. Reel's place, there is an exposure of the beds above the sandstone showing the following section:

	Feet.	In.
Soft brown shale	4 to	6
Bituminous shale	1 to	3
Dark, hard bituminous limestone		3
Coal—No. 10 ?		1 8
Clay shale	1 to	2
Massive sandstone	30 to	35

The limestone here is a steel-gray, passing into black, and weathering to an olive-brown, and filled with crushed shells of small size, among which *Rhynchonella Uta* seemed to be most conspicuous. It is possible that the sandstone at Hanging-rock belongs below that at Mt. Carmel, as the beds seemed to rise to the northward, so far as we could find the rocks exposed, and this sandstone may be the bed No. 4 in the boring made at the river bank. This seems the more probable from the fact that no trace of the limestone or coal has been found above the Mt. Carmel sandstone, where it should

appear if these sandstones are identical. Furthermore, the outcrop at Hanging-rock is about a mile to the eastward of the Mt. Carmel bluff, and the general western dip of the strata would naturally bring up the lower beds in this direction. Furthermore, the rock seemed harder and appeared to be less affected by atmospheric influences at the former locality than at Mt. Carmel. If the sandstone is the same at these localities, the limestone and coal at Reel's place must be a mere local deposit; but I believe this limestone to be identical with that at Rochester mills in the river bank, which represents the horizon of No. 10 coal. On Coffee creek there is a good exposure of the beds overlaying this limestone, and the following section, commencing in the bed of the river at low-water mark, and extending up the creek for about a mile, shows the general character and relative position of the rocks in this vicinity:

		Feet.	In.
No. 1.	Coal, hard and splinty—No. 13 ?	3	
No. 2.	Space unexposed	?	
No. 3.	Brown shale	4 to 6	
No. 4.	Shaly impure limestone	1 to 2	
No. 5.	Clay shale	1½ to 2	
No. 6.	Black shale	0	6
No. 7.	Coal—No. 12	0	4
No. 8.	Black shale—No. 12	0	6
No. 9.	Coal—No. 12	0	6
No. 10.	Blue and green clay shale	2 to 3	
No. 11.	Massive gray sandstone	18 to 20	
No. 12.	Clay shale	15 to 18	
No. 13.	Black laminated shale	2 to 3	
No. 14.	Dark shaly limestone	1	
No. 15.	Coal—No. 11	0	10
No. 16.	Clay shale	3 to 4	
No. 17.	Hard, nodular, dove-colored limestone	2	
No. 18.	Soft shales	15 to 20	
No. 19.	Hard, bituminous limestone	1 to 3	
No. 20.	Coal No. 10	1	
No. 21.	Sandy shale, and sandstone in the river bed	8	

The limestone No. 19 of the above section I believe to be identical with that at Reel's place, and the sandy shale and sandstone in the river bed at Rochester mills to be the upper part of the Hanging-rock sandstone, and the sandstone at Mt. Carmel is probably the equivalent of No. 11 of the foregoing section. The upper coal on Coffee creek, No. 1 of the above section, is probably the same formerly worked by Mr. Simonds and others southwest of Mt. Carmel, and is either a merely local seam, or a division of No. 12, as there is a heavy bed of sandstone, usually from sixty to eighty feet in thickness, intervening between coals 12 and 13, of which there was no trace here, the covered space represented by No. 2 of the section not exceeding 8 to 10 feet in thickness. It is possible

that the outcrop of No. 1, which was only some two or three hundred yards from the outcrop of Nos. 7, 8 and 9, may be only a thickening and reappearing of the same seam at a little higher level. The outcrop at the highest exposure was in the bed of the creek, and no roof but sand and gravel was found above the coal. The shaly brown limestone No. 4 of this section contained a few fossils, among which I noticed *Spirifer cameratus, Lophophyllum proliferum* and joints of *Crinoidea.* The hard, dove-colored limestone contained numerous examples of *Productus Prattenianus, Aviculopecten Clevelandicus,* and a small branching coral.

The old coal shaft on Mr. Simond's place, about three miles southwest of Mt. Carmel, has been abandoned for some time, and the sides have fallen in, so that nothing could be learned when I was there in regard to the thickness or quality of the coal, except from those who had worked in the mine when it was in operation. The seam is said to average about three feet in thickness, and lays from 30 to 35 feet below the surface.

Section of Simond's coal shaft:

	Feet.	In.
Drift clay and soil	5	6
Argillaceous shale	30	
Limestone	0	6
Coal	3	

This seam has been opened by several parties in this neighborhood, but the shafts have all been abandoned. This coal probably corresponds to coal 11 or 12 of the general section.

At Hershey's old mill, on Raccoon creek, there is an outcrop of the same fossiliferous shales found at Lawrenceville and Grayville, associated with coal No. 11. The section here shows the following beds outcropping in the bluffs of the creek:

		Feet.
No. 1.	Brown sandy shales and sandstone	8 to 10
No. 2.	Blue and gray shales, the lower part argillaceous	20 to 25
No. 3.	Blue fossiliferous shale, with iron nodules	3
No. 4.	Black laminated shale	1 to 2
No. 5.	Dark, bituminous limestone	0 to 2
No. 6.	Black laminated shale	1½ to 2
No. 7.	Blue clay shale	6

The argillaceous shales No. 2 of the above section contain numerous bands of argillaceous iron ore, which are more numerous in No. 3, and contain the same species of fossils that occur in the shale. I obtained here the following species: *Pleurotomaria tabulata, P. sphærulata, P. Grayvillensis, Bellerophon carbonarius, B. percarinatus, Polyphemopsis peracuta, Lophophyllum proliferum, Dentalium obsoletum, Orthoceras Rushensis,* and *Macrodon carbonaria.*

At Allendale this fossiliferous shale was found in a well sunk near the railroad, overlaid, as at Hershey's mill, by sandy shales and sandstone, which is found in sinking wells in the higher portions of the town. In one well near the summit level a thin coal 8 inches thick was passed through, with two feet of clay shale above it, and about the same thickness of fire-clay below. In the vicinity of Oriole the sandstone above this thin coal is found at several places, and quarries have been opened in it for building stone, flag-stones, etc. It probably underlays all the highlands in the northwest portion of the county.

At James McNair's well, one mile and a quarter north of Friendsville, the following beds were reported from memoranda furnished by Mr. J. Zimmerman:

	Ft.	In.
Soil and clay	18	
Impure coal—probably bituminous shale	2	
Clay shale, with iron nodules	3	
Hard sandstone	0	8
Gray sandstone, in even beds, 4 to 8 inches thick	15	
Sandy shales	11	
Hard sandstone in two layers	2	8
Dark bituminous shale	3	
Coal, said to be good	2	
	57	4

At Mr. Gilkerson's well, in the same neighborhood, after reaching the coal found at the bottom of McNair's well, a boring was made to the depth of 9 feet below the coal. The material obtained from the boring was a milk-white substance resembling fire-clay.

At Hamiker's old mill on the Bonpas, a little north of west from Allendale, a bed of bituminous shale outcrops at the base of the bluff, overlaid by a conglomerate of ferruginous pebbles and a rather soft, thin-bedded sandstone. The section here is as follows:

	Feet.
Soft, thin-bedded sandstone and shale	15
Ferruginous conglomerate	3 to 4
Hard black shale	2 to 3

The black shale extended below the bed of the creek, and I could not learn that any coal had been found underneath it here. These beds resemble the outcrop at the iron bridge on the Little Wabash, between Albion and Fairfield.

Prof. Cox reports the following sections at points I did not visit:

"On Sec. 5, T. 10, R. 12, there is a bed of light-blue clay, very plastic, exposed in the bank of Crawfish creek, as shown in the following section:

	Ft.	In.
Soil, calcareous shale and limestone	16	
Coal	0	8
Blue clay	4	
Sandstone in the bed of the creek	?"	

The calcareous shales above the coal contains the same species of fossils enumerated from the locality on Raccoon creek at Hamiker's old mill, indicating the horizon of coal No. 11.

"At Emanuel Reel's place, on Sec. 8, T. 1 S., R. 12, blue limestone at the foot of the hill one foot thick, underlaid by a thin coal. Bluish shale and sandstone in the hill forty feet above. The well at the house went through soil and drift 10 feet, clay shale 4 feet, sandstone 29 feet.

At Little Rock, on the Wabash river, Sec. 19, T. 1 N., R. 11 W.:

	Feet.
Shale and covered slope	80
Sandstone in solid bed	30"

This hill forms a conspicuous landmark on the river, and the sandstone at the base is probably the same as that found at St. Francisville, a little higher up the river, in Lawrence county.

EDWARDS COUNTY.

The outcrops of rock in this county are few and widely separated, and no continuous section of the beds could possibly be made from surface exposures only. The sandstones and shales intervening between coals No. 11 and 13 are probably the prevailing rocks. The following beds may be seen in the vicinity of Albion, in the railroad cut and on the small creek that intersects the town:

	Feet.	In.
Shale and shaly sandstones, with a pebbly bed at the bottom	20 to 25	
Sandstone, locally hard and concretionary	8 to 12	
Streak of bituminous shale	0	3
Hard nodular limestone	2	
Shale, with bands of argillaceous iron ore	4 to	6
Hard shaly sandstone	3 to 4	

The concretionary sandstone is their main quarry rock here, and it is sometimes quite hard, and affords a very durable material for foundation walls. Above this there are some layers of even-bedded sandstone that, although rather soft when first quarried, become harder after exposure and make a fair building stone.

At Dr. Smith's place, four miles north of Grayville, on the west bank of the Bonpas creek, the hill rises to an elevation of about a hundred feet, but the beds forming its upper portion are hidden beneath a covered slope. A thin coal is found in this hill at an

elevation of thirty-six feet above the bed of the creek, which is underlaid by sandy shales and sandstones that form a precipitous cliff to the creek bed. The coal is about 8 inches thick and of good quality, and is underlaid by a light-gray fire-clay. The sandstone and shale below this coal are the equivalents of the beds above the fossiliferous shale in the Grayville section, and the fossil bed of that locality would no doubt be found here a little below the creek bed. The thin coal found here has also been met with in sinking wells at Grayville in the upper part of the town. About half a mile above this, on the same side of the Bonpas, the same beds outcrop again where an old mill was formerly located. At the base of the bluff here there is from ten to twelve feet of blue shales partly argillaceous, and passing upward into a sandy shale and sandstone twenty feet or more in thickness, with a partial outcrop of the thin coal and bituminous shale still higher up. This coal probably corresponds to the ten-inch seam, No. 15, of the Coffee creek section.

At Mr. Nailor's place, six miles northwest of Grayville, a coal seam was opened many years since, and successfully worked for a time to supply the local demand for coal. It is probably the same seam worked by Simonds and others southwest of Mount Carmel. The seam is said to be about thirty inches thick and the coal hard and splinty, partaking of the block character.

At the ford on the Little Wabash, eight miles northwest of Albion, on the S. W. qr. of Sec. 7, T. 1 S., R. 10 E., there is an outcrop of a thin coal associated with the following beds:

		Feet.	In.
1.	Brown ferruginous clay shales	10 to 12	
2.	Brash coal	0	10
3.	Clay shale	0	8
4.	Brash soil	0	10
5.	Shale with numerous bands of iron ore	4	
6.	Gray sandy shale	6	
7.	Iron conglomerate in river bed	1	

The shale No. 5 of the foregoing section contains considerable clay iron ore of a fair quality, amounting to nearly or quite one-half of the whole thickness of the bed. If the quantity of the iron in this shale should, on drifting into the bluff, prove continuous for some distance, it would eventually justify the erection of an iron furnace in this vicinity. At another old ford, about a mile further up the river, the same coal outcrops in connection with a thin bed of nodular argillaceous limestone of a light-gray color, weathering to a yellowish-brown on exposure.

Five miles northwest of Albion, on the N. W. qr. of Sec. 22, T. 1 S., R. 10 E., an argillaceous limestone similar to that above mentioned, but rather darker colored, is found underlying a bed of bituminous shale, as shown in the following section:

	Feet.	In.
Sandy shale and thin-bedded micaceous sandstone	10 to 12	
Bituminous shale	1 to 1	6
Nodular argillaceous limestone	2 to 3	
Gray sandy shale with bands of ironstone	3 to 4	

This outcrop seems to be on the same horizon with the beds at the Wabash ford, the coal found there being represented here by the bituminous shale of the above section. The thin-bedded sandstone has been quarried here for building cellar walls, foundations, etc., and seems to be the best material in the neighborhood for such purposes.

At Mr. Hartman's mill, on the east side of the town of Albion, there was a boring made for oil some years since, of which the following is a reported section:

	Feet.
Clay and soil	7
Shale	49
Coal	1
Blue shale	107

The boring was ended in a hard rock, the character of which was not determined. It was made in the creek valley in which the mill is situated, and the first shale struck was probably the upper part of that forming the base of the Albion section given on a preceding page.

Prof. Cox reports the following section at Beal's mill, on Blockhouse creek, a branch of the Bonpas, in the east part of the county:

	Ft.	In.
Drift	5	
Gray shale with clay iron ore	12	
Siliceous iron ore	1	
Blue argillaceous shale	5	
Black bituminous shale	1	6
Impure limestone	0	6
Coal in the bed of the creek	0	8

All the beds represented by the foregoing sections in these two counties belong between coals Nos. 10 and 13, and do not attain an aggregate thickness of more than 150 to 200 feet.

Economical Geology.

Building Stone.—A fair quality of building stone may be obtained from the sandstones outcropping in various portions of these two counties, as indicated in the sections given on the preceding pages.

The best is probably that from the even-bedded brown sandstone above No. 11 coal, that is found in the northern and northwestern portions of Wabash, and the central and northern portions of Edwards.

Quarries have been opened in this sandstone in the vicinity of Oriole, in Wabash county, where a good evenly-bedded rock is obtained, the thin layers affording a good flagstone, and the thicker beds material suitable for foundation walls, etc. This sandstone probably underlies all the ridges and highlands in the northwest part of the county, and will be found accessible at many points as the demand for building stone increases. The sandstone in the river bed at Rochester has also been quarried to a limited extent, and quarries have been opened at Walden's place, between this point and Mt. Carmel, where a fair quality of sandstone has been obtained from a bed that is seemingly the equivalent of the sandstone in the Mt. Carmel bluff.

In the vicinity of Albion sandstone of a fair quality is obtained at several points, some of which is concretionary and very hard, yielding a very durable stone. This concretionary character is not persistent, however, but the rock passes locally into a thin-bedded sandstone or sandy shale. No limestone was seen in either county that could be recommended as a building stone, although that found at Rochester mills, and at Mr. Reel's place, north of Mt. Carmel, has been used to some extent in the neighborhood of these outcrops. The rock is argillaceous and locally highly bituminous, and is liable to split into fragments by long exposure.

Coal.—The upper coal seam in the Coffee Creek section was the only outcrop we were able to find in either of these counties that promised to be of any value for practical coal mining. The coal in this seam ranges from thirty inches to three feet in thickness, and appears to underlie a considerable area in the south part of Wabash and the southwestern part of Edwards. Several shafts have been sunk to this coal about three miles southwest of Mt. Carmel, where the coal is found from thirty to thirty-five feet below the surface. This seam affords a hard splinty or semi-block coal of fair quality, and with judicious management it might be worked to advantage, either by a shaft, or perhaps better by an inclined tunnel. The roof seems to be good, and if the thickness of the coal is all uniform, I see no reason why it may not be made to yield a fair return for the labor and capital required to put a mine in successful operation where the coal lies so near the surface. This is probaby the same coal worked at Mr. Nailor's place in the southeast part of

Edwards several years since, for the supply of Albion and the adjacent region.

No attempt has as yet been made to reach the lower seams in either of these counties, except at Mt. Carmel, where a boring was made to the depth of 180 feet, but this did not go deep enough to reach No. 7, which is the uppermost of the main seams. It commenced about the horizon of coal No. 10 or 11, and the depth from this horizon to No. 7 is probably from two to three hundred feet.

Iron Ore.—Bands of argillaceous iron ore are found disseminated more or less abundantly through many of the shale beds in these counties, but usually in too limited quantities to be of much value. At the ford eight miles northwest of Albion, on the S.W. quarter of Sec. 7, T. 1 S., R. 10 E., there is a larger quantity of iron ore than was seen elsewhere in this region. The shale bed is four feet thick, and nearly or quite one-half of this thickness is a clay iron ore of fair quality. Several tons of ore may be collected from the *debris* at the foot of the bluff, where it has been washed out of the shale by the river current. Twenty inches of coal of a fair quality immediately overlies the ferruginous shale.

Potters' Clay.—Potters' clay of fair quality is found in the bank of Greathouse creek, near Mt. Carmel, and a bed of fine white clay also occurs on Crawfish creek, on Sec. 5, T. 1 S., R. 12. E. This bed is four feet thick, and appears like a good fire-clay.

Brick Materials.—Good brick clay is abundant in almost every neighborhood, and sand suitable for mortar and cement may be found in the river bluffs, as well as in some of the creek valleys.

Soil and Timber.—The soil on the rolling upland is a chocolate-colored clay loam, well charged with humus from the decomposition of organic matters, and very productive, especially in wheat, oats and grass.

In the vicinity of the Wabash bluffs the character of the soil is modified by the sandy marls of the Loess upon which it rests; but these soils are very quick and productive, yielding annually large crops of all the cereals usually cultivated in this climate. Along the Wabash and Bonpas there are extensive tracts of heavily timbered bottom lands that have a deep alluvial soil with a sandy subsoil. These lands are very productive when cleared and brought under cultivation, and are decidedly the best corn lands in this portion of the State. They are subject to annual overflow from the river freshets, but these usually occur in the early spring time, and seldom interfere with the production of the usual crops. These two counties, though limited in area, have a thrifty and wealthy popu-

lation devoted mainly to agriculture, the Wabash river and the intersecting railroads furnishing all needed market facilities.

I am indebted to Mr. J. Zimmerman, of Mt. Carmel, for much valuable information and assistance while engaged in my examinations in this vicinity, and to Dr. Schenck for the following complete list of the trees and shrubs indigenous to Wabash county:

A List of the Forest Trees and Shrubs found in Wabash County.

Acer rubrum, L., (*Red* or *Swamp Maple.*)
Acer dasycarpum, Ehrhardt, (*White* or *Sugar Maple.*)
Acer saccharinum, Wang., (*Common Sugar Maple.*)
Acer saccharinum, var. nigrum, (*Black Sugar Maple.*)
Æsculus glabra, Willd., *Smooth* or *Ohio Buckeye.*)
Alnus serrulata, Ait., (*Smooth Alder.*)
Amorpha fructicosa, L., (*False Indigo.*)
Asimina triloba, Dunal., (*Common Pawpaw.*)
Betula lenta, L., (*Cherry* or *Sweet Birch.*)
Betula nigra, L., (*River* or *Red Birch.*)
Carpinus Americana, Michx., (*Ironwood; Hornbeam.*)
Catalpa bignoniodes, Walt., (*Catalpa; Indian Bean.*)
Carya oliyæformis, Nutt., (*Pecan nut.*)
Cary alba, Nutt., (*Shellbark* or *Shagbark Hickory.*)
Carya microcarpa, Nutt., (*Small-fruited Hickory.*)
Carya tomentosa, Nutt., (*Mockernut; White-hearted Hickory.*)
Carya procina, Nutt., (*Pignut* or *Broom Hickory.*)
Carya amara, Nutt., (*Bitternut* or *Swamp Hickory.*)
Celtis occidentalis, L. (*Hackberry; Sugarberry.*)
Celtis Mississippiensis, Bose., (*Mississippi Hackberry.*)
Cephalanthus occidentalis, L., (*Button bush.*)
Cersis Canadensis, L., (*Red-bud; Judas-tree.*)
Cornus florida, L., (*Flowering Dogwood.*)
Cornus sericea, L., (*Silky Cornell; Kinnikinnik.*)
Cornus paniculata, L'Her., (*Panicled Cornel.*)
Corylus Americana, Walt., (*Wild Hazelnut.*)
Corylus rostrata, Ait., (*Beaked Hazelnut.*)
Cratægus tomentosa, L., (*Black* or *Pear Thorn.*)
Cratægus tomentosa var., Mollis.
Cratægus punctata, Jacq.
Cratægus cordata, Ait., (*Washington Thorn.*)
Cratægus Crus-galli, L. (*Cockspur Thorn.*)
Cratægus veridis, L.

Diospyros Virginiana, L., (*Common Persimmon.*)
Euonymus atropurpureus, Jacq., (*Burning-bush; Waahoo.*)
Euonymus Americanus, L., (*Strawberry-bush.*)
Fagus ferruginea, Ait., (*American Beech.*)
Forestiera acuminata, Poir.
Fraxinus Americana, L., (*White Ash.*)
Fraxinus pubescens, Lam., (*Red Ash.*)
Fraxinus viridis, Michx., (*Green Ash.*)
Fraxinus quadrangulata, Michx., (*Blue Ash.*)
Gleditschia triacanthos, L., (*Three-thorned Acacia* or *Honey-locust.*)
Gymnocladus Canadensis, Lam., (*Coffee Tree.*)
Hydrangea arborescens, L., (*Wild Hydrangea.*)
Hypericum prolificum, L., (*Shrubby St. John's Wort.*)
Ilex decidua, Walt.
Juglans cinerea, L. (*Butternut.*)
Juglans nigra, L. (*Black Walnut.*)
Juniperus communis, (*Common Juniper.*)
Lindera Benzoin, Meisner, (*Spice-bush; Benjamin-bush.*)
Liquidambar Styraciflua, L., (*Sweet Gum Tree.*)
Liriodendron Tulipifera, L., (*Tulip-tree; Poplar.*)
Morus rubra, L., (*Red Mulberry.*)
Negundo aceroides, Mœnck, (*Box-elder.*)
Nyssa multiflora, Wang., (*Black Gum; Tupelo.*)
Ostrya Virginica, Willd., (*Hop-hornbeam; Lever-wood.*)
Platanus occidentalis, L., (*Sycamore; Plane-tree.*)
Populus heterophylla, L., (*Cottonwood; Downy Poplar.*)
Populus monilifera, Ait., (*Necklace Poplar; Cottonwood.*)
Populus tremuloides, Michx., (*American Aspen.*)
Prinos verticillata, Gray (*Black Alder; Winterberry.*)
Prunus Americana, Marshall, (*Wild Yellow*, or *Red Plum.*)
Prunus insitita, L., (*Bullace Plumb.*)
Prunus serotina, Ehrhardt, (*Wild Black Cherry.*)
Pyrus coronaria, L., (*Sweet-scented Crab Apple.*)
Pyrus angustifolia, Ait., (*Narrow-leaved Crab Apple.*)
Ptelea trifoliata, L., (*Wafer Ash; Shrubby Trefoil.*)
Quercus alba, L,, (*White Oak.*)
Quercus obtusiloba, Michx., (*Post Oak.*)
Quercus macrocarpa, Michx., (*Bur* or *Overcup Oak.*)
Quercus macrocarpa, var. (?) *Lyrata*, Michx., (*Lyre-leaved Oak.*)
Quercus prinus, Willd., (*Swamp Chestnut Oak.*)
Quercus bicolor, Willd., (*Swamp White Oak.*)
Quercus castanea, Muhl, (*Chestnut Oak.*)

Quercus tinctoria, Bartram, *Black* or *Tanner's Oak.*)
Quercus coccinea, Wang., (*Scarlet Oak.*)
Quercus rubra, L. (*Red Oak.*)
Quercus palustris, Michx., (*Pin* or *Water Oak.*)
Quercus nigra, L., (*Black-Jack* or *Barren Oak.*)
Quercus Phellos, L., (*Willow Oak.*).
Quercus imbricaria, Michx., (*Laurel* or *Shingle Oak.*)
Rhus typhina, L., (*Staghorn Sumach.*)
Rhus glabra, L., (*Smooth Sumach.*)
Rhus copallina, L., (*Dwarf Sumach.*)
Salix tristis, Ait., (*Dwarf Gray Willow.*)
Salix discolor, Muhl., (*Glaucous Willow.*)
Salix eriocephala, Michx., (*Wooly-headed Willow.*)
Salix petiolaris, Smith, (*Long-stalked Green Osier.*)
Salix nigra, Marshall, (*Black Willow.*)
Salix rigida, Muhl., (*Stiff-leaved Willow.*)
Sambucus Canadensis, L., (*Common Elder.*)
Sassafras officinale, Nees., (*Sassafras.*)
Staphylea trifolia, L., (*Bladder-nut.*)
Symphoricarpus occidentalis, R. Brown, (*Wolf* or *Buck berry.*)
Symphoricarpus vulgaris, Michx., (*Indian Currant; Coral-berry.*)
Taxodium distichum, Richard, (*American Bald Cypress.*)
Tilia Americana, L., (*Basswood; Linden.*)
Tilia heterophylia, Vent., (*White Basswood.*)
Ulmus fulva, Michx., (*Slippery Elm.*)
Ulmus Americana, L., (*American* or *White Elm.*)
Ulmus alata, Michx., (*Winged Elm.*)
Viburnum prunifolium, L., (*Black Haw.*)
Viburnum nudum, M., (*White Rod.*)
Zanthoxylum Americanum, Mill., (*Northern Prickly Ash.*)

CHAPTER XXIII.

WHITE AND HAMILTON COUNTIES.

White county has a geographical area of about four hundred and eighty square miles, and is bounded on the north by Wayne and Edwards counties, on the east by the Wabash river, on the south by Gallatin county, and on the west by Hamilton. The Little Wabash traverses the county from north to south through its central portion, and the Skillet Fork enters at the northwest corner, and after a southeast course enters the Little Wabash near the center of the county. These streams, with their smaller affluents, and the main Wabash river as its eastern boundary, drain nearly the whole area of the county. South of Phillipstown there is a considerable area between the Little and main Wabash rivers of rather flat land, intersected by a chain of ponds extending nearly due north and south, through townships five and six south, range ten east, which probably marks the course of an old river channel. This portion of the county is rather flat and heavily timbered. The remainder of the county is quite rolling, and portions of it south and west of Carmi are broken and hilly.

Superficial Deposits.—The Alluvium, Loess and Drift, the three principal divisions of the Quaternary, or most recent of the geological systems, are well developed in this county. Alluvial bottoms of considerable extent skirt the courses of the main and Little Wabash and Skillet Fork, but being subject to annual overflow, the land is only valued at the present time for the fine body of timber which it sustains. The soil, however, is a rich sandy loam, and when cleared and brought under cultivation will prove the most fertile land in the county.

The Loess is very heavily developed along the bluffs of the Wabash from Phillipstown to Grayville, and ranges from thirty to

sixty feet or more in thickness. It comprises a bed of brown clay immediately below the surface, of variable thickness, which is underlaid by the usual ash-gray and buff marly sands, containing the characteristic fresh-water and land shells usually found in this deposit.

The Drift deposits in this county vary from ten to thirty feet or more in thickness, and consist of brown gravelly clays, with some northern bowlders of considerable size. In the vicinity of the Little Wabash, north of Carmi, these seemed to be more abundant than elsewhere, and one was seen near the north line of the county, and about a mile east of the ford on the Little Wabash, that was fully four feet in its longest diameter, by two feet or more in the opposite direction. This is the most southerly point in the State where bowlders of this size have been seen.

Coal Measures.

The stratified rocks of this county belong to the lower part of the upper Coal Measures, and the lowest beds appearing in the county are to be seen in the bluffs of the Little Wabash, in the vicinity of New Haven and near Carmi, these two points being on nearly the same geological level. The New Haven limestone appears to be identical with the lowest limestone seen in Clark county, which there lies about seventy-five to eighty feet above coal No. 7. Here the space is probably a hundred and fifty to two hundred feet or more, with two thin coals intervening between the limestone and the main coals below. In the solid portions of this limestone fossils are comparatively rare, the only species we were able to find in an hour's search at New Haven being *Sprifer cameratus*, *S. plano-convexus*, *Productus Prattenianus*, *P. longispinus*, *Terebratula bovidens*, *Rhynchonella Uta*, *Platyostoma Peoriense*, joints of *Crinoidea*, etc. The rock is hard and brittle, and weathers to a rusty brown color. The section in the vicinity of New Haven, commencing at the base with this limestone and extending north along the small branches putting into the Little Wabash for about two miles and a half to land adjoining Mr. R. W. Boyd, and belonging to the Jones heirs, is as follows:

		Feet.	In
No. 1.	Sandstone, forming the bed-rock on top of the hills, and penetrated by Mr. Boyd, in his well	13	
No. 2.	Sandstone and sandy shale, passing downward into arg. shale (partial exposure)	40 to 50	
No. 3.	Ferro-argillaceous limestone, with fossils	0	3
No. 4.	Ferruginous shale, with fossils	0	2
No. 5.	Chocolate-brown calc. sandstone, with fossils	1	6

		Feet.	In.
No. 6.	Dark-colored shale	2 to 3	
No. 7.	Coal	0	2
No. 8.	Shaly fire-clay	2	6
No. 9.	Hard sandstone, partly in heavy beds	4 to 6	
No. 10.	Shale and thin-bedded sandstone	6 to 8	
No. 11.	Space covered, probably not more than	15 to 20	
No. 12.	New Haven limestone	3 to 4	

The three-inch band of ferruginous limestone, No. 3 of the above section, contains numerous well preserved fossils, and we obtained from it *Pleurotomaria Grayvillensis, Bellerophon carbonarius, B. Montfortianus Euomphalus subrugosus, Macrocheilus primigenius, Nucula ventricosa,* and *Polyphemopsis peracuta.* The chocolate-brown calcareous sandstone below it contains a peculiar group of fossils, among which are *Myalina ampla, Aviculopecten occidentalis, Avicula longispinus, Pinna peracuta, Schizodus Alpinus ? Edmondia Nebrascensis, Allorisma subcuneata, Bellerophon crassus, Naticopsis Pricei ? Platyceras Nebrascensis, Productus Prattenianus,* and some other undetermined forms. This bed is found at Carmi in the bed of a small branch south of the town containing the same group of fossils.

About three-quarters of a mile from New Haven, north on Rock creek, the beds numbered from two to ten of the foregoing section are well exposed, and a fair quality of thin-bedded micaceous sandstone is quarried for building purposes. From this point to Carmi by the road on the west side of the river the country is quite broken, and frequent outcrops of sandstone and shale may be seen in the hill sides and in the banks of the small streams. On Grindstone creek, seven miles south of Carmi, a bed of sandstone in rather even beds is exposed on a small branch running into the main creek from the southwest. The beds exposed are from twelve to fifteen feet in thickness, and the rock has been quarried for building stone, and some grindstones have also been made from it. Most of the beds are in tolerably even layers, but some portions of the mass show a more or less concretionary structure.

At Carmi we have a repetition of the same beds found in the vicinity of New Haven, with the upper part of the section better exposed, but only extending downwards to No. 5 of the section seen near New Haven, the lower part of that section being here below the level of the Little Wabash. Commencing with the sandstone to be seen in the north part of town, above the dam, and descending from thence along the river bluffs to the small creek just south of the town, we have the following section:

		Feet.	In.
No. 1.	Sandy shales and some sandstone in even beds	12	
No. 2.	Clay shales	16	to 18

		Feet.	In.
No. 3.	Two thin coals, parted by a foot or more of clay shale	1 to 1	6
No. 4.	Brown sandstone, quarry rock	8 to 10	
No. 5.	Band of cinnamon-shale, with *Posidonias*	0	2
No. 6.	Dark clay shale	1	
No. 7.	Gray sandy shales, passing downward into clay shale, with iron stones	18 to 20	
No. 8.	Ferro-calcareous chocolate-brown sandstone, with fossils	1½ to 2	

The lower bed of the above section was only partially exposed in the bed of the creek, where it presents the same general appearance, and contains the same group of fossils as were obtained from No. 5 of the section near New Haven. I was unable to find more than a partial exposure of it in the vicinity of Carmi. The brown sandstone No. 4 of the above section contains numerous specimens of broken plants, is somewhat ferruginous, and affords a good quality of building stone. The thin band of cinnamon-colored shale seems to have been formed from an impalpable brown mud, and on splitting it in thin layers countless numbers of minute shells like *Posidonia* are found covering the surface of the slabs.

In the banks of Skillet Fork, at Mill Shoals, there is an outcrop of thin coal, with a bituminous shale and limestone, as shown in the following section:

	Feet.
Hard shelly sandstone	3 to 4
Hard, black laminated slate, passing locally into clay shale	6 to 8
Shale, with thin coal	2 to 3
Hard, fine-grained limestone	2 to 3
Greenish, pebbly shale	2
Sandy shale, in creek bed	1

These beds afford no distinct fossils, but the limestone and black laminated slate bear a strong resemblance to beds found three miles northeast of Fairfield, in Wayne county, and two and a half miles south of Olney, which I have referred to the horizon of coal No. 13 of the general section. The cross-cleavage planes of the limestone shows *Stigmaria* rootlets, and these were the only indications of organic life we could find in it. The rock is fine-grained, of a bluish dove-color, the lower portion weathering to a yellowish-buff. The beds in the foregoing section are succeeded in the hills north and east of the station by sixty to seventy feet of shale and sandstone, with a thin bed of bituminous shale near the top of the exposure.

At Grayville, on the west bank of the Wabash river, the bluff rises to a height of more than a hundred feet above low-water level, and affords a fine section of the Coal Measure beds, as follows:

		Ft.	In.
No. 1.	Covered slope of Loess and Drift	48	
No. 2.	Heavy-bedded sandstone	15	
No. 3.	Slope, with partial outcrops of shale	25	
No. 4.	Siliceous shale	7 to 8	
No. 5.	Blue argillaceous shale, with bands of fossiliferous iron ore at the bottom	4	

		Ft.	In.
No. 6.	Bituminous shale	6 in. to 0	8
No. 7.	Calcareous shale, and shaly bituminous limestone	0 to 3	
No. 8	Black shale	6 in. to 1	
No. 9.	Green clay shales, or fire-clay	1 to 2	
No. 10.	Sandy shales and sandstone in river bed	10 to 12	

This section was taken about 300 yards below the ferry landing, and at the lowest stage of water in the river. The beds here lie in wave-like undulations, the black shale in the above section being at one point 15 feet above the river bed, and in a distance of about 50 yards they come down to within about 6 feet of the river level. In the calcareous shale No. 7 of the above section there is a thin band filled with crushed and broken specimens of a small *Myalina*, probably *M. perattenuata*. This shale is dark-colored and highly bituminous, and contains several species of crushed fossils in addition to that above mentioned, but all identical with those found in the clay iron band at the base of No. 5. Local patches of sandstone and conglomerate in lenticular masses a foot or more in thickness come in at two or three points immediately above the black shales, and where this occurs the shales are compressed into something less than one-half their normal thickness. At the upper end of this exposure the calcareo-bituminous shale No. 7 is replaced by three or four inches of blue clay shale. The thin-bedded sandstones and sandy shales in the river bed contain *Calamites*, and fragments of other coal plants, sometimes inclosed in iron concretions similar to those noticed in the river bed at Mt. Carmel. The ferruginous band at the base of the blue shale No. 5 of the foregoing section contains many fine fossil shells in a good state of preservation, and the locality has become somewhat noted on this account. The species to be found here include the following: *Nautilus occidentalis*, *N. Globatus?* *Cyrtoceras curtum*, *Dentalium obsoletum*, *Pleurotomaria tabulata*, *P. sphærulata*, *P. Grayvillensis*, *Macrocheilus primigenius*, *Ianthinopsis tumida*, *Euomphalus subrugosus*, *Nucula ventricosa*, *Astartella vera*, *Leda bella rugosa*, *Lima retifera*, *Orthis Pecosi*, and *Lophophyllum proliferum*. This is the same group of fossils found on Raccoon creek near the north line of Edwards county, at Lawrenceville in Lawrence county, and on Lamotte creek near Palestine landing, showing that the Wabash river, from the latter point to Grayville, continues on nearly the same geological level.

The exposure in the Grayville bluff affords an interesting exhibition of the variable character of the beds occurring at this horizon, and if the upper and lower extremities of this outcrop were only to be seen as separate exposures, their identity might not be suspected.

At the upper end of the hill a seam of pyritiferous shale from one to three inches thick is all that separates the black laminated shales, while at the lower end they are separated by about three feet of calcareous shale and shaly bituminous limestone. Fossils are abundant at the upper end of the exposure in clay iron ore in the lower part of No. 5 of the section, while three hundred yards below neither the iron stones nor the fossils they inclose can be found. Hence the difficulty of constructing a connected section of the upper Coal Measures from the examination of isolated outcrops, which are the only exposures of the strata to be found in this portion of the State.

On the Little Wabash, at the ford six miles west of Grayville, on Sec. 21, T. 3 S., R. 10 E., the bluff consists of sandstone and sandy shale, inclosing a bituminous shale and thin coal. The section here is as follows:

	Feet.	In.
Evenly-bedded sandstone and sandy shale	30 to 40	
Bituminous shale and thin coal	1	6
Clay shale	5 to 8	
Massive sandstone, partly concretionary	10 to 15	

A short distance below the ford the bituminous shale and coal appeared to be wanting, wedging out in a distance of about a hundred yards. The upper bed of sandstone is in part a hard micaceous rock, in even layers of moderate thickness, and will afford a good quality of building stone, as will also the concretionary bed below. About half way from Grayville to this ford, in crossing a ridge, there is from 20 to 30 feet of shales exposed, which probably overlie the sandstones at the ford, though the exact connection between them could not be determined.

Gossett station, on the Cairo and Vincennes railroad, is located on a high ridge something more than a hundred feet above the bed of Bear creek. At the summit the railroad cut shows about ten feet of coarse, soft, brown sandstone, that decomposes easily on exposure. A few feet below this sandstone a thin coal has been found at two or three places in the neighborhood, and some digging has been done here in the expectation of finding it somewhere thick enough to work to advantage, but so far without success. A section of the rocks seen in this vicinity show the following order:

	Feet.	In.
Brown clay, capping the ridge	10 to 15	
Coarse, soft, brown sandstone	10	
Space not seen, probably not more than	10 to 15	
Sandy shale	6	
Thin coal	0	4
Sandy shale	6	

	Feet.	In.
Space not seen	15 to 20	
Nodular argillaceous limestone, without fossils	1 to 2	
Sandy shale	4 to 6	
Even-bedded micaceous sandstone	6 to 8	

The lowest bed in this section affords sandstone in smooth even layers from an inch to a foot or more in thickness, which is an excellent and durable stone for flagging, foundation walls, etc., and the thickest beds could be easily cut for caps and sills. The rock at this quarry resembles that at McGilly's, a mile west of McLeansboro. No outcrop of coal of any value has yet been found in this portion of the county, and the four-inch seam in the above section is not likely to increase in thickness sufficiently to become of any practical value for mining purposes.

The following observations and sections are from Prof. Cox's notes in this county: "At the Grand Chain, one and a half miles below Black's ferry, the Wabash flows over a hard sandstone, that is here a fine-grained gray rock, excellent for building purposes. It forms a low reef across the stream, creating a strong current, and hence the name, 'Grand Chain.' On the Illinois shore the rock is but a few feet above the river bed, and is soon lost under the alluvial bottom. On the Indiana side it forms a ledge in the hills bordering the narrow bottom. At Warrick's riffle, six miles above, this sandstone is again seen at the water's edge, and on the Indiana shore, near the mouth of Rush creek, it is overlaid by a heavy bed of shale, including a soft, calcareous stratum, containing numerous fossils.

At Webb's ferry the equivalent of the Rush creek shale, alternating with shaly sandstone, again makes its appearance, and at Bonpas, a little higher up, we have the following section:

	Feet.	In.
Loess, with characteristic fossils	30	
Drift clay and gravel	2	
Buff sandstone	10	
Shale and covered space	80	
Thin coal	0	6
Fire-clay	1	6
Siliceous shale and sandstone	6	
Argillaceous shale	25	
	123	

The lower shale in the above section is first seen half a mile below the ferry, and contains fossil plants, *Sphenophyllum*, *Pecopteris* and *Neuropteris*, but too fragile to be preserved.

On the western borders of the county, opposite New Harmony, in Indiana, there is a large island formed by an arm of the Wabash,

called Fox river. This island is low and flat, and subject to overflow. Soon after crossing Fox river we ascend the Phillipstown ridge, which bears a little east of north, and strikes the Wabash river at Grayville. In this ridge we find the counterpart of the sections at Cut-off, below New Harmony, and at Grayville; but the creeks do not cut quite so deep into the argillaceous shales here, so as to show the lowest beds. Just before reaching Phillipstown, on the New Harmony road, a thin coal is seen in the bank of a branch. Below it there is a few inches of fire-clay, and then an argillaceous shale, which is seen in the bed of the branch. Above the coal, which is mostly decomposed, there is a calcareous band containing fossils similar to those found at Grayville. When first quarried this band is firm and hard, but after long exposure it becomes soft. Above the fossil band there is a few feet of argillaceous shale and a bed of sandstone, as seen in the following section:

	Feet.	In.
Yellow crumbling clay	20 to 40	
Loess with fossils	20 to 30	
Drift, with pebbles and small granite bowlders	35	
Siliceous shale	10	
Sandstone	2	
Argillaceous shale	10	
Calcareous fossil band		3
Fire-clay	1	
Thin coal and fire-clay	5	
	133	3

About a quarter of a mile southwest of this the sandstone of the above section is ten feet thick without seams. It is micaceous and soft when first quarried, but hardens on exposure and makes a good durable building stone. Two and a half miles southwest of Phillipstown this same ledge of sandstone forms a low cliff along the eastern face of the ridge and in places is weathered into caves, locally called rock houses.

On the road to Carmi the Loess is replaced by a loose yellow sand, that forms a bluff on the eastern border of a prairie, which is succeeded by a shallow slough or swamp that was probably once the bed of an arm if not the main stream of the Little Wabash.

Section on Seven-mile creek, on the Mt. Vernon road and near the ferry on Skillet Fork, sec. 30, T. 4, R. 9 E.:

	Feet.	In.
Drift clay	5 to 6	
Argillaceous shale	20	
Bituminous shale—black		10
Coal	1	
Fire-clay	3	

The black shale contained some poorly preserved specimens of *Polyphemopsis, Aviculopecten* and *Nucula ventricosa*. The argillaceous shale twenty feet or more in thickness appears again on the creek a short distance below the opening to the coal.

On Limestone creek, north of Enfield, T. 4 S., R. 8 E., there is an earthy limestone two feet thick passing down into hard siliceous fire-clay. No fossils in the upper part, but the lower part contains rootlets of *Stigmaria*. This rock has been burned for lime, and hence the name of the creek.

A thin coal is found at the following localities in this county not already mentioned: Sections 16 and 18, T. 4, R. 8; Sec. 8, T. 5, R. 10; Sec. 30, T. 4, R. 9; Sec. 21, T. 6, R. 8; Sec. 3, T. 6, R. 10; and Sec. 19, T. 3, R. 9.

Economical Geology.

Building Stone.—Sandstone of a fair quality for building purposes is found at a number of localities in this county, as noted in the sections already given in the preceding pages. At Carmi the brown sandstone that forms the bed-rock in the southeast part of the town is an even-bedded building stone. On Grindstone creek, six or seven miles south of Carmi, on the New Haven road, a bed of gray sandstone is quarried for building stone, and affords a durable stone for all ordinary purposes. Near Gossett station an excellent flagstone may be obtained as well as heavy-bedded sandstone for other purposes. This rock is micaceous and cuts freely, and could be cheaply wrought into door sills, lintels, window caps and sills, etc.

The sandstone outcropping in the bluffs of the Wabash river from Phillipstown to Grayville affords some good building stone at many points, as does that also that outcrops farther south at Grand Chain. In the bluffs of the Little Wabash, near the north line of the county, there is from thirty to forty feet of sandstone, nearly all of which might be used for building purposes, and the upper beds are in even layers of moderate thickness that could be cheaply quarried.

Coal.—No coal seam thick enough to be worked advantageously was found outcropping in the county, and the only resource of this county in that direction is in the main coals of the lower measures. These coals may be found here, in my opinion, at a depth of three to five hundred feet in any part of the county. At Carmi, and along the Wabash south of Grayville, coal No. 7 ought to be found not more than one hundred and fifty to two hundred feet below the

river level, and if that should be found too thin to be worked to advantage, about a hundred feet more would reach No. 5, one of the most persistent seams that we have in the Illinois coal basin. Situated as Carmi is at the junction of two important railroads, the citizens could well afford to make a test experiment with the drill, in order to determine whether they have coal beneath the surface at a reasonable depth and of sufficient thickness to justify the sinking of a shaft. This is a matter of public interest, and so far as the test experiment is concerned, the expense should be shared by the property holders of the town, and when this point is settled private enterprise will do the rest.

Brick Materials.—Sand and clay suitable for brick-making may be found in every neighborhood, and on the uplands on nearly every farm. Sand for mortar and cement is also abundant at some localities, as between Carmi and Phillipstown, where a bed of clean yellow sand is found replacing the Loess.

Soil and Agriculture.—The soil of this county includes three quite distinct varieties, to-wit: The low alluvial bottoms skirting the main water-courses, and subject to annual overflow; the higher alluvial lands southeast of Carmi, between the Little Wabash and the chain of ponds already referred to as indicating an ancient river channel, which are mostly above high water; and the rolling uplands forming the northern and western portions of the county. There is a small prairie on this second or higher bottom between Carmi and Phillipstown, about five miles in length by two in breadth, and also two small prairies on the northern border of the county, and partially within its limits, but the remainder of its surface was originally covered with a heavy growth of timber. On the low bottoms between the Fox river and the Wabash, cane-breaks are frequently met with, the canes usually ranging from three to six feet in height. This is the most northerly point that we have observed this shrub growing in Illinois. The soil on the low river bottoms is exceedingly productive, and especially adapted to the growth of corn, and were it not for the annual river floods, would be the most valuable land in the county. The higher alluvial land skirting the Little Wabash south of Carmi has a sandy soil, not quite so productive as that on the low river bottoms, but yielding fair crops of corn, wheat, oats and grass, and easily cultivated. On the uplands the soil is generally a clay loam, similar to that of Wayne and Edwards, but more variable in its productive capacities in consequence of the inequalities of the surface. On the oak ridges the soil is thin and yields only light crops of corn, but is better adapted to

small grains and grass, while the valleys and the level stretches of land between them have a deep loamy soil that is very productive, yielding good crops of all the cereals usually grown in this portion of the State. For a list of the trees of this county, the reader is referred to that already given in the report on Wabash county.

HAMILTON COUNTY.

Hamilton county embraces an area of four hundred and twenty-three square miles, and is bounded on the north by Wayne county, on the east by White, on the south by Saline, and on the west by Franklin and Jefferson counties. There are no streams of any considerable size in the county. The northern portion, however, is drained by the tributaries of Skillet Fork, the main stream intersecting the northeast corner of the county, and the southern by the North Fork of the Saline, several branches of which take their rise near the center of the county and coalesce near the south line to form the main stream. The surface is generally rolling, and was originally mainly covered with timber, though there are two or three small prairies within its borders.

Superficial Deposits.—The alluvial deposits in this county are limited to the valleys of the small streams mainly tributary to the North Fork of Saline, and are seldom more than a mile in width. They are very heavily timbered with several varieties of oak, hickory, elm, linden, ash, hackberry, black and white walnut, poplar, sugar maple, etc. The Drift deposits on the uplands range from ten to thirty feet in thickness, and consist of yellow and buff gravelly clays, with small bowlders of northern origin varying in size from a few inches to a foot or more in diameter. Branches of trees, and sometimes the stems also, of considerable size, are met with in sinking wells through the Drift in this county, as well as nearly every other portion of the State, and very frequently the ancient soil in which they grew remains *in situ* beneath the gravelly clays and hard-pan of the Drift.

Stratified Rocks.—The rock formations of this county belong to the upper Coal Measures, ranging from the horizon of coal No. 10 to coal No. 13, and including a total thickness of one hundred and fifty to two hundred feet of rock strata, but affording but little coal thick enough to be worked to advantage.

About a mile a little south of west from McLeansboro, at Mr. James McGilley's place, sandstone is quarried to supply the demand for building stone in this vicinity. The stone is of a good quality,

very evenly bedded, and can be quarried in slabs of any desirable size, and varying in thickness from two or three inches to two feet. The bed is from five to six feet thick at this quarry, and it affords most of the building stone used in McLeansboro and the adjoining neighborhood. The rock dresses easily and hardens on exposure, and can be cheaply cut for window caps and sills, ashlars, etc. The sandstone is underlaid at the quarry by about three feet of shale which, farther down the branch, thickens to ten or twelve feet, when the banks of the stream become alluvial, and no further outcrop is seen for some distance. Above the quarry rock there is a partial outcrop of ten to fifteen feet of sandy shale, with a few thin layers of sandstone intercalated therein from two to eight inches thick.

At Mr. Rice's place, about a mile north of McGilley's quarry, there is a band of hard argillaceous limestone from a foot to eighteen inches in thickness, outcropping at a considerable higher level than the sandstone at McGilley's. The limestone is overlaid by fire-clay and a thin seam of coal, which has been worked in a small way by stripping at several places hereabouts. The limestone has been burned for lime, but is evidently too impure to slack freely, and, moreover, the bed is too thin to be profitably quarried for any purpose. It contains no fossils. On the north side of the ridge, about a quarter of a mile from Rice's, there is another outcrop of the limestone where lime has been burned, and here it is overlaid by a black shale containing concretions of black limestone or septaria.

At Mr. Barnet's place, on Hog prairie, the coal overlying the limestone is from eight to twelve inches thick, with from one to two feet of fire-clay between. In the early settlement of the county this coal was worked by stripping to supply the neighboring blacksmiths, but since the opening of the beds in Saline county the work here has been abandoned. This limestone is probably somewhere from thirty to forty feet above the highest beds seen at McGilley's quarry, and the following section will show the general relation of the strata seen between Hog prairie and McLeansboro:

	Feet.	In.
Yellow ferruginous shale	10	
Black, or dark-blue bituminous shale	2 to 3	
Coal	⅔ to 1	
Fire-clay	1 to 2	
Limestone	1 to 1	6
Space unexposed, estimated at	30 to 40	
Shale and thin-bedded sandstone	10 to 12	
Evenly-bedded sandstone at McGilley's	5	
Sandy shales	8 to 10	

This coal seam is probably nowhere more than twelve to fifteen inches thick in this part of the county, and the coal is rather soft and slaty, but quite free from pyrite, and is a very good blacksmith's coal. The limestone is a hard fine-grained grayish rock, weathering to a yellowish-drab, and when thoroughly burned is said to yield a strong dark-colored lime.

To the westward of Hog prairie, sandstone and sandy shales outcrop at intervals in the small branches and in the hill sides to the Jefferson county line, just beyond which the following beds were seen, and as they probably underlie the northwest part of Hamilton county from the prevailing northeasterly dip of the strata, I deem it proper to give a description of them in this place.

At Dr. Wilkey's place on sec. 36, T. 4 S., R. 4 E., the following section was seen:

	Feet
Shales, sandy at the top but passing into blue clay shales below	18 to 20
Calcareo-bituminous shale with fossils, the upper part passing locally into limestone	4 to 6
Coal	1½ to 3
Shaly fire-clay	2
Shaly micaceous sandstone with fragments of plants	8 to 10

Among the fossils found here I recognize the following species: *Orthoceras Rushensis, Bellerophon carbonaria, B. Montfortianus, Euomphalus subrugosus, Nucula ventricosa, Astartella vera, Leda Oweni, Macrodon carbonaria, Spirifer plano-convexus, Chonetes Flemingii, Synocladia biserialis, Lophophyllum proliferum,* and plates and spines of *Eupachycrinus.*

About a mile north of Dr. Wilkey's, on Mr. Jines' place, another coal seam is found where the coal is about eighteen inches thick, and overlaid by a few inches of bituminous shale without fossils, passing upward into a chocolate-colored shale, of which about two feet in thickness is exposed on the branch in stripping the coal. This seam is opened on a small branch running northeastward into a tributary of Skillet fork, and the coal dips in the same direction about with the fall of the creek, while the outcrop at Dr. Wilkey's is on one of the branches of the Middle fork of Big Muddy, which runs to the south and southwestward. The coal at Mr. Jines' mine seemed to be harder than that at Dr. Wilkey's, and while at the latter locality the coal was quite variable in thickness, ranging from eighteen inches to nearly or quite three feet, at the former it varies but little from eighteen inches. I have no doubt but these outcrops are on two distinct seams, probably the equivalents of Nos. 10 and 11 of the general section. In the vicinity of McLeansboro the strata seem to be nearly horizontal, no continuous dip in any direction

being perceptible, but to the westward between Hog prairie and the county line there appeared to be a decided dip to the northeastward. These two coals, and possibly a still higher seam, No. 12 of the general section, must underlie the northwest corner of Hamilton county, and where there is no outcrop they will probably be found at a depth of less than a hundred feet from the surface.

Five miles southwest of McLeansboro, on the old Lockwood estate, there is a thin coal from six to fifteen inches in thickness, overlaid by bituminous shale, which passes upward into gray siliceous shale and sandstone, the latter but partially exposed. The coal is rather slaty, and has only been worked to a limited extent by stripping at the outcrop in the banks of a small branch. Neither the quality nor thickness of the coal would justify any attempts at systematic mining here.

On Esq. Twigg's land, about three miles west of Rectorsville station, a thin coal was found in sinking a shallow well near a sandstone quarry. The coal and a few inches of bituminous shale forming its roof lies immediately below the sandstone, but no outcrop of it could be found. It is probably too thin to be of any practical value. The sandstone quarry shows a space of about three feet in thickness of soft micaceous evenly bedded rock in layers from one to six inches thick, and contains fragments of plants and numerous casts of *Aviculopecten rectilaterarius*. Quarries have been opened at several places in this vicinity in this sandstone, and the coal has been found in several wells, but always too thin to be of any practical value for mining purposes.

At Hood's old mill on the North Fork, about two miles and a half southeast of Rectorsville station, the following beds outcrop in the bluffs of the stream:

	Feet.
Brown shale	2
Hard chocolate-brown, shaly, micaceous sandstone	5
Sandy micaceous shale	14

The chocolate-colored sandstone at this locality resembles somewhat the brown calcareous sandstone found in the bed of the creek at Carmi, but it is less calcareous here if they are equivalent strata, and contains but few fossils, and none of the species most characteristic of that bed in White county. The fossils observed in it here were *Productus Prattenianus*, *P. Nebrascensis*, *Terebratula bovidens*, *Bellerophon*, *Fenestella*, and joints of *Crinoidea*. Hand specimons of this sandstone, which is here ferruginous and perhaps slightly calcareous, very closely resemble those from the White county localities, and it is quite possible they may represent equivalent strata,

and if so this is probably about the lowest bed outcropping in this county.

The following outcrops are reported by Prof. Cox:

"On Sec. 23, T. 5, R. 5, on Knight's prairie, coal is found reported to be eighteen inches thick, overlaid by argillaceous and siliceous shale. At J. M. McDaniel's well on sec. 5, T. 5, R. 6, passed through eighteen feet of sandstone and two feet of blue shale. Mr. John Hall, in digging a well on Knight's prairie, struck coal at the depth of seventeen feet. Earthy limestone one foot thick exposed at S. Lane's, also at Platt Stephens' on sec. 16, T. 5, R. 7, where it is exposed in the bed of a branch overlaid by ten feet of siliceous shale. A thin coal is found on sections 14 and 23, T. 5, R. 7."

These isolated sections give the general character of the outcrops to be seen in this county, but they afford no data on which to construct a connected section of the several beds that outcrop within its borders. It is probable the total thickness of the strata that appear in natural outcrops within the county do not exceed one hundred and fifty to two hundred feet, and include no important limestones, and no coal seams above fifteen to eighteen inches in thickness except in the northwest corner of the county, where coals Nos. 10 or 11 may perhaps be found from two to two and a half feet thick.

Economical Geology.

Building Stone.—Sandstone of a fair quality for building purposes may be obtained at several places in this county, and the quarry at McGilley's, one mile southwest of McLeansboro, furnishes a good material for flagging and for cut stone, as well as foundation walls, etc. This quarry furnishes most of the stone used at McLeansboro, and in the adjoining neighborhood. A similar sandstone is found outcropping on a branch about three miles northwest of McLeansboro, a tributary of the Skillet Fork, and several quarries have been opened in the bluffs of the stream. In the southern part of the county the supply of good stone is not abundant, but the bed of micaceous sandstone near 'Squire Twiggs' place, three miles west Rectorsville station, affords a soft rock in thin beds that is used for walling wells, for foundations, etc. The hard chocolate-colored micaceous sandstone at Hood's old mill, on the North Fork, near the south line of the county, affords a very durable stone, but is too thin-bedded for heavy masonry. The only bed of limestone seen in the county is too thin to be of any practical value for building purposes, and is unevenly-bedded and nodular in structure.

Coal.—The coal seams appearing above the surface in this county are mostly too thin to be worked systematically, and no coal is mined in the county at the present time, except by stripping. The coal at Dr. Wilkie's, just over the line in Jefferson county, attains locally a thickness of about two feet and a half, and if that thickness should prove persistent, it might be worked to advantage in the usual way, by a tunnel or a shallow shaft. This seam probably underlies the northwest corner of Hamilton county, and would be found at a depth of fifty to a hundred feet below the surface. The seam above it, worked by Mr. Jines, north of Wilkie's, affords a harder coal, but it seldom exceeds a thickness of about eighteen inches, and can only be worked by stripping. The coal on Hog prairie ranges from eight to fifteen inches in thickness, and is not much worked at the present time. The main coals lie at a considerable depth in this county, and may be reached by deep shafts whenever the demand for coal shall be such as to justify extensive mining operations. The approximate depth to No. 7 coal would probably not be more than three hundred or three hundred and fifty feet in the south part of the county, and from four hundred and fifty to five hundred in the northern portion, and No. 5 may be found about a hundred feet below No. 7. These depths will prove to be no serious obstacle in the way of coal mining whenever the demand for a large amount of coal shall arise.

Lime.—The thin band of limestone below the coal on Hog prairie has been burned for lime, but the bed is too thin to furnish an adequate supply for the wants of the county, and the quality is inferior to that obtained from St. Louis.

Clay and Sand.—Clay suitable for brick-making is abundant in every neighborhood, and may be obtained from the subsoil of the upland almost anywhere that it is required, and sand suitable for mortar and cement is also abundant.

Mineral Springs.—There is a Chalybeate spring one and a half miles east of McLeansboro, the water of which is strongly charged with carbonate of iron. The water in Dr. DeFoe's well in McLeansboro, is also highly charged with mineral substances, of which the following qualitative analysis has been furnished by Prof. Cox:

Neutral to test paper.	Sulphate of lime.	Sulphate of protoxide of iron.
Chloride of Magnesia.	Sulphate of magnesia.	Carbonate of lime.
Chloride of sodium.	Sulphate of alumina.	Carbonate of magnesia.

Mr. J. M. McDaniel's mineral spring north of town, is a strong, saline, sulphureted water, that would probably prove beneficial in

cases of general debility. The water in Dr. DeFoe's well probably derives its mineral properties from the shale overlying the thin coal that outcrops on Hog prairie, as that coal and the overlying shale was passed through in sinking the well, and the two springs above named may derive their mineral ingredients from the same source. Possibly this shale may be the same that imparts its mineral properties to the water at several localities in Wayne county, especially west and north of Fairfield.

Soil and Agriculture.—On the main branch of North Fork and on some of the smaller streams in this county there are belts of alluvial bottoms of variable width, that were originally covered with a heavy body of most excellent timber. These lands possess a very rich soil, usually a sandy loam, and when cleared and brought under cultivation they are the most productive lands in the county. The prairies are small, and occupy the highlands forming the water shed between the streams. The soil is a chocolate-colored clay loam of average quality, and produces fair crops of corn, wheat, oats, grass, etc. Some of the best timbered uplands are equally as productive as the prairie, especially those on which the timber growth consists in part of black walnut, elm, linden, sugar maple, wild cherry, etc., in addition to the common varieties of oak and hickory. The oak ridges along the breaks of some of the streams have a thin soil with a stiff clay subsoil, and need the frequent application of artificial stimulants, in the way of manures, or by fallowing and plowing under green crops, to retain their productive qualities. These lands will produce good crops of wheat and clover, and by judicious management may easily be made to repay the labor of the well skilled husbandman. As an agricultural region this county ranks favorably with those adjacent in Southern Illinois, and the completion of the St. Louis and Southeastern railroad gives to the products of the county an easy access to the St. Louis market, or that of the large cities on the Ohio and lower Mississippi rivers.

CHAPTER XXIV.

WAYNE AND CLAY COUNTIES.

Wayne county embraces an area of seven hundred and twenty square miles, and is bounded on the north by Clay and Richland counties, on the east by Richland and Edwards, on the south by White and Hamilton, and on the west by Jefferson and Marion. It is located on the southern border of the prairie region, and at least three-quarters of its surface was originally timbered land. The prairies are mostly small, the largest being that in the northern portion of the county, between Elm creek and Skillet Fork.

The principal streams in the county are the Little Wabash, and Elm creek, its principal western affluent, which drains the eastern division, and Skillet Fork, with its numerous small branches, which flow through the southwestern part of the county.

The surface is generally rolling and elevated from fifty to a hundred feet above the beds of the streams. The bottoms on Skillet Fork and Little Wabash are rather low and flat and heavily timbered.

The geological features of this county are very similar to those of Wabash and Edwards, the Drift deposits and upper Coal Measures being the only formations exposed. In the southern portion of the county the Drift clays seldom exceed a thickness of fifteen to twenty feet, and in sinking wells the bed-rock is often found at a depth of ten or twelve feet below the surface. Towards the northern boundary of the county they are somewhat heavier, and on Elm creek there are bluffs thirty feet or more in height, that seem to be composed entirely of Drift. Here the lower portion consists of the bluish-gray hard-pan that has been more particularly described in the report on the more northerly counties, where it is sometimes found from fifty to seventy-five feet or more in thickness. The upper

portion of these superficial deposits may be represented along the bluffs of the Little Wabash by a few feet of Loess, but generally it consists of yellowish-brown gravelly clays and sand, with numerous rounded pebbles and occasionally bowlders of metamorphic rock of moderate size. Locally the gravelly clays are tinged a reddish-brown color, with the red oxide of iron, derived probably from the decomposition of a ferruginous sandstone that forms the bed-rock in many places in the southern part of the county. The undulations of the surface often take the form of long ridges from thirty to forty feet in height, with a direction nearly parallel with the course of the streams. These ridges usually have a nucleus of sandstone or shale, but their sides are so gently sloping, and the Drift clays cover them so evenly, that the bed-rock is seldom exposed to view. The streams are sluggish, and meander through wide flat valleys, seldom showing any outcrop of the bed-rock along their courses. This renders the construction of continuous sections very difficult, and the determination of the true sequence of the strata can only be made in a general way, by the examination of isolated outcrops.

Coal Measures.

At the iron bridge on the Little Wabash, on the stage road from Fairfield to Albion, the following section is to be seen on the east bank of the stream:

	Feet.
Sandstone, partly in regular beds and partly massive	25
Pebbly conglomerate, with fragments of coal and mineral charcoal	2 to 4
Black laminated shale, with concretions of bituminous limestone	3
Dove-colored clay shale, with fossil ferns	2 to 3
Shaly sandstone, appearing some distance below	3 to 4

No fossils were found here that would enable me to fix the horizon of these beds, but they presented nearly the same lithological characters as the outcrop at Hamicker's old mill on the Bonpas, in Edwards county. At Beech Bluff, three or four miles above the bridge, the sandstone is more massive, and extends to the river level, showing no outcrop of the underlying beds.

At Massillon, on the west bank of the Little Wabash, on the N. W. qr. of Sec. 15, T. 1 S., R. 9 E., the bluff is composed mainly of sandstone and sandy shale, with a few feet of argillaceous shales near the river level containing several bands of clay iron ore. This outcrop seems to be identical with that at the old ford three miles above in Edwards county, and it is quite probable the thin coal

found there is here a little below the river bed. A thin coal is found here in the sandstone some twenty feet or more above the river level; but it is probably only a local deposit or "pocket," such as may be frequently met with in the sandstones of the Coal Measures.

Mill Shoals is situated on the Skillet Fork, just over the line in White county, but the section made in this vicinity is partly in Wayne, and is as follows:

	Feet.
Sandstone in thin beds—partial exposure of about	6
Bituminous shale, with streak of impure coal near the top	2½ to 3
Sandstone and sandy shale	40 to 50
Space unexposed	15 to 20
Hard shaly sandstone in the bank of Skillet Fork	3 to 4
Hard, black, laminated shale, passing locally into clay shale	6 to 8
Shale, with a thin coal	2 to 3
Hard, fine-grained limestone, without fossils	2 to 3
Greenish, pebbly shale	2
Sandy shale	1

The three upper beds in the foregoing section are found in Wayne county about three-quarters of a mile northeast of the village. Prof. Cox reports a section six miles southeast of Fairfield, which seems to be nearly a repetition of that at Mill Shoals, as follows:

	Feet.
Yellow clay and Drift	15
Sandstone and locally some shale	45
Gray siliceous shale	10
Thin coal	—
Limestone, without fossils	2

These two sections will give a general idea of the prevailing character of the rocks in the south part of Wayne county. The following is a section of a well bored for oil by Major Collins, on Sec. 25, T. 2, R. 7:

	Feet.	In.
Soil and subsoil	3	
Sandstone	50	
Slate—(shale ?)	27	
Coal	3	6
Clay and blue shale	2	
Hard gritty rock	4	
Hard yellow rock	4	
Hard sandstone	8 to 10	
Dark slate—(shale ?)	28	
White sandstone	66	
Black shale	4	6
	207	

It is proper to state here again what we have already said on more than one occasion, that reports of oil wells are to be taken with due allowance, in consideration of the fact that the persons having the work in charge were seldom qualified to determine the true character of the beds through which their drill was passing, and we see in the above section that no attempt was made to define the char-

acter of two beds of hard rock, while the beds denominated slate were probably shale, with possibly a thin bed of slate intercalated therein. In this way bituminous slate is often mistaken for coal, and where the substance is reduced to an impalpable powder by the drill no one but an expert can fully determine the one from the other by the material brought up in the sand-pump.

At Mr. Black's place, about two miles northwest of Fairfield, there is an outcrop of hard, dark, bluish-gray limestone, weathering to a buff color, which is overlaid by clay shale, with a thin coal or bituminous shale intercalated therein, as indicated by a streak of smutty material to be seen a few feet above the limestone. A thin coal, sometimes as much as eighteen inches in thickness, occurs at another locality under a limestone similar to this, and the same may possibly be found here by digging a few feet below the rock. The limestone has been quarried here as well as on the adjoining farm for building stone and for lime, and ranges from two to three feet in thickness.

On Mr. J. H. Thomas' place, on Sec. 17, T. 1 S., R. 8 E., a thin coal has been found below a limestone similar to that above mentioned. The coal was opened a few years since by sinking a shaft some 15 or 20 feet in depth, and the coal is reported to have been 18 inches thick, and the limestone two feet. The shaly portion of the limestone contained a few fossils, among which we identified *Orthis Pecosi*, *Spirifer cameratus*, *Chonetes Verneuilianus* and *Lophophyllum proliferum*.

On Mr. E. Pilcher's land, on Sec. 20 of the same township, a bed of black shale crops out on a hillside at an elevation considerably above the coal shaft above mentioned, and was penetrated to the depth of fifteen feet in search of coal, but without finding it. On the opposite side of the hill, and below the level of the black shale, a calcareo-siliceous rock has been quarried for building stone. It has a slaty structure, and is filled with fragments of broken plants, and appears to be the exact equivalent of the arenaceous limestone found at Mr. Boden's place, two miles and a half south of Flora. The bituminous shale at Mr. Pilcher's place contains rounded bowlders of black limestone, that weather to a bluish dove-color, and similar concretions were seen at the exposure south of Flora, which leaves no reasonable doubt of the identity of the beds at these points. A short distance south of Mr. Pilcher's land limestone was formerly quarried for lime-burning, but the outcrop is now covered up. The relative position of the beds above described is indicated in the following section:

	Feet.	In.
Bituminous shale, with concretions of black limestone	15 to 20	
Slaty arenaceous limestone, with broken plants	2 to 4	
Shale partly exposed	10 to 15	
Dark limestone	2	
Shale, (thickness not determined)		
Coal	1	6

This is probably coal No. 13 of the general section.

On Mrs. Williams' place on the N. W. qr. of Sec. 29, T. 1 S., R. 7 E., about seven miles northwest of Fairfield, there is an outcrop of 15 to 20 feet of sandy and argillaceous shale, containing numerous bands of kidney iron ore of good quality. A thin coal has been passed through in digging wells in this neighborhood, and either underlies these shales entirely or is intercalated in them. This outcrop closely resembles that at McDaniel's place near the north line of the county, hereafter to be mentioned, and the well water in this vicinity is impregnated with epsom salts, like wells and springs at the locality above mentioned. Between this locality and Fairfield, and about three miles a little south of west from the town, an even-bedded sandstone is quarried for building purposes similiar to that at Hoag's quarry north of Xenia. This sandstone probably underlies the shales outcropping at the Williams place three or four miles to the westward, and the coal there is either a local deposit or else represents coal No. 14 of the general section.

On Sec. 21, T. 2 N., R. 6 E., in the bluffs of Bear creek, near the north line of the county, a massive sandstone outcrops for some distance along the bluffs of the stream in perpendicular cliffs from twenty to thirty feet in height. This sandstone was struck in the boring at Flora at the depth of about sixty feet, and was penetrated to the depth of eighty-four feet. The outcrops on Bear creek probably represents only the lower portion of the bed.

On Sec. 27, T. 2 N., R. 6 E., argillaceous and sandy shales with bands of kidney iron ore crop out in the slopes of the hills at various points, showing an aggregate thickness of twenty feet or more, with a bituminous shale or impure coal near the top of the exposure. A well sunk here struck a vein of water at the depth of twenty-one feet so strong that it soon rose to the surface and has been flowing freely to the present time. It has a strong taste of epsom salts, and produces an effect similar to that drug upon those who use it. At Mr. Eli McDaniel's place, adjoining the above, a spring of the same kind of water is found, somewhat stronger in mineral properties than that in the well. The water here seems to derive its mineral properties from the bed of argillaceous shale which forms

the bed-rock in this vicinity, as wells sunk in the overlaying sandstone afford pure water.

The following additional notes and sections are reported by Prof. Cox in this county: "At Liberty they pass through sandstone in digging wells from ten to forty feet, and obtain good water. On Sec. 30, T. 2, R. 7, limestone is obtained for building and for lime. Bed three feet thick, upper part shaly, contains *Productus longispinus, Macrocheilus primigenius, Athyris subtilita, Productus costatus* and joints of *Crinoidea*. The same limestone is exposed at Whitaker's, on Sec. 25, T. 2, R. 7. A thin coal is usually found beneath the limestone, and a thin, impure coal or bituminous shale is frequently seen in the shales above it. Clay iron ore occurs in a grayish shale seven miles north of Fairfield, exposed by a wash on a hill side. On Sec. 34, T. 1 S., R. 9 E., the following beds are seen:

	Ft.	In.
Heavy-bedded sandstone	25	
Arenaceous shale	10	
Black, slaty shale	2	
Pyritiferous shale, with fragments of shells	0	3
Fire-clay (good quality)	1	
Clay shale	0	6
Shaly sandstone in river bed	2"	

From the foregoing sections and remarks it will be seen that there is but little diversity in the character of the rocks exposed in this county. They probably represent a total thickness of one hundred and seventy-five to two hundred feet or more, comprising mainly sandstones and shales, most of which decompose readily on exposure, and are therefore seldom found in bold outcrops.

Economical Geology.

Building Stone.—Sandstone of a fair quality for building purposes is tolerably abundant, and quarries have been opened in nearly every township in the county. Three miles a little south of west from Fairfield, an excellent sandstone is quarried on a small branch tributary to Skillet Fork. The rock is in smooth even layers, and resembles the sandstone of Hoag's quarry, near Xenia. Along the Little Wabash a heavy-bedded sandstone is found throughout its course in the southeastern part of this county, which, from the bold cliffs it forms at many points along the bluffs of the stream, will no doubt afford a large amount of durable building material. Six miles southeast of Fairfield a good flag sandstone is quarried in large slabs six inches thick. Three and a half miles north of Jefferson, on Sec. 30, T. 1 N., R. 6 E., a grayish sandstone of good quality is quarried in large slabs from a foot to eighteen inches in thickness. A

similar stone is also quarried by Mr. Phillips, on Sec. 16, T. 1 N., R. 7 E. These are some of the most valuable quarries opened at the present time, but others equally good may be opened at various places in the county as the wants of the people may require. The limestone over the eighteen inch coal seam has been quarried at almost every point where it outcrops, but the bed is thin, and the supply to be obtained from it, without too great expense in stripping, is rather limited.

Coal.—The only coal in the county that promises to be of any value for practical mining is the eighteen-inch seam north and northeast of Fairfield. This might be worked in a limited way, either by stripping or by an inclined tunnel near its outcrop, but the seam is too thin to furnish an adequate supply for the general market. The main coals of the lower measures may be reached in the southern portion of the county at depths varying from four to six hundred feet, and in the northern portion from five to eight hundred.

Iron Ore.—Bands of iron ore of good quality occur at several places in the shales of this county, and have been noted in the sections already given. They seem to be in sufficient quantity at several localities to eventually become of some economical value. In Great Britain, bands of six to eight inches in thickness are said to be worked successfully, and we find many localities in our Coal Measures where from twelve to eighteen inches of good ore can be obtained from a vertical thickness of five or six feet of shale. The shale containing the iron ore observed in this county underlies a considerable area in the central and western portions, mainly in ranges 6 and 7 east. At Mrs. Williams' place, on the N. W. qr. of Sec. 29, T. 1 S., R. 7. E., iron ore of good quality seemed to be quite abundant, and also at several places on the ravines near Mr. McDaniel's place, not far from the north line of the county. Prof. Cox also notes an outcrop of clay iron ore in a grayish shale seven miles north of Fairfield, and also on Sec. 15, T. 1 N., R. 8 E.

Potters' Clay.—A good clay suitable for pottery or fire-brick was found on Sec. 34, T. 1 S., R. 9 E., but at the outcrop it was only one foot thick. Possibly it may be found at some other locality near by, where it is thick enough to be utilized for the manufacture of pottery or fire-brick.

Clay and Sand.—Materials for brick can be obtained from the subsoil of the uplands almost anywhere in the county, and from the abundant supply of wood for fuel, brick can be cheaply made in sufficient quantity to supply all future demands for this indispensable building material.

Soil and Agriculture.—The soil in this county is mainly a dark ash-gray or chocolate-colored clay loam, less highly charged with organic matters or humus than the black prairie soils of Central Illinois, but yielding fair crops of corn, wheat, oats and grass, both clover and timothy, and with judicious treatment will retain its fertility without any expense for artificial fertilizers. The ridges afford excellent fruit farms, and apples, peaches, pears, cherries and the small fruits may be grown here in the greatest abundance. The cultivation of the grape has only been attempted in a limited way, but the broken timbered lands could be profitably cultivated in vineyards. As an agricultural region, this county ranks favorably with the adjoining portions of Southern Illinois.

CLAY COUNTY.

Clay county embraces a surface area of about four hundred and sixty-six square miles, and is bounded on the north by Effingham and Jasper counties, on the east by Jasper and Richland, on the south by Wayne, and on the west by Marion and Fayette. The Little Wabash river runs diagonally across the county from northwest to southeast, and with its affluents, Elm creek on the south and Muddy creek on the northeast, drain nearly the whole of its area. The surface of the county is nearly equally divided into prairie and timbered land, the latter forming wide belts along the streams, and the former occupying the highest areas between them. The difference of level between the creek bottoms and the adjacent highlands is not very great, probably nowhere exceeding fifty to seventy-five feet.

Locally the streams are bordered with precipitous bluffs, from forty to fifty feet in height, and at other points there is a gradually sloping surface from the bottoms up to the level of the adjacent prairie. The bottoms along the Little Wabash vary in width from one to three miles, and are subject to overflow during the annual spring freshets, and hence have not been brought under cultivation, but are still covered with primeval forests of excellent timber. The alluvial soil of these bottoms is exceedingly rich, and if subdued and brought under cultivation, would produce abundant crops of corn, and all the cereals usually cultivated in this latitude.

Drift Deposits.—The uplands are covered with blue and yellow Drift clays ranging from ten to forty feet in thickness, and possibly along the bluffs of some of the streams they may attain even a greater thickness than that above indicated. The surface of the

bed-rock was often eroded into valleys of considerable extent before the Drift was deposited, and being subsequently filled with these gravelly clays, the deposit is not uniform, but is much thicker in some places than in others.

In the borings at Xenia and Flora, the bed-rock was struck at the depth of thirteen or fourteen feet, and generally upon the prairie in sinking wells, the Drift clays and gravel beds are found to range from ten to twenty feet. In the bluffs at Elm creek, south of Flora, and at some other points in the county, they attain a thickness of thirty to forty feet. The upper part is generally a brown or buff gravelly clay, with occasional bowlders of a foot or two in diameter, and the lower part, where the deposit attains its greatest thickness, consists of bluish or ash-gray clay, or hard-pan, as it is usually denominated, from its being more compact and harder to penetrate than the brown clay above it. Bowlders of granite, syenite, greenstone and quartzite are not uncommon, and occasionally nuggets of native copper and small specimens of galena are to be met with in these gravelly clays in this county.

Stratified Rocks.—The rock formations proper in this county all belong to the upper Coal Measures, and the only seam in the county that has been worked to any extent is No. 16 of the general section, and the highest seam but one known in the State. There have been three borings made in the county, one at Xenia and two in the vicinity of Flora, but none of them were carried down far enough to reach the main workable coals of the lower measures. The flax mill boring on the eastern edge of Flora is reported as follows:

		Feet.	In.
1.	Soil and Drift clay	13	0
2.	Sandy shale and gray sandstone	47	0
3.	Black shale, and coal, No. 14?	3	0
4.	Hard sandstone	84	0
5.	Clay shale—soapstone	33	0
6.	Black shale	3	0
7.	Shaly limestone	2	6
8.	Coal? No. 13?	7	3
		192	9

A shaft was commenced near where this boring was made, and carried down to the depth of one hundred and fifteen feet, mainly through sandstone and sandy shale. The flow of water in the shaft was so strong as to seriously interfere with the prosecution of the work, and finally filled it to within about five feet of the surface of the ground, where it still remains. The shaft terminated in the heavy bed of sandstone No. 4 of the preceding section. Another

boring two miles to the westward of this, near the Fair Grounds, was reported as follows:

		Ft.	In.
1.	Soil and Drift clay	13	
2.	Sandstone	40	
3.	Clay shale—soapstone	7	
4.	Hard gray sandstone	38	
5.	Hard rock—probably sandstone	3	
6.	Sandstone	47	
7.	Impure limestone	4	
8.	Black shale	8	
9.	Limestone	8	6
10.	Clay shale—soapstone	37	
		205	6

These borings commence at least forty or fifty feet below the coal and limestone northwest of Louisville, and were discontinued before reaching the horizon of any workable coal. The boring at Xenia was carried to the depth of 450 feet, passing through three thin coals, one of which was reported to be four feet thick. The following is the section of this boring as furnished by Captain Dyer:

		Ft.	In.
1.	Soil and Drift	14	
2.	Clay shale—soapstone	92	
3.	Bluish-gray sandstone	31	
4.	Coal, No. 13 ?		9
5.	Crevice ?—probably soft fire-clay	1	6
6.	Clay shale—soapstone	3	
7.	Limestone	1	6
8.	Conglomerate	3	
9.	Bluish-gray sandstone	4	
10.	Blue shale	64	
11.	Hard rock	1	
12.	Black shale, No. 12 ?	9	
13.	Sandstone	12	
14.	Blue shale	14	6
15.	Coal, No. 11 ?	4	
16.	Fire-clay		6
17.	Sandstone	15	
18.	Pebbly rock	2	
19.	Shale	2	6
20.	Blue shale	29	
21.	Micaceous sandstone	4	
22.	White sandstone	4	
23.	Rock with a few fossils	1	
24.	Coal, No. 10 ?	1	6
25.	Fire-clay	2	6
26.	Sandstone	11	6
27.	Blue shale	4	
28.	Sandstone	2	
29.	Black shale	15	
30.	Flint rock ?	10	
31.	Shale	23	
32.	Hard rock	4	
33.	Shale	11	
34.	Sandstone	7	
35.	Clay shale	6	

		Ft.	In.
36.	Sandstone	14	
37.	Blue shale	6	
38.	Gray sandstone	14	
		444	9

So far as it is possible to correlate this section with what is known of the upper Coal Measure strata of Central Illinois, I am inclined to believe that the 10-foot bed of hard rock described in the boring as *flint* is the limestone of Shoal creek and Carlinville, which is usually a very hard rock, and that the succeeding coals are 10, 11, 12 and 13 of the general section. The small coal outcropping north of Hoag's quarries about two miles, at Jacob Spiker's place, is probably No. 15, and the next succeeding seam would be the Nelson coal of Effingham county, which outcrops in this county about two miles northwest of Louisville, and at several points northwest of there in the bluffs of the Little Wabash and its tributaries, and will be more particularly described further on in this chapter.

One mile north of Xenia a fine evenly-bedded freestone is extensively quarried by Mr. Hoag. The rock is a rather fine-grained sandstone in even layers from two inches to two feet in thickness, and can be easily quarried in large slabs. It is partly brown and partly of a bluish-gray color, dresses freely and hardens after being taken from the quarry, and is the best building stone known in this portion of the State. The rock is as evenly-bedded as the magnesian limestone of Joliet, and the thin layers make good flagstones, while the heavier beds afford a fine quality of cut-stone for ashlars, window caps and sills, lintels, etc. A large quantity of this stone is furnished to the city of St. Louis, where it bears an excellent reputation as a superior building stone. About eight feet in thickness of this freestone is worked in this quarry, the heaviest beds ranging from one foot to thirty inches in thickness. This sandstone is overlaid in the vicinity of this quarry with twenty to twenty-five feet of soft brown shale with numerous bands of iron ore, closely resembling the shales on the waters of Raccoon creek, southwest of Flora, and described in the report on Wayne county. The water of a well sunk in this shale, about half a mile north of Hoag's quarry, has the same taste as that at McGannon's spring, near the north line of Wayne county, and I have no doubt the shales are identical. The shale here contains numerous bands of iron ore of good quality, and several points were observed on the small branches northeast of the quarry, and not more than a mile distant, where from twelve to sixteen inches of good ore could be obtained from a vertical

thickness of four or five feet of shale. The thin coal at Spiker's place overlies this shale, and the beds exposed there gave the following section:

	Feet.
Bituminous shale	4
Hard blue limestone—septaria	6 in. to 1½
Blue shale	1 ft. to 1½
Coal	½
Fire-clay and clay shale	?

A few well preserved fossils were found in the septaria over the coal, among which were *Nautilus occidentalis, Macrocheilus primigenius, Productus pertenuis, Spirifer cameratus, Myalina subquadrata, Chonetes,* joints of *Crinoidea,* etc. All the beds exposed from Hoag's quarry to this point are probably above those passed through at the Xenia bore.

At Mr. John Lamkins' place, about two miles northwest of Louisville, on the N. W. qr. of Sec. 20, T. 4, R. 6, there is an outcrop of gray limestone underlaid by a coal seam which ranges from twelve to eighteen inches in thickness, and is worked by Mr. Lamkins in a limited way, affording a coal of fair quality. The limestone over the coal is a compact, hard, gray rock, ranging from three to four feet in thickness, containing numerous fossils that may be obtained from the calcareous shaly layers associated with the limestone, in a fair state of preservation. The section here is as follows:

	Feet.
Buff shale with iron bands	5 to 8
Compact gray limestone	3 to 4
Calcareous shale	2 to 3
Coal	1 to 1½
Clay shale or fire-clay	1 to 2
Sandy shales	?

The fossils observed here include the following species: *Orthis Pecosi, Fusulina cylindrica, Spirifer cameratus, Spiriferina Kentuckensis, Lophophyllum proliferum, Productus longispinus, P. costatus,* and *P. punctatus.*

On Sec. 10, T. 4, R. 5, this limestone is found on Crooked creek, but little above the creek bed, and the coal, if found here at all, would be below the water level.

On the S. W. qr. of Sec. 25, T. 5, R. 5, about two miles east of Larkinsville, the coal and the overlaying limestone outcrop in the bluffs of Dismal creek. The limestone is here from four to five feet in thickness, and the coal is reported to be about the same as at Lamkins' place. There is here from ten to twelve feet of sandy shale exposed in the bluffs of the creek below the coal.

On Sec. 16, T. 4, R. 5, near the northwest corner of the section, a bed of hard shaly sandstone outcrops in the banks of a small branch, overlaid by a slaty bituminous shale a foot or more in thickness, containing lenticular masses of a black limestone or septaria. The shaly sandstone was about three feet in thickness, and it probably overlies the limestone and coal at Lamkins' place, though the exact connection between them was not determined.

On the S. E. qr. of Sec. 21, T. 4, R. 6, a sandstone quarry has been opened where the rock shows a perpendicular face from four to six feet in thickness. The sandstone is overlaid by a buff-colored shale, succeeded by a black laminated shale containing concretions of black or dark-blue limestone or septaria, containing a few fossils.

On section 16, in the same township, a hard sandstone is found in the bluffs of Crooked creek, which resembles the rock at the quarry on section 21, and it is here underlaid by shaly sandstone and shale to the water level. If these sandstones are identical, the section here would show the following order of succession:

	Feet.
Black laminated shale, with septaria	5 to 6
Buff or drab shale	6 to 8
Sandstone—quarry rock	4 to 6
Sandy shale—partial exposure	12 to 15

Just below the mouth of Crooked creek, in the bluffs of the Little Wabash, we find the following section:

	Feet.
Soil and Drift clay	12 to 15
Soft shales—partly argillaceous	15
Irregularly-bedded sandstone	3 to 4
Sandy shales	12 to 15

These beds outcrop at intervals along the bluffs of the stream from the mouth of Crooked creek to Louisville, and at the old mill dam we find nearly a repetition of the above section, as follows:

	Feet.
Black laminated shale	2 to 3
Coal	½
Buff and blue shales—partial exposure	6 to 12
Irregularly-bedded hard sandstone	4 to 6
Sandy shales extending below the river bed	10 to 12

The thin coal in the above section is locally overlaid by a few inches of chocolate-colored shale, passing into a hard blue limestone containing a few fossils, among which we were able to identify the following: *Productus Prattenianus, Chonetes granulifera. Lingula mytiloides, Pleurotomaria carbonaria, Macrocheilus,* etc. This thin coal is probably identical with that at Mr. Spiker's, three miles north of Xenia, and is either a local seam or else represents coal No. 15 of the general section. The beds on the Little Wabash at Louis-

ville underlie the limestone and coal at Lamkins' place and on Dismal creek, but the exposures were too isolated to obtain a complete section of the strata.

Four miles southwest of Flora, on a branch of Raccoon creek, sandstone and sandy shale outcrops along the bluffs of the stream for some distance. The bed is altogether some ten or twelve feet in thickness, the upper part a sandy micaceous shale passing downward into micaceous sandstone interstratified with the shales. The sandstone strata vary in thickness from six to fourteen inches, and when freshly quarried the rock is rather soft, but hardens on exposure and becomes a durable building stone. The quarry opened here belongs to Mr. John McGannon, and is located on Sec. 3, T. 2, R. 6 E. On section 4, in the same township, a massive sandstone outcrops in the bluffs of Raccoon, in an apparently solid bed, projecting in some places several feet over the bed of the stream by the wearing away of the lower strata.

On Bear creek, another tributary of Elm creek, just over the line in Wayne county, on Sec. 21, T. 2 S., R. 6 E., this massive sandstone is found in perpendicular cliffs of 20 to 30 feet in height above the bed of the stream. This is probably a part of the sandstone passed through in the shaft and borings at Flora, and it forms the bed-rock over a considerable area in the south part of Clay and the northern part of Wayne counties.

On Willow branch, about six miles southwest of Flora, a blue argillaceous shale is found containing several bands of argillaceous iron ore of good quality. The exposure of shale is twenty feet or more in thickness, with a streak of smutty coal or bituminous shale near the top of the exposure. The water that percolates through the shale becomes highly impregnated with salts, and acts as an effective cathartic on those who use it freely. This shale probably overlies the massive sandstone on Raccoon creek, but we found no continuous outcrop that would enable any one to determine definitely their true relations.

The following notes of localities I did not visit are reported from the notes of Prof. Cox: "On a branch of Skillet Fork, on Sec. 32, T. 4, R. 5, found the following beds:

	Feet.
Drift clay	4 to 5
Blue argillaceous shale	8
Bituminous shale and limestone in the bed of the creek	?

Crystals of selenite (sulphate of lime) of small size were found disseminated through the shale, and are reported to be abundant at many points on this branch and also on the main creek.

On Mr. R. T. Roberts' place, two miles and a half south of Clay City, a thin coal is found underlaid by fire-clay and argillaceous shale. The section of the exposure here is as follows:

	Feet.	In.
Soil and Drift	10	
Shale	0	6
Coal	0	6
Fire-clay	0	4
Argillaceous shale	1	
Siliceous shale	2	

In digging a well on the top of the hill about a quarter of a mile from this outcrop, Mr. Roberts went through from four to six inches of fossiliferous limestone which probably belongs above the coal.

Three-quarters of a mile south of Maysville is a sandstone quarry owned by Hugh Miller. The rock is of a yellowish-gray color, and the exposure from seven to eight feet thick. The so-called "salt-pond" is on the south half of Sec. 4, T. 3, R. 8, and is a bog surrounded by high ground. Sticks may be thrust into it through the spongy mass to the depth of ten or fifteen feet, and cattle, and formerly wild animals also, resorted here for water.

At Moore's quarry, on Sec. 14, T. 4, R. 6, there is a fine-grained buff sandstone that was used in the foundation, and also for caps and sills for the Masonic Hall building in Louisville. There are three layers of the rock exposed from 8 to 10 inches thick, overlaid by two feet of siliceous shale.

At J. Elkin's place, on Sec. 36, T. 5, R. 5, the following section was found:

	Ft.
Soil and Drift	2
Gray argillaceous shale	8
Limestone in the bed of the creek	?

Down the creek the limestone is two feet thick, the upper part full of encrinite stems and *Fusulina cylindrica*. The limestone is quite compact and will take a good polish. Still lower down on the creek there is a thin coal below the limestone. This limestone is again seen on Limestone creek, on Sec. 34, T. 6, R. 4? near the north line of the county."

The limestone above mentioned is undoubtedly the same as that found over the coal at Lamkins' mine near Louisville, and on Dismal creek east of Larkinsburg, and a limestone very similar in appearance is found on Muddy creek near the northeast corner of the county, where it is quarried both for lime and building stone.

Economical Geology.

Coal.—The only coal seam in the county that promises to be of any value for mining operations is that at Mr. Lamkins' place, northwest of Louisville, and this is so unevenly developed that there are probably but few localities in the county where it will prove to be of any practical value. At some points it affords from 18 to 20 inches of good coal, and possibly may thicken at some localities to a little more than that, while at others it thins out to a few inches or is wanting altogether, and its place is only indicated by a thin streak of bituminous shale. Where well developed it affords a very good quality of coal, and may be worked to advantage in a limited way to supply the local demand. I believe it to be the same as the Nelson coal found in the southwest corner of Effingham county, which is No. 16 of the general section, and the highest workable coal in the State.

The main coals of the lower Coal Measures are probably from eight hundred to a thousand feet below the surface in any part of this county, and borings or shafts should not be encouraged unless parties are prepared to go to that depth. The coal seam reported to have been found four feet in thickness in the boring at Xenia could not have been lower in the series than No. 11 or 12, and if its thickness was correctly ascertained, it is probably only a local thickening of one of these upper coals. Having been present at the time the drill passed through this coal in the Xenia boring, I can certify to the excellent quality of the samples brought up in the sand-pump, but could not testify as to the thickness of the seam. The distance to the lower coals is, of course, no serious impediment to their being mined successfully whenever the demand for coal shall be such as to justify such an expenditure of capital as will be required to open up a mine at this depth.

Building Stone.—Sandstone of fair quality for building purposes is found at several localities in the county, and the quarries near Xenia, described on a preceding page, afford a freestone of superior quality, that is extensively quarried for exportation to St. Louis and other points where a stone suitable for architectural display may be required. This rock has a very even texture, dresses freely, and can be easily cut into elaborate designs for ornamental work. A rock similar to this in texture and general appearance outcrops on Raccoon creek, south of Flora, which probably belongs to the same bed, as

the general trend of the strata appears to be from northwest to southeast.

Other sandstones, that afford a fair quality of building stone, outcrop in various parts of the county, as has already been noted in the preceding pages. The limestone over the eighteen-inch coal seam in the northern part of the county will afford a very hard and durable stone, but requires a greater amount of labor to quarry it and prepare it for use than the sandstone found in the same neighborhood, and hence has been but little used.

Lime.—The only rock in the county that seems at all adapted to the manufacture of lime is the limestone above mentioned as overlying the eighteen-inch coal at Lamkins' mine, and outcropping at several other points in the north part of the county. This rock varies in thickness from two to four feet, and seems usually pure enough to afford a fair quality of lime, and has been burned for that purpose in a limited way at two or three points in the county.

Iron Ore.—Bands of iron ore of good quality, intercalated in a bed of shale, were observed in two or three places in the county, especially on the upper course of Elm creek, and on some small tributaries of the same stream, southwest of Flora and near the Wayne county line.

Clays.—Clay suitable for pottery occurs on Mr. Bothwell's place, one mile south of Clay City, and good brick clays may be found in almost every neighborhood in the subsoil of the uplands.

Mineral Springs.—At Mr. Sailor's place, about eight miles east of Louisville, on the N. E. qr. of Sec. 25, T. 4, R. 7, there are several springs, the waters of which have some reputation for their medicinal qualities. The springs apparently have their origin in the quicksands below the Drift clays, and the water comes bubbling up very freely at numerous points along the valley of a small branch. Gas escapes quite freely from these springs at intervals, giving the water the appearance of boiling under a strong heat. After a short time the boiling motion ceases, and the water remains quiet until the escaping gas again sets it in motion.

An analysis of this water has been made, and I was promised a copy of the result for publication in this report, but it has not come to hand.

Soil, Timber, etc.—The soil in this county presents no marked variation from that in the adjoining counties, and need not be discussed farther in this place. Although much of the timbered land has been subdued and brought under cultivation since the first settlement of the county, the rapid growth of the remaining portion,

with the addition of the brushy lands, which, since the annual fires have been kept down, have been covered with a fine growth of young timber, has nearly or quite kept up the original supply, and there is probably about as much timber in the county at the present time as there was in its early settlement.

We are indebted to Mr. H. S. Watson and Mr. S. Johnson, of Louisville, for important information and personal assistance while prosecuting our work in this county.

CHAPTER XXV.

CUMBERLAND, COLES AND DOUGLAS COUNTIES.

Cumberland county contains eight full and four fractional townships, making a total area of 336 square miles, and is bounded on the north by Coles county, on the east by Clark, on the south by Jasper and Effingham, and on the west by Effingham and Shelby. The Embarras river traverses the county from north to south, and this river and its tributaries are the only streams of any note within its borders.

The central portion of the county along the river and its affluents is well timbered, while the eastern and western portions are mainly prairie. The bottom lands along the river are usually from a half mile to a mile or more in breadth, and heavily timbered with the usual varieties of timber found growing upon the bottom lands in Central Illinois. The prairie lands are from seventy-five to one hundred feet above the level of the river, and are generally rolling, though occasionally tracts of level prairie are to be found.

The superficial deposits of this county comprise the alluvial bottoms of the Embarras and its tributaries, and a considerable thickness of gravelly clays and hard-pan, which increases in depth to the northward. In the southern portion of the county the Drift deposits range from twenty to forty feet in thickness, consisting mainly of brown or buff gravelly clays, with numerous bowlders; but to the northward this thickness is increased to fifty or seventy-five feet, the lower portion being a bluish-gray hard-pan similar to that seen in Clark, and described in the report on that county. Bowlders of considerable size are not uncommon, and native copper and also specimens of the sulphuret of that metal are said to have been found in the Drift gravel in this county. A bed of potters' clay of fair

quality is found in the Drift clays in the vicinity of Greenup from four to six feet in thickness, from which a fair article of stoneware is made.

Coal Measures.—All the rock formations of this county below the Drift belong to the upper Coal Measures, and include the beds intervening between the Quarry Creek limestone of Clark county and the Shelbyville coal of Shelby county, making an aggregate thickness of 200 to 250 feet. Not more than one-half of these beds are exposed in the county, and we have to rely on the borings made at Greenup, and a general acquaintance with the outcrops in adjoining counties, for a full description of the strata.

The following is a record of the bore made just north of the town of Greenup, by Messrs. Dunlap & Co., in 1866, for oil:

		Feet.
1.	Shale	51
2.	Sandstone	11
3.	Shale	102
4.	Black bituminous and gray shale	17
5.	Very hard rock (limestone)	5
6.	Gray shale and sandstone	69
7.	White sandstone and shale	45
8.	Sandstone	35
		335

The very hard rock No. 5, which was here found at the depth of 181 feet, is probably the Quarry Creek limestone. Another boring was subsequently made by Mr. Talbot, near his mill at the railroad depot, for coal, and the following is his report, given from memory:

		Ft.	In.
1.	Soft sandstone	15	
2.	Gray shale	65	
3.	Black shale	2	
4.	Hard sandstone	8	
5.	Shale, dark-colored towards the bottom	20	
6.	Hard sandstone	5	
7.	Shale	8	
8.	Dark hard rock	4	
9.	Shale	13	
10.	Hard rock, probably limestone	3	
11.	Shale	17	
12.	Black shale	5	
13.	Coal	0	3
14.	Clay shale	20	
15.	Black rock	1	8
16.	Dark shale	8	
17.	Black slate—	8	
18.	Coal	0	3
19.	Fire-clay	4	
20.	Shale with pebbles	16	
		223	2

As this boring was made especially in search of coal, it is probable that closer attention was given to the character of the beds

passed through than at the other, and the section reported corresponds much better with the outcrops in Clark county. The hard rock, which I presume represents the Quarry Creek limestone, was found in the Talbot boring at a depth of 140, while at the Dunlap well it was reported at 181 feet, although the latter well was commenced at a level at least ten to fifteen feet below the former; hence we may infer that the reported depth of the boring was no more reliable than the character of the strata that were penetrated. Both these borings commence below the Fusulina limestone which outcrops in the bluffs of the Embarras from the bridge west of Greenup to the north line of the county.

In the bluffs of the Embarras, one mile west of Greenup, we find the following section at the bridge on the old National road:

	Ft.	In.
Gravelly Drift clay, buff, yellow and ash-gray	32	
Thin-bedded micaceous sandstone	6	
Argillaceous shales, with a streak of coaly matter	16	
Impure ferruginous limestone, (*Fusulina* bed)	1	6
Thin-bedded sandstone and sandy shales	15	
Slope covering shales to river bed	12	

A mile north of the bridge the limestone thickens to three feet or more, and is a nodular gray argillaceous rock, rather more calcareous than at the bridge below, nodular and thin-bedded, but containing a few of the fossils that are more abundant in it near the north line of the county. This is the only limestone found in the county, and varies in thickness from 18 inches to 8 or 10 feet, or more, at the different outcrops examined. It is usually too argillaceous to slack freely when burned, and too nodular and irregularly-bedded along the Embarras to furnish a good quality of building stone.

The sandstone underlying the limestone in the above section affords layers from 6 to 18 inches in thickness, and was used in the abutments for the bridge at the point; but not being carefully selected, the shaly layers soon gave way, endangering the whole structure so that it had to be abandoned.

On the branch north of the town of Greenup, where the oil well was located, the following beds outcrop in the bluff on the south side of the stream:

	Feet.
Yellow Drift clays	10 to 12
Nodular, brown impure limestone	1½ to 2
Sandy and argillaceous shales, with thin layers of sandstone, to the creek bed	35 to 40

A short distance above Ryan's ford, and about two miles below the north line of the county, this limestone is well exposed, showing a bench of rough, irregularly-bedded, brownish-gray, nodular, argillaceous limestone, from eight to ten feet in thickness, outcropping

just above the bed of the river. The upper part of the bed is of a brownish-gray, and the lower part a greenish-gray color. Numerous small fossils were found in the limestone at this locality, among which were the following well known species: *Athyris subtilita*, *Terebratula bovidens*, *Retzia Mormoni*, *Rhynchonella Uta*, *Spirifer camerātus*, *S. lineatus*, *S. plano-convexus*, *Fusulina cylindrica*, some undetermined corals, etc. The limestone is underlaid here by a greenish clay shale, of which not more than two feet in thickness was visible above the bed of the river. Descending the river from the ford towards Greenup the limestone gradually rises in the river bluff, and four miles below Ryan's it is found about twenty feet above the river level, associated with sandstone and shale, forming the following section:

	Feet.
Thin-bedded, nodular argillaceous limestone	5
Evenly-bedded sandstone	6
Sandy shale, with thin layers of sandstone	15

The *Fusulina cylindrica* and several other species of the fossils enumerated as occurring at Ryan's ford, were found here, but they were less numerous than at the other locality.

On Mr. Cullum's land, southwest of Jewett, the S. E. qr. of the S. W. qr. of Sec. 2[illegible], T. 9, R. 8, a quarry has been opened in a hard bluish-gray micaceous sandstone, of which some 8 to 10 feet is exposed. The rock is very hard, and affords a durable building stone. A quarter of a mile below this quarry, on the main creek, sandy shales form the main portion of the bluff, overlaid by a hard, brittle argillaceous limestone, which was seen only in tumbling blocks, indicating a thickness of about 18 inches. The beds were nowhere well exposed, but seemed to hold the following relative position:

	Feet.
Hard gray micaceous sandstone	8 to 10
Impure limestone	1½
Blue and brown sandy shales	25 to 30

Following down the creek these lower shales appear at intervals in the bluffs of the stream nearly to the bridge south of Jewett. North of the bridge, towards the town, several quarries have been opened in the same bed of sandstone that appears on Mr. Cullum's place.

On Long Point, a tributary of the Embarras, which enters the main river from the eastward six miles south of Greenup, we were unable to find any outcrops of rock, the bluffs of the stream being composed, so far as could be seen, of Drift clays from 30 to 40 feet or more in thickness.

On Webster creek, Sec. 33, T. 9, R. 8, a thin coal is found from 4 to 6 inches thick, associated with the following beds:

		Ft.	In.
No. 1.	Blue and brown argillaceous shales	3	
No. 2.	Band of brown argillaceous iron ore, with fossils	6 in. to 0	8
No. 3.	Shaly clay	0	4
No. 4.	Coal	0	6
No. 5.	Bituminous shale	2	
No. 6.	Clay shale—partly exposed	10 to 15	
No. 7.	Concretionary sandstone and sandy shale	12 to 15	
No. 8.	Gray and brown impure impure limestone	2	
No. 9.	Dark-gray sandy shales	20 to 25	

The band of argillaceous ironstone, or, more properly speaking, an argillo-ferruginous limestone, contains numerous fossil shells in a fine state of preservation, among which the *Euomphalus subrugosus* was most abundant, associated with *Aviculopecten carboniferous*, *Yoldia subscitula? Phillipsia scitula*, *Pleurotomaria sphærulata*, *P. Grayvillensis*, *Rhynchonella Uta*, *Productus longispinus*, *P. Lasallensis*, *Entolium aviculatum*, *Bellerophon percarinatus*, *Polyphemopsis peracuta*, *Macrocheilus primigenius*, *Nucula*, *Orthoceras*, *Nautilus*, *Lophophyllum proliferum*, etc.

The impure limestone, No. 8 of the foregoing section, I am inclined to regard as identical with the *Fusulina* bed, although I could not find the characteristic fossils in it at this locality. This limestone thins out in the south part of the county, and the most southerly outcrops observed contain few or no fossils, but the outcrops are so continuous on the Embarras and its western affluents that there seems to be no doubt that they all belong to the same formation.

In Coles county this limestone continues along the valley of the Embarras at least as far north as the mouth of Brush creek, where it overlies a seam of coal, No. 16 of the Illinois section, while the 6-inch coal in the foregoing section most probably represents the thin coal, or highest seam of the general section.

Prof. Cox reports a coal seam about a quarter of a mile west of the county line in Shelby county, which, from its thickness and general character, agrees very well with the Shelbyville coal, or No. 15 of the general section. "This is on Mr. Hancock's place, on Sec. 12, T. 10, R. 6, where the following beds were seen:

	Ft.	In.
Blue argillaceous shale	3	
Fire-clay	0	3
Coal	1	6
Slate parting	0	1
Coal, hard and impure	1	

About 200 yards west of the point where the coal was opened, on a branch of the Little Wabash river, there was ten feet of blue argillaceous shale above the coal, which further down the stream gives place to a thick-bedded sandstone."

He also reports the *Fusulina* limestone on Bear creek, Sec. 22, T. 10, R. 8, near Mr. John Prather's, where the bed is four feet thick, overlaid by 20 feet of sandstone. At Prairie City the limestone was passed through in sinking the well at the mill, and found to be four feet thick, with shales above and below it.

The trend of the strata in this county is evidently very nearly north and south, as the course of the Embarras is on nearly the same geological level through this county and Coles for a distance of 25 to 30 miles or more, and the dip, if any, is apparently to the westward. There are no streams in either county that intersect the general outcrop in an east and west direction, and no connected section of the outcropping formations could therefore be made. The small streams do not cut through the heavy Drift deposits, and hence exposures of the Coal Measures are only to be met with on the Embarras and the lower courses of its main affluents.

Economical Geology.

Coal.—No workable coal outcrops in this county, unless the seam mentioned above as occurring on the waters of the Little Wabash, just over the line in Shelby county, may be found in the northwest corner of Cumberland. The coal below the *Fusulina* limestone in Coles county seems not to have been developed in Cumberland, and the seam above the limestone is too thin to be of any practical value. For deep mining in this county a shaft would have to be carried down from six hundred to a thousand feet to reach the main coals of the lower measures. This would require an expenditure of capital that the present demand for coal in this county would scarcely justify, and hence it will probably be some years before any serious effort to reach the lower coals will be made. In the counties lying west of this, including Bond, Fayette, Montgomery and Shelby, according to the report of Mr. Broadhead, it is about six hundred feet from the Shelbyville coal (No. 15) down to the Danville seam (No. 7?), which would be the first one of the main coals that would be reached here, and if that failed to be well developed, about a hundred feet more would have to be penetrated to reach the next workable seam below.

Building Stone.—The best building stone met with in this county is the sandstone south and southwest of Jewett station, and that quarried in the vicinity of Greenup, in the bluffs of the Embarras. The former is a hard, gray, micaceous sandstone, that stands exposure well, and may be relied upon for bridge abutments and cul-

verts, as it will probably resist successfully the influence of frost and moisture. The other is a rather soft, brown sandstone, that will answer well for dry walls, but liable to crumble on long exposure to the elements. The *Fusulina* limestone, where sufficiently thick-bedded, will also furnish a fair quality of stone for rough walls, and several quarries have been opened in it in the northern and western portions of the county.

Lime.—The limestone just mentioned, which is the only rock of the kind found in the county, is too impure to make a good lime, though we saw one or two points where an attempt had been made to burn it, but evidently with indifferent success. At some points it looked as though it might possess hydraulic properties, and it is quite probable that by burning and grinding a very good water lime might be made from it.

Iron Ore.—Bands of kidney ore or carbonate of iron of a fair quality were found at several points in the shales over the *Fusulina* limestone, but in too limited quantities to be of any practical value for smelting purposes.

Sand and Clay.—Clays suitable for making brick may be found almost anywhere in the subsoil of the uplands, and sand for mortar or cement occurs abundantly in the valleys of the streams.

Soil and Timber.—In the southern part of the county the soil is rather thin, with a subsoil of light drab-colored clay, but in the northern portion it is darker colored and more productive, and has a subsoil of yellow clay. Much of the prairie and a portion of the timbered land is rather flat and requires thorough draining to make it productive. The bottom lands on the Embarras are from a half mile to a mile or more in breadth, and were originally covered with a heavy growth of timber, but portions of it have been cleared and brought under cultivation, and are very productive, though subject to occasional overflow. The varieties of timber in this county appeared to be about the same as in Clark, and need not be enumerated again here. A supply of water may usually be obtained in the gravelly Drift clays above the hard pan, but at some localities it can only be had by boring or digging through the hard pan to the quicksands below.

COLES COUNTY.

Coles county embraces an area of over five hundred square miles, and is bounded on the north by Douglas county, on the east by Edgar and Clark, on the south by Clark and Cumberland, and on

the west by Moultrie and Shelby. The principal water-courses in the county are the Embarras river, which traverses its eastern portion from north to south, and the Okaw or Kaskaskia, which runs diagonally across the northwestern corner of the county. The greater portion of its surface is prairie, though there are belts of excellent timber skirting all the water-courses, and the southeastern part of the county along the Embarras and its tributaries is heavily timbered.

This county lies in that portion of the State where the Drift deposits attain nearly to their maximum thickness, and bowlders of considerable size are quite commonly to be seen on the surface of the prairies, but partially embedded in the soil. The total thickness of the Drift in this county ranges from fifty to one hundred and fifty feet or more, the upper part consisting of a variable thickness of brown or buff gravelly clays, and the lower of blue clays or hard pan, the latter sometimes underlaid by gravel and quicksand.

In the boring for oil at Charleston, fifty-five feet of Drift was reported, as follows:

	Feet.
Soil and yellow clay	18
Sand and gravel	8
Blue clay (hard-pan)	16
Bowlder clay	13

At Mattoon, wells have been sunk from seventy-five to one hundred and fifty feet without reaching bed rock, and all the way through Drift clays and gravel, and sometimes without obtaining even then an adequate supply of water.

At Mr. Theophilus Van Doren's, on Kickapoo creek, there is a deposit of chocolate-colored sandy loam two and a half to three feet thick, filled with fragments of partially decomposed or carbonized vegetable matter which was once, without doubt, a surface deposit. It is associated with a bed of brownish-gray pipe-clay, and is overlaid by gravelly Drift clays. This old soil has been passed through at other localities in digging wells in this county, at a depth of thirty to fifty feet from the surface, and its position appears to be below the Drift clays, and above the quicksands that usually form the lowest part of this formation. The gray pipe-clay at Van Doren's is apparently a good potters' clay. In digging and boring through the Drift deposits in this county, veins of inflammable gas are sometimes struck about the horizon of this old soil, derived probably from the partially decomposed vegetable matters with which it is filled. Trunks of trees and smaller fragments of wood are frequently met with in sinking wells through the Drift

deposits in this portion of the State, and these constitute the only fossils hitherto obtained from it in this county. Probably if the quicksands below the hard-pan were accessible, some remains of fresh-water or land shells might be obtained from them, but no traces of either fresh-water or marine animals have as yet, so far as I know, been found either in the brown clays or the blue hard-pan of the Drift.

Coal Measures.

The stratified rocks of this county all belong to the upper Coal Measures, and correspond very nearly to those already described in Cumberland, except that the Fusulina limestone is rather thicker and more evenly-bedded in this county than it is further south. The course of the Embarras river still follows the trend of the strata, and the limestone alternately appears above and then sinks below the level of the river bed.

At Hanging Rock, just above the Cumberland county line, a bed of soft concretionary sandstone may be seen at the base of the bluffs, extending from thirty forty feet above, and also projecting below the level of the river bottoms. It shows no regular lines of bedding in the lower part of its outcrop, and the rock is so soft and crumbles so easily under a blow from the hammer that at some localities it is difficult to obtain a good hand specimen. A little further up the river there is about fifteen feet of dark-bluish shale cropping out beneath the sandstone.

At McCann's ford the same limestone apparently that was left at Ryan's ford, just below the north line of Cumberland county, appears in a bench on the west side of the river, where it is underlaid by ten or twelve feet of sandy, micaceous shale. The full thickness of the limestone was not seen here, the upper part having been cut away in the erosion of the river valley. The limestone is said to outcrop again a mile above McCann's, but I did not find the exposure. No rocks are seen on the east side of the river above the ford for two or three miles, and the hills, which are from a hundred to a hundred and twenty-five feet it height, were mainly composed of Drift material. The following section shows the relative position of the rocks found in the south part of this county:

	Feet.
Soft, brown, micaceous, shaly sandstone, passing down into an unstratified concretionary mass	30 to 40
Sandy and argillaceous shales	15 to 20
Rough, gray, unevenly-bedded limestone	8 to 10
Dark-gray micaceous shale	10 to 12

The coal which is found beneath the limestone higher up the river seems to be undeveloped here, as it is also in Cumberland, and no indications of it were seen south of the road running east from Charleston.

Three miles a little south of east from Charleston, near the bridge on the road to Westfield, the sandstone which forms the upper division of the foregoing section crops out at the foot of the bluff on the west side, where quarries have been opened in it for building stone. This sandstone is considerably harder here than at Hanging Rock, and affords a very good material for bridge abutments, foundation walls, etc. The lower twenty feet of the bed here is but partially stratified, but the upper portion is evenly-bedded, and as it hardens on exposure it affords a very good building material. Near the bridge there is an exposure of about fifteen feet of argillaceous shales with bands of carbonate of iron, and just at the water's edge below the bridge there is a partial outcrop of the upper part of the limestone. The outcrop of sandstone at the quarry measures thirty-three feet in thickness, including some shaly layers at the top of the exposure.

A half mile below the Westfield road, on the river, Prof. Cox reports the following detailed section, but whether above or below the main sandstone is not stated, though they are probably above that rock:

	Feet.	In.
"Gray, friable shale, with several bands of ironstone	20	
Fossiliferous ironstone	0	6
Friable shale	1	
Black shale	0	8
Gray clay shale	5	
Impure coal	0	2
Sandstone	7"	

He also reports the following beds as occurring above the sandstone on the river three miles east of Charleston:

	Feet.	In.
"Drift	15	
Buff argillaceous shale	4	
Calcareous shale, with fossils	0	1
Gray ironstone, with fossils	0	6
Brownish-black shale, with fossils	0	1
Black hard shale	0	8
Blue shale	5	
Brash coal	0	3
Sandstone, showing on the opposite side of a hill a vertical face of	35"	

Above Baker's mill, which is located on Sec. 25, T. 12, R. 10, he reports a similar section, that shows a thickening of some of the beds:

	Feet.	In.
"Covered slope	40	
Limestone, with fossils	1	
Gray shale	0	6
Black shale	8 to 10	
Calcareous pyrite band	0	3
Blue shale	?	
Sandstone, thin-bedded at the top and heavy-bedded below	20 to 30"	

On another ravine leading to the river he reports the following section, showing still further changes in the lithological character of the beds above the sandstone:

	Feet.	In.
"Limestone	0	6
Bituminous shale	0	8
Gray shale	2	
Decomposing gray shale	?	
Sandstone	3	
Coal	0	3
Blue clay	0	3
Coal	0	½
Blue shale, with fossil plants	2	
Brash coal	0	1
Blue argillaceous shale	3 to 5	
Solid sandstone	not measured."	

At the old mill on the Pole-cat creek, known as the Whorl mill, the following beds are to be seen:

	Feet.	In.
Sandstone, in thin beds, with pebbles in lower layers	10 to 12	
Hard black shale	0	10
Clay shale	6 to 8	
Coal	0	3
Sandy shale	2 to 3	

About two hundred yards to the westward of the mill the sandstone extended below the bed of the creek, showing a decided dip of the strata in that direction. This locality was visited especially on account of the reported occurrence of silver or some other valuable mineral at this point, but the reputed silver proved to be nothing more than the glittering scales of mica which was very abundant in the sandstone.

On the Embarras, about a mile and a half or two miles below the mouth of Brush creek, a hard brown argillaceous limestone from eight to ten feet in thickness outcrops above the bed of the stream and overlays a seam of coal that has been worked to a limited extent in this vicinity. This limestone is rather darker colored and more heavily bedded than the Fusulina limestone of Cumberland county, and might be supposed to belong to a higher level, but on comparing hand specimens I found it resembled its equivalent, the limestone over the Nelson coal in Effingham county, rather more than it did the specimens from Cumberland. However, these upper Coal Measure limestones are somewhat variable in their

lithological characters, and though I did not find the *Fusulina cylindrica* in it in Coles county, I am still inclined to believe that it is a representative of that limestone. The fossils found here were *Spirifer cameratus, S. lineatus, Productus longispinus, Spiriferina Kentuckensis, Athyris subtilita, Platyostoma Peoriense,* a delicate coral allied to *Cyathoxonia,* and joints of *Crinoidea.* The section seen here was as follows:

	Feet.	In.
Brownish-gray unevenly bedded limestone	8 to 10	
Dark shale	1	
Coal	1 to 1	3
Clay shale	4	

Higher up stream towards the mouth of Brush creek, some ten or twelve feet of sandy shale with bands of carbonate of iron are seen under the beds of the foregoing section.

A shaft was sunk for coal in this vicinity on the S. W. qr. of sec. 21, T. 13, R. 10, near the bank of the Embarras, the following report of which was furnished to Prof. Cox:

	Feet.	In.
Drift clay	20	
Limestone	7	
Coal	1	
Clay shale (soapstone)	3	
Soft blue sanstone	5	
Clay shale	1	
Coal		8
Clay shale	5	
Sandstone	5	6
Coal		7
Clay shale	2	
Hard bluish sandstone	3	
Dark clay shale (soapstone)	26	6

The foregoing sections of the Embarras river and the boring at Charleston by the Charleston Petroleum and Mining Company, affords the only data for determining the geological features of this county.

The following is a correct copy of the record of this boring:

		Feet.	In.
1.	Soil and drift clays	55	
2.	Yellow sandstone	21	
3.	Hard limestone	11	
4.	Shell rock (shale?)	2	
5.	Coal, No. 16	1	4
6.	Hard slate (shale?)	8	9
7.	Clay shale (soapstone)	13	
8.	Hard flint?	3	
9.	White sandstone	12	
10.	Shale and shaly slate	26	
11.	Coal, No. 15	2	
12.	Hard shale	15	
13.	Clay shale	10	
14.	Blue limestone	8	
15.	Shale and sandstone	14	
16.	Soft white rock	13	
17.	Shale and slate	27	
18.	Sandstone	31	

The limestone No. 14 of the above section, I believe to be the Quarry creek bed of Clark county, and the distance between that bed and the limestone of the Embarras (No. 3 of the section), which is here only about 93 feet, while at Greenup it is 130 feet or more, shows the same thinning out to the northward of the beds above the Quarry Creek limestone that was observed in Clark county in the strata below that rock. Hence, the main coals, if found fully developed here, would be reached at a depth somewhat less than in Cumberland. The total thickness of the outcrops to be seen along the Embarras river, in this county, does not exceed a hundred feet of Coal Measures, and includes the horizon of coal No. 15 of the general section and the thin coal above it. Coal No. 15 should be found underlying nearly the whole of this county, if it has not been cut out by denuding agencies. It is the thickest of the upper seams, sometimes attaining a thickness of $2\frac{1}{2}$ to 3 feet. It has been worked for many years in the vicinity of Shelbyville in shafts and inclined tunnels, and affords a semi-block coal of good quality.

Economical Geology.

Coal.—No outcrop of a coal bed thick enough to be worked to advantage was found in the county, and unless No. 15 may be found beneath the heavy Drift deposits in the western part of the county, there is no hope of obtaining an adequate supply of this indispensable article of fuel without sinking to the main seams in the lower part of the Coal Measures. A shaft from six to eight hundred feet in depth might reach No. 7 of the Danville seam, but it would require one more than a thousand feet deep to reach the bottom of the Coal Measures in any part of this county.

Building Stone.—Sandstone of a fair quality for building purposes may be obtained at various points along the bluffs of the Embarras river, and the rock obtained from the quarries near the Westfield road appears to be a durable stone, can be easily quarried, and has been very generally used for the supply of the adjacent region. In the southern portion of the county the rock is comparatively soft, and at the few outcrops examined did not promise well as a building stone. The limestone which outcrops along the river is thicker-bedded than in Cumberland, and between the railroad bridge and the mouth of Brush creek quarries have been opened in it at several points, where a hard brownish-gray limestone in beds from four to eighteen inches thick has been obtained for building purposes. The

western portion of the county is quite destitute of rock of any kind except the Drift bowlders found upon the surface or in the valleys of the small streams.

Lime.—The limestone on the Embarras is too argillaceous to be successfully used for making quicklime, and as this is the only limestone of any considerable thickness found in the county, some other region must be depended on for a supply of this article.

Clay and Sand.—Brick clays are easily obtained from the subsoil in almost any portion of the upland, and a potters' clay of fair quality is found in the Drift deposits on the Kickapoo. Sand can be readily obtained, either from the beds of the streams, or may be found in many places interstratified with the Drift clays.

Iron Ore.—Bands of carbonate of iron in small quantities were found interstratified in the shales above and below the heavy bed of sandstone that forms the lower portion of the bluffs on either side of the Embarras river.

Soil and Timber.—The prairies in this county, which constitute by far the greater portion of its surface, have a deep black loamy soil, highly fertile, and ranking among the best prairie lands in the State. On the timbered ridges adjacent to the streams the soil is thinner, but nevertheless productive, and especially adapted to the cultivation of wheat and other small grains, clover and fruit. On these ridges oak and hickory is the prevailing timber, but as the surface becomes more level toward the prairie region, we also find elm, linden, hackberry, wild cherry and honey locust, and on the bottom lands along the streams cottonwood, sycamore, ash, red birch, willow, coffeenut, black walnut, white and sugar maple, etc., etc.

DOUGLAS COUNTY.

Douglas county is bounded on the north by Champaign, on the east by Edgar, on the south by Coles, and on the west by Moultrie and Piatt. It embraces eight full and seven fractional townships, which gives it an area of about four hundred and ten square miles. The Okaw or Kaskaskia river drains the western portion, and the Embarras the central and eastern portion of the county. These streams are skirted with timber, but the greater portion of its surface is prairie.

The whole area of the county is covered so deeply with Drift clays that there is no outcrop of the underlying Coal Measure strata in the county. From the exposures in the adjoining counties it is known that the underlying beds belong to the upper Coal Measures,

and probably include two or three of the upper coals, but the extent to which they are developed here can only be determined with the drill. It is not probable that any heavy bed of coal will be found short of six to eight hundred feet from the surface, though one of the upper seams, two or three feet thick, might be found at a moderate depth.

The Drift clays are similar to those described in the counties of Edgar, Coles and Moultrie, but only the upper part of this deposit is to be seen in the natural outcrops in the bluffs of the streams. The soil is mainly a deep black vegetable mould, characteristic of the prairie lands throughout the central portions of the State, and is very productive, yielding annually heavy crops of all the cereals grown in this latitude.

CHAPTER XXVI.

WILLIAMSON AND FRANKLIN COUNTIES.*

Williamson county embraces a superficial area of twelve full townships, or four hundred and thirty-two square miles, and is bounded as follows: On the north by Franklin county, on the east by Saline, on the south by Johnson and Union, and on the west by Jackson.

The western portion of the county is drained by the Big Muddy and its tributaries, the main stream intersecting the northwestern corner of the county, while Crab Orchard creek, its main southern affluent, traverses the central portion from east to west, passing out of the county near the center of its west line. The eastern and southeastern portions are drained by the main branches of the middle and south forks of Saline, which have their rise in this county, and with an easterly course discharge their waters into the Ohio, the highlands in the eastern portion of this and Franklin forming the watershed that separates the waters of the Ohio from those flowing west into the Mississippi.

In the northern part of the county the surface is quite rolling, and in some portions broken and hilly, while the central part is generally level and the southern part quite broken, especially near the south line of the county, where the conglomerate and heavy-

* These two counties and the county of Livingston were assigned to Mr. H. C. Freeman in the spring of 1866, and he was paid in full for surveying and reporting on them, but failing to obtain any report from him, though repeatedly promised, and after a delay of eight years waiting for him to fulfill his obligations, I was compelled, when all the rest of the counties had been reported on, and this volume was otherwise ready for the press, to go into these counties myself and make such examinations as the limited time and unfavorable season would permit. A. H. WORTHEN.

bedded sandstones of the lower Coal Measures are the prevailing formations. There is, however, but little land in the county that is too much broken for cultivation, and as an agricultural region this county ranks among the best in Southern Illinois. Originally the surface was mostly covered with a heavy growth of timber, the prairie lands covering but a small fraction of its area. Some of the broken lands were originally but thinly timbered, forming what are known in the western States as "oak openings," through which one could travel with but little more difficulty than on the open prairie; but now, where these lands have not been brought under cultivation, they are densely covered with a heavy growth of young timber, which was previously kept down by the annual fires that swept over the county previous to its settlement by the dominant race.

The principal varieties of timber noticed on the ridges were black, white and black-jack oak and hickory, and on the more level portions of the uplands, in addition to these we find elm, linden, black and white walnut, sugar maple, black gum, wild cherry, honey locust, burr and post oak, pawpaw, persimmon, sassafras, and poplar, and on the creek bottoms the prevailing varieties are cottonwood, sycamore, red birch, coffeenut, pecan, ash, soft maple, redbud, dogwood, elm and hackberry.

The geological formations to be found in this county belong to the Quaternary and lower Coal Measures. The Quaternary is represented by a series of brown and yellow clays, sometimes mixed with gravel and small bowlders, and ranging from twenty to forty feet or more in thickness. These beds are generally pretty uniform, both in their depth and general character, and seem to partake largely of the character of the sandstones and sandy shales that form the underlying bed-rock. Locally they become quite gravelly, and contain small bowlders of granite, hornblende, quartzite and trap rock, seldom exceeding six inches to a foot in diameter, though a few were seen in the county of more than twice the size just indicated. Nothing resembling the bluish-gray hard-pan that constitutes the lower portion of the Drift deposits in the more northerly counties was seen here, but the yellowish sandy and gravelly clays that form the main portion of the deposit here rest directly upon the stratified rocks of the Coal Measures.

Coal Measures.

All the lower coals are found in this county, the outcrops embracing a part of the Conglomerate sandstone that underlies the hilly region along the southern line of the county, and all the succeeding beds up to the horizon of coal No. 10 of the general section. At Bainbridge, three miles southwest of Bolton, in the northeast corner of Johnson county, a seam of coal has been opened about three feet to three and a half in thickness, which is probably coal No. 1 of the general section, and from the trend of the strata, which is to the north of west, this coal must be found in the southwest portion of Williams county. In the bluff north of Bolton there are two seams that probably represent coals 2 and 3 of the general section. The lower one has been opened at two or three points in the vicinity of the village by tunneling into the hill on the outcrop of the coal, which averages about three feet in thickness, with a roof of bituminous shale. The coal has a parting of clay shale about a foot above the bottom of the seam from three to four inches in thickness. The upper seam is from 15 to 18 inches thick, and is underlaid by a sandy fire-clay with *Stigmaria*, passing into a hard nodular sandstone, below which there is a bed of dark steel-gray, tough limestone, weathering to a rusty brown color, and closely resembling that underlying the upper seam at Murphysboro. It is from eighteen inches to two feet in thickness here, and contains joints of *Crinoidea* and *Spirifer cameratus*. The coal is overlaid by a massive sandstone, partly concretionary and partly in regular layers, that is quarried for building stone, for which it seems well adapted. The following is a section of the bluff at this point:

	Feet	In.
Quartzose sandstone	20 to 25	
Coal	1	3
Siliceous fire-clay	2	
Hard steel-gray limestone	1	6
Slope with partial outcrops of shale	40	
Bituminous shale	2	
Coal	3	
Covered slope to the railroad level	20 to 25	

The coal obtained from the lower seam here contains a good deal of iron pyrites, and in quality is rather below the average of our Illinois coals, but it answers tolerably well for steam purposes.

At the crossing of Sugar creek, about three miles north of Bolton, on the Marion road, a massive sandstone outcrops in the banks of the stream extending to the height of fifteen to twenty feet above

the creek level, overlaid by a thin-bedded sandstone, of which about the same thickness could be seen. A coal seam has been opened here beneath the sandstone and some coal taken out for blacksmiths' use, but it was hidden by the high water when I was there, and hence I could neither determine its thickness nor ascertain the quality of the coal it afforded. This is probably coal No. 4 of the general section.

At the water mill on the south fork of Saline river, about two miles below the bridge on the road from Bolton to Marion, another seam of coal is found associated with the following beds:

	Feet.	In.
Brown sandy shale	4 to 6	
Band of hard bluish-gray limestone	0	6
Bituminous shale	5	
Coal No. 5	2	
Nodular clay shale	2	

The brown shale at the top of the foregoing section may be seen in a hill side near the mill, where it is about twenty feet thick, and its full thickness is probably as much as forty to fifty feet. The coal at the mill is rather hard and splinty, but is said to work well in the forge. The upper four inches is a cannel coal. This mill is located on the S. E. qr. of the N. W. qr. of Sec. 4, T. 10 S., R. 4 E.

At the bridge over the South Fork, two miles above the mill, near the old town of Sarahsville, a thin coal outcrops by the side of the road, associated with shale and thin-bedded sandstone. This is above the section seen at the mill. The following is the section here:

	Feet.
Thin-bedded sandstone	8 to 10
Sandy shale	4 to 6
Coal No. 6	1
Sandy shales to the water level	12 to 15

Davidson's mine, one mile and a quarter south of Crab Orchard, belongs to a still higher level, and the coal is there five and a half feet in thickness, overlaid by bituminous shale and a dark bluish-gray impure limestone. A little to the eastward of the coal mine the overlying sandstone is well exposed in the bed and banks of a shallow ravine, showing a thickness of twenty to twenty-five feet. This sandstone stands exposure well, and when found in beds of sufficient thickness for heavy work furnishes a durable building stone. About three-quarters of a mile east of Davidson's mine the thin coal that outcrops at Sarahsville was found in the bed of a small branch, and apparently from forty to fifty feet below Davidson's coal. A section of the beds seen here show the following order of succession:

	eet.
Brown and buff sandy shale and sandstone	20 to 25
Dark ash-gray limestone	2 to 3
Bituminous shale	1 to 3
Coal No. 7—Davidson's	5 to 6
Fire-clay	2
Unexposed	30 to 40
Brown and buff sandy shale	10
Coal No. 6	1 to 1½
Blue sandy shale, exposed	1

On Mr. Wiley's land, two miles and a half southwest of Marion, a thin coal has been found on Crab Orchard creek, which is probably identical with the thin seam in the foregoing section.

At Mr. Motsinger's mine, one mile and a half west of Crab Orchard village, the coal is about five feet thick, with a roof of bituminous clay shale. The coal is of fair quality, tolerably free from pyrite, and the upper eighteen inches is a good smith's coal. About a hundred yards to the south of the coal opening the hard, dark, ash-gray limestone usually found above No. 7 coal has been quarried and burned for lime, though but poorly adapted to that purpose. The coal here and at Davidson's is mined by tunneling into the hillside on the outcrop of the seam.

On Mr. Frank Ensminger's place, one mile east of Crab Orchard, the following beds overlying coal No. 7 were seen:

	Feet.
Hard sandstone in thin beds	8
Blue sandy shale	4 to 6
Brown shale and sandstone	10 to 12
Blue shale	8 to 10
Cinnamon-colored limestone	1
Bituminous shale	½ to 1
Coal, said to be six inches thick	½

About a mile and a half northeast of Mr. Ensminger's, on the S. E. qr. of the N.E. qr. of Sec. 16, there is an outcrop of the same cinnamon-brown limestone mentioned in the foregoing section, and the coal below it is said to be from two to three feet thick, and has been mined in a limited way for blacksmiths' use. This is probably coal No. 8 of the general section, and has been mined by stripping in the valley of a small creek. Owing to recent heavy rains the holes from which the coal had been taken were full of water, and the thickness of the seam could not be measured.

South of Mr. Ensminger's on Sec. 32, T. 9, R. 4, coals No. 5, 6 and 7 may all be seen within a short distance. No. 5 is here from two to six feet thick, while No. 7 is pinched out to about three feet. The following section was seen here:

	Feet	In.
Dark-gray massive limestone	4 to 6	
Bituminous shale	3 to 5	
Coal No. 7	0 to 5	
Fire-clay and clay shale	2 to 3	
Massive sandstone	15 to 18	
Sandy shale	10 to 12	
Blue and brown clay shale	15 to 20	
Coal No. 6	1½ to 1	10
Brown and blue shale	20 to 30	
Dark steel-gray limestone	1	
Bituminous shale with concretions of limestone	4	
Blue shale	8 to 10	
Coal No. 5—Ensminger's coal	1½ to 6	

One locality was noticed on the creek where the above section was made, where the massive sandstone beneath coal No. 7 seems to have pinched the coal entirely out, but a half mile to the eastward it comes in again and ranges from two to five feet in thickness. The bituminous shale over Ensminger's coal contains numerous large concretions of black limestone which weathers blue on exposure, but contain no fossils at this locality. This seam I believe to be the same as that at the water mill on the south fork of the Saline, though it is much thicker here than there, and varies from one and a half to six feet in a distance of less than half a mile. Owing to the limited demand for coal, no systematic mining has yet been attempted here, but an extensive coal mining business could be easily and cheaply carried on whenever this portion of the county is provided with railroad facilities, or manufacturing enterprises shall be established to create a market for the almost inexhaustible supply of coal now hidden beneath the soil.

At Dr. Smith's old place, south of Corinth, where a shaft was sunk several years since in search of silver, the following section was found:

	Feet.
Brown shale	10 to 12
Blue shale, partly bituminous	8 to 10
Coal No. 10	?
Fire-clay, good	2 to 3
Sandstone	10 to 15
Blue clay shale	4 to 6
Hard brownish-gray limestone	6 to 9
Bituminous shale	2 to 4
Coal, No. 9	2

The limestone exposed here I believe to be the same as that at New Haven, on the Wabash, and the equivalent of the Carlinville and Shoal creek bed. The fire-clay above the limestone was only partially exposed, and may be somewhat thicker than above indicated, and appeared to be of a suitable quality for pottery or fire brick.

About a mile and a quarter north of Corinth, a shaft was sunk some years ago in search of silver ore, which passed through this limestone at the depth of about forty-two feet. I am indebted to Mr. Shaw, who sunk this shaft, for the following data, given from memory, of the beds passed through in this shaft:

	Ft.	In
Surface soil and clay	9	
Sandstone	22	
Clay shale	2	6
Limestone	9	
Bituminous shale	1	6
Rotten coal	2	
Fire-clay	2	
Hard rock, probably sandstone	?	

A few fossils were observed in the fragments of limestone thrown out of this shaft, but belonging to species common throughout the Coal Measures. An outcrop of the upper sandstone near by showed a bed of ferruginous Conglomerate about two feet thick, composed in part of almond-shaped nodules of brown oxide of iron.

At Dr. Mitchell's place, on Sec. 22, T. 8, R. 4, a bed of hard, brittle limestone occurs in a single layer about a foot in thickness. It contained *Naticopis ventricosus*, *Productus longispinus*, and joints of *Crinoidea*. I am inclined to regard this limestone and the shales associated with it as the highest beds to be seen in this county, and probably the equivalent of the ferruginous beds usually found associated with coal No. 11 in the Wabash valley. At Mr. Robert's place, on the north side of the village of Corinth, coal was found in his well about fourteen feet from the surface. It was penetrated, according to the report, about two feet without passing through it. On Elijah Muse's place, near the northeast corner of the county, an inferior quality of coal said to be two feet thick outcrops in the bed of a small creek. These thin coals probably belong above the limestone at Dr. Smith's place and may represent the horizon of coals 10 or 11 of the general section, which are seldom found of sufficient thickness to be of any economical value. The foregoing sketch comprises all the coal seams probably occurring in this county, and it only remains now to note some of the most important outcrops of coals Nos. 5 and 7 not heretofore mentioned, as these are the only seams that are of sufficient thickness to justify mining operations on an extended scale at the present time.

Spiller's mine, two miles north of Marion, was the first one opened in this county, and has now been worked for about twenty-five years. The coal is obtained by stripping along its outcrop on a small creek, and the coal ranges from six to ten feet in thickness. The upper four feet is a good smith's coal and presents the irridescent appear-

ance characteristic of the variety known as "peacock coal." The roof is sometimes composed of hard, black shale, but locally this is replaced with a dark-blue clay shale, succeeded by a dark, ash-gray limestone which in this vicinity ranges from four to six feet in thickness, and weathers to a bluish-drab color on exposure. The following beds may be seen in the vicinity of Spiller's mine:

	Feet.
Shaly buff limestone	2 to 3
Hard, dark ash-gray limestone	4 to 5
Blue argillaceous shale	4 to 6
Bituminous shale	0 to 2
Coal, No. 7	6 to 10
Fire-clay and clay shale	2 to 4

The argillaceous shale over the coal contains numerous small, irregular-shaped nodules of pyritiferous clay, but no fossil plants were found here, though they occur in the roof shales of this coal at Carterville. The limestone contains but few fossils, and these belong to species common everywhere in the Coal Measures, such as *Spirifer cameratus*, *Athyris subtilita*, and *Productus longispinus*. Neither the limestone nor bituminous shale are very regular in their development, and at some localities both are wanting, and the roof of the coal consists of clay shale overlaid by sandstone. The coal has a parting of hard black shale about an inch thick some two feet from the bottom of the seam, and there are also several other leaf-like partings of shale separating the coal into distinct layers or strata.

A shaft sunk some years ago on the western borders of the town of Marion, is said to have penetrated a coal seam six feet in thickness at the depth of about fifty feet below the surface. This was probably coal No. 5, as the outcrop of Spiller's coal is two miles north of the town, and at about the same level as the surface on which the town is built, and the general dip of the beds being to the northeastward, that seam would outcrop above the level of the town. A thin coal has also been found in sinking wells in the town, probably No. 6, which belongs some forty to fifty feet below the Spiller coal.

The Carbondale Coal and Coke Company have opened a mine near Carterville station and are working No. 7 with a sloping tunnel carried down to the level of the coal, which lays about forty feet below the surface. The seam is here from eight to nine and a half feet thick of clean, bright, glistening coal, presenting the finest appearance to the casual visitor of any mine we have visited in the State. The roof consists of about fifteen feet of blue shale slightly bitumin-

ous at the bottom, and showing the remains of numerous fossil plants where the coal has been removed. This coal is quite free from pyrite, cokes well, and the product finds a ready market at the Iron Furnaces at Grand Tower. The same parting of bituminous shale noticed at Spiller's may be seen here. It is about an inch in thickness and some two feet above the bottom of the coal, and there are some other leaf-like partings that divide the seam into regular layers. The dip at this mine is said to be about two inches to the yard in a northwesterly direction, but this is probably local. About half a mile northeast of the opening this seam crops out in the bottom of a ravine, where the coal is much less than its average thickness, and is underlaid by two feet of fire-clay and a nodular gray limestone which weathers to a yellowish-buff color, and is from eighteen inches to two feet thick. The seam was first opened in this ravine, and considerable coal taken out by tunneling into the sides of the hill.

At Crane station, a half mile east of Carterville, a shaft was sunk to the depth of about forty feet to a seam of coal three feet eight inches thick, overlaid by a heavy bed of bituminous shale. Operations had been suspended here when I visited this locality, and the shaft was partially filled with water, so that no satisfactory examination could be made except from the material thrown out. The coal is said to be quite different from that obtained at Carterville, being harder and containing more pyrite. The coal is overlaid by a heavy bed of bituminous shale, with concretions of dark pyritiferous limestone and nodular masses of bluish-gray limestone resembling those occurring over Ensminger's coal southeast of Crab Orchard. If the dip determined in the mine at Carterville is continuous over any considerable area, that seam would be thrown out here, and I am of the opinion that this is the case, and that the coal at this station is No. 5, though it is somewhat thinner here than at Ensminger's, and from some local cause contains a greater amount of pyrite. In the roof shales thrown out at the air shaft we found several species of fossils, among which we recognized *Chonetes mesoloba*, *Productus longispinus*, *P. Prattenianus*, *Athyris subtilita*, *Spirifer cameratus*, *S. lineatus* and joints of *Crinoidea*.

From what has already been said in regard to the development of the lower coals in this county, and from the sections given on the preceding pages, it will be seen that the main coals, from No. 2 to No. 7 inclusive, are found on the eastern borders of the county, and all but No. 4 distinctly recognized and examined. It is probable, however, that there is a gradual thinning out of these lower

measures to the westward, and it is quite likely that some of these coals may not be found at all in the western part of the county, or, if found, will prove to be too thin to be of any practical value; but the outcrops are too meagre in that portion of the county to enable any one to trace out the exact sequence of the strata successfully. Borings have been made along the line of the railroad west of Carterville, and are said to have found no workable coal, but my efforts to obtain a record of the strata passed through in these borings for publication in this report were unsuccessful.

Economical Geology.

Coal.—The great mineral resource of this county will be found in its coal deposits, which are surpassed by but few portions of the State of equal extent. Nearly one-half of the county, comprising its northern portion, is underlaid by coal No. 7, the thickest seam to be found in the State, and it is probably nowhere more than from 75 to 200 feet below the surface. It outcrops at many points in township 9 south and ranges 2, 3 and 4 east, and will be found underlying nearly all the area north of these outcrops. No. 5 lays from 100 to 150 feet below No. 7, but its development in the western portion of the county is at present an unsettled problem. It is, however, developed over a large area in the northeastern part of the county. These two seams will yield from ten to twelve million tons of coal to the square mile, and they probably underlie nearly one-half of the entire area of the county. All that is required to make this one of the most prosperous coal mining regions in the State is a ready market for the vast stores of mineral fuel that are now hidden beneath the surface, awaiting the capital and skilled labor necessary for their full development. This market could be obtained by direct railroad communication with some large coal consuming city like St. Louis, Chicago or Cincinnati, where the coal products of the county could be sent at a minimum cost for transportation, instead of passing over two or three different lines of road, as is now necessary in order to reach a reliable market, thus increasing the cost of transportation until it equals or exceeds the full value of the coal on its delivery in market.

Building Stone.—Sandstone of fair quality for ordinary use may be found in abundance in nearly every township in the county, and the brown sandstone overlying coal No. 7, northeast of Marion and in the vicinity of Crab Orchard, dresses well and hardens on exposure, and forms an excellent material for caps and sills, and for all the

ordinary uses for which a dressed stone is required. In the vicinity of Bolton, and through the southern portion of the county, the sandstones associated with the lower coals are abundant, and that overlying coal No. 3 affords an excellent material for dressed work as well as for heavy masonry.

Lime.—Lime has been burned at several places in the county from the dark-gray limestone overlying No. 7 coal, but it affords only a poor quality of dark-colored lime that is mostly used as a top-dressing for the poorer qualities of soil. The limestone which is sometimes found beneath this coal would probably afford a better quality of lime if it should be found outcropping where it could be obtained at a moderate cost of labor. With proper railroad facilities, however, lime could be obtained from Union county at a less cost than it could be manufactured from any of the limestones met with in this county.

Iron Ore.—There is a notable quantity of *limonite,* or the brown oxide of iron, occurring in the shales and sandstones of the lower Coal Measures, but often too much mixed with sand or other siliceous matters to be of any economical importance. Bands of carbonate of iron or "kidney ore" also abound in the shales of the lower measures, but from the limited time devoted to the examination of the county I was unable to give as much attention to this subject as was desirable. Bands of good ore of this kind, aggregating a thickness of sixteen to twenty inches in a depth of six feet of shale, would be worthy of the attention of the iron master, in view of the unlimited supply of coal to be found here suitable for the use of the smelting furnace.

Brick Materials.—Good brick clays may be found in every neighborhood and on nearly every farm, the ordinary subsoil clays affording a suitable material for this purpose; and clean white sand of an excellent quality for mortar and cement is found in abundance about two miles north of Marion. It is composed entirely of rather coarse, angular grains of white quartz. Sand suitable for brick and for ordinary purposes may be found in the creek beds, and also in the hillsides in almost every neighborhood.

Soil and Agriculture.—There is considerable variety in the quality of the soils in this county, and their relative value for agricultural purposes may generally be determined by the growth of timber they sustain. Perhaps the poorest quality of soil may be found on the post oak flats, of which the area in this county is small, and next in order would be the oak ridges, where the timber growth consists mainly of black, white and black-jack oak. These lands possess a thin soil,

and if constantly cultivated require to be well manured, or frequently sown to clover and the green crop turned under with the plow. They produce fair crops of wheat, oats and grass if judiciously managed, and are excellent fruit lands. Next in value we would place the small prairies and the adjacent uplands, where the timber growth consists of the usual varieties of oak and hickory, interspersed with black walnut, elm, linden, wild cherry, sassafras and honey locust. The soil on these lands is a dark chocolate-colored clay loam with a yellowish clay subsoil, and they produce good crops of corn, wheat, tobacco, castor beans and cotton, and excellent crops of timothy and clover.

Tobacco is one of the staple products of the county, and during the rebellion cotton was planted extensively in this portion of the State, and was found to succeed so well that it has continued to be one of the staples of this county, most of the farmers raising all that is required for home consumption, besides exporting annually from eight hundred to fifteen hundred bales. The rolling lands are well adapted to the growth of fruit, especially peaches, which seldom fail on the high sandstone ridges in the southern part of this county. Apples, pears and small fruits flourish well and produce abundant crops, and some varieties of grapes would doubtless succeed well, though the Catawba has not succeeded well here, the fruit being subject to rot badly after a few years cultivation.

There are but few counties in Southern Illinois that possess a finer soil, or that present greater inducements for the investment of capital in agricultural pursuits than Williamson. The extension of the railroad, now terminating at Marion, through the county, giving increased facilities for the transportation of its agricultural products to market, would undoubtedly bring large accessions to the population and wealth of the county, and add largely to the present value of all the improved lands within its limits.

I take pleasure in acknowledging my obligations to Dr. Lodge, of Marion, and Dr. Mitchell, of Corinth, for important information and for personal attention and assistance while engaged in the survey of this county.

FRANKLIN COUNTY.

Franklin county contains nearly twelve townships, or about 420 square miles, and is bounded on the north by Jefferson, on the east by Hamilton and Saline, on the south by Williamson, and on the west by Jackson county and the Little Muddy river. This county lies on the southern border of the prairie region, and about one-

quarter of its area was originally prairie and the remainder heavily timbered, but much of this timber has been cleared off in the agricultural improvement of the county. The prairies are small, seldom exceeding a breadth of two or three miles, and are mostly rather flat, and there are also wide belts of low flat bottoms on all the main water courses in the county. The rolling and hilly uplands are heavily timbered with the common varieties of oak and hickory, and the best soils also sustain a heavy growth of elm, linden, wild cherry, black walnut, honey locust, etc.

That portion of the county lying between the Big and Little Muddys is generally quite rolling, and the above named varieties of timber indicate a very productive soil, and this land is undoubtedly equal to any in the county for farming purposes. Big Muddy river and its affluents drain nearly the whole area of the county, the main stream running a little to the west of south through its central portion, while the Middle and South Forks drain the southeastern, and the Little Muddy the northwestern, forming its western boundary for about ten miles from the north line. These streams furnish an abundant supply of water for stock, but are too sluggish to furnish any valuable water power for manufacturing purposes.

The geological formations in this county, like those in Williamson, consist altogether of Drift and Coal Measures, the latter belonging mainly, however, to a higher division of that formation.

Drift.—The Drift deposits of this county differ but little from those observed in Williamson, and are found to consist mainly of brown and yellow sandy clays, with gravel and small bowlders. Occasionally those of a larger size were met with, the largest ranging from two to three feet in diameter. It is a notable fact that bowlders of metamorphic rocks similar to those found in Northern Illinois, as well as specimens of native copper, are found in Southern Illinois beyond the southern limit of the bluish-gray "till" or hard-pan that usually constitutes the lowest division of the Drift deposits in the central and northern portions of the State. Frankfort, near the southern border of the county, is located on a hill from eighty to one hundred feet above the level of the surrounding country. No outcrop of stratified rocks was found in any of the deep gulleys that furrowed its sides, though it probably has a nucleus of Coal Measure shales or sandstone. Otherwise the Drift clays are much thicker here than they have been found in any other portion of the county. Their average thickness may be stated at about thirty feet, though in many places the bed-rock has been struck in sinking wells at the depth of ten to fifteen feet from the surface.

Coal Measures.

Wherever the streams cut through the Drift clays they expose a series of sandy and argillaceous shales and sandstones, with an occasional outcrop of bituminous shale or thin seam of coal, all of which belong to the Coal Measures and mainly to the upper division of that formation. The lowest beds to be found in the county outcrop in the southwest portion, and comprise the sandstone shales and thin coal that intervenes between the Spiller coal, two miles north of Marion, and the limestone that usually overlies coal No. 9. This limestone was met with on the S. E. (?) qr. of Sec. 22, T. 7 S., R. 4 E., about two miles a little south of east of Frankfort, and from its nearest outcrop in Williamson county, which was at Dr. Smith's old place, about two miles and a half southeast of Corinth, its trend seems to be nearly northwest, though it probably bends to the northward before reaching the west line of the county. It should be found on the Big or Little Muddys, but owing to the excessive rains of the past season no examinations could be made on these streams while I was at work in this county.

At Mrs. Ewing's place, on the S. W. qr. of Sec. 23, T. 7 S., R. 4 E., the following beds were found, that must overlie the limestone above named:

	Feet.
Sandy micaceous shale	10 to 15
Band of ferruginous conglomerate	1
Bituminous shale	3 to 4
Thin coal	½
Brown sandy shale, with fossil plants	3 to 4
Dark-blue micaceous shale	5
Brown shale	10 to 15

The coal noted in the above section varies in thickness in this vicinity from two to eighteen inches, and is probably a local seam overlying the limestone which outcrops about half a mile to the west of this point. This limestone is here a hard even-bedded rock of a steel-gray or brownish-gray color, weathering to a yellowish-drab. It dips gently to the northeastward with the fall of the small branch on which it is found, and only about three feet in thickness of its upper layers could be seen. The only fossils we noticed in it were *Athyris subtilita*, *Spirifer lineatus*, *Rhynchonella Uta*, and *Productus longispinus*. Coal No. 9 will probably be found a few feet below the limestone; but as it is usually too thin to be of any economical value, there is no inducement to expend either capital or labor in

its development. Coal No. 7 (Spiller's coal) should be found here at a depth of 125 to 150 feet below this limestone, and will be the first one of the main coals to be reached by a shaft in this county.

About two miles and a half west of Benton, and a mile south of the DuQuoin road, there is an outcrop of soft ferruginous sandstone overlaid by sandy shale. The beds exposed were about fifteen feet in thickness, and at one point a thin coal was found below the sandstone. The rocks here have a strong resemblance to those seen in the vicinity of Shaw's shaft, north of Corinth, in Williamson county, and if the equivalents of them, the Carlinville limestone will be found not very far below the level of the Big Muddy river. A similar bed of sandstone outcrops on Dr. Hickman's place, a mile and a half southwest of Benton, and the thin coal associated with it outcrops on a small branch where coal has been dug by stripping off the overlying clay.

The coal dips to the westward a little more than the fall of the small branch that runs in the same direction. The coal on the outcrop of the seam is not more than six inches thick, but near by it was said to have been found from a foot to eighteen inches thick. It is overlaid by a ferruginous sandstone, one layer of which is a conglomerate of iron pebbles.

Two miles north of Benton, on a small branch emptying into Big Muddy, there is an outcrop of sandstone interstratified with shale, presenting an exposure of fifty to sixty feet of strata. Following down the branch for about three-quarters of a mile, we found the following succession of beds:

	Feet.
Micaceous sandstone interstratified with shale	10 to 15
Micaceous shale	20 to 25
Sandstone	12 to 15
Micaceous shale	6 to 8
Sandstone in creek bed.	

This locality furnishes all the building stone used in Benton and the surrounding neighborhood, and the quarries here furnish an excellent freestone for foundation walls, and for dressed stone, as it cuts freely and has proved to be a reliable building stone. The beds appear to dip gently to the northeastward, and probably overlie the thin coal and sandstone seen at Dr. Hickman's place, southwest of the town.

At the ford on the Big Muddy, at the crossing of the road from Benton to Mulkeytown, there is an outcrop of about six to eight feet of brown sandy shale, overlaid by about twenty feet of brown and yellow gravelly Drift clay, containing numerous small bowlders from an inch to a foot in diameter.

South of this, for about three miles, no outcrop was found on the east side of the Big Muddy, the bluffs forming low sloping hills that appeared to be composed entirely of Drift material. Further to the southward, where the Frankfort and DuQuoin road crosses, a thin coal is said to outcrop, but I did not visit the locality. This may be coal No. 8 of the general section.

A boring was made just on the western borders of the town of Benton, which was suspended on reaching a hard gray limestone at the depth of one hundred and sixty-two feet. The record was carried away by the person in charge of the work, and no details could be obtained of the several beds passed through.

The limestone found at the bottom of this bore was probably the same as that met with two miles east of Frankfort. This rock was mistaken for the lower Carboniferous limestone, and the work consequently abandoned, when in fact it was really the bed which separates the upper and lower Coal Measures, and is at least six hundred feet above the base of the lower measures. Two or three thin seams of coal were reported in this bore, but none thick enough to be of any economic value.

Three miles and a half west of the Big Muddy bridge, on the road from Benton to DuQuoin, a coal about one foot in thickness has been opened at the outcrop and some coal taken out for the use of the neighboring blacksmiths. Still further west, in the barrens of Little Muddy, another outcrop of coal has been found about two miles south of the DuQuoin road. None of the seams outcropping in this county are thick enough to be successfully worked in a regular way.

All through the northeastern portion of the county sandstones and sandy shales are the prevailing rocks, and these outcrop at numerous points on the East Fork and its tributaries, from the Shawneetown road east of Benton to the northeast corner of the county, and numerous quarries have been opened for building stone in this portion of the county. Sandstone has been found at the following points in the county in addition to those already mentioned:

On Sec. 14, T. 6, R. 1; on Sec. 19, T. 5, R. 2; on Secs. 1, 2 and 26, T. 6, R. 2; on Sec. 20, T. 7, R. 2; on Secs. 27, 33 and 34, T. 5, R. 3; on Secs. 4, 8, 9 and 17, T. 6, R. 3; on Secs. 12, 13 and 14, T. 6, R. 3; on Secs. 20, 30 and 36, T. 6, R. 3; on Secs. 1, 2, 3 and 5, T. 5, R. 4; on Secs. 8, 10, 15 and 21, T. 5, R. 4; on Secs. 1, 5 and 12, T. 6, R. 4; on Secs. 24 and 30, T. 6, R. 4; on Secs. 1, 2, 8 and 11, T. 7. R. 4; on Secs. 12 and 30, T. 7, R. 4; and on Sec. 2, T. 7, R. 3.

Limestone is also reported in the northeast corner of the county, on Sec. 11, T. 5, R. 4. This may be the same bed that was found underlying the thin coal on Hog prairie, in Hamilton county.

Economical Geology.

Coal.—No coal seams thick enough to be worked in a regular way are known to outcrop in this county, yet its entire area is underlaid by the main coals of the lower measures, which outcrop in the adjoining counties on the west and south. In the southern and western portions of this county the Spiller coal (No. 7 of the general section) may be reached at a depth of one to two hundred feet, while in the central and northeastern portions it is probably from three to five hundred feet to this seam, and as much as eight hundred or a thousand to the base of the Coal Measures. At the present time there is but little inducement for the investment of capital in coal mining operations in this county, nor will there be until some foreign demand shall be created by the construction of railroads through this portion of the State, giving this county direct and cheap transportation to some of the large coal-consuming centers of the West.

Building Stone.—Sandstone of fair quality is abundant in the central and eastern portions of the county, and some of the quarries like that two miles north of Benton afford an excellent quality of freestone, that hardens by exposure, dresses easily, and becomes a durable and handsome building stone. Sandstones of fair quality for common use may be found on nearly all the streams, and more especially on the East Fork and its tributaries.

Lime.—The only outcrop of limestone suitable for the lime-kiln that we saw in this county was found about two miles a little south of west from Frankfort. Only about three feet in thickness of the upper part of the bed was uncovered, but it is probably from six to ten feet thick when fully exposed. The rock is a hard, gray, rather evenly-bedded limestone, and has been quarried in a small way for building stone, but I saw no evidence that any attempt had been made to manufacture lime from it here. It seems to be somewhat argillaceous, and might not slack freely when burned.

Soil and Agriculture.—There is considerable variety in the character of the soils of this county, though there is probably not a section of land within its limits that would not yield a fair return to the husbandman for the labor necessary to bring it into cultivation.

The bottom lands are rather low and subject to overflow, and are therefore somewhat neglected. The prairies are generally small and rather level, and are often surrounded by a limited area of post-oak flats, which have a thin soil, and are generally regarded as the poorest lands in the county. The prairies have a more productive soil, but are inferior to the best timbered lands. For all farming purposes the rolling timbered lands that were originally covered with a growth of oak and hickory, interspersed with black walnut, elm, linden, wild cherry, honey locust, sassafras, etc., are more productive, and will bear continued cultivation without artificial stimulants longer than any other uplands in this portion of the State.

The soil and agricultural products of this county are very similar to those of Williamson, though somewhat less attention is given here to the cultivation of tobacco, and cotton is only grown for home consumption. Stock raising, in the absence of railroad facilities for the transportation of flour and grain to market, is perhaps the most profitable branch of farming now, and beef and pork constitute a large part of the exported products of the county at the present time. Well improved farms can be purchased here at prices ranging from ten to twenty-five dollars per acre, and at these figures should command the attention of those who are seeking to invest in lands already under cultivation.

To Major Wm. Mooneyham, of Benton, I am under obligations for much valuable information in regard to points of especial interest in this county.

CHAPTER XXVII.

BOND COUNTY.

Section of the Rocks belonging to the upper Coal Measures in Bond, Fayette, Shelby, Montgomery and Christian counties. By G. C. Broadhead.

		Feet.	In.
1.	Shales and sandstone	45	
2.	Limestone	4	
3.	Fire-clay	2	
4.	Shales passing into sandstone	30	
5.	Limestone, with *Allorisma*, etc		4
6.	Shales at top, sometimes changing to argillaceous limestone	55	
7.	Sandstone, plants at bottom	4 to 40	
8.	Shaly bituminous limestone and bituminous shales	4 in. to 4	
9.	Coal No. 15, 18 in. to 3 ft., generally	1	10
10.	Fire-clay	15 in. to 5	
11.	Limestone, buff-color	0 to 4	
12. 13.	Shales and sandstone, 15 to 30 in Shelby, in Fayette 75 ?	50	
14.	Calcareous shales, fossiliferous	4	
15.	Shales	?	
16.	Calcareous and bituminous shales	2	
17.	Coal, No. 14, near Pana; on Beck's creek	16 in. to	22
18.	Fire-clay	5	
19.	Sandy limestone	5	
20.	Sandstone and shales	50	
21.	Shaly limestone	4	
22.	Limestone	4	
23.	Shales	6	
24.	Bituminous coal, No. 13	12 in. to	16
25.	Fossiliferous shales	8	
26.	Sandstone and shales	75 to 85	
27.	Limestone, lead-blue	2	
28.	Coal, No. 12	2 to 10 in.	2
29.	Shales	10	
30.	Shales and limestone, fossils numerous	4	
31.	Limestone	13 to 16	
32.	Bituminous	4	
33.	Coal, No. 11		17
34.	Mostly shales	39	
35.	Blue and bituminous shales	1	6
36.	Calcareo-bituminous shales—fossils	2	
37.	Coal, No. 10		7

		Feet.	In.
38.	Fire-clay	4	
39.	Sandy shales	3	
40.	Cone in cone—*tutenmergel*		2
41.	Ironstone	1	
42.	Argillaceous shales and flattened ironstone nodules	20	
43.	Sandy limestone, numerous fossils	2	
44.	Sandstone fossils	2	6
45.	Sandy shales	30	
46.	Sandstone—fossils		8
47.	Gray shales and sandstones	30	
48. 49.	Shoal Creek limestone	4	
50. 51. 52.	Gray and bituminous shales	16	6
53.	Coal, No. 9		10
54.	Fire-clay	2	
55.	Sandy shales	4	

Connected section from highest rocks of Effingham to lowest in the above named counties, condensed:

	Feet.	In.
Sandstone and shales	108	
Coal, No. 17		6
Sandstone, limestone and shales	145	
Coal, No. 16—Nelson's coal		16
Sandstone and shales	90	
Coal, No. 15—Shelby coal	1	10
Shales and sandstone	65	
Beck's Creek coal, No. 14	1	8
Shales and sandstone, some limestone	74	
Coal, No. 13, Lower Hickory creek	12 in. to	16
Sandstone and shales	95	
Coal, No. 12	2 to 10 in.	3
Mostly limestone, some shales	34	
Coal, No. 11—Litchfield and Lake Fork		17
Shales	42	
Coal, No. 10		7
Shales, sandstone, limestone, ironstone, etc., including Shoal Creek limestone	112	
Coal, No. 9		10
Shales and fire-clay	6	
Total upper Coal Measures	780	

Bond county is bounded on the north by Montgomery, on the east by Fayette, on the south by Clinton, and on the west by Madison county. Its area is about 380 square miles. Its surface originally consisted of about half prairie and half timber, but at present all the prairie and some of the timbered land is in cultivation or under fence.

Topopography, Timber and Soil.—The surface is diversified by mounds, hills, valleys and plains. It is mostly drained by Shoal creek and its tributaries; their general course is southward, with the Kaskaskia river and Hurricane creek on the east. The most broken part of the country is probably near Bethel bridge on Shoal creek,

where the hills are about 100 feet high. In the southern part of the county the hills are low. The country is generally somewhat broken for about a mile on each side of Shoal creek. The ravines are deep and somewhat abrupt, with hillsides covered with a growth of white oak, black oak and hickory, sloping back to poor flats, with a growth of post-oak, black oak, black-jack and black hickory. At the edge of the prairie on the west side of Shoal creek the soil is rather thin, with a growth of black-jack and post-oak; but further out on the prairie it becomes better. On the east side of Shoal creek, between the forks, near the edge of the prairie, there are some wet pin-oak flats blending into flat prairies.

Near East Fork the hills are lower than those of Shoal creek. Near the stream there is generally a good growth of white oak, black oak, hazel, hickory and sassafras. This is good wheat land. Eastwardly the country changes, and occasionally there are high sandy mounds, often a hundred feet above the creek bottoms, which, when not too sandy, are quite productive, supporting a natural growth of dogwood, sassafras, white oak, white walnut, hickory, black oak and ash, and on the shaded hillsides there are many ferns. Near the east county line a series of these mounds extends from the southern to the northern part, generally rising to about 50 feet above the surrounding plains, with which they almost imperceptibly connect by exceedingly gentle slopes. Sometimes these mounds extend into connected ridges, where we may find a luxuriant growth of vines, red and white elm, cherry, hickory, sassafras, ash, hazel, mulberry, black oak, red oak, and local groves of sugar trees. Occasionally they present a beautiful and picturesque view, gently rising and falling in the distance, resembling a low range of mountains. The plains are often four or five miles wide, generally with a very sandy soil, inferior to that of the mounds.

The banks of Beaver creek are low, not often more than 10 to 15 feet high, and the adjacent country is generally flat. Along its margin may be found pin oak, laurel oak, persimmon, crab apple, hazel, plum and elm.

The smaller creeks generally go dry during the summer. The beds of all the streams are very sandy; their bottoms are wide, rich and heavily timbered, among which may be found burr oak, red oak, sugar tree, black walnut, white walnut, hackberry, elm, honey locust, hickory, sycamore, birch and mulberry. On the hills there is an abundant supply of white and black oak timber.

Drift.—The bowlders seen in this county were all small, but among them were granite, quartzite, greenstone, syenite, fragments of coal

and fossils from the Devonian. In the western part of the county the Drift is not well developed, but is best seen near Greenville, At the bridge on East Fork, three miles northeast of Greenville. fragments of coal were found, which was a sufficient bait to the nexperienced to induce searching for more coal in the Drift deposits. A shaft was sunk 87 feet to rock, when the water broke in and checked any further work. The upper ten feet passed through was yellow clay; below it blue clay, extending to the bottom, becoming darker as they descended; at 25 feet a large lump of coal was found, and wood at 20 feet from the surface. The creek bank here shows:

	Feet.
1. Red clay, with some sand	10
2. Beds of clay, with some reddish sand, somewhat stratified, with blue sandy clay at bottom	30

At Greenville the Drift extends from the creek to the summit of the hill, a distance of about 100 feet vertically; on top there is a deep red clay. The road washings disclose beds of coarse sand, pebbles and bowlders. The washings on the hillside filter the sand very much, and towards the bottom there are deposits of very fine clean sand.

At John Hall's, three miles east of Greenville, there was found in his well conglomerate masses of rounded Drift pebbles, evidently cemented together by the siliceous matter in solution in the infiltrating water. I noticed a fragment of magnesian limestone with many small pebbles, and some sand closely adhering to it.

It is evident that over the whole of this part of the State, including all of the counties I have examined, the surface was formerly 50 to 100 feet higher than at present, the missing portion having been composed of sands, clays, pebble and bowlders; that this continued until near the close of the Drift period; that the Pleistocene sea still spread over the country, with the exception of a few of the highest mounds; that the sea subsided at a rate sufficiently rapid to wear away most of the upper clays and bear them away, leaving finer sands strewn along the surface, just as we see exemplified at present at the Greenville hill.

Coal Measures.

Outcrops are seen on Shoal creek, Locust Fork, Dry Fork and Lake Fork. The total thickness in this county is about 220 feet, all belonging to the upper series, from No. 26 to No. 53, and include about three coal beds.

The following is a general section of the Coal Measure rocks in Bond county. [Note.—The numbers used correspond to those used in my general section in this and adjoining counties, on a foregoing page.]

		Ft.	In.
No. 26.	Clay shale	0	8
No. 27.	Dark shaly limestone	0	10
No. 28.	Coal, No. 12	0	3
No. 29.	Shale	13	0
No. 30.	Shale and limestone	8	0
No. 31.	Limestone	13	0
No. 32.	Blue and bituminous shale	4	0
No. 33.	Coal, No. 11	0	17
No. 34.	Mostly shale	39	0
No. 35.	Blue and bituminous shale	1	6
No. 36.	Calcareo-bituminous shale, fossils	2	0
No. 37.	Coal, No. 10	0	7
No. 38.	Fire-clay	4	0
No. 39.	Sandy shale	3	6
No. 40.	Tutenmergel	0	2
No. 41.	Ironstone	1	0
No. 42.	Argillaceous shale and flattened ironstone nodules	20	0
No. 43. No. 44.	Sandy limestone and sandstone, fossils	4	6
No. 45.	Sandy shale	30	0
No. 46.	Sandstone, fossils	0	8
No. 47.	Gray shale and sandstone	30	0
No. 48. No. 49.	Shoal Creek limestone	4	0
No. 50. No. 51. No. 52.	Clay and bituminous shale	16	6
No. 53.	Coal, No. 9	0	10
No. 54.	Fire-clay	2	0
No. 55.	Sandy shale	4	0

The rocks occupying the highest geological positions are those on Dry Fork and Lake Fork.

On a branch of Lake Fork, near McCracken's, I observed the following beds:

		Ft.	In.
No. 26.	Brown and drab clay shales	8	0
No. 27.	Black shaly limestone, with *Bryozoa*	0	10
No. 28.	Coal, No. 12	0	3
No. 29.	Clay shales, the lower part a nodular limestone bed	7	0

On the head of Dry Fork the same bed occurs, thus:

		Feet.
1.	Limestone, with fossils, *Hemipronites crassus*, *Athyris subtilita*, and *Synocladia biserialis*	?
2.	Shales, with brown ironstone nodules	5
3.	Shale	8
4.	Limestone, No. 31	10

Part of the same section, one mile down stream, appears as follows:

	Ft.	In.
1. Dark coarse shaly limestone, abounding in *Polypora, Synocladia biserialis*, contains also *Productus Nebrascensis, Aviculopecten* and *Spiriferina Kentuckensis*	0	4
2. Drab clay shale	8	0
3. Buff limestone, referred to No. 31, with many remains of *Crinoids*, contains also *Productus longispinus*	5	0

On Lake Fork, near McCracken's coal bank, limestone (No. 31) is thirteen feet thick, and has many minute particles of calcareous spar disseminated; the bottom bed of one foot consists of dark ash-colored limestone; beneath this is four feet of bituminous and blue shale resting on seventeen inches of coal. This coal I have marked as No. 11, counting upward, and its place in the section is No. 33.

From this downward, according to record of the Litchfield boring, there is thirty-nine feet vertical thickness to the next rocks coming under my observation. In a descending series we next observe on the tributaries of Dry Fork, in Sec. 19, T. 6 N., R. 4 W.:

		Ft.	In.
No. 34.	Clay shale	12	
No. 34½.	Rough, calcareo-ferruginous bed, with *Bellerophon carbonarius, Pleurotomaria sphærulata*, and *Macrocheilus*		3
No. 35.	Lead-blue calcareous shale		8
No. 35½.	Bituminous shale		8
No. 36.	Lead-blue calcareous shale, fossiliferous: it is sometimes a limestone, contains *Productus longispinus, Chonetes variolata? Ch. Verneuilianus* and *Lophophyllum proliferum*	2	
No. 37.	Bituminous coal	0	7
No. 38.	Dark olive fire-clay	4	
No. 39.	Green sandy shales, containing rough brown nodules	3	
No. 40.	Cone in cone, good specimens	0	2
No. 41.	Four inches ironstone at top and bottom, separated by four inches of dark shales, contains *Hemipronites crassus* and *Productus Prattenianus*	1	
No. 42.	Argillaceous shale, with flattened ironstone concretions	20	
No. 43.	Ash-gray siliceous limestone, upper surface sandy and shelly, made up almost entirely of fossils, including *Aviculopecten occidentalis, Hemipronites crassus, Productus Nebrascensis, Athyris subtilita*, together with *Myalina Swallovi, Euomphalus subrugosus, Myalina subquadrata, Pinna peracuta, Chonetes granulifera?* and *Meekella striato-costata*	2	
No. 44.	Brown sandstone, fracture, sometimes shows a greenish-drab, contains *Pinna peracuta* and *Bryozoa*. This is sometimes merged into that above, and they then both present the characteristics of a ferruginous sandstone	2½	
No. 45.	Drab-clay shale, with flattened concretions of ironstone	30	
No. 46.	Dark-drab indurated sandstone, with some remains of a few fossils, could scarcely distinguish species, *Aviculopecten occidentalis*		8

Two miles above Bethel bridge, on Shoal creek, there are thin layers of No. 46 containing *Myalina Swallovi, Aviculopecten occidentalis*, with fragments of plants (*Calamites*). Just below, on the creek, No. 47 appears thus:

	Feet.
1. Shaly ferruginous sandstone, with ironstone concretions	6
2. Blue sandy shale	2

3. Sandstone, upper part sometimes gray, indurated below, and bright brown, lower part dark-gray, with carbonaceous bands 4
4. Gray micaceous sandy shale and shaly sandstone 3

Half a mile east of Bethel bridge the following beds are exposed:

		Feet.
No. 42.	Drab argillaceous shale, with concretions of ironstone	18
No. 43. No. 44.	Sandy limestone and sandstone	3
No. 45.	Argillaceous shale	17

East of Fairview, near the east county line, on a branch of Hurricane creek, there is exposed about six feet of chocolate-colored sandstone (part referred to No. 46), containing *Productus Prattenianus, Aviculopecten occidentalis,* and remains of plants (*Calamites*). The position of this rock would indicate that the easterly dip of the rocks in this county does not exceed thirty feet across its whole breadth. Below No. 46 are seen on Shoal creek occasional outcrops of thin-bedded gray sandstone amounting to about thirty feet in total thickness:

Shoal Creek Limestone.

		Ft.	In.
No. 49.	At many places on Locust Fork there crops out about four feet of an ash-blue limestone, with a somewhat splintery fracture jointed vertically, the upper part shelly on exposure; contains *Productus longispinus, Spirifer lineatus, Sp. cameratus, Productus (Boonensis ?), Rhynchonella Uta, Retzia Mormoni, Athyris subtilita, Chonetes variolata?* and *Hemipronites crassus*	4	

Below this are seen, on Locust Fork:

No. 50.	Greenish-drab clay shale	2½	
No. 50½.	Blue shale, somewhat bituminous	2	
No. 51.	Bituminous shale	2	
No. 52.	Blue clay shale, with occasional flattened concretions of pyritiferous ironstone and septaria	10	
No. 53.	Coal No. 9, good except lower 2 inches		10
No. 54.	Light-blue fire-clay, from a few inches thick to 2 feet. Next below is 3 feet of yellow and brown sandstone in 1-inch layers, then argillaceous shale. Passing eastwardly down the creek, the rocks dip about 20 feet per mile. One mile southwest, at the county line, there is a local dip north of 4 feet in 100.		

Economical Geology.

Coal.—McCracken's, on Lake Fork, is the only place where coal in any quantity has been taken out; it is only when the creek is dry that this can be advantageously worked. The coal is seventeen inches thick, and of good quality; it is dug out at several other places on Lake Fork, and has also been found on the head of Dry Fork. The other coal beds seen in this county are too thin to be worth working. Shafts have been sunk in the Drift clays for coal

east of Greenville, but in order to reach any valuable coal bed they will have to go about 225 to 300 feet or more below the general surface of the county.

Building Material.—The only really good building rock is the Shoal Creek limestone, of which Tobias Files and Mr. Reams have good quarries. The sandy limestone No. 43 is also good for building purposes, and it may be procured one mile southwest of James Vallentine's, on a branch of Dry Fork. Plenty of good limestone for lime can be procured on Lake Fork, on the head of Dry Fork, and on Shoal creek near the north county line.

Fire-clay.—No. 38 may prove to be a good material for fire-brick, and good clay for common bricks can be everywhere procured.

Water.—Springs are scarce. Good water can generally be procured at twenty to thirty feet beneath the surface.

Soil and Agriculture.—On the mounds and white oak ridges the soil generally inclines to a red color; on the flats it is of a whitish or gray color, and often quite sandy. The richest soil is that of the bottoms, next the high mounds, then the prairie in the southwest part of the county, and next succeed the white oak lands and the flats. There is a small area of very good limestone soil near Locust Fork, with a growth of red oak, white oak, shellbark hickory, elm, hackberry, laurel oak, black oak, black walnut, mulberry, red bud, sassafras, and honey locust. The average yield of wheat is good, occasionally varying from fifteen to thirty bushels per acre; of corn, thirty to forty, very rarely on the best mound slopes reaching seventy-five bushels to the acre.

CHAPTER XXVIII.

FAYETTE COUNTY.

This county is bounded on the north by Montgomery and Shelby, on the east by Effingham and Clay, on the south by Marion and Clinton, and on the west by Bond and Montgomery. It embraces an area of 720 square miles. It is intersected by the Kaskaskia river from the northeast to the southwest, nearly equally dividing it. Dismal creek flows southeastwardly through T. 5 N., R. 4 E. All the other streams are tributaries of the Kaskaskia river, including East Fork, Flat, Carson, Richland, Hickory, (three forks,) Sand, Camp, Linn, Sugar, Rock, Big, Moccasin, Wolf and Waller's creeks on the east, with Hurricane, Buck, Bear, Buckmaster, Ramsey, Asher's, Beck's and Mitchel's creeks on the west.

Topography and Timber.—In passing from the streams to higher land we generally ascend by white oak slopes to post oak flats, thence to flat prairies, around which there is generally a margin of pin oak and sometimes black-jack and post oak. Between the various streams there are flats and mounds, the latter rising from fifty to seventy-five feet above the flats. There is a low mound in T. 4 N., R. 1 W., another in T. 7 N., R. 1 E. The mound just west of Vandalia is about ninety feet above the plains. Occasionally they occur along the prairie between Hurricane creek and Kaskaskia river, and there is one large mound northwest of Bowling Green. East of Beck's creek the rise is gentle from the post oak flats to the white oak mounds about sixty feet above. On the post oak flats and flat prairie we often find swampy places and sometimes ponds. In the north part of T. 5 N., R. 1 W., there is a remarkable chain of ponds several miles long trending east and west, and mostly connected. Their margins are marshy, with a growth of *Cephalanthus occidentalis* or button bush, pin oak, rose, maple *iris* and rushes.

Some are said to contain fish. Northwardly towards Vandalia there are several other ponds. Township 5 N., R. 4 E., is generally very gently undulating. Dismal creek rises from very gentle depressions in the flat prairies; no bluffs appear for several miles, but near the Chicago railroad they are sixty to seventy feet high and rise by long gentle slopes. T. 4 N., R. 1 W., east of the river, is mostly flat with a gradually rising low mound in the south part. Near Carson, Flat and Richland creeks the country is gently undulating, with low hills near the streams, passing from rich land with pin oak, laurel oak, *cornus* and willow near the prairie, to land with elm, ash, pignut and common hickory, hazel and plum; thence to open post oak flats. Near Hickory creek the country is somewhat broken into short white oak ridges blending into post oak and white oak flats. Near the creek the hills are not over fifty feet high. East of Vandalia to the prairie the country undulates very gently, having mostly a gray soil with sometimes an abundant growth of hickory, varied by richer land with black oak, white oak, shell bark hickory, laurel oak and flats with post oak and black oak. Passing thence along an undulating prairie down the gentle slopes of Sugar creek to Big creek and London City, there are broken white oak hills spreading out into flats with post oak, black oak, black-jack, and black hickory. On Rock and Wolf creeks the hills are sometimes sixty feet high, and on the bottoms as well as those of Sugar creek sugar trees are very abundant. The bottoms of Big and Wolf creeks are tolerably wide and flat and sustain a growth of red birch, sycamore, burr oak, coffee tree, ash, red mulberry, hickory, *cornus*, coral berry and *amorpha fruticosa*. Beck's creek is rather a sluggish stream with wide and often wet pin oak bottoms; thence to the higher lands there are long slopes reaching to the flat post oak ridges. The neighboring prairies have a margin of pin oak, laurel oak and swamp white oak. Ramsey is a clear stream with a sandy bed; its bottoms are wide and high enough for good farming lands. On its bottoms may be found linden, buckeye, white walnut, bladder nut, hornbeam, hackberry, sugar tree, with iron wood, service berry and Spanish oak (?) on the hill sides. Lower down the stream the hills are low, but above the railroad they are more abrupt. From Vandalia westwardly to the county line the country is mostly flat with occasionally small prairies, a few low Drift mounds, some ponds and some good timbered land with white oak, black oak and hickory, and occasionally poorer land with post oak, and richer land with sassafras, elm and ash. Hurricane creek is rather a sluggish stream; its bottoms are rich and often wet, varying in width, sometimes being a half

mile wide and increasing near the Kaskaskia river. On its bottoms I observed sassafras trees one and a half feet in diameter and rose bushes twenty feet high, and the trees generally are very tall. Other trees observed on its bottoms were burr oak, hackberry, red bud, ash, elm, shell-bark and pignut hickory, hazel, wild allspice and grape vines. East of Fairview the growth on Hurricane bottoms consist mostly of pin oak and swamp white oak. The trees are larger and taller near the Kaskaskia river; one hickory growing on a hill side was noticed, four inches in diameter and sixty feet high. The Kaskaskia river (or Okaw, as it is commonly called,) has a deep channel and often sandy banks. Its bottoms below Vandalia are generally two miles wide, diminishing to one mile at the north county line. On the bottoms there is a heavy growth of timber, including pin oak, walnut, red oak, burr oak and cotton wood; and in wet places opposite Vandalia I noticed *Catalpa bignonioides.* The hills south of Vandalia are from fifty to seventy-five feet high. Towards the northern part of the county they are generally higher, being about 80 feet near the north county line, and 150 feet near the mouth of Beck's creek. On the other streams the hills are lower. On Buck creek are found *cornus florida,* white walnut, hornbeam, sugar tree, black gum, red oak, ash, linden, cotton wood, sycamore and white oak.

Stratigraphical Geology.

In this county the formations consist of the Quaternary and the Coal Measures.

Alluvium.—The wide flat bottoms of the Kaskaskia embrace an extensive area of Alluvium.

Prairie Formation.—The prairie near Dismal creek has a grayish soil containing a few small concretions of oxide of iron. Nine miles east of Vandalia on the National road the prairie soil contains a good deal of iron ore.

On Flat prairie, ten miles southwest of Vandalia, the roadside washings expose:

	Ft.
1. Dark soil	1
2. Dark brown clay with darker stains exposed	2

This I consider older than the Alluvium, and may be equivalent to the Bottom prairie of the Mo. Geol. Report.

On the north side of Big creek there is exposed six feet of dark and buff clays, containing small nodules, probably Loess.

Drift.—This formation is well developed in this county. A well near Ramsey was dug 100 feet deep through clay and gravel to solid rock. The mound west of Vandalia is about 100 feet above the general surface of the surrounding country, and 55 feet of Drift is exposed on the bank of the river at the National road bridge. This would make the total thickness of the Drift in this county not less than 150 feet; probably a little more, but not over 200 feet.

On the bank of the Kaskaskia river, at the National road bridge, the upper 15 to 20 feet consists of red clay with coarse sand and gravel below, with 30 to 35 feet of blue clay at the bottom. The blue clay is very hard and compact, and contains numerous small rounded pebbles. One mile southwest the railroad cut exhibits red clay, sand and pebbles at the top; below, gray and brown beds, with alternations of beds of sand and pebbles, the latter sometimes partially cemented together.

The mound west of Vandalia has ash-colored clay at the top, and darker-colored clay and pebbles below; then brown sand, pebbles and bowlders; two-thirds up the hillside there is a fine spring of pure water issuing out of the brown sand. One and a half miles southwest of Vandalia the river bluffs are formed of steep, broken Drift hills, with blue clay and bowlders at the bottom, overlaid by brown sand; towards the upper part there is a two-foot stratum of ferruginous sandstone, passing into a hard iron ore. Its firm hard appearance might induce one to think it belonged to an older age than the Drift, but it lies at about the same horizontal level along the hillside, and is also found cropping out in other ravines at the same elevation, with drift sands below. Furthermore, its frequent occurrence in this county, and also in others, associated with the same Drift beds, shows that it must belong to this formation. The blue clay at this point is quite hard, and the water passing over it forms a tufaceous deposit on the surface. In the ravines there are many fine springs of water issuing from the base of the sand beds.

On Buck creek, near the Kaskaskia bottoms, there is a dark-gray clay and sand conglomerate, which when struck emits a dull hollow sound. A good spring of water flows from just over it, and a tufaceous deposit is there formed.

Twelve miles southeast of Vandalia masses of ferruginous conglomerate were observed similar to that found near Vandalia. A well here shows 8 feet of sand at the top, and 18 feet of sand and pebbles below. In the road north of Greenland I observed—

		Ft.
1.	Buff clay and gray sandstone	5
2.	Ferruginous sandstone	4
3.	Buff clay and pebbles	4
4.	Blue clay and pebbles in sight	6

In Sec. 31, T. 6 N., R. 2 E., on the land of George Phifer, a broken stratum of coal 1½ inches thick occurs in the Drift, with blue clay and pebbles both above and below. One unacquainted with geology might imagine a permanent coal bed to be here.

A similar place was examined on Bear creek, five miles from Vandalia. The hill is here 27 feet high, and near the middle there is a thin stratum of black sand; beneath this are streaks and fragments of coal enveloped by red sand and small bowlders, and near the base of the hill there is a mass of Coal Measure fire-clay. There are also masses of sandstone and limestone not much worn, all evidently drifted but a short distance. Other bowlders found here are of granite, sienite and quartzite.

At the mill on Beck's creek, in Sec. 10, T. 8 N., R. 2 E., Coal Measure limestone is seen apparently resting on a bed of Drift; some of the sand and pebbles are even cemented to the limestone, which must have been overhanging when the Drift was deposited, and the latter washed beneath.

Mounds.—In the western part of the county there are many mounds rising above the general surface of the country 50 to 90 feet, and occasionally there are a few east of the river. The various clays, sands and pebbles found on these mounds, and entering into their composition, present the same character peculiar to mounds found in other counties.

Among the Drift bowlders found in this county are syenite, granite, hornblende rock, greenstone, quartzite, sandstone, limestone and clays from the Coal Measures. No very large bowlders were found.

Coal Measures.

On account of the non-appearance of certain intermediate beds necessary in the connection, we can only approximate the thickness of the Coal Measures in this county; but there is sufficient data to assume that the total thickness may reach 350 feet, ranging from No. 1 to No. 46 of the section of upper Coal Measure strata, and include the horizon of four coals, viz: 13, 14, 15 and 16, although the latter has not yet been found in the county.

The rocks occupying the highest geological horizon in this county are probably those on Dismal creek, of which the following is a section:

		Feet.
No. 1.	Sandy shale	10
No. 2.	Buff limestone, upper part nodular, middle in even layers; no fossils seen	5
No 3.	Clay shales with nodules, middle red, remainder olive-colored	12
No. 4.	Sandy shales and thin beds of hard gray sandstone	24

The next highest beds are found on Hickory and Rock creeks:

On Hickory Creek.

		Feet.
No. 1.	Sandy shales: in the middle are dark micaceous and carbonaceous partings; below there are occasional thin beds of sandstone, color yellow, drab and gray	20
No. 2.	Sandstone, hard, gray and brown, ferruginous and yellow; part of it, for 100 feet horizontally, is a vermillion red, containing *Lepidodendron* and *Sigillariæ*	5
No. 3.	Slaty coal and bituminous shale, passing into a cannel coal at Odell's, contains *Solenomya radiata* and *Aviculopecten Whitei*, equivalent to No. 15 Shelby coal	3
No. 4.	Dark-blue clay shales, stained brown	1
No. 5.	Yellow clay	2
No. 6.	Soft yellow sandstone and shales	3
No. 7.	Greenish-blue clay shales	2

In passing down stream a quarter of a mile the rocks rise 1 foot in 60.

		Feet.	In.
No. 8.	One and a half miles down stream there is exposed 25 feet of clay shales; they may be as much as 50 or 75 feet in thickness. Men boring at Odell's report 80 feet below No. 3 (coal No. 15) without reaching any coal. In the road near the creek at Slabtown, the following beds were seen:		
No. 9.	Dark grayish-blue shaly limestone, sometimes in solid layers suitable for building purposes, contains remains of fossils	0	8
No. 10.	A few inches of shale		?
No. 11.	Coal—smut in the road, in a well	1	0
No. 11½.	Fire-clay, covered by *debris* at this place	4	0
No. 12.	Ochre-brown sandy shales, with nodules of ironstone and some hard rough masses of sandstone	25	0

Below this there may be 25 to 50 feet more of sandy shales, to the next lowest rock seen at Richardson's coal bank, in Sec. 27, T. 6 N., R. 2 E.

		Feet.	In.
No 14.	Yellow clay shales	6	0
No. 15.	Dark-gray shelly limestone, passing into a calcareous shale, very fossiliferous; contains *Hemipronites crassus, Chonetes Flemingii, Spirifer cameratus, Productus Nebrascensis, Aviculopecten occidentalis, Myalina ampla, Myalina Swallovi, Leda arata, Monopteria gibbosa, Schizodus, Macrodon, Edmondia, Phillipsia Sangamoensis, Poteriocrinus?* near *P. hemisphericus*, stems of *Crinoids, Synocladia biserialis*, and *Fistulipora*	4	0
No. 16.	A few feet of clay shale and a few inches of dark shale		
No. 17.	Covered by *debris*—Bituminous coal, 13, said to be	0	16

Below the forks of Hickory creek there is exposed 8 feet of thin-bedded sandstone. On the South fork of Hickory part of the above section appears, thus:

		Feet.	In.
1.	Bituminous shale		?
2.	Dark-blue shaly limestone	0	6
3.	Bituminous coal—coal No. 14	0	10
4.	Olive clay shale	2	0
5.	Nodular arenaceous limestone, contains *Productus Prattenianus, Allorisma,* and a large *Pleurotomaria*	2	0
6.	Dark-red and olive clay shales, with nodules and concretions of ironstone	4	0

A quarter of a mile down the creek there is about 40 feet of hard sandstone and sandy shales.

On Rock creek and Wolf creek coal No. 15 (Shelby coal) with the adjacent rocks is found. At Phifer's and at Joel Blakely's the section is as follows:

		Feet.	In.
1.	Yellow and brown sandstone, containing remains of plants, with a few red ochrey bands at the lower part	35	0
2.	Soft black shales	1	0
3.	Coal—15	0	18
4.	Clay, with some nodules of limestone	4	0
5.	Rough-looking fine-grained buff limestone, no fossils except a few Crinoid stems	4	0
6.	Sandy shale	8	0

Below the forks of Moccasin there is exposed 25 feet of shales, the upper 5 feet sandy, below dark bluish-olive clay shale. At 12 feet from the bottom there is a 5-inch calcareous stratum, abounding in *Myalina subquadrata;* also contains *Leda arata, Schizodus, Lingula, Macrodon* (large Sp.), and fragments of crinoids. This bed is probably 30 or 40 feet below coal No. 15.

Near Howard's point the following beds are below coal No. 15. In Sec. 36, T. 7 N., R. 2 E., there is an outcrop on the head of Camp creek of about 2 feet of hard grayish-blue fucoidal sandstone, which turns dark-brown on exposure.

At Howard's Point part of the same sandstone appears thus:

		Feet.
1.	Yellow shaly sandstone	1
2.	Hard bluish-gray sandstone	1
3.	Sandy shales, and thin beds of chocolate-colored sandstone	10

A quarter of a mile down the creek there is 15 feet of dove-colored clay shale. In the lower part are concretions of sulphuret of iron and carbonate of iron and lime.

		Feet.	In.
No. 2.	Dark shales, lower part bituminous; sometimes there is a bed of dark shaly limestone	1	6
No. 3.	Bituminous coal—No. 14	0	10
No. 4.	Dove-colored fire-clay	4	0
No. 5.	Thickly laminated soft chocolate-colored and red sandy shales	4	0

On Kaskaskia river, in Sec. 28, T. 9 N., R. 3 E.:

		Feet.	In.
1.	Slope from hilltop	about 80	0
2.	Olive clay shales, with some ferruginous concretions		?
3.	Dark-blue shaly limestone		4
4.	Brownish-ash calcareous shales, contains *Athyris subtilita*, *Chonetes Flemingii*, crinoid arms and columns	2	0
5.	Bituminous coal—No. 14	0	14
6.	Fire-clay	4	0
7.	Coarse, rough, nodular sandy shales, some hard, nodular, sandy and calcareous, beds, containing *Productus Prattenianus*, *Aviculopecten*, etc	6	0

Down the river 300 yards, the same sandstone appears at the water's edge.

At Brown's coal bank on the west fork of Beck's creek, at the county line, in the south part of Sec. 22, T. 9 N., R. 1 E., the coal is said to be 16 inches thick, capped by dark slate. The section is:

		Ft.	In.
1.	Dark lead-blue limestone, dull appearance, weathers ash-blue	1	
	Lead-blue calcareous shales, abounds in *Productus Nebrascensis*, *Orthis Pecosi*, *Retzia Mormoni*, *Athyris subtilita*, also contains *Spirifer planoconvexus*, *Spiriferina Kentuckensis*	2	
3.	Coal—14	16 to 22½ inches	

A half mile down the creek there is found:

		Ft.	In.
1.	Ferruginous limestone rather shaly, contains remains of crinoids and *Lophophyllum proliferum*		6
2.	Light greenish clay shales	2	
3.	Thinly laminated sandy shales	2	
4.	Hard bluish-gray or drab calcareous limestone	1	
5.	Drab and blue clay shales	8	

In Sec. 30, T. 9 N., R. 2 E., (known as the Gooden coal bank) we have:

		Ft.	In.
1.	Drift slope	?	
2.	Dull ash-blue shaly limestone, weathers to a dirty drab, fossils are *Productus Nebrascensis*, *P. Prattenianus*, and *Chonetes*	1	6
3.	Clay shales	8	
4.	Thinly laminated clay shales with plants	1	
5.	Clay shales in thin layers in the creek; beneath there is said to be a thin seam of coal	?	

An interesting group of rocks occurs on Ramsey creek, comparatively isolated from any other group in this county, no other outcrop being observed within six miles, but from the topography of the country it is apparent that their position is below that of the rocks previously mentioned. Their position is near No. 22 of section on page 467.

Section at the railroad on Ramsey creek and just below:

		Ft.	In.
1.	Sandstone and sandy shale	21	
2.	Clay shales with compact nodules of iron ore	7	
3.	Semi-bituminous dark slate		2
4.	Indurated clay shale, a few inches		?
5.	Even bed of iron stone, outside brown, fracture purplish-drab, abounds in *Estheria*, also contains *Aviculopecten*		2

		Ft.	In.
6.	Light-blue argillaceous shale	4	
7.	Drab-colored clay shales or fire-clay	4	
8.	Drab clay shales, nodules in the upper part, lower part talus of above, about	15	
9.	An ⅛ to a ¼ mile down the creek we have an ash-blue limestone, upper part turns brown and shells off on exposure	3	

The lower part is sometimes shelly; abounds in *Syntrilasma hemiplicata*, also contains *Meekella striato-costata, Chonetes, Spirifer cameratus, Sp. lineatus, Spiriferina Kentuckensis, Athyris subtilita, Terebratula bovidens, Hemipronites crassus, Productus longispinus, P. costatus, Nautilus, Stenopora lepidodendroides, Polypora, Synocladia,* and *Lophophyllum proliferum;* it has also dark fucoidal veins passing irregularly through it.

		Ft.	In.
10.	Clay	1	
11.	Coarse gray limestone, contains only a few crinoid stems and a few remains of fish teeth	2	6
12.	Yellow clay and nodules of limestone		?

About two miles down the creek there is an outcrop on the hillside of about two feet of even-bedded chocolate-colored and yellowish sandstone, with twenty-five feet of sandy shale beneath, and towards the foot of the bluff, two inches of blue, compact limestone with a pot-metal ring; this is probably near No. 4 of the above section. One and a half miles further down the creek, at a ford, the following appears:

		Ft.
1.	Drift of sand and clay	?
2.	Sandy shales	4
3.	Yellow, ochre-colored sandstone	2
4.	Gray shales with ironstone concretions abounding in some very nice fossils, including *Leda arata, Solenomya radiata, Myalina,* resembling *M. meliniformis, Schizodus* near *S. Rossicus, Allorisma, Aviculopecten* and *Edmondia*	5

No. 4 of this section is near No. 5 of the section at the railroad bridge. The course of Ramsey creek is generally southeast. From the above it will be seen that the rocks have a slight dip down stream.

On Beck's creek, at the mill, in Sec. 10, T. 8 N., R. 2 E., there appears 6 feet of buff limestone abounding in *Syntrilasma hemiplicata,* and *Lophophyllum proliferum,* also contains *Athyris subtilita, Productus costatus* and *P. punctatus.* This bed of limestone is seen extending along the creek for 100 feet, and has a regular local dip of 17°. On Hurricane creek, near the line of Bond county, east of Fairfield, beds of sandstone occur containing fossils resembling those of No. 46.

Economical Geology.

Coal.—Much anxiety was manifested by the citizens of Vandalia on the subject of coal. At present their supplies are brought by rail from Perry county.

Coal 15 or Shelby coal is only found near the head of Hickory creek, 2½ miles from the east county line, and northwardly near the county line, on Rock creek and Wolf creek.

At Jas. P. Odell's, in Sec. 34, T. 6 N., R. 3 E., a slaty coal has been taken out, but as yet is not much used. A shaft was in process of being sunk, and had reached 80 feet, without coming to any other coal.

On the land of Joel Blakeley, near Rock creek, an 18-inch seam has been worked, the upper and lower two inches pyritiferous and 14 inches of good coal. At Blakeley's bank part of the coal bifurcates, and insinuates thin veins into the overlying sandstone.

The neighboring hills are low, and the coal can be easily reached. Mrs. Mary Grant and Mrs. Phifer also have coal banks in the same vicinity. This coal crops out one foot thick at the edge of the water of Wolf creek, in Sec. 12, T. 8 N., R. 3 E.

Coal No. 14 crops out on the Kaskaskia river, at Wm. Thomas', in Sec. 2, T. 9 N., R. 3 E., 14 inches thick; at Jas. Brown's, near the north county line, on the waters of Beck's creek, in Sec. 21, T. 9 N., R. 1 E., 16 to 22 inches thick; a half mile north of Howard's Point, 10 inches. On the south fork of the Hickory, in Sec. 10, T. 5 N., R. 2 E., it is 10 inches; at Col. Forman's, 18 to 20 inches.

Only at Brown's and Col. Forman's has there been much mining. At Brown's a drift 2½ feet high has been run into the hill, but recently nothing has been done. At Forman's, in Sec. 1, T. 5 N., R. 2 E., a good many pits have been dug at various places on the bottom, and a good deal of coal taken therefrom at different times. On the bank of a branch the coal appears very well, extending nearly horizontally along the stream for about 50 feet, and 20 inches thick, with 4 feet of fire-clay beneath; at one place the coal measures 2 feet in thickness. A trace of this coal appears in the road at "Slabtown."

Coal No. 13.—Banks have been opened at two places on Little Hickory creek, viz: At Wm. Hamilton's, in the S. W. qr. of the N. W. qr. of Sec. 26, T. 6 N., R. 2 E., and at Wm. Richardson's,

in Sec. 27, T. 6 N., R. 2 E. At Hamilton's, several pits have been dug on low ground near the creek, but they are now filled with *debris*. At Richardson's the coal was taken from the side of the bluff, but is now hidden from view by the talus from above; the thickness of the seam is reported to be from 16 inches to 2 feet, and the coal of good quality. These places can be worked without much cost.

On Beck's creek, about a mile above the Shelbyville road, a good deal of coal has been taken from the creek, but the water is generally in the way. This is known as the Gooden coal bank. A bed of coal is reported to be at the bottom of the Kaskaskia river, in the S. E. corner of T. 9 N., R. 2 E., but the water is generally at least 6 feet over it.

The western boundary of coal No. 15 is a north and south line two miles from the east county line. The western boundary of coal No. 14 is nearly parallel to the last and three miles west of it, with an outlier of a few miles square, near the north county line, east of the railroad.

The western boundary of coal No. 13 passes northwardly near the middle of R. 2 E., crossing Kaskaskia river near the mouth of Beck's creek, and thence northwestwardly. West of this line no coal beds have appeared in the county.

The coal under the Shoal Creek limestone is about 230 to 240 feet below the lower Hickory Creek coal. Coal No. 7 is 375 to 500 feet below coal No. 13. From this I would suppose that, in order to reach a good workable coal, a shaft would have to be sunk 300 to 500 feet at Vandalia; at that depth, coal No. 7 (6 to 8 feet thick) might be reached.*

Iron ore.—Thin beds and concretions of carbonate of iron ore are common in the Coal Measure shales, but were not found sufficiently abundant to work in this county. On the National road, nine miles east of Vandalia, I noticed a deposit of very dark-colored oxide of iron in prairie clay or soil; it crops out about 4 inches thick, in a rough massive stratum around the margin of a washed place of 50 feet square; on one side it is 6 inches beneath the surface, and on the other 2 to 3 feet. The clay at this place is probably of older age than the soil or alluvium; probably nearly, if not quite, as old as the Loess. Small concretionary nodules of a similar variety of iron ore are often found washed out of the prairie clays.

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* See section of shaft and boring at Vandalia, at the close of this chapter.

The ferruginous sandstone previously spoken of under the head of "Drift," may sometimes be considered an iron ore; it is abundant near Vandalia, and is also found near Greenland and at William Porter's, on Little Hickory.

Building Rock.—There is a good sandstone quarry near Ramsey creek, two miles below the railroad; the rock is generally about two feet thick and of good quality; part of the stone arch culvert on the I. C. R. R., at Vandalia, was procured here.

The *Syntrilasma* limestone on Ramsey creek has been very extensively used on the railroad, and also in bridge abutments on the National road. Part of it seems to stand the weather well, but a good deal has been cracked by frost. The lower bed under that containing *Syntrilasma*, has the appearance of being a very durable stone, but I am not aware that it has been used.

The buff limestone on Beck's creek, near its mouth, would probably make a very good lime.

In Sec. 10, T. 5 N., R. 2 E., there is a quarry of hard brownish-gray sandstone, rather irregular in its character, changing color on exposure. It has been used in some bridge abutments on the National road, but has not proved durable.

At. Wm. Yokes', north of the National road, nine miles east of Vandalia, there is a good sandstone quarry. The rock is thin-bedded, tolerably hard, but works freely and is of even thickness. On Dismal creek, near Laclede, there is a five-foot bed of buff limestone, which makes a tolerably good building rock and good lime.

Road Material.—At Vandalia there are very extensive beds of sand and rounded gravel, very suitable for road-beds and much used for ballasting on the railroad. Several lumps of native copper have been found in this county; one a half pound and another 10 ounces in weight.

Soil and Agriculture.—The Kaskaskia bottoms embrace a large area of, as yet, untilled lands, being subject to annual overflows, which have heretofore been a drawback to their cultivation, but there certainly will be a time when these lands will be sources of great wealth. The prairies in the southern and southeastern parts of the county probably contain the best upland; the other prairies have generally a thin soil, similar to that on the post-oak flats, but probably richer. Much of the timbered land is poor, but there are occasionally very rich spots of elm and cherry land, for example, on the Vandalia and Carlyle road.

The best uplands will produce 40 to 50 bushels of corn per acre; other lands 25 to 30.

A good average of wheat is 20 bushels per acre, the timbered land producing the best crops.

Recently the bugs have been quite destructive to the potato crop; but generally, with proper culture, very fine crops can be raised. I would suppose that on the broken ridges fine vineyards could be made, but none have yet been started.

Wells and Springs.—There are some very good springs in this county, generally originating in the Drift sands, and are sometimes a pleasant chalybeate.

On the land of Geo. Phifer, in Sec. 31, T. 6 N., R. 2 E., there are several chalybeate springs issuing from the sands of the Drift, and Mr. P. says that they always have the same flow of water. In the hills south of Vandalia there are a good many fine springs of mostly very pure and clear water.

In the north part of the county, the wells are 12 to 18 feet deep, with weak veins of water. A well on Rock Creek prairie was dug 39 feet and plenty of water obtained.

One mile south of Vandalia a well was dug 30 feet, mostly through sand with some clay at the top, and plenty of water procured. On a hill, at an elevation of about forty feet above, another well was dug 60 feet deep, through similar material, with no water; near the latter another was dug 65 feet deep, mostly passing through sand, to water. A half mile north is another well, 30 feet deep, through clay and sand, with plenty of water.

Antiquities.—There are a good many ancient mounds of human construction in this county; a few near Vandalia, some on Hurricane creek, and some near Ramsey. But few of them have been opened. I obtained only a few flint arrowheads and a stone hatchet made of syenite, and picked up a few broken fragments of pottery near the site of a mound that had been opened.

A particular examination of these mounds might develop some interesting relics.

In conclusion I would state that I am under many obligations to Mr. Tevis Greathouse, of Vandalia, for assistance in furnishing maps, and am also particularly indebted to Dr. G. W. Bassett, of the same place, for assistance in making collections, in getting information, and for spending several days in assisting me.

NOTE.—Since the foregoing report was made by Mr. Broadhead, a shaft was sunk at Vandalia to the depth of 377 feet 3 inches, and a boring from the bottom of the shaft to a total depth of about 574 feet.

The following section of this shaft and boring was furnished by Dr. G. W. Basset, of Vandalia:

		Ft.	In.	Total.	
No. 1.	Soil and yellow clay, sand, gravel, bowlder clays and quicksand (drift)	94	6		
No. 2.	Hard sandstone	1	2	95	8
No. 3.	Dark, sandy, clay shale	6	3	101	11
No. 4.	Clay shale	4	3	106	2
No. 5.	Black shale	10	2	116	4
No. 6.	Dark gray shale	7	4	123	8
No. 7.	Coal, No. 10		10	124	6
No. 8.	Fire-clay	8	9	133	3
No. 9.	Hard gray shale, with iron nodules	17		150	3
No. 10.	Hard gray sandstone	7	11	158	2
No. 11.	Bituminous shale	7	10	166	
No. 12.	Clay shale	5	6	171	6
No. 13.	Dark gray, sandy shale	16	2	187	8
No. 14.	Fire-clay		4	188	
No. 15.	Hard gray, sandy shale	9	5	197	5
No. 16.	Dark gray shale	11	2	208	7
No. 17.	Lime conglomerate	3		211	
No. 18.	Clay shale	2	8	213	8
No. 19.	Shale	3		216	8
No. 20.	Bituminous limestone, with *Pinna peracuta*, etc	2		218	8
No. 21.	Fire-clay	5		223	8
No. 22.	Clay shale	4		227	8
No. 23.	Dark clay shale, with *Avic. rectilaterarius*	38	2	265	10
No. 24.	Bituminous shale	1	5	267	3
No. 25.	Limestone, Carlinville and Shoal creek bed	4	3	271	8
No. 26.	Gray shale	27	6	299	2
No. 27.	Bituminous shale	1	2	300	4
No. 28.	Coal, No. 9		6	300	10
No. 29.	Bituminous shale		3	301	1
No. 30.	Gray shale	1	8	302	9
No. 31.	Gray sandstone	1		303	9
No. 32.	Gray shale	21	7	325	4
No. 33.	Coal, No. 8		9	326	1
No. 34.	Fire-clay	1		327	1
No. 35.	Bituminous shale	1	6	328	7
No. 36.	Sandstone	3	7	332	2
No. 37.	Sandy shale	13		345	2
No. 38.	Dark gray shale with bands of iron ore	7	3	352	5
No. 39.	Bituminous shale, with fossil ferns	2	6	355	11
No. 40.	Coal		1	356	
No. 41.	Clay with ironstone concretions	9	3	365	3
No. 42.	Sandstone with fossil ferns	9	2	374	5
No. 43.	Sandy shale with clay parting	2	10	377	3
	Bottom of Shaft—boring as follows:				
No. 44.	Sandstone	111		488	3
No. 45.	Limestone	2		490	3
No. 46.	Clay shale	9	10	500	1
No. 47.	Gray sandstone	5	7	505	8
No. 48.	Shale	8	10	514	6
No. 49.	Clay shale	6		520	6
No. 50.	Bituminous shale	5	6	526	
No. 51.	Dark gray shale	5	2	531	2
No. 52.	Clay shale with lime nodules	12		543	2

		Ft.	In.	Total.	
No. 53.	Bituminous shale	1		554	2
No. 54.	Gray shale	5	11	550	1
No. 55.	Blue clay shale	4		554	1
No. 56.	Gray clay shale	12	3	566	4
No. 57.	Limestone		10	567	2
No. 58.	Bituminous slate and coal		6	567	8
No. 59.	Fire-clay	6		573	8
No. 60.	Limestone		8	574	4

This shaft and boring reaches a depth of 574 feet without finding a workable coal. The shaft at Centralia was sunk to the depth of 576 feet, at which depth a seam of coal 7 feet in thickness was found. This coal is 373 feet below the Carlinville limestone in that shaft, and if the strata retain the same thickness at Vandalia, their boring terminated 80 feet above the Centralia coal seam. It seems from these shafts and borings that there is a very decided increase in the thickness of the strata associated with the lower coals in the central portion of the State, and that they will be found relatively at a greater depth here than at points nearer the borders of the coal field. The parties interested in the matter at Vandalia should prosecute their boring at least to the horizon of the coal seam at Centralia, to determine, if possible, whether that coal extends into Fayette county. A. H. W.

CHAPTER XXIX.

MONTGOMERY COUNTY.

This county is bounded on the north by Christian, on the east by Christian, Shelby and Fayette, on the south by Fayette, Bond and Madison, and on the west by Macoupin. Its superficial area is 19½ townships, or 702 square miles.

Topography.—On Ramsey creek the hills are low and the country gently undulating; near Nokomis there are several mounds, with long, gentle depressions between, stretching off into rich plains. Westwardly, across the country, through townships 10, 11 and 12 N., the country is for the most part rather flat. Near the East Fork of Shoal creek the hills are generally low, becoming higher as we descend the stream; in the south part of T. 8 N. they are 40 to 50 feet high. On Shoal creek and Middle Fork the hills are 40 to 50 feet high, and rise by long, gentle ascents.

On the West Fork of Shoal creek the country is generally broken for a few miles from the stream, and the hills are 60 to 70 feet high. Near Lake Fork the hills are not very high. In the south half of the county between the main streams there are occasional mounds, often a mile or more across their base and about 50 feet above the adjacent plain, with which they are connected by a long descent.

Timber and Prairie.—Probably a little less than two-thirds of the area of this county is prairie. The northern part is mostly prairie; the southern has a large proportion of timber. Near Hurricane creek there are post oak flats, changing to large white oak hills near the creek. At the edge of the prairie the growth is mostly laurel oak, sumac, hazel, plum, etc. Near Ramsey creek the upland growth consists of white oak, black oak, post oak, laurel oak, hazel and

sassafras. The East Fork hills have mostly pin oak, black oak and post oak, changing near the prairies to laurel oak, black oak and hazel. Shoal creek hills have mostly white oak, black oak, sassafras and hickory, changing to poorer flats with post oak, black-jack and black hickory, often extending to the prairie. Near Hillsboro the growth is principally black oak, with some white oak, hickory, sassafras and hazel.

Near Walshville and Lake Fork the country is gently undulating, with a growth principally of plum, black walnut, honey locust, wild cherry and grape vines. Wild vines loaded with grapes were observed nearly everywhere in the woods, proving the soil to be naturally well adapted to the grape.

Post oak flats occur near West Fork as far as T. 10 N.

Sugar trees are occasionally found along the Middle and West Forks, and some extensive groves are found on the bottoms of main Shoal creek.

The following comprises a list of such trees and shrubs as were observed occurring in this county: Crab apple, ash, prickly ash, red birch, bladdernut, buckeye, box elder, button bush, bitter sweet, blackberry, coralberry, choke cherry, common cherry, coffee tree, *cornus* (2 species), cottonwood, *Clematis Virginiana*, elder, grape (4 or 5 species), gooseberry, black haw, hackberry, honey locust, *hop tree*, hazel, shellbark and thick shellbark hickory, pignut hickory, black hickory and common hickory, iron wood, linden, white maple, sugar tree, red mulberry, paw-paw, persimmon, plum, black, red, white, post, laurel, pin, chestnut, black-jack, burr and swamp white oak, red and American elm, red-bud, raspberry, rose, red root, poison oak, sassafras, service berry, sarsaparilla, sumac, trumpet creeper, Virginia creeper, willow (several species), and black and white walnut.

Geological Formations.

Washings in the road at Walshville show 8 feet of brownish-buff clay with but few pebbles. Along the various streams are occasional exposures of sand and pebbles with some beds of brownish-yellow clay. Five miles north-east of Litchfield 45 feet of drift is exposed, the lower part a compact bed of dark clay, with some sand and pebbles. In Sec. 8, T. 8 N., R. 3 W., the following description was given me of the various clays passed through in well digging:

1.—Soil. 2.—Yellow clay or hard-pan; at 24 feet reached a 3-foot bed of sand, then soft, moist clay.

Seventy-five yards from this another well was dug, showing in the upper part brownish-yellow clay at 20 feet, and at 38 feet was a 2-foot bed of sand, and at 42 feet specimens of wood.

On the head waters of Ramsey there are many springs slightly chalybeate, and some containing sulphate of iron, issuing from beds of drift sand and pebbles.

There is certainly evidence that at some former period of time the whole surface of the county was 50 to 75 feet higher than at present; that since the original Drift deposition (it may have been just at the close of the Drift period) large masses of these deposits were washed off, leaving occasional mound-like elevations, several of which may be seen near Nokomis, a few between the East and West forks, and the hills between Hillsboro and Butler.

Coal Measures.

The upper Coal Measures appear in part in this county, and underlie all the superficial deposits, and include coal beds No. 11 and No. 13, with a trace of No. 12, and embrace about 150 feet of rocks, reaching from the base of No. 33 to No. 20 of the upper Coal Measure section.

Nos. 20 and 21.—In Sec. 12, T. 10 N., R. 1 W., there crops out along the creek 8 feet of sandy shale and blue limestone; close by is an outcrop of brown, shaly, soft limestone, containing *Hemipronites crassus* and Crinoid stems; *Machrocheilus* and *Spirifer cameratus* were also found. The exact thickness between 21 and 22 is unknown; the outcrops are ten miles apart, with no evidence of a continuous easterly dip, but it is probable that 25 or even 50 feet may intervene.

Rocks on the East Fork of Shoal Creek.—In Sec. 24, T. 8 N., R. 3 W., we have:

	Feet.
1. Mostly dark lead-blue shales, upper part sandy with brown nodules of ironstone, the lower two-thirds calcareous, with many fossils, *Productus Nebrascensis, Spirifer cameratus, Poteriocrinus hemisphericus, Bellerophon montfortianus, B. carbonarius, Orthoceras cribrosum, Leda bella-striata,* a fossil near *Soleniscus typicus, Bryozoa,* and a few branching corals	10
2. Ash-blue limestone, jointed and shelly on top; contains *Productus Prattenianus, Chonetes, Aviculopecten, Pecten? aviculatus,* and *Prod. Boonensis*	?

The last named limestone I regard as No. 22 of my upper Coal Measure section.

Northeast of Irving on East Fork, and down stream for a mile, there are occasional outcrops of an ash-blue hard shelly limestone, abounding in a large variety of *Productus Prattenianus.* It also con-

tains *P. costatus, P. punctatus, P. Nebrascensis, Spirifer cameratus, Aviculopecten carboniferus, Chonetes Verneuiliana, Ch. Flemingii,* and a branching coral.

In Sec. 7, T. 8 N., R. 2 W., I obtained the following section:

		Feet.
1.	Masses of tumbled limestone, with *Hemipronites crassus, Productus Nebrascensis, Edmondia,* and *Bryozoa*	?
2.	Dove and brown clay shales	4
3.	Coal	1
4.	Greenish-blue fire-clay	2
5.	Olive shales, changing to darker-colored below; contains a few brown ironstone concretions, the middle part abounding in a large *Pleurotomaria* similar to one found by Mr. Meek at Rulo, in Nebraska; the fossils are very fragile; a species of *Macrocheilus* is also found; thickness exposed	about 8

A quarter of a mile up stream the limestone appears in a regular layer, stretching across the bed of a small branch.

Three miles up stream many fossils were collected, weathered out of the shale beds in a fine state of preservation, including beautiful specimens of *Pleurotomaria sphærulata, P. tabulata, Orthoceras, Macrocheilus paludinaformis* and one like the *M. primigenius,* but with body, whorl and spire more elongated; *Goniatites globulosus, Bellerophon carbonarius, Leda bella-striata, Nucula ventricosa, Astartella vera, Conularia, Leda Oweni, Euomphalus subrugosus,* and *Polyphemopsis peracuta.* These shales contain round and oblong clay and ironstone concretions.

In Sec. 28, T. 10 N., R. 3 W., a few fossils were obtained, indicating the presence of the same beds as those last named.

The upper blue limestone, named above, undulates along East Fork for about eight miles, and I regard it as equivalent to No. 22 of my general section.

Near Sec. 36, T. 8 N., R. 3 W., on the East fork of Shoal creek, there crops out eight feet of sandy shale and sandstone. On West Fork, at the bridge on the Hillsboro and Walshville road, there is a bluff of 35 feet of bluish-gray sandy shales, with a thin bed showing markings resembling those of *Fucoides cauda galli,* and containing one *Bellerophon.*

East of Litchfield, at the creek bluffs, is seen 30 feet of sandy shale, and below that 10 feet of thick-bedded sandstone, resting on limestone. Four miles up stream this sandstone is quite ferruginous at the base, and contains many remains of plants, *Calamites, Sigillariæ,* etc.

One mile further up stream there was observed 45 feet of dark-ash micaceous sandy shale. On Five-mile creek, in Sec. 26, T. 10 N., R. 5 W., there is 12 feet of sandy shales, with a thin bed of

partially carbonized wood, containing a fossil fern. A quarter of a mile up the creek there is an exposure of 16 feet of olive-drab clay shales, with ironstone nodules. These shales are evidently continuations of the same beds, and make the total thickness of No. 26 not less than 85 feet.

Nos. 27 to 33 inclusive.—The best exposures of these beds are on Lake Fork and at Litchfield. The section on Lake Fork, at the Bond county line, near McCracken's coal, is as follows:

		Feet.	In.
1.	Drift slope	20	0
2.	No. 27—Lead blue limestone, with crinoid stems, and *Athyris subtilita*	2	0
3.	No. 28—Coal	0	2
4.	No. 29—Blue clay shales	10	0
5.	No. 30—Shale and shaly limestone abounding in fossils, but many are much crushed, including *Spirifer cameratus, Productus punctatus, P. Nebrascensis, Spirifera Kentuckensis, Hemipronites crassus, Productus Prattenianus, Athyris subtilita, Terebratula bovidens, Myalina subquadrata*, a *Macrocheilus*, a *Pleurotomaria*, and one fish tooth	4	0
6.	No. 31—Ash-gray limestone; in the lower part there is from one to one and a half feet of dark ash-colored limestone, often traversed by fine lines of calc-spar; fossils not abundant; contains *Productus longispinus*	13	
7.	Bituminous shale	4	0
8.	No. 33—Coal No. 11	0	17

Part of No. 27 appears two and one-half miles northwest in the bed of the creek, containing *Spirifer cameratus, Fistulipora, Productus costatus, P. Nebrascensis, P. Prattenianus*, and *Myalina subquadrata*. The fossils here have a well preserved and nacreous appearance. On Rocky branch, east of Litchfield, No. 31 appears thus:

		Feet.	In.
1.	Ferruginous limestone, containing *Pinna per acuta, Bryozoa, Prod. Nebrascensis*, and *Synocladia biseralis*	0	2
2.	Nodular drab shale, soon becoming a firm bed of rock	2	0
3.	Rough and irregularly-bedded limestone, lower part a pretty bluish-gray; has a few small drusy cavities, with crystals of calc spar; fossils are *Athyris subtilita, crinoid stems, Prod. longispinus, Aviculopecten carboniferus, Terebratula bovidens*, and *Spirifer cameratus*	16	0

One and a half miles southwest of Bethel part of No. 31 crops out along the creek, the upper portion is an even-bedded bluish-gray sub-crystalline limestone; but below it is more irregularly-bedded. *Productus longispinus* abounds, associated with *Aviculopecten carboniferus*. Four miles northeast of Litchfield the upper part of No. 31 is a thick-bedded brownish-gray limestone, abounding in *Rhynchonella Uta*.

Economical Geology.

Coal.—On J. Wilson's land, Sec. 7, T. 8 N., R. 2 W., coal No. 13, (No. 24 of upper Coal Measures section) has been mined; that used

was from near the outcrop and does not appear very favorably; the quality and thickness might improve by thorough opening. The same coal has also been taken out on the land of Jno. L. Newsman, in Sec. 28, T. 10 N., R. 3 W. I was informed that it was 18 inches thick, but I could not thoroughly examine it on account of the overlying *debris*. On the land of Mr. McCracken near the south county line (probably in Bond county), coal 13 is 17 inches thick. Occurring as it does below the bed of the creek, it can only be reached at low water, and even then the labor of one man is required most of the time to keep the pit sufficiently dry for two others to work; but with this trouble it will repay very well to work for neighborhood purposes. The same bed has also been worked at Ross' old mill, on Shoal creek, at the south county line, and may also be reached just below the surface of the water on shoal creek above Long bridge. At the limestone quarries on the creek near Butler, it may be reached at about 10 to 14 feet beneath the bed of the creek; also about 4 feet beneath the darker colored limestone at the base of Michael Cleary's quarry east of Litchfield.

Section of the Litchfield shaft, conducted by Andrew Howard:

	Ft.	In.
Clay and hard-pan	35	
Soft blue sandstone in thin layers	18	
Blue shale	16	
Black calcareous shale	3	
Light-blue limestone	4	6
Gray limestone	4	
Black shale—probably coal	1	
Limestone with fossils	22	6
Black slate and coal	3	
Fire-clay	3	
Clay shale	1	
Limestone	4	
Soft slaty sandstone	30	
Blue shale	12	
Black and white sandstone	4	
Black slate and bituminous limestone	2	
Coal—No. 10	0	6
Fire-clay	6	
Hard and soft limestone—dark-ash color	12	
Soft sandstone	6	
Slate	5	
Hard black and white sandstone	7	
Black slate and coal	1	
Blue and red sandstone	2	
Shaly sandstone	38	
Blue slate	10	
Black slate and coal	1	
Fire-clay	6	
Soft limestone—Carlinville bed ?	5	
Sandstone	18	
Coal impure—No. 9	0	4

	Ft.	In.
Sandstone	23	
Bituminous shale	1	
Coal No. 8 ?	0	4
Blue shale	3	
Limestone	0	6
Shale	24	
Shale with numerous iron bands	42	8
Black slate	4	6
Shale	1	
Limestone—hard	3	
Shale and iron bands	8	6
Limestone—solid	4	6
Shale	2	
Nodular limestone	1	6
Shales with nodules of black limestone	4	
Black shale with fossils shells	12	
Fire-clay	3	
Gray shale	19	
Coal	3	
Fire-clay	1	6
Nodular limestone	4	
Shale and sandstone	about 40	
Coal	1	6
Sandstone and some shale	45	
Coal, with shaly parting, No. ?	5	

Building Rock.—On East Fork, about Sec. 26, T. 8 N., R. 3 W., there is a tolerably good bed of hard bluish limestone. On Rocky Branch, east of Litchfield, there are extensive quarries of pretty good limestone, the beds are rather irregular, but the rock is very extensively used for ordinary stone work and makes very good lime. North of the railroad, on the West Fork, there are several outcrops of a brown and gray limestone in three-foot beds. The same rock is also found four miles further up stream. At the latter place part of it presents a beautiful bluish-gray variegated appearance. I regard this limestone as possessing much durability, and, being in a thick even bed, may become in time very useful for large columns. I believe it to be equivalent to that used in the construction of the old State House at Springfield.

West of Butler there are good quarries of limestone for lime, and it is also much used in the neighborhood for ordinary building purposes.

Soil and Agriculture.—The richest land lies in the northern part of the county, mostly north of the line between townships 9 and 10 N. East of Nokomis there are a few high mounds quite rich on top and along their sides, and especially so in the valleys between. The northwest townships have a rich soil and are capable of producing heavy crops of corn and wheat. Southwardly, on the prairie, good wheat crops and occasionally good corn crops are produced.

In many places fresh plowing will disclose rich spots alternating with poorer land. This is due to the existence of what are commonly called "scalds." These "scalds" are spots of very thin, poor soil, with naturally a very scanty vegetation, mostly *Ambrosia bidentata*. Good manuring and deep plowing might make these barren spots more productive. With careful tillage, deep plowing and thoroughly rolling or harrowing, so as to render the soil quite loose, good crops of wheat can be raised on most of the whitish soils. On ordinary land, by good preparation and sowing with a drill the farmer may feel sure of twenty-five to thirty bushels of wheat per acre.

CHAPTER XXX.

CHRISTIAN COUNTY.

This county is located near the center of the State, is regular in outline, excepting the northern boundary, is twenty-one miles in width from east to west, and thirty-two in greatest length from north to south, and is bounded on the north by Macon and Sangamon, on the east by Macon and Shelby, on the south by Shelby and Montgomery, and on the west by Montgomery and Sangamon counties. Its superficial area is about nineteen and a half townships or seven hundred and two square miles.

General Features, Soil, Timber, etc.

On the north it is drained by the Sangamon river, and the central, southern and western parts of the county are watered by the South Fork of Sangamon and its tributaries, Bear, Locust Fork, Prairie Fork and Flat creeks. The smaller streams are sometimes nearly dry, but the two main forks of Sangamon generally flow the year round. The South Fork is rather a sluggish stream, with muddy banks, but occasionally, as at Taylorville, the water is clear and fresh, indicative of latent springs.

The topographical features of this county do not vary much in different localities. The prairies in the southeast are rolling, often rising into mounds. In every other part of the county they are flat or very gently undulating. Near the streams the slopes are often very gentle. In the southern half of the county we very rarely find a bluff twenty-five feet high, and in passing down the South Fork no broken nor hilly land is seen until we get below Taylorville. Four miles northwest of Taylorville the country is rather hilly, the hills about sixty feet high, but not often too steep to admit of cul-

tivation. A few miles further down there is a gradual descent from the prairie to the river, the bluffs of which are about twenty feet high. In the northeast the slopes are often so gentle as to render it impossible to trace a line between the upland and lowland.

On the North Fork of the Sangamon there are occasional drift bluffs thirty to fifty feet high, capped with a heavy growth of white oak, but the white oak lands do not often extend more than a quarter of a mile from the river, giving place to a more undulating surface, with a growth of elm, hickory, oak, sassafras, cherry, hazel, etc.

This county consists mostly of prairie, the timbered land being confined to a narrow belt along the streams. On the South Fork of the Sangamon the timber belt is generally about three miles wide, and along the other streams from one to two miles. The prairies are generally flat, with a luxuriant growth of resin-weed, two species, viz: *Silphium laciniatum* and *S. *terebinthinaceum*, golden rod, *solidago*, several species, *Liatris* or blazing star, two species, and the beautiful and delicately colored *Physostegia Virginiana* and *Gerardia tenuifolia*. Occasionally, on the basin-like depressions or flat marshy spots on the prairies, I found *Iris versicolor* and *Vernonia fasciculata*.

There is not much difference in the quality of the prairie soil, it being all a rich black loam of from one to two and a half feet in depth, and in the northern part of the county slightly sandy. The soil along the edge of the prairie near Taylorville is quite sandy; eastwardly for six miles there are occasional spots of poor sandy soil, with post-oak and black-jack, but this often gives place to better land, with white oak, black oak, hazel and sassafras, or cherry, laurel oak, hazel, pin-oak, hickory, plum and crab-apple. Along Locust Fork, its whole length, and on South Fork above the mouth of Locust Fork, both on the bottoms and hillsides the soil is deep and rich, with principally a growth of American elm and *cornus*. On Bear creek the soil and growth is similar. On and near Mosquito creek the soil is rich and black, with a growth of elm, linden, coffee tree, cherry, red oak, hickory, red-bud, spice bush, hackberry, black walnut, honey locust, ash, mulberry, etc. West of Mosquito creek, on the slopes leading to the North Fork, the timbered land is quite sandy and the growth variable; on some soil black oak pre-

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NOTE.—*The *S. terebinthinaceum* abounds on the rich prairies of Illinois, whereas in Missouri I have only found it on the post-oak and black-jack barrens in the southern portions of the State.

dominates; where there is much clay mingled with sand there is a growth of red elm, sassafras, etc.; when there is still more clay, laurel oak, American elm, white oak, black hickory, shell-bark hickory, red-bud, black oak and sassafras.

On the south side of South Fork, below the mouth of Bear creek, the prairie land often approaches the stream, and the adjoining woodland growth reaching to the river bank consists of laurel oak, elm, hickory, linden and sassafras.

North of the South Fork there are white oak hills occasionally spreading out into flats.

Along the Sangamon river and adjacent hills there is a good supply of very good timber, consisting of white oak, burr oak, black walnut, red oak, elm and linden.

Out on the prairies the farmers have planted many hedges of Osage orange, and they seem to thrive very well. Near Rosamond I noticed a thrifty berberry hedge.

Crops.—This is an excellent corn producing county, generally averaging forty to fifty bushels per acre, and often sixty to seventy-five can be raised. Fall wheat gives a fine return to the farmer, but requires the ground to be well broken and grain put in with a drill. It will average fifteen bushels, and often reach twenty-eight to thirty-two per acre. As yet there have not been many orchards planted, but the apple crop is generally sure, and the peach trees often bear two years in succession. Where the prairies are grazed down the blue grass naturally springs up and soon affords excellent grazing.

The Geological Formations of this county include the Quaternary and the Coal Measures.

Quaternary.

Under this head were recognized the Alluvium, Loess and Drift. The Alluvium includes the soil and recent deposits from the streams, and the black clays of the wide rich Sangamon bottoms are good examples of Alluvium. On Mosquito creek the exposures along the banks show as much as six feet of dark, rich loam. On the south fork of the Sangamon the black loam is often ten feet or more in depth.

The Loess is but partially developed, and is scarcely recognized as separate from the Drift.

East of Taylorville the washings in ravines exhibit about ten feet of buff and brown clays and sand, which may be referred to the

Loess; and in digging wells, about ten to fifteen feet of similar clay is passed through, reaching beds of sand and gravel, in which good streams of water are generally found. Sand beds are often reached within eight feet of the surface. The well at the hotel in Taylorville is thirty-eight feet deep, passing through eight feet of dark and light clay; then sand, gravel and clay to the bottom. Good streams of pure and pleasant tasting water are generally reached at a depth of from twelve to sixteen feet on the prairies, sometimes as much as twenty feet, and very rarely they have to dig deeper; but in the timber wells have to be dug deeper, often twenty to thirty-five feet.

Bluffs of well marked Drift deposits are often seen along the streams, and consist of brown sand with rounded pebbles and bowlders, and brownish-yellow and blue clay.

On Prairie Fork of Bear creek, ten miles south of Taylorville, the washings on the hillsides exhibit at the top soft brown clay, and below clay with many small rounded pebbles. On the North Fork of the Sangamon, one mile west of the east county line, the river bluff is fifty feet high, the upper portion of blue and dark-brown clay with sand and pebbles; below there is a loose mass of sand and pebbles, sometimes cemented into a rough sandy Conglomerate, at times sufficiently firm and regular to make rough walls. Below this there is a dark-colored bed of finely comminuted sand and clay. Two miles further down stream there is a low bluff of dark Drift clay, with pebbles and small bowlders at the bottom and brown clay at the top. At this place I observed a quantity of bituminous shale, a little coal and some fragments of limestone, all associated with the Drift.

The Drift bowlders in this county are generally small, and their character and composition various. Among them may be found greenstone, quartzite, granite, syenite, epidote rock, corals from the Devonian and limestone from the Silurian, but no peculiar Drift fossils.

At Pana, the I. C. R. R., passing through a mound, exhibits the following section:

	Ft.	In.
1. Soil and subsoil		18
2. Ash-brown clay	8	
3. Brown clay and small rounded pebbles	15	

This section is similar to what may be found in all the mounds of this part of the State.

Coal Measures.

This formation, as seen in this county, embraces a thickness of about 230 feet, in which are visible two coal seams, only one of which is of workable thickness. These measures underlie the whole of the county, although there are no outcrops in the southwest, nor do we find any in the northeast quarter of the county, they being restricted to a small district south of Pana, to Locust Fork; to South Fork for ten miles up the stream from the west county line; on North Fork for three miles from the west line of the county, and one other outcrop between the forks. The deep Drift deposits cover the rocks in other places. These rocks belong to the upper Coal Measures, and their position in my upper Coal Measure section is from No. 12 to No. 32 inclusive.

The highest rocks (geologically speaking) are the beds south of Pana, at or near White's coal bank, of which the following is a section:

	Ft.	In.
1. Drift of clay, pebbles, etc	23	
2. Clay shale	10	
3. Blue and bituminous shale, part quite calcareous, passing into a dark-colored limestone	4	
4. Bituminous coal—No. 14		16 to 22
5. Fire-clay	5	
6. Rough-looking, hard gray sandstone, sometimes in thin, even beds, No. 20 of the section	4	
7. Sandy shales, with ironstone concretions	15	

There is here a regular southerly dip at the rate of thirty feet to the mile, extending from Pana for four miles south. It is probable that near or north of Pana the rocks are horizontal, and soon dip northwestwardly, which they evidently do ten miles northwest of Pana, although the dip is slight.

The next rocks in descending order crop out on Locust Fork, on Sec. 2, T. 11 N., R. 1 W., and just north. They belong near No. 21 of the section, and appear thus:

	Feet.
1. Dark-blue clay shales, with some regular layers of lenticular concretions of ironstone, and occasional strata of brown ferruginous shales, containing remains of fossils, including *Prod. longispinus, Bellerophon, Crinoid* stems, etc., part exposed, remainder in shaft—total	31
2. Ash-gray limestone, weathers drab, has buff shaly partings, abounds in *Prod. costatus, P. longispinus, Athyris subtilita;* also contains *Prod. Nebrascensis, Sp. cameratus, Prod. Prattenianus,* a fish tooth, and one specimen each of *Syntrilasma hemiplicata* and *Allorisma subcuneata* were obtained from it.	

I regard the rocks of the above section equivalent to the Ramsey creek Fayette county beds. The limestone (No. 2) contains the

fossils of the *Syntrilasma* limestone of Ramsey creek, although but one specimen of that fossil was found. The lithological character, thickness and fossils are the same as beds found on Beck's creek, Fayette county, and the overlying shales (No. 1) are similar to corresponding beds at the railroad bridge on Ramsey creek. Down the creek three miles there appears in the creek four feet of lead-blue argillaceous limestone, equivalent to No. 22 of the section. The upper beds are shaly, the lower part a firm, even, thick bed of sub-crystalline, fine-grained, deep-blue limestone, having a conchoidal fracture. The upper shaly part is traversed by fucoidal markings, and contains many fossils, mostly *Prod. Prattenianus, P. Nebrascensis,* and *Sp. cameratus*; but fragments of a *Nautilus* and *Bryozoa* were also found here.

A mile further down stream rocks near No. 25 crop out in the bank of the creek, of which the following is a section:

	Feet.
1. Soft yellow ochrey calcareous shales	5
2. Dark olive clay shales	2
3. Deep blue fucoidal sandstone and sandy shale	1½
4. Bituminous shales	?

Fossils found in Nos. 1 and 2 were *Pleurotomaria sphærulata, Spirifer cameratus, Sp. plano-convexa, Productus longispinus, P. Prattenianus, Orthis Pecosi, Retzia Mormoni, Lophophyllum proliferum, Macrocheilus* (small sp.), *Bellerophon,* crinoid stems, and one fine specimen of *Pleurotomaria tabulata.*

The next in descending order is 12 feet of sandstone (No. 26), seen on South Fork, five miles below Taylorville. The upper part is shaly, the lower beds thick, hard and gray, and a softer brown with dark specks; contains remains of *Calamites, Sigillariæ,* and other coal plants.

Nos. 27, 28 and 29.—In Sec. 29, T. 14 N., R. 3 W., a quarter of a mile above Greenwood's mill, I observed at the top—

	Feet.	In.
Red shales	1	0
Dark-olive calcareous shales, *Athyris subtilita,* a small *Macrocheilus, Nucula ventricosa,* and crinoid stems	2½	0
Coal No. 12	0	10
Slope to limestone No. 30 of general section	3	0

Three miles above Ralston's bridge, on the South fork of the Sangamon, I observed Nos. 30 and 31, as follows:

	Feet.	In.
1. Ash-gray compact limestone, showing facets of calc-spar: very few fossils.	0	8
2. Shales, with nodules of buff limestone abounding in fossils, *Productus costatus, Productus longispinus, Spirifer cameratus, Spiriferina Kentuckensis, Athyris subtilita, Chonetes variolata, Crinoid* stems, *Fistulipora,* and *Synocladia biserialis*	3	0

At Ralston's quarry, in Sec. 3, T. 13 N., R. 3 W., we have—

		Feet.
1.	Slope from top of hill	20
2.	Gray limestone; fossils are *Productus costatus, P. punctatus, Spirifer cameratus, Spiriferina Kentuckensis, Hemipronites crassus*	1
3.	Like the last, but more shelly; fossils about the same	1
4.	Green shales	1
5.	Brown shales, with nodules of limestone; abounds in *Athyris subtilita, Crinoid* stems and plates, *Lophophyllum proliferum, Sp. camerata*	1
6.	Gray or drab limestone; but few fossils; those seen were *Athyris subtilita, Productus longispinus, P. Prattenianus,* and *Lophophyllum proliferum*	9

Part of the same at Greenwood's mills, as follows:

		Feet.
1.	Clay and sandy alluvium	1
2.	Clay, with nodules of brown limestone, containing *Chætetes, Fistulipora, Athyris subtilita, Productus Nebrascensis, P. costatus, P. Prattenianus, P. punctatus*	2
3.	Gray or brown and buff limestone; contains *Productus longispinus, P. Prattenianus, P. punctatus, P. costatus, P. Nebrascensis, Sp. cameratus, Hemipronites crassus, Athyris subtilita,* and *Lophophyllum proliferum*	12
4.	Bituminous shale—No. 32—in sight	2

At North Fork mills, on the North Sangamon river, in Sec. 13, T. 15 N., R. 3 W., we have—

		Feet.
1.	Slope—clay and sand—drift	50
2.	Limestone, upper part gray and nodular, lower part more firmly bedded; soon weathers brown; fossils, *Productus longispinus, P. costatus, P. Prattenianus, P. Nebrascensis, Athyris subtilita, Spirifer cameratus, Hemipronites crassus*	8
3.	Clay shale; contains a *Crinoid* allied to *Poteriocrinus hemisphericus*	2½
4.	Limestone, weathering brown	4

Three miles down stream, near the west county line, the lower part of the last section appears 7 feet thick, with brown shaly partings between the beds, which abound in *Athyris subtilita;* the other fossils are *P. costatus, P. Nebrascensis, P. Prattenianus,* and *Lophophyllum proliferum.*

The limestones above described, Nos. 30 and 31, correspond to similar beds at Litchfield, and on Lake Fork, in Montgomery county.

Economical Geology.

Coal.—South of Pana coal has been taken out at several places along the head waters of Coal creek; but at the time of my visit the only place worked was White's bank, on Sec. 34, T. 11 N., R. 1 E. The seam here is about 22 inches thick, of good quality, and obtained by drifting into the hillside at an elevation of about 30 feet

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NOTE.—I also believe them equivalent to Nos. 162 to 166 of my Missouri River section, published in Vol. 2, No. 2, Trans. St. Louis Acad. Sci., St. Louis, 1866. The limestones of the North and South Fork of Sangamon closely resemble, both in lithological appearance and fossils, beds in the northern part of Cass county, and those near Randolph, in Clay county, Missouri.

above the level of the creek. The position of this coal in the geological series is about 420 feet above coal No. 7, and corresponds to No. 14, counting from lowest coal upward, and is numbered 17 in my general section of this and adjoining counties. A ten-inch seam crops out a quarter of a mile up stream from Greenwood's mill, but the coal is of poor quality. Beneath the limestone at Greenwood's mill, and a little below low water, a 17-inch seam ought to be found; the same bed also probably exists beneath the limestone at North Fork mills, probably six feet below low water. This coal is probably about 365 feet above coal No. 7.

Building Material.—South of Pana Mr. Burke has a quarry of hard gray sandstone, which appears to be very durable. At Mr. Walcher's six miles northwest of Pana, on Locust Fork, there is four feet of ash-gray limestone, weathering bluish-drab. The beds are rather thin, but the rock is of good quality. On Jas. P. Durban's land, two miles northwest of Walcher's, there is a very good quarry of deep-blue limestone; the lower bed, if properly quarried, would make a pretty and durable building stone.

Ralston's and Greenwood's quarries, on the south fork of Sangamon, each contain several good beds of building stone, and make excellent lime. There are similar quarries at North Fork mills, and three miles west.

The lower two feet at Stokes' quarry, in Sec. 16, T. 14 N., R. 3 W., would probably make a pretty marble; it is a fine-grained, even-textured dove-colored limestone, with many lines and specs of calc-spar.

CHAPTER XXXI.

SHELBY COUNTY.

Shelby county is bounded on the north by Christian, Macon and Moultrie, on the east by Moultrie, Coles and Cumberland, on the south by Effingham and Fayette, and on the west by Montgomery and Christian. It embraces an area of about 755 square miles, about two-thirds of which is prairie land. Its surface is agreeably diversified by mounds, hills, valleys and plains.

Streams.—The principal streams are the Little Wabash river in the southeast, and the Kaskaskia and its tributaries in the central and western portions of the county.

Topography.—The hills skirting the "Okaw" or Kaskaskia river are generally 60 to 70 feet high, but 4 miles northeast of Shelbyville they attain a height of 130 feet. For the distance of a half mile to a mile from the river the country is somewhat broken. The growth on these hills consists for the most part of white oak with some black oak and hickory. The bottoms vary in width from a quarter of a mile in the northern to three-quarters in the southern part, and are generally from 14 to 16 feet above the ordinary stage of water in the rivers, with sometimes a second bottom a few feet higher. During wet seasons the river often extends over the first bottom several feet in depth. Near the margin of the stream are found birch and willows, on the lower bottoms elm, maple and sycamore, and on the higher bottoms sometimes sugar tree and burr oak. Other trees occurring here are ash, pin oak, coffee tree and honey locust. Where the bottoms are low and the soil very sandy, mixed with river drift, *Vernonia fasciculata* is the most abundant plant.

The southeast portion of the county is flat, between the streams. The timbered part of townships 9 and 10 consists mostly of flat

post oak ridges, with thin light ash soil changing locally to better land with an abundant growth of hickory; and at the edge of the prairie pin oak and laurel oak, with hazel undergrowth. Along the hillsides white oak predominates. The hills near Green creek attain a height of about 40 feet; on Little Wabash generally 25 to 30 feet. Passing northwardly along the west fork of Little Wabash, the change from low to high ground is very gradual, the country at the same time increasing in fertility. The growth in the south part of township 11, R. 6 E., consists of elm, grape vines, wahoo, laurel oak, black haw, arrow wood, hazel, and honey locust. Farther north the land continues rich, with a growth principally of burr oak, shell-bark hickory, black walnut, chestnut oak, pignut hickory, sassafras, red bud, ash and mulberry, and a carpet of pennyroyal and goose-grass. Near Windsor the surface is either flat or gently undulating, with a deep, rich black soil. From the high ground at Windsor there is an exceedingly easy descent towards Sand creek. At the edge of the timber northwest I noticed four species of *Cratægus*, also laurel oak, elm, pin oak and hickory, and the surface of the ground was covered with pennyroyal. On Richland and Brush creeks the hills are not generally very high—about 50 feet near the mouth of Richland, becoming lower further up stream; its bottoms are one-eighth to one-quarter of a mile wide, and not too low to be cultivated, and have a growth of white walnut, elm, black walnut, sycamore, coffee tree, burr oak, sassafras, red bud, coral berry, and raspberry. From the bluffs the ascent is gentle, to white oak and post oak flats and small prairies. In the southern part of the county, on the west side of the Kaskaskia river, broken and flat ridges extend to the flat prairies; towards the center of the county these gradually rise to the mounds.

Between Mitchell's and Beck's creeks there are a series of mounds extending from the southern part of the county as far north as Mud creek. Northwardly near Prairie Bird there are several low mounds. The soil on the highest is of a reddish color, sometimes containing a good deal of gravel and sand. The high timbered mounds near Williamsburg have on them a good growth of white oak, black oak, shell-bark and common hickory, red bud, sassafras and hazel. The mound slopes are very rich, and sustain a growth of elm, cherry, walnut, hickory, mulberry, hackberry, red bud and hazel.

The bottoms of Beck's creek are one-quarter of a mile wide, low and flat, with mostly pin oak, laurel oak, elm, ash, hackberry, buck-eye, maple and sugar trees; the hills are low, sloping at 15° to 20°, and sustain a growth of white oak, black oak, shell-bark hickory,

plum, hazel, etc. Near the edge of the neighboring prairie the surface is flat and sometimes swampy, with pin oak and button bush (*Cephalanthus occidentalis*).

Robinson's and Mud creeks are sluggish streams, with muddy banks and wide bottoms, and generally low hills, the highest not above 50 feet in height. On the hills the timber for the most part consists of white oak, black oak and occasionally post oak and black-jack; sometimes there are low ridges where the black hickory prevails, with shell-bark hickory, white oak, sassafras and hazel, and locally elm land. Skirting the prairie are found elm, hackberry, honey locust, laurel oak, black haw, arrow wood, *cornus* and hazel.

From Prairie Bird northwardly there is gently undulating rich land, and occasionally there are small thickets with elm, plum, honey locust and hazel.

Near Flat branch there is some gently sloping and very fertile land with a growth mostly of red and American elm, black walnut, shell-bark and pignut hickory, mulberry, burr oak, red-bud, *cornus*, hazel, buckeye, red oak, prickly ash and grape vines. There are occasional spots with a luxuriant growth of *Impatiens fulva* and *I. pallida*, indicating a rich moist soil.

The prairie in the northern part of the county is either flat or very gently undulating, with some wet or swampy depressions, and possesses a rich soil.

The river bottoms and neighboring hills afford an abundant supply of good timber.

Geological Formations.

The formations in this county include the Quaternary and upper Coal Measures.

Quaternary.—A well on Kaskaskia bottoms, 2 miles below the mouth of Jordan's creek, presents: 1st, soil and dark clay—5 feet; 2d, sandy material with some pebbles—11 feet.

The hills at Shelbyville exhibit about 50 feet of sand and clay, with many rounded pebbles of various sizes, including mica slate, sienite of various colors, granite several kinds, including graphic granite, quartzite, greenstone, chert, etc. At an old well 3 miles above Shelbyville, a Drift bluff is well exposed. At this place the sand and pebbles have partially united, forming disconnected layers of rather firmly cemented conglomerate. At Lilly's mill there is a brown conglomerate in the Drift similar to that above named.

On the Wabash river the Drift is only partially developed. Below the forks I observed 12 feet of chocolate and buff-colored clays, the lower part sandy, with a few small pebbles. Near Williamsburg the washings expose a reddish-brown clay, with rounded pebbles on the north side of the ridge. A well was dug by Mr. Draper on J. Gallagher's farm, 72 feet deep. He states that the first 38 feet was through clay to sand, then a muddy sand, with occasional leaves and sticks and one log; from 52 to 72 feet he bored in stiff clay.

Coal Measures.

In this county there are exposures of about 175 feet of upper Coal Measures, from No. 1 to No. 20, in which are included about two workable coals, Nos. 14 and 15. The following is a condensed section of the various beds:

		Ft	In.
1.	Shales and sandstone, not recognized		
2.	Limestone, dove-colored	4	
3.	Fire-clay	2	
4.	Shales passing into sandstone	30	
5.	Limestone	0	4
6.	Shales at top, changing to argillaceous limestone	55	
7.	Sandstone	4 to 40	
8.	Shaly bituminous limestone and bituminous shales	4 in. to 4	
9.	Coal No. 15	18 in. to 3	
10.	Fire-clay	15 in. to 5	
11.	Limestone	0 to 4	
12.	Shales and sandstone	15 to 30	
13.	Shales		
14.	Calcareous shales	4	
15.	Shales		
16.	Calcareous and bituminous shales	2	
17.	Coal, near Pana	16 to	22
18.	Fire-clay	5	
19.	Sandy limestone	5	
20.	Sandstone		

No. 1 of the above section was not recognized in this county, but occurs in Moultrie. No. 2, five miles from Windsor, at a mill on Sand creek, extends quite across and down stream for 100 feet. Four miles northeast of Shelbyville, on and near the river, there is seen 4 to 4½ feet of limestone, the upper one foot sometimes shaly and fossiliferous, containing *Spirifer cameratus, Sp. lineatus, Spiriferina Kentuckensis, Productus punctatus, Athyris subtilita, Hemipronites crassus,* and crinoid stems. The lower part is of a gray or dove-color, and contains few fossils. In the same neighborhood we find just beneath the fire-clay (No. 3) 20 feet of sandy shales. At various places on the river there are beds of buff sandstone, making the entire thickness of sandstone and shales (No. 4) amount to 30 feet. No. 5 is 4 inches of tough and very coarse dark-gray limestone, mottled with

dove-colored spots, abounding in fossils, including *Myalina subquadrata, Pinna peracuta, Allorisma subcuneata, Prod. Prattenianus, Nautilus occidentalis* and *Aviculopecten occidentalis.* At an old mill on the Kaskaskia river, four miles above Shelbyville, it is found about three feet above low water; one mile up stream it is seen sticking out of the bank at about the same distance above the water; at the latter place it is easily recognized, and very good fossils can be procured; but at the former it is not so firm, and the fossils are almost blended with the rock itself.

Below the last, and included in Nos. 6, 7 and 8 of my section, there is about 96 feet of sandy and argillaceous shale, sandstone and argillaceous limestone, with calcareous and bituminous shale. The upper part consists principally of argillaceous shale, below; the beds are not all persistent, and are interchangeable. The argillaceous shale sometimes assumes the form of a deep blue argillaceous limestone. It crops out near Kaskaskia river, one mile above the mouth of Long Branch, 25 feet in thickness, with 15 feet of thin-bedded sandstone separating it from coal No. 15. Near the railroad one mile west of Robinson's creek it is 30 feet in thickness. Its beds are very irregular, with buff shaly partings. Its fracture is smooth, conchoidal, the thinner beds shaly, and the only fossils found were two specimens of *Chonetes variolata?*

The sandstone (No. 6) is also changeable, both gradually and abruptly. Sometimes it is entirely absent, its place being occupied by sandy shales, as on Little Wabash river; at other places it is a thin-bedded sandstone. Two miles southeast of Shelbyville it changes rapidly to a shale, again to a sandstone, and again to a shale. Sometimes it rests on the coal as at Smith's, then it is separated from the coal by bituminous shales, which I have seen beginning at 0, and in a short distance increasing to $1\frac{1}{2}$ feet in thickness.

At Lilly's mill a calcareous shale overlies the coal, which, in 200 feet distance, thickens from 0 to 3 feet; it is divided, after a short distance, by two feet of clay shales, and the upper part becomes a firm bed of limestone.

There are but few fossils in these several beds; in the sandstone, *Sigillariæ* and *Calamites,* and probably *Cordaites* in the shales. In the calcareous shales the fossils are very much crushed, but I could distinguish *Athyris subtilita, Sp. Kentuckensis, Prod. Prattenianus* and *Bryozoa.*

The following sections were obtained at the various outcrops of coal, from which the changeable character of the adjacent rocks will be seen. On Copperas creek, west of Nioga, at J. Young's coal bank—

		Feet.	In.
1.	Drab and blue shale	3	
2.	Bituminous coal	0 to	20
3.	Fire-clay	3	
4.	Slope	10 to 15	
5.	Chocolate and drab-colored arenaceous limestone	2	6
6.	Slope	5	
7.	Sandstone, hard and rough	5	

On Little Wabash, one mile above the mouth of Copperas creek—

		Ft.	In.
1.	Clay and Drift	25	
2.	Clay shale	14	
4.	A little black slate		
4.	Bituminous coal	0 to	22
5.	Fire-clay at top for a few feet, then clay shales, with nodules of ironstone, one nodule with zinc-blende, etc	18	

A mile up stream the coal is four feet above the water, and a quarter of a mile further it is two feet above, and capped by 12 feet of gray shale, passing into thin beds of sandstone.

J. Gallagher's coal, on Richland creek, in Sec. 33, T. 10 N., R. 4 E., is capped by about 30 feet of sandy argillaceous shales. South of this on Brush creek we have shales above, with dark lead-blue shaly limestone, containing remains of fossils, just over the coal.

At Wm. A. Rudy's, in the north half of the southeast quarter of Sec. 14, T. 9 N., R. 3 E., the coal is 18 inches thick, with clay shales above, and blue fire-clay beneath. The hills here are about fifty feet high.

At Mrs. Matthews', a quarter of a mile east, the coal is capped by two inches of dark lead-blue calcareous shale. Half a mile down Richland creek it is 20 feet above the water, with five feet of yellow clay beneath, resting on 16 feet of thin-bedded, dark-gray and brown sandstone.

In Sec. 6, T. 9 N., R. 4. E., the section is—

		Ft.	In.
1.	Olive-clay shales	4	
2.	Bituminous coal	1	6
3.	Fire-clay	2	
4.	Buff limestone, fracture gray	4	

The coal at this place is seen occupying the bed of a small dry branch, and is easily taken out. On land of S. Syfert's, near by, the coal is a little thicker. On Mrs. Fancher's land, in the S. E. qr. Sec. 32, T. 10 N., R. 4 E., we have—

		Ft.	In.
1.	Argillaceous shales		
2.	Coal		22
3.	Fire-clay	5	
4.	Sandstone in thin beds, alternating rough, hard, with gray ripple-marked and thicker brown beds	15	

I saw a very good grindstone that had been made from the last named sandstone.

The following is a section at Lilly's mill, in Sec. 1, T. 9 N., R. 3 E.:

		Ft.	In.
1.	Slope, gentle	60	
2.	Drift clay, sand and pebbles	10	
3.	Ash-blue clay shale	4	
4.	Calcareous shale, changing to shaly limestone	0 to 3	
5.	Coal		22
6.	Fire-clay	3	
7.	Hard and soft shales, shaly and thickly-bedded gray and grayish-blue, very changeable within a short distance	20	

No. 4 at one place is separated by a two-foot bed of clay shale from No. 5, and becomes a firm but thinly laminated limestone. At the mouth of Long Branch in Sec. 10, T. 10 N., R. 3 E., we have:

		Feet.
1.	Brown ash-clay, a few pebbles in the lower part	20
2.	Bituminous coal, the upper one foot has thin bands of clay shale—the lower is good coal	3
3.	Upper part fire-clay, in middle are buff nodules of arenaceous limestone	16

A mile up stream the coal is twelve feet above the water in the river. One mile south of Shelbyville the coal is at the water's edge, and we have:

		Ft.	In.
1.	Sandy shales	55	
2.	Coal, thin seam	0	2
3.	Calcareous shales, fossiliferous	1 to 2	
4.	Bituminous coal	2	

Two hundred yards down stream a sandstone begins in the lower part of No. 1 and gradually thickens to four feet.

The following are the results of observations on Robinson's creek. At a coal bank on the S. hf. of the S. W. qr. of Sec. 21, T. 11 N., R. 3 E., the section is:

		Ft.	In.
1.	Gray sandstone	25	
2.	Ferruginous bed	0	5
3.	Black shale	0	10
4.	Coal	2	8

One hundred yards south of the last locality:

		Ft.	In.
1.	Limestone with thin laminæ of coal traversing the lower part	5	
2.	Ochrey ferruginous stratum	0	5
3.	Blue and dove-colored clay shales		4
4.	Coal	2	6

The hills at this place are about fifty feet high. Near the railroad in the south part of the S. W. qr. of Sec. 17, T. 11 N., R. 3 E., at William Howard's:

		Ft.	In.
1.	Sandstone		
2.	Dark gray calcareous shale thinning out; at the old opening it appears forty feet from the entrance	2	
3.	Coal		18

At Minto's, a short distance north:

		Ft.	In.
1.	Sandstone		
2.	Ferruginous conglomerate	1 to	4
3.	Dove-colored shales		16
4.	Coal		18
5.	Fire-clay		15
6.	Hard limestone	2	

One hundred and fifty yards further up:

		Ft.	In.
1.	Sandstone		
2.	Calcareo-bituminous shale	4	
3.	Coal	0	20
4.	Fire-clay		

One mile west the sandstone appears in a branch on the north side of the railroad, and further up the branch there is thirty feet of deep blue argillaceous limestone.

At Smith's coal bank on Sec. 5, T. 11 N., R. 3 E., the coal is capped by about forty feet of thick-bedded soft gray and brown sandstone. Occasionally there rests upon the coal about four inches of bituminous or blue shale. At one place the shale commenced at 0 and thickened to $1\frac{1}{2}$ feet within 100 feet distance. Below the coal there is not over one and a half feet of fire-clay, and then a hard nodular limestone.

A half mile west of Prairie Bird, on Sec. 30, T. 12 N., R. 3 E., on Brush creek:

		Ft.	In.
1.	Soil and buff clay		
2.	Soft buff sandstone	8	
3.	Thinly laminated light-blue shales	4	
4.	Bituminous coal		18
5.	Fire-clay	2	
6.	Coarse rough nodular calcareous sandstone		

The hills near this place are about thirty feet high and of easy slope. Down the creek half a mile the coal is seventeen inches thick and capped by ten feet of chocolate-colored sandy shales.

On the land of J. Armstrong, on Sec. 35, T. 12 N., R. 2 E., there is over the coal four or five feet of firm gray or brown sandstone containing plants.

Below the hard sandstone on Copperas creek, previously mentioned, there is two feet of bituminous shales resting on two feet of dark-blue clay shales. These beds are probably near the horizon of coal No. 14.

Between coal Nos. 14 and 15 there is about forty feet of sandstone and shale. Coal No. 14 was only found on the waters of Beck's creek.

On Mrs. Sides' land, one and a half miles south of the railroad, we have:

	Ft.	In.
1. Sandstone, at one place very hard, at another soft	5	
2. Ferruginous shales passing into a conglomerate		4 to 12
3. Lead-blue calcareous shales	2	
4. Coal		13 to 15
5. Fire-clay		?

At one place the sandstone is scarcely separated from the coal. In the south part of Sec. 2, T. 10 N., R. 1 E., I observed as follows:

	Ft.
1. Mostly chocolate-colored argillaceous shales	10
2. (= No. 4 of upper Coal. Meas. sec.) Calcareous shales containing *Hemipronites crassus, Spiriferina Kentuckensis, Lophophyllum proliferum, Zeacrinus*, and a crinoid resembling *Agassizocrinus*	1
3. Blue and bituminous shales	3
4. (= No. 16 of upper Coal Meas. sec.) Dark lead-blue calcareous shales, passing into a shaly limestone; abounds in *Spirifer plano-convexus* and *Hemipronites crassus;* also contains *Orthis Pecosi, Orthoceras cribrosum, Pleurotomaria Sphærulata, Chonetes Flemingii, Productus costatus, Sp. cameratus, Euomphalus subrugosus, Lophophyllum proliferum*	?

Besides the above named fossils, there is found on the Fayette county line: *Prod. Nebrascensis, Prod. longispinus, Retzia Mormoni, Spiriferina Kentuckensis*, and *Orthis Pecosi.*

	Ft.	In.
5. Bituminous coal		20 to 22
6. Fire-clay, calcareous nodules in the lower part	5	
7. Hard, rough, calcareous sandstone, containing *Productus Prattenianus*		?

No. 3 of the above section sometimes reposes on the coal. These rocks preserve a slight southerly dip for ten miles, and are found on Beck's creek at the south county line, about the same distance above the creek; but northwardly for four of five miles they rise more rapidly.

Economical Geology.

On a small branch of the Kaskaskia river, four miles north-east of Shelbyville, I was informed that there was a six-inch seam of coal. A small pit has been dug here and some coal taken out, but the place was filled up with *debris* at the time of my visit. The limestone No. 2 of the upper Coal Measure section crops out very near, so that it is probable that this coal is the equivalent of that found on Limestone creek and at Nelson's in Effingham county.

Two coal beds are worked in this county; the upper, sometimes spoken of as the "Shelby coal," I refer to No. 15 coal; it varies in thickness from eighteen inches to three feet, but is generally about twenty-two inches thick. It crops out on Copperas creek and at several places above its mouth near Little Wabash river; at the water's edge, near Shelbyville, and occasionally for ten miles south; on Richland creek and its tributaries, on Robinson's creek near the railroad, above on Mud creek and Brush creek below Prairie Bird, and on Beck's creek at the railroad. It is generally a firm, good coal, tolerably free from impurities. A good deal of labor and money has been spent at various places in mining for it. The following are the principal places that have been worked:

At J. Young's, in Sec. 24, T. 10 N., R. 6 E., several pits have been dug, but at present the place is abandoned. On the west side of Little Wabash river, in the north half of township 10 north, there have been several workings for coal, but at present all are abandoned. In Sec. 10, T. 10 N., R. 6 E., Cornelius Barrett reports having passed through three feet of coal in the bottom of a well thirty feet from the surface. Coal has been taken out from several of the neighboring ravines. Wm. Rudy's, J. Gallagher's, Henry Allen's on Richland creek, and the railroad bank on Brush creek, have been worked at various times. The coal at these places is above the ordinary stage of water in the creek. At Mrs. Matthews' the coal was taken out of pits sunk in the bed of a branch of Richland creek. Coal crops out at many places within three miles of Lilly's mill, and is generally of easy access. A good deal has been taken out on land of the heirs of Middlesworth, in and near Sec. 6, T. 9 N., R. 4 E. At these places it is easily mined. On Sec. 32, T. 10 N., R. 4 E., they have drifted a short distance in the hillside and got very good coal; a spring of water issues from beneath. At Lilly's mill it occurs very favorably for side drifting, but no work has yet been undertaken there. Formerly a very good quality of coal was dug a quarter of a mile below the mill. A good deal of side drifting has been done on the land of Nichols and Whitfield, on Long branch. A few years ago quantities of coal were taken out at low water, one mile south of Shelbyville, but at present the miners have retreated to a short distance back on the bluffs and sunk shafts. Sam. Kelly's, on Jefferson Brewster's land, is fourteen feet deep to coal; the coal is twenty-four to twenty-eight inches thick, and of good quality, with three feet of underclay. Near this there are two other shafts.

J. J. Cline has run in two drifts, one for one hundred and fifty feet, with six rooms at the side from sixteen to twenty-one feet wide, one of them fifty feet long; it was opened in October, 1866. Since then he has taken out one hundred and fifty thousand bushels of coal. He has to haul it one mile to the railroad, or about four miles to Shelbyville.

Near Robinson's creek station, and one mile from Cline's coal banks, a good deal of coal has been taken out, mostly by drifting into the hillside.

Litton Smith's coal lies mostly beneath the creek bed; a great many pits have been dug, and about forty-three thousand bushels have been taken away. The creek only runs a few months in the year, so that water is no serious drawback to the miner. At the other openings up the creek, near Prairie Bird, but little mining has been done. At Elliott's, on the Terre Haute railroad, they have drifted and also sunk pits, where the coal is only sixteen inches thick.

I now come to speak of the Beck's Creek or Pana coal, No. 14. On a small branch leading into the West fork of Beck's creek, in the south part section 15, township 9 north, range 1 east, on land of the heirs of Samuel Roberts, some mining has been done. I observed several old pits, now filled with water and rubbish; the coal was said to be sixteen inches thick. On Beck's creek, in Sec. 31, T. 10 N., R. 2 E., twenty-one feet of shales and thin-bedded sandstone was observed resting on two feet of bituminous shale at the water's edge. I was informed that coal has been taken out of the creek at this place. Six miles north the coal appears a few feet above the water in Coal Bank creek. None of these places are now worked.

Building Stone.—The siliceous limestone on Copperas creek appears to be excellent and durable for heavy work. For the construction of culverts on the Illinois Central railroad a good deal of sandstone was quarried on the west side of the East fork of Little Wabash river; the rock appears to be durable, but is hard and irregularly-bedded. Two miles southeast of Shelbyville good gray sandstone has been quarried. The limestone occurring on Sand creek and west of Kaskaskia river, four or five miles northeast of Shelbyville, affords a superior building rock; it was used in the construction of the Shelbyville railroad bridge. The deep-blue argillaceous limestone west of Robinson's creek has been used for common culverts and rip-raps on the Terre Haute railroad. It seems durable, but is

very irregularly-bedded, and often has too much clay in its composition. Some of the sandstones of this county will make very good coarse grindstones.

Sand and Material for Roads.—Good sand for plastering can be procured on Little Wabash and Kaskaskia rivers, on Sand creek, and from some of the Drift exposures. The sands and numerous rounded pebbles of the Drift are destined to be of great utility in the construction of roads, especially at Shelbyville, where there is an almost inexhaustible supply of it. Good clay for bricks occurs everywhere. Limestone good for lime can only be procured four and five miles above Shelbyville, and on Sand creek.

Soil and Agriculture.—A pretty good idea of the soil of this county may be gathered from the first part of this report. The soil of most of the northern half of the county is a dark rich loam, the broken land near the streams being not so rich. South of the Terre Haute railroad, and in the southwestern part of the county, the soil of the flat prairie and timbered lands is thin; on mound slopes it is rich and very productive. Near Windsor, and south and west for six miles, both prairie and timbered land is rich. The woodland near Flat branch is all very good, and capable of producing all crops raised in this latitude. Most of the northern part of the county, and the timbered land and mound slopes in the south, are good wheat lands.

The general average of fall wheat is 20 to 25 bushels.

The finest crops of corn are raised in the northern part of the county, generally averaging 45 to 50 bushels per acre. According to Mr. L. Smith, he has raised, on rolling upland, 80 bushels per acre. The flat prairies and post oak and white oak flats in the south produce indifferent crops of corn.

Water.—For supplies of water the people chiefly depend on wells. Their depth is variable, from 20 to 50 feet; on the flat prairies not so deep as on the hilly lands.

One and a half miles north of the south county line, on the west side of Beck's creek, I observed a number of chalybeate springs, some impregnated with sulphur, others quite sweet. There is a fine spring of excellent water at Mr. Johnson's, a half-mile north of Williamsburgh.

In sections 5 and 6, T. 10 N., R. 3 E., a lake possessing the euphonious name of *Miantonomah* extends over an area of several hundred acres. Around its margin are many broad-leaf water-plants, and *Cephalanthus occidentalis* is also abundant. It is a clear fresh-

water lake, and is nearly level with the upland flat prairie. Lake Emtah, in Sec. 5, T. 9 N., R. 5 E., is another quite large body of water.

Before closing I will mention a natural curiosity in Sec. 32, T. 10 N., R. 7 E., on the west side of Little Wabash river, a quarter of a mile above a saw-mill. Two elm trees grow close to each other, relatively 3 and $2\frac{1}{2}$ feet in diameter; from the latter a large limb branches off about 4 feet above the ground, crossing to the other tree, to which it soon unites, then separating again, but solidly uniting at 40 feet from the ground, forming one trunk of three feet in diameter.

CHAPTER XXXII.

EFFINGHAM COUNTY.

This county is bounded on the north by Shelby and Cumberland, on the east by Cumberland and Jasper, on the south by Clay and Fayette, and on the west by Fayette. It has an area of 486 square miles, probably more than one-half of which consists of timbered land.

Streams.—The Little Wabash river passing southwardly nearly equally bisects the county. Its tributaries are: On the east, Lucas, Big Bishop, with its forks, Little Bishop and Ramsey creeks, Big and Little Salt creeks, and Brush creek, Green creek and Sugar Fork; on the west are Fulfers and Limestone, Big and Brocket's creeks, Second creek, Funkhouser, Blue Point and Shoal creeks.

Topography.—The higher surface land is either flat prairie or flat wood-land, some post-oak, some white oak, some hickory and oak, and some pin-oak flats, changing mostly to white oak on the breaks and slopes. Above the flats there are a few low mounds, not so abundant nor elevated as in the counties west; one or two in the eastern part, Blue Mound in the northwest, and the low ridge at Mason. The mound or ridge at Mason is probably two miles across its base, and but little over fifty feet high, descending very gently for over a mile to prairie flats which are soon merged into post-oak flats.

Near the south county line the Wabash bluffs are sometimes 80 feet high, near the railroad bridge they are 30 to 40 feet, near Ewington about the same, and 50 to 80 feet near the north county line.

The bottoms of the Little Wabash are an eighth to a quarter of a mile wide.

The hills near Salt creek are often quite abrupt, sometimes 75 feet high; its bottoms are low and narrow, and its channel full of quicksands. Near Sugar creek, Shoal creek, and Green creek, the hills are somewhat steep, bottoms very narrow and beds of the streams very sandy. Near the other streams the hills are generally low and of easy ascent, and the bottoms rather wide.

Timber and Prairie.—The prairie in the western part of the county is very flat, with occasional ponds, on the margin of which may be found *Cephalanthus occidentalis* and *Iris versicolor;* at the border of the prairie we found red oak and some laurel oak; on the flats west of the prairie post-oak and shell-bark hickory; in the woods between the prairies and Ewington hazel, laurel oak, hickory, sassafras, ash, etc.; and near the river white oak is more abundant.

On the prairie north of Ewington there are occasionally small willows and a low species of *cornus.*

On the bluffs of Sugar Fork we found white oak, Spanish oak, iron-wood, sugar tree; and on the bottoms, buckeye, sycamore, ash, burr oak, red oak, red-bud, elm, hornbeam and linden.

On the flats near Shoal creek we found white oak, shell-bark hickory, post-oak and black oak; and on the hills and flats near Funkhouser's and Big creeks white oak, shell-bark hickory and black oak.

The streams west of the Little Wabash river take their rise in very gentle depressions in the prairies.

The banks of Fulfer creek, on the prairie, are muddy and fringed with *cornus,* plum, cherry, grape vines and willow.

Lower down stream we found on the bottoms, white walnut, sugar tree, elm, grape vines, *clematis,* trumpet creeper, red birch, ash and sycamore.

Geological Formations.

Quaternary.—At the top of the Drift there are beds of brown clay, which may probably be referred to the Loess. West of Little Wabash there is exposed in the National road 4 to 6 feet of brown clay resting on blue clay with bowlders.

Drift.—On the bank of Green creek near the north county line a deposit of altered Drift is exposed thus:

		Ft.
1.	Brown soil	1
2.	Brown sandy clay	6
3.	Brown sandstone	4 in. to 1
4.	Sandstone and pebbles	?

Other Drift sections were observed as follows:

In the railroad cut south of Watson:

		Ft.
1.	Brown clay (Loess?)	8
2.	Clay and sand with some pebbles	20

On Bishop's creek:

		Ft.
1.	Brown and buff clay (Loess)	12
2.	Blue clay and bowlders	15

On Salt creek:

		Ft.	In.
1.	Brown and buff clays and sands, a few small springs at the bottom	?	
2.	Sandy conglomerate		6
3.	Blue clay and bowlders	8	

On the National road, 3 miles west of Ewington:

		F.
1.	Brown clay	6
2.	Brown clay and gravel	6
3.	Sand and gravel, blue and brown clay and gravel in a tolerably even bed, partly formed into a conglomerate	6
4.	Drift of sand and bowlders, some of the latter very large	25

In sections 17 and 30, T. 8 N., R. 5 E., there are regular beds of ferruginous Drift conglomerate 2 to 3 feet in thickness. In the first named locality a coral was found of lower Silurian age.

Six miles northwest of Effingham a pocket of black clay was observed, resembling the black humus deposits of the Drift, mentioned in my report of Moultrie and Macon counties.

A citizen of Effingham, engaged in well digging, gave me the following general section of wells:

		Ft.
1.	Soil and subsoil	1
2.	White, buff and blue clay (Loess?)	10
3.	Red clay and gravel—hard-pan	3 to 4
4.	Hard-pan, blue or gray clay and gravel, as much as 24 feet, general average	12
5.	Sometimes black clay	

He generally found good streams of water in the sand and gravel beneath the hard-pan, lumps of coal and pieces of wood were found at twenty feet from the surface. One well at Effingham, forty-four feet deep, had brown and black clay at the bottom and afforded plenty of water.

The surface of this county, like that of others which I visited, gave evidence of having once been much higher than at present, and the few low mounds scattered over the county are not connected, as we found them in other counties, but are isolated, often many miles apart.

Coal Measures.

There are 285 to 300 feet of upper Coal Measure rocks in this county; the highest beds about 190 feet above the highest rocks of Shelby county. They include the horizon of three coal beds, viz: 15, 16 and 17. The following is an approximate section of the beds in this county:

		Ft.	In.
1.	Sandstone and sandy shale, upper part gray, middle brown with plants	60	
2.	Bituminous shale and septaria	6	
3.	Dark clay shale	4	
4.	Shales and nodular limestone, fossils	1½	
5.	Blue and olive shales	5	
6.	Gray sandstone and sandy shale	26	
7.	Dark shale and thin beds of gray limestone	5	
8.	Coal No. 17	0	6
9.	Fire-clay	5	
10.	Mostly bluff sandstone	12	
11.	Clay and calcareous shales, fossils	20	
12.	Similar to No. 11, with fossils	13	
13.	Bituminous shale and pyritiferous limestone	9	
14.	Gray pyritiferous sandstone	30 to 40	
15.	Shale, with fucoids	40	
16.	Cherty beds	4	
17.	Limestone	4	
18.	Calcareous and bituminous shale		16
19.	Nelson's coal, No. 16		16
20.	Fire-clay	40	
21.	Shale?		
22.	Sandstone	30	
23.	Coal No. 15, or Shelby coal	1	
24.	Fire-clay	3	
25.	Nodular limestone	2	

The rocks on Salt creek include the upper part of the section Nos. 1 to 11, inclusive, and are more particularly described as follows:

		Ft.
1.	Just south of Effingham, the road passes over irregular beds of mostly hard gray sandstone with some shaly beds	15 to 20
2.	In a ravine lower down the branch, sandy shale with coal smut	6
3.	At the quarry below, yellow and brown sandstone, with many plants near the upper part, including *Calamites*, etc	30
4.	Dark-gray pyritiferous sandy shale and sandstone, probably 12 or 15 feet, in sight	8
5.	Up a branch to the west, bituminous shale, with thin coal laminæ, contains a calcareo-pyritiferous bed of septaria changing to a broad, flat, 5-inch bed of rock, perpendicular jointed, forming rhomboidal blocks; it contains a few very pretty fossils, *Pleurotomaria sphærulata*, *Spirifer plano-convexus*, *Rhynchonella Uta*, *Nautilus occidentalis*, and *Nautilus ferrata ?*	6
6.	Dark-olive shale and clay	4
7.	Dark ash-brown shaly and nodular limestone, abounding in a *Myalina*, like *M. sub-quadrata*, narrow and regularly rounded at the anterior margin; also contains *Aviculopecten occidentalis Bellerophon Montfortianus*, *Edmondia*, a small *Pleurotomaria*, *Leda* (coarsely striated), *Macrodon* (like *M. carbonaria*), and a small univalve	1½
8.	Black and olive shale	1
9.	Olive clay shale	4
10.	Rough thinly-bedded gray sandstone and sandy shale	3

At a quarry half a mile further down the creek, Nos. 4 and 5 crop out with the rocks below to No. 11:

		Feet.
11.	Hard blue and gray even-bed led sandstone	6

Two miles southwest, on a western branch of Salt creek:

12.	Mostly dark-olive or chocolate-colored sandy and clay shale	17
13.	Dark shale, with two 1-inch even beds of gray limestone, abounding in remains of fossils, including *Hemipronites crassus, Spirifer plano-convexus, Chonetes Flemingii*, an *Edmondia*, a Trilobite, crinoid stems and plates, *Stenopora lepidodendroides*, etc	1
14.	Dark olive and slate-colored shales	4
15.	Bituminous coal (No. 17)	0½
16.	Light dove-colored fire-clay, nodules in the middle	5
17.	Sandy shale, with brown nodules	2
18.	Down the same branch, and on Salt creek, are occasional outcrops of thick and thin-bedded gray, buff and drab sandstone and shale, No. 10 of the county section; in all about	20
19.	On Big Salt creek, half a mile above its junction with Little Salt, are twenty feet of clay shale; near the middle are two fossiliferous beds of carbonate of iron, with calcareo-argillaceous shales between, and abounding in very pretty fossils, viz: *Leda bella-striata, Astartella vera, Nuculu ventricosa, Spirifer plano-convexus, Chonetes Flemingii, Myalina subquadrata, Macrocheilus primigenius, Pleurotomaria Grayvillensis, Bellerophon Montfortianus, Bellerophon carbonarius, Bellerophon Sp. ?* and *Orthoceras cribrosum*	?

In sec. 27, T. 6 N., R. 6 E., on a small branch tributary to Ramsey, we get:

		Feet.
1.	(10 of county section.) Brown soft sandstone, towards the bottom hard and gray; plants in the upper part; at the bottom there is a calcareous bed containing *Nautilus occidentalis, Macrochelius* (small sp.), *Diplodus*, etc	8
2.	Fine-grained dark dove-colored limestone, containing some very nice fossils, *Rhynchonella Uta, Productus costatus, P. longispinus, P. Prattenianus, Euomphalus subrugosus, Schizodus, Orthoceras cribrosum, Goniatites*	1

This limestone is also found on P. H. Hume's land, in Sec. 35, T. 7 N., R. 6 E., containing only *Productus longispinus*. On Shoal creek there is a limestone which may also be its equivalent.

		Feet.
3.	(Last section continued.) Bituminous shale, containing a bed of carbonized and silicified wood, also a 1½-inch bed of pyritiferous limestone	4½
4.	Clay shale	4
5.	(14 of county section.) Hard sandstone and shale	10

On the Wabash river, near the south county line, the last named sandy shales are thirty feet thick, containing in the upper part lenticular and regular beds of ironstone, with ferns and *Calamites*. It is often very pyritiferous, as seen at the old mill on Fulfer creek, one mile from Little Wabash river, also in the Wabash bluffs at the railroad, where it contains some finely-striated stems of plants. On Big creek we find the sandstone containing similar stems and some ferns. There is also on Big creek twenty to forty feet of drab, dove and dark-colored sandy shales, containing ironstone concretions,

some of the latter with spherical-shaped small brown balls embedded in the side of the concretion.

On Little Wabash river, in Sec. 35, T. 7 N., R. 5 E., there is an outcrop of rocks as follows (Nos. 11 and 12 of county section):

	Feet.
1. Rough dark calcareous shale, or shaly limestone and shales; abounds in *Spirifer plano-convexus, Nucula ventricosa, Productus longispinus;* also contains *Athyris subtilita, Productus costatus, Bellerophon*, etc	2
2. Blue and bituminous shales	3
3. Dark-bluish-olive argillaceous shale	7

A quarter of a mile below, thirty feet of hard gray and yellow sandstone forms the river bluff; in it are found plants, *Calamites*, and fruit. On a small branch of Fulfer creek, in Sec. 2, T. 6 N., R. 5 E., there are thick beds of brown and buff sandstone (No. 10); tracing it around the bluff to the creek, it is high up in the hill; a little further, on a lower horizon, there are outcrops of bituminous shale and limestone, evidently belonging to No. 13 of county section. One mile up the creek, at an old mill site, a fine section, including parts of 12, 13 and 14, was obtained, as follows:

	Feet.	In.
1. Various colored shales, with lenticular beds of carbonate of iron. In a gray shale at the base are found casts of *Lophophyllum proliferum* and *Spirifer plano-convexus*	25	0
2. Blue shales and calcareous ironstone; fossils very abundant in both, including *Prod. costatus, Sp. plano-convexus, Orthis Pecosi, Leda arata, Athyris subtilita, Orthoceras, Pleurotomaria Grayvillensis, Diplodus*	2	0
3. Blue clay shales	3	0
4. Compact dull-ash pyritiferous limestone, with fossils, *Productus* (small sp.) *Sp. plano-convexus, Leda arata, Hemipronites crassus, Bellerophon Montfortianus, Euomphalus subrugosus*	1	0
5. Blue shales, fossils as above	5	0
6. Ash-brown shales	1	0
7. Coarse ash-blue pyritiferous limestone; contains *Prod. Prattenianus*	0	4
8. Shales	4	0
9. Bituminous shales	6	0
10. Ash-blue pyritiferous limestone	1	0
11. Shales, thin seams of coal, and some bituminous shale	2	0
12. Gray pyritiferous sandstone	15	0

A specimen collected from a portion of the last is of very even thickness, and marked with fine ripple-like striæ. The rocks here have a local dip of 5° to 10° south, 25° west.

One mile west we have:

	Feet.
1. Bituminous shale, with black concretionary limestone in the upper part	3
2. Dark-blue limestone, mottled with black fucoidal markings; contains some beautiful fossils, including *Productus Boonensis, P. Prattenianus, P. longispinus, P. costatus, Rhynchonella Uta, Retzia Mormoni, Hemipronites crassus, Schizodus* (like *S. Rossicus*), *Edmondia, Orthoceras cribrosum, Bellerophon per carinata, Nautilus* (like *N. elliptica*), *Euomphalus subrugosus, Macrocheilus* (like *M. Newberryi*), and one like *M. ventricosus*	
3. Blue and bituminous shales	10

The following is the section on Shoal creek:

		Feet.	In.
1.	Ash-blue clay shale	15	0
2.	Dark-gray shaly limestone	2	0
3.	Bluish-drab limestone, with the following fossils: *Nautilus occidentalis, Nautilus, Prod. semireticulatus, P. longispinus, P. scabriculus? P. costatus, Chonetes Flemingii, Athyris subtilita, Spirifer plano-convexus, Hemipronites crassus, Rhynchonella Uta, Terebratula bovidens*, and *Orthoceras cribrosum*	1	3
4.	Dark ash-blue clay shales	0	10
5.	Bituminous shales	4½	0
6.	Blue limestone, lower part shelly, and contains some fossils, *Prod. Prattenianus, P. semireticulatus, Spirifer cameratus*, and *Myalina quadrata*	2	0
7.	Bituminous coal	0	6
8.	Fire-clay	3	0
9.	Sandstone	25	0
10.	Red shale	4	0
11.	Hard gray sandstone	6	0
12.	Sandy and clay shales, with some nodules	18	0

On the head of East fork of Shoal creek, one mile northeast of last section:

		Feet.	In.
1.	Dark-ash clay shales	2	0
2.	Brown calcareo-arenaceous bed	1	0
3.	Semi-bituminous shale; contains *Bellerophon*	0	2
4.	Dark-blackish bituminous limestone	0	6
5.	Dark-ash fire-clay	2	
6.	Hard drab sandstone.		

The following on Limestone creek:

		Feet.	In
1.	Sandy shale	2½	0
2.	Hard drab sandstone	2½	0
3.	Buff-drab and olive clay shales	4	0
4.	Red clay shales	1½	0
5.	Olive clay shales	3	0
6.	Hard sandstone	3	0
7.	Mostly clay shales	5	0
8.	Limestone	3	2
9.	Coal No. 16		16
10.	Drab sandy shales	8	

The last named limestone (No. 8) is No. 17 of the general section in this county, and regarded as the equivalent of No. 2 of the section in Shelby county; the shales and sandstone above it are similarly developed on the south fork of the Kaskaskia, in Moultrie. The limestone occupies the bed of Fulfer creek, two miles above the mouth of Limestone creek, extending quite across, and is beautifully jointed by perpendicular cracks meeting at oblique angles, thereby forming rhomboidal blocks. This limestone dips down and is soon out of sight beneath the water. It is not found below the mouth of Limestone creek, and the overlying sandstones and shales appear n its stead. Its fossils mostly occur near the middle, and are *Spirifer cameratus, Productus punctatus*, and *P. longispinus*. On Lime-

stone creek the limestone rests directly on the coal. At Mahon's quarry it is separated by eight inches of clay, and the coal rests on five feet of thinly laminated buff and gray sandy shales.

At G. W. Nelson's, in Sec. 20, T. 6 N., R. 4 E., a section of his well shows:

		Ft.
1.	Chocolate-colored shales	14
2.	Blue shales	6
3.	Clay and nodules of limestone and some peculiar-looking fucoids, flat, with round edges and a spiny hirsute appearance	18

A half mile west, at the coal bank, the section continues thus:

		Ft.	In
1.	Loose cherty rock, with casts of fossils, *Hemipronites crassus*, *Productus punctatus*, *Spirifer cameratus*, *Prod. costatus*, *Chonetes*	2	
2.	Bluish-drab limestone; under ground it has a white surface. Its fossils are *Athyris subtilita*, and *Leptodomus*	4	
3.	Dark-blue and buff shales		8
4.	Calcareo-bituminous shales	2	
5.	Coal—No. 16	said to be 3	
6.	White clay	?	

I regard the limestone and coal as Nelson's equivalent to that of Limestone creek—it agrees with the dip.

The lowest rocks occur on Beech creek, and consist of:

		Ft.
1.	Sandstone, the lower three or four feet streaked with thin seams of red oxide of iron,	30
2.	Coal—No. 15, or Shelby coal	1
3.	Ash-blue clay	3
4.	Earthy limestone, mostly nodular	2
5.	Coarse drab shaly sandstone	?

Economical Geology.

Coal.—There are no thick beds of coal in this county, and excepting "Nelson's," no workable beds.

Mr. G. W. Nelson's coal bank is on a high prairie in Sec. 20, T. 6 N., R. 4 E. A pit has been opened, and good coal procured; but when I was there it was full of water, so that the thickness could not be correctly ascertained; but I was informed that it was 3 feet. Six miles down the creek, at Mahon's, it is 10 inches; and on Limestone creek, in Sec. 18, T. 6 N., R. 5 E., it is 16 inches thick. These several outcrops—the one at the head of the creek, the other six miles below in the bed of the same creek—indicate a decided easterly dip. The same coal is also found on Big creek, in Sec. 25, T. 7 N., R. 4 E. At these several places it is of variable thickness, and only separated from the overlying limestone by a few inches of clay. I have catalogued this coal as No. 16, counting from the lowest.

Except at Nelson's, neither black slate nor shale was observed overlying it. At Nelson's the black shale is calcareo-bituminous and fossiliferous.

On Salt and Brush creeks there is a 6-inch seam of bituminous coal, which I have marked as No. 17; its sure guide is two thin, even layers of gray limestone, occurring about 4 feet above, and abounding in *Spirifer plano-convexus*. This coal was reported to me to be 16 inches and 2 feet in thickness, but I observed it nowhere so thick. On Salt creek, near the mouth of Brush creek, several pits have been dug at different times, but are now all full of earth and rubbish.

A thin coal seam observed in Sec. 26, T. 9 N., R. 5 E., may be referred to either No. 16 coal, or else locally between 16 and 17; but I am in doubt regarding its exact horizon.

Coal No. 15 is only found on Beech creek, a branch of Rock creek, in Sec. 30, T. 8 N., R. 4 E., one foot in thickness, with thick-bedded sandstone overlying it. A shaft at Effingham, in order to reach coal No. 5, would have to be sunk about 900 or 950 feet.

Iron Ore.—The Drift conglomerate occurring in Sec. 17, T. 8 N., R. 5 E., is 3 feet thick, and contains a good deal of iron ore. It crops out on a point of the hillside, extending for 30 feet across. A similar deposit occurs near the mouth of Big creek, in Sec. 30, T. 8 N., R. 5 E. Coal Measure shales on Big creek abound in many concretions of oxide and carbonate of iron; there are also some in other localities, but the quantity is insufficient.

The sandstone below Effingham, in the fossiliferous portion, is very ferruginous. Red oxide of iron occurs on Beech creek in sandstone over coal No. 15.

Building Rock.—On Sugar Fork, near its mouth, there is a good quarry of hard sandstone, and one of siliceous limestone on Green creek above the mouth of Sugar Fork.

A very good quarry is that of Eversman's, on Salt creek bluffs, two miles south of Effingham. The rock is a firm, gray sandstone, in even beds. Very good sandstone, in thick beds, occurs in the bluffs of Shoal creek near its mouth, on Fulfer creek, in Sec. 2, T. 6 N., R. 5 E.; near Ramsey creek, half a mile from its mouth, in Sec. 27, T. 6 N., R. 6. E.; and on Big creek, in Sec. 29, T. 9 N., R. 5. E.

On Limestone creek, and on Fulfer creek for two or three miles above the mouth of Limestone, there are good limestone quarries. A good deal of rock used on the National road was obtained at Mahon's quarry on Fulfer creek, also northwest on Big creek. I do not consider this rock of superior quality; that on the National road has

undergone the test of twenty-five years, and is very much cracked by frost. The limestone at Nelson's coal bank is apparently of better quality. All these limestones will make tolerably good lime.

The various streams nearly all abound in a good quality of clean sand, useful for plastering, etc.

Potters' Clay.—The buff and darker clays from just beneath the soil of the white oak lands is very much used at Effingham to make common pottery.

Supply of Water.—Good water can be procured anywhere by digging. On the prairies in the southeast it is obtained at from 12 to 20 feet; at Effingham, 30 to 44; at Watson, 16; in Southwest, 20; at Mason, 18 to 30. The deepest wells I heard of were G. W. Nelson's of 50 feet, through clay and Coal Measure rocks to good limestone water, and at Jesse Newman's, at Mason, 145 feet, with scant supply of water. On the prairie, between Big creek and Fulfer, I detected a strong taste of sulphate of iron in water from a well 25 feet deep. Near the mouth of Fulfer, in Sec. 2, T. 6 N., R. 5 E., there is a chalybeate spring of very excellent water; it issues from beneath thick-bedded Coal Measure sandstone.

On Brush creek, one mile from its mouth, there is a never-failing spring of very good water. It is called by some a sulphur spring, but I could detect no taste of sulphur.

Soil.—There is more or less sand mingled with the soil of this county. The yield of corn is generally about 40 bushels per acre. Some persons think the country is too flat to be good wheat land; the general average is 20 bushels per acre—sometimes, but rarely, 30. When the seasons are not too dry good vegetable crops can be raised. The soil is well adapted to raising most kinds of fruit, but as yet orchards are not numerous. The peach crop sometimes fails.

At Mason I saw some very thrifty young pines growing in a yard, indicating their adaptation to this soil.

Scalds.—On the prairies in this county there are often found "scalds," or spots of barren and almost entirely unproductive land; fresh plowings often disclose spots of light and dark soil. The few plants found growing on these barren spots are of the same genera and species of those growing on poor land by the roadsides, or on and near an abandoned road, especially on a post-oak flat, and consists mostly of *Erigeron divaricatum* and *Ambrosia bidentata*. If the character of these scalds results from the same causes producing the wastes on and near roads, it must have been produced by the tramping or wallowing of buffaloes.

In Missouri I have often seen places known as deer-licks or buffalo-wallows, and the growth on them is the same as on the prairie scalds.

So far, they may be buffalo-wallows; but if they are wallows or licks, we would expect them to be basin-shaped, but they are generally about level with the surrounding plain.

In concluding, I must tender my sincere thanks to Mr. W. B. Cooper, of Effingham, for the presentation of specimens of silver ore from Nevada; and I am also under many obligations to Mr. Geo. W. Wright, of Effingham, for valuable assistance in giving me lists of many important localities in the county, by which my labor was much reduced. To Dr. Cornwell, of Mason, I also am obliged for assistance.

CHAPTER XXXIII.

MOULTRIE, MACON AND PIATT COUNTIES.

Moultrie is bounded on the north by Piatt and Macon, on the east by Douglas and Coles, on the south by Shelby, and on the west by Shelby and Macon counties. It comprises an area of about 339 square miles, a little more than one-fourth of which is timbered land. It is drained by the south and west forks of the Kaskaskia river and their tributaries. The timbered belt along the main streams varies from two to four miles in width. The west fork of Kaskaskia is a sluggish stream with low muddy banks, and does not run in dry seasons. The South Fork is the only stream with any lasting quantity of water; it runs during ordinary seasons, and below Sullivan has low sandy banks, but eastwardly they are muddy. On the bars we found many pretty mollusks, including *Unio zigzag, U. dilatata, Alasmodonta truncata, Melania, Paludina, Cyclas,* etc.

Topography.—The prairies are either nearly flat or very gently undulating. The timbered land, gradually sloping near the heads of creeks, becomes more uneven near the main streams, but there is no extensive tract of broken land. The bluffs on the south fork of Kaskaskia, near the east county line, are sometimes forty feet high, but for four or five miles down stream are not often over twenty feet in height, and spread out into white oak flats. Southwest of Sullivan the hills are sometimes sixty or eighty feet high, but not very abrupt.

Prairies.—There is an extensive tract of nearly flat prairie west of the west fork of Kaskaskia; the northeast quarter of the county is nearly all a very gently undulating or flat prairie, still, in great part, preserving its native state, and we here find tall grasses *Liatris* (two species), *Solidago, coreopsis, Monarda* (horsemint), resin weed (two species), *Veronica Virginica,* several species of aster, *Vernonia Noveboracensis, Dipteracanthus ciliosus* and *Eryngium yuccæfolium.*

The above imperfect list of species evidently indicates a transition from a wild state. Occasionally swampy depressions are found, or marshy ponds with *Physa*, etc., and such plants as *Vernonia fasciculata, Lythrum alatum*, etc. On the dry, low elevations are occasional clumps of hazel and low willow.

Stratigraphical Geology.

The formations in this county consist of the Quaternary and limited Coal Measure outcrops.

Alluvium.—This includes the soil, the loose material and more recent formations along the streams.

Below Sullivan, the soil of the south fork of Kaskaskia bottoms is very sandy, and along the stream there are many sandbars. The sandy bottoms are often entirely covered with a growth of *Vernonia fasciculata*. The principal trees and shrubs are spice bush, sassafras, white and red elm, mulberry, red bud, grape vines, Virginia creeper, trumpet creeper, cottonwood, sycamore, white maple, hickory, coral berry, ash, black walnut, hazel and *cornus*.

Three miles southeast of Sullivan, on land of George Purvis, on the west bank of Kaskaskia, I discovered the head of a bison. It measured across the forehead above the eyes twelve inches, the same between the roots of the horns; the latter were short, thick and slightly curved. The hill above the bank is probably twenty-five feet high; the bank about eight feet high, forming a narrow bench with the hill, of about ten feet in width; in this bench or terrace, a few feet from the top, the skull and part of the cervical bones were found; the surrounding clay was rich black loam. There were several trees two feet in diameter growing on this terrace.

Drift.—The Drift is of great depth in this county. At Sullivan, which is about as high ground as any other part of the county, a well was dug 210 feet deep without reaching any older formation. Mr. Patterson, who had charge of the digging, informed me that he passed through:

	Ft.
1. Yellowish clay	15
2. Green clay	10
3. Whitish clay and some gravel	6
4. At 60 feet from top struck a soft white sandstone (probably a bowlder), then 21 feet alternations of sand, gravel, red clay, blue clay, etc.; at 81 feet struck a big bowlder; at 110 feet blue clay, continuing to 210 feet; next 5 feet of quicksand—he could go no further. A strong vein of water came in at 15 feet from the surface, also at 105 feet; another at 180 feet, the last rising to within 5 feet of the top, but subsided to 15 feet. It has a strong sulphate of iron taste.	

On Whitley's creek, on land of Daniel Brown, the following section of Drift was exposed:

	Ft.
1. Soil at top, with a growth of white oak and black hickory; below brown clay, with a few small pebbles	8
2. Mostly blue and brown clay, with pebbles	16
3. Black spongy stratum, apparently vegetable mold, with no pebbles; when struck gives a hollow sound	4
4. Buff clay and brown sands, with talus from above	11

Up a ravine a hundred yards distant is a fine spring of exceedingly clear pleasant tasting water four feet in depth; bubbles of sulphuretted hydrogen occasionally rise to the surface; no taste of sulphur was perceptible, but there was a slight odor of it. The spring is on the land of Daniel Brown, and there are several similar springs near by.

On the edge of the prairie near the east county line, a half mile south of the river, a well was dug twenty-two feet, through first, yellow clay, lower six or eight feet blue clay, then bored twelve feet through blue clay to a bed of black sand and vegetable mold, in which plenty of water was obtained. The latter dark material is probably the equivalent of No. 3 of section at Brown's, and is also equivalent to a similar bed seen on Big creek, in Macon county.

On the South fork of Kaskaskia, below the mouth of Whitley's creek, observed as follows:

	Ft.
1. Soil, local Drift, etc	?
2. Blue clay, with a few pebbles; at the lower part a very dark stratum of clay	8
3. Brown sand and small bowlders	5
4. Blue and brown sand and clay, with some pebbles and bowlders	8
5. Very comminuted fine sand bed, some of it concretionary	3
6. Dark purplish-blue sands	4
7. Talus of above, with fragments of coal, etc	?

From the appearance of the dark stratum in Nos. 2 and 7, James W. Loomis & Co. have run in a drift for seventy feet in search of a coal bed; of course they were unsuccessful. The dark stratum at Daniel Brown's also induced certain parties to dig in search of coal. A little knowledge of geology would have taught them the futility of searching for coal at these places.

Drift bowlders of various kinds of metamorphic rocks are often found alone on the prairies, especially in the northern part of the county. Four miles northeast of Sullivan there is a bowlder of granite 10x5x8 feet, surrounded only by the black prairie soil; how deep it lies beneath is not known.

Coal Measures.

I was informed that near Sullivan Mr. John Patterson had dug a well 200 feet deep, through Drift clays, and struck a soft sandstone, into which he bored 43 feet. This is probably equivalent to No. 1 of my general section of the Coal Measure rocks observed in Shelby and adjoining counties. The top of this rock is probably about 140 feet above the Shelby coal (No. 15.) On the South fork of Kaskaskia, two miles above the junction, I obtained the following section:

		Ft.	In.
1.	Long slope of Drift, along which are strewn many bowlders of various kinds	50	
2.	Drab sandy shale	5	
3.	Rough, chocolate-colored limestone		4
4.	Olive clay	2	6
5.	Red clay	2	
6.	Dark olive clay	2	
	To low water in the river.		

Northwest of the above, on West Fork above the ford, I found many tumbled blocks of limestone sticking out of the bank, at a regular elevation above the water in the creek. They are somewhat surrounded by a local Drift, but apparently about their proper place. Down the river a few miles, in Shelby county, this limestone (No. 2 of general section) crops out in regular layers 4 feet thick. I regard the above named Coal Measure rocks as equivalent to those seen on Limestone creek in Effingham county. I would therefore say that a shaft would have to be sunk about 330 feet at Sullivan in order to reach coal No. 15, or probably 850 feet to reach coal No. 7.

Springs and Wells.—There are but few springs in this county. On the southeast and northeast portions of the county water is generally obtained at a depth of from 15 to 22 feet. Some wells on the prairies north of Bethany are but 13 feet deep. In digging, blue clay is generally passed through, and water found in the beds of sand. A well at the mill near Sullivan was dug 80 feet deep, with no water; six rods from it one was dug 30 feet deep, and water procured.

Soil.—We have here the prairie soil and the soil of the timbered land, each differing from the other, both in appearance and in relative fertility. The prairie soil is very nearly of the same character everywhere, is very black, and generally $1\frac{1}{2}$ feet or more in depth. Around Sullivan, although it has been cultivated for many years, it does not seem to be impoverished, but still retains great fertility, producing annually 40 to 50 bushels of corn per acre, and often reaching 75—never less than 20; wheat 15 to 30, often 30 to 35; and barley 46 bushels per acre.

Near Whitley's creek there is a very narrow strip of probably less than a quarter of a mile in width extending along the stream for four miles from its mouth, with a growth mainly of white oak, black oak and hickory, and sometimes sugar tree. Near the prairie this gives place to a richer land, with crab-apple, thorn, plum, etc.; further up stream the soil becomes still richer, with hackberry, elm, walnut, honey locust, laurel oak, ash, burr oak, and sometimes chestnut oak. This soil is very productive, yielding, according to Mr. Smizer, a general average of 50 bushels of corn per acre, and as high as 83, with 33 of wheat.

Around Bethany the growth is very similar, but the soil is generally of a lighter color, containing a few pebbles; the growth is honey locust, elm, hackberry, hazel, laurel oak, hickory, linden, grape vines, *cornus*, cherry, coral berry, mulberry, and a surface covered with grass and pennyroyal.

Between this and Sullivan the growth is somewhat different, consisting of black oak, hazel, hickory, sassafras, and occasionally burr oak, walnut and *cornus*. This land is very well adapted to the growth of fruit, and yields excellent crops of wheat, averaging 20 to 25 and sometimes as much as 35 bushels per acre.

There is generally a belt a mile in width of poorer land with a yellowish soil extending along the South Fork, often spreading out into white oak flats, with a growth principally of white oak, black oak, post oak and low willow. Indifferent corn and tolerably good wheat can be raised on this soil.

Good Osage-orange hedges have been planted, and succeed very well in this county, and there are also some willow hedges.

MACON COUNTY.

Macon county is bounded on the north by DeWitt, on the east by Piatt and Moultrie, on the south by Moultrie, Shelby and Christian, and on the west by Christian, Sangamon and Logan counties.

It embraces an area of about 555 square miles, the greater part of which is prairie, the timber being restricted to a three-mile belt along Sangamon river, becoming narrower towards the eastern part of the county, a similar belt near Big creek, and a two-mile strip along Friends' creek. There is a quantity of good timber both on the hills and bottoms, including white oak, black oak, burr oak, red oak, laurel oak, pin-oak, swamp white oak, chestnut oak, hackberry, hickory, elm, honey locust, sassafras and ash. White walnut and blue ash are found on the bottoms of Big creek, but are not common.

The general surface of the country is flat or gently undulating on the prairies, becoming more hilly as we approach the streams. From the northern part of the county the surface declines with gentle undulations southwardly to the timber, and from the high prairie in the north there is a fine southward view to the Sangamon timber ten miles distant. West of Harristown the slopes are extremely gentle from the high prairies to the Sangamon bottoms. Eastwardly the timbered land is more hilly, becoming quite broken near Decatur, with lower hills near the east county line. Near Decatur the hills rise by long slopes to a height of about 90 feet above the bottoms, and are higher than the general surface of the country a little south. On Sangamon river near the east county line, and on Big creek north of Mt. Zion, the hills are not often over 30 or 40 feet high.

Near the edge of the prairie south of Niantic there is a low sandy ridge with a growth of burr oak, black walnut, red oak, hackberry and hickory, changing to black oak, elm and hickory, then to black oak, hickory, elm and laurel oak. Where clay predominates pin-oak and elm constitute the principal growth; the richest spots abound in cherry, laurel oak, hazel, elm, mulberry, red-bud and black walnut. A well dug at this place gives the following section:

	Feet.
1. Clay	2½
2. Dry sand	10
3. Yellow and mottled clay	3
4. Quicksand with water	

Two hundred yards distant another well was dug with somewhat different results, passing through 27 feet of clay to clay and gravel, with a fine stream of water at the bottom.

Near Decatur, and for three miles west and eastwardly on Sangamon hills, the soil is of a light mulatto color, reddish-brown clay with a few pebbles appearing near the surface. Near Decatur the growth is black oak, white oak, hickory, hazel and some walnut. Near the edge of the prairie the growth is principally burr oak, laurel oak, hickory, hazel, plum and cherry; passing from the timber to the prairie the change is rapid from the light-colored and yellowish soil of the timber to the deep rich black prairie soil.

Two miles south of Decatur the soil and growth changes from that of the black oak land to richer, with groves of elm, white oak, walnut, hickory, sassafras, vines, chestnut oak, laurel oak and mulberry.

Near Mt. Zion are tracts of good land, with white oak, walnut, chestnut oak, hazel, sugar tree and buckeye; the washings disclose some gravel. On the hillsides are goose grass and pennyroyal. On

the bottoms of Big creek blue ash, white walnut, sugar tree, elm, linden, with large buckeye and burr oak trees are found.

Pin oak and laurel oak are generally found at the edge of the prairies.

On Sangamon bottoms there is plenty of good timber, including burr oak, red oak, black walnut, elm, linden, hackberry, buckeye, hickory, etc.

Prairies.—In many places the prairies still preserve their native beauty, covered with tall grass and adorned with Flora's bright gifts, among which are found the delicately beautiful *Physostegia Virginiana, Gerardia tenuifolia, Gentiana puberula,* with the coarser plants, *Silphium laciniatum* and *S. terebinthinaceum, Liatris* (2 or 3 species), *Helianthus, Solidago,* etc.

Stratigraphical Geology.

The geology of this county is only "surface." Except in one well, no older formations than the Drift have been discovered; at about 100 feet in a well at Macon it is said solid rock was struck, which may be doubted, inasmuch as large bowlders are often found in the clays of that vicinity.

Alluvium.—This includes the soil and recent formations along the streams. The Sangamon banks are 8 or 9 feet high and composed of dark clay, vegetable mold and a little sand. On the gravelly shoals many small shells are often found, belonging to the genera *Paludina, Melania, Cyclas* and *Unio;* where the water is more sluggish *Anodontas* are common.

On the flat prairies there are many small marshy tracts, fresh plowing of one of them disclosed to view remains of old shells of the *Planorbis* and *Lymnea.* It is not improbable that in a few years most of these ponds or marshes will be drained and cultivated, and the calcareous material of the shell remains will be found a useful addition to the productiveness of the soil.

Drift.—At Decatur there appears 6 to 10 feet of mostly yellowish-brown clay, then similar clay with bowlders and pebbles extending downwards several feet, then blue and brown clay and pebbles.

On Big creek, in Sec. 4, T. 15 N., R. 3 E., the Drift appears thus:

1. Thirty feet of Drift clays with loose pebbles, sand and clay; at lower part comminuted sand and clay. On the lower slope of this is an abundant growth of *Equisetum* or scouring rush, associated with *Gentiana alba* and *Pedicularis lanceolata.*
2. Eight feet. The upper part dark brownish-black; lower part black and apparently of vegetable origin, no pebbles seen; when struck a hollow sound is produced. *Debris* from above falling over unites with this, forms a marshy talus, on which were growing *Lobelia syphilitica, Sagilaria variabilis* and several other marsh plants.

The above Drift section is very similar to an outcrop on Whitley's creek in Moultrie county.

Bowlders and pebbles of granite, quartzite, altered sandstone, porphyry, limestone, chert, etc., are found along the streams and irregularly scattered on the prairies, and sometimes very large ones are found alone on the flat prairie. Three miles south of Oakley observed a bowlder of gray granite of an irregular shape, measuring 8 feet across in two directions, and sticking up 4 feet above the ground. The surrounding soil is rich and black and no other bowlders were seen near by.

Wells.—At the railroad depot, Decatur, Mr. Isaac C. Pugh informed me that a well had been dug 90 feet deep through sand and gravel, but no permanent stream of water was reached. Mr. Pugh's well is 35 feet deep and affords plenty of water.

On the flat prairie south of Decatur water is found at a depth of 13.

Near the east county line, south of the railroad, it is reached at from 12 to 57 feet, but the supply fails in dry seasons; but at 27 to 40 feet fine streams are generally obtained, occurring in beds of sand beneath the blue clay. In the northeast part of the county water is obtained at from 10 to 20 feet from the surface, and near Forsyth from 16 to 30. On the rolling prairies in the western part of the county, water occurs at very irregular depth.

Harristown is located on what seems to be an elevated prolongation of a low Drift ridge. At this place a well was dug through 10 feet of yellow clay, then 70 feet of blue clay with no sand, and only surface water obtained. Two miles northwest, also on high prairie, another well was dug 30 feet deep, and has generally contained about 25 feet in depth of water.

Springs.—In Sec. 4, T. 17 N., R. 2 E., there is a large spring, the water of which is reported to contain sulphur, but I could not detect its presence.

On the land of John Good, near Bethel church 4 miles northwest of Decatur, is a boiling spring. Carburetted hydrogen gas accompanied with small white flakes frequently escapes to the surface. The surface of the water presents a slighly irridescent appearance; it is very cold and pleasant to drink, with a faint taste of sulphur. Along its margin a small species of *Physa* is found. The flat ground is marshy for as much as an acre in extent.

In the Decatur fair grounds are several large and fine springs.*

Agriculture.—It is apparent from what I have heretofore said, that all the prairie land is very rich, most of the timbered land either rich or of fair quality, and all capable of producing fine crops. On the prairies, especially in the northern part of the county, fine corn crops are annually produced, in ordinary seasons yielding 65 bushels per acre, and often more. Although the soil is very rich, good wheat crops are rare, fall wheat extremely uncertain, except near the south county line. The farmers generally sow spring wheat and raise from 15 to 20 bushels per acre. They consider the ground too loose for fall wheat, but sometimes raise good crops of it on new land. Other grains, oats, barley and rye yield well. The potato grows finely when not injured by the bug, but late vines during the last few years have suffered very much from their depredations.

Fruit.—As yet, there are very few bearing orchards, but the county bids fair to become a good apple-growing district. There are only one or two small vineyards near Decatur, and they promise well; this soil I believe to be admirably adapted to the vine. Other small fruits when planted do well. The peach crop of 1868 was very good but such crops may not be expected every year.

A few good hedges were observed on the prairies. The Osage orange does very well. I observed, growing, some good walnut groves on the prairies.

In conclusion, I would say that for richness of soil Macon county will favorably compare with any other county in this portion of the State.

NOTE.—Since the foregoing report was written, a boring was made at Decatur with a diamond drill, by the Western Coal Mining Company, and I am indebted to Mr. Bean, their agent here, for the following record of the work. The boring stopped at the depth of 507 feet, 1 inch, and in my opinion from 85 to 100 feet above the horizon of the Springfield and Howlett coal. The following (p. 539) is the record of this bore:

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* NOTE.—Mr. Wm. A. Wilson of this county, living ten miles south of Decatur, struck gas on his farm in the autumn of 1871, at a depth of 45 feet. It came from immediately beneath the hard-pan and was found at seven different localities on the place, and the flow appearing to be constant, he utilized it in furnishing his dwelling house with both light and fuel. It comes from a bed of quicksand beneath the hard-pan, which has been penetrated to the depth of fifteen feet without reaching the bottom. When last heard from, some eighteen months after its discovery, the gas still continued to flow without any apparent decrease in the quantity.

A quarter of a mile east of this gas well another boring was made, which at a depth of about fifty feet passed through a bed of black peaty soil some four or five feet in thickness, but no gas was found. A. H. W.

	Ft.	In.
Surface soil, clay, gravel, etc., (Drift)	118	
Coarse micaceous sandstone	4	
Arenaceous clay shale	34	
Grayish limestone	4	
Dark clay shale	6	6
Light clay shale	12	
Micaceous sandstone	18	
Clay shale	24	
Dark slaty clay with fossils	2	
Light slaty clay	3	
Red shale	10	
Brown and red shale with fossils	11	2
Hard conglomerate	3	
Coal with red clay and gravel	1	4
Fire-clay	3	6
Arenaceous clay shale	7	1
Hard lime conglomerate	3	
Bluish clay shale	4	
Soft micaceous sandstone	21	
Dark gray shale with ironstone	9	
Clay and quicksand ?	3	
Blue limestone	1	6
Gray sandy shale with fossils	22	1
Gray limestone	11	6
Black and gray shale	7	
Mud vein (fire clay ?)	2	
Blue limestone	11	9
Hard conglomerate	2	1
Blue shale and some rock	13	8
Hard, gray, sandy and micaceous shale	44	6
Black shale	2	
Coal, hard and bright	1	2
Fire-clay	9	9
Bluish, sandy clay shale	8	4
Mud vein (fire-clay)	2	1
Dark slaty clay with fossils	17	4
Hard conglomerate rock	1	4
Dark shale with fossils	4	8
Sulphur balls		6
Lime conglomerate	5	
Red, sandy clay shale	29	
Bluish clay shale with shells	8	3
	507	1

The 11 feet 9 inch blue limestone found in this bore at the depth of 345 feet is probably the same as the Carlinville and Shoal creek bed, which is usually from 250 to 300 feet above the Springfield coal, and later a shaft has been sunk to the coal, which was found at a depth between six and seven hundred feet, but no record of it could be obtained, although repeated applications for it have been made. A. H. W.

PIATT COUNTY.

Piatt county is bounded on the north by DeWitt and McLean, on the east by Champaign and Douglas, on the south by Moultrie, and on the west by Macon and DeWitt counties. It embraces an area of about 436 square miles, most of which consists of prairie.

The prairies of this county are very rich, and in a great measure still preserve their native wildness; are beautiful in the summer season, covered with tall grass adorned with many beautiful flowers, among which are the rose, *Liatris* (2 sp.), *Physostegia Virginiana*, *Phlox pilosa*, *Gerardia tenuifolia*, *Lobelia spicata*, *Lythrum alatum*, *Echinacea*, *Gentiana puberula*, *Veronica Virginica*, *Aster sericeus*, and several other species of aster; together with coarser plants, including *Monarda* (horsemint), *Solidago* (several species), *Silphium* or rosin weed (3 species), *Pedicularis lanceolata*, *Eryngium yuccæfolium*, *Nabalus asper*, *Helianthus* (several species), *Ceanothus*, etc. Marshy spots and ponds are often seen, even on the highest prairies, some of them containing living shells of the genus *Physa Lymnea* and *Planorbis*, and having on their margin a growth of *Lobelia cardinalis*, *Vernonia fasciculata* and *Aster carneus*.

Streams.—Willow Branch heads in several large springs N. W. of Bement; one of these on Thomas Davis' land is said to contain sulphur, but if so, the quantity must be very minute, for I could not detect its presence. This spring spreads out into a large grassy marsh.

The South Fork of Kaskaskia river rises in the southeast part of the county, a little east of Bement, runs southwardly for 12 miles and enters Moultrie county; along it there is a strip of timber varying from one to two miles in width. The West Fork takes its rise in the southwest and runs southwardly, soon entering Moultrie; there is but little timber near it, only first a fringe of willows with a few crab apple bushes beyond; lower down, the thorn (*Cratægus*) appears, then plum and cherry; next cherry, plum, pin oak, laurel oak, elm; still further down, elm, red and white oak, hickory and burr oak.

The largest stream in this county is the North Fork of the Sangamon river, which traverses the county from northeast to southwest, and along its margin are many springs, which afford a constant supply of pure water. In the river we found many very pretty mollusks similar to those already enumerated in the adjoining counties.

Timber and Topography.—Near the Sangamon the hills are low and of easy ascent, the highest not over 45 feet; the neighboring country is not broken, but somewhat hilly for a half mile from the stream. Along the river and Goose creek there are timber belts of about two miles in width. The total area of timbered land in the county probably does not exceed 50 square miles.

The prairies are bordered with a growth of laurel oak, pin oak, hickory, cherry, plum and crab apple, with sometimes burr oak and black walnut. Between the prairies and the Sangamon bluffs we found white oak, sassafras, shellbark hickory, black oak and hazel; on the sloping bluffs, white oak, black oak, service berry, iron wood, black haw, red wood, sugar tree, linden, ash, red oak, walnut, red elm and poison oak. Good timber abounds on the bottoms, including black walnut, burr oak, ash, maple, hickory, honey locust, hackberry, mulberry, red oak, linden, sycamore, and a few blue ash trees were observed.

Away from the streams the country is either flat or very gently undulating, rising by easy ascent to the upland prairie and gradually blending into the higher mound-like elevations.

Stratigraphical Geology.

No formations older than the Drift appear in this county.

The character of the *alluvium* is similar to that of the adjoining counties, and it includes the soil and recent deposits along the streams.

Drift.—At the bridge on Sangamon river, near Monticello, it is thus exposed:

	Feet.
1. Yellowish-brown clay	5
2. Clay, sand and bowlders	5
3. Dark ash-brown clays, fine sand and a few pebbles	4
4. Black clay	1
5. Clay streaked, black and dark-brown with ochrey red	8

On Sangamon bluffs, four miles below Monticello, there is exposed:

	Feet.
1. Brown clay	6
2. Pebbles and clay	10
3. At top dark-brown clay, below reddish-brown, finely comminuted sand and clay.	14

Between Monticello and Centreville the road washings disclose three to four feet of bright brown clay, sometimes brown sand, pebbles and bowlders.

On the prairies there are bowlders of granite of various colors, generally gray, red and gray syenite and syenitic granite, quartzite

and altered sandstone, gneiss and greenstone; and in the altered drift we found Devonian fossils and fragments of Coal Measure rocks.

Springs highly colored with oxide of iron are often found issuing from the Drift sands. On Willow Branch, in Sec. 29, T. 19 N., R. 5 E., there are many such springs, some of them strongly chalybeate. In one of them gas arises, and a quantity of brown sediment is deposited on its sides; the ground in front is very marshy for the space of two acres. The bluff at this place is about thirty feet high and composed of brown sand and small rounded pebbles. Three-quarters of a mile up the Sangamon river there is a similar marsh.

Wells.—In the timbered land wells have to be dug deeper than on the prairies, and on the higher rolling prairie deeper than on flat prairie. In the northern part of the county plenty of water is reached at twelve to twenty feet; on the high prairie northeast of Bement, fifteen to thirty feet; on high prairie near Monticello, twenty to thirty feet; in the southwest, eighteen to thirty feet.

In Sec. 26, T. 16 N., R. 5 E., Mr. Love has a well ten feet deep, passing through clay and sand, but the water sunk in the sand; a half mile west plenty of water is obtained at five feet depth. At the Monticello hotel the well is fifty-five feet deep, the water generally standing at twelve feet from the surface, but in the summer of 1867 it sunk to forty-seven feet from the top. At Centreville a well was dug on the hillside thirty-six feet deep, passing through six feet of yellow clay and sand at the top, then blue clay with occasional streaks of sand and some pebbles; a little quicksand near the bottom, and at the bottom a stratum of dark clay and sand, with a weak stream of water. The bottom of this well is near the horizon of the bottom of Sangamon river. One hundred feet distant, and at an elevation of twenty feet higher, a well was dug twenty-six feet deep, and a good stream of water procured.

Soil and Agriculture.—The soil may be divided into two classes—the prairie and the timber. The timber is a loose, mulatto soil, producing good vegetables, and for fruit and vines is said to be quicker and better than the prairie, and is evidently dryer.

The prairie consists of dark, rich, loose loam, sometimes containing a little gravel; after the first sod plowing, if left thus for one season, a species of *Helianthus* grows up very thick over it to the almost entire exclusion of all other plants.

The southern prairies, I was informed, could be plowed within two days after very heavy rains.

The prairie soil seems admirably adapted to the growth of corn, the yield averaging fifty bushels and often more per acre. This is not a good wheat growing county; crops of spring wheat have been generally good, but this year (1868) the yield was not a half crop. Fall wheat is uncertain, but sometimes yields well; better than the spring wheat.

CHAPTER XXXIV.

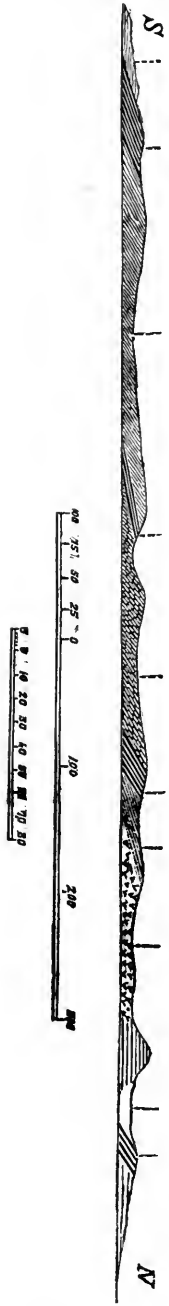
GALLATIN COUNTY.

Gallatin county is one of the most interesting counties in the State, not merely geologically, but also from an economical point of view.

A marked feature in the topography of this county is an axis of disturbance or upheaval that crosses it, in an east and west direction, along the southern tier of sections on the parallel of township 9. The ridge, which is formed by this line of uplift, attains an elevation of three hundred and forty-two feet above the high water of the Ohio river, and has received the name of "Gold Hill."

Its summit is capped with the Conglomerate or Millstone grit, a massive sandstone that usually contains small quartz-pebbles, and lies at the base of the Coal Measures in this part of the State, whilst along the northern face of the ridge the Chester sandstone and limestone, which comprises the upper group of the Lower Carboniferous, are brought to the surface, and show, as well as the superimposed Conglomerate, a strong dip to the south, varying in places from ten to forty degrees. Especial attention was directed to discover a reversal of dip or anticlinal axis, but at every locality visited on the north side of the ridge, the strata from top to bottom were basseting at a high angle to the north. On the east end, approaching the Ohio river, Gold Hill descends with a very gradual slope, and is lost in the alluvial of the overflowed bottom back of Shawneetown. In front of this town, on the Illinois shore, the rocky axis here crossed by the Ohio river is exposed to view at low water, where the Conglomerate and superimposed strata lie in great confusion, but generally show an unmistakable dip of from ten to twenty-five degrees to the south, as shown in the diagram, which represents a horizontal section of the rocks running north and south. The basseting Conglomerate seen on the north end of this

Section at Shawneetown, Gallatin county, Ill., of Millstone-grit and overlying shales exposed at low water of the Ohio river.



Argillaceous shale, nearly horizontal.

Argillaceous and siliceous shale, with band of septaria limestone, "Black Marble." Some coaly matter; dip 15° S.

Argillaceous shale, with numerous bands of clay iron-stone; dip 10° to 25° S.

Shale and coaly matter; dip 10° S.

Shale, with thin irregular-bedded sandstone; general dip about 20° S.

Pyritiferous shale, some coaly matter and intercallated limestones; dip 20° S.

Hard gray sandstone, coarse-grained; patches of thin coal; dip 10° S. Conglomerate.

Shelly uneven-bedded sandstone.

Conglomerate; large casts of *Sigillaria.*

Covered space.

Conglomerate; dip 10° S.

Horizontal (long) *scale*, 150 *feet to the inch.*
Vertical (short) *scale*, 80 *feet to the inch.*

section appears to jut against a reddish, coarse-grained micaceous sandstone, that lies apparently horizontal, and may be traced along the water's edge for several hundred yards up the river, without presenting any appearance of an anticlinal axis. It weathers roughly and is coated in spots with a saline efflorescence, and is charged in places, also, with iron ore, that forms a kind of ferruginous conglomerate or pudding stone, and here and there small patches of coal, but no regular seam. Large stems of *Sigillaria* are embedded in it, one of which is twelve inches broad and six feet or more in length.

On the south end of the section the argillaceous shales lie also, apparently horizontal, after passing a short distance below the point where they show a dip of fifteen degrees. Several thin seams of coal are seen, as shown in the section, but so crushed and broken up that it is difficult to determine with certainty their position in the vertical section of the Coal Measures hereafter to be described. The coaly matter in the shale dipping ten degrees, may occupy the position of the Battery-rock coal, or No. 1 of the section above referred to. Several intercalated bands of limestone occur in the section; one, a black septaria rock, is susceptible of a fine polish, and presents an appearance almost equal to the Irish black marble.

A casual observer of the tilted rocks at Shawneetown landing would be likely to exaggerate the thickness of the strata to far beyond what is shown in the above diagram, the measurements for which were carefully made by stepping the distance, and it is thought they will prove to be nearly exact. The horizontal length is between nine hundred and fifty and one thousand feet; which, taking the average dip at fifteen degrees, would make the vertical thickness of the strata to be from two hundred and thirty to two hundred and fifty feet. Now, if we make a reasonable allowance of one hundred and sixty feet, as the thickness of the millstone-grit at this locality, it will be seen by reference to the vertical section of the Coal Measures that no workable coal, above the Battery rock coal No. 1, has been brought to the surface here.

There is another low depression in the Gold Hill range in this county where it is crossed by Saline river, at Island riffle, section 36, township 9, range 8. At this locality a Coal Measure sandstone is exposed, but I was unable to determine its position in the measures, or to decide positively upon the direction of its dip, which is but slight, and apparently to the northeast, while at Dorsey's riffle, a short distance above, the shales and thin-bedded sandstone in the river are dipping 35° south, 30° west.

"Coal Hill" is the name of a short range of hills commencing on Sec. 4, T. 10, R. 9, and terminating on Sec. 8 of the same township and range. With the exception of Coal Hill ridge and another range of hills that skirt along the north side of Saline river, the country south of Gold Hill and east of Saline has but a slight elevation; much of it, in fact, is subject to overflow. South of the Saline river, and along the waters of Eagle creek, the country is broken by hills from seventy to one hundred and fifty feet high. Another short range of hills, lying to the north of the Gold Hill axis and running nearly parallel thereto, terminate at or near Equality, on the west side of the north fork of the Saline. The remainder of the county north of the Gold Hill axis is destitute of prominent hills, with the exception of an elevated narrow ridge running nearly north and south along the road from New Haven to Shawneetown, and terminating within three miles of the latter place.

Gallatin county is well supplied with water-courses. Besides the Ohio and main Wabash rivers on its eastern boundary, the Little Wabash river enters the county at the village of New Haven, and flows through the northeastern corner to form its junction with the main Wabash twenty miles above the confluence of the latter stream with the Ohio. The north fork runs through the northwestern portion and joins the Saline river at the town of Equality, on the eastern border of the county, while the latter river in its course cuts through the Gold Hill axis about three miles below Equality and flows out at the southeastern corner of the county to form its junction with the Ohio river just above the Battery rock coal mines, in Hardin county. Eagle creek, a large tributary of the Saline river on the south, and its numerous affluents, ramify through the southwestern portion of the county. Besides these streams, it may be mentioned that there are a few ponds or small lakes seen in the low lands of the Ohio and Wabash rivers, which are supposed by many, with seeming plausibility, to be the remains of old river channels.

Stratigraphical Geology.

The geology of this county will be best understood by an examination of the section on page 549, in which is shown the chronological order of all the strata visible in this county.

Lower Carboniferous.—Along the northern face of the Gold Hill ridge, in two or three places the upper part of the lower Carboniferous rocks has been brought to the surface by the axis of disturbance

which produced this noted ridge. These rocks belong to what is designated in the first volume of the report on the geology of Illinois as the *"Chester group."*

The most easterly exposure is on the S. hf. ¼ Sec. 33, T. 9, R. 9, about three miles east of Shawneetown, where the following section was obtained:

	Ft
Covered slope to top of ridge	50?
Conglomerate, with pebbles	50
Irregular-bedded sandstone	20
Covered sandstone and shale ?	90
Limestone, with Archimedes	55
Covered to high-water of Ohio	40
	305

The rocks in this section basset to the north at an angle of 20°. The Chester limestone exposed near the base is, for the most part, a coarse crystalline, grayish rock filled with small entrochites, the organic structure of which is almost obliterated by crystallization, which gives a glimmering lustre to the freshly broken fragments. It is remarkably poor in other fossils; for, after a long and diligent search, I was finally able to obtain only a very badly preserved specimen of *Archimedes* and a few fragments of a small *Spirifer*, too imperfect for determination. There is a thin stratum of fine-grained bluish limestone, in which no trace of organisms could be found, lying between strata of the gray rock and near the lower part of the exposure.

The large amount of talus strewed along the base on the north side of Gold Hill, covers up the lower strata so completely that I was compelled to make two separate trips, having a guide each time, and to spend two days in searching before being able to find the limestone at this locality. It is true, lime had been burned here, but so long ago that people generally knew nothing about it. Though, for the causes herein stated, this limestone could be traced for only a few hundred feet along its outcrop, it is thought that it may extend half a mile or more along the ridge until it disappears through an east and west depression beneath the drainage of the county. To the west of Sec. 33 the ridge gradually sinks, and is crossed by the Saline river in Sec. 31, T. 9, R. 9, and in Sec. 36, T. 9, R. 8, at what is known as Island Riffle, where rapids are formed by the stream flowing over a coarse-grained, yellowish sandstone, which weathers roughly, and the position of which, in the series, is above the Conglomerate; but I was unable to determine its exact place in the vertical section. After crossing to the west side of the Saline river, and following up the stream to Sec. 27, T. 9, R. 8, the Ches-

ter limestone makes its appearance again high up in the ridge, and forms with its associate strata an abrupt escarpment. They basset to the north at an angle of about 10°

The following section was taken at low-water of the Saline:

	Ft.
Soil, Drift and covered	60
Quartzose sandstone, mostly covered up, probably equivalent of the Chester sandstone	50
Chester limestone, gray, with thin seams of calc-spar, has a paucity of fossils; yielded a fragment of *Productus elegans*	23
Covered to low-water of Saline	70

Besides dipping to the south, which is the regular pitch of the strata in the ridge, there is here also an east and west wave of elevation and depression, which carries the limestone down from forty to fifty feet, a few hundred yards to the east, where the old salt springs—formerly known as the "Nigger Works"—break out in the bank of the Saline river, apparently at the junction of the limestone with the sandstone which lies above it. Consequently, we may consider this as the geological horizon of the main salt brine of this portion of the State.

With the exception of a small outlier of Chester limestone in the southwestern part of the county, near the corner of Pope and Hardin counties, no other localities are known in Gallatin where the lower Carboniferous rocks can be found outcropping; and wherever examined these rocks, quite contrary to what is usual, show a remarkable paucity of organic remains, and the few that were observed it was found impossible to preserve.

Coal Measures.

The section which accompanies this report represents the entire thickness of coal strata in Gallatin county, and contains, it is believed, all the workable beds of coal, together with some of the most important thin seams that are to be found in the county.

Section of the rocks in Gallatin county:

		Ft.	In.
No. 1.	Siliceous shale	10	
No. 2.	Heavy-bedded sandstone	.5 to 40	
No. 3.	Siliceous and argillaceous shale	25	
No. 4.	Limestone—Carthage rock ?	8	
No. 5.	Shale and thin coal No. 9	3	
No. 6.	Shales, partly bituminous and calcareous	30	
No. 7.	Bituminous shale	2	
No. 8.	Coal No. 8	2	
No. 9.	Siliceous shale and sandstone	40	
No. 10.	Limestone	4	
No. 11.	Bituminous shale	.0 to 3	
No. 12.	Coal No. 7	.4 to 7	

No. 13.	Sandstone and shale	41	
No. 14.	Coal No. 6	2	6
No. 15.	Shales and thin-bedded sandstone	65	
No. 16.	Bituminous shale	2 to	5
No. 17.	Coal No. 5	5	
No. 18.	Fire-clay	3	
No. 19.	Clay shale with ironstone	3	
No. 20.	Sandstone and shale	78	
No. 21.	Shale, partly bituminous	2	
No. 22.	Coal No. 4	2	6
No. 23.	Shale and thin-bedded sandstone	42	
No. 24.	Thin coal—local	0	4
No. 25.	Fire-clay	5	
No. 26.	Shale with ironstones in upper part	43	
No. 27.	Coal No. 3	3	
No. 28.	Sandstone and shale	19	
No. 29.	Bituminous shale	5	
No. 30.	Coal No. 2	4	
No. 31.	Argillaceous shale	20	
No. 32.	Thin-bedded sandstone and siliceous shale with thin coal	60	
No. 33.	Hearth sandstone	20	
No. 34.	Argillaceous shale	40	
No. 35.	Coal No. 1	1 ft. 8 in. to	3
No. 36.	Argillaceous and siliceous shale	70	
No. 37.	Conglomerate sandstone	110	
No. 38.	Bluish argillaceous shale—lower Carboniferous	15	
No. 39.	Thin coal—lower Carboniferous	0	4
No. 40.	Argillaceous shales—lower Carboniferous	10	
No. 41.	Covered space with sandstone—lower Carboniferous	60	
No. 42.	Chester limestone—lower Carboniferous	55	
No. 43.	Covered space	40	

No. 1, or "Battery-rock coal," is not worked in Gallatin county, and no exposure of the seam could be recognized with any degree of certainty. It is thought probable that the thin seam of coal-rash shown in the horizontal section of the disturbed strata in front of Shawneetown, and a thin seam, opened some years ago by Mr. Baker, on Sec. 36, T. 9, R. 9, west of Shawneetown, and near the eastern terminous of Gold Hill, may be that seam; but no reliable evidence was found to establish this conclusion. In the decomposing shales above the rash-coal in the river bank at Shawneetown a few fossils were seen, that are thought to be characteristic of much higher strata, as *Bellerophon carbonaria, B. per-carinatus, Productus longispinus* and *Spirifer cameratus;* but they crumbled to pieces on being removed from their matrix. If the actual horizon of this coal is above No. 1 in the vertical section, and near the horizon of No. 7, as its fossils and the associated limestone seem to indicate, it shows a remarkable thinning out of the intermediate strata, and a total absence of workable coal, for the Conglomerate cannot be more than one hundred and ten or one hundred and thirty feet below it provided that the latter rock is referable to the Battery-rock Con-

glomerate. I am aware that the coal seams thin out to the northward of "Gold Hill," but at the same time I believe that the associated strata increase, instead of diminish in thickness in that direction.

The opening to the thin coal west of Shawneetown (section 36) in "Gold Hill" was entirely filled with rubbish, and no good view could be had of it. The strata are all basseting to the north at an angle of 20° to 40°, which renders it almost impossible to work a coal from such an outcrop. Mr. Beck, who has been, I believe, interested in the mine, accompanied me to the locality, and he expressed the opinion that the seam was found to be two feet thick in the opening. Judging from what I could see, the coal is of an inferior quality, and resembles very much the coal in front of Shawneetown. The following section will show its position in the ridge, commencing from the high water of the Ohio river, which point was determined by the drift wood along the foot of the ridge:

	Feet.
Covered slope and soil	10
Buff sandstone	10
Sandy shale and flagstone	100
Blue, soft shale	2
Flag-sandstone	10
Gray and blue shale, with ironstone	40
Coal, mostly rash	2?
Covered	30
High water of the Ohio river	?
	204

The buff-colored massive sandstone near the top of this section forms a vertical wall in many places along the ridge; and, from this point, gradually descends to the east, so that where last seen in that direction, about a quarter of a mile distant, it is found to be only sixty feet above high-water, a rate of dip that would carry it to the water's edge in front of Shawneetown.

In Hardin county, below the mouth of the Saline river, and opposite the town of Caseyville, in Kentucky, the Conglomerate rises into a vertical wall known as the "Battery-rock," and forms here the western bank of the Ohio river. It is divided into two beds by a thin parting of shale and coal. The latter is very irregularly-bedded, and is not anywhere more than a few inches in thickness; and, though not considered persistent, it is seen at the mouth of Tradewater river, on the opposite side of the Ohio. My measurement of that portion of this rock seen above low water, taken with an Aneroid barometer, made the lower bed fifty and the upper sixty feet thick; and the space between low water and the coal, which is here referred to No. 1, one hundred and eighty feet.

The "Battery-rock coal," as it is called, is the equivalent of the seam worked by Bell, Cook and Casey, on Tradewater river, in Kentucky, and also the equivalent of the Ice-house seam, or No. 3 of Owen's section; and likewise it is believed to be synchronous with the Cannelton seam in Indiana and the Hawsville seam in Kentucky, on the eastern margin of the basin.

On Tradewater river this coal ranges from two and a half to five feet in thickness; but back of Caseyville, and on Shotwell's property, in Union county, Kentucky, it averages only from eighteen to twenty-two inches. At Battery-rock also it is a thin seam, rarely reaching twenty-two inches. At every locality where this coal was seen it has from one to four inches of coal-rash at the bottom, above which the coal is highly bituminous, and is held in excellent repute by steamboat men on the Ohio river.

Battery-rock coal has been opened in three or four places along the river front, but it is too thin and too subject to horsebacks to admit of extensive mining operations. The gray-colored roof shales contain a few fossil plants belonging to the genera *Lepidodendron* and *Stigmaria, Pecopteris lonchitica* and *Neuropteris hirsuta*, but they are too friable to be preserved. No fossil shells were found, though *Lingula umbonata* is common in the roof shales of this coal on the opposite side of the Ohio, and on Tradewater river.

The following section obtained along the river, commencing at Battery-rock ferry and extending up stream nearly to the mouth of Saline river, will serve to show the position of No. 1 coal and the Conglomerate, together with the change of level at the various places given.

Section at Battery-rock ferry:

	Ft.	In.
Soil, clay drift, and covered space	50	0
Massive gray sandstone—hearth stone	20	0
Shale, mostly siliceous	40	0
Coal, No. 1	1 ft. 4 in. to 1	10
Siliceous shales, passing down into flagstone	70	0
Conglomerate, upper member	60	0
Thin coal, wedged in	0	4
Conglomerate, lower member	50	0
Low-water of the Ohio	0	0
	292	2

Three-quarters of a mile above the ferry, in a northwest direction, N. 40° W., the top of the Conglomerate is just at the water's edge, while three-quarters of a mile again above this, and half a mile below Sellers' paper mill, the base is eighty feet above the river, where the following section was taken:

	Ft.	In.
Conglomerate sandstone, forming a cliff	35	
(Shows 70 feet thick at Sellers' paper mill, where large masses have broken off and tumbled to the plain below; one block, larger and more conspicuous than the others, has received the name of "Stack rock.")		
Blue argillaceous shales, with numerous bands of carbonate of iron, comprising altogether from one to one and a half feet of good iron ore; one band, four to six inches thick, contains a number of imperfect casts of fossil shells: *Athyris subtilita*, *Macrocheilus primigenius?* *Spirifer cameratus?* small *Bellerophon*, *Nucula*, and a fragment of a *Cyathophylloid* coral	14	
Coal, reported from a bore	0	8
Sandy and argillaceous shale	7	0
Covered, to low-water	58	
	114	8

Half a mile above Sellers' paper mill, in a direction N. 47° W., coal No. 1 is ninety-five feet above low-water, and may be seen above and below the mouth of Coal creek; and one-half mile above the last locality, in a direction N. 61° W., it is one hundred and twenty-two feet above low-water, at T. Rees & Co.'s mines. The general dip of the strata is north, about 20° east, and the irregularity in the elevation of the Conglomerate and coal along the river bluff is mainly due to the position of the exposure being on one or the other side of the strike line, and furnishes no evidence of more than one seam of coal above the Conglomerate at the localities here cited.*

Coal No. 2, or "four-foot seam," as it is generally called here, is the next workable coal in the ascending order; it has been reached by a shaft on the Saline river, in Gallatin county, at the Independent Coal Company's mines, where, as well as in Union county, Kentucky, it is uniformly four feet thick, and of fine quality for steam and manufacturing purposes; the color brownish-black; it has a laminated or splinty structure, with carbonaceous partings, and appears to be remarkably free from sulphur. The space between Nos. 1 and 2 is about one hundred and forty (140) feet, and contains, on the Kentucky side of the Ohio, two or more thin seams of coal, but no bed that is thick enough to be worked.

The Independent Coal Company work both No. 2 and No. 3 from the one shaft, which commences just below No. 4, or "Well coal," and is one hundred and fourteen feet deep. The following section, made from this shaft, will exhibit the character of the strata passed through:

*Since this report was written, I visited this locality in company with G. E. Sellers, Esq., of Bowlesville, and traced the bluffs carefully from Battery-rock to the mouth of the Saline. From this examination I am confident there are two seams of coal above the Battery-rock coal outcropping between these points, which either represent coals Nos. 2 and 3 of the general section given on page 172, volume 1, or else they are local seams that have not been seen elsewhere. A. H. W.

Section of the Independent Coal Company's shaft, Sec. 35, T. 10, R. 9; coal dips N. 10°, E. about 3°:

	Ft.	In.
Soil and clay	10	
Sandstone	6	
Blue argillaceous shale	8	
Siliceous shale, with ironstone	18	
Coal, thin	0	4
Fire-clay	5	
Siliceous shale, with ironstone	40	
Gray, sheety sandstone, with bitumen	3	
Coal, No. 3	3	
Fire-clay	0	6
Sandstone	8	
Siliceous shale, with ironstone	10	0
Black, bituminous, hard slate	5	
Coal, No. 2	4	
	121	4

The space between Nos. 2 and 3 coal is only twenty-four feet in this shaft, but it is nearly double this depth at Shotwell's mines in Kentucky.

Coal No. 3.—Is of fair quality, but it contains some sulphur, and its reputation in the market is not quite so good as that of the seam below it.

In drifting or running an entry to the west in this shaft after coal No. 3, a serious fault was encountered; the coal was abruptly terminated by a solid wall of sandstone, and was not recovered up to the time of my visit. No 2 was being worked in the same direction, with a view to learn if it also is affected by the fault, and to endeavor to discover its nature. My opinion is that the coal will be found above the level of the entry, as the sandstone which occupies its place appears to be the same as the rock which underlies this seam.

A few hundred yards above the Independent Coal Company's shaft, No. 3 outcrops in the bank of Saline river, and No. 2 was reached there by a shaft thirteen feet below the bed of the stream. The old works at this locality have long since been abandoned, and the openings are filled up with rubbish, brought by the overflows of the Saline river.

Near the foot of the hills, a few hundred yards north of the above mines, and on land belonging to the same company, No. 4 coal was struck by sinking a well, and was subsequently bored through at the company's office. It is two and a half feet thick and lies between ninety and one hundred feet above No. 3, as proved by the bore at the office and by the section of the shaft above given.

Nos. 5, 6 and 7 are seen in their regular sequence outcropping in the hill on the Independent Company's property north of the shaft,

and on the above section No. 5 is from eighty-eight to one hundred feet above No. 4. This space is filled with thin-bedded sandstone and shales, with more or less iron ore. It is generally a little less than five feet thick, though usually called in this county and Union county, Kentucky, the "five-foot coal." The color is a dull black, and on the Saline river it is often marked by a beautiful play of colors, giving rise to the appellation of "peacock coal." It contains a large percentage of fixed carbon, and but for the sulphur bands which are mixed with it, would prove the very best coal for steam and manufacturing purposes in the basin. It has been extensively mined for the supply of steamboats, both along the Ohio river in Kentucky, and on the Saline river in this county, but from injudicious mining or other causes, it has fallen into bad repute, and Nos. 2 and 3 have for the time being supplanted it in public favor. The poor reputation which has befallen this seam I have no doubt may be traced to the coal not having been properly screened, and not separating it from the sulphur bands with which it is contaminated.

No. 5 has been opened and worked at many places on sections 27, 35, 21 and 9, township 10, range 9, and was reached in a bore on Eagle creek, on section 13, township 10, range 8, on the south side of the Saline. It has been worked by a shallow shaft to furnish fuel for Ross' mill at Equality, and can be seen in the bed of the Saline river at the latter place, when the river is extremely low. About two miles southwest of Equality, on the eastern edge of Saline county, it is worked by drifting into the hill, and furnishes the fuel to evaporate the brine of the salt works owned by Messrs. Temple & Castle.

The black bituminous roof shales of No. 5 coal contain, usually, an abundance of beautiful, compressed shells, completely gilt with brilliant yellow pyrites of iron. This shale, with its fossil treasures, rapidly decomposes when exposed to the weather, and can be preserved only when obtained fresh from the mines, and properly cared for. When I visited the mines on the Saline river for the purpose of making this report, no fresh shale was being brought from the mines, and the old would not bear handling, especially when it contained pyritiferous fossils, but would crumble into fragments. The most abundant shells are *Aviculopecten rectilaterarius*, *Productus longispinus*, *Nautilus decoratus*, *Solenomya soleniformis*, *Nucula ventricosa*, *Orthoceras Rushensis*, *Pleurotomaria Grayvillensis*, *Bellerophon carbonarius*, and *Chonetes mesoloba*.

Coal No. 6.—Lies from sixty to seventy feet above No. 5, is from two to three feet thick, and was formerly worked on the Saline river at Tolbert's mines, and on the Curlew mines' property, near Caseyville, in Kentucky; the quality is said to be very good, but the old openings have long since been filled up, and there was no chance of collecting specimens or of seeing the solid coal. The outcrop of this seam was seen at the localities above cited for No. 5. In the hill at Equality it is of very poor quality, and is not over fifteen to twenty inches thick. At this latter locality it is underlaid by a massive sandstone, and the latter is underlaid by gray and buff siliceous shales, with ironstones down to the black shales overlying No. 5 coal.

No. 7 Coal.—This seam lies from one hundred to one hundred and twenty feet above No. 5, and is at some localities from eight to nine feet thick. Its color is a jet black, it breaks into cubes and has numerous cross fractures lined with salts of calcium. The bed is divided into two seams by a parting of fire-clay from half an inch to four inches or more in thickness, and near the top of the seam there is a very thin sulphur band (bi-sulphide of iron,) which seldom exceeds one-eighth of an inch in thickness. That portion of the bed above the fire-clay parting is generally considered the best, and in Union county, Kentucky, at the Curlew mines, this part of the seam is assimilated to a cannel coal. No. 7 has been opened and mined on the Independent Coal Company's land in connection with No. 5; also, at Tolbert's, in section 21, township 10, range 9, and at Boswell's, half a mile north of the former mines. At these localities the bed is from three to four feet thick, the clay parting is two inches thick, and is eight inches from the bottom of the bed. The following section was taken at Boswell's mine, section 26, township 10, range 9:

	Ft.	In.		Ft.	In.
Covered slope	0				
Thick-bedded sandstone	9				
Flagstones	6				
Siliceous shale	4				
Gray limestone	3				
Black shale	2				
Coal	2	4			
Fire-clay	0	2	} Coal No. 7	3	2
Coal	0	8			
Covered	0				
	27	2			

The direction of the dip is north 10° east, at the rate of about three inches to the yard. In the decomposing roof shale, at the mouth of this mine, *Aviculopecten rectilaterarius* and *Cardinia? fragilis* were seen, but they were too friable to bear handling. As the

strata rise, from Boswell's, in the direction of the Saline river, No. 7 is found high up in the ridge on the Independent Coal Company's property, and No. 5 outcrops near the base. On the property of Mr. Hines, section 13, township 10, range 8, on Eagle creek, No. 7 is seen outcropping in the bed of the creek, but following to the south some two hundred yards, on the rise of the strata, it is found thirty-three feet above the creek, where it has been mined to a limited extent by Mr. Hines, for fuel to run his saw-mill. At these outcrops the overlying limestone could not be seen; however, Mr. Hines informed me that it made its appearance at the end of his drift, where I was unable to see it for the want of lights, but I fully satisfied myself of the identity of the bed by the clay parting and sulphur band, the former ten inches from the bottom, and the latter a few inches below the top. Mr. Hines informed me that at the creek he bored forty feet below this seam, and passed through a lower coal that was two and a half feet thick; the latter is in the position of No. 6. Along Eagle creek, westward to the county line, No. 7 has been reached in wells, and can be traced in a northeast direction to Bowlsville. At Bowlsville, on sections 8 and 9, township 10, range 9, in the range called Coal Hill, Nos. 7, 6 and 5 outcrop. Coal No. 7 outcrops on both sides of Coal Hill, and has been opened in a number of places at various elevations above high water of the Ohio river of 1848, as determined by E. F. Lee, Civil Engineer.

The following descriptions of these openings are given to show that no reliance can be placed on the local dip of a coal seam as a means of identifying the beds over any great extent of country.

At the Mason entry into No. 7 coal, on the north part of section 9, the seam is ninety-eight feet above high-water of the Ohio, is three feet ten inches thick, has a clay parting of two inches, about one foot from the bottom, and a thin band of sulphur near the top. Above the seam is:

	Ft.	In.
Shale	1	6
Dark limestone	4	
Black bituminous shale		8
Coal, No. 7	3	10
Fire-clay		?

One hundred yards to the northeast, near the line between sections 9 and 4, seventy-eight feet above high water, there is another opening showing a dip of the strata, on this part of Coal Hill, to the northeast at the rate of twenty feet in four hundred of horizontal distance.

Section at the Vaughan entry:

	Ft	In
Shale		4
Limestone	5	
Shale		6
Coal, No. 7	4	
Fire-clay		

The coal at this entry is one hundred and forty-six feet above high water, showing a rise to the southwest of forty-eight feet in nineteen hundred and fifty.

Section at the Forrester entry:

	Ft.	In.
Limestone	2	
Shale		6
Coal, No. 7	4	
Fire-clay		?

At the Forrester entry, near the middle of section 8, the elevation is one hundred and thirty-nine feet above high water, showing a difference of only seven feet in half a mile, which apparently indicates that it is nearly on the strike of the formations on this part of the hill. The limestone here has diminished to two feet.

At the Barlow entry, near the middle of the southeast quarter of section 8, the coal is eighty-four feet above high-water, which shows a dip S. 10° E., of fifty-five feet in a horizontal distance of fourteen hundred and fifty feet.

Section at A. Barlow's entry:

	Ft.	In.
Shale		6
Coal, No. 7	4	
Fire-clay		?

At this entry, on the north side of section 8, the coal is one hundred and twenty-eight feet above high water, and the limestone is absent, being replaced by shales. The coal is four feet thick, and has the sulphur band and clay parting.

On the northwest quarter of the same section, the limestone is in place again, and the coal is one hundred and two feet above high-water, showing a southwest dip of twenty-six feet in one thousand one hundred. On the northeast quarter of section 7, at the Jones entry on Coal creek, No. 7 coal is at high-water mark, showing a dip of 6° or 7° to the west, and a fall of one hundred and two feet from the last entry, in rather less than half a mile.

At the town of Equality on the western boundary of the county, Nos. 5, 6 and 7 occur in their regular sequence, as seen at Bowlsville, in the Independent Company's mines, and other places. At these localities all three beds have been opened, and more or less mined, to supply the home market.

No. 7 is usually four feet thick in the many openings where it is mined in the streets, and around the town. The miners report the dip here to be in every direction; that is, that no two openings show the same pitch, and that they can hardly pronounce upon any decided dip. The identity of the bed is proved by the presence of the limestone roof, sulphur band, and clay parting. The following section shows the strata in the hill at Equality:

	Feet.	In
Soil and Drift	25	
Sandstone	15	
Siliceous shale	5	
Limestone	4	6
Shale		6
Coal No. 7—with clay parting	4	
Fire-clay		6
Shale, and massive sandstone	45	
Coal No. 6	1	6
Sandy flag-stones, and lightblue shale with ironstones	68	
Black shale	2	
Coal No. 5, in shaft at Ross's mill	5	
	176	0

About two miles, a little west of north, from Equality, No. 7 coal was seen at low-water of the North Fork of the Saline river, making a descent in that direction of nearly one hundred feet; it was traced along the bank of the river for more than half a mile before it disappeared under the low lands to the northward. Coal was first mined in this county at the above locality, and was hauled at an early day to Equality over bad roads, before the fact was known that every family in the town could, if they so desired it, have a coal mine in their own yard. North of this locality no workable coal has been found in the county.

At Christmasville, eight or nine miles north of Equality, in the northwestern part of the county, and where the bridge crosses the North Fork of the Saline river on the road from Equality to Carmi, there is exposed in the bank of the river a few feet of argillaceous and siliceous shales, containing a thin fossiliferous band of calcareous sandstone, as shown in this section:

	Feet,	In.
Soil to the street of the village	10	
Yellow argillaceous shale, with ironstones	5	
Ferruginous calcareous sandstone, with casts of fossil shells		3
Schistose, gray sandstone		6
Hard sandstone		8
Schistose sandstone	1	
Bluish argillaceous shale, some coaly matter	3	
Low-water, North Fork of the Saline		
	20	5

The fossils found in the three-inch band of the above section are: *Aviculopecten occidentalis, Edmondia reniformis, Athyris subtilita, Pterinea gibbosa, Myalina Swallovi, M. meliniformis, Eumicrotis Hawni, Macrocheilus primigenius, Schizodus Sp? Turritella? Stephensana, Bellerophon nodocarinatus, Allorisma Sp? Pleurophorus subcostatus,* etc.

About three and a half miles north of Shawneetown the following section was obtained at "Roundpond hill," which forms a part of the ridge or range of hills reaching northward to New Haven, on the Little Wabash river:

	Ft.	In.
Soil and Drift	10	
Shale	5	
Limestone—"Carthage rock?"	6	8
Black bituminous shale	1	
Coal, No. 9		6
Shale, in covered space	20	
Reddish schistose sandstone, weathers rough	15	
Argillaceous and siliceous shale	30	
Black sheety shale	2	
Calcareous shales, with nearly the same species of fossils as are found at Grayville, Ill., and Rush creek, Posey county, Indiana: *Leda bella-striata, Nucula ventricosa, Bellerophon carbonarius, B. Montfortianus, B. percarinatus, Macrocheilus primigenius, Myalina subquadrata, Pleurotomaria sphærulata, P. Grayvillensis,* and *Schizodus Sp.?*		6
Coal, No. 8		3
Fire-clay		6
Siliceous shale	6	
Covered to low-water of the pond	10	
	108	9

The limestone at the top of this section is generally poor in fossils, but it contains at this place large crinoid stems and a few shells; among which were recognized *Productus longispinus* and *Athyris subtilita.* The rock is a hard gray limestone which weathers roughly and readily splits up into irregular slabs, with reddish-brown stains of oxide of iron on the weathered surface. It occupies in the geological horizon the position of a similar limestone which is seen opposite Wabash Island, on the east side of the Ohio river, in Union county, Kentucky, and at Carthage, one mile below Uniontown; it has been designated by OWEN, in the Kentucky report, as the "Carthage Limestone."

At New Haven, on the Little Wabash river, this limestone is seen in the bank of the river, where the following section was obtained:

	Ft.	In.
Covered space to street in New Haven	10	
Limestone—"Carthage"	4 to	5
Black sheety shale	1	6
Thin coal		3
Fire-clay and shale	3	

	Ft.	In.
Reddish-gray sandstone	4	
Gray micaceous sandstone	4	
Siliceous shale	5	
Low-water	?	
	32	6

The limestone has here, also, a paucity of fossils; *Productus longispinus* and large stems of encrinites only were seen. The thin-bedded sandstone of this section extends across the river; and though forming a serious barrier to navigation, furnishes a good foundation for a mill dam, which supplies a valuable and never-failing power for manufacturing flour and for other mechanical uses.

Quaternary Formation.

Drift and Loess.—The Drift deposit occupies the hills and ridges all over the county, resting unconformably on the Carboniferous rocks, and is from ten to twenty feet thick; composed chiefly of yellow, more or less plastic clay, containing small rounded gravel with occasionally a granite or trappean bowlder. The largest erratic rock seen in the county is a granite bowlder, about one foot broad and one and a half feet long, lying by the side of the road from Shawneetown to Equality. No fossils, scratches or groove-marks were observed in this transported material.

Loess.—The Loess is from ten to forty feet thick, and occupies the top of the ridges along the road from Shawneetown to New Haven. This deposit is usually characterized by a whitish-gray calcareous clay or marl, that contains an abundance of land and fresh-water shells, belonging to species now living in this State, with the single exception of *Helicina occulta*, Say, which has not, I believe, been found living north of Arkansas.

Economical Geology.

Besides the many beds of mineral fuel so extensively spread over this county, and already discussed in a general way, there is an inexhaustible reservoir of salt brine underlaying its surface.

The brine springs of Gallatin county were worked at an early date, under the management of army officers, at a time when the general government reserved from sale all lands containing salt springs. Though there are outbreaks of saline springs at various places in

this county, and though the water-courses, creeks and their branches, and the river, all contain more or less salt, from which circumstance arose the name of Saline river for the principal water-course which runs through the southern part of the county, yet, though thousands of dollars have been spent and fortunes lost in the search, there has never been any profitable brine found in the county, except on the north side of Saline river, about one mile south of the town of Equality, on section 19, township 9, range 8, and near what is known as the "Half-moon," a semi-circular excavation as its name implies, that was made by the buffalo and other wild animals that congregated in vast herds to lick the muriatiferous earth. The diameter of this remarkable excavation is about one hundred yards, and the depth varies from six to eight feet. The surface level is from ten to twelve feet below high-water mark, and the soil is a river or lacustrine deposit, of fine, whitish, clay loam, containing in spots many fresh-water shells belonging to species now living. Beneath this alluvial soil, the excavation at the "Half-moon" shows a yellowish clay, mixed with gravel and sand, which belongs to the age of the Drift. This locality must have been, likewise, a favorite resort for the *Mammoth* and *Mastodon*, huge monsters that roamed in immense numbers over the country when the present site of the salt works was an alluring swamp, for there has been found, from time to time, resting on this Drift in the Half-moon, a great many bones belonging to these extinct animals. While examining this locality several small fragments of the enameled crowns of Mammoths' teeth were picked up, the less enduring parts of the structure having mouldered into dust. The liability of fossilbones to crumble and fall to pieces immediately after their exposure to air, has been a serious drawback to their collection, and many valuable specimens have, in consequence, been lost to science for want of knowing how to secure their preservation.

It may not, therefore, be out of place here to state to the citizens who may be interested in the promotion of geological science that bits of paper should be glued over the specimen as fast as the parts are exposed by the removal of the earth, as in this manner highly interesting bones may be removed with safety from their matrix of earth, which, without this precaution, would drop into useless fragments. A further preservation may be secured by subsequently boiling the bones or teeth in a weak solution of glue, which will supply the lost animal matter, and cement the earthy particles firmly together.

Teeth of the Mastodon were found last summer close to the water's edge in front of Shawneetown. I subsequently visited the locality, and saw that the bones were embedded in a shallow deposit of bluish clay, resting upon yellow clay and gravel, which corresponds in geological time with the bone beds at the Half-moon.

While the Saline salt works were under the control of the General Government, the strong brine on the Kanawha had not been discovered; consequently an immense district of country had to receive its supply of salt from these works.

The brine then used required from one hundred and twenty-five to two hundred and eighty gallons to make one bushel (50 pounds) of salt. Between one and two hundred hands were employed, and the yield of the works has been estimated at eighty to one hundred bushels of salt *per diem*. So greatly was the demand beyond the power of the works to supply, that, as I am informed, applicants for salt coming from Tennessee, Kentucky, Indiana, and other parts of the country, were regularly ticketed, and could be supplied only by awaiting their proper turn. No one thought of stopping for the drainage of the salt crystals, but all were glad to receive it as soon as it was cool enough to handle, and to start off with their pack-horses loaded with sacks of salt, from which the water trickled as they journeyed home. The fuel required to evaporate such an immense amount of water stripped the country of timber for miles around, and the expedient was resorted to of conveying the brine for miles in wooden pipes, to the rapidly receding forest. The idea never once occurred to these early salt-makers that the five-foot bed of coal through which their wells generally were dug, could furnish, ready at hand, a never-failing supply of the best and cheapest fuel.

After the establishment of salt works on the Kanawha river, in Virginia, and at Pomeroy, in Ohio, the Saline mines could no longer profitably compete in the market; therefore, the works were finally abandoned, and every vestige of former prosperity was effaced by the ravaging hand of time, and all efforts to revive the manufacture of salt on the Saline river, until recently, proved a ruinous loss to the parties engaged in it.

About the year 1850 the Saline property was purchased by Messrs. Temple & Castles, the present proprietors, who soon thereafter commenced to bore a new and deeper well. The first brine was struck in this well at 108 feet; at 600 feet a cavity with some gravel was passed, and at 1,100 feet the bore stopped in brine which marks 7.2° of Baume's saltometer, and requires only seventy-five gallons to make a bushel (fifty pounds) of salt, which is fully as strong as the brine

of the Kanawha. The well is not artesian, but the brine comes within a few feet of the surface and is pumped. Messrs. Temple & Castles were not present when this well was bored, and no further record was made of the rocks passed through, except noting a five-foot bed of coal at forty feet below the surface. This coal outcrops in the river at Equality, also in the hills one mile to the west; and being referable to coal No. 5 of the general section, it serves to establish a starting point, by means of which the horizon of the saline reservoir in the rocks below may be determined with a tolerable degree of accuracy. The first brine, at 108 feet, is probably in the shales overlying the sandstone above coal No. 4; the cavity with gravel at 600 feet is about the place of the shale dividing the Conglomerate in two members, as seen at the Battery Rock and elsewhere, while the 1,100 feet may stop in the Chester limestone, which therefore forms the base of the muriatiferous rocks in this part of the State. It is my opinion, also, that the strong brine has its main lodgment in this limestone—finding its way upward by hydrostatic pressure through permeable strata—and that it is more or less reduced in strength by the fresh water which it encounters on the way.

At the "Old Nigger Works," on Sec. 27, T. 9, R. 8, the saline spring, as before mentioned, issues out from near the junction of the Chester sandstone and limestone, marking only 4° of Beame—a diminution in strength that may be accounted for on the hypothesis above stated, from the fact that several springs still less brackish break out a few feet higher up the bank, the latter tending to show the liability of the brine to mix with fresh water as it approaches nearer to the surface. The main spring emits a distinct odor of sulphuretted hydrogen, and it may possess important therapeutic properties.

Around these brine springs fragments of Indian pottery are found in great plenty, some of which are ornamented with bands of vertical lines, arranged with considerable taste. To judge by the curvature of some of these fragments, the vessels to which they belonged were not less than four or five feet in diameter, a size truly astonishing, made, as they appear to have been, of common clay and fragments of fresh-water shells. From the large size of these pots, it is natural to infer that they were used as evaporating pans by a prehistoric race of salt manufacturers. The rapid destruction of iron evaporating pans, together with their cost, is a heavy tax to the modern salt-maker: therefore, if a more durable and less expensive pan could be formed of some kind of clay, it would prove a large

saving in the cost of production of salt; and it would be strange indeed should we be able to hit upon a valuable idea from the lost arts of the Mound-builders.

Messrs. Temple & Castles recommenced the manufacture of salt at the "Saline" about the year 1856, from the brine of their new well, which was analyzed for them by Prof. Geo. Cook, of New York.

I was kindly permitted to take a copy of this analysis for publication:

Specific gravity, 1.047. 100 parts of brine contains 7.2 per cent. of dry matter.

The brine contains in 100 parts:		The resulting salt contains in 100 parts:
Chloride of sodium—common salt	6.2431 ——	86.77
Chloride of calcium	.3996 ——	5.55
Chloride of magnesium	.2124 ——	2.95
Sulphate of lime	.3448 ——	4.79
	7.1999 ——	97.06
Water	92.8000	
	99.9999	

Traces of bromide of sodium, chloride of potassium, iodide of sodium, and chloride of iron.

The "Saline" brine is of the same strength as the Kanawha, and requires seventy-five gallons to make a bushel (fifty pounds) of salt. I have no analysis of the latter brine for comparison, but I have been informed that it contains more chloride of calcium and less sulphate of lime. The sulphate of lime in the "Saline" brine is a source of much annoyance, and large sums of money were expended by Messrs. Temple & Castles before their efforts to get rid of it were crowned with success. They are now, however, manufacturing an article of salt that ranks equal to the Kanawha in purity and antiseptic properties.

When I first visited the "Saline" in the summer of 1867, the average product of the works was from thirty to forty barrels of salt *per diem;* since then it has been increased to double that quantity. There is a system of manipulations connected with the operation of making good salt from this brine that belongs exclusively to the company. It has been established by an outlay of large sums of money spent in experimenting, by much anxiety, and with failure after failure. Taking this property, with the previous disastrous failures staring them in the face, Messrs. Temple & Castles have built up a successful manufacture which is creditable to themselves as enterprising gentlemen, and of incalculable importance to the county. It is therefore hoped that they will reap, as they deserve, a rich reward for their meritorious labor.

They have adopted the plan of graduation houses, as in parts of Germany and France, for concentrating the natural brine before it

goes into the evaporating pans. These houses consist here of two frames from two hundred to two hundred and fifty feet long, and forty to forty-five feet high; the longest of the two is divided into two parts, so that the brine may be divided into three grades. Thorn bushes are spread on parallel horizontal frames, arranged from top to bottom of the houses, so that the brine, which is pumped and forced to the top of the frames, may descend in a shower through the whole series. After passing the brine, successively, in this manner, over the three houses, the graduation in favorable weather carries it from 7° 2 to 9° 5. From the third house, or after the third graduation, the brine is conveyed to the pans, where the evaporation is completed over the fire. The fuel used for this purpose is stone coal, mined on the company's land, one mile west of the works, from No. 5 coal, which is here of excellent quality and almost entirely free from sulphur. It is brought to the works on a tramroad, and about three hundred bushels are consumed in the manufacture of thirty-five barrels of salt.

Iron Ore.—More or less clay ironstone is found with the shales of the coal throughout the county, but at no one locality in quantity sufficient to make it of commercial value.

Building Stone.—There is an abundance of good freestone, suitable for building purposes, all along the Gold-hill axis, along Eagle creek and its tributaries in the south, at Equality, and in the river bank at New Haven. Some members of the Chester limestone might answer for building stone, but as a general rule it will not endure where unprotected from rain and frost. A black septaria limestone, belonging to the Coal Measures, which is exposed at low-water in the river bank at Shawneetown, is susceptible of a remarkably fine polish, and being chequered with veins of white calc-spar, it presents a beautiful appearance, but can only be obtained in small pieces, owing to its almost inaccessible position and extreme brittleness.

Quicklime.—The Chester limestone, in the Gold-hill ridge, is a rich source of excellent lime. The limestone over No. 7 coal, and the Carthage limestone in Round-pond hill, and at New Haven, will make good lime also, though not generally so pure as the former.

Potters' Clay.—The fire-clays forming the bottom of the coal beds in this county that have been tried do not, I am told, make a good potters' clay, but there is reason to believe that the search has not been thorough, and that some of the clays on the Saline river will be found suited for manufacturing the ordinary stoneware of commerce. Plastic clay for bricks can be had in most places over the county.

Soil and Agriculture.—The soil in the eastern part of the county is principally derived from sediments deposited by the inundations of the Ohio river, and by washings from the Quaternary and Carboniferous strata of the high ground. It is in most places a sandy loam, rich in elements of fertility, and is especially adapted to growing Indian corn.

The bottom lands along the main Saline river and its main tributary, the North Fork, though partaking, in part, of the character of the Ohio river bottom land, contains a large proportion of a light-colored fine sedimentary clay loam, which is compact, and tenacious of water, and therefore difficult to bring into good cultivation. If properly worked, it would bring good crops of grain, provided the season is favorable; but a very dry or a very wet season is peculiarly injurious to crops on this soil. This latter variety of soil has been derived principally from the argillaceous shales of the Coal Measures, and its general want of fertility is owing to its physical condition, and not to any deficiency in the proximate constituents of plant-food. Underdrainage would prove an efficient means of bringing land of this description into a high state of cultivation. The soil of the yellowish, gravelly, clay land in the northwest part of the county, is derived from the Drift, and is formed of the *debris* of the rocks rasped and ground to fragments by ancient rivers of ice, which moved over the northern part of this continent with snail-like pace during that period of the earth's history known as the *Glacial epoch.* This third variety of land will grow all the cereals, grasses and clover well, but it is better adapted for small grain than for corn, and is particularly good for clover.

On the ridges between Shawneetown and the Little Wabash river there is a calcareous clay soil, derived from the Loess, which, in an agricultural point of view, ranks next to the sandy loam of the river bottom lands.

Tobacco, sorghum, and some cotton are cultivated in this county; but the principal crops are the cereals and clover. Apples, peaches and pears grow remarkably well, and the taste for orchard-culture is reported to be constantly on the increase. As yet but little attention has been paid to the cultivation of the grape. Messrs. Temple & Castles, at the salt works, are cultivating a young vineyard containing about eight hundred vines, of which the greater number are Concord, with some Catawba and Delaware, together with a few of the more recent varieties, such as Norton's Virginia, Ionia, Israella, Ives' seedling, and Diana. The Concord and Catawba succeed remarkably well; the other varieties have not yet been sufficiently

tested to be pronounced upon with certainty. While enjoying the kind hospitality of these gentlemen I had an opportunity to make a substantial test of the wine which they made from their vineyard, and feel satisfied that it will compare favorably with the native wines of the professional wine-maker.

Timber.—This county is abundantly supplied with all the usual varieties of trees found in this latitude. On the river bottoms, particularly in the eastern and northern part of the county, large black walnut, white, red and black oaks, hickory, and poplar predominate. On the high lands, in other parts of the county, oak and hickory are the principal timber; on the flat, wet land, post-oak prevails; and along some of the sloughs and ponds there is a fine growth of large cypress.

CHAPTER XXXV.

SALINE COUNTY.

Saline county is bounded on the north by Hamilton county, on the east by Gallatin, on the south by Pope, and on the west by Williamson.

In shape it is a parallelogram, and embraces about eleven townships; therefore, it has an area of about three hundred and ninety-six square miles.

Its topography is marked by the Gold Hill axis, which, beyond the boundary of Gallatin county, forms a conspicuous elevation in the southeastern part of this county, where it is known as "Prospect Hill." The height of this hill, as determined by barometrical measurement, is five hundred and ninety feet above the low-water of the Saline river. Though the Gold Hill axis disappears beneath the lowlands to the west of this hill, it is again seen as a conspicuous ridge of massive Conglomerate sandstone in the southwestern corner of the county, near the village of Stone Fort.

Viewed from the summit of Prospect Hill, the northern, middle and western part of this county appears to be perfectly level, but it is nevertheless much broken by hills and ridges, that range in elevation from ten to eighty feet above the high-water mark of the streams. However, a large portion of the county is level, and much of the land may be termed "wet," with here and there a not inconsiderable swamp. Harrisburg, the county town, is situated nearly in the geographical center of the county, and is built on a hill fifty to sixty feet high, formerly known as "Crusoe's Island," from the fact that it is entirely surrounded by bottom land which is subject to inundation during periods of great freshets. The approaches to the town are consequently made by levees. Nothwithstanding the apparently unfavorable situation, Harrisburg is a thriving town, and

is looked upon as one of the healthiest localities in Southern Illinois. The Vincennes and Cairo railway runs through this place, and makes it a point of considerable commercial importance. The principal water-course is the Saline river, which, with its tributaries, the South Fork and Little Saline, drain the southern, while the other two main tributaries, the North Fork and Middle Fork, drain the remainder of the county. These streams, as well as the smaller tributaries, have generally low banks, which are occasionally overflowed, at which times the water spreads over an extensive area of what is termed "bottom land."

Geological Formations.

The geological formations of this county are the Chester limestone and sandstones forming the upper part of the lower Carboniferous series, the Millstone-grit and lower Coal Measures, and the Drift or glacial deposits of the Quaternary or Post-Tertiary epoch.

Chester Group.—The rocks belonging to this group are seen on the north side of a ridge, in the southeastern part of the county, where they have been brought to the surface by the Gold Hill axis, and basset at a high angle to the north. The following section was taken at Prospect Hill, which is supposed to be the highest point on this ridge, and it will serve to show the relative position of the Millstone-grit with reference to the Chester group:

Section taken at Prospect Hill, on section 10?, township 10, range 7; average dip of strata 10° south:

	Feet.
Millstone-grit, a pebbly sandstone	160
Covered space, sandstone ? belonging to the Chester group	120
Archimedes limestone	2
Green marly shale and covered space	20
Gray limestone, "cave rock."	25
Covered space	120
Quartzose sandstone	20
Cherty limestone	30
Covered, sandstone?	20
Chester group	357?
	517

It was found impossible to determine with accuracy the thickness of the members under the Millstone-grit at the place where the above section was obtained, or in fact at any other locality along the line of disturbance in this county, on account of the tumbling masses of rock which lie strewed over the side of the mountain in such a manner as to admit of only an occasional glimpse of what exists beneath them; however, I believe that this section will convey a

pretty accurate idea of the sequence of the strata, and gives the total thickness of the exposed rocks of the Chester group, which cannot fall far short of three hundred and fifty-seven feet. Neither in the lower members of the group, nor in the gray limestone containing the "Cave," could any trace of fossils be found, but in the band of limestone exposed above the green marly shales, a fragment of *Archimedes* was found associated with entrochites. There is at Prospect Hill, in the limestone marked "Cave rock" in the above section, a subterranean cavern, which has acquired considerable local notoriety. Accompanied by Mr. Temple, one of the proprietors of the salt works (to whom I am under many obligations for acts of kindness), I undertook to explore this cave, but we forgot to supply ourselves with candles before leaving the salt works, therefore we had to undertake the task with a glass coal oil lamp, which was procured from a farm house close by, but with a light so liable to accident a partial examination was all that it was deemed prudent to make. The entrance is through a hole not more than two feet high, by three feet broad, down which the descent is rather abrupt to the bottom of the cave, where we found ourselves in a narrow, tortuous gallery, averaging from three to five feet in width and twenty feet in height. We went along the main gallery and a number of its branches and cut-offs, until it was supposed that we had penetrated at least a quarter of a mile beyond the entrance, still we saw no end nor any appearance that seemed to indicate that the exploration might not be continued much farther, yet it was thought advisable to return on account of the danger to be encountered, should we have the misfortune to break the lamp, for notwithstanding every branch or turn that was passed has been marked by some thoughtful explorer with the figure of an arrow scratched on the limestone wall to indicate the direction to be taken in returning, nevertheless this unfailing guide would be of no avail amidst the intense darkness of subterranean passages. The walls and roof were covered with moisture, but the floor was quite dry. It is said that the cave usually contains a spring of cool sulphur water, and we hoped to obtain from it a refreshing drink, but no water was seen along our route; the bed of the sulphur spring pointed out by Mr. Temple was now dry, probably from the effect of the severe drouth which had prevailed in this county for several months. A great many bats were observed clinging to the roof, with their heads hanging down, some of which were alarmed by the proximity of our lamp, and taking wing, whizzed about our faces, as if to scrutinize closely the enemies who dared to penetrate into their dark abode. The occasional widening of

the galleries formed small, irregularly-shaped rooms, some of which gave evidence of having been at one time very beautiful, but the stalactites with which they were once adorned have nearly all been broken off by thoughtless visitors, who thus wantonly destroy the sublime architectural works of quaint and inimitable patterns that were brought into existence during long periods of chemical action, in Nature's great workshop. One cannot help expressing deep mortification on contemplating the ruthless and blind destruction of that which makes these subterraneous grottoes beautiful as Aladdin's garden, and the defacers merit universal condemnation.

No thorough exploration has yet been made of this cave; therefore, as it appears to be quite extensive, it is possible to discover chambers or rooms surpassing both in size and decorations those at present known.

While in the cave diligent search was made, but no trace of organic remains could be found in its walls, which are formed of decomposing limestone.

Much still remains to be learned regarding the effect of the disturbance which has brought the Gold Hill strata to the surface, as to the influence which it may have had in modifying the shape of the coal-basin, for here, as at other places before mentioned, on the north side of the ridge the coal-bearing strata are seen apparently undisturbed.

A very good mineral spring issues from about the junction of the limestone and sandstone, on Mrs. Ross' place, at the foot of Prospect Hill. It furnishes a bountiful flow of clear, cool water, that possesses a faint odor of sulphuretted hydrogen gas, and leaves a white sediment on the "gum," and on the sides of the little branch to which it gives rise. The reputation which it has acquired is no doubt well deserved, and if suitable buildings were erected to accommodate the public, there is reason to believe that it would become a place of considerable resort during the summer months, especially for invalids suffering from general debility. Its medicinal effects are most likely to be alterative and aperitive.

The lower Carboniferous limestone appears above the surface also, on Secs. 36 and 35, T. 9, R. 7, near the line of Gallatin county. The hill above it at this locality is eighty feet high, and exhibits the following succession of strata:

	Ft.
Slope covered with chert	55
Red clay mixed with chert	20
Blackish-gray limestone veined with calc-spar	5
	80

The limestone in the above section dips to the south at an angle of 40°. It is a hard, close-textured rock, traversed by veins of white calc-spar that would make it a beautiful marble, if polished.

Coal Measures.

The Millstone grit—or Conglomerate, as it is indiscriminately called by geologists—lies in this county conformable to the Chester group, and is at the base of the productive Coal Measures. Its position has already been indicated in the section given of the strata at Prospect Hill, where it is principally represented by a massive reddish-brown sandstone that contains, at many places along its exposure, small rounded pebbles of quartz. It is sometimes divided into two members by a few feet of shale; but I was unable to detect this parting at Prospect Hill, probably on account of the tumbled masses of rock and *debris* which may have covered it up.

The Conglomerate is also seen in the southeastern and southwestern part of the county. On Sec. 34, T. 10, R. 6, at what is known as the "Stone Fort," it is a massive pebbly-sandstone sixty to seventy feet thick, where it forms an abrupt escarpment on the south face of the ridge, 150 to 160 feet above the Little Saline river, which flows along the foot of the ridge. This ridge appears to be a continuation of the Gold Hill axis; and so far as I have been able to discover in traversing its course, the strata present here the appearance of an anticlinal axis, as they dip about 10° to the northward.

The name of the latter locality is derived from an old fort-like inclosure built upon the highest part of the Conglomerate. It contains an area of three or four acres, which is surrounded by a semicircular wall of sandstone three or four feet high. The rocks of which this wall was built furnish no evidence of having been quarried, but, on the contrary, present the appearance of having been loose stones picked from the surface and thrown into the wall-heap without any attempt at order in their arrangement. This ancient fort was well protected on the south side by a bastion or perpendicular wall of Conglomerate sixty to seventy feet thick on its exposed vertical face. In this "fort" we have undoubtedly another monument of a pre-historic race of men who inhabited this Continent at so remote a period that no clue to their history can be obtained from the existing races of Indians—the traditions of whose forefathers give no account of the Mound or Fort-builders.

While standing on the parapet of this ancient stronghold, the mind naturally wandered back over the immense lapse of time since this fortress or citadel was thronged with beings who were filled with hopefulness, or oppressed with all the cares and anxieties of life peculiar to man, and who, no doubt, felt proud of the supposed security against their foes obtained by the selection of so strong a position. Here probably they placed their sentinels to give alarm on the first approach of an enemy; here, likewise, the *elite* of the community may have assembled to contemplate the grand and beautiful scenery around their stronghold; for then, as now, the Little Saline river had cut its passage through the Conglomerate ridge, and its banks were strewed with cyclopean blocks fallen from the parent mass above.

Coal No. 5.—This bed of coal is the fifth in the ascending order on Saline river in Gallatin county, but in Saline county it is the lowest workable seam that I have been able to identify. It is opened and worked by Messrs. Temple & Castles, on sec. 24, T. 9, R. 7, one mile west of the salt works, where it outcrops on the east side of a short ridge bearing a little east of south from Equality. The mouth of the mining entry is twenty feet above high-water of the Saline river; and as the same bed was passed through at forty feet below the surface in the salt well one mile directly east of this entry, it shows the dip to be to the east at the rate of seventy feet per mile, if an allowance of ten feet is made for the place of high-water mark above the salt well. The following section was made at this mine, starting at high-water of the Saline river.

Section at Messrs. Temple & Castles' coal mine on sec. 24, T. 9, R. 7. Coal dips east at the rate of seventy feet per mile:

	Feet.	In.
Slope covered with Drift	60	
Grayish-white micaceous sandstone	30	
Gray siliceous shale	25 to 35	
Black slate	2	
Coal No. 5 ("five-foot coal")	4	8
Fire-clay	2?	
Covered slope	18	
High-water of the Saline river	0	
	151	8

About 300 bushels of this coal are consumed daily at the salt works, under the evaporating pans and boilers. It appears here to be free from the sulphur bands so common in coal No. 5 at Equality and other localities, consequently it has acquired a high reputation for smithing purposes. There is in the roof shales an abund-

ance of compressed marine shells coated with yellow pyrites of iron, which gives them the appearance of having been gilded. They are, however, for the most part in a bad state of preservation, and rapidly decompose after exposure to the atmosphere. The shells most common in this shale are: *Aviculopecten rectilaterarius, Productus longispinus, Nautilus decoratus, Nucula ventricosa?* and *Orthoceras Rushensis.*

There is an outcrop of coal dirt on the side of the ridge opposite to the above mine on sec. 25, T. 9, R. 7, that is referable, also, to coal No. 5. No opening has been made to test the thickness and quality of the coal at this outcrop, but it is my opinion that No. 5 coal will be found thinning out to the southwest and west, and will in the latter direction almost, if not entirely, give out after passing west of the third tier of sections in range seven; and in the former direction it is represented in the vicinity of Whitesville by only an eighteen-inch seam.

At the outcrop on sec. 25 it is underlaid by several feet of fire-clay, which contains bands of gray ironstone of a character similar to that which is seen under the coal at the salt works, only it appears to be in much larger quantity at the former place.

At the crossing of Saline river, on sec. 26, T. 9, R. 7, the gray siliceous shales, commonly over No. 5 coal in this part of the coal field, outcrop in the bank of the river, and may be traced for half a mile or more along the stream.

West of the mines, at the salt works, and on the extreme western side of the ridge in which those mines are situated, at Mr. Whissen's, on section 23, T. 9, R. 7, a coal that is reported to be four feet thick was struck in digging a well. On account of the mineral character of the water no use was made of this well, and it is now filled up, but pieces of coal can still be found mixed with the *debris* of gray and black shale that was thrown out at the time of digging. The agreement of the shale and superimposed sandstone with the rocks seen at Equality, and on the east side of the same ridge above No. 5 coal, can leave no doubt as to its synchronism with that bed. The following section gives the succession of rocks in the hill that lie above the coal in Whissen's well:

	Ft.
Reddish, coarse-grained sandstone	60
Siliceous shale	20
Gray, argillo-siliceous shale	15
Black slate (reported in well)	2
Coal No. 5, " "	4
	101

About one mile south of the above locality a four-foot bed of coal is reported in a well at Mr. Taylor's place, which I refer also to No. 5.

Coal No. 7.—This is the next coal in the ascending order that was seen in Saline county.

At Equality, on the eastern edge of Saline county, Nos. 5, 6 and 7 coals are seen in regular sequence, but westward the two lower beds are replaced by shales, and No. 7 increases in thickness.

Three and a half miles west of Equality, on sec. 15, T. 9, R. 7, at Mr. Grear's, coal No. 7 was passed through in sinking a well. It is said to be four feet thick, and is overlaid by a limestone as at Equality. In some fragments of the limestone lying around the well a few fossils were detected: *Athyris subtilita, A. Royisii? Spirifer cameratus,* and *Lophophyllum proliferum.* In a ravine about fifty feet east of the well the limestone outcropped, and is overlaid by shales and shaly sandstone, as follows:

	Feet.	In.
Drift and soil	25	
Hard gray limestone	2	6
Shale	?	
Coal, No. 7	4	

Between Mr. Grear's place and Harrisburg No. 7 is found on some of the low ridges, but the greatest part has been removed by denudation, though there may be outcrops of it before reaching the Horse-swamp and the broad bottom land along the middle fork of the Saline river.

The thin-bedded rock in the mound-like hill upon which Harrisburg is built is in part the representative of the sandstone over No. 7 coal, and in confirmation of this Dr. Pearce informed me that he had a well dug some years ago in the bottoms on the west side of the town, which struck a bed of coal at the depth of eighteen feet. Plenty of water was obtained, but it was so contaminated with sulphurous salts from the coal that it was considered unhealthy, and the well was filled up, without previously testing the thickness of the coal.

One mile west of Harrisburg, on Mr. Dove's farm, a coal was drilled into at the depth of twenty-one feet; but here again nothing was ascertained in regard to its thickness. It is possible that immediately around Harrisburg, to the north and west, coal No. 7 will prove to be only a thin seam. However, at Mr. Warfield's, six miles northwest of the town, on Sec. 10 or 11, T. 9, R. 5, there is an outcrop of coal in the bank of Bankston creek, which is reported to be four to five feet thick. This must be No. 7, for though I was

unable to see the coal on account of high water, the sandstone, which lies above it, was traced from Harrisburg to the northwestern corner of the county.

The thick beds of coal, in this county, are found in the southwestern part, chiefly between the South fork of Saline river and the parallel of township 8. One and a half miles southeast of Harrisburg, on Sec. 26, T. 9, R. 6, the first place at which coal No. 7 is seen west of the middle fork of Saline river, is at Mr. Ingram's mine, being readily recognized by all the peculiar features characterizing that bed at Equality, and at the other localities referred to in the report on Gallatin county, namely: a limestone above the shale roof, a thin band of bisulphide of iron nearest to the top of the coal, and a parting of clay nearest to the bottom of it.

At Ingram's mine No. 7 is five to six feet thick. The entry from which the coal is mined runs with the dip of the strata, which prevents the outward drain of the percolating water, and the mine is consequently wet and disagreeable to the workmen. This inconvenience can readily be avoided by a small expenditure in opening another entry on the north side of the hill, where the Drift may be carried along the rise of the strata, and thus secure a natural drainage.

Section taken at Ingram's mine—dip 3° east of north:

	Feet.
Soil and Drift	10
Thin-bedded, soft sandstone	20
Gray limestone	8 to 10
Coal, No. 7	5 to 6
Covered slope	5
High water, middle fork of Saline river.	
	51

One mile west of Ingram's mine, on Sec. 27, T. 9, R. 6, Mr. Norman is mining No. 7 coal, both by stripping and drifting, on opposite sides of the hill. The coal here has about the same thickness as at the former mine, with a similar succession of strata in the hill above the Drift, but the limestone is reduced to four feet, and contains a few fossil shells badly preserved, of which *Spirifer cameratus*, *Athyris subtilita*, and *A. Royissii?* only could be determined. The quality of the coal at these two mines is not of the best, as it is more or less contaminated with sulphur, which renders it unsuitable for blacksmithing. It has, however, a good reputation as a grate coal for household uses.

From Norman's No. 7 can be traced, on the parallel of township 9, west to the county line. Within this district it has been worked

by stripping at a great many places, where it lies exposed in the creek bottoms. At these exposures the limestone is not always visible, but it may be seen all along the ridges.

Only a few of the mines west of Norman's, where the coal is worked by stripping, have gone to the bottom of the bed; this is owing in a great measure to the interference of water, when the excavation is carried below the level of the creek bed, and partly to the fact that the upper part of the coal bed contains less sulphur. It was found impossible, therefore, under such circumstances, at most of the mines, to get the exact thickness of the coal, but the general impression is that it will average about six feet.

At Miller's mine, on Sec. 3, T. 9, R. 5, and at Russel's mine, on Sec. 29, of the same township and range, the limestone overlying the coal forms in places a conspicuous wall five to six feet thick, along the valley of Coal creek; it is a hard gray rock containing a few fossils, including *Productus longispinus*, *Spirifer cameratus*, *Athyris subtilita*, *Productus semi-reticulatus*, and *Chonetes mesoloba*.

The Miller coal has a jet black color, is free from sulphur and has a good reputation in the neighborhood for smithing purposes.

At Holeman's mine, also, on section 29, of the above township and range, coal dirt is seen above the main coal, in the position occupied by No. 8.

In the bank of the Little Saline river, on Sec. 23, T. 10, R. 5, at Hay's mill site, there is an exposure of the coal with a thick parting of clay, which on my first visit to this locality I was disposed to refer to one of the lower coal beds of the general section; and I then held the same opinion with regard to the coal bed in the southwestern corner of the county, at the village of Stone Fort. But subsequent investigations have proved to my satisfaction that there is but little probability that any bed of coal of workable thickness can be found below No. 7, west of the line of range 7 in Saline county. I now, therefore, with still some doubt on the subject, refer the former coal to No. 7, and the latter to No. 8.*

*NOTE:—From an examination of the Coal Measures in Williamson county, which joins Saline on the west, I found all the lower coals from No. 2 to No. 7 well developed, from which it would seem that the conclusion above expressed is not well authenticated, for the coal beds in the vicinity of Stone Fort cannot possibly belong higher in the series than coals No. 2 or 3 of the general section. A. H. W.

The section obtained on the Little Saline river is here given:

	Feet.	In.
Soil	2	
Drift, yellowish clay with gravel	10	
Ferruginous schistose sandstone	8	
Coal	1	6
Fire-clay	2	
Coal	1	2
Low water of the river	0	
	24	8

The Little Saline river, after cutting its way through the Conglomerate ridge at the old fort, as before mentioned, runs through a low bottom until it reaches the above mill site, and forms its junction with the South Fork of the Saline river a quarter of a mile beyond.

In the southeast portion of Saline county, and on the south side of Prospect Hill, No. 7 coal outcrops at several places, and has also been struck in digging wells. As yet no effort has been made to open mines in this part of the county, consequently it is difficult to determine definitely in all cases the synchronism of the seams. At Mr. Nicomb's pottery, on Sec. 14, T. 10, R. 7, there are two seams of coal partially exposed in the face of the bluff bank of a creek, one on the head waters of Eagle creek. The lower of these lies in the bed of the creek, separated from the upper seam by eleven and one-half feet of argillaceous shale and three and one-half feet of good fire-clay. An opening which had been made to test the thickness and quality of the lower bed is now filled up by the caving in of the bank and washings of the creek; therefore, no opportunity was afforded of seeing or measuring it myself. Mr. Nicomb, however, who made the opening and mined the coal for burning at the pottery, informed me that it was two and a half feet thick. From the marked appearance of there having been a slide in the bluff, I was at first rather disposed to believe that the lower coal was in fact only a portion of the seam above, broken off and brought down by the sliding of the shale; but Mr. Nicomb is confident that this cannot be so, as they neither agree in thickness nor quality, the lower seam being, as he says, a good burning coal, and has beneath it a very dark-colored fire-clay that cannot be used at the pottery; whereas, the fire-clay beneath the upper seam is light-colored, works well, and not only makes good stone-ware, but is, likewise, excellent for fire-brick; in fact, he considers it the best potters' clay in this part of the coal basin. The coal is only about one foot thick, of inferior quality, and resembles the coal at the village of Stone Fort, being composed principally of carbonaceous

shale, alternating with thin bands of bituminous coal. Without being fully satisfied, from the want of further evidence, as to the truth of the conclusion arrived at, I am nevertheless inclined to believe that the upper seam of coal at the above locality is No. 8, and the lower one No. 7.*

Section of the bluff at Nicomb's. Dip of strata, 5° N., 20° E.:

	Ft.	In.
Schistose sandstone	5	
Coal rash, No. 8 ?	1	
Fire-clay, good for stone-ware and fire-brick	3	6
Argillaceous shale	11	6
Coal No. 7,? reported to be	2	6
	23	6

About three-quarters of a mile southwest of Nicomb's the following section was obtained, the dip of the strata being the same as at the above locality:

	Feet.
Strewed with chert, top of hill	20
Thick-bedded sandstone, with some pebbles	60
Covered slope, strewed with sand-rock	80
Bed of creek	0
	160

The sandstone in this section, which is inferred to be the Conglomerate on account of finding a few pebbles in it, was followed along the dip until it disappeared beneath the strata at Nicomb's.

Coal No. 8? The coal at the village of Stone Fort, in the southwestern corner of the county, is referred to this number and horizon, but not without some doubt on the subject, for it is just on the margin of the basin, where the seams are subject to much variation, both as regards the quality of the coal and the thickness of the strata. Therefore, unless it is seen in connection with No. 7, especially where so little has been done to develop the coals, it is not always possible to distinguish the former from the latter bed. At the village of Stone Fort the strata dip a little east of north at an angle of 20°, which, taken in connection with the dip of the rocks at the old fort, about two miles to the east, appears to indicate that this village also is on the prolongation of the Gold Hill axis of Gallatin county. The following section was taken at the village of Stone Fort:†

* These are probably divisions of coal No. 1 or 2, both of which are occasionally divided, forming two distinct seams. A. H. W.

† This section may be compared with that given in the report on Williamson county, on page 451, the section being in the bluff back of the village of Stone Fort, now called Bolton, where coals 2 and 3 have been opened in the face of the bluff. A. H. W.

	Ft.	In.
Sandstone	15	
Bluish siliceous shale	2	
Yellowish argillaceous shale and yellow clay	1	6
Coal rash, No. 8?	3	6
Friable siliceous shale	10	
Soft flaggy stone in cube-like clocks	2	
	34	

The sandstone at the top of this section forms a cliff that skirts the eastern edge of the village and bassets to the southward at an angle of 20°. It is a whitish-brown, micaceous rock, easily quarried in large blocks that can be split with wedges in pieces of any required size. The facility with which this stone can be worked, its beauty and durability, have brought it into great requisition for building chimneys, foundations to houses, and various other kinds masonry, for all of which it is well adapted.

The coal which is marked No. 8? has been imperfectly opened on the basseting face of the cliff, and some coal taken out. The quality is not good for fuel, and consists of alternate layers of bituminous coal and carbonaceous, soft, fissile shale, largely composed of fragments of obscure plant stems, and belongs to a class known as coal rash. Though it is not good for burning, it may prove to be a valuable fuel for smelting and foundry use, as it appears to be remarkably free from sulphur. To properly test and work this coal, a shaft should be sunk on the northeastern edge of the village, where it can be mined on the rise of the strata, not on the pitch, as has been attempted. By this means there would be a natural drainage for the water usually met with in coal mines, and admit of operations being carried on with ease and comfort to the miners.

In the north part of Saline county there are two or more thin seams of coal of indifferent quality, and of but little, if any, commercial value: consequently there has been scarcely any steps taken by the citizens towards their development. In the neighborhood of Gallatin, near the northwestern corner of the county, on section 9, township 8, range 6, Mr. L. Karns has opened a thin seam of coal, and was endeavoring to work it by drifting into the hill.

This coal may be traced all through the northern part of the county, and is not found at any locality to exceed one foot in thickness.

The section at Karns' mine is as follows; dip of strata, 5° W. of S.:

	Ft.	In.
Covered space, drift and soil	22	
Yellow, ferruginous, brecciated limestone, very siliceous	8	
Soft, blue clay shale	0	6
Coal	8 in.	1
Bluish shale, with stems of plants	5	

The limestone is very impure; it has a reddish-brown color derived from the large amount of oxide of iron with which it is contaminated. It has a brecciated appearance, and seems to be destitute of fossils; in the former respect it resembles very much the brecciated limestone under the sandstone at Merom, on the Wabash river, above Vincennes.

A limestone that is more or less impure, but not nearly so thick as the limestone in the above section, can be traced through the northern part of the county, usually in connection with a thin seam of coal; the latter is referred to the same horizon as the coal at Karns' mine. The intercalated limestones, in the space between the sandstone and the limestone above No. 7 coal, in the northern part of Saline county, possess a variable character, and seldom exhibit the same features at any two localities.

Drift.—The Drift in this county is characterized by a yellow plastic clay mixed with small gravel, with occasionally a granite bowlder as large as a goose egg, more rarely as large as a man's head. In some places the clay is replaced by sand, which forms the only source of supply in this county for the sand which is used in mortar for plastering houses and for masonry. The Drift is from ten to twenty feet thick, and extends all over the county, except where it has been removed by denudation or other causes.

Minerals.

Copper.—I was informed by Dr. Smith, a very intelligent and observing gentleman, who lives near Gallatin, in the northern part of the county, that he had at different times found small pieces of native copper, both in this county and the southern part of Hamilton, in ravines or washed places, and in the beds of branches. The doctor spoke of a gentleman who had picked up in the bed of a branch, near Gallatin, a lump of native copper larger than a hen's egg. The latter specimen is still owned in the town, and Dr. Smith tried to procure it for my inspection, but the parties to whom it belonged were away on a visit, and it was locked up in their residence. From the malleability and other characteristic tests to which the specimens were subjected by Dr. Smith, they are proved beyond a doubt to be native copper.

The circumstances connected with the finding of small quantities of native copper in Hamilton and Saline counties, clearly indicate that it came from the Drift deposit. Therefore, it will be useless to expend time and money in searching for valuable mines of copper

in this county. The Drift, as before stated, covers a large portion of Saline county, and is composed of material transported by glacial agency from and beyond the copper regions to the northward.

Salt.—At an early period, when the agents of the General Government were manufacturing salt at the Saline works in Gallatin county, some speculative adventurers dug a well on the Middle Fork of the Saline river, about two miles east of Harrisburg; it is reported that at the depth of eighty feet they found a brine from which a considerable quantity of salt was made. At this late day, it is impossible to obtain any information respecting the quality or number of gallons which it required of this brine to make a bushel of salt, but there is reason to believe, from the geology of the district, that brine, just as pure and strong as that now worked at the "Saline," can be found by boring in the vicinity of Harrisburg. In order to test the matter, the bore should penetrate the muriatiferous shales which lie below the Conglomerate. On the Middle Fork of the Saline river, or on the bottom land at Harrisburg, a bore would start from a geological horizon fifty to sixty feet above the wells at the "Saline," yet it is believed that the great salt repository will be reached at a much less depth than at the "Saline," from the thinning out of the subordinate coal strata.

Building Stone.—There is an abundance of good limestone for building purposes in the southeastern part of the county, where the lower Carboniferous rocks have been brought to the surface by the Gold-hill axis. In the southwestern part there is a durable and handsome sandstone, which is very extensively used for building foundations to houses and for chimneys. It can be obtained in large blocks and is easily worked. The sandstone in the northern part of the county answers very well for ordinary building purposes, but is not so good as that found in the southwestern part.

Quicklime.—The Coal Measure limestone, which overlies No. 7 coal, makes a very fair article of dark lime at some localities, but generally contains too large a quantity of impurities, and owing to the extra cost of quarrying, it will never be extensively used for that purpose. The lower Carboniferous limestone, at Prospect Hill, in the southeastern part of the county, can furnish a bountiful supply and of excellent quality.

Plastic Clay.—Good clay, suitable for fire-brick and stoneware, is found in the southeastern part of the county, and Mr. Nicomb has established a pottery there, and is making out of this clay both fire-brick and stoneware.

Good clay, for making the ordinary brick used for building purposes, may be found in the Drift deposits throughout the county.

Timber.—For the most part Saline county is well timbered and can furnish a large quantity of black walnut, white oak, cypress and poplar lumber. Besides the trees suitable for lumber, there is the usual variety for this latitude of forest growth.

Agriculture.—The soils of this county are very similar in their physical features to those of Gallatin county.

Along the water-courses there is, in places, a black sandy loam, very rich in organic matter, which supports a fine growth of black walnut, poplar, large oaks, hickory, dog-wood and spice bushes. Then, there are extensive tracts, known as post-oak flats, which have an ashen-colored, close, compact clay soil which holds water like a jug. When properly ditched and drained, the latter soil is highly productive, being rich in all the elements of fertility. Without under-drains, however, it will require much labor to bring it into a productive condition, and will need to be subsoiled to as great a depth as it is possible to attain with the plow. Though not naturally as productive as the first mentioned soil, which ranks equal to any in the State, it will, nevertheless, prove fully equal to it for growing small grain, provided it is under-drained. An intermediate soil, which ranks between that of the post-oak flats and the sandy loam, is known as the "gum-land," which, like the former, requires ditching and draining to bring it into good condition.

The foregoing soils have all been derived from the disintegration and wearing away of the sandstones, argillaceous shales and calcareous rocks of the Coal Measures; but there is still another characteristic soil, which occupies the greater portion of the county, that is composed of yellowish tenacious clay and sand, with more or less rounded gravel and small bowlders. On the highest points and on the low rolling land, the Drift soil has a depth varying from ten to twenty feet or more. This a good, strong soil; but, owing to the tenacious nature of the clay which forms its principal part, it, also, requires more or less draining. It is particularly good for small grain and clover, and grows fine crops of tobacco. Considerable attention is paid to the cultivation of the latter article in Saline county, and there are large warehouses at Gallatin and Raleigh for the purpose of preparing the tobacco for shipment.

Conclusion.

Saline county is rapidly filling up with immigrants from other parts of the country and bids fair to be a populous and wealthy county. The Vincennes and Cairo railroad runs nearly diagonally through the center of the county, and will materially aid its commercial prosperity by opening a market for its vast stores of fossil fuel.

To Dr. Mitchell, of Harrisburg, and to the citizens of the county generally, I here tender my sincere thanks for their kind assistance in promoting the interests of the Survey.

CHAPTER XXXVI.

LIVINGSTON COUNTY.

This county comprises the congressional townships Nos. 27, 28, 29 and 30 north, and ranges east of the third principal meridian Nos. 3 to 8 both inclusive, making 24 townships, with 3 townships and 3 half townships additional on the south comprised in township 26 north, and ranges 6, 7 and 8 east; and township 25 north, and the north half of ranges 6, 7 and 8 east, equal altogether to 28½ townships, or 1,026 square miles. This is increased, however, about 18 square miles, owing to the north tier of sections in the three half townships being two miles long from north to south, making the aggregate of the county 1,044 square miles.

The Big Vermilion river, running from southeast to northwest through the county, divides it into nearly equal parts, and this stream affords the only means within the county of determining its geology below the surface, excepting the coal shafts and a few borings.

These data would be meagre without the aid of the exposures of LaSalle county north of it, which furnish the key to the geology of Livingston.

The great anticlinal axis which crosses the Illinois river near Utica, in LaSalle county, and which is very clearly defined in the north bluff of the Illinois valley, having its central line two miles west of Utica and a direction of south 33° west, extends through Livingston county, its central line lying a little east of the Vermilion river—the course of this stream evidently having been determined by the influence of this axis, with which it is, in its general direction, nearly or quite parallel.

After a full investigation of LaSalle county, Livingston county in its general features is easily determined; yet there are details with

respect to the Coal Measures—particularly in that portion of the county lying east of the Vermilion—that can only be ascertained as time develops them through the aid of coal shafts and borings.

Along the Vermilion and west of it, the Coal Measures appear to be as complete, generally, as found in the corresponding part of LaSalle county. Soon after passing to the east of it the disturbance of the axis referred to appears.

Almost the entire area of the county belongs in the Coal Measures, the exception being a small strip in the southeast part, equivalent to about one and a half townships in area. The eastern boundary of the Coal Measures within the county has been determined approximately. Prof. F. H. Bradley traced the line in Will and Kankakee counties; in the latter, running south through the center of the second tier of sections east of the west line of that county, to the south line of Sec. 32, T. 31 N., R. 9 E., thence bearing a little west to the center of Sec. 32, T. 30 N., R. 9 E. No further evidence of it could be obtained without boring, and it was considered that a straight line from this latter point to the rim of the basin—as determined at Chatsworth—would be a close approximation to correctness. This would make the county line cross the outcrop at the southeast corner of T. 29 N., R. 8 E, and thence a straight line to Chatsworth in the southwest half of Sec. 4, T. 26 N., R. 8 E. From thence, whether this line continues in the same direction to the south line of the county, or whether it bears eastward, is yet unknown. Some indications of the northern boundary of the Coal Measures in Iroquois county favor the latter supposition.

The general character of the surface of the county is rolling prairie, and very little broken along the Vermilion river, which, with its branches, is fringed with timber. The southeast part of the county is quite high land. From four to six miles south of the county line, in Ford county, about the centre of T. 24 N., R. 7 E., is the highest land of this region, and the Illinois Vermilion, the Wabash Vermilion, the Mackinaw and Sangamon rivers, all have their sources here near together.

East of and parallel with the Vermilion is a ridge, which may be traced from a point west of Chatsworth northwesterly into LaSalle county, into T. 32 N., R. 3 E. This is gravelly and sandy, giving it a distinctive character as compared with the adjacent prairie.

Drift.—The Drift of this county is very variable, and thinnest in the northwest part of the county—in the vicinity of the Vermilion, and throughout the course of this stream it is much thinner than away from it on either side. At Pontiac, in the north part of the

town, it is eighteen feet; at Fairbury and vicinity it is from a few feet to ninety feet; at Odell, Matson's boring reported it two hundred feet to sand and water, and three hundred and fifty feet to rock, showing a great depth of Drift. Wells there have a very unequal supply of water. Some in town get abundance at five to ten feet; others fail to get water at one hundred feet. In two borings water was obtained at about ninety-five feet in gravel, while others got none, showing that the two gravel beds so general in LaSalle county furnishing water, have run out, and that here the gravel and sand are in veins rather than stratified over extensive areas. This, however, may apply only to the eastern side of the Vermilion. The well at the station at Odell was down one hundred and thirty feet. Record as follows:

	Feet.	In.	Feet.	In
Soil	0	0	4	0
Yellowish-blue clay	5	0	9	0
Blue clay	66	0	75	0
Gravel, with some sand	5	0	80	0
Blue clay	15	0	95	0
Gravel, with sand	2	0	97	0
Blue clay	8	0	105	0
Gravel	0	4	105	4
Blue clay	22	8	128	0
Gravel	0	4	128	
Blue clay	2	0	130	0

At Dwight, on the N. E. qr. of Sec. 12, T. 30, R. 6 E., a boring of twenty-five feet was reported all Drift, and the well was abandoned at that depth from tools getting fast. Water at fifteen to twenty feet.

A boring was reported in the S. W. qr. of Sec. 21, T. 28 N., R. 9 E., of one hundred and five feet in Drift, but no statement whether this reached the bottom of it. This is over the line two miles, in Ford county.

At Chenoa, at the railroad crossing, a well bored one hundred and thirty feet struck water at ninety feet and at 130 feet, both rising to within 30 feet of the surface, or so reported. This is probably from gravel in Drift.

At Avoca and west of it, water is found from six to eighteen feet from the surface. East of this, thirty to forty feet, and not so reliable as west of the Vermilion.

Sand is found on Sec. 27, T. 27 N., R. 6 E., between Fairbury and Avoca, with three feet of soil above it, and also found on Sec. 1, T. 27 N., R. 5 E., on the west side of the ridge half a mile west of the Vermilion—reported sixteen feet deep and resting on coarse gravel. Pontiac is supplied with sand from this point.

The country between Fairbury and Chatsworth is a succession of ridges rising gradually towards Chatsworth, the highest point being one or two miles west of Chatsworth, and this is probably one hundred feet or more higher than the ridge at Fairbury.

The upper limestone of the shafts at Fairbury is traced in the wells, and along low ground outcrops in a northwesterly direction, showing the Drift at less depth. It appears on Indian creek, two miles southwest of town, and also outcrops three and a half miles northwest of town. This limestone underlies a low ridge which is observable running in a northwesterly direction in the prairie. Two miles east of Fairbury is a ridge higher than the one on the west. The railroad cuts through it to a depth of five or six feet, showing a considerable amount of Drift, mainly derived from the Niagara limestone. A limestone reported six miles south and one mile west of Forest, is probably the continuation of the low ridge near Fairbury above referred to.

At Chatsworth, two borings three-quarters of a mile apart show much difference in thickness of Drift. In the S. E. qr. of Sec. 4 it is eighty-four or eighty-eight feet, which includes an old vegetable dirt bed. In the S. E. qr. of Sec. 3 the Drift is two hundred and twenty-one feet according to the record of the boring at the sugar works; and in this, water was struck at a depth of fifty-two feet in gravel; again, at seventy-five feet in quicksand; a third vein at one hundred and nine feet in sand and gravel. The water of these three veins rose to within twenty-seven feet of the surface. A fourth vein in gravel at two hundred and ten feet rose to within twenty-five feet of the surface.

Coal Measures.

The Big Vermilion river, from the north line of the county to Pontiac, affords many exposures that help to determine the changes in the Coal Measures.

A coal bank on the S. W. qr. of the S. E. qr. of Sec. 1, T. 30 N., R. 3 E., shows the Streator coal, which is here divided by a clay seam fifteen inches thick, leaving thirty-three inches of coal above and twelve inches of coal below it. The coal here is a little below the bed of the river, and a quarter of a mile below, it is at the river level. A quarter of a mile above the mine the coal at Newtown mill is in the bed of the river below the dam. A half mile below the mine the clay parting is only one-eighth of an inch thick.

Glenwood mill is on the N. E. qr. of Sec. 12, about the middle of the quarter section. The river runs north 35° west, and the sandstone above the shale that overlies the coal at Streator, shows here with a dip south 35° east, one foot in ten. At the mill the dam rests upon the coal.

One mile above the dam the coal appears again. It was worked in 1860 and 1861, and said to be three and a half feet thick.

One hundred and twenty rods north of the south line of Sec. 18, T. 30 N., R. 4 E., the coal is four and a half feet thick on the east side of the river. At the south line of Sec. 18 the coal is under the river not more than eight feet. Farther down the river a short distance, on the west side, the coal is three feet thick.

At the northwest corner of the S. E. qr. of the N. W. qr. of Sec. 19, T. 30, R. 4 E., a limestone nearly six feet thick appears where the river makes a bend west. This rests on a blue clay, and appears to be No. 12 of the general section of LaSalle county. Fossils found in it were *Productus longispinus*, *Spirifer cameratus*, *Sp. lineatus*, *Athyris subtilita*, and *Cyathoxonia*.

The same limestone appears again in the elbow of the river on the right bank, on the south part of section 19, near the middle line; also in a detached mass slipped down in the east part of the S. E. qr. of Sec. 19, with the underlying greenish clay and shale forming the bank.

Sandstone appears on the north line of Sec. 30, T. 30, R. 4 E., near the middle corner. This seems to be No. 49 of the general section of LaSalle county. The base is shaly, discolored by wafer bands of coal and coal-plant fragments. This sandstone continues in sight to the mouth of Long Point creek, on the left bank of the river, in the southeast corner of Sec. 29; then reappears on the right bank just above the mouth of Long Point creek. The dip shows well here to the northeast one foot in twenty. In the N. E, qr. of the N. W. qr. of Sec. 32, in the bend of the river, the direction of the dip is a little more east, and the massive sandstone is overlaid by a bed of siliceous and micaceous shale, on which rests a clay shale of light-blue color, the siliceous shale being a grayish light-blue. In the clay shale are two bands of limestone somewhat like ironstone, irregular, separated by clay shale, and each about one foot thick. The main sandstone appears again one-quarter of a mile below the mouth of Mud creek, on the left bank of the river, and at the mouth of Mud creek is the underlying shaly sandstone. This is near the middle of Sec. 32.

Continuing up the river this sandstone appears in the south part of Sec. 5, T. 29, R. 4, with five or six feet of the underlying shales. One-quarter of a mile further up, and probably in the north part of Sec. 8, coal comes in suddenly, with section as follows:

	Feet.
Sandstone	?
Coal	1½
Fire-clay	1
Shale	?

This 18 inches of coal is generally represented elsewhere, and in LaSalle county, by fragments and wafer seams of coal. The fire-clay is absent. A thin shaly sandstone of 18 inches is here found two feet below the coal.

Southeast three-quarters of a mile or less, in a straight line from this point, a coal seam appears in the bed of the river. Its thickness could not be determined, but it is at least one and a half feet. The right bank shows argillaceous shales, with bands of nodules, and thin shales indicating the Streator coal. The dip is between southeast and east. This point is a little below the mouth of Scattering Point creek, and is probably in the north part of the southeast quarter of Sec. 8. The shales in the right bank of the river in the northwest quarter of Sec. 9, in that part of the river which runs near the west line of the section, appear to be the same just referred to. In the bend of the river at the middle of the northwest quarter of Sec. 9 the strata of sandstone and shale dip about west one foot in twenty. Ten rods further up the river the dip is a little south of east at the same rate.

Near the south line of Sec. 9 the same sandstone shows again, and dips southeasterly. In the bank of the river in the S. E. qr. of Sec. 16, the S. W. qr. of Sec. 15, and the N. W. qr. of Sec. 22, the limestone before referred to appears in loose masses, the banks formed of the underlying blue clay. A slippery bank, and the limestone slipped down, is, everywhere it appears, characteristic of this portion of the vertical section, often obscuring the details. Near the north line of Sec. 22, and a quarter of a mile east of the northwest corner, the limestone in place is down to the river level. The character of this rock to disintegrate into irregular fragments is exhibited here in abundant loose, coarse limestone gravel, two to four inches in diameter.

From this point to Allen's mill, in the southwest quarter of Sec. 23, nothing noticeable is to be seen. This limestone appears again at the mill-dam, and also at the ford, two miles and a half below Pontiac, and at Pontiac. The fossils are *Spirifer cameratus*, *S. linæatus*, *S. plano-convexus*, *Productus longispinus*, and *Bellerophon*.

The branches of the river in this county afford no aid in determining the rock strata, excepting at a very few points, the Drift concealing everything below. Above Pontiac but little rock exposure is found.

The details given of the tracing of the river up to Pontiac shows the upheaval of the Coal Measures continued as in LaSalle county, and also seems to indicate some slight local disturbances or parallel axial lines with the main axis.

On Rook's creek, in the N. W. qr. of the N. E. qr. of Sec. 23, T. 28, R. 4 E., a sandstone is quarried. The section is as follows:

	Feet.
Sandstone in thin laminæ	5
Sandstone in thick beds, slightly micaceous, bluish-color, fine building stone	2
Shaly sandstone to water level	1
Dip S. 80° W	1 in. to 1

One hundred yards west, down the creek, it shows again. Two hundred yards west, on the left bank of the creek, a limestone comes in, stratified in masses, brecciated, about five feet altogether—no fossils. The sandstone shows again in the bed of the creek about 80 to 100 rods in a southeast course. Section of coal shaft at Pontiac, as furnished from the records of the company:

		Ft.	In.	Ft.	In.
1.	Drift clay			18	9
2.	Limestone	1	5	20	2
3.	Blue shale	5		25	2
4.	Limestone	4		29	2
5.	Brown shale	4		33	2
6.	Red shale	2		35	2
7.	Blue shale	1		36	2
8.	Limestone	17	6	53	8
9.	Black slate	1		54	8
10.	Brown shale	8	2	62	10
11.	Limestone	6		68	10
12.	Dark shale	2		70	10
13.	Limestone	5		75	10
14.	Red shale	16		91	10
15.	Blue shale	40		131	10
16.	Black slate	14		145	10
17.	Black slate	19		164	10
18.	Black slate	12		176	10
19.	Rock—limestone?	4	6	181	4
20.	Soapstone	1		182	4
21.	Coal	4	6	186	10
22.	Dark slate—2 in. clay on top	12		198	10
23.	Brown shale	7		205	10
24.	Dark slate	6	6	212	4
25.	Brown shale	12		224	4
26.	Very dark clay	7		231	4
27.	Black slate	50		281	4
28.	Rock—limestone	7	6	288	10
29.	Soapstone	18		306	10
30.	Limestone	6		312	10

		Ft.	In.	Ft.	In.
31.	Soapstone—hard	20		332	10
32.	Black slate—hard	30		362	10
33.	Septaria, containing bitumen	2		364	10
34.	Fire-clay?	3		367	10
35.	Coal	2	6	370	4
36.	Fire-clay	3	6	373	10

I do not regard the section as a reliable one. Some specimens of *Aviculopecten rectilaterarius*, found in the waste pile, were reported as from No. 27 of the section, and *Productus longispinus*, said to be from No. 34.

The following is a copy of A. Matson's boring at Pontiac, one-quarter of a mile northeast of the coal shaft, made in 1863:

		Ft.	Ft.
1.	Drift		18
2.	Limestone	1	19
3.	Blue slate	9	28
4.	Hard rock	4	32
5.	Red shale	13	45
6.	Blue shale	20	65
7.	Hard rock	10	75
8.	Light-colored shale	20	95
9.	Hard rock	4	99
10.	Red shale	18	117
11.	Blue shale	30	147
12.	Black shale	9	156
13.	Blue shale	44	200
14.	Coal shale	3	203
15.	Coal	1	204
16.	Blue shale	23	227
17.	Black shale	5	232

Shaft of H. L. Marsh, Fairbury, on southwest qr. Sec. 4, T. 26, R. E.:

Section.

		Ft.	In.	Ft.	In.
1.	Black soil	2		2	
2.	Yellow clay	14		16	
3.	Blue clay	8		28	
	Soft blue clay	4			
4.	Quicksand	5		33	
5.	Limestone	3	6	36	6
6.	Blue clay	5	10	49	4
	Red and brown clay	5			
7.	Limestone	10	2	57	6
	Limestone, shale and clay	7		64	6
8.	Blue clay	5	5	75	5
	Red clay	6	6		
9.	Limestone	0	4	75	9
10.	Coal, 0 to 3; slate, 2 ft	2	3	78	0
11.	Blue clay	5	1	83	1
	Red clay	5	0	88	1
	Red clay, very dark	7	3	95	4
12.	Blue limestone, very hard	1	2	96	6

		Ft.	In.	Ft.	In.
13.	Red clay	8	10	105	4
14.	Sandstone, fine and light-colored at top, coarser descending	70	0	175	4
	Sandstone, in thin bands, interstratified with thin bands of clay	9	0	184	4
15.	Soapstone	31	8	282	3
16.	Coal	4	10	220	10
17.	Fire-clay	26	8	247	6
18.	Limestone, hard	1	2	248	8
19.	Slate, dark 2				
	Slate, light 15 6				
	Slate, dark 10 8				
	Slate, black 1 5	31	8	280	4
	Slate, band of nodules 0 2				
	Slate, black, with some coal 1 11				
20.	Clay, light-colored, soft	1	11	282	3
21.	Limestone	6		288	3
22.	Soapstone, light, sandy	3	2	291	5
23.	Slate, dark, soft		7	292	0
24.	Sandy shale	1	5	293	5
	Sandy shale, changing to clay shale at bottom	38	7	332	
25.	Sandstone, micaceous and shaly at top, harder at bottom	40	7	372	7
26.	Shale soft at top, and hard at bottom	8	11	381	6
27.	Coal	2	5	383	11
28.	Fire-clay	20	6	404	5
29.	Sandstone, sandy shales, with thin clay bands, to			571	

From the coal No. 27 the section was ascertained by boring in bottom of shaft. Water was noticed at 427 feet. The upper sixteen feet of No. 25, reported to contain *calamites* and large wood-like fossils, body being of sandstone, probably *Sigillaria* incrusted with coal. Limestone No. 5 of the section outcrops near town.

The shaft and boring of Amsbury & Jones, on southwest qr. of sec. 2, at Fairbury, exhibits the following section, as reported by them:

Section.

		Ft.	In.	Ft.	In.
1.	Soil			2	6
2.	Yellow clay	8	8	11	2
3.	Blue clay and mixed with sand	9	7	20	9
4.	Gravel, with little water	1	1	21	10
5.	Hard-pan, sand and gravel, with little clay, cemented and very hard.	39	2	61	
6.	Blue clay	29	4	90	4
7.	Black and brown shale mixed, changing into sandstone, and bottom 6 or 8 feet contains fossil plants covered with coal crust, making gray-colored debris; water abundant at bottom of this	43		133	4
8.	Sandstone	14		147	4
9.	Clay, light-colored	4		151	4
10.	Coal, (working this bed)	4	2	155	6
11.	Fire-clay, with pyrite balls	8		163	6
12.	Red shale	7		170	6
13.	Sandstone	4		174	6
14.	Limestone	0	7	175	1
15.	Shale	6		181	1
16.	Limestone	1	6	182	7
17.	Blue shale or clay	21		203	7
18.	Coal	0	2	203	9
19.	Sandstone	3		206	9

		Ft.	In.	Ft.	In.
20.	Blue shale or clay	2		208	9
21.	Coal	0	2	208	11
22.	Shale 7 Shale or dark clay 10	17		225	11
23.	Black slate and little coal	2		227	11
24.	Fire-clay	1	6	229	5
25.	Sandstone	5		234	5
26.	Fire-clay	7		241	5
27.	Limestone, hard	1	8	243	1
28.	Fire-clay	3	6	246	7
29.	Sandstone	11		257	7
30.	Blue clay or shale	45		302	7
31.	Coal	3	6	306	1
32.	Fire-clay	1	0	307	1
33.	Sandstone	2	0	309	1

The mine is wet, water dripping from the sandstone, No. 8 of the section, the clay next above the coal giving way, and varying from two to eight feet in thickness. H. L. Marsh's mine is dry.

Chatsworth boring, west of town, for coal, southeast qr. sec. 4, T. 26, R. 8 E.:

Section.

		Ft.	In.	Ft.	In.
1.	Soil, blue clay and sand	0	0	65	0
2.	Soft sandstone (sand?)	15	0	80	0
3.	Vegetable dirt bed, grains of wool discernable like old rotten logs and portions of leaves	0 4	0 0	0 84	0 0
4.	Fire-clay (so-called)	4	0	88	0
5.	Sandstone	35	0	123	0
6.	Shale	13	0	136	0
7.	Coal or black slate	0	2	136	2
8.	Fire-clay	1	0	137	2
9.	Soapstone or shale	11	0	148	2
10.	Coal	1	3	149	5
11.	Fire-clay	3	0	152	5
12.	Soapstone	15	0	167	5
13.	Black slate	1	6	168	11
14.	Soapstone or shale To coal or slate, a thin bed, with iron pyrite.	31	1	200	0

This boring is fifty feet from the railroad, near east line of section 4.

Artesian well at Chatsworth, southeast qr. sec. 3, T. 26, R. 8 E.:

Section.

			Ft.
1.	Soil and clay	0	4
2.	Yellow clay	4	8
3.	Blue clay	44	52
4.	Sand and gravel	8	60
5.	Blue clay	10	70
6.	Sand	5	75
7.	Hard-pan (clay and gravel)	53	128
8.	Sand	7	135
9.	Hard-pan and clay	52	187

			Ft.
10.	Soft clay and gravel	13	200
11.	Soapstone	21	221
12.	Limestone	69	290
13.	Limestone	94	384
14.	Limestone	70	454
15.	Limestone	115	569
16.	Black slate	40	609
17.	Gritstone	80	689
18.	Limestone	65	754
19.	Limestone	70	824
20.	Dark shale	36	860
21.	Limestone	147	1,007
22.	Flint (?)	109	1,116
23.	Dark gray shale, with streaks of flint	84	1,200

A comparison of the two borings above shows an abrupt change from the Coal Measures to the older rocks and a great difference in the depth of the Drift.

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