REPORT UPON THE GEOLOGY OF DEKALB COUNTY.

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DeKalb county was organized in 1837 out of territory then belonging to Allen and Lagrange. It includes nine full Congressional townships and three fractional, its length east and west being twenty and one-half miles, and its breadth north and south eighteen miles. Its area is 3,690 square miles, and its population 20,225. It contains within its limits four considerable towns: Auburn, the county seat, Waterloo, Garrett and Butler. It is bounded on the east by Ohio, on the south by Allen county, on the west by Noble, and on the north by Steuben. The civil township originally corresponded to the Congressional in the following manner:

Tp.	*Range XII.*	*R. XIII.*	*R. XIV.*	*R. XV.*
35.	Fairfield.	Smithfield.	Franklin.	Troy.
34.	Richland.	Union.	Wilmington.	Stafford.
33.	Butler.	Jackson.	Concord.	Newville.

The two southern tiers of sections in Richland and the two northern in Butler have been taken to form the civil township of Keyser, but references in this report will be to townships as given in the table.

The whole county is covered by a heavy mantle of drift which borings show to be in some places 400 feet thick, and it is probable that the rock nowhere approaches nearer to the surface than 200 feet. Physically, the county belongs almost wholly to the Wabash-Erie region, a full description of which will be found in the accompanying report upon the geology of Allen county. Except a small portion in the northwest corner it is drained by the St. Joseph river, and its tributaries.

The lowest point in the county, at the southeast corner, is about 775 feet above sea level; the highest, near the northwest corner, has an elevation not far from 1,000 feet. Between these limits the relief of the surface consists of three parallel ridges with two intervening valleys, which cross the county in a direction nearly northeast and southwest. It is as if some gigantic plow had turned three furrows, the northwestern one being a "back furrow" thrown up against another turned from the

opposite direction. To a certain extent this comparison is a simple statement of a fact, but the whole fact is not quite so simple. The Van Wert and Hicksville ridge, which marks the shore line of a body of water elsewhere described as the Maumee Lake, touches the county at the southeast corner. Between that and the St. Joseph River lies the first great ridge, five miles wide and with an elevation at the summit of 76 feet above the Hicksville ridge, and of 60 feet above the river. It occupies the township of Newville and portions of Concord and Stafford. West of the St. Joseph a second great ridge, about eight miles wide, occupies the townships of Troy, Stafford, Wilmington, Jackson, one half of Union, and the greater part of Concord and Franklin. It is bounded on the west by the valley of Cedar Creek, and the prolongation of that valley from the northern part of Union to Aldrich Lake on the north line of Franklin. The crest of this ridge, within a mile or two of its western border, is about 125 feet above the St. Joseph, 60 feet above Cedar Creek, and averages 65 feet higher than the first ridge. A third ridge, still more massive and elevated, occupies the townships of Fairfield, Smithfield and the greater part of Richland, having its watershed near the northwestern border of the county and its longest slope in Noble, Lagrange and Steuben counties. Its summit is probably nowhere less than 1,000 feet above the sea, and from 100 to 150 feet above Cedar Creek Valley.

The eastern border of this ridge can be distinctly traced along the road from Hamilton, Steuben county, to Waterloo. On the road from Auburn to Corunna it is marked by a sharp rise at the southwest corner of section 13, Richland, whence it continues as a well defined bluff to the southwest corner of section 27, thence southward along Little Cedar Creek. Cedar Creek valley therefore increases in width from one mile at Aldrich Lake to five miles in Butler township.

The surveys of northwestern Ohio by Gilbert and Winchell, of the whole territory north of the Ohio & Missouri rivers by Chamberlain, and of northwestern Indiana by the present writer, show that these ridges are glacial moraines and a portion of a vast morainic system extending from Cape Cod to Dakota. The last continental ice-sheet which covered northeastern North America was divided along its southern border into numerous lobes or tongues which projected many miles beyond the main mass. One of these, after scooping out the bed of Lake Erie, thrust itself up the present Maumee Valley and down the Wabash nearly to Illinois. In its progress it slid over, pushed along and plowed up the debris left by former ice sheets, and when compelled by a slowly ameliorating climate to retreat, it added its own load of bowlders, gravel and sand to the previously accumulated mass. At the same time a smaller tongue of ice was pushing from Saginaw Bay southwestward through Michigan to northern Indiana. It was crowded upon by a much larger mass which passed southward through the bed of Lake Michigan. The Saginaw Lake was

thus hemmed in between mightier antagonists; but it was sufficient to offer considerable obstruction to the Erie Lake, which was thus prevented from spreading out to the northwest.

Between the two a broad ridge of earth was piled up several hundred feet high to form the hills of Steuben, Lagrange, Noble and northwestern Dekalb. This is the "back furrow." The two ice lobes acted to some extent like road scrapers, but a large part of the material was carried by the scrapers themselves upon their upper surface and frozen into their mass. When the ice melted this portion gradually settled down or was dumped in heaps upon the top of the ridge. Thus originated the "hog backs," dome-shaped and conical hills, "potash kettles" and lake basins, so numerous and characteristic of the region. The whole ridge extends from Sanilac County, Michigan, to Cass County, Indiana, and is called *the Saginaw-Huron interlobate moraine.*

The retreat of the Erie glacier was interrupted by several periods during which the severity of the climate was such that the outer edge of the ice maintained its position in spite of melting. It was like the advancing column of an army, the head of which, on reaching a certain point, is constantly swept away by the fire of the enemy, while the loss is supplied by new forces from the rear. The ice was continually pushing forward, but could not pass beyond a certain line because it melted as rapidly as it advanced. Along this line all the material carried by the ice was deposited, and thus formed a ridge of earth called a terminal or peripheral moraine. There is some evidence which indicates that along the northwestern border of the Erie lobe in Dekalb County two of these terminal moraines are piled up against and coalescent with the interlobate moraine. The position of the crest so much nearer the Erie border than the Saginaw border, the greater smoothness of the southeastern slope, and the comparatively small number of lakes upon that slope may thus be accounted for. Two terminal moraines remain distinct. *The Wabash aboit moraine* extends from Hillsdale County, Michigan, along the right bank of the St. Joseph River to the northeastern corner of Huntington County, Indiana, thence along the right bank of the upper Wabash River to Mercer County, Ohio. In Dekalb County it occupies the space between the river and Cedar Creek Valley. *The St. Mary's and St. Joseph moraine* extends from Lenawee County, Michigan, along the left bank of the St. Joseph River to Fort Wayne, Indiana, thence along the right bank of the St. Mary's River to Allen County, Ohio. In Dekalb County it occupies the space between the river and the southeast corner of the county.

The ridges on either side of the St. Joseph are broad but comparatively high and rolling tracts of land. That upon the western side is the more massive and level. It bears upon its surface numerous and extensive swamps, depressions wherein the water is retained by impervious strata

of clay. These are being drained by an elaborate system of ditches chiefly into the St. Joseph. Its western slope is quite abrupt, and in Jackson Township cut by deep ravines. Here occurs the only lake east of Cedar Creek, Duncan's Lake in section 31. Its basin is a symmetrical oval, about eighty acres in extent, with bold shores and a border of marsh all around it. One mile northwest, in section 36, is a similar basin of double the area, now occupied by a black ash swamp. Both are drained into the St. Joseph, although the swamp is only a mile from Cedar Creek. Just south of the Dekalb County line the moraine rises to its highest elevation in "Dutch Ridge," Perry Township, Allen County, about 900 feet above the sea. Near the northeast corner of Dekalb County, this moraine is crossed by Fish Creek, which has cut a valley 25 to 40 feet below the general level. That portion of the county which lies upon the interlobate moraine presents surface features distinctly different from those of the terminal moraines. The topography is more strongly morainic, and characterized by high, irregular ridges, abrupt slopes, deep winding valleys and numerous lakes. These characters in great variety and perfection render Fairfield Township the most picturesque portion of the county. In sections 3 and 4 Story Lake occupies a valley now much too large for it, and empties northward into Pigeon River and the St. Joseph of Lake Michigan. Indian Lake (section 29), Cedar Lake (section 30, Smithfield), and several smaller bodies of water form the sources of Cedar Creek which flows down the slope to the southeast until it strikes the western border of the Wabash, Aboit moraine, and is turned to the southwest. These lakes, originally shallow, are being rapidly encroached upon by the growth of aquatic vegetation. The open water is surrounded by a wide border of quaking bog, so that a solid shore for launching or landing can hardly be found anywhere. The water swarms with vegetable and animal life, and furnishes an almost inexhaustible store of material for the naturalist. The artist, too, would find here many forms fit for his study and use. He would have only to copy and combine the shapes and tints of pickerel weed, spatter-dock, arrow-head and pond lily to form designs at once natural, beautiful and unique. The lakes are all approaching the verge of extinction, and in a few years or generations will become swamps, or, by artificial drainage, fertile farms. Some of the lakes of this region have met a different fate. Instead of being gradually filled with muck from the bottom, they have been buried alive by a growth of vegetation which has spread over the surface of the water. The L., S. & M. S. Railroad attempted to cross such a one three miles west of Waterloo, but the track fell through into water 40 to 60 feet deep. The "sink hole" was finally bridged with timber and old ties. The final stage of a lake, just before extinction, is often a tamarack swamp, of which there are many examples in the county. The largest, just west of Garrett, occupies more than a square mile, and still conceals within a small remnant of open water.

During the period of the melting glacier large quantities of water poured over the country in channels now much too large for the insignificant streams which occupy them. The soil was washed over, sorted out and rearranged, and the general unevenness of the surface was greatly reduced. The smoothing process is still going on, and many prominent features of topography have been obliterated or buried. At that time the St. Joseph River continued its southwest course into the Wabash through a channel now occupied by the Little River prairie from Fort Wayne to Huntington. The Maumee River had no existence, its present basin being partly occupied by the retreating ice, and partly by a lake which emptied into the St. Joseph, at Fort Wayne. There is abundant evidence to show that the latter river was originally much larger than at present, and flowed at a level about 25 feet above its present bed. Its valley in Indiana is seldom less than half a mile wide. The river is bordered by plains and terraces of fine sand, whose limits are sometimes indefinite, but usually marked by a distinct bluff. In sections 6 and 7, Newville, the east bank is bordered by a wide terrace 25 feet high for a distance of three miles. Where crossed by the Hicksville road it is broken by benches of three or four feet into three terraces. In sections 32, 29 and 28, Stafford, a series of low sand dunes rest upon this terrace and extend about two miles, the northern half along the right bank, and the southern half along the left bank, but at a distance of a quarter of a mile from the river. Opposite Spencerville, section 33, Concord, the bluff is 35 feet high, broken by a terrace 20 feet above low water, which extends up the river to a hummocky ridge of sand half a mile long, and 20 to 30 feet high. These peculiar features of terrace and dune are continued along the river in Allen County. The ridges exactly resemble kames, but their position indicates that they were formed by the action of water rather than by ice. Yet that the river ever stood high enough to flow over them seems a rather violent supposition.

Throughout the innumerable variations of soil in Dekalb County, one law prevails: upon the elevations the soil is clay, in the valleys sand and gravel. The railroad cut at Corunna shows 18 feet of clay underlaid by coarse sand, and this is a typical specimen. Continued observation has deepened the impression that the whole region was originally covered by a sheet of clay, which subsequent erosion has cut through and removed, except upon the higher points. The source and manner of deposit of this upper member of the drift is still an open question. That it was the surface load of the glacier and deposited by the final general melting of the mass, that it is the sediment from the waters of a post-glacial lake, and that it was dropped by floating icebergs, are each possible but hardly satisfactory theories. During the post-glacial subsidence of the waters and the rearrangement of materials, some remarkable results were accomplished. On the farm of A. Stapleton section 31, Stafford, in a basin

of about ten acres extent, under three or four feet of quaking muck, has been found a bed of calcareous clay of unusual character. Its color is a very delicate light gray, which darkens a little on exposure to the air. When wet it is so smooth and unctuous as to have led to the belief that it contains oil. When dry it forms a compact mass which can be polished until the surface resembles glass or marble. The dry powder is as fine and soft as flour without a particle of grit. It is alkoline in reaction and acts as a very efficient cleansing, scouring and polishing agent for all surfaces. On account of its tenacity it can be moulded into the most delicate ornamental designs, and specimens of pottery made from it burn extremely hard and of a light terra cotta color. The following analysis shows its chemical composition:

Calcium carbonate	15.00	per cent.
Magnesium carbonate	1.84	" "
Ferric oxide	4.52	" "
Silica	37.32	" "
Alumina	29.85	" "
Combined water	11.47	" "

Its physical characters are more remarkable than its chemical. It is genuine "rock-flour," which could be produced in no other way than by

* * * the slow and ponderous creep
Of ice a thousand fathoms deep.

By what delicate adjustment of currents was this flour sorted out from all admixture of coarser particles, and finally deposited by slow settling from still water until the basin of the little lake was filled with it to a depth of more than twenty feet. It is a product of glacial action as peculiar and characteristic as striated stones, and it ought to be distinguished by the name of *glacierite*.

The following section of the drift in the boring for gas at Butler is instructive:

"Hard-pan" (generally clay)	15	feet.
Gravel and coarse sand	275	"
Red quick sand	40	"
Clay (glacierite)	45	"
Cobble stones and bowlders	3	"
	378	"

The same stratum of bowlders at the bottom of the drift was struck in the boring at Garrett. Borings for gas have been made at four different localities in the county, sections of which are shown in the following table:

	Auburn.	*Garrett.*	*Butler.*	*Waterloo.*
Surface above sea level	872	892	867	887
Drift	280	378	378	365
Black shale	120	. .	108	. .
Limestone	963	1,050	1,064	. .
Shale	568	. .	500	. .
Trenton Limestone at . . .	1,937	1,912	2,050	. .
Total depth	1,964	2,220	2,139	. .

Boring No. 1 at Auburn yields gas estimated at 450,000 cubic feet per day. No. 2 was shot and filled with salt water; it nevertheless yields gas, the water being "blown off" once a day. A third boring is in progress. In the Butler well gas was obtained, but after being shot with 120 quarts of nitro-glycerine the well was filled up 200 feet and the flow stopped. The Waterloo boring yields a quantity of gas nearly equal to that at Auburn. The Garrett boring yielded no gas.

The drift of Dekalb county has furnished some interesting and unusual specimens. A mass of pure galena weighing ten pounds was found near Corunna. Near Fairfield Center a large bowlder of mica schist was full of crystals of colophonite, some as large as a hen's egg. A small nugget of pure copper found in Wilmington Township may have been an aboriginal importation free of duty, but the occurrence of the galena remains a mystery. That savage races often regard black stones as sacred is well known, and the conjecture is not unreasonable that the brilliant black mass of lead ore may have been brought to Indiana and treated as a god. Mastodon remains have been found in five different localities in the county, one in section 27, Smithfield, being remarkable because the bones, excellently preserved, were found not in a swamp but under four feet of blue clay.

Hon. R. Wesley McBride, of Waterloo, who has given much attention to the geology and archæology of his county, reports mounds and prehistoric remains as being very abundant. Out of mounds and fortifications examined by him in eleven different localities he has obtained a large collection of pottery, stone implements and human bones. From one mound near Waterloo the skeletons of at least twenty-five persons were exhumed. They had been thrown in promiscuously and covered with twelve or fifteen feet of charcoal.