

THE DRIFT OF THE WABASH-ERIE REGION—A SUMMARY OF RESULTS.

BY CHARLES R. DRYER.

The Wabash-Erie Region is a part of that shallow trough which continues the basin of Lake Erie southwestward across Ohio and Indiana. Along the axis of the trough extends one uninterrupted river channel, occupied, however, by different streams; from Lake Erie to Fort Wayne by the Maumee, thence for about twenty miles by a marsh known as the Little River prairie; thence by the Little Wabash River to its junction with the main stream below Huntington; and thence by the latter river. Down the sides of the trough nine streams of considerable size flow toward the central axis, arranged opposite each other, the Auglaize and the Tiffin, the St. Mary's and the St. Joseph, the Upper Wabash and the Aboit, the Salimonie and the Mississinewa opposite the Eel. Those upon the southern side occur at regular intervals and flow in symmetrical curves parallel with the southwest shore of Lake Erie. The drainage system as a whole is sagitate resembling an arrow with a four-barbed head. The general course of these tributaries is toward the western end of the trough and according to hydrographical precedents all ought to be tributaries of the Wabash, yet four are on the eastern side of the divide and turn back upon themselves in a remarkable manner. The St. Mary's, after flowing northward sixty miles, and the St. Joseph, after flowing southwestward eighty miles, unite to form the Maumee, which then turns abruptly to the northeast, so that in a course of ten miles the waters of the St. Joseph suffer a change in direction of more than 160 degrees. The behavior of these rivers is sufficiently peculiar to attract the attention of the casual observer of the map.

In the Report of Progress of the Geological Survey of Ohio for 1870, John H. Klippart has a chapter upon the Maumee Valley, in which he attributes the deflection of these rivers to the lake ridges or old shore lines of Lake Erie, which had then just been consecutively traced.

At the meeting of the American Association for the Advancement of Science at Dubuque, in August, 1872, Mr. N. H. Winchell read an

elaborate paper upon the Surface Geology of Northwestern Ohio (Proceedings of A. A. A. S., Vol. 21, page 152), in which he described six ridges between the west end of Lake Erie and the Indiana State line, and supposes them all to be moraines of recession made by a glacier which filled and passed up the St. Lawrence Valley across Northern Ohio into Indiana. He describes minutely the St. John's Ridge in Auglaize County, Ohio; the Wabash Ridge from Mercer County east to Crawford County; the St. Mary's Ridge along the east banks of the St. Mary's and St. Joseph Rivers; the Van Wert Ridge inside the St. Mary's and parallel with it; the Blanchard Ridge along the east banks of the Blanchard-Auglaize and Tiffin rivers, and the Belmore Ridge inside of and parallel with the Blanchard.

In the seasons of 1869 and 1870, Mr. G. K. Gilbert located these ridges north of the Maumee River, described two of them in the American Journal of Science and Arts for May, 1871, and in his report upon the Surface Geology of the Maumee Valley, (Geological Survey of Ohio, Geology, Vol. 1, page 572), published in 1873, clearly distinguishes two classes of ridges; lake beaches represented by the Belmore and Van Wert ridges, and moraines. Of the St. Mary's ridge he says: "I conceive that this ridge is the superficial representation of a terminal glacial moraine that rests directly on the rock bed and is covered by a heavy sheet of Erie clay, a subsequent aqueous and ice-berg deposit."

In this interpretation the sagacity of Mr. Gilbert recognized the existence of one of the most obscure moraines in the then unknown morainic belt of North America, and furnished a key to the structure of the Wabash-Erie region which subsequent observers have had only to apply. The moraines of the Maumee Valley were among the first to be recognized upon this continent, the work of Gilbert and Winchell antedating that of Chamberlain upon the kettle moraine of Wisconsin, of Upham upon the moraines of Minnesota and Iowa, of Cook in New Jersey, and of Lewis and Wright in Pennsylvania, Southern Ohio, and Indiana.

In the same report Gilbert describes the upper lake beach known as Van Wert ridge, and the prolongation of its two wings to form the Wabash-Erie channel from New Haven to Huntington, "through which the great Lake basin discharged its surplus waters southwestward into the valley of the Wabash."

The Third Annual Report of the United States Geological Survey, 1881-2, contains the report of T. C. Chamberlain upon the Terminal Moraine of the Second Glacial Epoch, in which what was then supposed to be the outer morainic belt is described and mapped from New Jersey to Dakota, and the hitherto isolated moraines of the Maumee Valley were brought into correlation with the general system.

Such was the state of knowledge when the writer took up the work in 1886, first in Allen County. In that year a careful examination of the

Wabash-Erie channel was made from New Haven to Huntington and the conclusion reached that the channel cuts through at least two moraines. The Wabash ridge was located along the right bank of the St. Joseph River extending to the mouth of the Aboit and the southwestern corner of Allen County. A map was made upon which were placed all the then described moraines of the Wabash-Erie region, including two ridges in Jay County, described by G. S. McCaslin in the Twelfth Report of the State Geologist of Indiana, the levels of the G. R. & I. R. R. from Fort Wayne to Ridgeville and of the F. W. C. & L. R. R. from Fort Wayne to Muncie were noted, and a working hypothesis formed that the courses and parallelism of the St. Mary's, the upper Wabash, the Salimonia the Mississinewa are due to the parallelism of four terminal moraines of the Erie glacier, the northern wings of which are crowded together in Huntington, Whitley, Allen, Dekalb, Noble and Steuben counties. This map was shown and hypothesis stated at the meeting of the Indiana Academy of Science in December, 1886.

In 1887 and '88 the work was continued under the direction of Maurice Thompson, then State Geologist, and was the first geological work done officially by the State upon the great drift region of Northern Indiana, the areas of Allen and Dekalb counties were surveyed and reports submitted which appear in the Sixteenth Report of the State Geologist. In 1889 the work was continued and completed in Whitley and Steuben counties, reports of which appeared in the Seventeenth Report of the State Geologist. In 1890, '91 and '92 some observations were made in Noble and Huntington counties. In 1893 the survey of Noble and Lagrange counties was completed.

In 1889 Mr. Frank Leverett, of the U. S. Geological Survey, examined and mapped the moraines of Northern Indiana. In January, 1890, the writer submitted to him a map showing the moraines as he found them. Mr. Leverett returned the map with additions and comments. Since that time the writer has been indebted to Mr. Leverett for valuable information and suggestions conveyed by correspondence and personal interview. In many instances his general knowledge of a wide area and the writer's minute knowledge of a limited area have happily supplemented each other.

The general result has been to confirm the working hypothesis adopted at the beginning. Four Erie moraines have been distinguished and correlated in Northeastern Indiana, and their relation to the Saginaw moraines determined. They have been named from the rivers along which they lie wholly or in part, and numbered first, second, third and fourth, westward from the St. Mary's, the first one distinguished by Gilbert more than twenty years ago.

The Van Wert Ridge of Gilbert and Winchell is not a moraine, but a former shore line of a glacial lake. It marks the highest level at which

the glacial waters of the Erie basin ever stood long enough to form a beach. Its elevation in Indiana is about 220 feet above the present level of Lake Erie. It enters Indiana in the northeast corner of Monroe Township, Allen County, and at the northeast corner of Allen County, the two wings converging to a point four miles east of Fort Wayne, where they do not meet, but turn westward, forming the banks of the Wabash-Erie channel. This channel, with a width varying from a half to one mile, passes from Fort Wayne southwestward to Huntington, and formerly carried the waters of the Erie basin and the St. Joseph and St. Mary's rivers to the Wabash. The height of the present bank on either side varies from forty to one hundred feet. The Van Wert Ridge is double in southern Allen County and, according to Gilbert, in northwestern Ohio, but the complete relations of the two members have not been worked out.* The body of water which formed these ridges has been called by the writer the Maumee Lake. It probably never occupied any part of the present basin of Lake Erie, which was then filled with ice. Its eastern boundary was the ice-foot when it stood along the line of the Blanchard moraine. The lake occupied an arrow-head shaped space, with its point at New Haven, the extremities of its barbs at Adrian, Michigan, and Findlay, Ohio, and the bottom of its notch at Defiance. It was an inter-morainic lake with an area of 800 or 1,000 square miles, and a maximum depth near Emerald, Ohio, of sixty feet.

The St. Mary's and St. Joseph, or First Erie Moraine, the St. Mary's Ridge of Gilbert & Winchell, enters Indiana in the northeastern part of Adams County, and follows closely the east banks of the St. Mary's and St. Joseph rivers to the northeast corner of Williams County, Ohio. In Adams and southern Allen it is perceptible only upon the map by its influence upon the course of streams. "It is like a dead wave upon the surface of the ocean, hardly perceptible to the eye on account of its smoothness, but revealed by its effect upon everything that encounters it." Its inner slope is gentle, its outer more abrupt. It is apparently composed of boulder clay and its crest is about eighty feet above the level of the river. In Wayne Township, Allen County, it becomes rolling and bluff, and is bordered by an extensive series of kames or eskers extending westward into the Wabash-Erie channel. In Adams Township it is cut by an old channel of the St. Mary's River, which emptied into the Maumee Lake at New Haven. In Northern Allen it is more strongly defined, has a width of four or five miles, and is bordered by the Van Wert Ridge. Its elevation is 800 feet A. T. at its apex at Fort Wayne, and rises to 900 feet at its extremities in Ohio.

The Wabash-Aboit, or Second Erie Moraine, the continuation of the Wabash ridge of Winchell, enters Indiana at the southeast corner of

*Leverett On the Correlation of Maraines with Raised Beaches of Lake Erie, Am. Journ. of Science, April, 1892.

Adams County and follows the right bank of the Wabash River to Lancaster Township, Wells County, where the present river bends to the west, but an old channel of the Wabash, now occupied in part by Flat Creek, follows the outer face of the moraine to the Wabash-Erie channel at the north line of Union Township, Huntington County. The outer border of the moraine in northern Wells is a line of bluffs fifty to seventy feet high. The moraine widens in Lafayette Township, Allen County, and rises to a level of more than 100 feet above the Wabash-Erie channel. On the north side of that channel, its outer face is marked by the valley of the Aboit River and the Eel River marshes in Lake and Eel River townships. It increases in width to the northeast, from five miles in Allen to eight in Dekalb, and occupies the space between the St. Joseph River and Cedar Creek. Cedar Creek, Fish Creek and other tributaries of the St. Joseph follow the outer face of the moraine for ten or more miles, then, turning at a right angle, cut directly through it to the St. Joseph. The gorge of Cedar Creek is fifty to 100 feet deep and 800 to 1,000 feet wide; that of Fish Creek of smaller dimensions. The moraine is a broad, rolling table land, its general crest-level about 100 feet above the St. Joseph and fifty feet above the interval on the west. The chief material is gravelly clay, but more of sand and gravel appear upon its surface than upon the first moraine, which it resembles, except in being more massive. Its elevation increases from 870 feet at its apex to 1,000 feet in Southern Michigan and 950 feet in Hardin County, Ohio.

The first and second moraines are well-defined ridges, but present only occasional evidences of the peculiar topography usually regarded as characteristic of terminal moraines. Hills, knobs, kames, kettle holes and lakes are chiefly conspicuous by their absence.

The valley of the St. Joseph River, about half a mile wide, is hemmed in between the first and second moraines. It is marked by frequent kame-like dunes and by terraces twenty to thirty feet above the present river level, corresponding to the summit-level of the Wabash-Erie channel. The river was once a much larger stream, flowing at a higher level, being, in fact, the Upper Wabash, which the outlet of the Maumee Lake joined at Fort Wayne.

The Salimonia, or Third Erie Moraine, the continuation of the St. John's ridge of Winchell, lies along the right bank of the Salimonia River in Jay, Wells and Huntington counties. Compared with the other moraines, it is weak, diffused and inconstant in character. In Huntington County, it is broken up into several narrow strips; in southern Whitley, it is represented by a mild boulder belt. Its northern wing extends through northeastern Whitley, northwestern Allen, southeastern Noble, northwestern Dekalb and eastern Steuben counties. It is separated from the second moraine by an interval of three miles, and from

the fourth by the valley of Blue River in Whitley and Upper Pigeon River in Steuben. In Noble and Dekalb the third and fourth moraines are contiguous and partially coalescent, but the former is distinguishable by its lower level and milder topography. Its elevation varies from 800 feet in Huntington County to 1,073 feet at the Michigan line, and 1,063 feet at St. John's, Ohio. Its width varies from 4 to 6 miles.

The Mississinewa, or Fourth Erie Moraine, enters Indiana in the southern part of Jay County, follows the right bank of the Mississinewa River to Wabash County, passes through eastern Wabash, western Whitley, eastern Noble, northwestern Dekalb and western Steuben. In Whitley it is bordered on the west by a level interval; in Noble, Lagrange and Steuben, by an irregular fringe of Saginaw drift. It is joined by five terminal moraines of the Saginaw glacier. North of Wabash County it is 6 to 8 miles wide, and of the most rugged and massive character, rising to a climax of elevation and ruggedness in northern Steuben. It is cut by the valley of the Wabash at LaGro; the valley of Eel River in Whitley, and the valleys of Turkey Creek, Pigeon River and Fawn River in Steuben. Its elevation varies from 700 feet at LaGro to 1,200 in northern Steuben and 1,050 in southern Jay. In Noble County it has a vertical thickness of nearly 500 feet.

The approximate limit of Erie drift can be traced from the northeast corner of Wabash County through South Whitley, Larwill, the foot of Crooked Lake in Noble County, Albion, Brimfield, Rome City, Tamarack, Hogback, Grass and Gage lakes to a point near the middle of the north line of Steuben County.

The four Erie moraines show progressively a change of form from sagittate to crescentic, a depression of their apices, an elevation of their extremities, a crowding together of their northern wings and a shifting of their apices southward. Most of these phenomena are the result of the obstruction offered by the Saginaw glacier, which, though comparatively feeble, had pre-occupied the country north of the Wabash River. The northern curve of the extremity of Erie lobe impinged against the side of the Saginaw lobe, hence the Saginaw-Erie interlobate moraine of Chamberlain is interlobate or lateral only with reference to the Saginaw lobe, but strictly terminal with reference to the Erie lobe, and by far the greater part of its bulk was contributed by the latter.

The less massive Saginaw glacier retreated first and left the country open for free and rapid drainage from the melting Erie ice, which for a long time continued to occupy its bed, and to discharge drift-laden streams into the present valleys of the St. Joseph of Lake Michigan and the Kankakee. Thus the material upon the Saginaw side was extensively washed and redistributed, many original features were obliterated by removal or burial and a system of deep channels established which were subsequently partially filled. After the ice had retreated to the line of

the second moraine, drainage was through Cedar Creek and the Aboit and Eel rivers into the Wabash. During the formation of the first moraine the St. Joseph-Wabash channel was opened, into which the St. Mary's emptied. The gorge of Cedar Creek probably at first transmitted water westward until the filling up of the interval between the second and third moraines and the opening of the St. Joseph channel reversed the current. Out of the present Maumee basin there was no drainage until the ice began its retreat from the St. Mary's moraine leaving behind the growing Maumee Lake, which found an outlet into the St. Joseph. The Erie glacier advanced up hill and during the whole period of retreat from the fourth moraine, the waters, failing to find adequate outlet, were set back under the ice, establishing conditions favorable to the deposition of sub-glacial and lacustrine clays, the Erie clay of Logan.

The advance of the Erie ice into that part of Indiana north of the Wabash-Erie channel was marked by a prolonged period of obstruction, struggle and confusion, followed by a slow and disorderly retreat. In the region south of that channel each step was taken with good order and precision. A periodic retreat of fifteen miles, the building of a morainic breastwork in front of its outer line, and the establishment of a drainage channel along the outer face of the moraine were four times repeated. Hence the symmetrical parallelism of the southern tributaries of the Wabash. As soon as ice and water had retreated to the present basin of Lake Erie the Maumee River came into existence and attained its maturity by the piratical appropriation from the Wabash of the St. Mary's and St. Joseph.

The work of the Saginaw glacier, so far as it can now be distinguished in Noble and Lagrange counties, was feeble, fitful and capricious. Besides its comparatively trifling contribution to the interlobate moraine, it has left vestiges of four or five terminal moraines, broken and irregular in their course, and characterized by diffused aprons and fringes, isolated outliers and local developments of unaccountable magnitude and strength. The glacial invasion of northeastern Indiana is a story of advance in double but unequal columns, of prolonged struggle between them, of defeat and evacuation on the part of the weaker forces and of deliberate but final retreat of the stronger from the field of battle.