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Information Circular No. 25

THE BEACH RIDGES OF NORTHERN OHIO

By

Jane L. Forsyth

COLUMBUS
1959

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Some years ago, Frank Carney mapped the glacial lake beaches of northern Ohio. This mapping, accompanied by an extensive text, is to appear as a bulletin of the Ohio Geological Survey sometime within the next few years. A small-scale generalized map of these beaches has been drawn from his detailed mapping and will be included in that report. In order to make this generalized map available before publication of the large report, however, it is being published in this small circular, together with a brief summary of the glacial lake history drawn together by Jane L. Forsyth.

The Beach Ridges Of Northern Ohio

Low continuous sandy ridges are present throughout wide areas of northern Ohio. Roads commonly follow these ridges and many early homes were built on them. Because of their sandy nature, pits for the removal of sand have been opened in them in many places and the early inhabitants located their cemetaries here where digging was easy and drainage was good.

Although most people are aware of these ridges, very few people know why they are there or how they were formed. Each ridge represents an ancient beach, formed along the shore of Lake Erie at a time in the past when the elevation of the lake was much higher than it is today. These higher lake levels, which were as much as 200 feet higher than modern Lake Erie, were caused by damming, to the north, by the glacier which once covered Ohio. The lake first appeared when the edge of the ice had retreated far enough north out of the state so that a depression formed along its southern margin, located in the Lake Erie basin area. No eastern outlet was available to this lake, so drainage was to the west along the edge of the glacier to the Mississippi River, through an outlet that was much higher than that of today. As the ice front continued to retreat, a sequence of new and lower outlets became exposed, so that the level of the lake lowered and the outlines of the lake (and of the beach patterns) changed. Several times the ice readvanced somewhat, causing the lake level to rise again and to submerge beaches made during a previous stage, smoothing them and causing the materials of which they were composed to become scattered. Because the lake had different outlines at each of the different stages, each stage being marked by a separate set of beaches at a characteristic elevation, different names were applied to each stage. The chronological history of the different lake levels, which has been interpreted from a study of the beach ridges, is outlined briefly below and is shown, in tabular form, in the accompanying chart.

Lake Maumee I The first lake came into existence when the ice front had receded far enough to the north so that a basin was uncovered which was blocked to the north by the ice and to the south by the Ohio divide (east-west height of land in Ohio which separates the north-flowing and south-flowing drainages). This first lake, called Maumee I, is identified by beaches which characteristically occur at an elevation of 800 feet (Figure 2). Drainage from the lake was to the west through Indiana to the Mississippi River, by way of the Maumee amd Wabash Rivers.

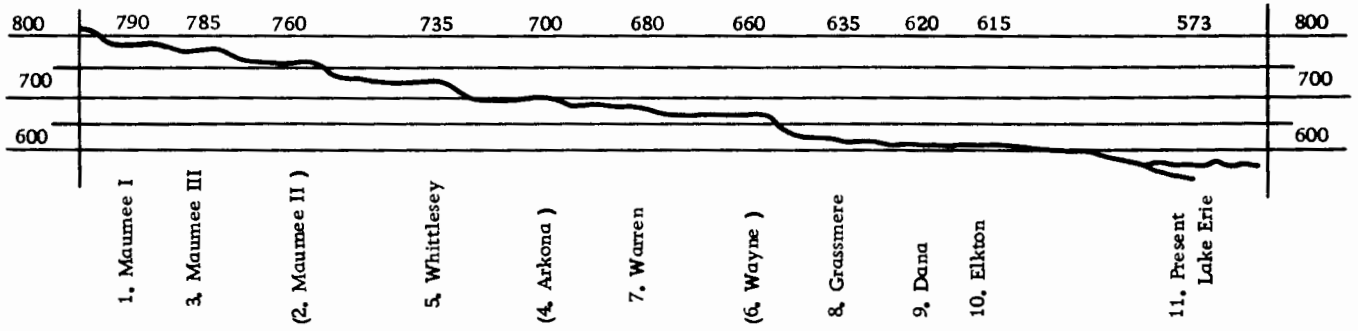
Because the ice still covered most of the Lake Erie basin at that time, Lake Maumee I was present only in the southwestern part; its beaches are not found east of Findlay because, to the east, there was still ice. This ice is known to have been present there partly because of the lack of beaches that far east and partly because of the presence of the Defiance moraine, a broad low east-west ridge of glacial clay occurring at the north edge of Findlay and farther east, which marks the edge of the ice. The glacial clay, called "till", of which this moraine is composed, can be observed in places lying directly on lake clays which were deposited earlier. Subsequent lakes have left beach deposits on the Defiance moraine; only beaches of Lake Maumee I are lacking because of the contemporaneity of this first lake and the ice which deposited the Defiance moraine.

MAJOR PLEISTOCENE LAKE LEVELS OF THE ERIE BASIN IN OHIO

All the major Pleistocene lake beaches of the Erie basin in Ohio are listed in the chart below, arranged chronologically from the bottom up. For each is given, also, the age, the elevation of the beach, the geologic reason for the change in lake level, the outlet of the lake, and the moraine (if any) built at the same time. The names of the lakes with the best-defined beaches are underlined. The diagram at the bottom of the page is a generalized cross-section, drawn to illustrate the topographic sequence of these lake beaches which lie above present lake level. Beaches later covered by a higher water level are in parentheses.

Substage	Radiocarbon years ago	Order	Lake	Elevation	Reason for change in level	Outlet	Contemporaneous moraine
RECENT		13.	Erie (modern)	573'	Isostatic uplift to the north	Niagara River	-----
		12.	Erie (Early Algonquin)	535'?	Continued ice retreat	Kirkfield to L. Iroquois	-----
		11.	Erie (early)	550'?	Continued ice retreat	Niagara River	-----
		10.	Lundy (Elkton beach)	615'	Erosion of outlet (continued ice retreat)	Mohawk R., N.Y. or west to L. Calumet and Miss. R.	-----
		9.	Lundy (Dana beach)	620'	Erosion of outlet (continued ice retreat)	Mohawk R., N.Y. or west to L. Calumet and Miss. R.	-----
		8.	Lundy (Grassmere beach)	640'	Retreat of ice	Mohawk R., N.Y. or west to L. Glenwood and Miss. R.	-----
	9640						
		7.	Warren	680-665'	Continued ice advance	Grand River, Michigan	Valders red drift and Niagara Falls moraine
		6.	Wayne	660'	Advance of the ice	Mohawk River, N.Y.	-----
TWO CREEKS	11,400		Low water stage	573'? or lower?	Extensive retreat of ice	Niagara River and St. David (Whirlpool) filled gorge	-----
MANKATO		5.	Whittlesey	735'	Readvance of ice	Grand River, Mich. via Ubly	Port Huron (Mich.) and moraine crossing L. Erie at Erie, Pa.
	13,000						
		4.	Arkona	710-690'	Retreat of ice and erosion of outlet	Grand River, Mich.	Galt (Ontario)
		3.	Maumee III	780'	Readvance of ice	Wabash River, Ind.	Lake Border
		2.	Maumee II	760'	Continued retreat of ice	Grand River, Mich., via Imlay	-----
		1.	Maumee I (present only in western lake basin)	800'	Formation of first major depression between ice and state divide	Wabash River, Indiana	Defiance
	14,000	0.	-----	-----	-----	-----	Fort Wayne

DIAGRAM OF EXPOSED BEACHES



Data compiled from Leverett 1902, Leverett and Taylor 1915, Hough 1958, Goldthwait 1958; substage names in accordance with recent changes by Wright and Rubin 1956 and Leighton 1957.

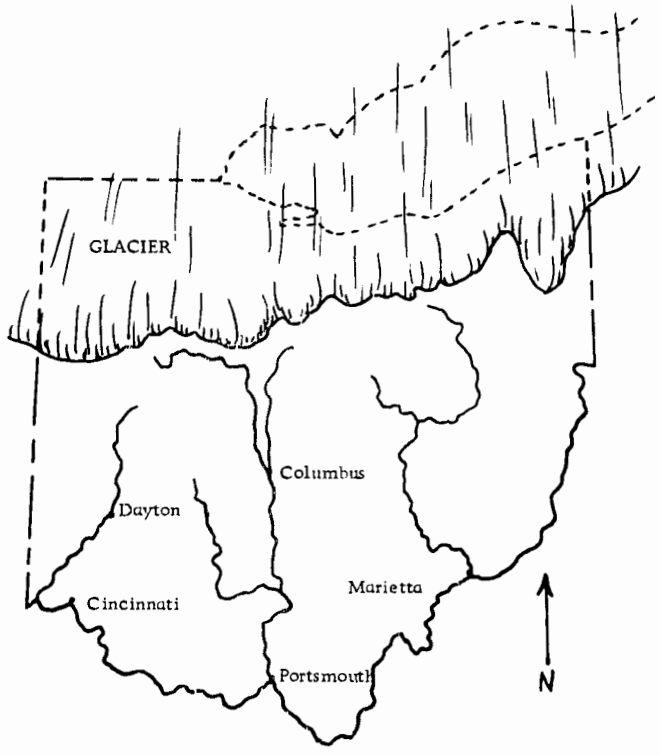


Figure 1. Fort Wayne moraine (pre-lake) stage.

None of the Lake Maumee I beaches are strongly developed. They may be best observed along the northwestern edge of the lake between Hicksville, Bryan, and West Unity, on the Bryan and Alvordton quadrangles.

Lake Maumee II After the deposition of the Lake Maumee I beaches, the ice retreated somewhat allowing the lake to drain westward by a new, lower outlet through Michigan (through the Grand River by way of the Imlay channel), thus establishing a new lake, called Maumee II, at an elevation of 760 feet. Beaches associated with this lake are present across most of northern Ohio, showing that, by this time, the ice edge had retreated northward to or beyond the boundary of the state.

The beaches of Lake Maumee II are not prominent topographic features because they were subsequently submerged by a rise in lake level caused by a minor readvance of the ice. Good examples of beaches associated with this lake occur in a number of localities: four miles west of Delphos (Delphos quadrangle), near Columbus Grove (Columbus Grove quadrangle), between McComb and Fostoria (Deshler-Findlay-Fostoria quadrangles), seven miles southwest of Vermilion (Vermilion quadrangle), and northwest of Bellevue where the beach sand has mostly been redeposited in the form of dunes (Bellevue quadrangle). Chestnut Ridge east of Elyria and Murray Ridge west of Elyria (Oberlin quadrangle) are Maumee II beaches.

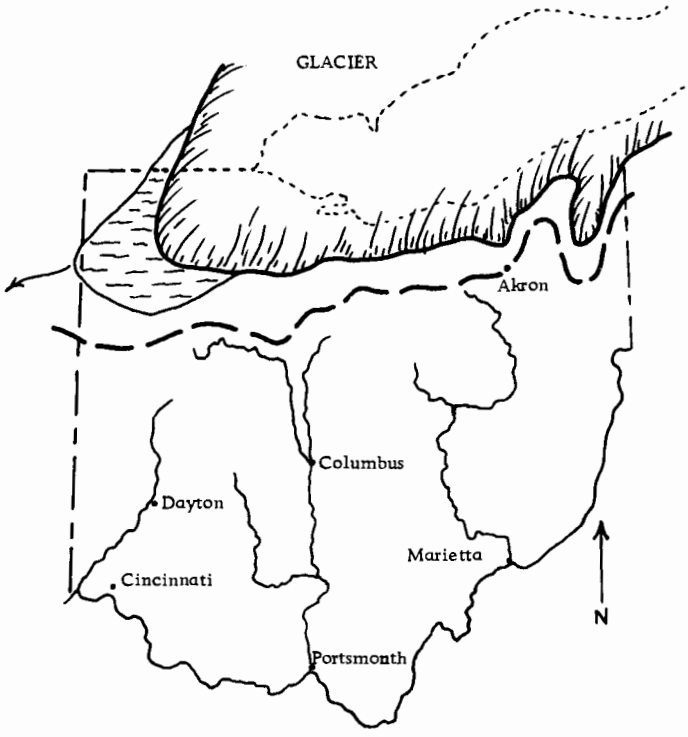


Figure 2. Lake Maumee I

Lake Maumee III With a readvance of the glacier, the Grand River (Michigan) outlet was blocked by ice, causing the lake drainage to shift back to the Maumee-Wabash River route through Indiana (this interpretation, which is different from the standard view of Leverett and Taylor of 1915 is from Hough 1958, p. 145), thus forming a new and higher lake at an elevation of 780 feet, which flooded the Lake Maumee II beaches. This lake, which is called Maumee III (Figure 3), has the highest, most characteristically developed, and most extensive beaches of any of the Maumee lake levels; indeed, these are some of the best examples of any of the beaches present anywhere in the glacial lake area of northern Ohio. Because this beach is so prominent and, by virtue of its sand and gravel content, so well drained, a number of highways are located on it: route US 30 west of Delphos, route 12 from Delphos to Findlay, route 113 from Leipsic to Fostoria, route 18 from Van Buren to Tiffin, route 101 from Tiffin to west of Bellevue, and route 10 southeast of Elyria. Particularly good places to observe the Maumee III beach are: north of Ottawa (Ottawa quadrangle), near Bellevue (Bellevue quadrangle), and near Elyria and Berea (Oberlin quadrangle). In the Elyria area the Maumee III beach is called Butternut Ridge; in Putnam County it is called the Leipsic Beach (Deshler-Ottawa quadrangles).

Lake Maumee III beaches are present along the entire length of the Erie basin in Ohio, as are all the younger beaches; this means that, by Lake Maumee III time, the glacial front had retreated out of the state to the north. The ice actually never returned to Ohio again, but it still controlled the development of several more different lake stages, by oscillations of its margin which covered and uncovered outlets and by diminishing in thickness and therefore in weight, causing the land to rise.

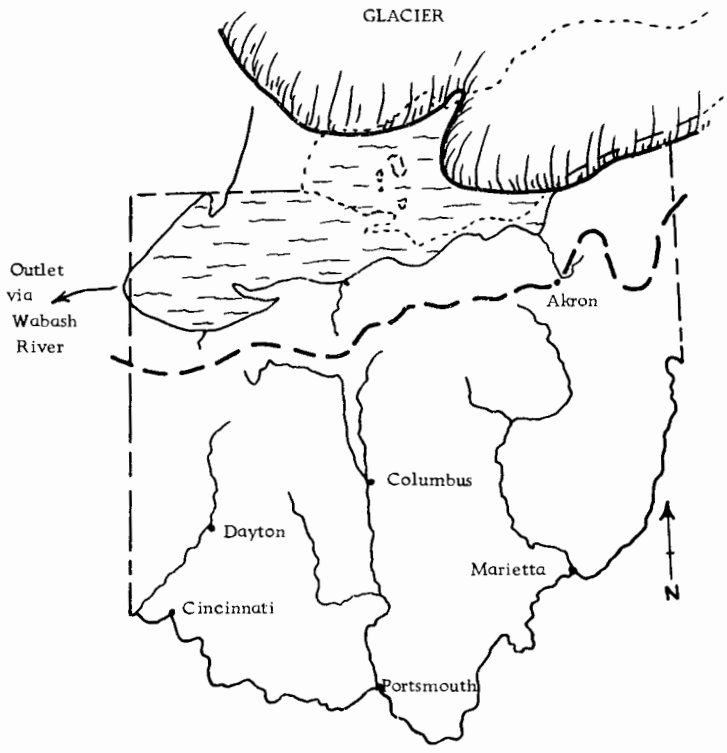


Figure 3. Lake Maumee III

Lake Arkona As the ice retreated at the end of Lake Maumee III time, a new and lower outlet through Michigan (Grand River) became available, so that the lake level in the Erie basin dropped to 710 feet elevation. This new lake, called Lake Arkona, produced beaches which are now very discontinuous and indistinct. The obscurity of these beaches is attributed to the fact that the outlet of the lake was continuously being eroded during its use, thus slowly lowering lake level and producing only poorly defined beaches at several different elevations, all of which were submerged by the next lake.

Lake Arkona beaches are best observed along Rocky Ridge five miles northeast of Elyria (Oberlin quadrangle), eight miles north of Fostoria (Elmore quadrangle), and along a northeast-southest line near Swanton (Swanton quadrangle). The beaches are not sufficiently prominent for roads to have been located on them.

Radiocarbon dates are available which date the end of glacial Lake Arkona. Near Cleveland, where Goldthwait (1958, p. 218) says that the sample "represents the water rise at the end of Lake Arkona", the date is 13,600±500 (W-33). At the junction of Ohio route 4 and the Ohio Turnpike, south of Sandusky, wood occurs "underlying a good shingle beach of Lake Whittlesey" (Goldthwait 1958, p. 218) and the date is 12,920±400 (W-430). Since the ice was still present at its southernmost maximum position (Wisconsin stage) near Chillicothe and Cincinnati about 18,000 years ago (according to radiocarbon dates quoted by Goldthwait 1958), the glacier must have taken only about 5000 years to dissappear from Ohio.

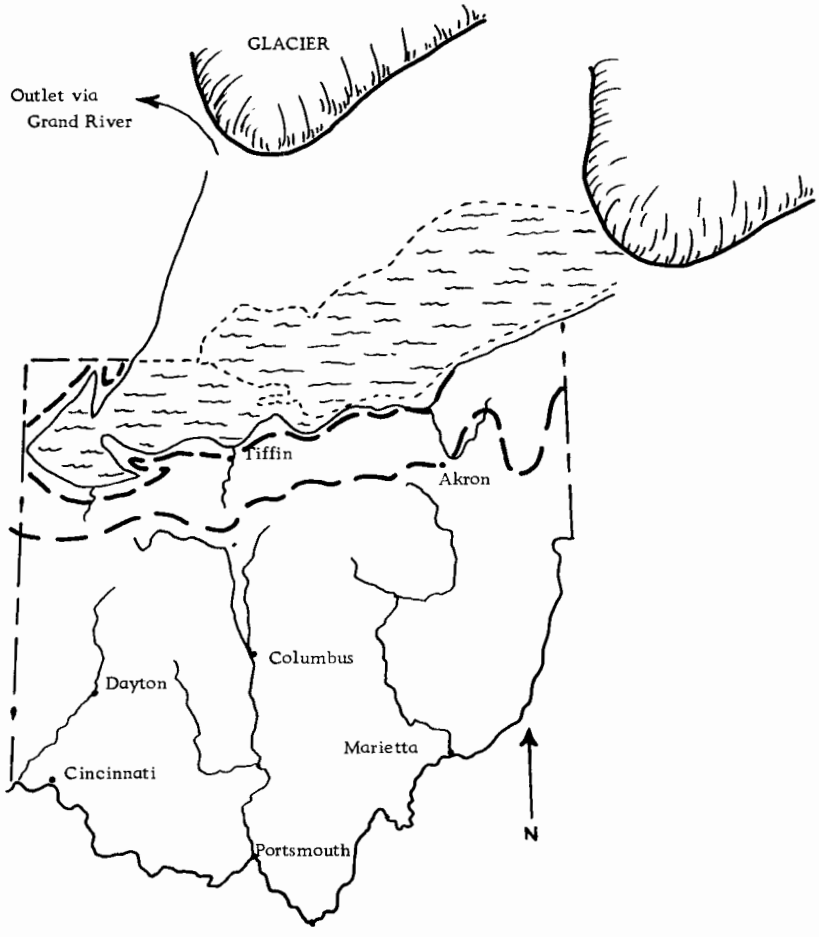


Figure 4. Lake Whittlesey

Lake Whittlesey A major readvance of the glacier buried the older Arkona outlet with ice and forced the drainage the shift back to the Ubly channel to the Grand River, across central Michigan. The lake formed by this readvance, named Lake Whittlesey (Figure 4), had an elevation of 735 feet.

The ice edge at this time stood not far to the north, at the massive Port Huron moraine in northern Michigan and its eastern correlatives in Ontario. A low ridge across the bottom of Lake Erie at Erie, Pennsylvania, probably represents the extension of the moraine eastward across the Erie basin (Hough 1958, p. 149).

In general, the beaches of Lake Whittlesey are the highest and most prominent of all the glacial lake beaches in northern Ohio. Their heighth and steepness increase to the east, apparently because, in this part of the basin, the fetch (extent of open water over which the wind blows)was greater, with the prevailing westerly winds, thus producing larger beaches. Near Ashtabula, the Whittlesey beaches reach the striking heighth of 70 feet, far greater than any other beach anywhere in Ohio. Toward the west, where beaches are considerably smaller, the Whittlesey beaches are only 10 to 15 feet high, but they still form prominent ridges.

The Whittlesey beaches are consistent features throughout the lake plain area and may be observed almost anywhere at an elevation of 735 feet. They are followed by route US 20 west of Norwalk, route 61 east of Norwalk, US 20 from Elyria to Westlake, and route 84 from Painesville to Ashtabula. Particularly good localities for observing them are: southwest of Ashtabula where they are so high (Ashtabula quadrangle), near Willoughby (Mentor quadrangle), north of Berea (Berea quadrangle), near Elyria where the beach is called Middle Ridge (Oberlin quadrangle), north and west of Bellevue (Bellevue quadrangle), and at Kansas (Fostoria quadrangle). Just east of Defiance, the Whittlesey beach is double, forming two "V"-shaped patterns to the north and south (see map of beaches), which mark the two sides of the breached Defiance moraine. (The Defiance moraine is low and smooth here because, after its deposition in Maumee I time, it was submerged by Lake Maumee III.)

Following Lake Whittlesey time, there was an extensive retreat of the glacier, which drastically lowered water level. At its lowest position, the lake level appears to have been far below the present level of Lake Erie. In the Niagara gorge area, there is a valley filled with glacial drift, the so-called St. David gorge, which lies somewhat west of the present valley and intersects it at the whirlpool. The whirlpool occurs here because the fill of this valley is so much less resistant to erosion than the bedrock of the old valley sides that an enlarged basin has been formed. Hough (1958, pp. 150-151) believes that this filled valley is the one through which the drainage of the post-Whittlesey low level lake flowed. When the glacier readvanced, this gorge was filled completely with drift so that, following the subsequent retreat of the ice edge, the overflow of Lake Erie established a new route, the present course of the Niagara River.

Lake Wayne As the glacier, then far to the northeast in Ontario, readvanced somewhat, a new level, called Lake Wayne, was established at an elevation of 660 feet. Drainage was still to the east, although the advancing ice had shifted the outlet in New York from the Niagara River to the Mohawk River valley.

Lake Wayne beaches are low and are lacking in many areas because they were submerged by a subsequent rise of the lake level. Beaches of this stage may be observed north of Elyria (Oberlin quadrangle) and between Whitehouse and Sylvania (Swanton-Maumee quadrangles).

Lake Warren As the glacier, still far to the northeast, continued to advance, the level of the lake rose more than a hundred feet to a maximum elevation of 680 feet, forming Lake Warren (Figure 5). The ice advanced far enough so that, for this one brief additional period, the eastern outlet was again blocked and the lake drained to the west through central Michigan.

The area covered by the advance of this ice is outlined in northern Michigan by till with a characteristic red color called Valders. Contemporaneous drift has been identified in southern Ontario and in western New York; this is the drift which filled the St. David gorge in the Niagara region.

Beach ridges of the Warren stage are strikingly sandy and gravel is rare. Sand is so abundant in the western half of the state that sand dunes are more common than beach ridges. Furthermore, in the west, the lake was rather shallow and, as a result, many patchy areas of dunes and beaches occur in what must have been offshore positions, in places associated with low islands.

Route US 20 in northeastern Ohio follows one of several Warren beach ridges from the Pennsylvania line to Lakewood; west of Lakewood Ohio 254 is the route which follows the

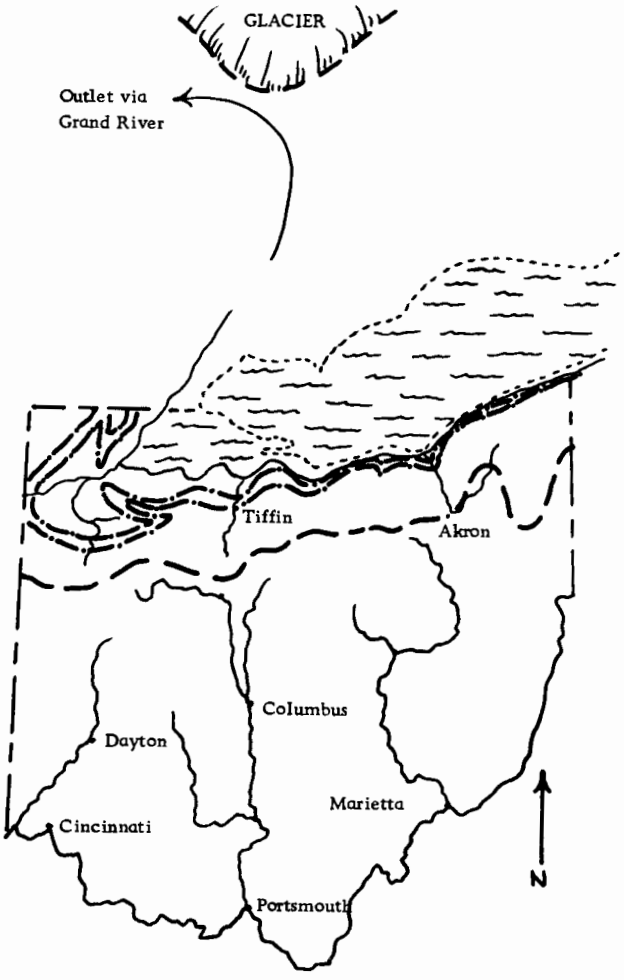


Figure 5. Lake Warren

Warren beaches and between Clyde and Castalia it is route 101. These ridges are good examples of beaches characteristic of this lake stage; those in the western part of the state are less pronounced, but they are still clearly identifiable. North Ridge in the Berea-Elyria area (Oberlin quadrangle) is one of the best examples of a Warren beach ridge. Warren dunes occur in patches in many areas, such as near Bradnor (Elmore quadrangle) and southeast of Milan (Sandusky quadrangle).

Lake Lundy A new lake, Lake Lundy, was initiated when the glacier began to retreat from southern Ontario. This retreat carried the ice edge so far north that it was never again of any real significance in Ohio lake history. It is believed by most people that the outlet of Lake Lundy was to the east through the Mohawk River valley (Leverett and Taylor 1915, p. 399). Hough has published a different hypothesis, however, in which he suggests that Lake Lundy drained north and west around Michigan, then into the glacial lakes occupying the basins of Lake Huron and Lake Michigan, and thence into the Mississippi River (Hough 1958, pp. 152-161).

As erosion occurred at the outlet of Lake Lundy, three minor lake phases occurred. Beaches associated with these levels are discontinuous and indistinct. However, because each level is marked by a set of beaches at a consistent elevation, each stage has received a separate name: Grassmere at an elevation of 640 feet, Dana at 620 feet, and Elkton at 615 feet. All of these beaches are low and inconspicuous in the few places where they are present. The Dana beaches are not shown on the map accompanying this report.

The best places to observe the different levels are:

Grassmere: near Geneva (Ashtabula quadrangle), east of Cleveland (Euclid quadrangle), and five miles southeast of Sandusky (Sandusky quadrangle).

Dana: not mapped (mainly in the Ontario basin).

Elkton: four miles north of Willoughby (Mentor quadrangle) and four miles south of Sandusky (Sandusky quadrangle).

Lake Erie When a large part of the earth's crust is subjected to a heavy load for a long period of time, it depresses somewhat, like a mattress under a load of books. While the load is present, the surface remains depressed, in adjustment to the load; when the load is removed, the surface raises up again, but only after a short period of lag. The heavy load applied to Ohio was the glacier. Not immediately after the retreat of the ice, but a short time after, the glaciated land of Ohio and the neighboring area rose slightly. As a result of this, the glacial lakes could no longer drain northwestward and then southward into the Mississippi River or eastward by the Mohawk valley (the two hypotheses), so the outlet was again to the northeast by the Niagara route. Modern Lake Erie is considered to have begun when this change took place. Because the ice had left the Niagara area such a short time previous, however, this area had not yet completely risen to its present elevation. As a result, the lake formed at this time was lower than modern Lake Erie (573 feet). The position of sandy material on the bottom of Lake Erie suggests that the lake stood about 20 to 30 feet lower than today at that time (Leverett and Taylor 1915, p. 442). The erosion of the modern Niagara gorge was begun at this time.

For a short time, as the ice retreated from central Ontario, part of the Lake Erie drainage flowed north into Lake Huron and then east by a temporary route near Kirkfield, Ontario,to Lake Iroquois (Ontario). This was possible only because the land there was still so much depressed from the weight of the ice that had just retreated from the area. Because the outlet was so low, the level of Lake Erie (sometimes called Early Lake Algonquin) was about 10 to 15 feet lower than that of the previous low level. (Leverett and Taylor 1915, p. 442). It was only a short time until the Kirkfield area raised up to its present elevation. At this time this outlet was abandoned and, since then, all the drainage from Lake Erie and most of that from all the Great Lakes has been to the east over Niagara Falls.

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BEACH RIDGES OF THE GLACIAL LAKES

Generalized from mapping
by
Frank J. Carney

LEGEND

- Lake Lundy, Elkton beach
- Lake Lundy, Grassmere beach
- Lake Wayne
- Lake Warren
- Lake Arkona
- Lake Whittlesey
- Lake Maumee II
- Lake Maumee I and III

LAKE ERIE

PERRY
ASHTABULA
CONNEAUT
LAKE
GEAUGA
CUYAHOGA
LORAIN
MEDINA
SUMMIT
PORTAGE
TRUMBULL
MAHONING
ERIE
HURON
SANDUSKY
CRESTLINE
KELLEYS ISLAND
EUCLID
CLEVELAND
CHAGRIN FALLS
GARRETTSVILLE
BRISTOLVILLE
KINSMAN
ANDOVER
JEFFERSON
CHARDON
MENTOR
WILLOUGHBY
ELYRIA
OBERLIN
VERMILION
BEREA
AKRON
KENT
RAVENNA
WARREN
YOUNGSTOWN
ALLIANCE
NORWALK
NEW LONDON
WELLINGTON
MEDINA
BARBERTON

DRAFTING BY HAROLD J. FLINT

PIONEER
ALVORDTON
WAUSEON
SWANTON
TOLEDO
MAUMEE BAY
OAK HARBOR
PUT-IN-BAY
KELLEYS IS
BELLEVUE
SANDUSKY
BRYAN
DEFIANCE
NAPOLEON
MC CLURE
BOWLING GREEN
ELMORE
FREMONT
PAULDING
CONTINENTAL
OTTOWA
DESHLER
FINDLAY
FOSTORIA
TIFFIN
SIAM
NORWALK
VAN WERT
DELPHOS
COLUMBUS GROVE
BLUFFTON
ARLINGTON
UPPER SANDUSKY
SYCAMORE
BUCYRUS
CRESTLINE
WILLIAMS
FULTON
LUCAS
OTTAWA
SANDUSKY
SENECA
HURON
PAULDING
PUTNAM
ALLEN
HANCOCK
WYANDOT
CRAWFORD
RICHLAND
HARDIN
DEFIANCE
HENRY
WOOD
VAN WERT
Defiance Moraine