Guidebook for the 44th Midwest Friends of the Pleistocene Field Conference

Environments and processes along the margin of the Laurentide Ice Sheet in north-central Wisconsin

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Wisconsin Geological and Natural History Survey
Open-File Report 1998-01

Meetings of the Midwest Friends of the Pleistocene

1	1950	Eastern Wisconsin	Sheldon Judson
2	1951	Southeastern Minnesota	H.E. Wright, Jr. and R.V. Ruhe
3	1952	Western Illinois and eastern Iowa	P.R. Shaffer and W.H. Scholtes
(4)	1953	Northeastern Wisconsin	F.T. Thwaites
(5)	1954	Central Minnesota	H.E. Wright, Jr., and A.F. Schneider
6	1955	Southwestern Iowa	R.V. Ruhe
(7)	1956	Northwestern lower Michigan	J.H. Zumberge and W.N. Melhorn
8	1957	South-central Indiana	W.D. Thornbury and W.J. Wayne
9	1958	Eastern North Dakota	W.M. Laird and others
10	1959	Western Wisconsin	R.F. Black
11	1960	Eastern South Dakota	A.G. Agnew and others
12	1961	Eastern Alberta	C.P. Gravenor and others
13	1962	Eastern Ohio	R.P. Goldthwait
14	1963	Western Illinois	J.C. Frye and H.B. Willman
15	1964	Eastern Minnesota	H.E. Wright, Jr. and E.J. Cushing
16	1965	Northeastern Iowa	R.V. Ruhe and others
17	1966	Eastern Nebraska	E.C. Reed and others
18	1967	South-central North Dakota	Lee Clayton and T.F. Freers
19	1969	Cyprus Hills, Saskatchewan and Alberta	W.O. Kupsch
20	1971	Kansas–Missouri Border	C.K. Bayne and others
21	1972	East-central Illinois	W.H. Johnson and others
22	1973	West-central Michigan and east-central Wisconsin	E.B. Evenson and others
23	1975	Western Missouri	W.H. Allen and others
24	1976	Meade County, Kansas	C.K. Bayne and others
25	1978	Southwestern Indiana	R.V. Ruhe and C.G. Olson
26	1979	Central Illinois	L.R. Follmer and others
27	1980	Yarmouth, Iowa	G.R. Hallberg and others
28	1981	Northeastern lower Michigan	W.A. Burgis and D.F. Eschman
29	1982	Driftless Area, Wisconsin	J.C. Knox and others
30	1983	Wabash Valley, Indiana	N.K. Bleuer and others
31	1984	West-central Wisconsin	R.W. Baker
32	1985	North-central Illinois	R.C. Berg and others
33	1986	Northeastern Kansas	W.C. Johnson and others
34	1987	North-central Ohio	S.M. Totten and J. P. Szabo
35	1988	Southwestern Michigan	G.J. Larson and G.W. Monaghan
36	1989	Northeastern South Dakota	J.P. Gilbertson
37	1990	Southwestern Iowa	E.A. Bettis III and others
38	1991	Mississippi Valley, Missouri and Illinois	E. R. Hajic and others
39	1992	Northeastern Minnesota	J.D. Lehr and H.C. Hobbs
40	1993	Door Peninsula, Wisconsin	A.F. Schneider and others
41	1994	Eastern Ohio and western Indiana	T.V. Lowell and C.S. Brockman
42	1995	Southern Illinois and southeast Missouri	S.P. Esling and M.D. Blum
43	1996	Eastern North Dakota and northwestern Minnesota	K.I. Harris and others

- No meetings were held in 1968, 1970, 1974, 1977, and 1997.
- Meeting numbers in parentheses have been listed previously as “U” or unnumbered.
- The 1952 meeting that is commonly included in the list of Midwest FOP meetings as Southwestern Ohio was actually an Eastern FOP meeting in central Ohio, to which Midwest Friends were invited by Dick Goldthwait the previous week in Western Illinois.

Acknowledgments

We thank the Wisconsin Geological and Natural History Survey for the support of many aspects of the preparation for this field conference. We thank Mindy James and Susan Hunt for their efforts in preparing the guidebook and other materials, and Kathie Zwettler and Tom Evans for their assistance with many aspects of the planning and preparation for the meeting. University of Wisconsin–Extension agents Dan Renzoni and Tom Geiger helped with many arrangements in Taylor and Lincoln Counties.

Introduction

This guidebook was prepared for the 44th Midwest Friends of the Pleistocene Field Conference. For the first time in a nearly 50-year history of field conferences, the Midwest Friends are meeting in north-central Wisconsin. During the conference we will examine the marginal zone of the eastern part of the Chippewa Lobe, the Wisconsin Valley Lobe, and the Langlade Lobe of the Laurentide Ice Sheet. The marginal zone of the Laurentide Ice Sheet in this area provides an excellent backdrop for discussions related to regional stratigraphy and history, processes of ice-marginal deposition, patterns and processes of ice disintegration, ice-flow patterns, meltwater drainage, and the influence of late glacial climate on landscape evolution. The routes for the field trips that make up this conference lie within Taylor, Lincoln, and Langlade Counties (fig. 1).

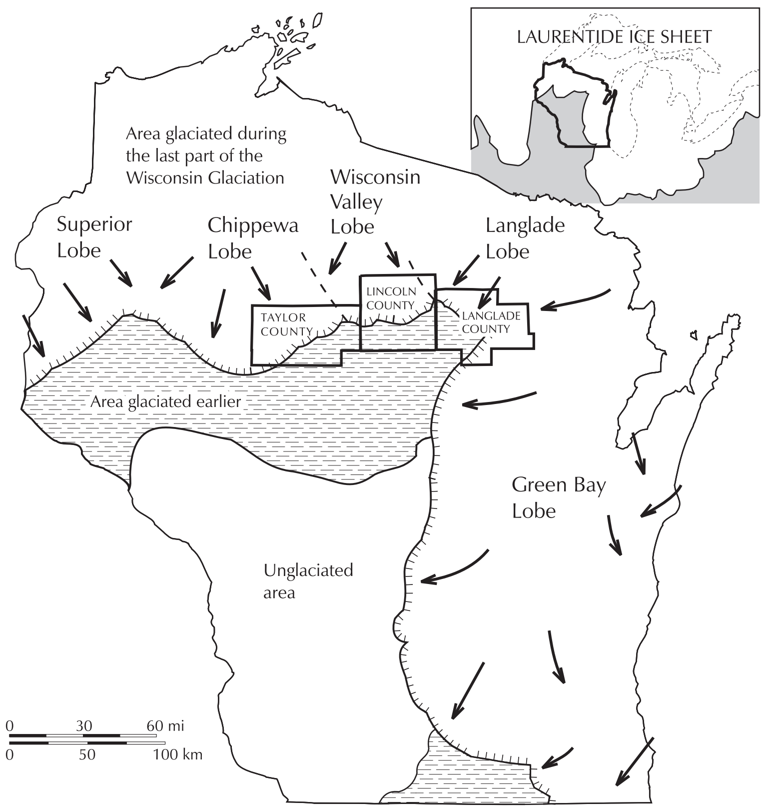


Figure 1. Map showing the location of Taylor, Lincoln, and Langlade Counties, the location of the margin of the Laurentide Ice Sheet in north-central Wisconsin, and generalized ice-flow directions.

The work of Weidman (1907) in north-central Wisconsin, Leverett (1929) in the Lake Superior region, and Thwaites (1943) in northeastern Wisconsin defined many of the regional aspects of the Pleistocene geology of the marginal zone of the Laurentide Ice Sheet in north-central Wisconsin. It was not until the 1970s and 1980s, when David M. Mickelson and his graduate students at the University of Wisconsin–Madison began to work in the area, that the details of the glacial geology began to be worked out. This work resulted in the publication of a Wisconsin Geological and Natural History Survey (WGNHS) report with 1:100,000 map describing the glacial and related deposits of Langlade County (fig. 1; Mickelson, 1986) as well as

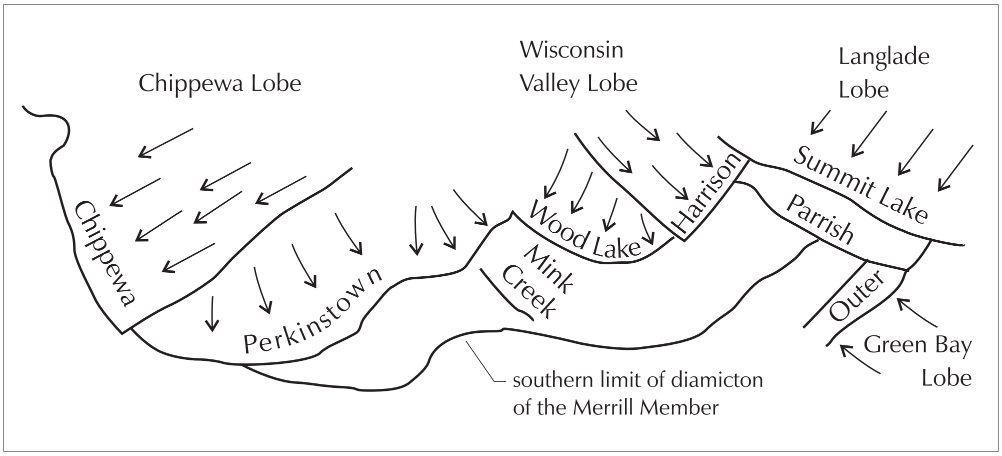


Figure 2. Map showing the moraines deposited near the maximum extent of the Chippewa, Wisconsin Valley, and Langlade Lobes of the Laurentide Ice Sheet in north-central Wisconsin. The names applied to the moraines marking the maximum extent of the Chippewa and Wisconsin Valley Lobes follows the usage of Attig (1993), Ham (1994), and Ham and Attig (1997).

theses and publications regarding the stratigraphy of pre-late Wisconsin deposits (Mode, 1976), the clay mineralogy and relative age of till units in north-central Wisconsin (Stewart, 1973; Stewart and Mickelson, 1976), and the age relationships of deposits of the Wisconsin Valley and Langlade Lobes (Nelson, 1973; Nelson and Mickelson, 1977).

More recently, work in Taylor (Attig, 1993) and Lincoln Counties (Ham, 1994; Ham and Attig, 1997) have resulted in the publication of WGNHS Bulletins including 1:100,000 maps that describe the Pleistocene geology of these areas of north-central Wisconsin. These projects have provided the opportunity to evaluate the pattern and ice wastage (Attig, 1993; Ham and Attig, 1996a) and the complex ice-flow patterns that developed near the margins of the Wisconsin Valley and Chippewa Lobes (Attig, 1993; Ham, 1994; Attig and Ham, 1997).

Regional ice-margin history

The exact timing of the advance and retreat of the southern margin of the Laurentide Ice Sheet into north-central Wisconsin during the last part of the Wisconsin Glaciation is not precisely known. Radiocarbon dates that closely constrain the chronology of late Wisconsin ice-margin fluctuations in north-central Wisconsin are lacking. Regional correlation of ice-margin positions in north-central Wisconsin to distant, better-dated sites indicated that the southern margin of the Laurentide Ice Sheet had advanced southward across the drainage divide south of the Lake Superior basin by about 26,000 years ago, reached its maximum extent by 20,000 to 18,000 years ago, and had begun to recede by about 15,000 years ago (Clayton and Moran, 1982; Mickelson and others, 1983; Attig and others, 1985). The margin of the ice sheet wasted north of the divide along the southern flank of the Lake Superior basin and then advanced and formed the Winegar moraine in the area of the Michigan–Wisconsin border in northernmost north-central Wisconsin. The margin of the ice sheet was distinctly lobate. Three prominent lobes, the Chippewa, Wisconsin Valley, and Langlade Lobes, flowed southward across north-central Wisconsin (fig. 1). Regional reconstructions of ice-margin history have been based on the assumption that the maximum extent of the lobes was broadly synchronous, and that the deposits marking the maximum extent of each lobe were deposited during a single cycle of advance and retreat. As we will discuss during the field conference, the history of ice advance and wastage may be quite complex in the marginal area of these lobes (Attig, 1993; Ham, 1994; Ham and Attig; 1996a; Attig and Ham, 1997). Figure 2 shows the names we apply to the moraines marking the maximum extent of the lobes of the Laurentide Ice Sheet in north-central Wisconsin. Note that on this figure the terms Chippewa moraine and Harrison moraine are used in a more restricted sense than general previous usage because we believe at least two distinct advances were involved in the deposition of the deposits that mark the maximum extent of the Chippewa and Wisconsin Valley Lobes.

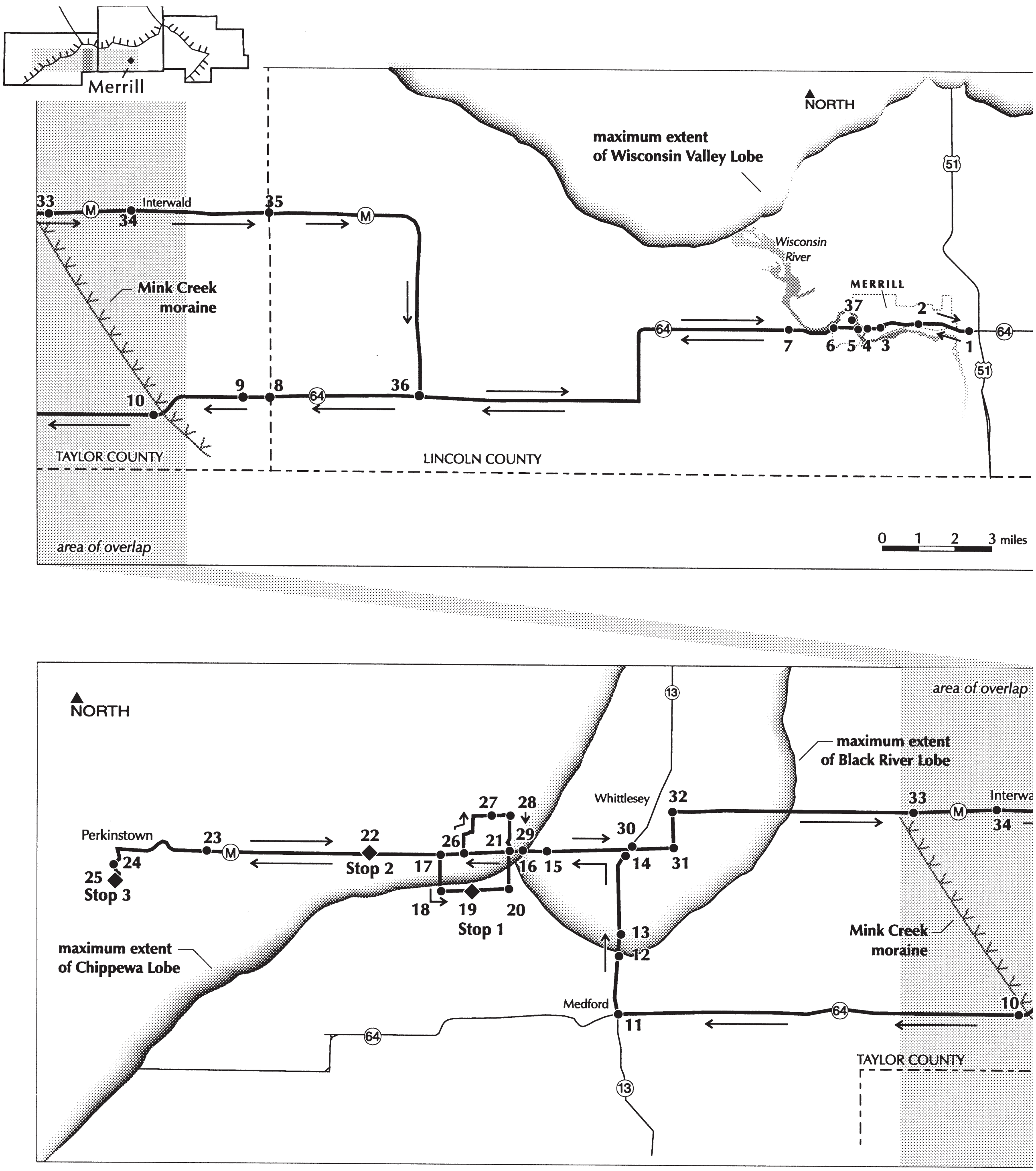
Field trip guide

The following field trip guide is divided into three parts, one each for Saturday morning, Saturday afternoon, and Sunday morning. The Saturday morning part of the conference will consist of a trip west of Merrill to examine the marginal zone of the eastern part of the Chippewa Lobe. The Saturday afternoon trip will travel north of Merrill to examine the marginal zone of the Wisconsin Valley Lobe. The Sunday morning trip will travel east of Merrill to examine the marginal zone of the Langlade Lobe.

Throughout all three parts of this guide we note when the trip route crosses from one county to another, and therefore from an area covered by one WGNHS county report and 1:100,000 Pleistocene geologic map, to an area covered by another report and map.

Stops and locations between stops are shown in bold type. Route maps are shown at the beginning of each of the three field trip parts. Route directions and notes related to WGNHS publications that cover the route are in italics.

Map of the route for the field trip on the morning of Saturday, May 30.



Part 1. Eastern part of the Chippewa Lobe area

John W. Attig

Overview. The focus of Part 1 of this field conference will be to examine the marginal zone of the eastern part of the Chippewa Lobe. Specifically, we will contrast the late Wisconsin and pre-late Wisconsin landscapes, discuss the pattern and sequence of late glacial ice disintegration, and examine ice-walled-lake plains and other components of the landscape of the marginal zone of the Chippewa and Black River Lobes in Taylor County.

> *Refer to WGNHS Bulletin 93,* Pleistocene Geology of Lincoln County, Wisconsin *(Ham and Attig, 1997) for a 1:100,000 map of Pleistocene materials and additional information about the area traversed by the first part of this field trip, the part between Merrill and the Taylor County line.*

LEAVE THE SUPER 8 MOTEL PARKING LOT AND TURN LEFT (WEST) ON HIGHWAY 64.

1. For about the next 5 miles the route crosses a series of late Wisconsin outwash plains deposited in the valleys of the Wisconsin and Prairie Rivers. The highest outwash plains were deposited when the Wisconsin Valley Lobe of the Laurentide Ice Sheet was at or near its maximum late Wisconsin extent. At its maximum extent the Wisconsin Valley Lobe reached to within about 4.0 miles of Merrill. The late glacial history of the Wisconsin Valley Lobe will be discussed in detail during Part 2 of this field conference.

TRAVEL WEST 1.4 MILES ON HIGHWAY 64.

2. Intersection of Highway 64 and Business 51 in Merrill. Merrill had its beginning in 1846 when Andrew Warren set up a sawmill near where the Prairie River joins the Wisconsin River. The timber resources of the area and the transportation of timber on the Wisconsin River drew others to the area. Merrill was incorporated as a city in 1883.

The Lincoln County Courthouse is on the left on the west side of the intersection. The Courthouse is listed on the National Register of Historical Places. Construction of the Lincoln County Courthouse began May 4, 1901.

TRAVEL WEST 1.1 MILES ON HIGHWAY 64 THROUGH MERRILL.

3. Cross the Prairie River.

Meltwater from the eastern part of the Wisconsin Valley Lobe drained to the Wisconsin River through the Prairie River. Parts of the Prairie River north of

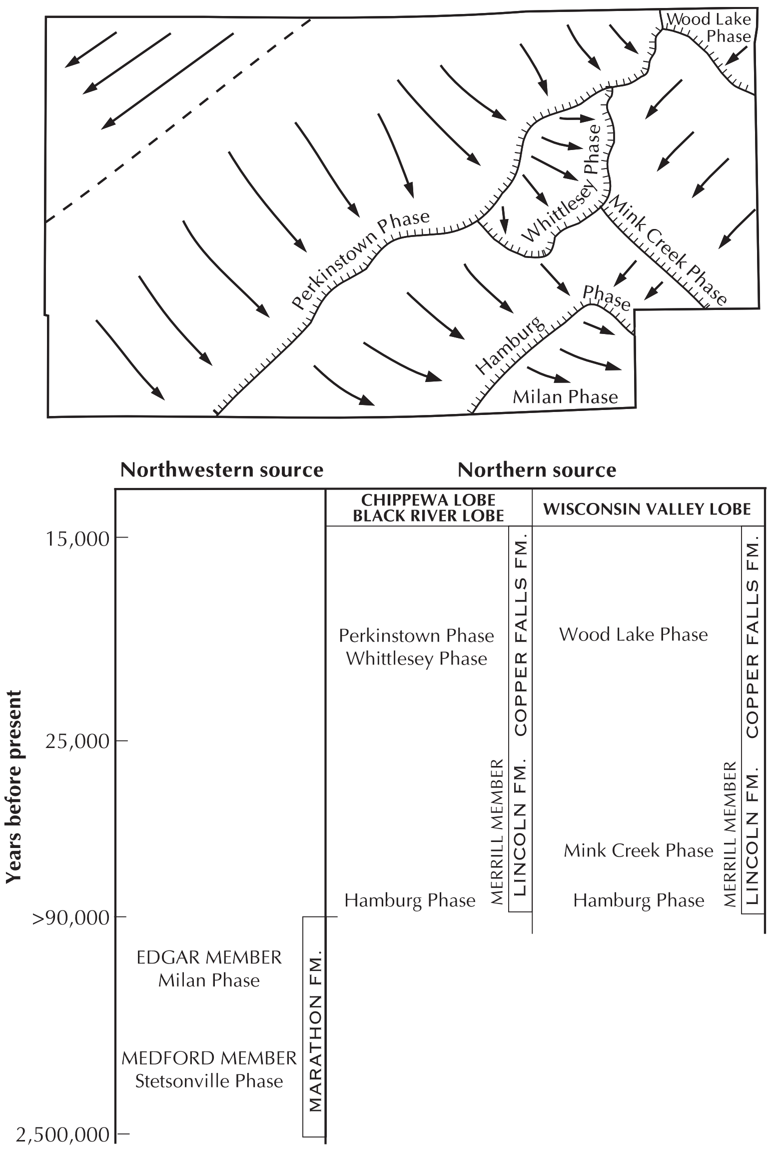


Figure 1.1. Map showing the extent of glacial phases and the direction of ice flow in Taylor County and correlation chart for glacial phases and stratigraphic units in Taylor County (from Attig, 1993).

Merrill are considered some of the best trout waters in Wisconsin. We will get a close look at the Prairie River along the east side of the Wisconsin Valley Lobe this afternoon.

4. Cross the east channel of the Wisconsin River. In this area the Wisconsin River and its tributaries drained meltwater from the Wisconsin Valley and Langlade Lobes. Meltwater from the Laurentide Ice Sheet in north-central Wisconsin drained through the Wisconsin River system until the margin of the ice sheet had receded far enough that meltwater no longer spilled southward across the southern divide of the Superior basin. Farther south the Wisconsin River system also drained meltwater from the eastern part of the Green Bay Lobe.

TRAVEL WEST 0.2 MILE ON HIGHWAY 64.

5. Cross the west channel of the Wisconsin River.

TRAVEL WEST 0.6 MILE ON HIGHWAY 64.

6. Here the route crosses a high outwash terrace deposited along the Wisconsin River. We are about 4 miles south of the maximum extent of the Wisconsin Valley Lobe. The Wisconsin River can be seen to the right (north) of Highway 64. The mature white pine trees on the north bank of the river are in Council Grounds State Park.

TRAVEL WEST 1.6 MILES ON HIGHWAY 64.

7. Here the route leaves the outwash terraces along the Wisconsin River and rises onto a gently rolling, stream-dissected surface underlain by diamicton of the Merrill Member of the Lincoln Formation (figs. 1.1 and 1.2). The Merrill

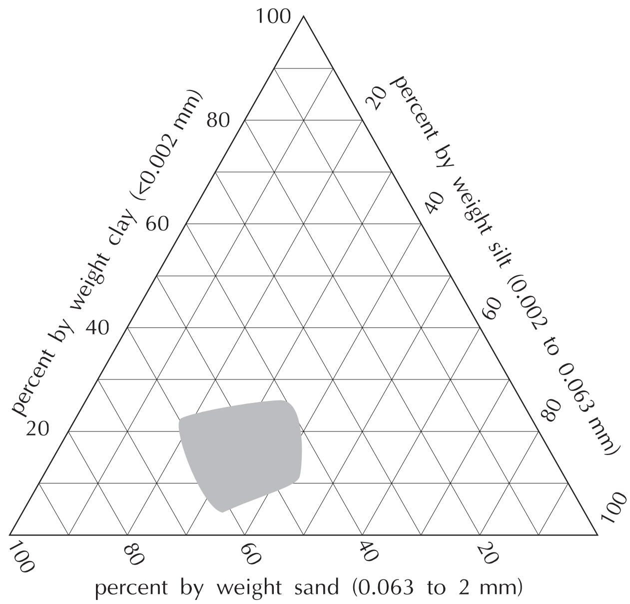


Figure 1.2. Grain-size distribution of the finer-than-2-mm fraction of samples of diamicton of the Merrill Member of the Lincoln Formation in Taylor County. The shaded area covers the range of results from the analysis of 33 samples (from Attig, 1993).

surface is the youngest of the pre-late Wisconsin till surfaces in the area. Well preserved glacial landforms are absent on the Merrill surface, but some subdued moraines are present. We will cross one of these subdued moraines in eastern Taylor County. The subdued glacial landforms of the Merrill surface are in sharp contrast with the well preserved glacial landforms that mark the maximum extent of the ice sheet in north-central Wisconsin. The high-relief ice-marginal landforms that mark the maximum extent of the Wisconsin Valley Lobe can be seen to the north as the skyline from many high points along Highway 64 between Merrill and the Taylor County line.

The time of deposition of the sediment of the Merrill Member is poorly constrained. Two radiocarbon age estimates from organic-rich sediment found on top of the Merrill till at Schelke Bog (see location 39, Part 3, this roadlog) in eastern Lincoln County are 40,800 BP ±2000 (IGS-256) and >36,500 BP (IGS-262) (Stewart and Mickelson, 1974, 1976; Dirlam, 1979). In addition, Stewart and Mickelson (1976) reported that the Merrill till shows a greater degree of weathering of its clay fraction than does sediment of the Copper Falls Formation, which was deposited during the last part of the Wisconsin Glaciation by the Laurentide Ice Sheet (fig. 1.1).

Travel west 15.3 miles on Highway 64.

8. Taylor County line.

> *Refer to WGNHS Bulletin 90,* Pleistocene Geology of Taylor County, Wisconsin *(Attig, 1993), for a 1:100,000 map of Pleistocene materials and additional information about the area traversed by the next segment of this field trip.*

Highway 64 continues to traverse the area underlain by the Merrill Member of the Lincoln Formation. In Taylor County till of the Merrill Member is brown to reddish brown (field color 7.5YR 4/4 to 5YR 4/3), noncalcareous, gravelly, and rich in sand (typically about 55% sand, 30% silt, and 15% clay in the less-than-2-mm fraction; fig. 1.2).

Sediment included in the Merrill Member of the Lincoln Formation is rich in rocks derived from the Superior basin. Typically, pebbles and cobbles in diamicton of the Merrill Member are fairly well rounded. Numerous piles of frost-heaved rocks collected by farmers are characteristic of the Merrill surface, but are absent from surfaces farther south underlain by the Edgar Member of the Marathon Formation (fig 1.1), where surface and near-surface rocks have presumably been destroyed by weathering.

The broad rolling hills characteristic of areas of Taylor County underlain by diamicton of the Merrill Member are a reflection of the topography on the underlying bedrock. Although topographic relief commonly exceeds 100 feet, diamicton of the Merrill Member is typically less than 20 feet thick.

Travel west 0.7 mile on Highway 64.

9. Cross the Rib River. The Rib River drained meltwater from the easternmost part of the Chippewa Lobe and the western part of the Wisconsin Valley Lobe. Where Highway 64 crosses the Rib River, the outwash plain is quite narrow because the bedrock valley is quite narrow. Upstream from Highway 64 the outwash plain broadens out to more than 2 miles wide in several places.

Travel west 3.3 miles on Highway 64.

10. Crest of the Mink Creek moraine. The Mink Creek moraine (Attig, 1993) consists of a northwest–southeast trending linear zone of subdued slightly hummocky topography (fig. 1.3). The surface of the area underlain by diamicton of the Merrill Member is somewhat more hummocky northeast of the Mink Creek moraine than it is to the south and southwest, indicating the possibility of a substantial time span between phases of glaciation that deposited the Merrill Member. Between this location and Medford, Highway 64 continues to cross the Merrill surface.

Travel west 10.1 miles on Highway 64.

11. Intersection of Highways 64 and 13 in Medford. The intersection is underlain by diamicton of the Merrill Member.

Turn north (right) and travel 1.9 miles on Highway 13.

12. Cross onto an area of well preserved ice-walled-lake plains and hummocky topography of the late Wisconsin Black River Lobe. Leverett (1929) recog-

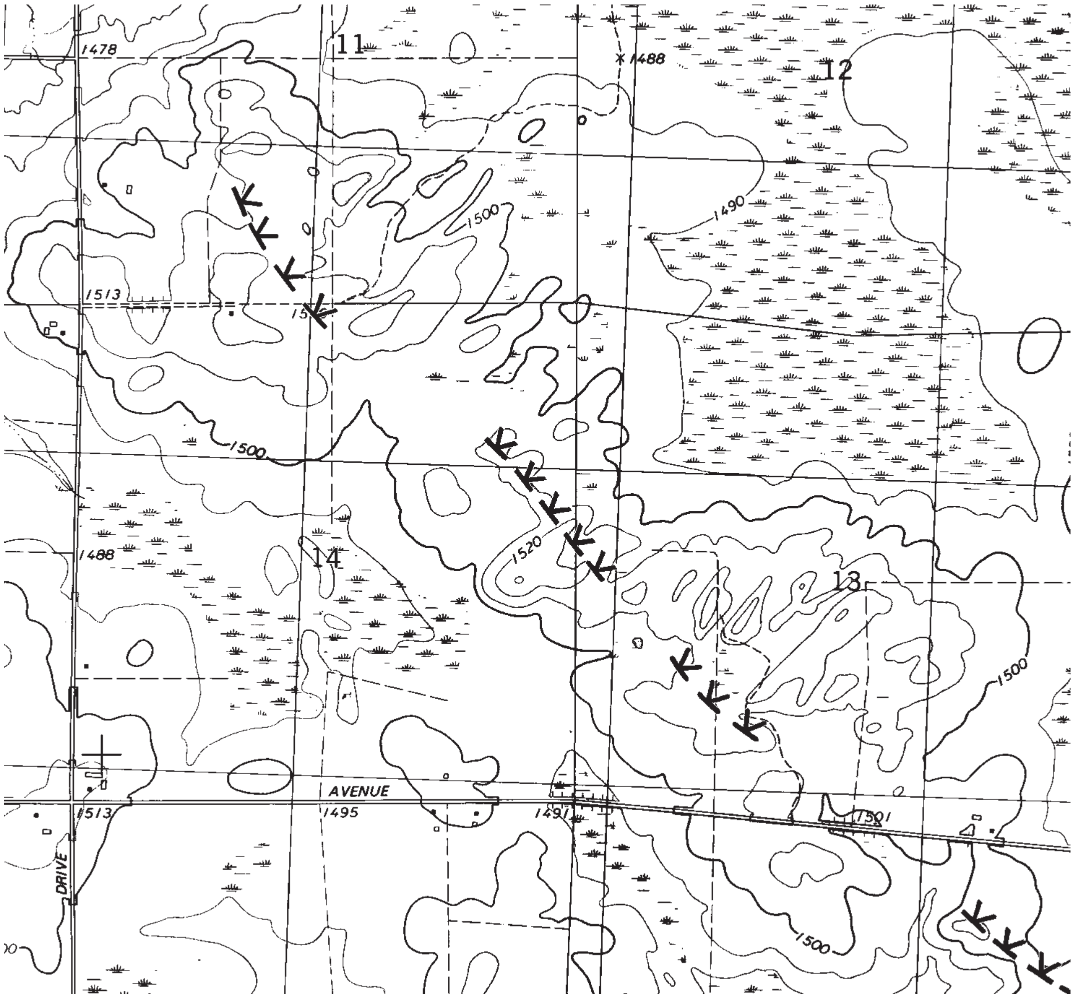


Figure 1.3. Part of the Rib River Lookout Tower Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1979) showing the Mink Creek moraine trending northwest-southeast through secs. 11, 14, 13, and 24, T31N, R2E. The moraine crest is indicated with a line symbol (from Attig, 1993). The moraine crest is very clear on 1:20,000 black and white aerial photographs.

nized an area of well preserved glacial topography in this area beyond the margin of the Chippewa Lobe (Leverett's St.Croix morainic system and correlated moraines). Between the rolling diamicton-mantled hills of the area underlain by the Merrill Member and the high-relief hummocky topography formed along the eastern margin of the Chippewa Lobe is a conspicuous, lobe-shaped area of well preserved ice-walled-lake plains and hummocky topography that extends beyond the southeastern margin of the Chippewa Lobe. The ice that covered this area was named the Black River Lobe and the maximum extent of the lobe was referred to as the Whittlesey Phase by Attig (1993; fig. 1.1). The glacial landforms deposited in the area covered by the Black River Lobe are equally as well preserved as those in the area covered by the Chippewa Lobe, indicating either little difference in the time of advance of these two lobes or that buried stagnant ice in the area of both lobes melted at about the same time.

Travel north 0.4 mile on Highway 13.

13. Ice-walled-lake plain on right. In this area, in the area of the Black River Lobe, and several miles to the north in the area of Whittlesey, there were several brickyards in the early 1900s (Buckley, 1901); a number of old brick buildings can still be seen. Although the exact locations of these early 1900s brickyards are not well known, it is likely that the clayey sediment used to manufacture the bricks was mined from ice-walled-lake plains. Flat remnants of a number of ice-walled-lake plains separated by areas of hummocky topography composed of collapsed lake sediment and diamicton can be seen throughout this area.

It is typical here and in other areas with ice-walled-lake plains in northern Wisconsin that buildings are located on the rim ridges of the lake plains and farm fields are on the central part of the plains. On topographic maps and aerial photographs the ice-walled-lake plains typically appear as "bullseyes" of agriculture in otherwise densely forested areas. The lake plains are mostly free of rocks, have a longer frost-free growing season because they are elevated above the surrounding topography, and are well drained; the silty lake sediment maintains moisture in the root zone throughout the growing season.

Travel north 2.2 miles on Highway 13 and turn left (west) on Highway M.

14. The intersection of Highways 13 and M is on the flat central part of an ice-walled-lake plain deposited in the area of the Black River Lobe.

Travel west 2.2 miles on Highway M to the intersection of Highway M and Anderson Road.

15. At the intersection with Anderson Road, Highway M crosses an outwash plain about 0.6 mile east of the southeastern margin of the Chippewa Lobe. This outwash plain was deposited between the Chippewa Lobe on the west and the Black River Lobe on the east. The high-relief hummocky topography that marks the margin of the Chippewa Lobe can be seen ahead (west) and to the right (north).

Continue straight ahead and travel west 0.6 mile on Highway M.

16. Here, Highway M rises onto the hummocky topography marking the southeastern margin of the Chippewa Lobe. The maximum extent of the Chippewa Lobe is clearly defined by a sharp-crested moraine, outwash fans, and a several-mile-wide band of hummocky topography that contains many ice-walled-lake plains. The outwash, diamicton, and lake sediment deposited in the area covered by the Chippewa Lobe are included in the Copper Falls Formation (fig. 1.1; Mickelson and others, 1984). In Taylor County the color and grain-size distribution of the less-than-2-mm fraction of the diamicton of the Merrill and Copper Falls Formations (figs. 1.2 and 1.7) are very similar.

Travel west 2.2 miles on Highway M to the intersection with Highway E south. Turn left (south) on Highway E.

17. Intersection of Highways M and E. For the next mile Highway E crosses the hummocky zone behind the moraine marking the maximum extent of the Chippewa Lobe. Here, the hummocky topography consists of a complex mixture of remnants of ice-walled-lake plains and hummocks that contain laminated silty lake sediment, stratified sand and gravelly sand, and crudely stratified reddish brown sandy diamicton.

Travel 1.0 mile to the intersection with Perkinstown Ave. and turn right (east).

18. The intersection is on the crest of the moraine marking the outermost extent of the Chippewa Lobe. Looking south (straight ahead on Highway E) from the intersection, the outwash plain beyond the moraine can be seen. Uplands underlain by diamicton of the Merrill Member of the Lincoln Formation can be seen in the distance to the south.

Travel east 0.9 mile on Perkinstown Ave. to the intersection with Sunset Road.

Perkinstown Ave. east of Highway E obliquely descends the outwash fan in front of the moraine onto the outwash plain beyond. The well defined moraine ridge formed along parts of the Chippewa Lobe margin is visible to the left (north).

Turn left (north) into the gravel pit just beyond (east of) the intersection with Sunset Road.

19. **Stop 1—Jacobson Pit—Chippewa Lobe moraine—pattern of ice disintegration.** At the intersection Sunset Road goes to the south. To the north of the

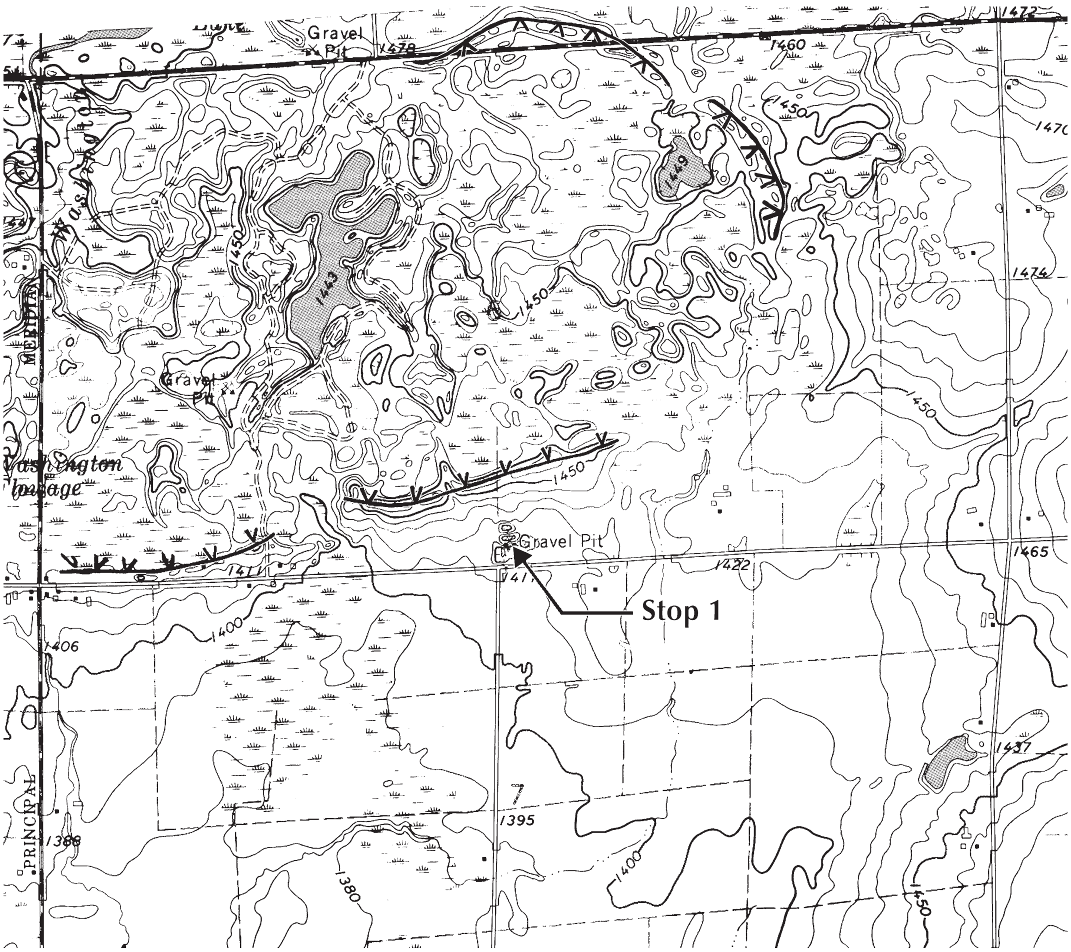


Figure 1.4. Part of the Medford NW Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1970) showing location of Stop 1 in the Perkinstown moraine. Line symbols indicate segments of the well defined ridge that forms a discontinuous border around an oval area of hummocky topography. The pit is now larger than shown on this map and extends northward to beneath the crest of the ridge.

intersection is a gravel-pit entrance road to a large but mostly inactive gravel pit that exposes the sediment in the moraine ridge and the proximal part of the outwash plain (fig. 1.4). This section is not well exposed at this time, but in the late 1980s several sections that exposed gravelly diamicton of the Copper Falls Formation were well exposed. Is the sediment exposed in the moraine till or debris-flow sediment? How was the distinct moraine that borders the hummocky zone deposited? Was it deposited primarily by accretion of sediment from the bed of the glacier or was it formed by the accumulation of sediment that flowed from the ice surface?

In map view the distinct, discontinuous moraine exposed in the Jacobson Pit can be traced around areas of hummocky topography (fig. 1.4). The ridge is oval to circular in map view. This pattern (at different scales) is well expressed in several places in Taylor and Lincoln Counties. Attig (1993) and Ham and Attig (1996a) suggested that this pattern, along with a characteristic distribution of other landforms, indicates that the marginal zone of the ice sheet stagnated and persisted for some time after the margin of the ice sheet had wasted northward (fig. 1.5).

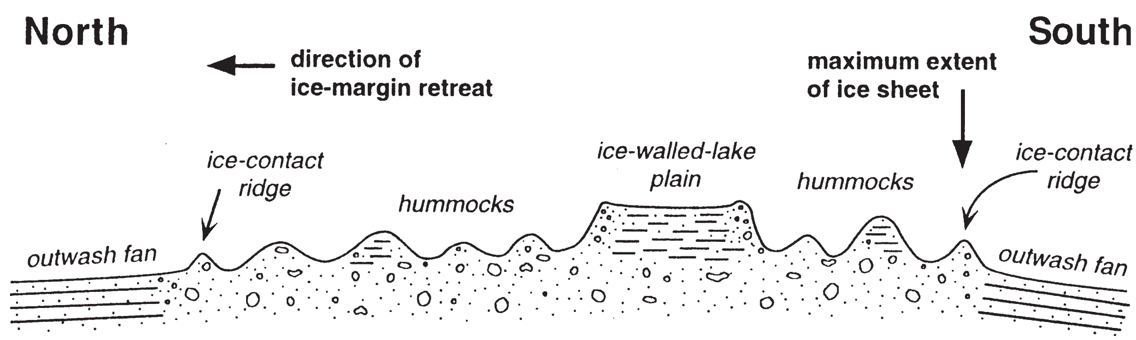


Figure 1.5. Schematic diagram showing the typical distribution of landforms in the marginal zone of the Wisconsin Valley and eastern Chippewa Lobes (from Ham and Attig, 1996a).

Leave gravel pit and turn left (east) on Perkinstown Ave. and travel 1.0 mile to the intersection with Castle Road.

20. Intersection of Perkinstown Ave. and Castle Road. Between the gravel pit and the intersection with Castle Road, Perkinstown Road crosses a southward sloping outwash plain and then rises onto an area of subdued hummocky topography. This area is more hummocky than is typical of the areas underlain by diamicton of the Merrill Member, and does not contain the well preserved landforms typical of the area of the Black River and Chippewa Lobes. The history of this surface is uncertain. A similar area is present along the western margin of the Wisconsin Valley Lobe in eastern Taylor County and western Lincoln County (Attig, 1993; Ham and Attig, 1997).

Turn left (north) on Castle Road and travel 1.0 mile to the intersection with Highway M.

About 0.1 mile north of the intersection of Perkinstown Ave. and Castle Road, Castle Road crosses a meltwater channel cut between deposits of the Black River Lobe to the south and the margin of the Chippewa Lobe to the north. The road then crosses a locally collapsed ice-walled-lake plain. The buildings on the north edge of the lake plain are on the rim ridge of the ice-walled-lake plain.

21. Intersection of Castle Road and Highway M.

Turn left (west) on Highway M and travel 4.0 miles to the intersection with Highway E to the north.

22. **Stop 2—Photo stop—ice-walled-lake plain.** The intersection of Highways M and E north is on a large, well preserved ice-walled-lake plain (fig. 1.6). The buildings that can be seen to the west and northwest are on the rim ridge, the fields are on the central part of the lake plain. Several remnants of rim ridges can be seen in the central part of the lake plain, indicating that the lake in

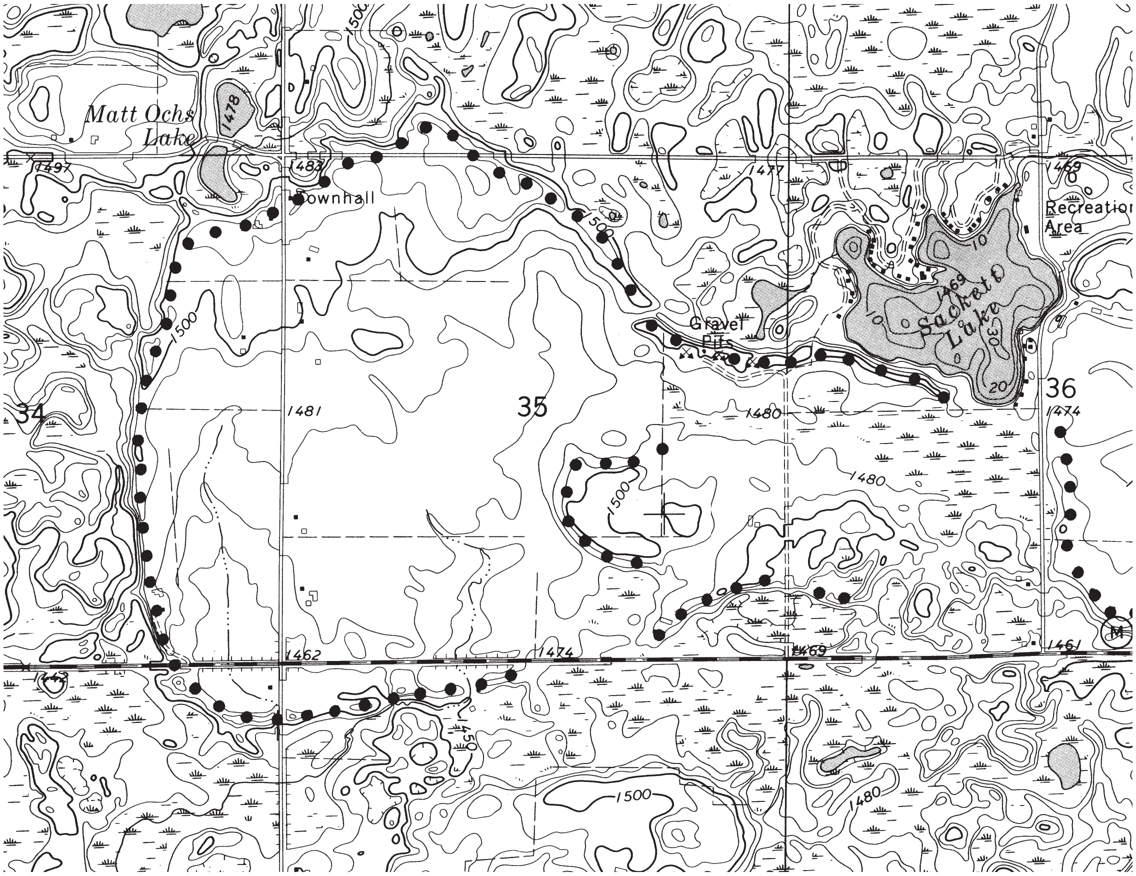


Figure 1.6. Part of the Medford NW Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1970), showing an ice-walled-lake plain in sections 34 and 35. Stop 2 is near the southwest corner of the lake plain. The rim ridge is indicated with dots. A segment of a rim ridge formed when the lake was smaller in the southeast part of section 35 (from Attig, 1993).

which this plain was deposited evolved through several phases from a smaller to a larger lake. West of the intersection of Highways M and E, the highway passes through a cut in the rim ridge on the west edge of the lake plain and then descends the ice-contact face.

Travel west 4.6 miles on Highway M.

23. Ice Age Trail crossing. The Ice Age Trail will eventually be a continuous trail along the margin of the late Wisconsin Laurentide Ice Sheet in Wisconsin linking the units of the Ice Age National Scientific Reserve. The trail has many

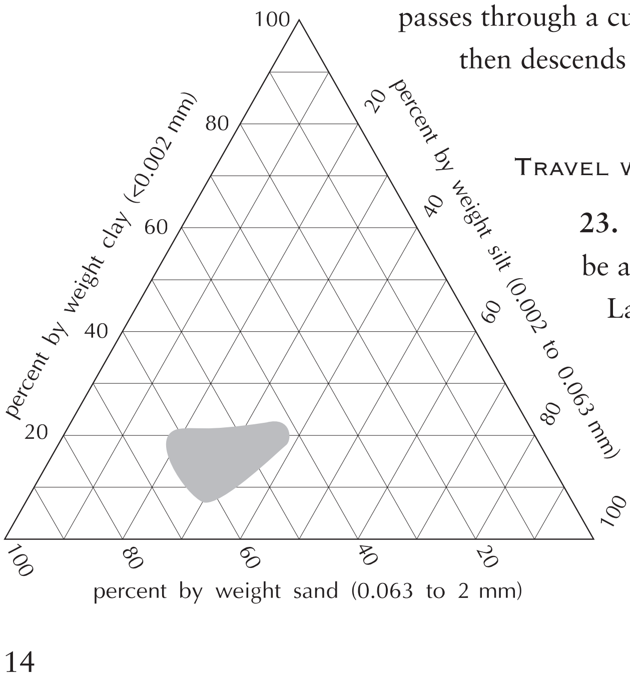


Figure 1.7. Grain-size distribution of the finer-than-2-mm fraction of samples of material interpreted to be basal till of the Copper Falls Formation in Taylor County (from Attig, 1993). The shaded area indicates the range of values resulting from the analysis of 56 samples.

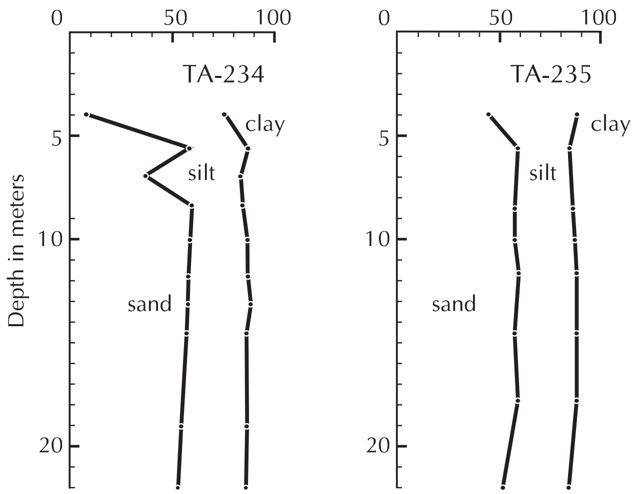


Figure 1.8. Down-section variability in grain-size distribution in the less-than-2-mm fraction of samples from two drillholes in an area of high-relief hummocky topography (from Attig, 1993).

connections to other trails. At present not all parts of the trail are complete, but the corridor through which the trail will pass has been identified in most areas. In north-central Wisconsin many segments of the trail have been completed across county, state, and national forest land as well as on some private land. The geological education aspects of the trail development have progressed in some areas, especially the Ice Age Scientific Reserve units, but trial guides are lacking for most segments.

The hummocky topography in this area is underlain primarily by collapsed lake sediment. Cobbles and boulders are typically lacking on the surface, and those that are present occur in linear patterns that are probably the ice-contact parts of collapsed lake plains. It seems as if much of the ice surface in this area was covered by ice-walled lakes. Some melted through to the glacier bed and were preserved as ice-walled-lake plains. Others were underlain by ice, and the lake plain morphology was mostly destroyed when the underlying ice melted. Why were ice-walled lakes so common in this and other areas of the margin of the Laurentide Ice Sheet in northern Wisconsin? Why were they not common along the margin of the Green Bay Lobe? What role if any did permafrost play in the formation of the ice-walled lakes and the pattern of ice disintegration?

Samples from two drillholes in hummocks composed of diamicton in eastern Taylor County showed that the diamicton is quite uniform with depth (fig. 1.8). Is this uniformity the result of very slow melting of debris-rich ice with little opportunity for sorting? Is it the result of the deposition of uniform basal sediment? How does the uniform diamicton in the hummocks fit into the regional pattern of ice wastage?

Travel west 2.3 miles on Highway M to the intersection of Winter Sports Road to the left. Turn left (south) onto Winter Sports Road and travel 0.6 mile.

24. Where Winter Sports Road passes the Perkinstown Community Cemetery it begins to ascend the ice-contact face of an ice-walled-lake plain in an area of very high-relief hummocks and ice-walled-lake plains.

Travel along Winter Sports Road another 0.5 mile and turn right into a gravel pit at the top of the hill. Be sure to keep to the right

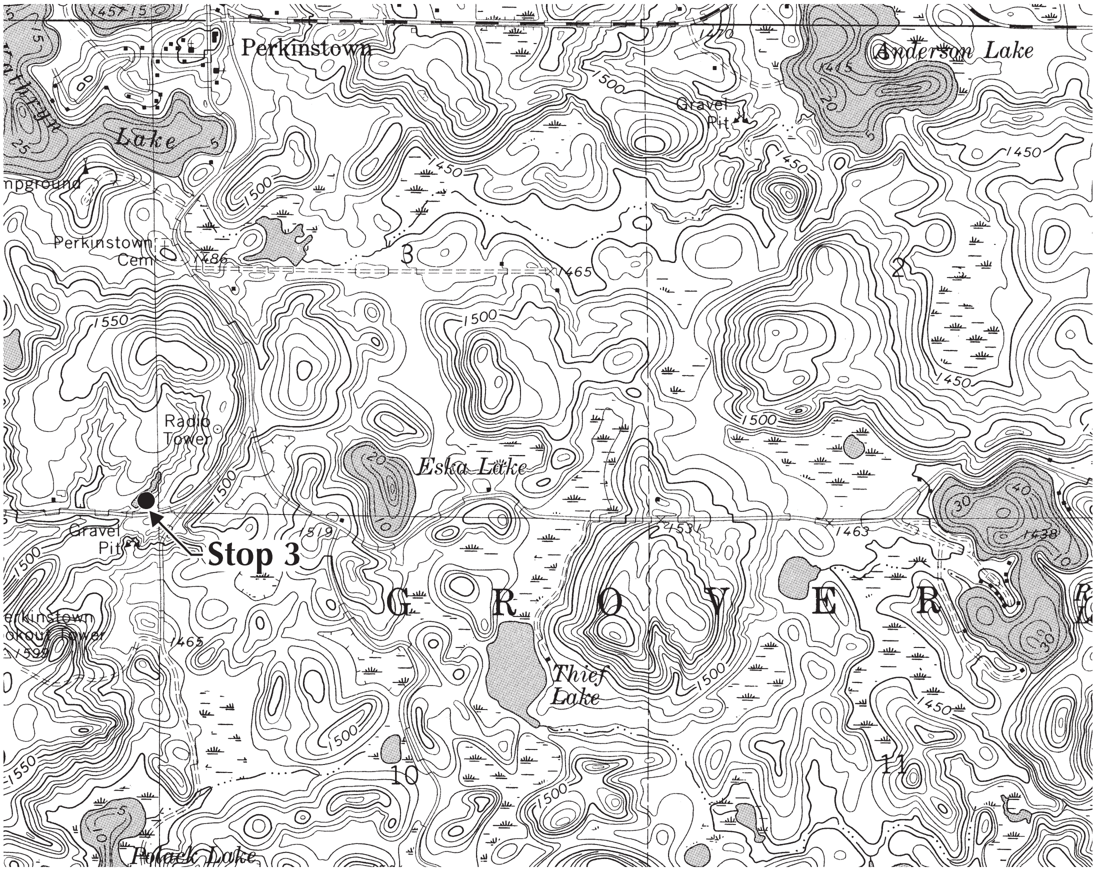


Figure 1.9. Part of the Perkinstown Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1969), showing the location of Stop 3. The area is characterized by high-relief hummocky topography that contains an abundance of collapsed lake sediment. The stop is in a pit in the distal part of the rim ridge of an ice-walled-lake plain.

at the intersection with Perkinstown Ave., which is about halfway up the hill.

25. **Stop 3—Section in ice-walled-lake plain.** The gravel pit at this location exposes the internal structure of part of the rim ridge and the edge of the central plain of an ice-walled lake plain (fig. 1.9). In north-central Wisconsin many small gravel pits are located in the gravel-rich part of the rim ridges of ice-walled-lake plains. In the late 1980s, when this pit was more active, gravel-rich diamicton interpreted to be debris-flow sediment could be seen to overlie laminated silty lake sediment in this exposure (fig. 1.10). That part of the exposure is now badly slumped, but can be dug out if desired. What is exposed is the gravelly sand deposited near the margin of the lake plain.

Leave pit, turn left, and retrace our route by traveling 1.1 miles to the intersection with Highway M. Turn right and proceed 9.5 miles to the intersection with Hillcrest Road. Turn north on Hillcrest road.

26. Intersection of Highway M and Hillcrest Road. At the intersection the rim ridge of an ice-walled-lake plain crosses Hillcrest Road. North of the intersection, Hillcrest Road crosses what was the center of the basin of the ice-walled lake.

Figure 1.10. Photo showing the contact between laminated lake sediment and overlying poorly sorted, crudely stratified debris-flow sediment. The area shown is approximately 150 feet from the rim ridge of the ice-walled-lake plain (from Attig, 1993). This sequence was well exposed at Stop 3 in 1990.

PROCEED 1.7 MILES ON HILLCREST ROAD TO THE INTERSECTION WITH NORWAY DRIVE. THIS SECTION OF HILLCREST ROAD TURNS SHARPLY RIGHT, THEN LEFT, THEN BACK TO THE RIGHT.

Where Hillcrest Road turns back to the right (east), it descends into a low swale between two ice-walled-lake plains. It then rises up the steep ice-contact face of an ice-walled-lake plain, crosses a well preserved rim ridge, and descends slightly onto what was the central part of the ice-walled lake. Samples from drillholes in the central part of the lake plain have shown it to be underlain by laminated silty fine sand. The thickness of this lake sediment is typically about the same as the elevation of the lake plain above the surrounding topography. On aerial photographs deltas and sand-bars are visible on this and many other ice-walled-lake plains in the area.

27. Intersection of Hillcrest Road and Norway Drive. Ice-walled-lake plain to south of intersection.

CONTINUE STRAIGHT AHEAD (EAST) 0.5 MILE ON HILLCREST ROAD TO THE INTERSECTION WITH CASTLE ROAD.

Toward the intersection with Castle Road, the route traverses the eastern part of the lake plain, crosses the rim ridge of the lake plain, and descends the ice-contact face. Here, shovel excavations show the rim ridge to contain interbedded laminated lake sediment, sorted and stratified sand and gravel, and diamicton. This is typical of the ice-contact parts of the ice-walled-lake plains in this area.

28. Intersection of Hillcrest Road and Castle Road.

TURN RIGHT (SOUTH) ON CASTLE ROAD AND PROCEED 1.0 MILE TO THE INTERSECTION WITH HIGHWAY M.

This section of Castle Road crosses the remnants of the plain of a large ice-

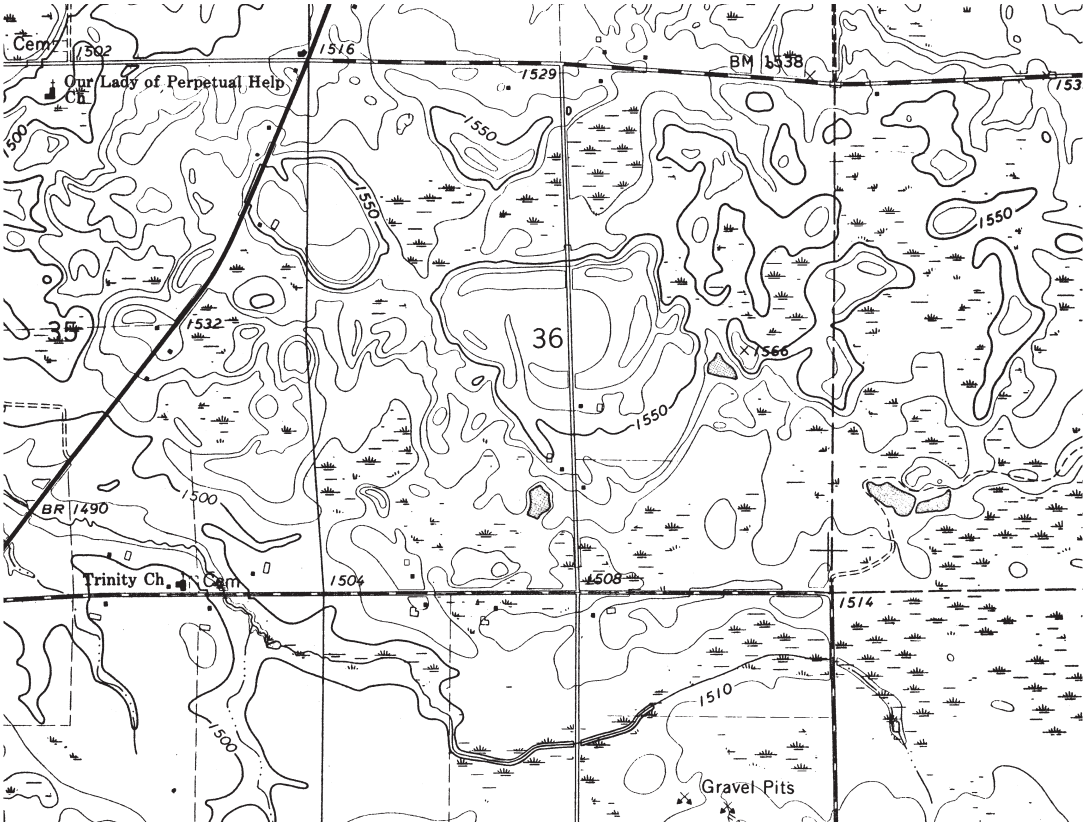


Figure 1.11. Part of the Medford Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1969) showing a well preserved ice-walled-lake plain in the center of sec. 36, T32N, R1E (from Attig, 1993). The field trip route follows the north–south road across the center of the lake plain.

walled lake. Much of the sediment that accumulated on the floor of this lake was underlain by ice.

29. Intersection of Castle Road and Highway M.

Turn left (east) on Highway M and proceed 3.2 miles to the intersection with Highway 13.

This part of Highway M descends off the hummocky uplands formed along the eastern part of the Chippewa Lobe, crosses an outwash plain deposited between the Chippewa and the Black River Lobes, and rises slightly onto an ice-walled-lake plain formed in the area of the Black River Lobe. Glacial landforms that developed in the area of the Black River Lobe appear to be equally as well preserved as those formed in the area of the eastern Chippewa Lobe and the Wisconsin Valley Lobe. The final stabilization of the landscape when buried ice melted probably occurred at about the same time in both places.

30. Intersection of Highways M and 13.

Cross Highway 13 and proceed straight ahead (east) on Dassow Ave. 1.2 miles to the intersection with Neumann Road.

Between Highway 13 and Neumann Road, Dassow Ave. crosses a broad, flat ice-walled-lake plain.

31. Intersection of Dassow Ave. and Neumann Road.

Turn left (north) on Neumann Road and proceed 1.0 mile to the intersection with Highway M.

Neumann Road climbs the ice-contact face of an ice-walled-lake plain, crosses the rim ridge, and then descends into the central basin of an ice-walled lake (fig. 1.11). This lake was walled by ice of the Black River Lobe. Material from a drillhole near the center of this lake basin penetrated 30 feet of laminated lake sediment, consisting of silty fine sand. It is typical throughout this area that the lake sediment in the ice-walled-lake plains is about as thick as the difference in elevation between the lake floor and the elevation of the landscape between the ice-walled-lake plains. A drillhole in the west rim of this ice-walled-lake plain penetrated 25 feet of gravelly sand. The central part of this lake plain, the center of the field west of Neumann Road, is quite wet. During our drilling we had both the WGNHS drill truck and a pickup truck stuck up to their floorboards in mud. Fortunately, this farm is owned by a very cooperative, interested farmer with a very large tractor.

The area of high-relief ice-marginal landforms marking the maximum extent of the eastern part of the Chippewa Lobe is visible to the northwest near the intersection with Highway M.

32. Intersection of Neumann Road and Highway M.

Turn right (east) on Highway M and proceed 6.5 miles to the intersection with Highway C.

East of the intersection with Neumann Road, Highway M continues to cross hummocky deposits of the Black River Lobe for a distance of about 3.2 miles before descending slightly onto an area of low-relief hummocky topography underlain by diamicton of the Merrill Member.

33. Intersection of Highways M and C.

From the intersection a fire tower is visible about 1.0 mile to the south. The fire tower is on a high point of the Mink Creek moraine. The Mink Creek moraine is conspicuously more hummocky than surrounding areas that are also underlain by diamicton of the Merrill Member.

Continue east on Highway M for 3.0 miles.

34. Highway M crosses the Big Rib River. The Big Rib River carried outwash from the western part of the Wisconsin Valley Lobe and the eastern part of the Chippewa Lobe. The outwash plain along the river is nearly 1 mile wide where Highway M crosses it. After crossing the outwash plain east of the Big Rib River, Highway M rises onto a gently rolling surface underlain by diamicton of the Merrill Member, and then descends onto a low, broad outwash plain before reaching the Lincoln County line.

Continue east 3.5 miles to the Lincoln County line.

35. Lincoln County line.

> *Refer to WGNHS Bulletin 93,* Pleistocene Geology of Lincoln County, Wisconsin *(Ham and Attig, 1997) for a 1:100,000 map of Pleistocene materials and additional information about the area traversed by the following part of this field trip.*

In Lincoln County, Highway M continues to cross a broad outwash plain for about 1.5 miles before rising onto an area of subdued hummocky topography similar to that west of Medford. Where Highway M turns to the south it crosses a low, wet, outwash plain.

Continue straight ahead (east) 4.0 miles on Highway M. Highway M then turns right (south). Follow Highway M south for 2.5 miles to where it turns left (east). Do not turn left. Continue straight ahead (south) 2.5 miles on Hager City Road to the intersection with Highway 64.

36. Intersection of Hager City Road and Highway 64.

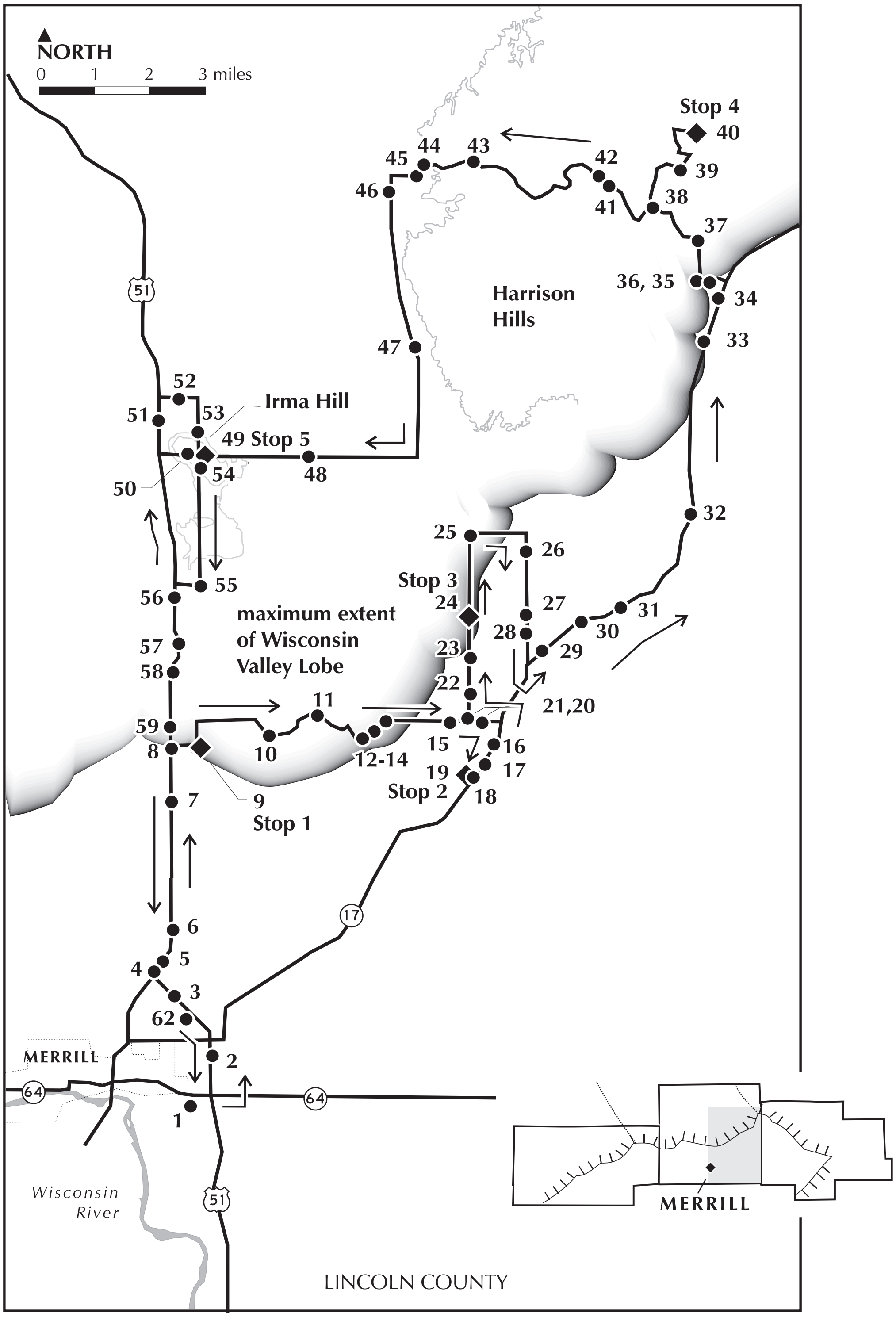
Hager City Road crosses a surface underlain by diamicton of the Merrill Member.

Turn left (east) on Highway 64 and travel 14.2 miles to Merrill. Cross the Prairie River.

(The route from location 36 to 37 is the reverse of that described for locations 3 to 7 at the beginning of this field trip.)

37. Lunch stop at Merrill City Park on the bank of the Wisconsin River.

Map of the route for the field trip on the afternoon of Saturday, May 30.



Part 2. Wisconsin Valley Lobe area

Nelson R. Ham

Overview. The purpose of this trip is to examine the complex assemblage of glacial landforms that developed in the marginal zone of the Wisconsin Valley Lobe during the last part of the Wisconsin Glaciation. Special attention will be given to the pattern and sequence of landform development (see Ham and Attig, 1996a) and ice-flow patterns. The trip route will traverse the area glaciated by the southeastern part of the Wisconsin Valley Lobe in east-central Lincoln County.

The Wisconsin Valley Lobe was the smallest of six distinct lobes of the Laurentide Ice Sheet to enter Wisconsin during the last part of the Wisconsin Glaciation. The Wisconsin Valley Lobe advanced generally southward, out of the Lake Superior basin, and reached its maximum extent in what is today Lincoln County in north-central Wisconsin. The lobe was bounded on the east by the Langlade Lobe and on the west by the Chippewa Lobe, although these lobes were not synchronous in their advances and retreats. The timing of the advance and wastage of the Wisconsin Valley Lobe is poorly constrained. The glacier probably reached its maximum extent between about 20,000 and 18,000 years ago and began to waste back into the Lake Superior basin between about 18,000 and 15,000 years ago (Clayton and Moran, 1982; Mickelson and others, 1983; Attig and others, 1985).

Diamicton and other sediment associated with the advance of the Wisconsin Valley Lobe in northern Wisconsin are included in the Wildcat Lake Member of the Copper Falls Formation (Mickelson and others, 1984; Attig and others, 1988). Exposures are generally rare in northern Wisconsin, and most information about this lithostratigraphic unit is based on widely scattered subsurface information. In general, diamicton of the Wildcat Lake Member is typically reddish-brown, slightly clayey, silty, gravelly sand (in eastern Lincoln County typically 80% sand, 15% silt, and 5% clay; Ham, 1994). The maximum extent of the Wisconsin Valley Lobe is marked by a broad band (up to about 6 miles wide) of hummocky glacial topography that includes many ice-walled-lake plains. The hummocky terrain trends roughly east–west and crosses the central part of Lincoln County. Drumlins, recessional moraines, eskers, outwash terraces and fans, and outwash heads occur to the north and northwest (up-ice) of the hummocky zone (Ham, 1994; Ham and Attig, 1997). Although this trip will also cross areas of Lincoln County underlain by sediments of the Merrill Member of the Lincoln Formation, the origin and history of these older glacial deposits will be addressed in more detail during other parts of this field conference.

Refer to WGNHS Bulletin 93, Pleistocene Geology of Lincoln County, Wisconsin *(Ham and Attig, 1997) for a 1:100,000 map of Pleistocene materials and additional information about the area traversed by this field trip.*

1. Super 8 Motel parking lot.

TURN RIGHT (EAST) ON HIGHWAY 64. TRAVEL EAST 0.4 MILE ON HIGHWAY 64 AND PASS BENEATH THE HIGHWAY 51 OVERPASS. TURN LEFT (NORTH) ON THE HIGHWAY 51 ENTRANCE RAMP.

2. For about the next mile, the route rises onto a slightly hummocky moraine underlain by diamicton of the Merrill Member. Three such moraines are preserved in the vicinity of Merrill and trend roughly northeast to southwest, indicating that the glacier that deposited the moraines flowed approximately northwest to southeast. However, glacial landforms are generally not preserved over much of north-central Wisconsin where diamicton of the Merrill Member is the surface sediment. Studies by Stewart and Mickelson (1974, 1976) and Dirlam (1979) demonstrated that sediment of the Merrill Member of the Lincoln Formation was deposited prior to the last part of the Wisconsin Glaciation and thus has undergone an extensive period of subaerial weathering.

TRAVEL NORTH AND NORTHWEST 2.2 MILES ON HIGHWAY 51.

3. Cross the Prairie River. The trip route will cross the Prairie River at several locations in Lincoln County. The river valley is only about 0.5 mile wide at this location, but widens to about 4.0 miles in the eastern part of the county. The Prairie River served as a major drainageway for late Wisconsin meltwater as well as meltwater from earlier advances. The most extensive deposits of outwash in the east-central part of Lincoln County occur in the Prairie River valley. The Prairie River is one of the best trout streams in Wisconsin. A brief discussion of the recent history of the river is provided later in this guide.

TRAVEL NORTHWEST 0.2 MILE ON HIGHWAY 51. EXIT RIGHT (NORTH) TO HIGHWAY K (OLD HIGHWAY 51).

4. A new four-lane segment of Highway 51 between Merrill and Tomahawk was completed in 1996. The new highway segment begins at this point. The old two-lane segment of Highway 51 has been renamed Highway K. Note that the base map used for the Lincoln County Pleistocene geologic map (Ham and Attig, 1997) shows the old route of Highway 51.

TRAVEL NORTHWEST 0.3 MILE ON THE EXIT RAMP. TURN RIGHT (NORTH) ON HIGHWAY K.

5. The interchange between Highway 51 and Highway K is located on the crest

of a second slightly hummocky moraine on the Merrill surface. A third moraine occurs approximately 2.0 miles to the west.

Travel north 0.9 mile on Highway K.

6. Cross Little Hay Meadow Creek, a tributary of the Prairie River. For about the next 3.3 miles, the route crosses a gently rolling landscape underlain by diamicton of the Merrill Member.

Travel north 2.3 miles on Highway K.

7. Cross the intersection with Black Alder Drive on the right (east). Continue north on Highway K. For the next 0.5 mile, the trip route drops slightly into a shallow late Wisconsin meltwater channel and then back onto a narrow strip of the Merrill till surface. The prominent hummocky terrain visible approximately 1 mile to the north is the terminal moraine of the Wisconsin Valley Lobe.

Travel north 1.0 mile on Highway K to the intersection with Highway R. Turn right (east) on Highway R.

8. For the next 0.5 mile, the route crosses a late Wisconsin outwash fan that slopes to the south. The forested, discontinuous ridge immediately to the east and north is the terminal ice-marginal ridge of the Wisconsin Valley Lobe. The outwash fan heads at the ridge to the north. The pit on the north side of Highway R exposes reddish-brown diamicton of the Wildcat Lake Member of the Copper Falls Formation (late Wisconsin). The diamicton grades to outwash to the south. The Wildcat Lake Member is the lithostratigraphic name given to the materials deposited by the Wisconsin Valley Lobe in north-central Wisconsin.

Travel east 0.5 mile on Highway R. Turn right (east) onto gravel road where Highway R bends to left (north). Follow road into the gravel pit.

9. **Stop 1—Perkins Pit—Wisconsin Valley Lobe moraine.** The Perkins pit is a sand and gravel pit located in an ice-marginal ridge and adjacent outwash fan that formed along the southern margin of the Wisconsin Valley Lobe (fig. 2.1). In general, the maximum extent of the Wisconsin Valley Lobe is marked by a prominent, sharp-crested, discontinuous ridge, with ridge segments typically less than 1,500 feet long and between 50 and 100 feet high. Outwash fans head at the ridges in most places. In the Perkins pit, two ridge

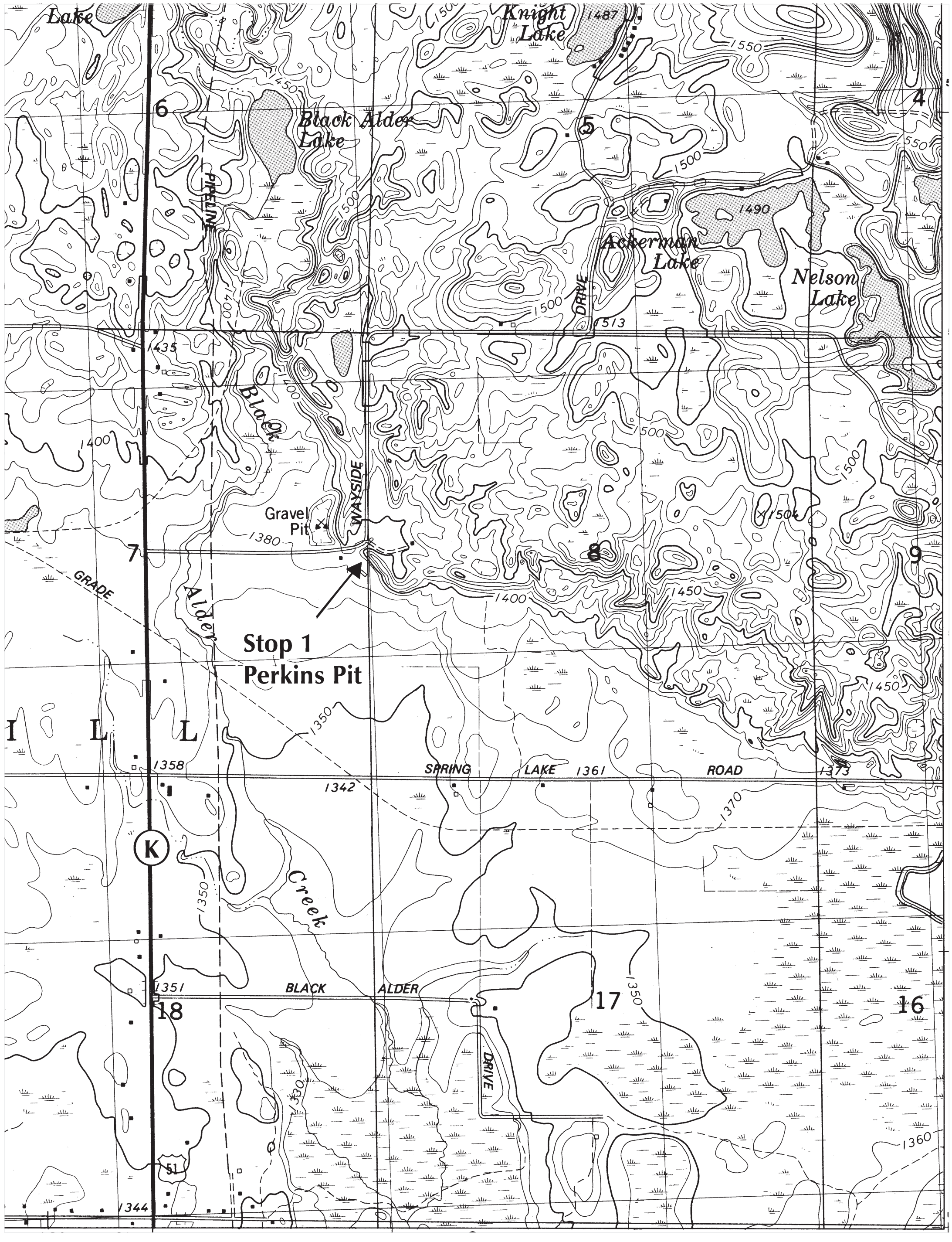


Figure 2.1. Part of the Irma Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1982), showing hummocky topography of the Wisconsin Valley Lobe and outwash fans sloping to the south. The local direction of ice flow was generally from north to south. The Perkins pit (Stop 1) is located in the ice-marginal ridge marking the maximum extent of the Wisconsin Valley Lobe. The contour interval is 10 feet.

segments are visible, and the core of one ridge is exposed by a 30- to 60-foot high cut. Most of the sediment exposed consists of reddish-brown (5YR4/4), slightly clayey, silty, gravelly sand (diamicton) considered to be part of the

Wildcat Lake Member of the Copper Falls Formation. Ten samples from the ridge cut average 70 percent sand, 22 percent silt, and 8 percent clay. This sediment grades to moderately well sorted outwash toward the south (summarized from Ham and Attig, 1997).

The origins of the diamicton and formation of the ridge segments are open to interpretation. Is the diamicton mainly debris-flow sediment or till? Did the ridges form primarily by subglacial deposition or do they represent a considerable amount of debris deposited from the ice surface that flowed to its present position?

Leave the gravel pit and proceed to pit entrance at Highway R.
Turn right (north) on Highway R.

10. For about the next 5 miles, the route crosses through prominent high-relief hummocky topography that formed in the marginal zone of the Wisconsin Valley Lobe (fig. 2.2). This area is known locally as the Underdown, named after a hermit who spent many years living in this essentially unpopulated area. The Underdown is a prominent, oval area of ice-disintegration topography that formed along the southeastern margin of the Wisconsin Valley Lobe. The trip route will cross this area from an up-ice location to the position of the ice margin; thus we are traveling in the general direction of ice flow. A similar but larger area of high-relief hummocky topography occurs to the northeast of the Underdown and is known as the Harrison Hills. Both areas of hummocky terrain consist of a mosaic of high-relief hummocks (up to 200-feet relief), kettle lakes and bogs, and ice-walled-lake plains. These roughly oval areas of ice-disintegration landforms are nearly surrounded by discontinuous ice-marginal ridges and outwash fans indicating they formed by slow melting of stagnant ice after the margin of the ice sheet had wasted northward.

Travel east 3.0 miles on Highway R.

11. Entrance to Lincoln County Sanitary Landfill to left (north). Continue east on Highway R. The landfill is constructed in part on the former offshore plain of a partly collapsed ice-walled-lake plain (fig. 2.2). In an area composed predominantly of sandy diamicton, the silty and clayey deposits of the lake plain serve as a confining bed and form a natural liner beneath the landfill.

Travel east 1.0 mile on Highway R.

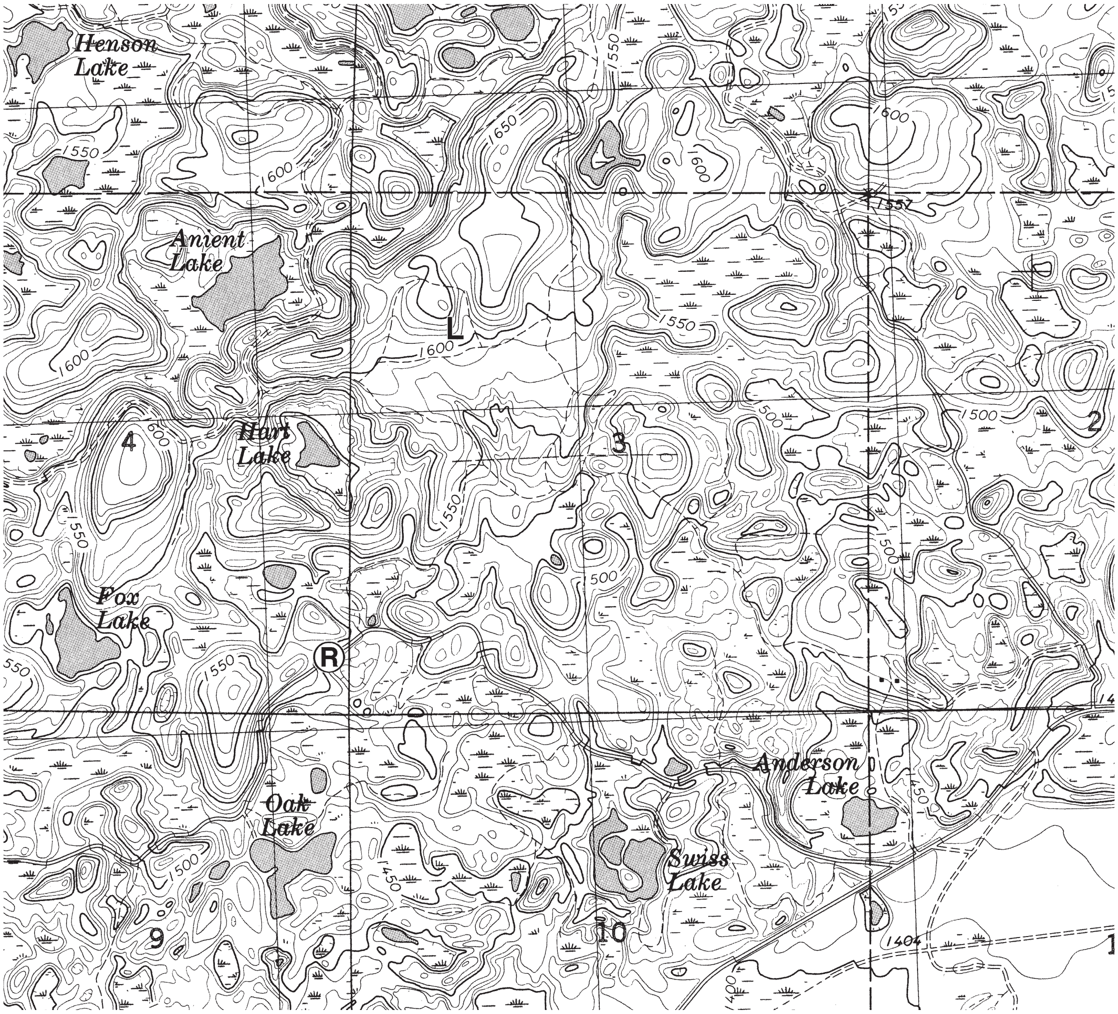


Figure 2.2. Part of the Bloomville Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1982), showing high-relief hummocky topography typical of the central part of the Underdown area. The location of a large, partly collapsed ice-walled-lake plain is indicated (L). The Lincoln County Sanitary Landfill is in the southern part of this lake plain. The contour interval is 10 feet.

12. Highway R ends at the junction with Spring Lake Road. Continue straight (soft left) on Spring Lake Road.

TRAVEL EAST 0.1 MILE ON SPRING LAKE ROAD.

13. Pass the Merrill Memorial Forest Wildlife Area on the south. Continue straight (east) on Spring Lake Road.

TRAVEL EAST 1.0 MILE ON SPRING LAKE ROAD.

14. Spring Lake Road ends and becomes Heineman Road. Continue straight (east) on Heineman Road. Over the next 1.0 mile, the route traverses a prominent boundary between the high-relief hummocky topography of the

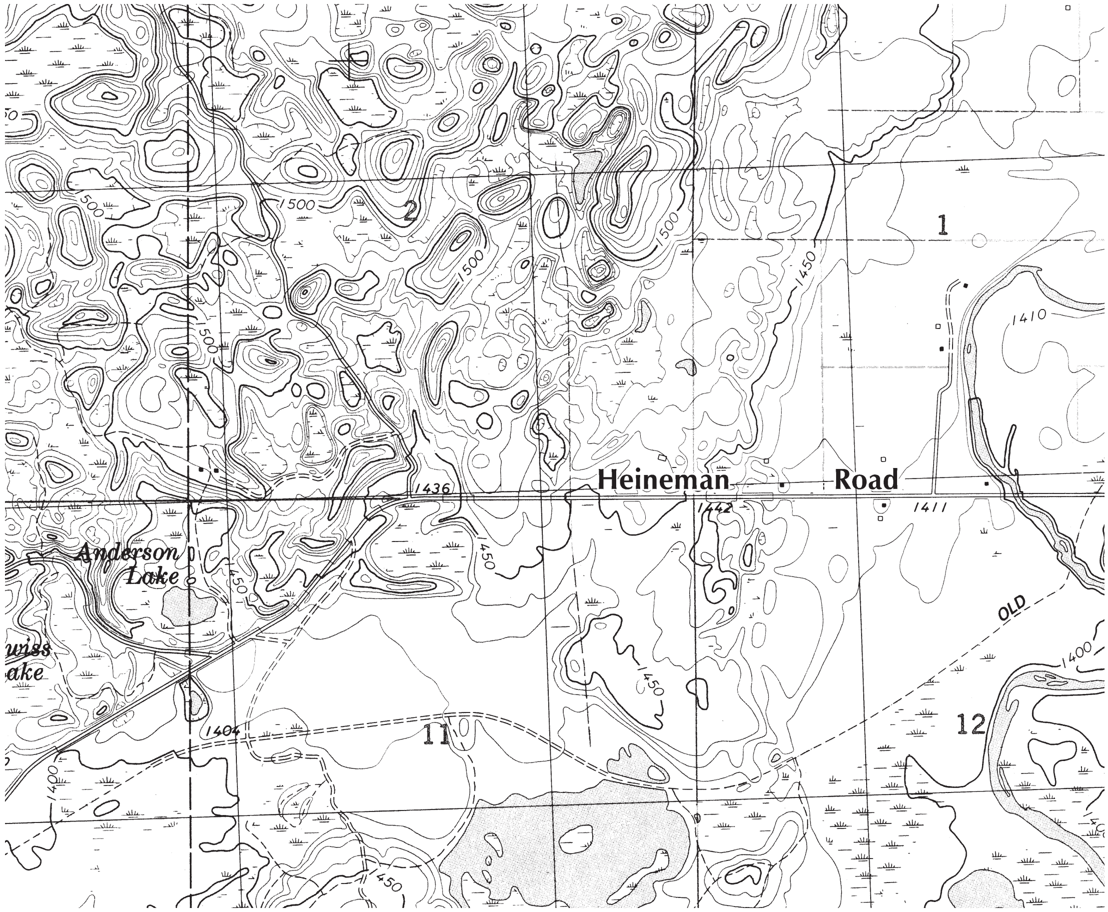


Figure 2.3. Part of the Bloomville Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1982), showing the transition between high-relief hummocky topography of the Underdown (west), which formed in the marginal zone of the Wisconsin Valley Lobe, and late Wisconsin outwash terraces deposited in the Prairie River valley (east). Ice flow was generally from northwest to southeast. Meltwater flow was generally to the south and southwest, approximately parallel to the ice margin. The contour interval is 10 feet.

Wisconsin Valley Lobe and the relatively flat outwash plain of the Prairie River valley (both late Wisconsin) (fig. 2.3). Locally, the flow of glacial ice was to the east and southeast, and meltwater rivers flowed to the south, approximately parallel to the ice front.

TRAVEL EAST 0.6 MILE ON HEINEMAN ROAD.

15. Cross the Prairie River. In this area, the route crosses late Wisconsin outwash terraces.

TRAVEL EAST 0.9 MILE ON HEINEMAN ROAD TO STOP SIGN AT INTERSECTION WITH HIGHWAY 17. TURN RIGHT (SOUTH) ON HIGHWAY 17.

16. For about the next 1.5 miles, the route continues over late Wisconsin outwash terraces deposited in the Prairie River valley. The prominent rise to the south is the rolling, stream-dissected landscape of the Merrill till surface. In this area, Precambrian bedrock is relatively close to the surface and to a large extent controls the topography.

Travel south 0.8 mile on Highway 17.

17. Intersection with Prairie Drive. Continue straight (south) on Highway 17.

Travel south 0.2 mile on Highway 17.

18. Turn right (west) on Old Highway 17 to Hay Meadow County Park.

Travel west 0.2 mile on Old Highway 17. Stop in parking lot at Hay Meadow County Park.

19. **Stop 2—Recent history of the Prairie River—coffee break.** This stop presents a good opportunity to discuss the recent history of the Prairie River. Following the break, the trip route will periodically follow the Prairie River in eastern Lincoln County. The Prairie River is considered one of the best trout streams in Wisconsin. It begins in northwestern Langlade County and flows southwest through Lincoln County to its confluence with the Wisconsin River at Merrill. The river averages about 65 feet wide and has daily mean flows ranging from 35 cfs to 4200 cfs during peak runoff periods. In the early part of this century, the Prairie River was used to float logs down to mills along the Wisconsin River. In 1904, the 60-foot-high Prairie Dells Dam was constructed along the river about 3 miles southwest of the community of Gleason. The dam was originally built to generate power, but was never adequate for the proposed needs. However, it did create a 126-acre lake called the Prairie Dells Pond, which became a popular recreation area. After many years of deterioration and public debate, the dam was finally removed in 1991 by Lincoln County and the Wisconsin DNR at a cost of about $200,000. Although the lower Prairie River experienced some siltation problems after the dam was removed, trout habitat will continue to improve in the coming years. The area of the Prairie Dells Pond is now a wetland.

The Prairie River is popular with trout fishers. The river has a diverse and healthy population of aquatic insects that support naturally reproducing brook trout. In addition, brown trout, rainbow trout, and brook trout are periodically stocked. The Wisconsin state record inland brook trout (9 pounds, 15 ounces) was caught in the Prairie River on September 2, 1944 by John Mixis (summarized from Born and others, 1997).

LEAVE PARK, TURN LEFT, AND RETRACE THE ROUTE TO HIGHWAY 17. TURN LEFT (NORTH) ON HIGHWAY 17. TRAVEL NORTH 1.0 MILE ON HIGHWAY 17 TO INTERSECTION WITH HEINEMAN ROAD. TURN LEFT (WEST) ON HEINEMAN ROAD.

20. High-relief hummocky topography of the Underdown is visible to the west (straight ahead) and to the northwest (front-right).

TRAVEL WEST 0.6 MILE ON HEINEMAN ROAD TO INTERSECTION WITH PRAIRIE DRIVE. TURN RIGHT (NORTH) ON PRAIRIE DRIVE.

21. Cross small bridge across a tributary of the Prairie River.

TRAVEL NORTH 0.5 MILE ON PRAIRIE DRIVE.

22. Cross the Prairie River. A good view of hummocky topography (Underdown) to the west (left).

TRAVEL NORTH 0.4 MILE ON PRAIRIE DRIVE. ROAD CURVES TO RIGHT TO INTERSECTION WITH HIGHWAY J. TURN LEFT (NORTH) ON HIGHWAY J.

23. For about the next 2.5 miles, the route crosses late Wisconsin outwash terraces that formed in front of the hummocky moraine of the Underdown. The meltwater rivers that deposited the outwash flowed generally to the south and southwest, parallel to the ice margin. Excellent views of the high-relief hummocky topography of the Underdown and Harrison Hills can be seen to the west (left) and north (straight ahead) respectively.

TRAVEL NORTH 1.0 MILE ON HIGHWAY J.

24. **Stop 3—Highway J photo stop—margin of Wisconsin Valley Lobe.** The discontinuous ice-marginal ridge (forested) to the west (left) marks the maximum extent of the Wisconsin Valley Lobe in this area (fig. 2.4). Segments of the ridge almost completely encircle the zone of high-relief hummocky topography (Underdown area) that formed in the marginal zone of the ice sheet. Note the outwash fan exiting a gap in the ridge. The prominent sag immediately in front of and parallel to the moraine is the shallow channel of a meltwater stream that flowed to the southwest, parallel to the ice front. This setting is very similar to that observed in the Perkins pit.

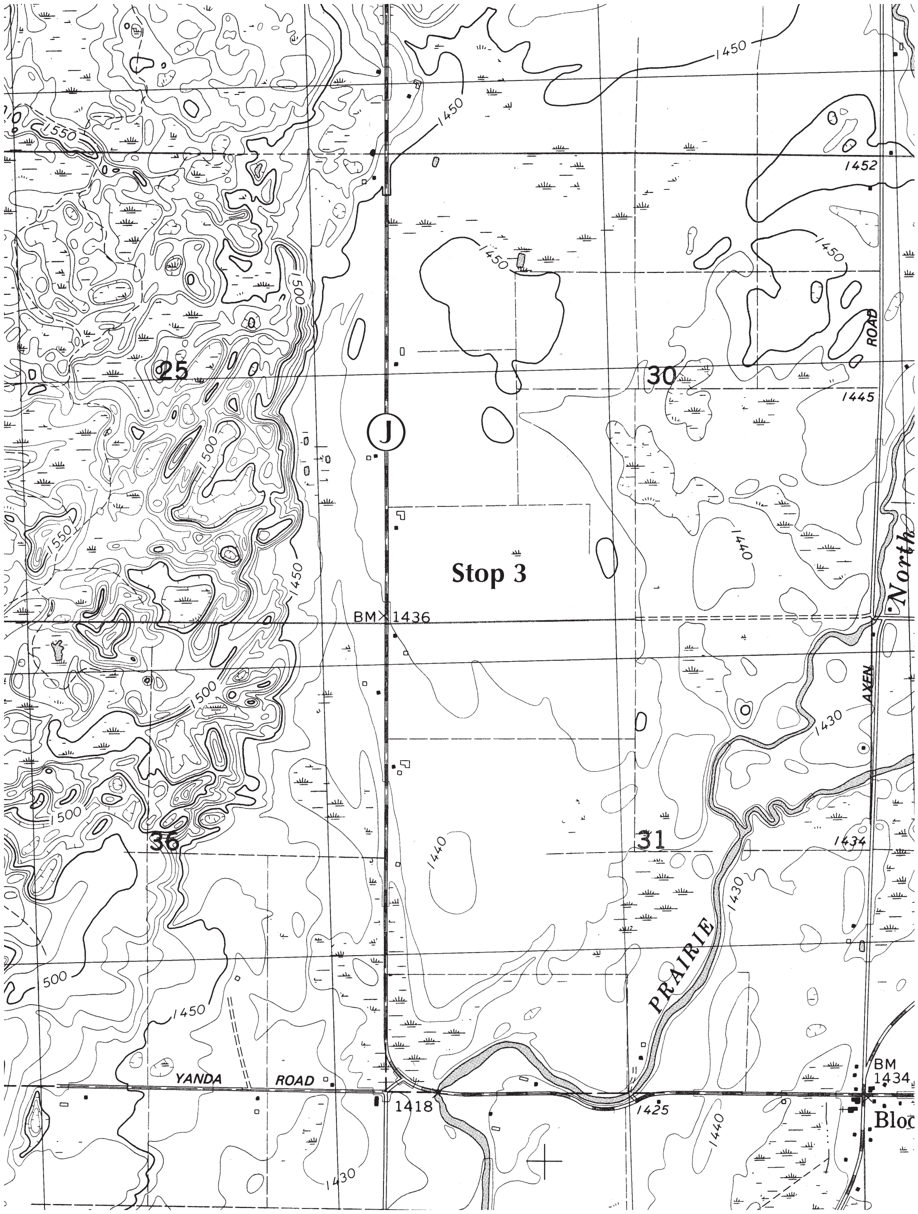


Figure 2.4. Part of the Bloomville Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1982), showing the hummocky topography and ice-marginal ridge that formed along the southeastern margin of the Wisconsin Valley Lobe. Ice flow was generally from west to east. Note the broad outwash terraces to the east. Meltwater flow was generally to the south. A prominent meltwater channel is preserved immediately adjacent to the ice-marginal ridge. The contour interval is 10 feet.

Travel north 1.4 miles on Highway J.

25. Intersection with Axen Road.

Turn right (east) on Axen Road. Travel east 1.0 mile on Axen Road to stop sign at the intersection. Turn right (south) and continue south on Axen Road.

26. The route continues across late Wisconsin outwash terraces in the Prairie River valley.

Travel south 1.4 miles on Axen Road.

27. Cross the North Branch River, a tributary of the Prairie River.

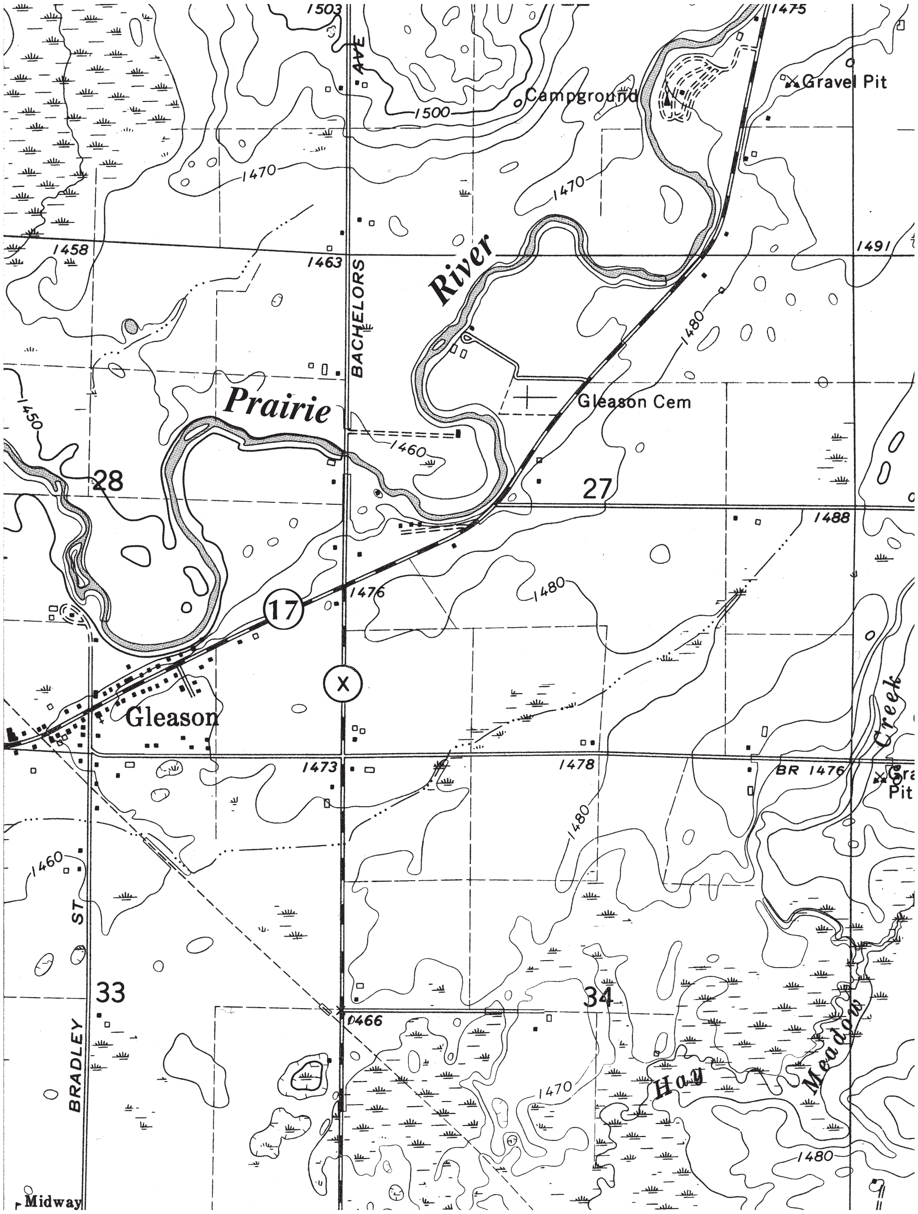


Figure 2.5. Part of the Gleason Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1973), showing the Prairie River along the west side of Highway 17 near the community of Gleason, Wisconsin. Most of the area shown on this map is late Wisconsin outwash terraces that formed in the Prairie River valley. Meltwater flow was generally to the southwest. The contour interval is 10 feet.

Turn right (south) and continue traveling south 0.4 mile on Axen Road.

28. Cross the Prairie River.

Travel south 0.6 mile on Axen Road to the intersection with Highway 17. Turn left (north) on Highway 17.

29. The route continues across late Wisconsin outwash terraces.

Travel north 1.2 miles on Highway 17.

30. Community of Gleason, Wisconsin; The trout fishing capital of the world. For about the next 3 miles, the Prairie River meanders along the west (left) side of Highway 17 (fig. 2.5).

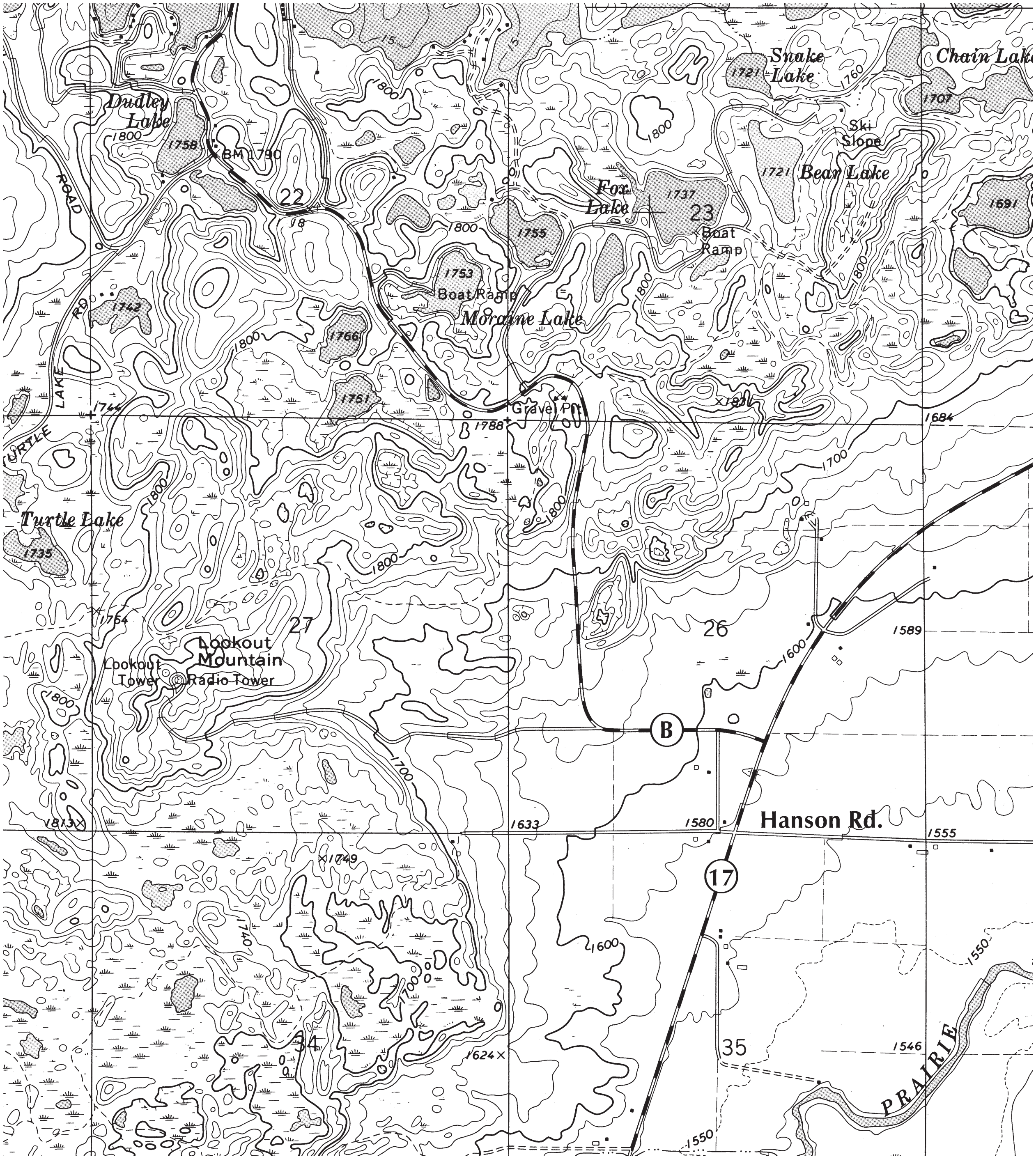


Figure 2.6. Part of the Parrish Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1973), showing an area of high-relief hummocky topography that developed in the marginal zone of the Wisconsin Valley Lobe. This area of hummocky topography is known as the Harrison Hills. The hummocky zone is marked by a discontinuous ice-marginal ridge. The local direction of ice flow was from northwest to southeast. Note the large outwash fan sloping to the southeast. The contour interval is 20 feet.

Travel north 1.5 miles on Highway 17.

31. The Prairie River is visible along the west (left) side of Highway 17. The high-relief hummocky moraine of the Wisconsin Valley Lobe is visible to the west.

Travel north 1.5 miles on Highway 17.

32. Intersection of Highway 17 and Highway CCC at the community of Dudley. At this point, the route crosses the Prairie River, which now flows on the east (right) side of Highway 17.

Travel north 2.8 miles on Highway 17.

33. The route ascends onto high, erosional remnants of outwash fans that are graded to the maximum extent of the Wisconsin Valley Lobe to the west. The prominent gaps between the fan segments are meltwater channels. The fan segments and meltwater channels slope toward the east (right). The Harrison Hills can be seen to the north.

Travel north 1.0 mile on Highway 17.

34. The route crosses a large ice-marginal fan (farm field to west) that is graded to the ice-marginal ridge marking the maximum extent of the Wisconsin Valley Lobe. Prominent, high-relief hummocky topography of the Harrison Hills is visible behind the ice-marginal ridge (fig. 2.6).

Travel north 0.4 mile on Highway 17 to the intersection with Highway B. Turn left (west) on Highway B.

35. The route ascends the large outwash fan mentioned previously (fig. 2.6). The Harrison Hills are visible to the west (straight ahead).

Travel west 0.5 mile on Highway B.

36. Highway B curves to right. The route crosses from the head of an outwash fan into hummocky topography.

Travel north 0.8 mile on Highway B.

37. Highway B curves to left. The Ice Age National Scenic Trail crosses the highway here.

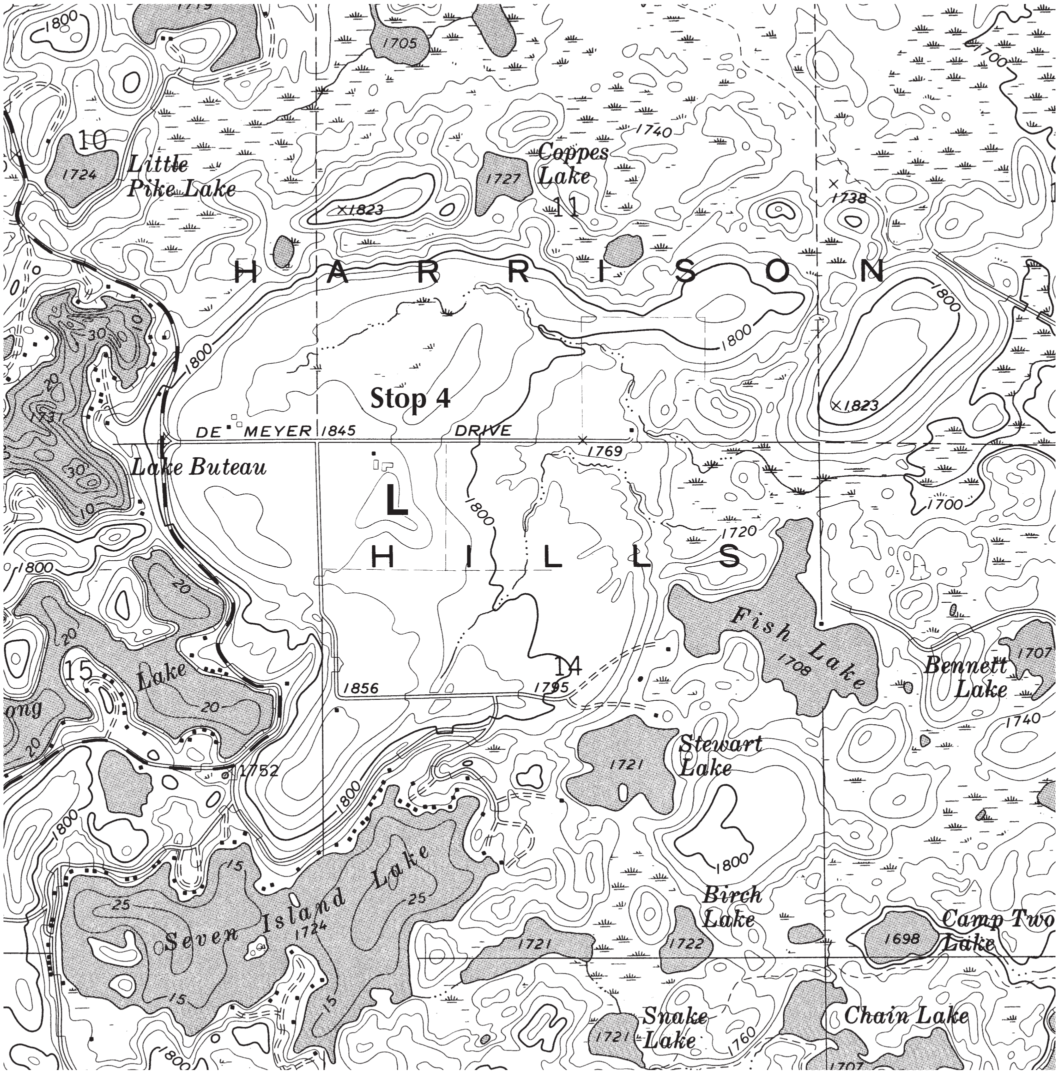


Figure 2.7. Part of the Parrish Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1973), showing a large, well preserved ice-walled-lake plain (L) in an area of high-relief hummocks in the central part of the Harrison Hills (Stop 4; Renn Farm ice-walled-lake plain). The contour interval is 20 feet.

Travel northwest 1.1 miles on Highway B.

38. Intersection with Bear Trail Road on left (west).

Travel north 1.2 miles on Highway B.

39. Intersection with Seven Island Lake Drive on the right (east). For the next 0.8 mile, the route ascends along the ice-contact face of a prominent ice-walled-lake plain (fig. 2.7). This particular lake plain is the largest in the Harrison Hills and the Underdown.

Travel north 0.8 mile on Highway B to the intersection with De Meyer Road. Turn right (east) and travel east 0.4 mile to farm at end of road. Stop in driveway.

40. **Stop 4—Renn Farm—ice-walled-lake plain.** This stop is near the center of the largest and most prominent ice-walled-lake plain in the Harrison Hills (fig. 2.7). The owner of the farm and most of the lake plain is Mr. John Renn. Ice-walled-lake plains are a conspicuous part of the landscape in the areas of hummocky topography marking the marginal zone of the Wisconsin Valley Lobe. Especially in areas of high-relief hummocks, such as the Harrison Hills and the Underdown, ice-walled-lake plains are typically the highest areas in the landscape. The lake plains consist of flat, bowl-shaped, or convex-upward plains, with or without raised rims preserved along their margins. The Renn ice-walled-lake plain is roughly circular in map view and approximately 1 mile in diameter. The eastern part of the plain is partly collapsed.

Numerous drillhole and hand-auger samples show that the lake plain is underlain by sorted silt and clay (at least 60 feet thick), in places rhythmically laminated. The margin and raised rim is underlain by sorted sand, gravelly sand, or sandy gravel. The distribution of lake sediments indicates a predictable pattern in the depositional environments of the former lake. The general characteristics of the hummocks and ice-walled-lake plains in the Harrison Hills and the Underdown suggest that the ice-cored landscape may have been stable for some period before final ice disintegration, perhaps in part controlled by late-glacial climate conditions. A conceptual model for the sequence, timing, and pattern of ice-disintegration and landscape evolution in the region was discussed on an earlier trip. This area provides evidence in support of that model. For a complete discussion of this landscape and model of landform evolution, see Ham and Attig (1996a).

Turn around in farm driveway. Travel west 0.4 mile on De Meyer Road to intersection with Highway B. Turn left (south) on Highway B. Travel south 2.0 miles on Highway B to intersection with Bear Trail Road. Turn right (south) on Bear Trail Road. Travel south 0.3 mile on Bear Trail Road to junction with Turtle Lake Road. Bear Trail Road turns to the right (northwest). Continue on Bear Trail Road. Travel northwest 1.1 miles on Bear Trail Road.

41. Intersection with Pickerel Lake Road on right (north). On west (left) side of road, a 20-foot high wall in a slumped pit exposes reddish-brown, sandy diamicton typical of the hummocks in the Harrison Hills. Pebble fabrics and sedimentary structures indicate the diamicton was deposited as gravity flows on the stagnant ice surface. The trip route now travels through the central part of the high-relief hummocky topography and ice-walled-lake plains in the Harrison Hills (fig. 2.8).

Travel northwest 0.4 mile on Bear Trail Road.

42. Intersection with Pickerel Lake Road on right (north).

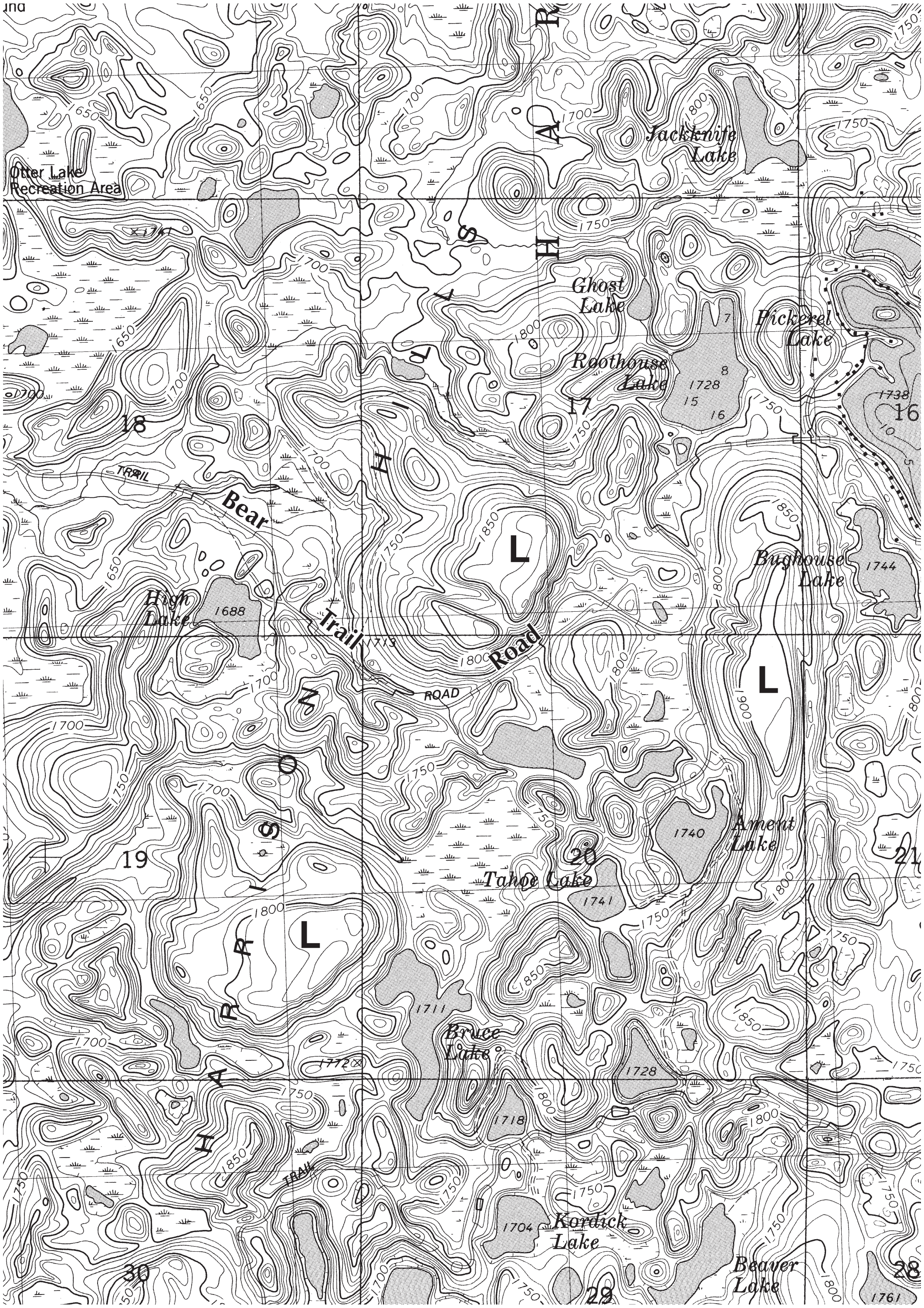


Figure 2.8. Part of the Harrison Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1982), showing an area of high-relief hummocks and three ice-walled-lake plains (L) in the west-central part of the Harrison Hills. The contour interval is 10 feet.

Travel west 2.8 miles on Bear Trail Road.

43. Intersection with Otter Lake Road on right (north). Lincoln County main-

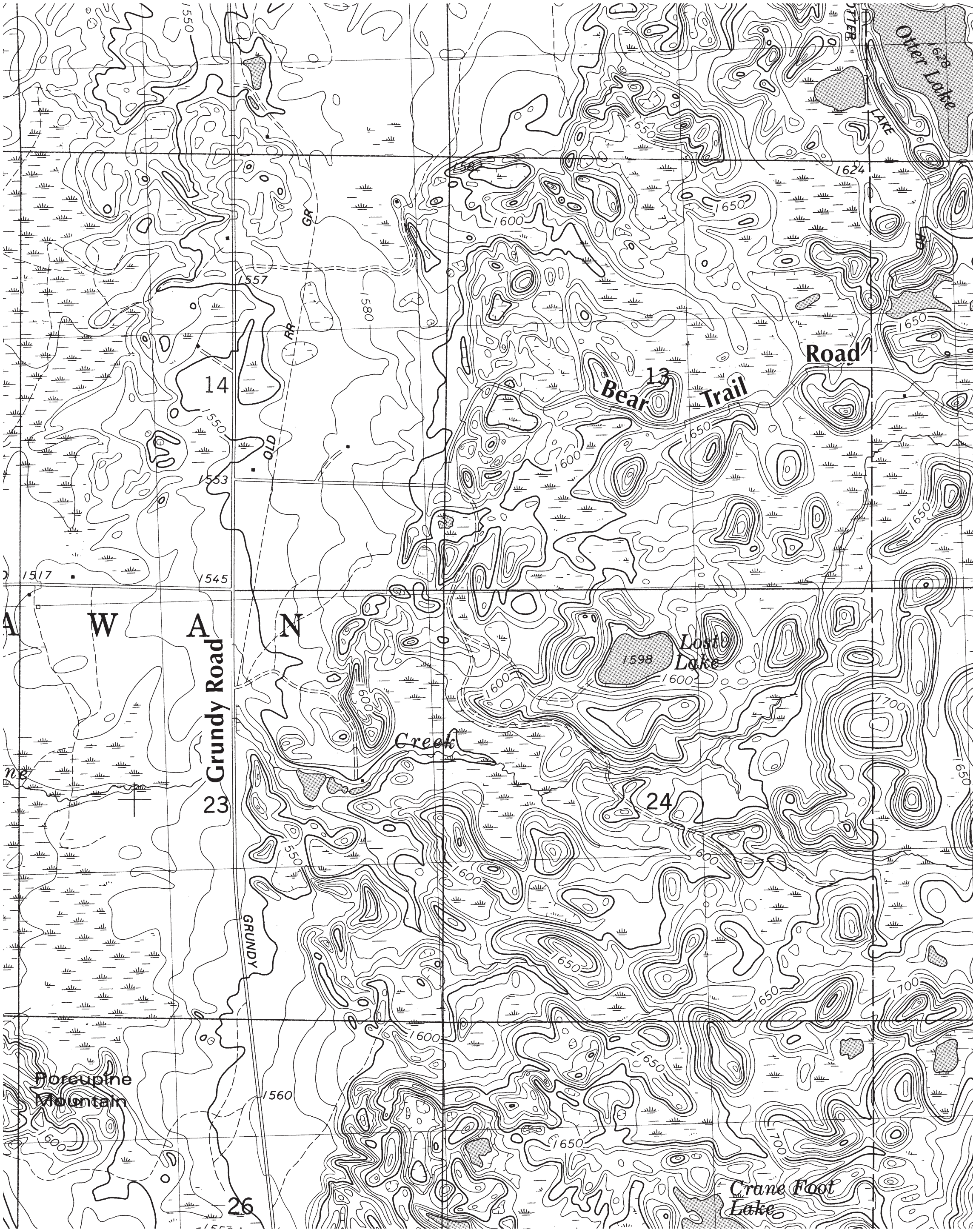


Figure 2.9. Part of the Harrison Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1982), showing a discontinuous ice-marginal ridge and outwash fans on the proximal (up-ice) side of the hummocky topography of the Harrison Hills. The original direction of ice flow in this area was from the northwest to the southeast. The maximum extent of the Wisconsin Valley Lobe is east of the area shown on this map. The contour interval is 10 feet.

tains a small public campground and park on scenic Otter Lake. The lake has good fishing for bass and bluegill. For about the next mile along Bear Trail

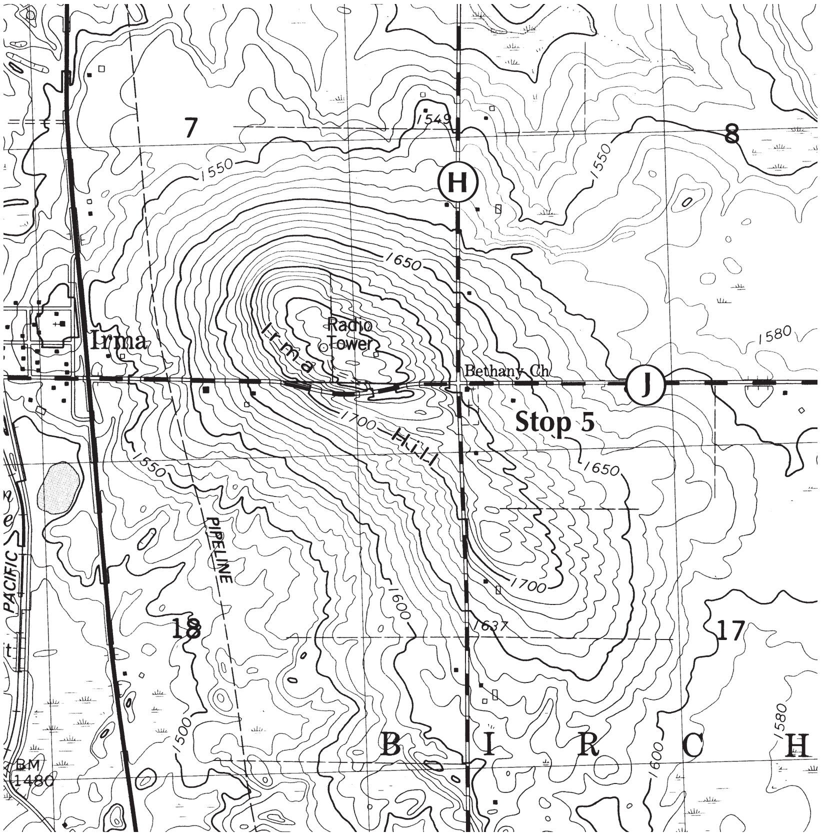


Figure 2.10. Part of the Irma Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1982), showing Irma Hill, the upper part of which is underlain by resistant, probably Cambrian, quartz sandstone. The jagged contour lines reflect the presence of several small moraines at the surface. The contour interval is 10 feet.

Road small (3- to 10-foot) slumped roadcuts expose reddish-brown, sandy diamicton to sorted sand and gravel in several hummocks (fig. 2.9). Pebble fabrics and sedimentary structures indicate much of the diamicton was deposited as gravity flows on the stagnant ice surface.

Travel west 1.0 mile on Bear Trail Road.

44. Bear Trail Road curves abruptly to the left (south) at the up-ice margin of the Harrison Hills (fig. 2.9). The prominent ridge immediately to the west (left) is an ice-marginal ridge that formed on the up-ice (proximal) side of the hummocky topography that developed in the marginal zone of the Wisconsin Valley Lobe. The route crosses over the upper parts of several low-relief, sandy outwash fans that head at the ridge segments. The fans slope to the west (right) indicating meltwater flow in that direction during ice wastage.

Travel south 0.2 mile on Bear Trail Road.

45. Bear Trail Road curves abruptly to the right (west). The route descends an outwash fan that heads at the ice-marginal ridge previously mentioned.

Travel west 0.5 mile on Bear Trail Road to the intersection with Grundy Road. Turn left (south) on Grundy Road. Travel south 0.6 mile on Grundy Road.

46. Excellent view of ice-marginal ridge on the up-ice side of the Harrison Hills to the east (left). For the next 4.5 miles, the trip route crosses over several outwash fans that head at the ridge segments and slope toward the west (right).

Travel south 2.6 miles on Grundy Road.

47. Intersection of Grundy Road with David Road on the right (west). Good view of the Harrison Hills to the east (left).

Travel south 2.0 miles on Grundy Road to intersection with Highway J. Turn right (west) on Highway J.

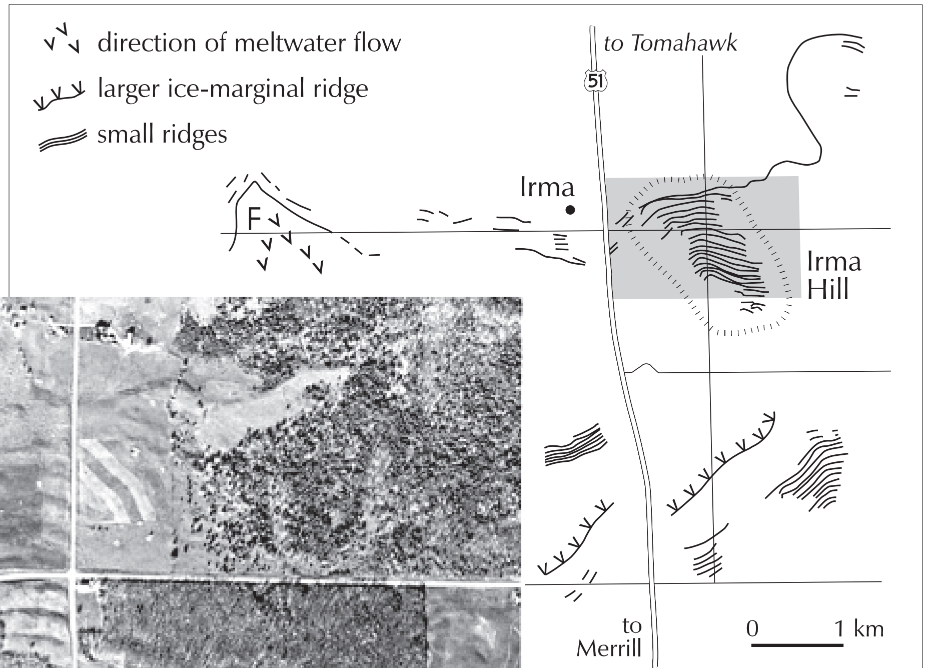
48. The route along this part of Highway J crosses low-relief hummocky topography, small areas of outwash, and a collapsed ice-walled-lake plain. The prominent hill to the west (straight ahead) is called Irma Hill (fig. 2.10).

Travel west 3.9 miles on Highway J to intersection with Highway H. Turn left (south) into cemetery parking lot and stop. From cemetery parking lot, walk to radio towers across the intersection.

49. **Stop 5—Irma Hill moraines—regional pattern of ice flow.** A series of more than 35 small (less than 15 feet high), parallel ridges occur in this area of Lincoln County (figs. 2.10 and 2.11). The best preserved and most accessible ridges are found on Irma Hill, Chase Hill, and the site of the Lincoln Hills School. The ridges are not well expressed on topographic maps, but they are clearly visible on 1:20,000-scale aerial photographs (fig. 2.11). The ridges are found between 4 and 10 miles behind the maximum extent of the Wisconsin Valley Lobe, and they lie between a region of drumlins to the northwest and hummocky topography to the southeast. The form, composition, and origin of the ridges have been discussed by Ham (1994) and Ham and Attig (1994, 1996a). In summary, the ridges trend generally northeast to southwest, approximately parallel to the margin of the Wisconsin Valley Lobe. In places, the ridges clearly appear to outline the position of the wasting glacier margin. The ridges are between 3 and 15 feet high, up to 1 mile long, and spaced between 100 and 250 feet apart. They tend to have an asymmetrical form with a steeper up-ice slope and a more gentle down-ice slope.

In 1993, road construction resulted in a 0.75 mile exposure through about 20 of the ridges. Five ridges were exposed to a depth of about 15 feet, revealing

A



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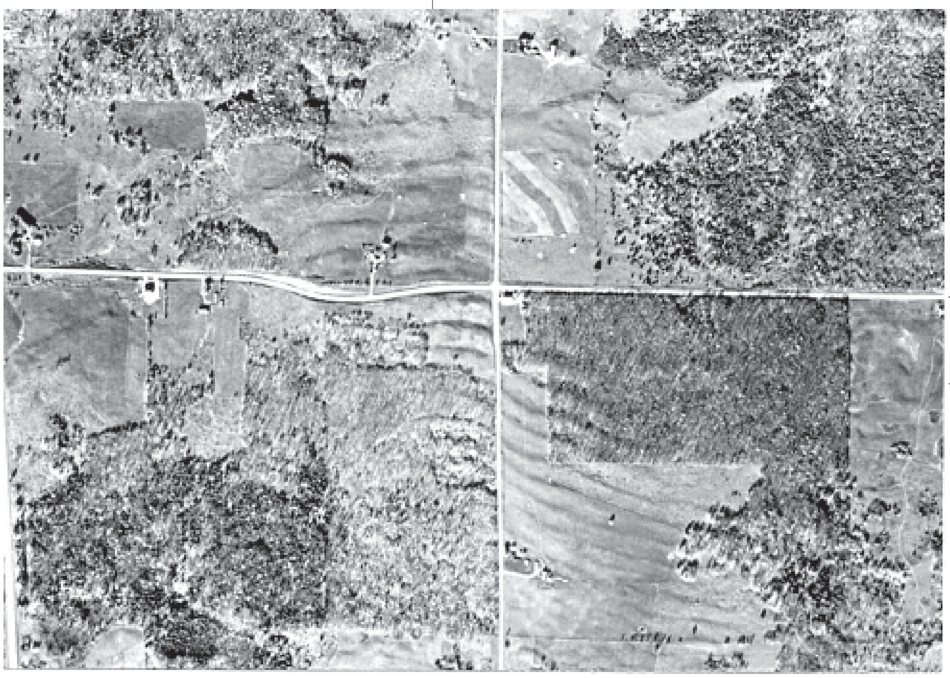


Figure 2.11. A. Map of the central part of Lincoln County, Wisconsin, near the community of Irma, showing the orientations of the crests of small, parallel ridges (moraines) that formed along the margin of the Wisconsin Valley Lobe. The location of an ice-marginal fan is indicated (F). B. USDA aerial photograph of Irma Hill showing well preserved moraines in the farm fields. The local direction of ice flow was to the south. The width of view is about 1.4 miles. Irma, Wisconsin, is located just to the west

good information about their composition. The ridges consistently showed four major sedimentary facies: a core of variable deformed sediment (e.g., sand and gravel, fine sand, etc.), uniform diamicton on the up-ice sides, variable diamicton on the down-ice sides, and a cover of hillslope sediment. On the basis of their morphology, pattern, and composition, Ham and Attig (1994) suggested the ridges are small ice-marginal ridges (moraines) that likely formed annually during wastage of the Wisconsin Valley Lobe due to small winter readvances of the ice margin. Based on the assumption that the ridges are annual moraines, simple calculations of the net annual rates of ice-surface lowering when the ridges formed yielded estimates between about 6 and 20 feet per year (Ham, 1994).

Detailed mapping of ice-margin positions and ice-flow indicators in the Chippewa and Wisconsin Valley Lobes suggests that the sequence of advances of both lobes was much more complex than previously thought. In addition, these lobes clearly interacted with each other. The trends of drumlins, eskers,

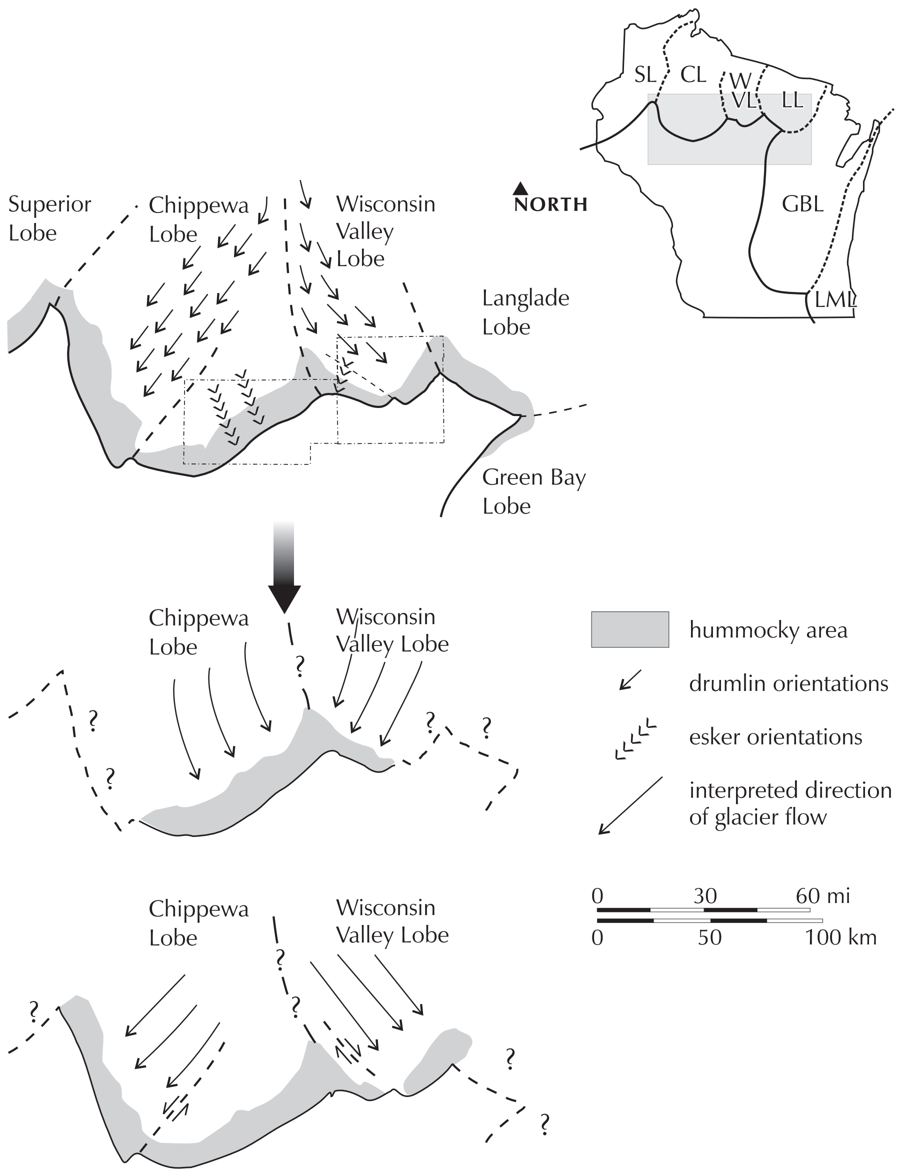


Figure 2.12. Schematic diagram showing a reconstruction of the flow history of the Chippewa and Wisconsin Valley Lobes during the last part of the Wisconsin Glaciation. This interpretation is based largely on the regional distribution of ice-flow indicators (mainly drumlins) and ice-margin indicators such as moraines, eskers, and tunnel channels in north-central Wisconsin.

and tunnel channels formed beneath both lobes indicate large changes in ice-flow direction (~90 degrees) during at least two distinct advances of each lobe (Ham, 1994; Attig and Ham, 1997). The boundaries between landforms with different trends are narrow (<1,500 feet wide) and can be traced to areas of hummocky topography along the former ice margins that are clearly offset (displaced) several miles beyond adjacent moraines. In addition, reconstructions of the longitudinal profiles of the Chippewa and Wisconsin Valley Lobes suggest they were gently sloping and had low values of driving stress, possibly due to surge or ice-stream conditions. These observations indicate a complex flow history for both lobes. Initially, the Chippewa Lobe advanced to the southeast and the Wisconsin Valley Lobe to the southwest (toward each other), followed by readvances of the Chippewa Lobe to the southwest and the Wisconsin Valley Lobe to the southeast (away from each other). Large changes in flow direction may have been caused by the deflection of fast-flowing ice by areas of stagnant ice near the ice margin (summarized from Attig and Clayton, 1990; Attig, 1993; Ham, 1994; Ham and Attig, 1996b). This regional view of ice-flow history is shown schematically in fig. 2.12.

Travel west 0.3 mile on Highway J.

50. The route descends the west side of Irma Hill. A prominent outcrop of Cambrian sandstone occurs on the north (right) side of Highway J.

Travel west 0.4 mile on Highway J to the intersection with Highway 51. Turn right (north) on Highway 51.

51. For the next mile, the route crosses mainly over collapsed outwash.

Travel north 1.0 mile on Highway 51 to intersection with Highway V. Turn right (east) on Highway V.

52. For about the next 0.7 mile, the route crosses mainly over collapsed outwash. The prominent hill immediately to the east (straight) is Chase Hill (underlain by a bedrock high).

Travel east 0.7 mile on Highway V to the intersection with Highway H. Turn right (south) on Highway H.

53. The route now ascends the north slope of Irma Hill. Note the prominent moraines preserved in the field on the west (right) side of the highway.

Travel south 1.0 mile on Highway H to intersection with Highway J. Continue south on Highway H. Travel south 0.2 mile on Highway H.

54. Note the large, vegetated roadcut on east (left) side of highway and several moraine ridges clearly visible in the farm field.

Travel south 2.3 miles on Highway H.

55. Intersection of Highway H with Horseshoe Lake Drive. Highway H curves abruptly to right (west).

Travel west 0.4 mile on Highway H to intersection with Highway K. Turn left (south) on Highway K. Travel south 0.2 mile on Highway K.

56. Farm field to the east (left) and west (right) is part of an ice-walled-lake plain. For the next 3.0 miles, the route primarily crosses lower-relief hummocky topography that formed near the margin of the Wisconsin Valley Lobe.

Travel south 0.8 mile on Highway K.

57. Larson Lake and a rest stop are located on the west (right) side of Highway K.

Travel south 0.5 mile on Highway K.

58. A small but prominent ice-walled-lake plain is preserved immediately to the east (left) side of Highway K. The ice-contact face and rim ridge (farm house) are clearly visible. For about the next 1.3 miles, the route crosses low-relief hummocky topography of the Wisconsin Valley Lobe and then descends onto the Merrill-till surface.

Travel south 1.3 miles on Highway K.

59. At this point, the route descends onto the surface underlain by diamicton of the Merrill Member of the Lincoln Formation.

Travel south 0.1 mile on Highway K.

60. Intersection of Highway K with Highway R. The remaining portion of this log retraces the first part of the field trip.

Travel south 4.3 miles on Highway K to entrance ramp with Highway 51. Turn right (south) on Highway 51 to Merrill. Travel south 0.5 mile on Highway 51.

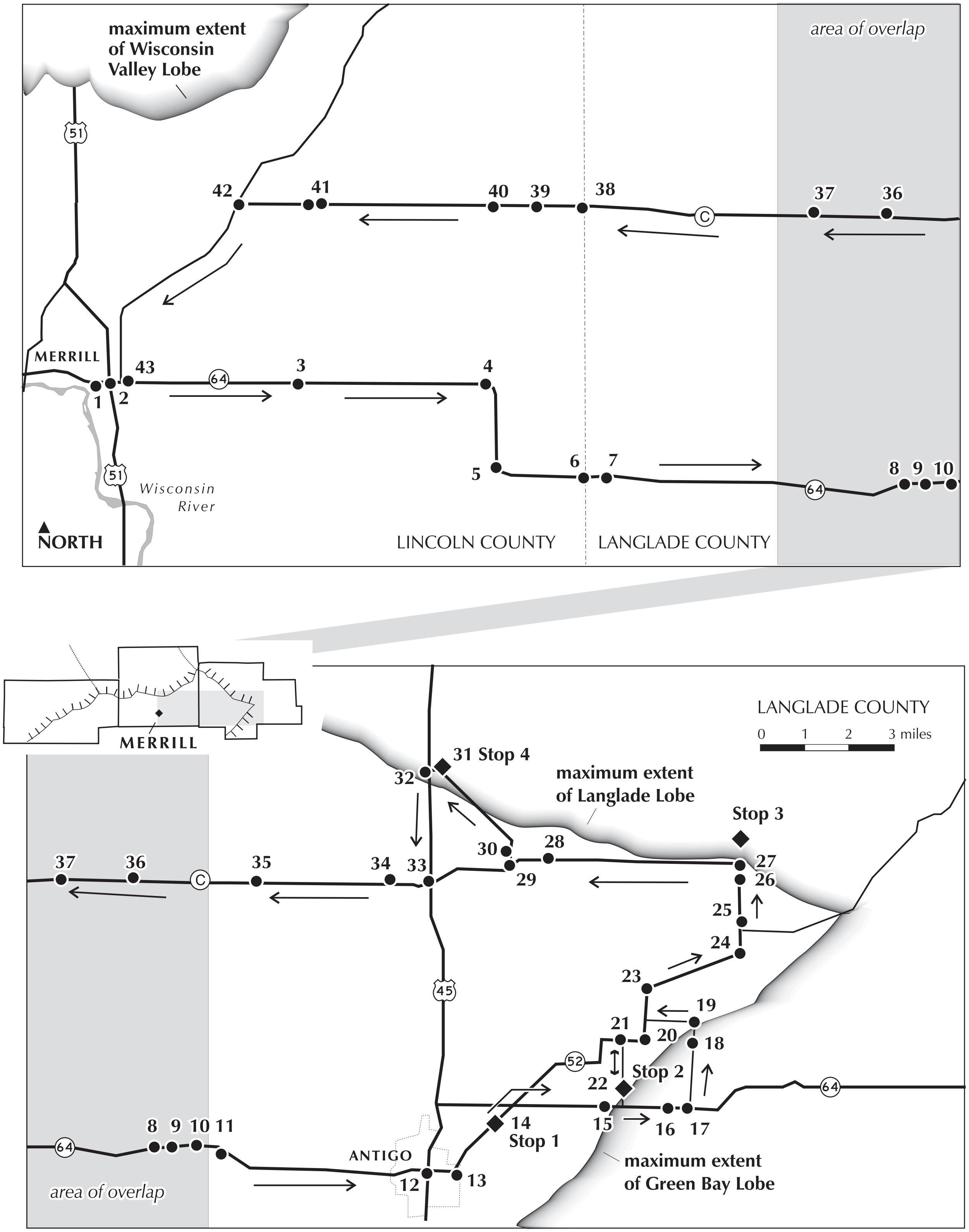
61. Cross the Prairie River.

Travel south 0.5 mile on Highway 51.

62. The gravel pit on the west (left) side of Highway 51 exposes outwash in the Prairie River valley.

Travel south 4.0 miles on Highway 51 to Interchange with Highway 64/17. Exit Highway 51 (exit 208) to Merrill. Proceed to stop sign and turn right (west) on Highway 64. Travel west 0.3 mile on Highway 64. Turn left (south) into Super 8 Motel parking lot.

Map of the route for the field trip on the morning of Sunday, May 31.



Part 3. Langlade Lobe area

David M. Mickelson

Overview. The field trip for Part 3 of this field conference will travel east from Merrill to examine the marginal area of the Langlade Lobe. Specifically, we will continue our discussion of the pre-late Wisconsin stratigraphic units, discuss meltwater drainage in eastern Lincoln County and Langlade County, and examine tunnel channels and other ice-marginal landforms.

> *Refer to WGNHS Bulletin 93,* Pleistocene Geology of Lincoln County, Wisconsin *(Ham and Attig, 1997) for a 1:100,000 geologic map of Pleistocene materials and additional information about the area traversed by the first part of this field trip, the part between Merrill and the Langlade County line.*

Leave Super 8 Motel and turn right (east) on Highway 64.

1. For the next 13 miles, the route crosses a rolling, stream-dissected landscape underlain primarily by diamicton of the Merrill Member of the Lincoln Formation (fig. 3.1). Precambrian metavolcanic and granitic bedrock is close to the surface on uplands, typically within 30 feet. The bedrock topography largely controls the surface topography in this area of Wisconsin. As noted yesterday, diamicton of the Merrill Member (also referred to as the Merrill till) is typically reddish-brown, slightly clayey, silty, gravelly sand. Stewart and Mickelson (1976) reported an average sand:silt:clay ratio of 60:30:10 for 21 samples of the diamicton. Pebble-fabric measurements and the orientations of several subdued moraines near Merrill indicate that the glacier that deposited Merrill till flowed to the southeast in eastern Lincoln County and western Langlade County. In general, no glacial landforms are preserved on the Merrill surface in southern Lincoln County.

The age of sediment of the Merrill Member is poorly constrained. Two radiocarbon age estimates from organic-rich sediment found on top of the Merrill till at Schelke Bog (see location 39, this roadlog) in eastern Lincoln County are 40,800 BP ±2000 (IGS-256) and >36,500 BP (IGS-262) (Stewart and Mickelson, 1974, 1976; Dirlam, 1979). In addition, Stewart and Mickelson (1976) reported that the Merrill till shows a greater degree of weathering of its clay fraction than does sediment of the Copper Falls Formation, which was deposited during the last part of the Wisconsin Glaciation by the Laurentide Ice Sheet (fig. 3.4). These observations indicate that the Merrill till was deposited prior to the last part of the Wisconsin Glaciation and has undergone an extensive period of subaerial weathering. Perhaps the Merrill till was deposited during the early part of the Wisconsin Glaciation.

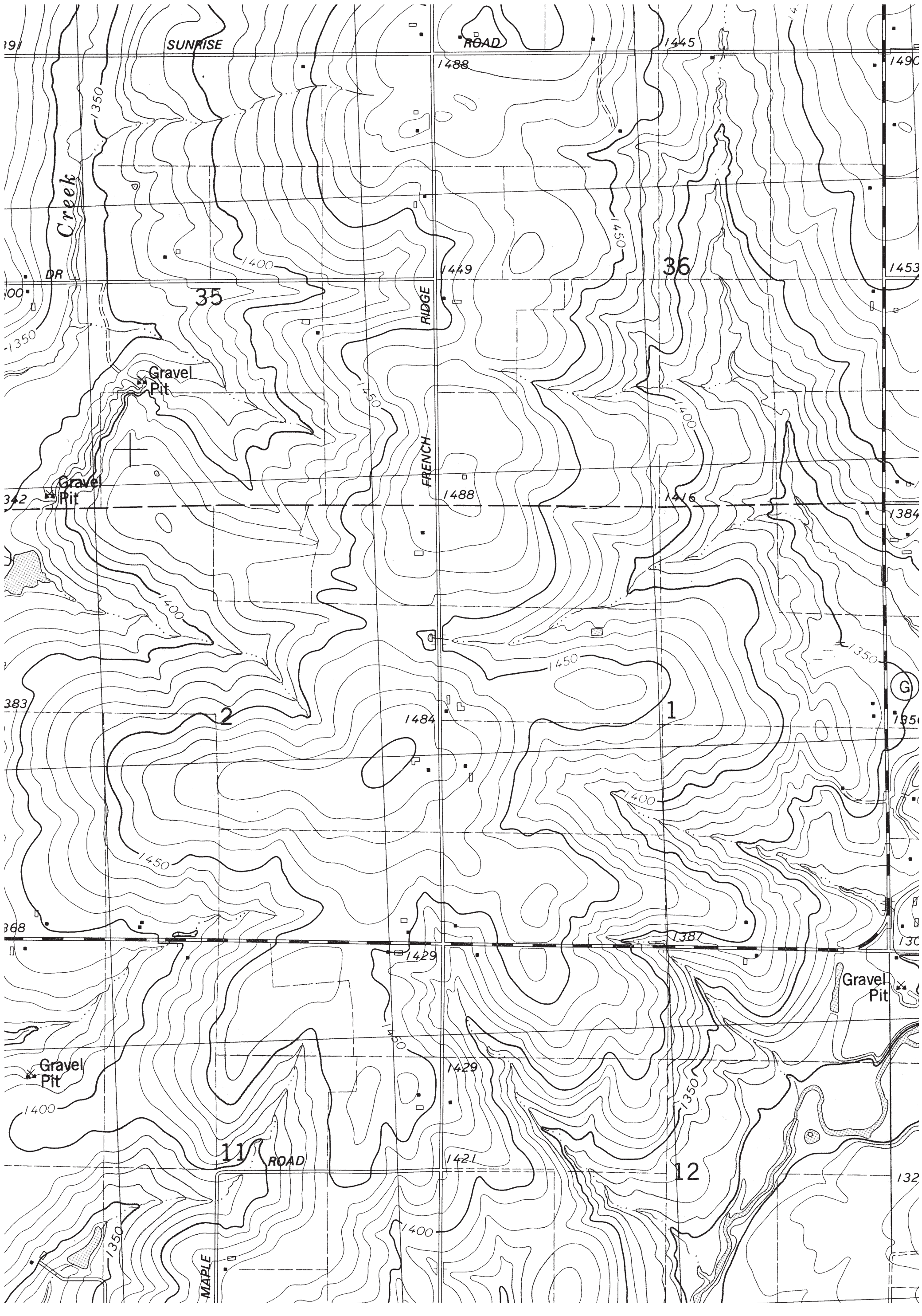


Figure 3.1. Part of the Pine Dells Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1982) showing broad, rolling, stream-dissected topography typical of the Merrill till surface in southeastern Lincoln County. The contour interval is 10 feet.

Travel east 0.4 mile on Highway 64.

2. Highway 51 overpass.

Continue east 4.0 miles on Highway 64.

3. Cross the Pine River. Although the Pine River valley is only 0.5 to 1.0 mile wide at this point, to the northeast the valley is up to 3.0 miles wide and contains extensive outwash deposits (fig. 3.2). The valley served as a major drainageway for meltwater from the glacier that deposited the Merrill till. For the next 3.0 miles, the route crosses a series of till-mantled uplands and intervening shallow meltwater channels.

   In addition to meltwater-stream valleys such as that of the Pine River, several abandoned channels cross modern drainage divides in southern Lincoln County and appear to have served as lake spillways. These features suggest that two modes of meltwater drainage, controlled by the relationship between the ice margin and local topography, functioned during deglaciation. In northern Marathon County and southern Lincoln County, the topography generally consists of broad ridges that trend approximately northeast to southwest. In places where the topography sloped toward the ice margin, meltwater must have ponded in small ice-marginal lakes. Some of these lakes apparently drained through spillways that cut across drainage divides. However, no significant lake sediment is preserved in the area probably because the lakes only existed for short periods and possibly because the ice was relatively clean. In places where the topography sloped away from the ice margin, lakes were absent and meltwater drained in streams such as the one in the Pine River valley (Ham, 1994; Ham and Attig, 1997).

Travel east 4.8 miles on Highway 64.

4. Highway 64 bends sharply to the right (south).

Travel south 2.0 miles on Highway 64.

5. Highway 64 bends sharply to the left (east).

Travel east 2.0 miles on Highway 64.

6. Langlade County line. Thwaites (1943) and Mickelson and students have studied the Langlade County area (Nelson, 1973; Stewart, 1973; Mickelson and others, 1974, Mickelson, 1986). Specifics of distinguishing the pre-

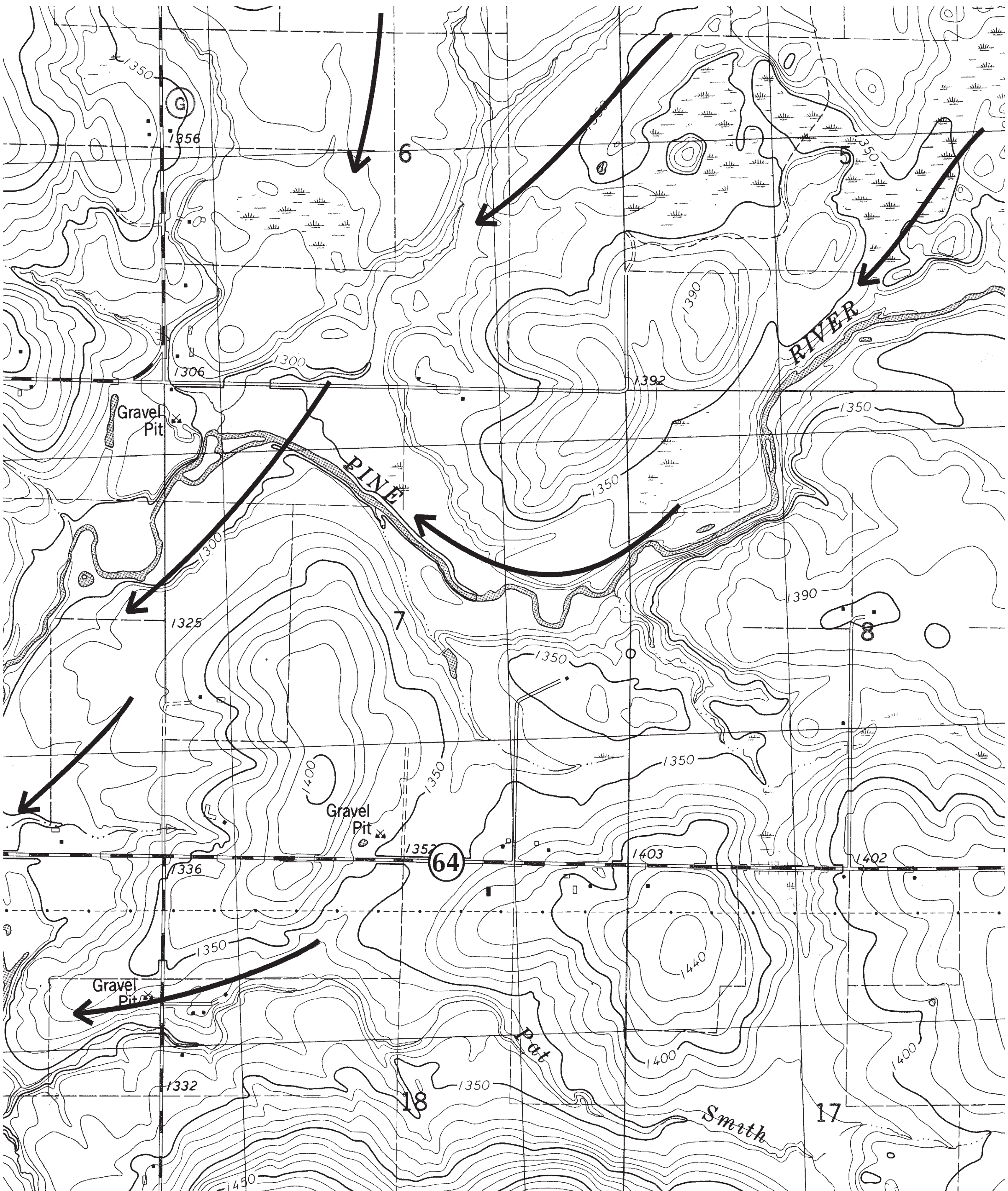


Figure 3.2. Part of the Pine Dells Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1982) showing the valley of the Pine River, which carried meltwater and outwash from the glacier that deposited the Merrill till. The uplands are underlain primarily by thin Merrill till. The valley contains extensive deposits of outwash of the Merrill Member. Meltwater flow was to the southwest (indicated by arrows). The contour interval is 10 feet.

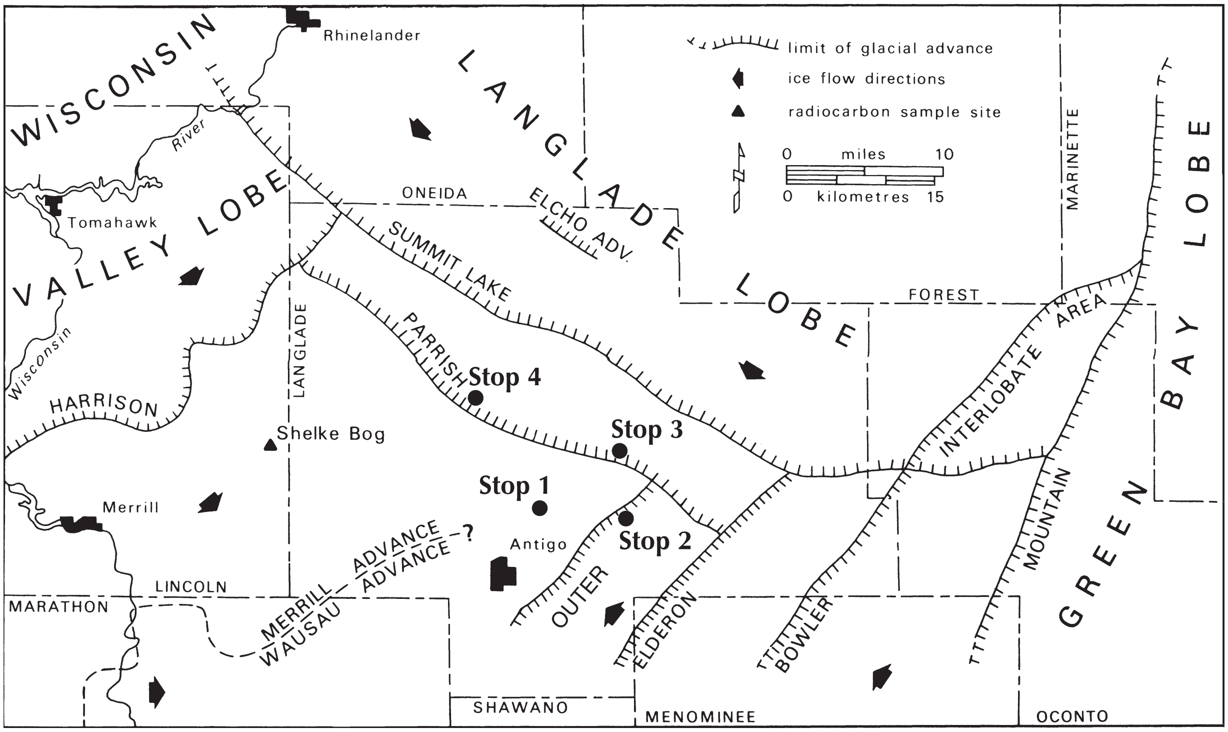


Figure 3.3. Map of north-central Wisconsin showing ice margin positions of the Green Bay, Langlade and eastern Wisconsin Valley Lobe with field trip stop locations shown (modified from fig. 1, of Mickelson, 1986).

Wisconsin stratigraphic units (Merrill Member of the Lincoln Formation and the Wausau Member of the Marathon Formation) using clay minerals are given by Stewart (1974) and Stewart and Mickelson (1976). Figure 3.4 presents a summary of the clay mineral content of stratigraphic units in this area. Exposures of the older units are poor and here we concentrate on the moraines and outwash deposited during the late Wisconsin advances of the Green Bay and Langlade Lobes. See figure 3.3 for ice-margin positions and the location of field trip stops in Langlade County.

> *Refer to WGNHS Information Circular 52*, Glacial and Related Deposits of Langlade County, Wisconsin *(Mickelson, 1986) for a 1:100,000 geologic map of Pleistocene materials and additional information about the area traversed by the remainder of this field trip.*

Travel 0.4 mile east on Highway 64.

7. A drillhole on the south side of the road penetrated 12 feet of clayey silt lacustrine sediment over 3 feet of diamicton of the Merrill Member over rotten granite. Hills nearby are capped with Merrill Member.

Continue east 6.8 miles on Highway 64.

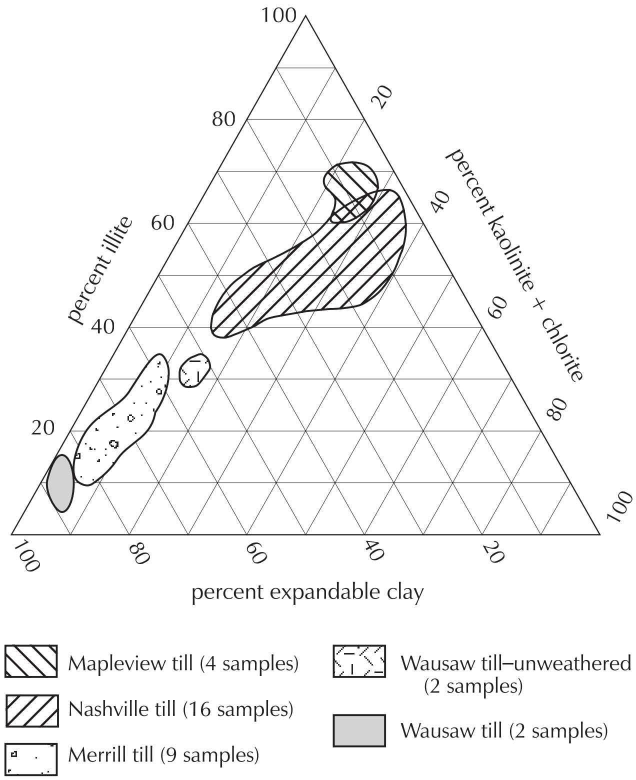


Figure 3.4. Clay mineralogy of stratigraphic units in Langlade and southern Lincoln Counties (from Stewart and Mickelson, 1976).

8. Cross Black Brook. This drainage was probably dammed by aggrading outwash of the Antigo Flats, the large outwash plain that we will see ahead.

Travel east 0.5 mile on Highway 64.

9. A drillhole on the north side of the road here penetrated less than 6 feet of poorly sorted sediment over rotten granite. This is the westernmost edge of the Antigo Flats.

Continue east 0.5 mile on Highway 64.

10. Cross West Branch of Eau Claire River. This channel probably developed as stream flow across the outwash plain from the Green Bay and Langlade lobes began to decline. We are now on the Antigo Flats.

Drive 0.8 mile east on Highway 64.

11. Cross East Branch of the Eau Claire River. Water table here at the west edge of this outwash plain is shallow and limits productivity. As we continue toward Antigo the water table is deeper and the soils are intensively farmed. Potatoes do especially well on this surface, which has about 3 feet of loess over gravel. The piles of cobbles you see here and there on the surface are harvested with the potatoes.

Follow Highway 64 for 4.5 miles into Antigo.

12. Intersection of Highway 64 and 52 in Antigo.

Go straight through the intersection on Highway 52 and continue 0.7 mile.

13. Intersection of Highway F.

Continue 1.2 miles on Highway 52. The terminal moraine of the Green Bay Lobe (Outer moraine) can be seen in the distance to the right (east).

14. **Stop 1—Historical marker for the Antigo Silt Loam—State Soil of Wisconsin.** The Antigo Silt Loam is very productive soil particularly for potatoes and snap beans. Alfalfa is also an important crop here. The soil is classified as a Typic Glossoboralf (Mitchell, 1986). About 3 feet of loess overlies sand and gravel producing excellent drainage below and good moisture retention in the B horizon, although potatoes are commonly irrigated. The Outer moraine (Thwaites, 1943) of the Green Bay Lobe is in the distance to the east.

Continue 0.5 mile on Highway 52. Turn right (east) on Highway 64. Travel 2.1 miles heading toward the Outer moraine.

15. As we approach the moraine note the slight depression on the outwash surface close to the moraine front. Evidently, the last water being produced by melting of buried ice downcut this channel that parallels, then becomes oblique to, the moraine front. The channel was probably still braided, but carrying finer material than when the major part of the outwash plain was built. We then rise onto the outwash apron at the front of the moraine. The moraine does not have a distinct, single crest, but is a zone of hummocky diamicton and sand and gravel about 1 mile wide (fig. 3.5). The structure of the moraine was described by Nelson and Mickelson (1977).

Continue 1.3 miles east on Highway 64.

16. A tunnel channel crosses the road obliquely at this location. Note the linear pattern and the relative depth of this depression compared to shallower kettles in the rest of the moraine. Our next stop will be at the mouth of this tunnel channel. The sharp-crested ridge just to the west of the tunnel channel appears to be mostly diamicton. One possibility for the genesis of the ridge is that it was squeezed into the edge of the tunnel from below. Green Bay Lobe tunnel channels commonly have a ridge on one or both sides that is composed of diamicton; deposits in the tunnel channel itself are mostly sand and gravel. A summary of Wisconsin tunnel channel characteristics is given in Clayton and others (submitted). Stop 2 will be in the fan at the mouth of this tunnel channel.

Continue 0.6 mile east on Highway 64, then left on Hill Street.

17. Intersection with Hill Street. We are now in an area of pitted outwash. The

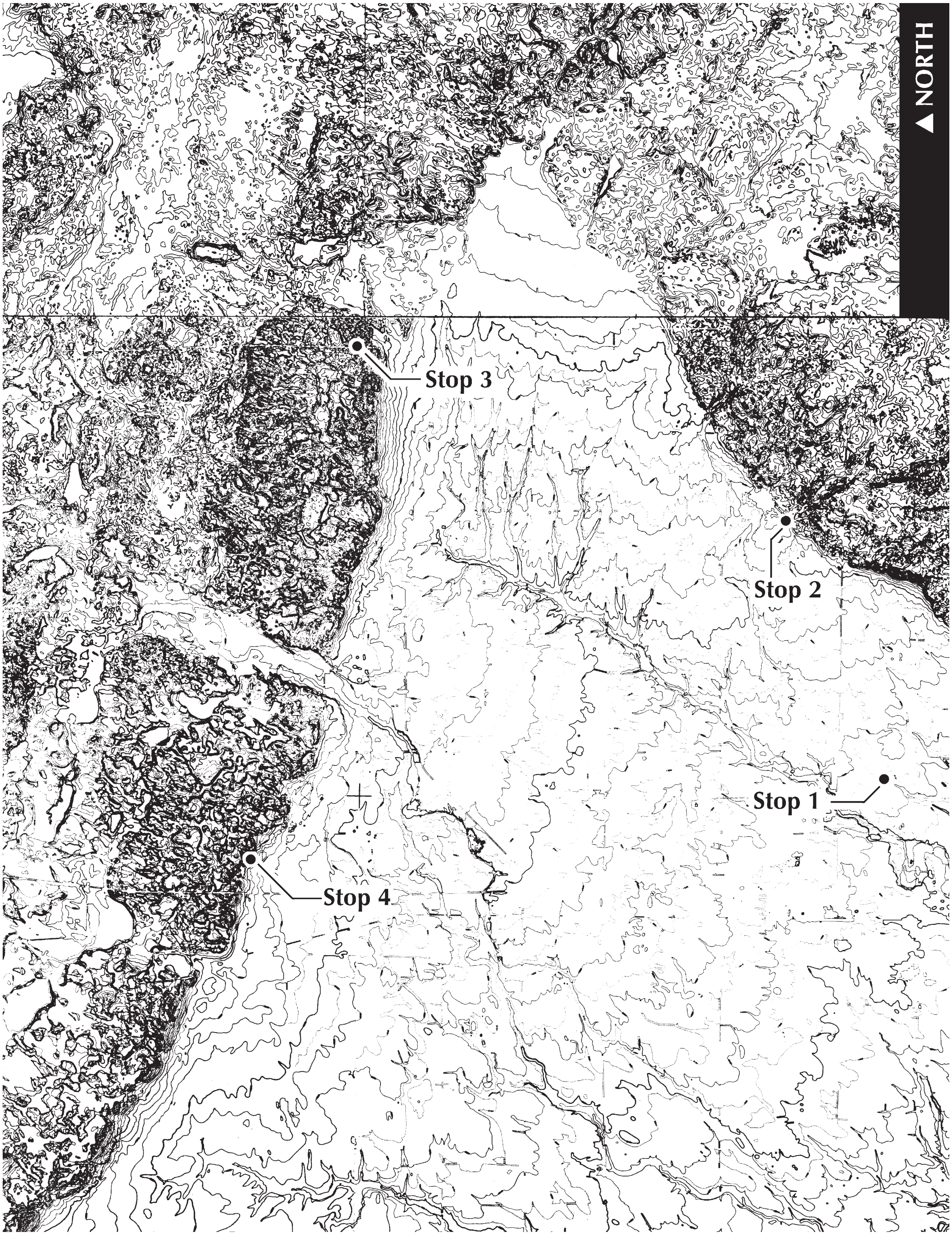


Figure 3.5. 1:100,000 mosaic of contour lines from 1:24,000 topographic quadrangles showing stop locations and major geomorphic features of the marginal areas of the Langlade and Green Bay Lobes.

higher, more hummocky topography of the moraine is to the left and ahead (north). The orientation of the moraine is southwest to northeast, so the route crosses it obliquely. Notice that as we approach the moraine (mostly wooded) the elevation rises. Is this is an expression of the amount of debris in the ice? All along the edge of the Green Bay Lobe the regional slope is down to the east, producing a series of moraines or outwash heads at successively lower elevations separated by pitted outwash. The ice margin was being buried by sand and gravel as it retreated.

PROCEED NORTH 1.6 MILES ON HILL STREET.

18. As we leave the moraine, we cross through a shallow channel with 2- to 4-inch diameter gravel and then rise slightly onto the outwash plain.

CONTINUE NORTH 0.4 MILE ON HILL STREET. TURN LEFT ON EDISON ROAD.

19. We are now heading west on the outwash surface. The moraine is to the left, but the view is mostly blocked by trees.

TRAVEL WEST 1.0 MILE ON EDISON ROAD. TURN LEFT (SOUTH) ON HIGHWAY 52. THE MORAINE LIES AHEAD AND TO THE LEFT. CONTINUE 1.0 MILE ON HIGHWAY 52.

20. After rounding the corner on Highway 52, a small gravel pit is visible to the left. We will be going to the one that can be seen in the distance south of there.

TURN LEFT (SOUTH) ON CLOVER ROAD.

21. Just after making the turn, note the small depression and then the rise on the outwash surface. We are rising onto a fan, the head of which is at the mouth of the tunnel channel we crossed a few miles back.

CONTINUE 0.7 MILE SOUTH ON CLOVER ROAD. TURN LEFT AND DRIVE INTO THE NORTHEAST ASPHALT PIT.

22. **Stop 2—Northeast Asphalt Pit.** We interpret the coarse boulders present in the fan apex as evidence of high-velocity discharge of water out of the tunnel channel. All the boulders here came from this pit. Most are Wolf River granite, the local rock just to the east and beneath the tunnel channel. Bedding is crude, but dips back toward the tunnel channel in places. Is this the

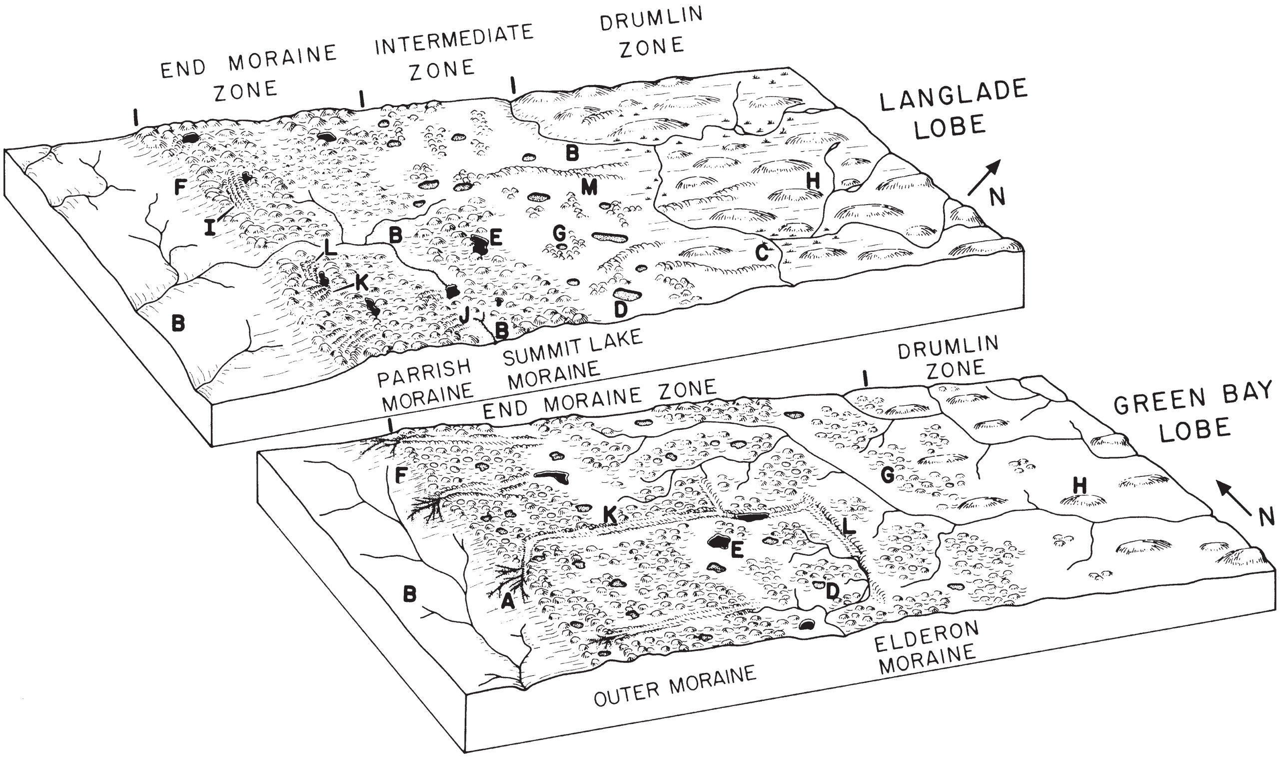


Figure 3.6. Diagrams showing the pattern of distribution of landforms in the marginal area of the Green Bay and Langlade Lobes (from Mickelson, 1986, fig. 16).

deposit of a jokulhlaup? Did these boulders roll off the ice margin? Were they carried a substantial distance by water? by ice? A handout will be distributed at this stop to describe the boulder sizes and discuss possibilities of reconstructing the flow velocity.

Leave pit and turn right (north) on Clover Road and travel for 0.8 mile. Turn right on Highway 52 and continue 1.6 miles.

23. Intersection of Highway I. As we drive northeastward here, note the Parrish moraine of the Langlade Lobe on the left and the Outer moraine of the Green Bay Lobe on the right. We are on outwash that was likely deposited by rivers that flowed from both the Langlade and Green Bay Lobes.

Continue on Highway 52 for 2.2 miles.

24. Intersection with Highway S.

Continue to the left on Highways S and 52 for 0.5 mile.

25. Highway 52 turns to the right.

Continue straight (north) 1.1 miles on Highway S toward the Parrish moraine.

26. The Parrish moraine (Thwaites, 1943) is more massive than the Outer moraine and stands about 150 feet above the outwash plain. Note the shallow depression produced by late drainage out of the moraine, presumably from buried ice. We then begin rising on the outwash apron in front of the Parrish moraine. This surface has a distinctly steeper gradient than the flatter outwash plain we have been on, and it steepens continuously to the moraine itself. Note the change in land use, presumably because the gravel here is so coarse that it can not be easily farmed.

Stop 3—Crest of the Parrish moraine on Highway S. This is a view stop, not a digging stop. Here at the distal edge of the moraine is where the elevation is highest. This high, distal ridge is composed mostly of sand and gravel in the south with increasing amounts of diamicton, mostly mass-wasting deposits, in its proximal side. These deposits belong to the Nashville Member of the Copper Falls Formation (Mickelson, 1986). Note the drop in elevation to the north. This marginal zone of hummocky topography (see fig. 3.6) is about 5 miles wide here and contains many types of sediment and a wide array of stagnation forms such as kettles, ice-walled-lake plains, and a variety of ridges both parallel and perpendicular to ice flow (fig. 3.5). The Outer moraine can be seen to the south across the Antigo Flats.

Continue north on Highway S to a turn around about 100 yards north. Turn around and return south on Highway S 0.75 mile. Turn right (west) on Highway O.

27. Highway O parallels the front of the Parrish moraine of the Langlade Lobe (possible photo stop here). Note the boulder piles, especially to the left. Boulders are presumably even coarser closer to the moraine, but there are no exposures.

Travel 4.1 miles on Highway O.

28. Intersection with Highway A.

Turn left on Highway A. Travel 1.1 miles on Highway A.

29. Intersection with Highway V.

TURN RIGHT (NORTH) ON HIGHWAY V AND TRAVEL 0.2 MILE.

30. Here the route heads towards the Parrish moraine and almost immediately drops into the valley of the east branch of the Eau Claire River. Gravel in the cut bank to the right is 4 to 6 inches in diameter. The modern valley was probably cut by water leaving the Parrish moraine as stagnant ice in the moraine slowly melted, perhaps for thousands of years after retreat of the ice margin. It appears that most loess deposition was complete before all ice was melted out of the moraine and before streams like this stopped carrying outwash; thus, the silt cap is thin or absent on these low terraces.

CONTINUE 2.5 MILES ON HIGHWAY V. THE MORAINE CONTINUES ON OUR RIGHT AND WE SLOWLY APPROACH IT.

31. **Stop 4—Anton Benes Pit in the crest of the Parrish moraine.** Here the moraine has a ridge of diamicton of the Nashville Member of the Copper Falls Formation at its outer edge, topographically above the outwash apron (fig. 3.5). The diamicton is interpreted to be basal meltout till. It retains strong fabric perpendicular to the moraine front and is exposed along the east edge of the pit. The remainder of the pit contains ice-marginal deposits that are mostly sand and gravel. Some debris-flow sediment has been visible in the pit as well. Note the absence of dolomite and Wolf River granite, both of which were so abundant in the deposits at Stop 2.

LEAVE ANTON BENES PIT AND TURN RIGHT ON HIGHWAY V. TRAVEL 0.2 MILE WEST ON HIGHWAY V. INTERSECTION WITH HIGHWAYS 45 AND 47. TURN LEFT (SOUTH) AND TRAVEL 2.5 MILES ON HIGHWAYS 45 AND 47.

32. Descend the steep outwash apron in front of the moraine. Agriculture here is less intense than farther east on the Antigo flats, probably because the water table is nearer to the surface here. Note the signs of poor drainage on both sides of the road (Tamarack bog) at the bottom of the outwash apron.

33. Intersection with Highway C. Pull into small park just to the right on Highway C.

HERE THE 1998 MIDWEST FRIENDS OF THE PLEISTOCENE FIELD CONFERENCE ENDS.

END OF FIELD CONFERENCE

Those returning to Merrill may return by following Highway C using the following road log. Those going east toward Green Bay or south toward Milwaukee may continue south on Highways 45 and 47 to Antigo and points beyond.

To return to Merrill continue west on Highway C for 0.9 mile.

34. Intersection with Highway B. Notice that the prosperity of farms decreases to the west. Several things contribute to this. The water table in the outwash is higher than that to the east, there is no carbonate in the sand and gravel, and the loess cap is thin to absent.

Continue west 3.1 miles on Highway C.

35. Intersection with Highway H. The Parrish moraine is now out of sight to the right. The hills ahead are mostly bedrock controlled and covered with thin diamicton of the Merrill Member.

Continue 2.9 miles west on Highway C.

36. Leave the Antigo flats and rise onto surface of Merrill diamicton.

Continue 1.7 miles on Highway C.

37. Junction with Highways I and H.

Continue straight ahead 4.9 miles on Highway C across Merrill diamicton surface.

38. Lincoln County line.

Continue west 0.9 mile on Highway C.

39. Intersection with Schelke Road. Just south of this intersection is Schelke Bog, the site where several radiocarbon ages from peat overlying Merrill diamicton were obtained (Mickelson and Hole, 1974; Dirlam, 1974). Under road fill is 24 feet of outwash sand carried from the Parrish Moraine, now about 6 miles to the north. This overlies 6 feet of organic sand, then 1 foot of peat. The peat overlies Merrill diamicton. Dirlam (1974) reported that the abundance of pine pollen is distinctly different than the postglacial spectrum, and is similar to pollen content in Illinois about 40, 000 BP reported by Gruger

(1972). The percent of spruce pollen increases upward in the core, possibly signaling colder conditions of the late Wisconsin.

Continue 1.0 mile west on Highway C.

40. Intersection with Highway X. All of the uplands here are capped with diamicton of the Merrill Member.

Continue 4.0 miles west on Highway C.

41. Intersection with Highway G.

Continue 1.9 miles west on Highway C.

42. Intersection with Highway 17.

Turn left and travel 5.2 miles southwest on Highway 17.

43. Intersection of Highways 17 and 64.

Turn right on Highway 64 and travel 0.5 mile west.

44. Intersection with Pine Ridge Road. Turn right to return to the Best Western Motel or continue to the Super Eight Motel just ahead on the left.

References

Attig, J.W., 1993, Pleistocene geology of Taylor County, Wisconsin: Wisconsin Geological and Natural History Survey Bulletin 90, 25 p.

Attig, J.W., and Clayton, Lee, 1990, Strike-slip features and possible late Wisconsin surging of the Chippewa Lobe, north-central Wisconsin: Canadian Quaternary Association/American Quaternary Association, Program and Abstracts, p. 13.

Attig, J.W., Clayton, Lee, and Mickelson, D.M., 1988, Pleistocene stratigraphic units of Wisconsin 1984–1987: Wisconsin Geological and Natural History Survey Information Circular 62, 61 p.

Attig, J.W., Clayton, Lee, and Mickelson, D.M., 1985, Correlation of late Wisconsin glacial phases in the western Great Lakes area: *Geological Society of America Bulletin,* v. 96, p.1585–1593.

Attig, J.W., and Ham, N.R., 1997, Pattern and sequence of ice advance and wastage near the margin of the Wisconsin Valley and Chippewa Lobes*: Geological Society of America Abstracts with Programs,* v. 29, no. 4, p. 2.

Born, S., Mayers, J., Morton, A., and Sonzogni, B., 1997, *Exploring Wisconsin Trout Streams (The Angler's Guide):* Madison, The University of Wisconsin Press, 287 p.

Buckley, E.R., 1901, Clays and clay industries of Wisconsin: Wisconsin Geological and Natural History Survey Bulletin VII, 304 p.

Clayton, Lee, Attig, J.W, and Mickelson, D.M., submitted for review, Tunnel channels in Wisconsin.

Clayton, Lee, and Moran, S.R., 1982, Chronology of late Wisconsinan glaciation in middle North America: *Quaternary Science Reviews,* v. 1, p. 55–82.

Dirlam, D.M., 1979, Pollen analysis of a mid-Altonian peat in Schelke Bog, Lincoln County, Wisconsin: M.S. thesis, University of Wisconsin–Madison, 24 p.

Gruger, E., 1972, Pollen and seed studies of Wisconsinan vegetation in Illinois: *Geological Society of America Bulletin,* v. 83, p. 2715-2734.

Ham, N.R., 1994, Glacial geomorphology and dynamics of the Wisconsin Valley Lobe of the Laurentide Ice Sheet, Lincoln County, Wisconsin: Ph.D. dissertation, University of Wisconsin–Madison, 235 p.

Ham, N.R., and Attig, J.W., 1997, Pleistocene geology of Lincoln County, Wisconsin: Wisconsin Geological and Natural History Survey Bulletin 93, 31 p.

Ham, N.R., and Attig, J.W., 1996a, Ice wastage and landscape evolution along the southern margin of the Laurentide Ice Sheet, north-central Wisconsin: *Boreas,* v. 25, p. 171–186.

Ham, N.R., and Attig, J.W., 1996b, Unstable flow of the Chippewa and Wisconsin Valley Lobes during the last part of the Wisconsin Glaciation (~15-20 ka): American Quaternary Association, Program and Abstracts, p. 165.

Ham, N.R., and Attig, J.W., 1994, Origin of possible annual moraines and rate of ice-surface lowering of the Wisconsin Valley Lobe: American Quaternary Association, Program and Abstracts, p. 214.

Leverett, Frank, 1929, Moraines and shorelines of the Lake Superior region: U.S. Geological Survey Professional Paper 154-A, 72 p.

Mickelson, D.M., 1986, Glacial and related deposits of Langlade County: Wisconsin Geological and Natural History Survey Information Circular 52, 30 p.

Mickelson, D.M., Clayton, Lee, Baker, R.W., Mode, W.N., and Schneider, A.F., 1984, Pleistocene stratigraphic units of Wisconsin: Wisconsin Geological and Natural History Survey Miscellaneous Paper 84-1.

Mickelson, D.M., Clayton, Lee, Fullerton, D.S., and Borns, H.W., Jr., 1983, The late Wisconsin glacial record of the Laurentide Ice Sheet in the United

States, *in* Porter, S.C., ed., *Late-Quaternary Environments of the United States,* v. 1, *The Late Pleistocene:* Minneapolis, University of Minnesota Press, p. 3–37.

Mickelson, D.M., and Hole, F.D., 1974, Glacial geology and pedology in central and northeastern Wisconsin (field guide), *in* Knox, J.C., and Mickelson, D.M., eds., *Late Quaternary Environments of Wisconsin:* American Quaternary Association, Third Biennial Meeting, Madison, p. 1–23.

Mickelson, D.M., Nelson, A.R., and Stewart, M.T., 1974, Glacial events in north-central Wisconsin, *in* Knox, J.C., and Mickelson, D.M., eds., *Late Quaternary Environments of Wisconsin:* American Quaternary Association, Third Biennial Meeting, Madison, p. 134–162.

Mode, W.N., 1976, The glacial geology of a portion of north-central Wisconsin: M.S. thesis, University of Wisconsin–Madison, 85 p.

Mitchell, M.J., 1986, Soil Survey of Langlade County: U.S.D.A. Soil Conservation Service, 167 p.

Nelson, A.R., 1973, Age relationships of the deposits of the Wisconsin Valley and Langlade Glacial Lobes of north-central Wisconsin: M.S. thesis, University of Wisconsin–Madison, 130 p.

Nelson, A.R., and Mickelson, D.M., 1977, Landform distribution and the genesis in the Langlade and Green Bay glacial lobes, north central Wisconsin: *Transactions of the Wisconsin Academy of Science, Arts, and Letters,* v. 65, p. 41-57.

Stewart, M.T., 1973, Pre-Woodfordian drifts of north-central Wisconsin: M.S. thesis, University of Wisconsin–Madison, 92 p.

Stewart, M.T., and Mickelson, D.M., 1976, Clay mineralogy and relative age of tills in north-central Wisconsin: *Journal of Sedimentary Petrology,* v. 46, p. 200–205.

Stewart, M.T., and Mickelson, D.M., 1974, Clay mineralogy and relative age of tills in north-central Wisconsin, *in* Knox, J.C., and Mickelson, D.M., eds., *Late Quaternary Environments of Wisconsin:* Wisconsin Geological and Natural History Survey, p. 220–232.

Thwaites, F.T., 1943, The Pleistocene of part of northeast Wisconsin: *Geological Society of America Bulletin,* v. 54, p. 87-114.

Weidman, Samuel, 1907, The geology of north central Wisconsin: Wisconsin Geological and Natural History Survey Bulletin XVI, 697 p.