Pleistocene Stratigraphic Units of Wisconsin 1984-87

Editors

John W. Attig, Lee Clayton, and D.M. Mickelson

Wisconsin Geological and Natural History Survey

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Cover photograph: This outcrop of till illustrates the wide range of grain sizes, angularity of clasts, and unbedded appearance of typical glacial sediment.

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FIGURES

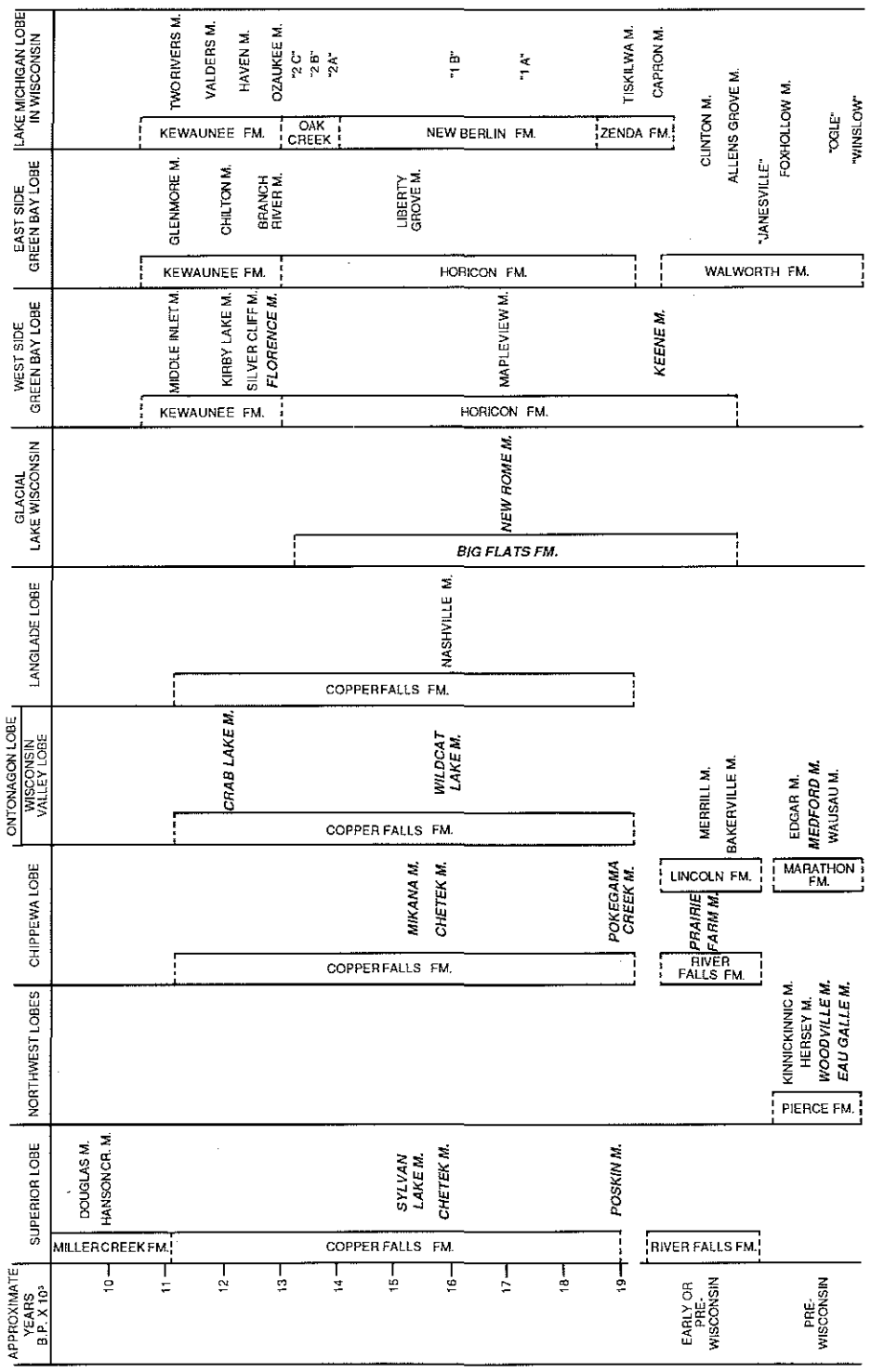

Figure 1. Diagram showing the Pleistocene stratigraphic units of Wisconsin organized by source area or glacial lobe and the approximate time of deposition (modified from Mickelson and others, 1984). Lithostratigraphic units formally named in this paper are shown in italic type.

ABSTRACT

This paper continues the process of describing and formally naming the Pleistocene stratigraphic units of Wisconsin begun by Mickelson and others (1984). One formation and fourteen members are formally named here. These units have been described as a result of research projects completed since 1984.

In this paper the following units are formally named: one member of the Marathon Formation, the Medford Member; two members of the Pierce Formation, the Eau Galle and Woodville Members; one member of the River Falls Formation, the Prairie Farm Member; a formation, the Big Flats Formation and a member of this formation, the New Rome Member; one member of the Horicon Formation, the Keene Member; seven members of the Copper Falls Formation, the Pokegama Creek, Poskin, Mikana, Sylvan Lake, Chetek, Wildcat Lake, and Crab Lake Members; and one member of the Kewaunee Formation, the Florence Member.

INTRODUCTION

Mickelson and others (1984) began the process of developing a formal classification of Pleistocene lithostratigraphic units in Wisconsin. They formally named 11 formations and 28 members and established the principles of lithostratigraphic classification of Pleistocene deposits in Wisconsin. Since the publication of that work, a number of research projects in various parts of Wisconsin have been completed or are near completion, and 15 additional lithostratigraphic unit names have been used informally.

We continue the process in this paper by formally naming 15 additional Pleistocene lithostratigraphic units (one formation and 14 members). Formations and members discussed in this paper but not formally named here have been formally named by Mickelson and others (1984) (figs. 1 and 2).

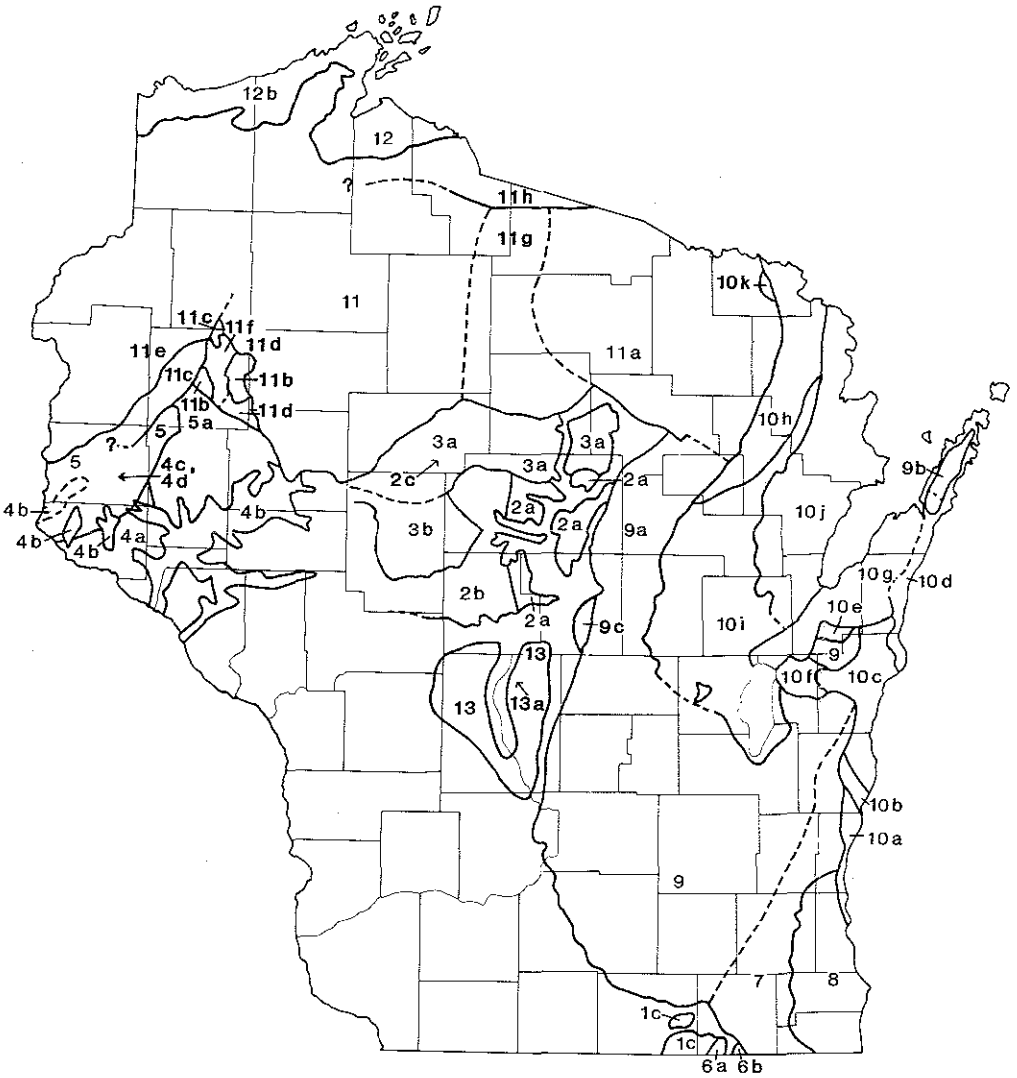
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Figure 2. Map of Wisconsin showing the surface distribution of formally named Pleistocene lithostratigraphic units. Number and letter designations of units not named in this report correspond to those of figure 2 of Mickelson and others (1984). The names of units formally named in this paper are shown in bold type. New units that are only known in the subsurface are shown on the map with an arrow pointing to the type area. (1) Walworth Formation. 1c: Clinton Member; (2) Marathon Formation. 2a: Wausau Member, 2b: Edgar Member, 2c: Medford Member (type section shown); (3) Lincoln Formation. 3a: Merrill Member, 3b: Bakerville Member; (4) Pierce Formation. 4a: Hersey Member, 4b: Kinnickinnic Member, **4c: Eau Galle Member, 4d: Woodville Member;** (5) River Falls Formation. **5a: Prairie Farm Member;** (6) Zenda Formation. 6a: Capron Member, 6b: Tiskilwa Member; (7) New Berlin Formation; (8) Oak Creek Formation; (9) Horicon Formation. 9a: Mapleview Member, 9b: Liberty Grove Member, **9c: Keene Member;** (10) Kewaunee Formation. 10a: Ozaukee Member, 10b: Haven Member, 10c: Valders Member, 10d: Two Rivers Member, 10e: Branch River Member, 10f: Chilton Member, 10g: Glenmore Member, 10h: Silver Cliff Member, 10i: Kirby Lake Member, 10j: Middle Inlet Member, **10k: Florence Member;** (11) Copper Falls Formation. 11a: Nashville Member, **11b: Pokegama Creek Member, 11c: Poskin Member, 11d: Mikana Member, 11e: Sylvan Lake Member, 11f: Chetek Member, 11g: Wildcat Lake Member, 11h: Crab Lake Member;** (12) Miller Creek Formation. 12a: Hanson Creek Member, 12b: Douglas Member, **(13) Big Flats Formation, 13a: New Rome Member** (type section shown).

MARATHON FORMATION

Medford Member of the Marathon Formation

John W. Attig and Maureen A. Muldoon

Source of name. Town of Medford, Taylor County, Wisconsin.

Location of type section. A stream cut in the south bank of the Little Black River. It is located in the SE1/4NE1/4SE1/4 sec. 3, T. 30 N., R. 1 E., an area shown on the Stetsonville Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1969; fig. 3).

Location of reference section. Two power-auger holes (Wisconsin Geological and Natural History Survey [WGNHS] numbers Mr-1138 and Mr-1169) near the crest of a hill, between two barns, on the north side of county highway N, in the SE1/4SW1/4SW1/4 sec. 17, T. 28 N., R. 2 E., an area shown on the Abbotsford Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1981; fig. 4).

Description of unit. The Medford Member contains till and associated lake and stream sediment. Medford till is calcareous loam or silt loam. The average sand:silt:clay ratio of 23 samples is 33:47:20. Semiquantitative analysis of clay mineralogy of four samples yielded an average montmorillonite:vermiculite:illite:kaolinite-plus-chlorite ratio of 45:13:26:16. Median magnetic susceptibility for 23 samples was 1.4 x 10^{-3}. The average carbonate content of the coarse-silt fraction of six samples was 5.1 percent by weight, containing 1.8 percent calcite and 3.3 percent dolomite. Moist field color is typically very dark gray to gray (10YR 3/1 to 2.5Y 5/1 on the Munsell scale). The pebble fabric in this unit (measured in four locations at the type section) is strongly developed; the long axis of most pebbles is oriented north-northwest south-southeast and dips upglacier (north-northwest).

Nature of contacts. The lower contact of this unit has only been observed in three drill holes. In those holes the transition to undifferentiated Marathon Formation material is sharp. In many areas the Medford Member is overlain by till of the Edgar Member of the Marathon Formation. The contact with the overlying material is typically sharp.

Differentiation from other units. The till of the Medford Member is distinguished from the overlying till of the Edgar Member by color and

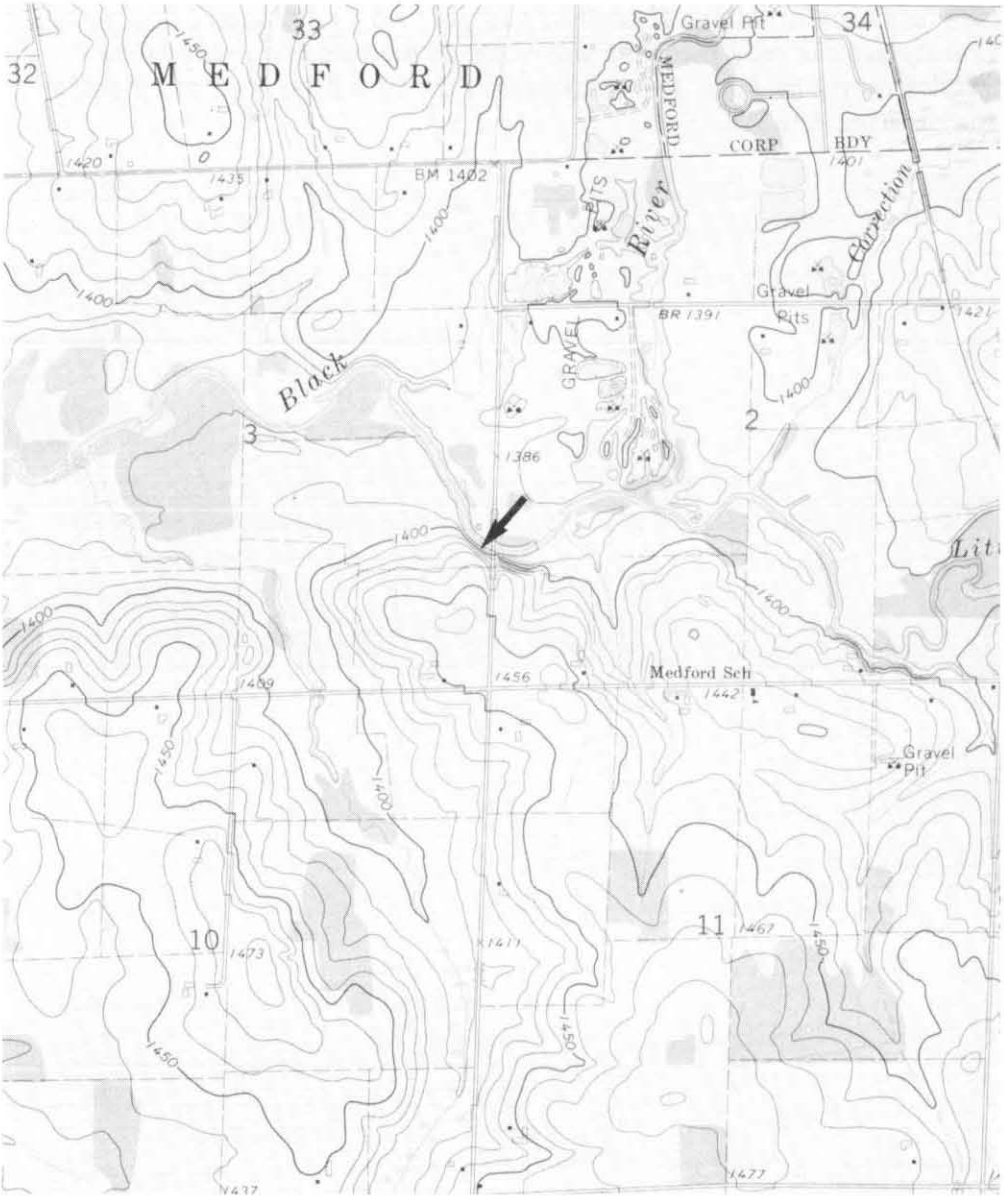

Figure 3. Part of the Stetsonville Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1969), showing the location for the type section of the Medford Member.

clay mineralogy. Medford till is darker, grayer, and contains more shale fragments and more montmorillonite clay than Edgar till. For four samples taken from a drill hole (Mr-1146) near the type section, the average ratio of montmorillonite:vermiculite:illite:kaolinite-plus-chlorite was 28:17:38:17 for the Edgar Member.

Regional extent and thickness. Except at the type section, the Medford Member has been identified only in the subsurface. Drill-hole

logs from northwestern Marathon County and southeastern Taylor County are the only record of this unit. It presumably extends into Clark County as well. The thickness of the till of the Medford Member ranges from 4 to 7 m.

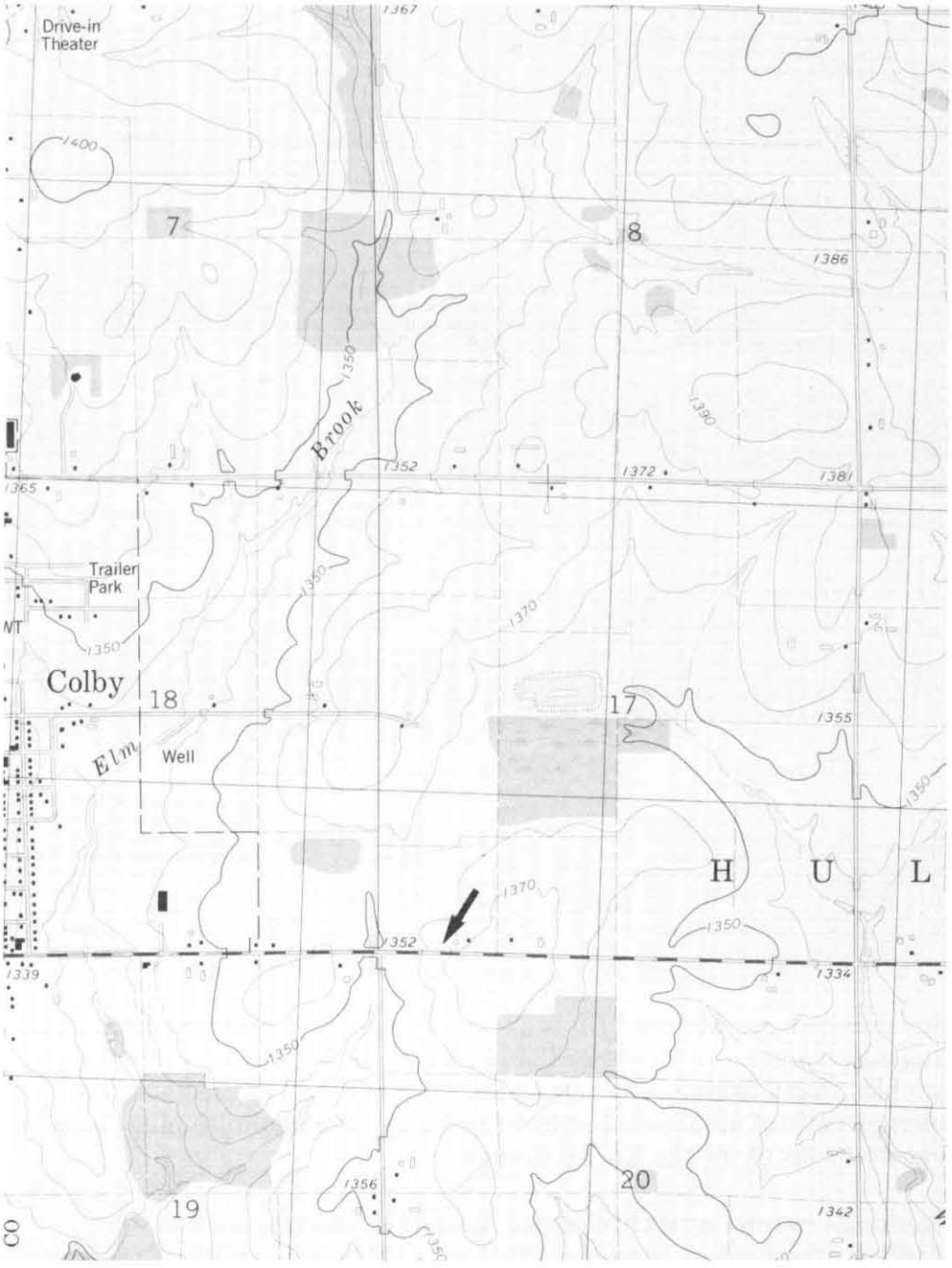

Figure 4. Part of the Abbotsford Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1981), showing the location of the reference section for the Medford Member.

Origin. The till of the Medford Member was deposited by ice flowing from the north-northwest during the Stetsonville Glacial Phase (Attig and Muldoon, in preparation).

Age and correlation. The age of the Medford Member is not known. The unit is probably pre-late Wisconsin in age. It may be equivalent to the Hersey Member of the Pierce Formation in western Wisconsin. Baker (1984) has interpreted the Hersey Member to be pre-Illinoian in age.

Description of type section. The type section is a stream-cut bank on the south side of the Little Black River southwest of the community of Medford. The bank is about 8 m high. In the uppermost 2 m of the bank the reddish brown, noncalcareous, sandy till of the Merrill Member of the Lincoln Formation is exposed. Beneath the till of the Merrill Member 3 m of dark gray, calcareous, silty till of the Medford Member of the Marathon Formation is exposed. The contact between the two units is sharp. The sediment underlying the lower part of the bank is buried by slopewash sediment. In a drill hole (Mr-1146) about 15 m south of the type section, about 7 m of the Edgar Member of the Marathon Formation lies between the Merrill and Medford Members.

Description of reference section. The reference section consists of two closely spaced power-auger holes (WGNHS numbers Mr-1138 and Mr-1169). The auger penetrated 7.4 m of yellowish brown to brown, calcareous loamy material that Attig and Muldoon (in preparation) interpreted as till of the Edgar Member; this material is leached to a depth of 2.6 m. The auger then penetrated 3.5 m of dark grayish brown to gray, calcareous, loam to silt loam, and a 0.22 m layer of silty sand at 9.7 m. The loamy material was not leached; we interpret it as the till of the Medford Member.

Previous usage. This name has been used by Muldoon (1987) and Attig and Muldoon (in preparation).◆

PIERCE FORMATION

Eau Galle Member of the Pierce Formation

Robert W. Baker

Source of name. The Eau Galle River in St. Croix, Pierce, and Dunn Counties, Wisconsin.

Location of type section. Drill hole at the reference section for the Hersey Member of the Pierce Formation located in the SE1/4NW1/4 NW1/4 sec. 35, T. 29 N., R. 16 W., on the Baldwin East Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1974; fig. 5).

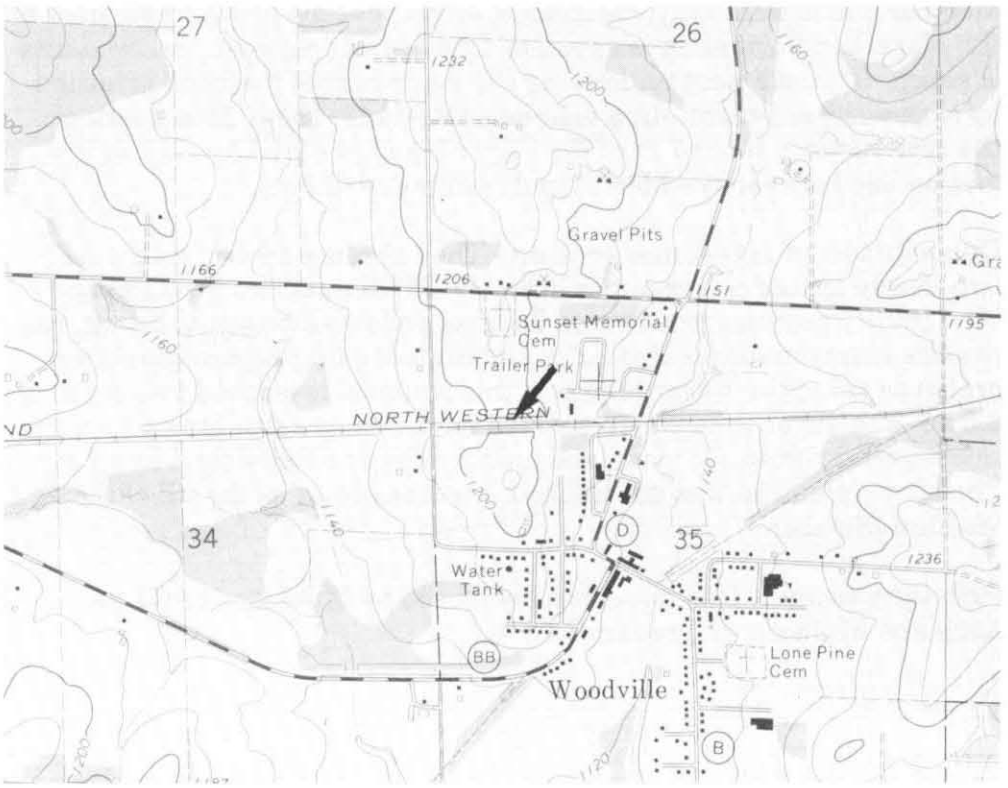

Figure 5. Part of the Baldwin East Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1974), showing the location of the type section for the Eau Galle Member.

Description of unit. The Eau Galle Member contains unbedded, noncalcareous silty and clayey glacial-lake sediment. Its color ranges from yellowish brown (10YR 5/4 on the Munsell scale) to gray (10YR 5/1). Samples from the Eau Galle Member average 7 percent sand, 36 percent silt, and 57 percent clay (fig. 6). The clay averages 65 percent montmo-

rillonite, 20 percent mica (illite), 10 percent kaolinite, and 5 percent chlorite.

Nature of contacts. The upper contact with the Woodville Member of the Pierce Formation is abrupt and sharp. The nature of the lower contact is unknown.

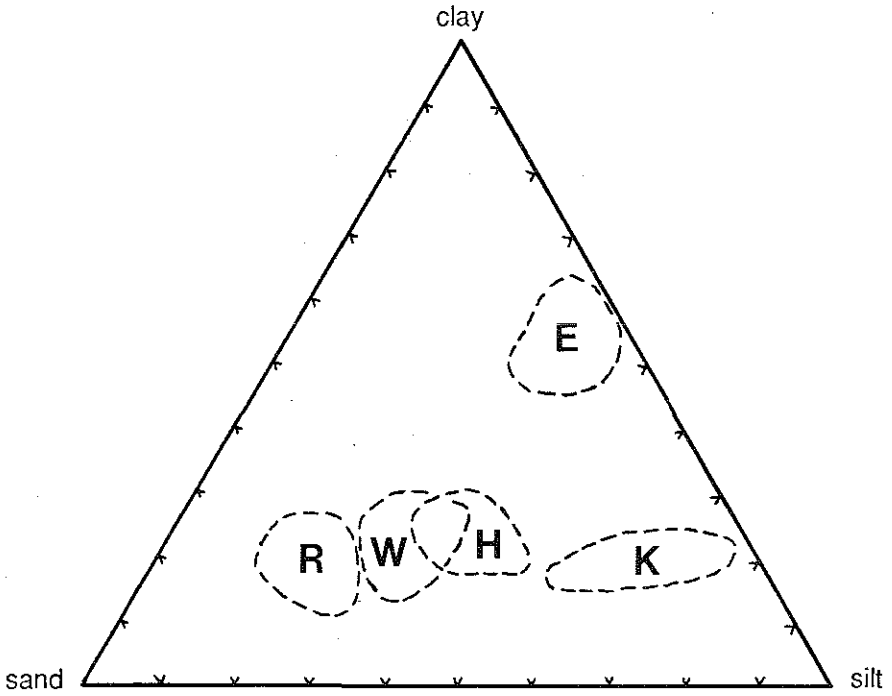

Figure 6. Diagram showing the grain-size distribution of material from pre-Wisconsin units in west-central Wisconsin (from Baker, 1984). Enclosed areas show the distribution of 23 samples from the River Falls Formation (R), 10 samples from the Woodville Member (W), 26 samples from the Hersey Member (H), 17 samples from the Kinnickinnic Member (K), and 7 samples from the Eau Galle Member (E).

Differentiation from other units. The till of the Eau Galle Member is readily distinguished from the till of the Hersey and Woodville Members by its conspicuous lack of clasts and its fine grain size. It can be distinguished from the Kinnickinnic Member by the abundance of clay (57% as compared to 20%), by the abundance of montmorillonite, and by the scarcity of kaolinite.

Regional extent and thickness. Because the Eau Galle Member has been found only in the subsurface, its distribution in western Wisconsin and its thickness are unknown. On the basis of sampling of a drill hole at Woodville, Wisconsin, the thickness of the Eau Galle Member is known to exceed 8 m.

Origin. The Eau Galle Member was probably deposited in proglacial lakes dammed by the glacier that deposited the Woodville Member.

Age and correlation. The Eau Galle Member is thought to have been deposited before the Illinoian Glaciation on the basis of its position below the Hersey Member, which has reversed remanent magnetization. No correlative unit is known to exist in Wisconsin or Minnesota.

Description of type section. The type section is a drill hole at the reference section of the Hersey Member at Woodville, Wisconsin (fig. 7). Here the Eau Galle Member is overlain by 8.3 m of till and sand and gravel of the River Falls Formation, 3.8 m of till of the Hersey Member, 0.3 m of organic sediment, and 4.5 m of till of the Woodville Member. The thickness and grain-size distribution of units at the type section are given in figure 8.

Previous usage. This name was first used by Baker (1984).◆

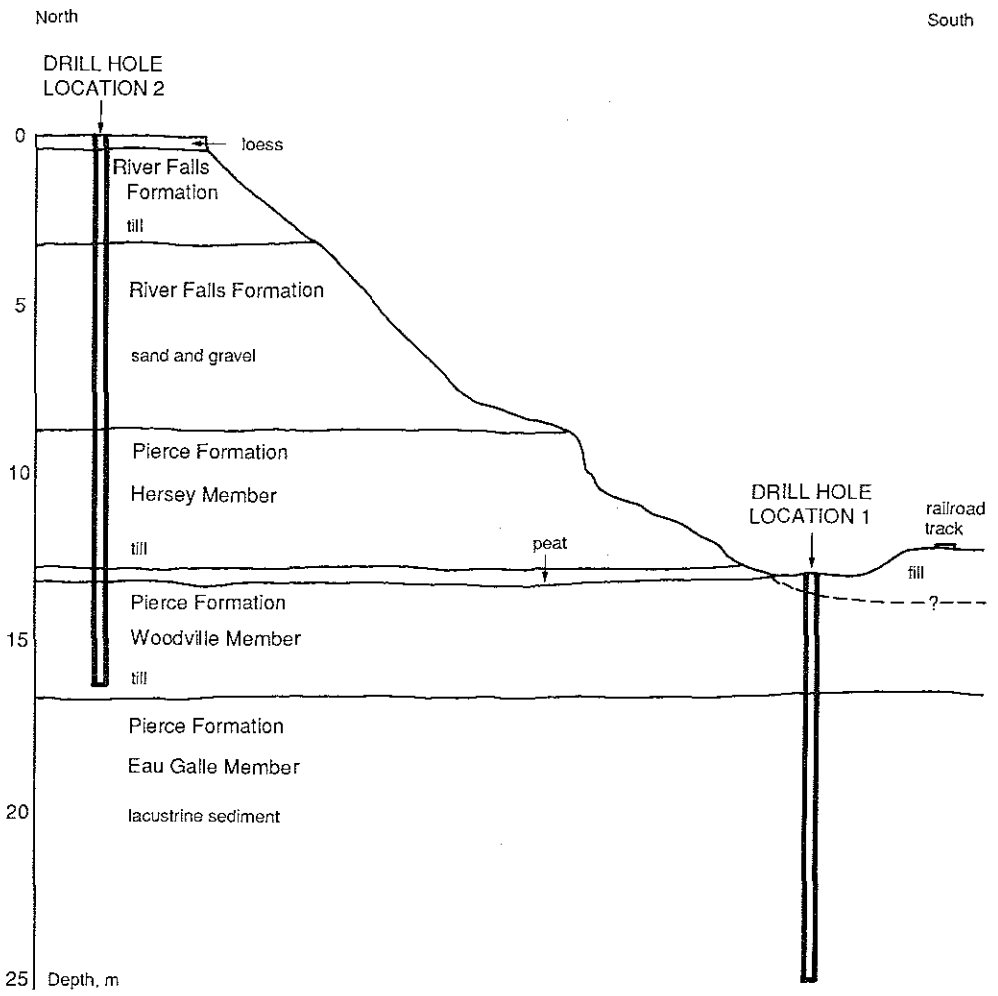

Figure 7. Diagram of the type section for the Eau Galle and Woodville Members showing the location of drill holes and stratigraphic units (from Baker, 1984).

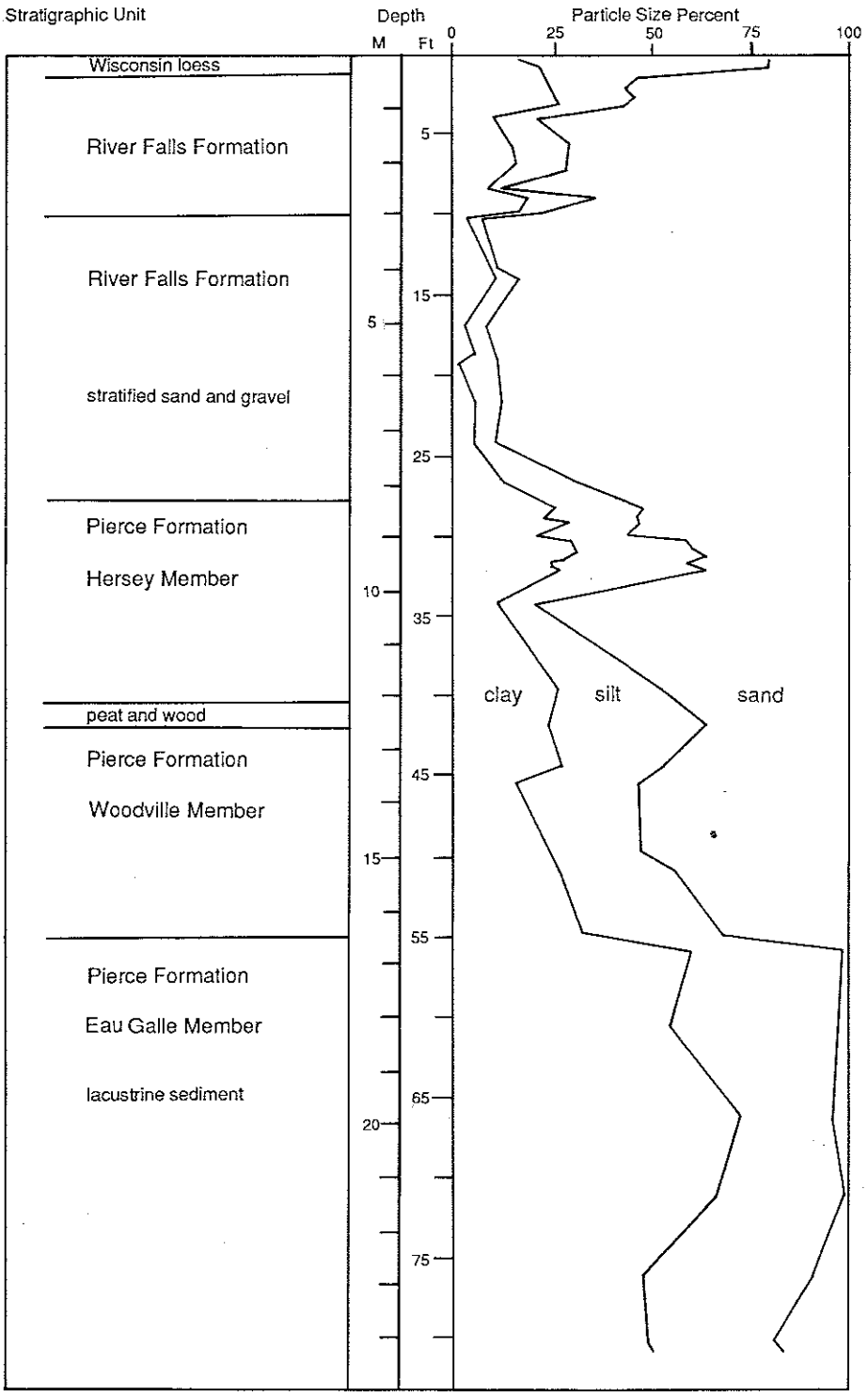

Figure 8. Thickness and grain-size distribution at the type section for the Eau Galle and Woodville Members (modified from Baker, 1984).

Woodville Member of the Pierce Formation

Robert W. Baker

Source of name. The town of Woodville, eastern St. Croix County, Wisconsin.

Location of type section. Drill hole at the reference section for the Hersey Member of the Pierce Formation located in the SE1/4NW1/4 NW1/4 sec. 35, T. 29 N., R. 16 W., on the Baldwin East Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1974; fig. 9).

Description of unit. The Woodville Member is an unbedded, structureless, and strongly calcareous till. Its color ranges from gray (5YR 5/1 on the Munsell scale) to dark gray (10YR 4/1). Samples from the matrix of the Woodville Member averaged 45 percent sand, 31 percent silt, and 24 percent clay (fig. 6). The clay of the unweathered Woodville Member averages 64 percent montmorillonite, 22 percent kaolinite, 14 percent mica (illite), and no vermiculite.

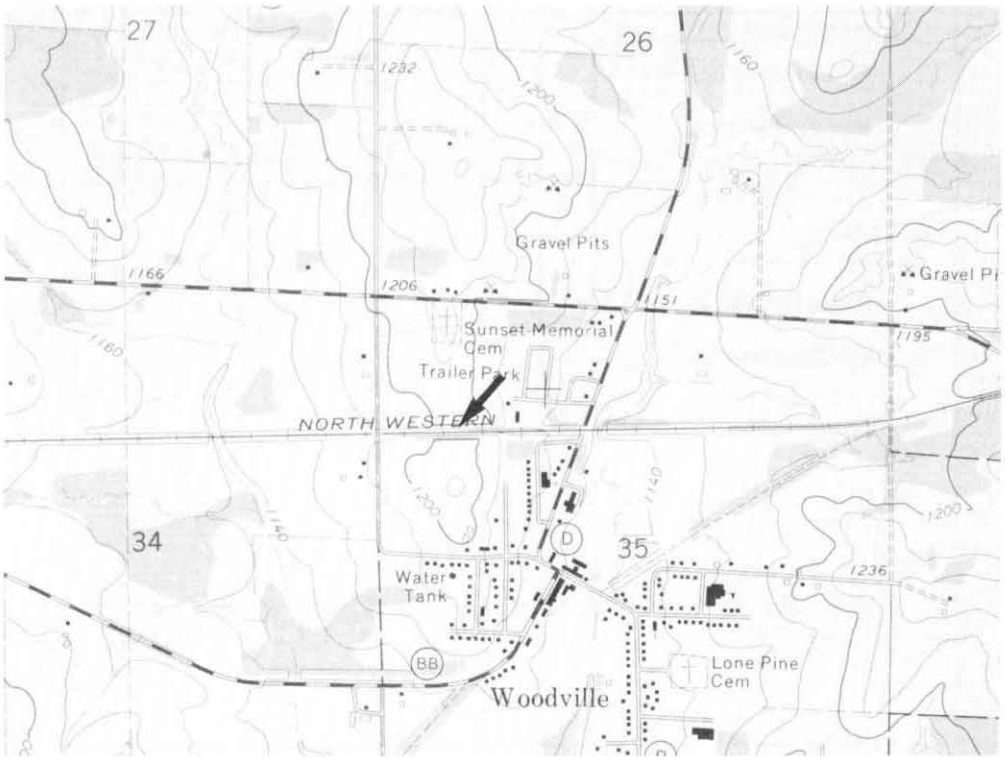

Figure 9. Part of the Baldwin East Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1974), showing the location of the type section for the Woodville Member.

Nature of contacts. The upper and lower contacts are abrupt and sharp.

Differentiation from other units. The Woodville Member is easily differentiated from the glacial lake sediment of the Kinnickinnic and Eau Galle Members by its coarse clasts and by its abundance of sand. It can be distinguished from the till of the Hersey Member by its somewhat more abundant sand and by its more abundant montmorillonite and kaolinite.

Regional extent and thickness. Like the Eau Galle Member, the Woodville Member has only been recognized in the subsurface. Consequently, its distribution and maximum thickness are unknown. However, at Woodville, Wisconsin, the Woodville Member is known to be 4.5 m thick.

Origin. The carbonate content, color, grain size, clay mineralogy, and pebble abundance of the Woodville Member are similar to till units in Iowa and Minnesota, which have a northwestern source (Manitoba area).

Age and correlation. The Woodville Member is thought to have been deposited before the Illinoian Glaciation because the Woodville is below the Hersey Member, which has reversed remanent magnetization. The color, grain-size distribution, and pebble and clay mineralogy suggest that the Woodville Member correlates with the Aurora Member of the Wolf Creek Formation in eastern Iowa (Hallberg, 1980). No correlative units are recognized in Wisconsin or Minnesota.

Description of type section. Same as Eau Galle Member.

Previous use of name. This name was first used for this unit by Baker (1984).◆

RIVER FALLS FORMATION

Prairie Farm Member of the River Falls Formation

Mark D. Johnson

Source of name. Community of Prairie Farm, Barron County, Wisconsin.

Location and description of type section. Roadcut on south side of an east-west road, NE1/4NW1/4SE1/4 sec. 13, T. 32 N., R. 13 W., in the Dority Creek Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1978; fig. 10). At this site, 0.2 to 0.4 m of loess overlies till of the Prairie Farm Member, which is exposed to a depth of 3 m. The upper part of the till contains stringers of sand that were intruded down into the till after its deposition. The sand occurs along root channels and may be the result of frost churning or tree tip. The pebble fabric, measured below the sand-stringer zone, shows that the till was deposited by ice flowing S. 20° W. A transect of closely spaced samples shows that relative magnetic susceptibility increases with depth.

Location and description of reference sections. 1) Till in a roadcut on the north side of an east-west road, SW1/4SW1/4SW1/4 sec. 19, T. 33 N., R. 12 W., in the Dority Creek Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1978; fig. 11). At this site, 0.3 to 0.4 m of loess overlies till of the Prairie Farm Member, which is exposed to a depth of 2 m. A pebble fabric at this site shows that the till was deposited by ice flowing S. 40° W.

2) Sand in a pit in the SW1/4SW1/4SW1/4 sec. 3, T. 31 N., R. 9 W., Chippewa County, in the New Auburn Quadrangle, Wisconsin (U.S. Geological Survey 7.5-minute series, topographic, 1975). At this site loess overlies sand of the Prairie Farm Member. The sand is crudely bedded horizontally and no sedimentary structures are apparent within beds. The sand was probably deposited by streams, but the origin is not clear. A large channel-shaped deposit of cobble gravel truncates the sand in the west face of the pit and an ice-wedge cast occurs in the south face. Illuviated clay coats the gravel in the channel but is not present in the sand of the ice-wedge cast. In the sand, magnetic susceptibility increases with depth.

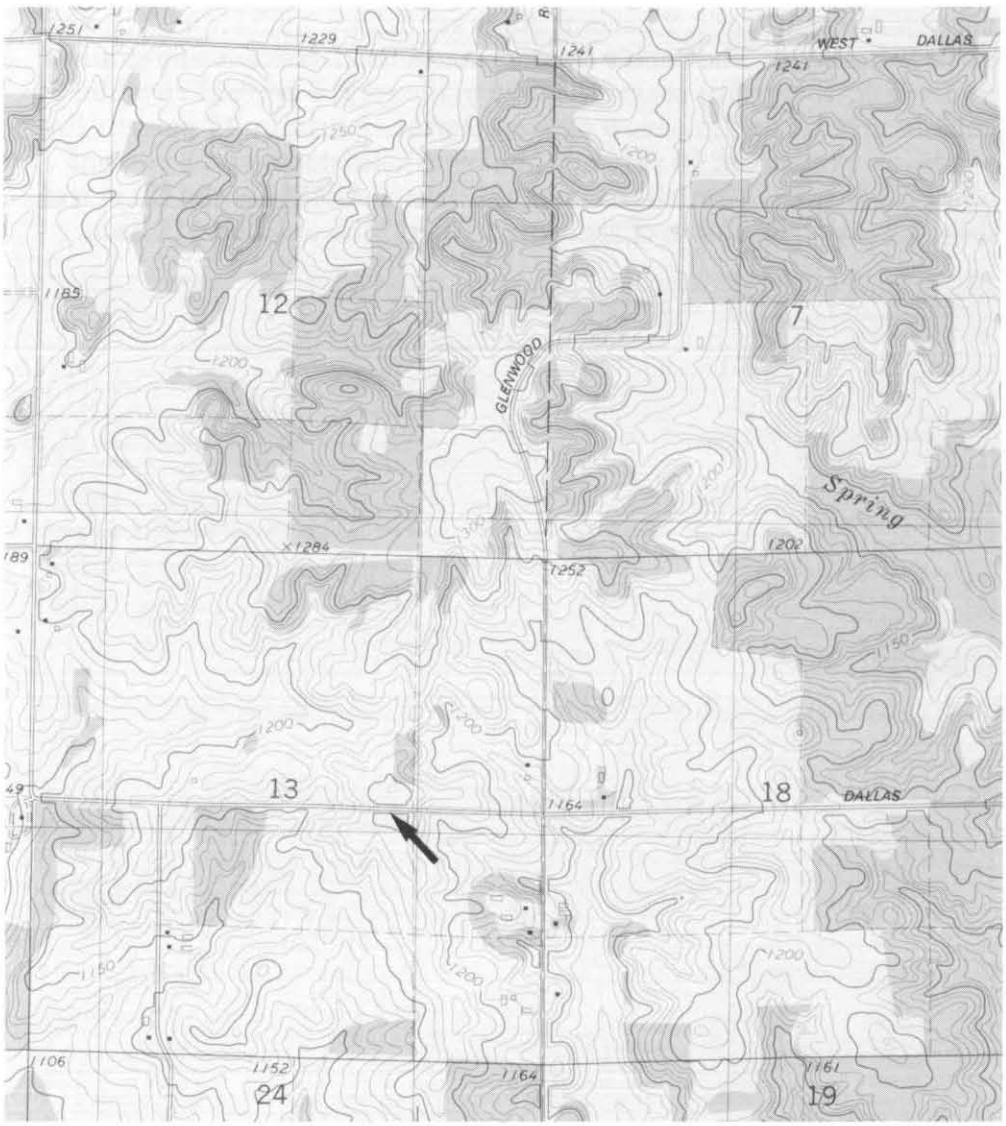

Figure 10. Part of the Dority Creek Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1978), showing the location of the type section for the Prairie Farm Member.

Description of unit. The till of the Prairie Farm Member is slightly gravelly to gravelly sandy loam; part of the till is slightly gravelly to gravelly loamy sand. Samples of this till have an average grain-size distribution in the matrix (less than 2 mm) of 73 percent sand, 16 percent silt, and 11 percent clay. It is yellowish red to dark brown (5YR 4/6 to 4/8 to 7.5YR 4/8 on the Munsell scale). The clay-mineral composition is variable; it averages 21 percent kaolinite, 53 percent illite, and 26 percent expandable clay. The very-coarse-sand fraction contains about 59 percent quartz, 5 to 6 percent fine-grained mafic rock, 4 to 5 percent granite, 10 percent coarse-grained mafic rock, 1 to 2 percent quartzite, 5

percent red sandstone, 2 percent other sandstone, and 11 to 12 percent other lithologies. The pebble fraction contains 22 percent fine-grained mafic rock, 15 percent coarse-grained mafic rock, 6 percent rhyolite, 9 percent granite and gneiss, 9 percent Barron quartzite, 17 percent Precambrian sandstone, 14 percent Cambrian sandstone, and 8 percent other lithologies. The relative magnetic susceptibility of the till is typically 4.9 (arbitrary units of the University of Wisconsin at Madison,

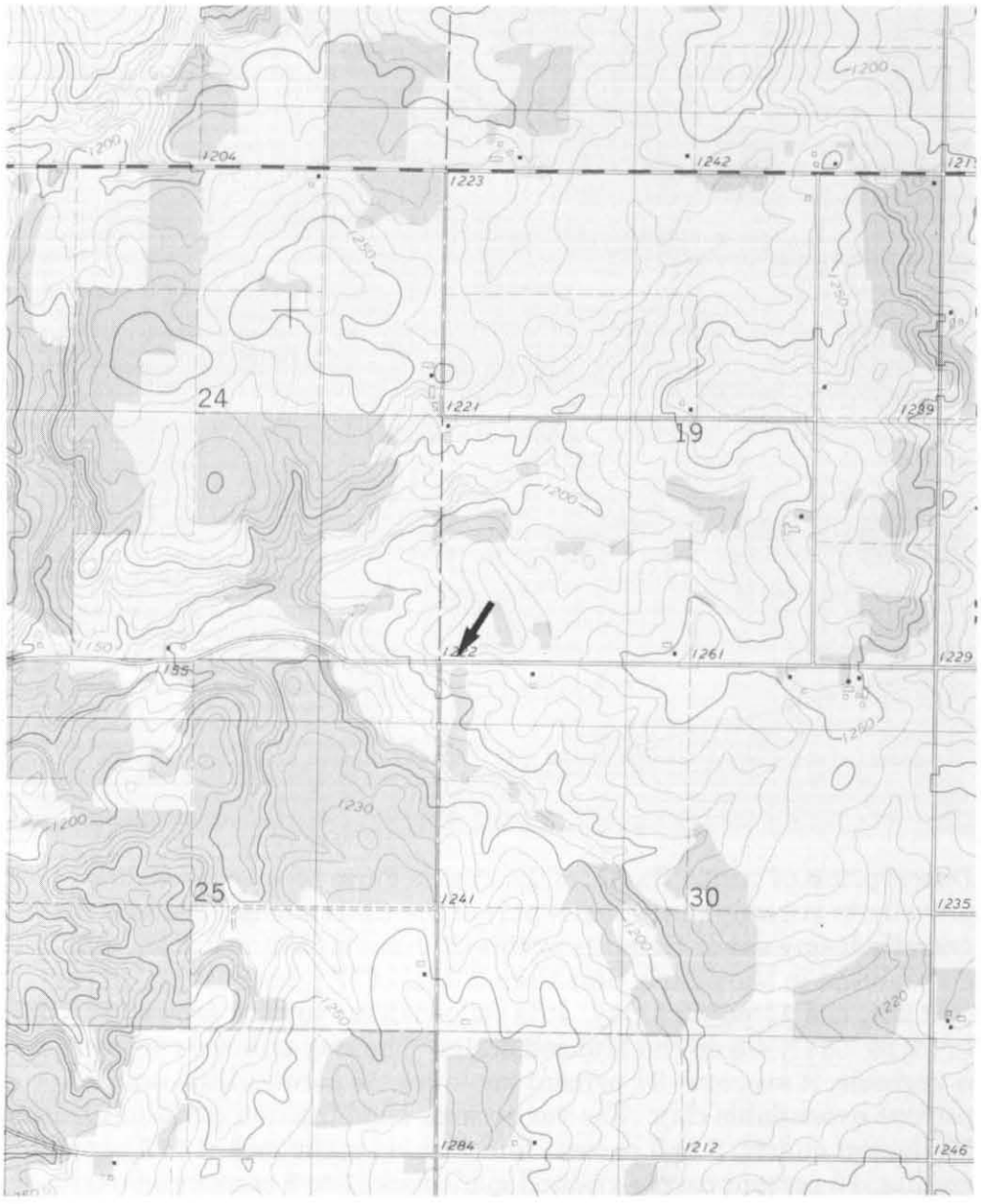

Figure 11. Part of the Dority Creek Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1978), showing the location of the reference section for the Prairie Farm Member.

Department of Geology and Geophysics Pleistocene laboratory). The unit is leached of carbonates to an unknown depth. The till is unbedded.

Nature of contacts. In the region where the till of the Prairie Farm Member crops out, it has a sharp contact with the underlying Cambrian sandstone. The till is overlain by loess. The upper contact tends to be either sharp or gradational over a few centimetres.

Differentiation from other units. The till of the Prairie Farm Member contains more Barron quartzite in the pebble fraction (9%) than other till of the River Falls Formation (less than 1%), or the till of the Poskin (1%) or Sylvan Lake (1 or 2%) Members of the Copper Falls Formation. The till of the Prairie Farm Member has a lower relative magnetic susceptibility (4.9) than till of the Copper Falls Formation (8 to 12). Prairie Farm till is easily distinguishable from the till of the Pierce Formation, which is olive-black, slightly gravelly loam. The kaolinite:illite ratio (Johnson, 1984) is higher in the till of the Prairie Farm Member (1.7) than in the till of the Poskin (1.4), Pokegama Creek (1.2), Sylvan Lake (1.1), or Mikana (1.0) Members of the Copper Falls Formation.

Regional extent and thickness. The till of the Prairie Farm Member occurs at the surface in a triangular-shaped area in southern Barron County (fig. 2). Its southern limit in Dunn County is not known. To the northeast, it extends to the southern margin of the Pokegama Creek Member; to the northwest, to the margin of the Poskin Member. In southwestern Barron County, till of the Prairie Farm Member lies adjacent to till of an unnamed member of the River Falls Formation. Most surface exposures show the till of the Prairie Farm to be less than 2 m thick, although well logs show thicknesses as great as 10 m.

Origin. The till of the Prairie Farm Member was deposited during the Dallas Advance of the Chippewa Lobe (Johnson, 1986) by ice flowing to the south and southwest.

Age and correlation. The age of the Prairie Farm Member is unknown, but probably was deposited before the Wisconsin Glaciation. Some of its characteristics (clay minerals, magnetic susceptibility) have been affected by weathering. This weathering suggests that the Prairie Farm is much older than the Copper Falls Formation, which was deposited during the last part of the Wisconsin Glaciation. Baker and others (1983) concluded that the River Falls Formation was deposited in its type area either during the Illinoian Glaciation or the early part of the

Wisconsin Glaciation. The Prairie Farm till is probably older than the till of the Merrill Member of eastern Wisconsin because the till of the Merrill Member does not show similar weathering characteristics. Stewart and Mickelson (1976) concluded that the till of the Merrill Member was deposited during the early part of the Wisconsin Glaciation because of C^{14} dates older than 40,000 years.

The till of the Prairie Farm Member is included with other till units in the River Falls Formation because they have similar grain size, color, magnetic susceptibility, and clay-mineral content. Prairie Farm till was probably deposited at about the same time as the River Falls Formation, described in St. Croix County by Baker and others (1983). It may be similar in age to the Edgar Member of east-central Wisconsin (Mode, 1976). The Edgar Member appears to be similarly weathered because it has less magnetic susceptibility near the surface.

Previous use of name. The name Prairie Farm Member of the River Falls Formation was first used by Johnson (1984 and 1986).◆

BIG FLATS FORMATION

Jim Brownell

Source of name. Big Flats Township, northwestern Adams County, Wisconsin.

Location of type section. Drill hole located at the unincorporated community of Big Flats 0.1 km east of highway 13 on highway C (NW1/4 NW1/4NE1/4 sec. 20, T. 19 N., R. 6 E.). It is located in northwestern Adams County on the Roche a Cri Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1967; fig. 12).

Description of unit. Most of the Big Flats Formation is composed of beds of moderately well sorted to well sorted sand. The mean grain size of 21 samples is 0.26 mm, ranging from 0.19 to 0.32 mm. Sixty-two percent of the samples have a mean size in the medium-sand range (0.25 to 0.50 mm), and 38 percent have a mean size in the fine-sand range (0.125 to 0.25 mm). Most of the sand is quartz that is derived from Cambrian formations. Non-quartz grains commonly make up less than 1 percent of the sand beds but may range up to 5 or 10 percent. Field colors are generally 10YR 4/2 to 4/6 or 7.5YR 4/4 on the Munsell scale. The New Rome Member (described in a separate section) and other poorly known silt and clay beds that occur below it compose the remainder of the Big Flats Formation.

Nature of contacts. Typically, the Big Flats Formation is found at the surface (fig. 2). The unit overlies rock of Cambrian or Precambrian formations or sand of the Copper Falls or Horicon Formations. Where the Big Flats overlies Precambrian igneous and metamorphic rock, the contact is sharp; it is sharp to diffuse where the Big Flats overlies Cambrian sand or sandstone or other Pleistocene sand.

Differentiation from other units. The Big Flats Formation is distinguished from overlying and underlying sand units by stratigraphic position, grain-size distribution, and amount and lithology of non-quartz grains; from underlying Cambrian sand, by its grains, color, and lithification. Big Flats sand commonly includes rather angular dark-colored grains; the Cambrian sand is almost entirely well rounded quartz and is commonly whiter and more lithified. A widespread paleosol separates the Big Flats Formation from overlying sand found in Holocene eolian dunes (Lee Clayton, Wisconsin Geological and Natural History Survey, verbal communication, 1986). The Big Flats Formation sand is differen-

tiated from sand of the Copper Falls and Horicon Formations by the degree of sorting and the percent and lithology of non-quartz grains in samples. Big Flats Formation sand is better sorted (contains little or no very coarse sand and gravel), commonly has less than 1 percent non-quartz grains, and is generally noncalcareous.

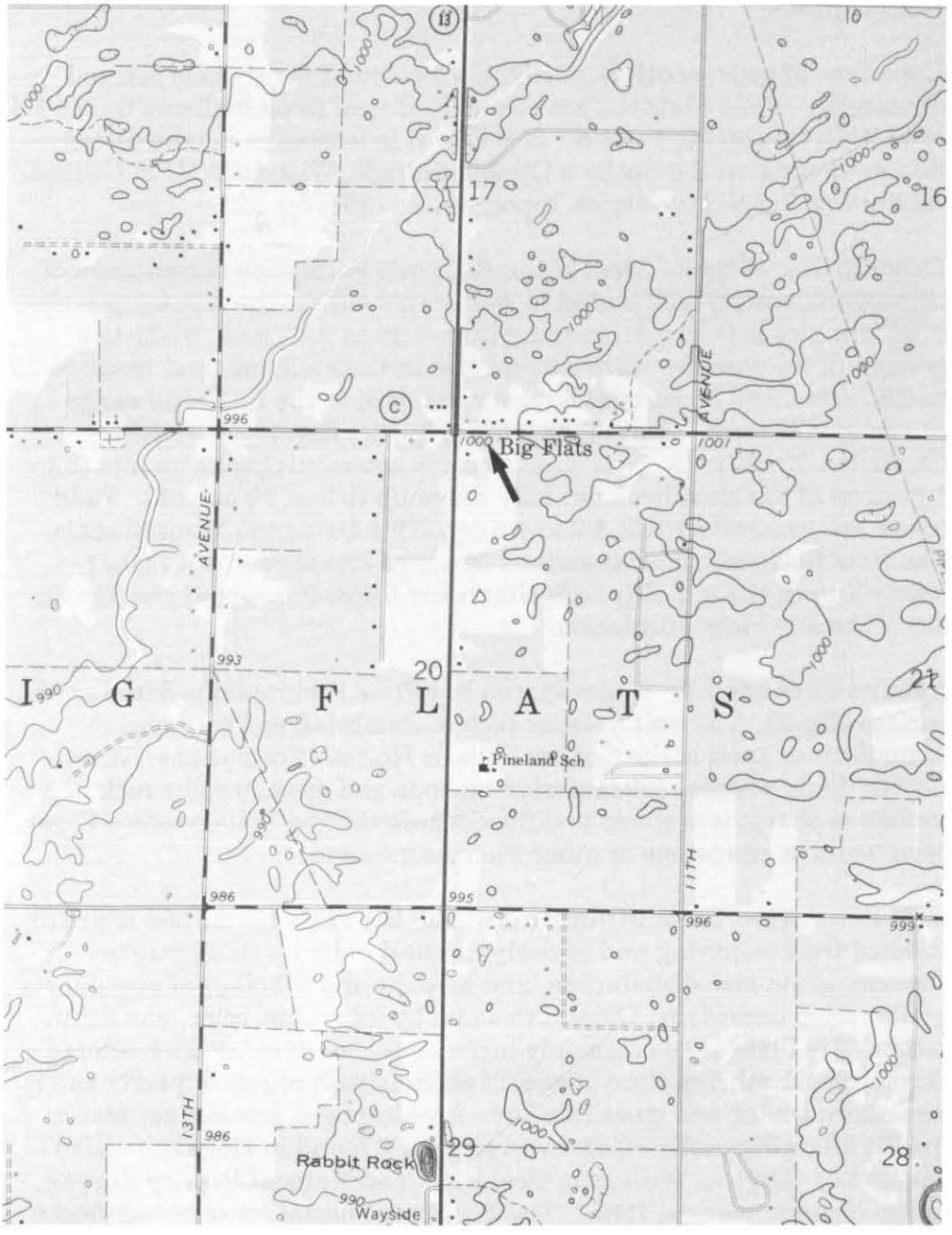

Figure 12. Part of the Roche a Cri Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1967), showing the location of the type section for the Big Flats Formation.

Regional extent and thickness. The Big Flats Formation is the surface unit throughout much of Wisconsin's central sand plain. The eastern limit of the Big Flats is marked by a break in slope located several kilometres west of the Hancock moraine in Waushara and Adams Counties; the western limit is marked by the sandstone escarpment on the east side of the Driftless Area in Juneau and Monroe Counties. It includes sand in Jackson County on and west of the divide between the drainages of the Yellow and Black Rivers at the northwest end of the central sand plain. The southern limit is marked by the Baraboo Hills; the northern limit occurs near the border between Wood and Juneau Counties and the border between Portage and Adams Counties. The Big Flats Formation is absent under the Wisconsin River and its terraces and is usually absent between the Wisconsin and Yellow Rivers. The Big Flats Formation ranges from about 1 m to more than 40 m thick. Its thickness is generally between 1 and 10 m thick on the west side of the Wisconsin River in Juneau County and ranges from 10 to more than 40 m on the east side of the river in Adams County.

Origin. The Big Flats Formation is composed largely of lake and stream sediment. The silt and clay beds are offshore sediment of proglacial Lake Wisconsin. The sand units probably include meltwater-stream sediment deposited west of the Green Bay Lobe; offshore, nearshore, and beach sediment of Lake Wisconsin; nonglacial-stream sediment derived from Cambrian uplands; and eolian sediment.

Age. The upper part of the Big Flats Formation was deposited about 20,000 to 13,000 B.P., during the last part of the Wisconsin Glaciation. The lower part of the formation may have been deposited during the early part of the Wisconsin Glaciation or during pre-Wisconsin time.

Description of type section. The type section is a drill hole located in Adams County. About 8 m of well sorted fine sand overlies the New Rome Member silt and clay. The sand contains about 1 to 3 percent non-quartz grains and is noncalcareous. The New Rome Member is about 4.5 m thick at the type section. The New Rome Member overlies at least 3.5 m of sand; the distance to the base of the Big Flats Formation is unknown.

Previous use of name. Name previously used by Brownell (1986).◆

New Rome Member of the Big Flats Formation

Jim Brownell

Source of name. The community of New Rome in northwestern Adams County, Wisconsin.

Location of type section. Clay pit in a terrace scarp of the Wisconsin River about 0.3 km north of Apache Avenue, Adams County, NE1/4 SE1/4SE1/4 sec. 15, T. 20 N., R. 5 E.; located on the Arkdale NW Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1969; fig. 13).

Location of reference section. The type section for the Big Flats Formation serves as the reference section for this unit.

Description of unit. The New Rome Member is composed of thinly laminated, commonly rhythmically bedded, glaciolacustrine sediment. The average grain size of the less-than-2-mm fraction of 103 samples taken at 48 sites is 27 percent sand (2.0 to 0.63 mm), 48 percent silt (0.063 to 0.004 mm), and 25 percent clay (less than 0.004 mm). The average gravel content of these samples is 1 percent. A rhythmite is typically composed of a reddish brown clay bed (7.5YR 7/4, pink, to 10YR 7/4, very pale brown, on the Munsell scale) and a gray silt bed (7.5YR 6/2, pinkish gray). Where the rhythmites are not apparent, the color is typically brown (7.5YR 5/4). The carbonate in the coarse-silt fraction (0.0625 to 0.037 mm) as measured with a Chittick apparatus is 20 percent dolomite and 3 percent calcite (average of 71 samples) (Brownell, 1986).

Nature of contacts. In most drill holes the upper contact of the New Rome Member appears to be sharp; its lower contact is sharp to gradual. In some places the New Rome Member is interbedded with sand.

Differentiation from other units. The New Rome Member is easily differentiated from most other units of the central sand plain by the abundance of rhythmically bedded silt and clay. It is differentiated from older lacustrine bedded silt and clay beds by stratigraphic position.

Regional extent and thickness. The New Rome Member is found throughout the central sand plain. This member's eastern limit appears to be marked by the Hancock moraine in southern Adams County, but is about 24 km west of the moraine in southwestern Portage County.

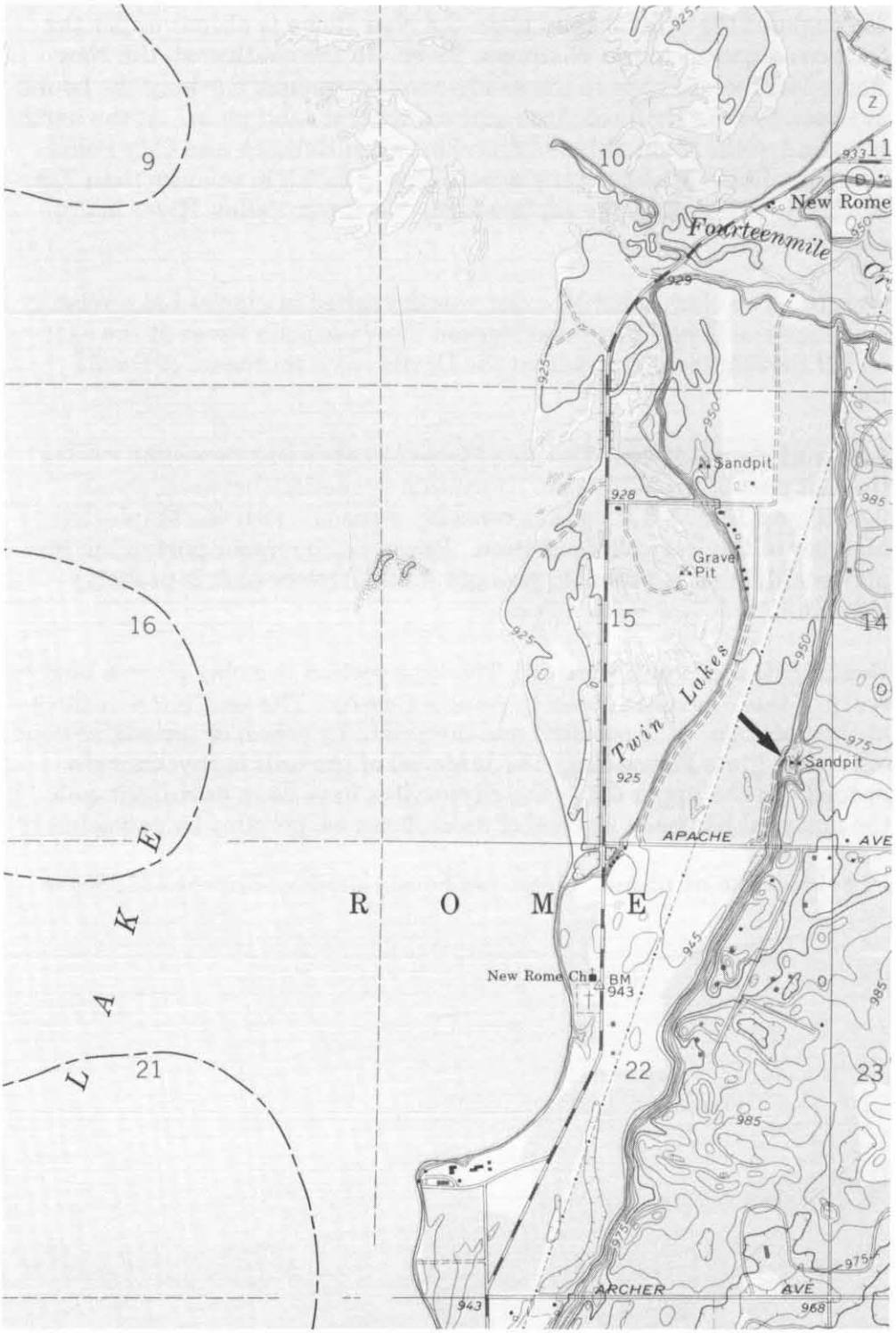

Figure 13. Part of the Arkdale NW Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1969), showing the location of the type section for the New Rome Member.

Throughout the central sand plain the New Rome is absent under the terraces adjacent to the Wisconsin River. In the southwest, the New Rome Member extends to the sandstone escarpment marking the boundary between the Driftless Area and the central sand plain. At the northwest end of the plain, it is not found between Babcock and City Point. The New Rome Member ranges from less than 0.3 m to more than 9 m thick. It is near or at the surface along the lower Yellow River in Juneau County.

Origin. The New Rome Member was deposited in glacial Lake Wisconsin when the Green Bay Lobe blocked the Wisconsin River at the east end of the Baraboo Hills and at the Devils Nose southeast of Devils Lake.

Age and correlation. The New Rome Member was deposited during the last part of the Wisconsin Glaciation (sometime between about 20,000 and 14,000 B.P.) and is contemporaneous with the Mapleview Member of the Horicon Formation. However, the upper part of the Mapleview Member is probably younger and the lower part is probably older than the New Rome Member.

Description of type section. The type section is a clay pit in a terrace scarp of the Wisconsin River in Adams County. The unit is 2.4 m thick at this location. It is overlain and underlain by eolian or lacustrine sand of the Big Flats Formation. The material of the unit is rhythmically bedded. In the upper 0.3 m the rhythmites have been destroyed, and the material has been leached of its carbonates, possibly by pedogenesis.

Previous use of name. Name previously used by Brownell (1986).◆

HORICON FORMATION

Keene Member of the Horicon Formation

Lee Clayton

Source of name. Community of Keene.

Location of type section. An auger hole along the road on the south side of SE1/4 lot 23, sec. 30, T. 22 N., R. 9 E. (equivalent to SE1/4SW1/4 SW1/4E1/2 sec. 30, T. 22 N., R. 9 E.); Portage County, located on the Almond Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1969; fig. 14).

Location of reference section. An auger hole in NE1/4 lot 5, sec. 19, T. 23 N., R. 9 E. (equivalent to NE1/4NE1/4NE1/4W1/2 sec. 19, T. 23 N., R. 9 E.); Portage County, located on the Arnott Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1969).

Description of unit. The material of the Keene Member is brown or reddish brown (5YR or 7.5YR 4/4 on the Munsell scale) and is unbedded. It consists of 2 to 20 percent gravel; the smaller-than-2-mm fraction is 60 to 85 percent sand, 5 to 25 percent silt, and 8 to 17 percent clay. Carbonates are absent to a depth of several metres; below that depth the sand and gravel fractions consist of zero to several percent dolomite. In outcrop, the Keene Member has differential concentrations of iron oxides in joints and across other permeability discontinuities; bright oxide stains can be seen in auger holes to a depth of 10 m. Weathered-looking feldspar grains are abundant in the upper 10 m.

Nature of contacts. The Keene Member is the surface unit in the type area; it overlies sand of the Horicon Formation, although it might rest on older formations elsewhere. In eastern Portage County it is presumably overlain by the Mapleview Member.

Differentiation from other units. The Keene Member differs from the overlying Mapleview Member primarily in the absence of near-surface carbonates and has less carbonate content at depth, is finer grained, is more weathered looking, and has greater magnetic susceptibility below a depth of 5 m. Like the Mapleview, the Keene contains lithologic types derived from the northeast, which distinguishes it from units in Marathon County derived from the north or northwest.

Figure 14. Part of the Almond Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1969), showing the location of the type section for the Keene Member.

Regional extent and thickness. Typically, 10 to 30 m of the unit underlies a north-south ridge about 25 km long and 1 km wide in central Portage County. It is at present unknown beyond this ridge.

Origin. The Keene Member is composed primarily of till of an end moraine formed by the Green Bay Lobe. Some associated meltwater deposits may also be included in the unit, although proglacial stream deposits just to the west of the unit have been, by definition, excluded. The surface of the unit probably also includes as much as a few metres of solifluction deposits.

Age. The till and end moraine were formed during the Arnott Glaciation, which has not been dated. The degree of weathering and erosion indicates it occurred before at least the last part of the Wisconsin Glaciation (before 25,000 B.P.) and probably also before the early part (before 100,000 B.P.).

Correlation. No correlative units are known at the present time.

Description of type section. From the surface to 5 m, reddish yellow, slightly gravelly sandy loam till; 5 to 11 m, reddish brown, slightly gravelly to gravelly loamy sand or sandy loam till; 11 to about 27 m, brown gravelly loamy sand till; about 27 to 31 m, slightly gravelly to gravelly sand.

Previous usage. The unit was named and described by Clayton (1986b).◆

COPPER FALLS FORMATION

Pokegama Creek Member of the Copper Falls Formation

Mark D. Johnson

Source of name. Pokegama Creek, which heads in the Blue Hills of Barron County, Wisconsin.

Location and description of type section. Gravel pit in the NW1/4 NE1/4SW1/4 sec. 1, T. 34 N., R. 11 W., shown on the Rice Lake South Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1978; fig. 15). At this site, loess overlies till of the Pokegama Creek Member, which in turn overlies several metres of coarsening-upward gravelly sand of the Copper Falls Formation. Ventifacts occur on the till and beneath the loess, and several ice-wedge casts occur in the till. The pebble fabric at this site shows that the till was deposited by ice flowing S, 15° W. Magnetic susceptibility does not vary with depth.

Location and description of reference section. Gravel pit in SW1/4 SE1/4SW1/4 sec. 1, T. 35 N., R. 10 W., shown on the Mikana Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1981; fig. 16). More than 2 m of till of the Pokegama Creek Member is exposed at this site. The pebble fabric shows that the till was deposited by ice flowing S. 25° W.

Description of unit. The till of the Pokegama Creek Member is slightly gravelly to gravelly sandy loam; part is slightly gravelly to gravelly loamy sand. Samples of the till have an average matrix (less than 2 mm) grain-size distribution of 69 percent sand, 20 percent silt, and 11 percent clay. It is yellowish red to dark brown (5YR 4/6 to 7.5YR 4/6 on the Munsell scale). The clay in samples of the till averages about 13 percent kaolinite, 41 percent illite, and 45 percent expandable clay, but individual samples vary greatly from these figures. The very-coarse-sand fraction averages 51 percent quartz, 9 percent fine-grained mafic rock, 5 percent granite, 13 percent coarse-grained mafic rock, 2 percent Barron quartzite, 5 percent red sandstone, 1 percent other sandstone, and 14 percent other lithologies. The pebble fraction averages 26 percent fine-grained mafic rock, 23 percent coarse-grained mafic rock, 7 to 8 percent rhyolite, 11 percent granite and gneiss, 19 percent Barron quartzite, 6 percent Precambrian sandstone, 3 percent Cambrian sandstone, and 4 percent other lithologies. All samples analyzed were leached of carbonate.

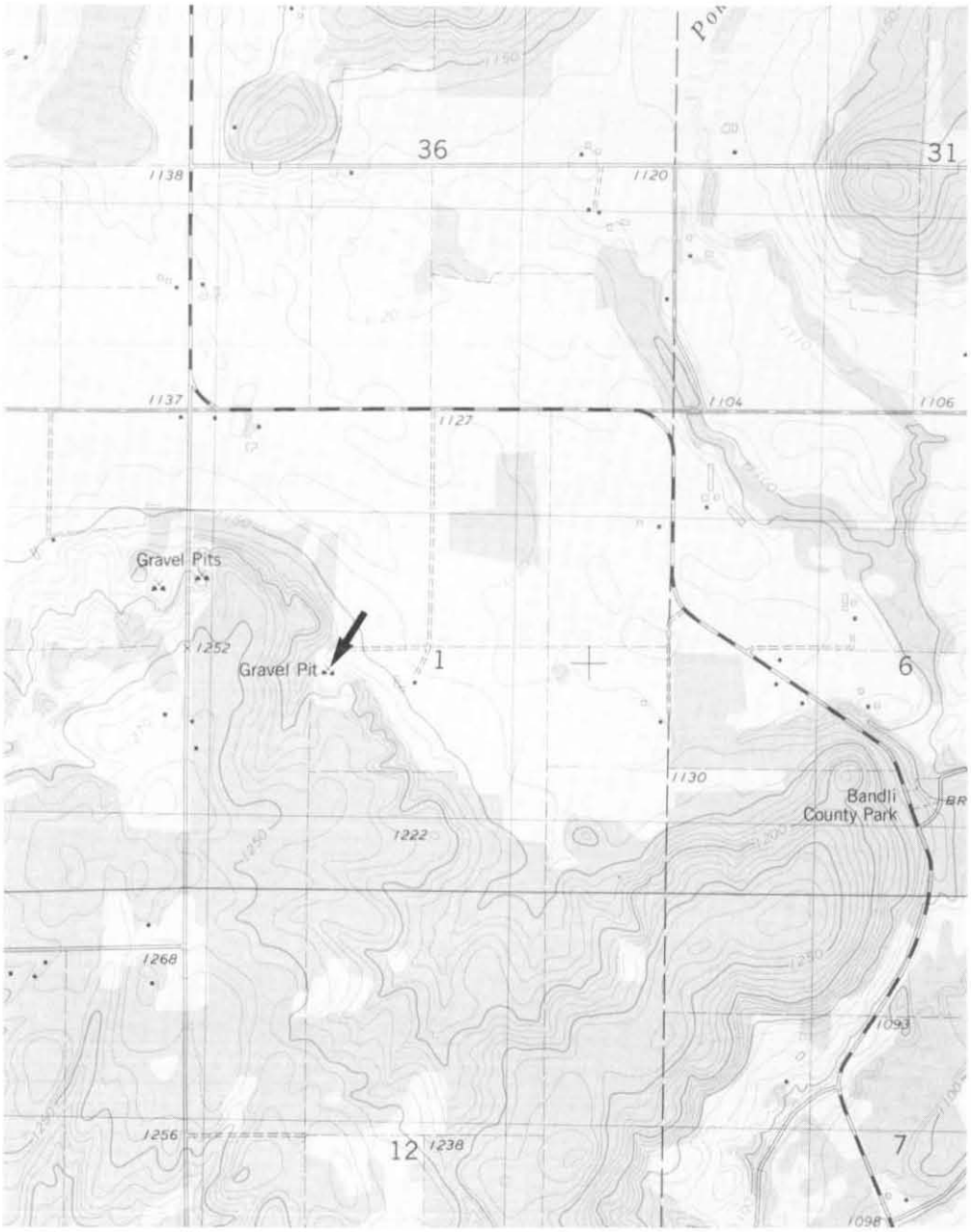

Figure 15. Part of the Rice Lake South Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1978), showing the location of the type section for the Pokegama Creek Member.

Nature of contacts. Till of the Pokegama Creek Member has a sharp contact with the underlying material, which can be sand and gravel, as at the type section, or Barron quartzite or Cambrian sandstone. The upper contact with loess is gradational in places but is generally sharp. In places, the till is at the surface. Near Cameron, till of the Pokegama Creek Member is buried by stream sediment.

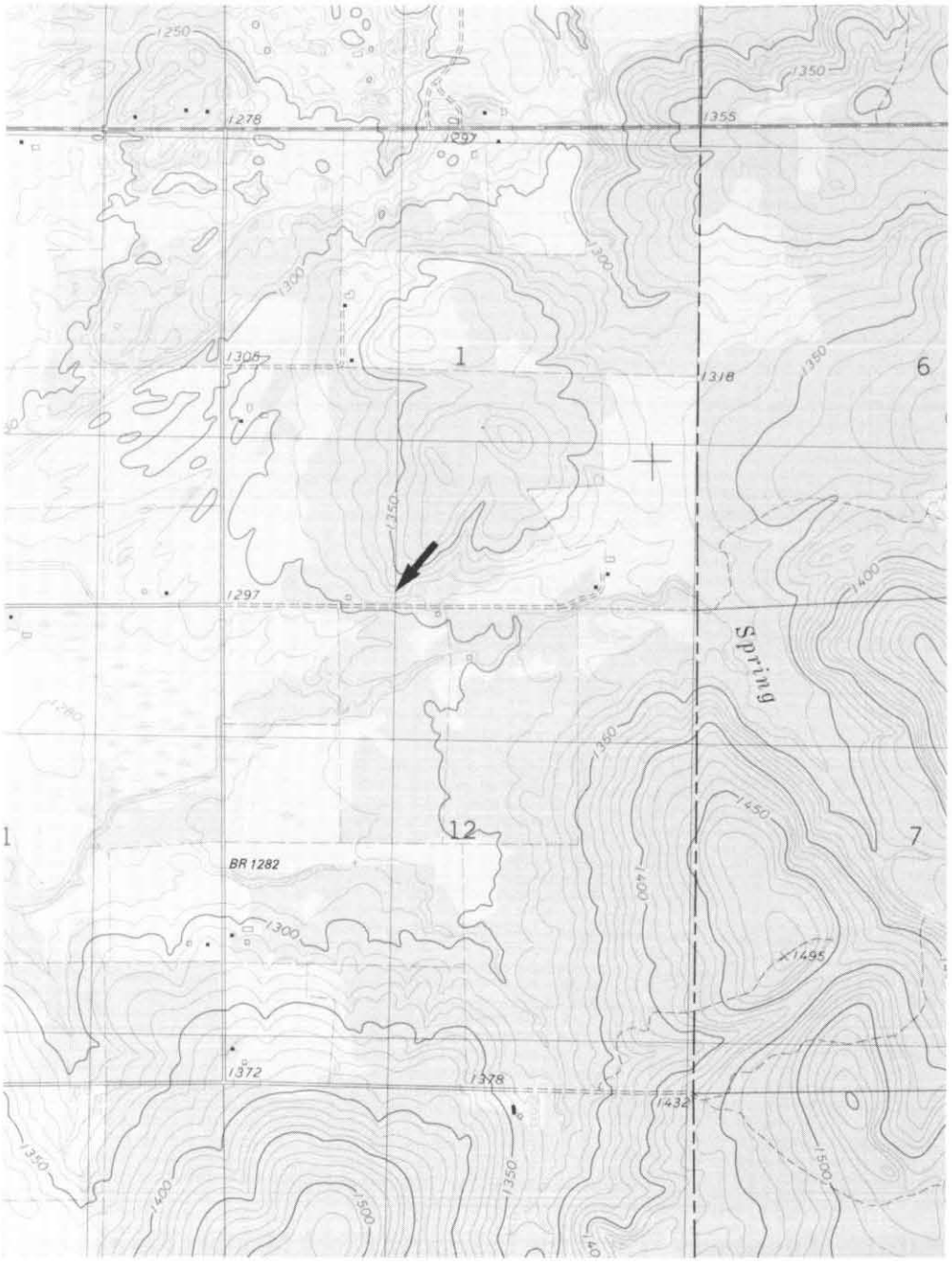

Figure 16. Part of the Mikana Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1981), showing the location of the reference section for the Pokegama Creek Member.

Differentiation from other units. The till of the Pokegama Creek Member can be readily distinguished from the till of the Pierce Formation on the basis of color and grain size; from till of the River Falls Formation, on the basis of magnetic susceptibility and kaolinite:illite

ratio. The Pokegama Creek Member has a relative magnetic susceptibility of 8.3 and a kaolinite:illite ratio of 1.2. Respective values for the till of the River Falls Formation are 4.0 and 2.3 (arbitrary units of University of Wisconsin at Madison, Department of Geology and Geophysics Pleistocene laboratory). The till of the Pokegama Creek Member has a fabric that indicates ice flow to the southwest and a relatively large amount of Barron quartzite compared to the till of the Poskin and Sylvan Lake Members. The till of the Pokegama Creek Member is most similar to the till of the Mikana Member, but contains more quartzite than Mikana till, probably because Pokegama Creek till often rests on Barron quartzite. In the Blue Hills, till of the Mikana Member presumably overlies Barron quartzite. Here, Mikana till may be similar to the till of the Pokegama Creek Member, although the fabric of the two till units is different. The till of the Pokegama Creek Member has a fabric whose mode is oriented S. 10° E. to S. 20° W.; the till of the Mikana Member has a fabric whose mode is oriented S. 20° W. to N. 45° W.

Regional extent and thickness. The till of the Pokegama Creek Member occurs at the surface beneath a few centimetres of loess in a triangle-shaped area in east-central Barron County (fig. 2). To the east, it is overlain by till of the Mikana Member deposited by the late Chippewa Advance of the Chippewa Lobe (Johnson, 1986). To the northwest, it is overlain by till of the Poskin Member. The southern extent is marked by an outwash head (secs. 9, 10, 11, T. 32 N., R. 10 W.) and ice-marginal ridges (sec. 7, T. 32 N., R. 10 W. and NE1/4 sec. 14 T. 32 N., R. 11 W.). The thickness is variable: 1 m of till commonly is exposed in the south-central part of the county where sandstone is close to the surface; elsewhere the till is 4 to 7 m thick.

Origin. The till of the Pokegama Creek Member was deposited during the early Chippewa Advance of the Chippewa Lobe (Johnson, 1986) by ice flowing to the south and south-southwest.

Age and correlation. The Pokegama Creek Member was deposited during the latter part of the Wisconsin Glaciation but prior to deposition of the Poskin Member of the Copper Falls Formation. Ice left by this advance did not melt until after the late St. Croix and late Chippewa Advances. Johnson (1986) suggests that it was deposited sometime between about 25,000 and 15,000 B.P. No age equivalent is known in Wisconsin.

Previous use of name. The name Pokegama Creek Member of the Copper Falls Formation was first used by Johnson (1984 and 1986).◆

Poskin Member of the Copper Falls Formation

Mark D. Johnson

Source of name. Community of Poskin, Barron County, Wisconsin.

Location and description of type section. Gravel pit on west side of a north-south road, NE1/4NE 1/4SE1/4 sec. 25, T. 35 N., R. 12 W., shown on the Barron Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1978; fig. 17). At this site, the till is overlain by stream sediment and loess. The till is up to 6 m thick and overlies stream sediment. The till contains layers of till that differ slightly in color and grain size. In places, the beds are folded. The pebble fabric at this site shows that the till was deposited by ice that flowed S. 35° E. (fig. 18).

Location and description of reference section. Gravel pit on north side of Wisconsin state highway 48, SE1/4SW1/4 sec. 14, T. 35 N., R. 12 W., Haugen Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1982; fig. 19). At this site, 2 m of collapsed stream sediment of the Poskin Member overlies 3 m of till of the Poskin Member. Part of the till contains sand stringers and is interbedded with the collapsed stream sediment. Unbedded till occurs beneath the till with sand stringers. These two types of till have similar color and grain size. The till with the sand stringers contains pebbles with widely scattered orientations; the unbedded till contains pebbles dipping predominantly to N. 60° W. The till with sand stringers is interpreted to be supraglacial in origin; the unbedded till, to have been deposited by meltout or lodgement.

Description of unit. The till of the Poskin Member is slightly gravelly to gravelly sandy loam with a typical matrix (less than 2 mm) grain-size distribution of 71 percent sand, 20 percent silt, and 9 percent clay. It is yellowish red (5YR 4/6 on the Munsell scale) and has a typical clay-mineral composition of about 10 percent kaolinite, 30 percent illite, and 60 percent expandable clay. The very-coarse-sand fraction averages 47 percent quartz, 12 percent fine-grained mafic rock, 6 percent granite, 16 percent coarse-grained mafic rock, 2 percent Barron quartzite, 5 percent red sandstone, less than 1 percent other sandstone, and 11 to 12 percent other lithologies. The pebble fraction averages 35 percent fine-grained mafic rock, 21 percent coarse-grained mafic rock, 8 percent rhyolite, 11 percent granite and gneiss, 1 percent Barron quartzite, 10 percent Precambrian sandstone, 4 percent Cambrian sandstone, and 10 percent

other lithologies. All samples analyzed were leached of carbonates. The till is generally unbedded but is stratified in places, as at the type section, but most exposures are not large enough to show stratification.

The character and distribution of stream sediment of the Poskin Member is not well known. The composition is predominantly slightly gravelly sand. Pebbles from a sample of stream sediment from the Poskin Member along Dority Creek include 39 percent fine-grained mafic rock, 40 percent coarse-grained mafic rock, 9 percent granite and gneiss, 4 percent rhyolite, 3 percent Precambrian sandstone, 4 percent Cambrian sandstone, and 1 percent other lithologies.

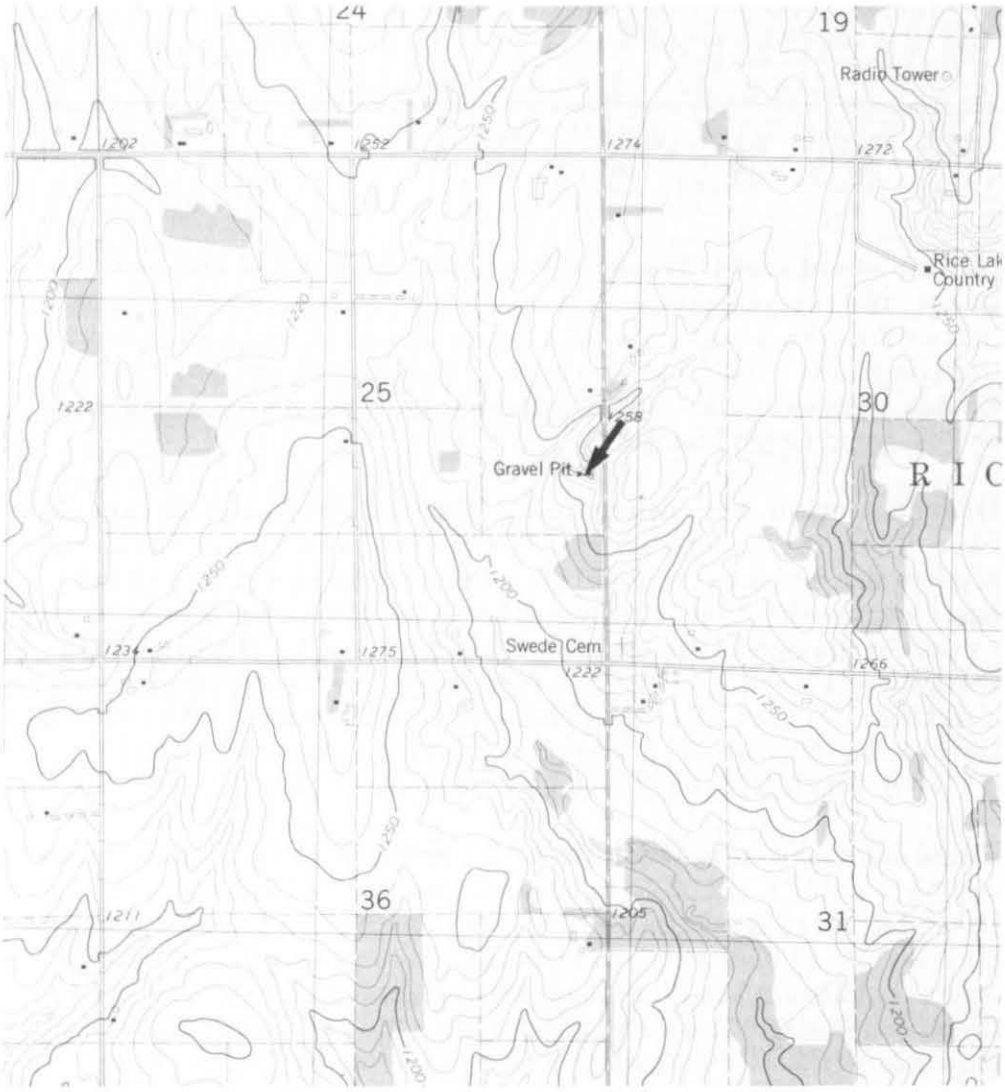

Figure 17. Part of the Barron Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1978), showing the location of the type section for the Poskin Member.

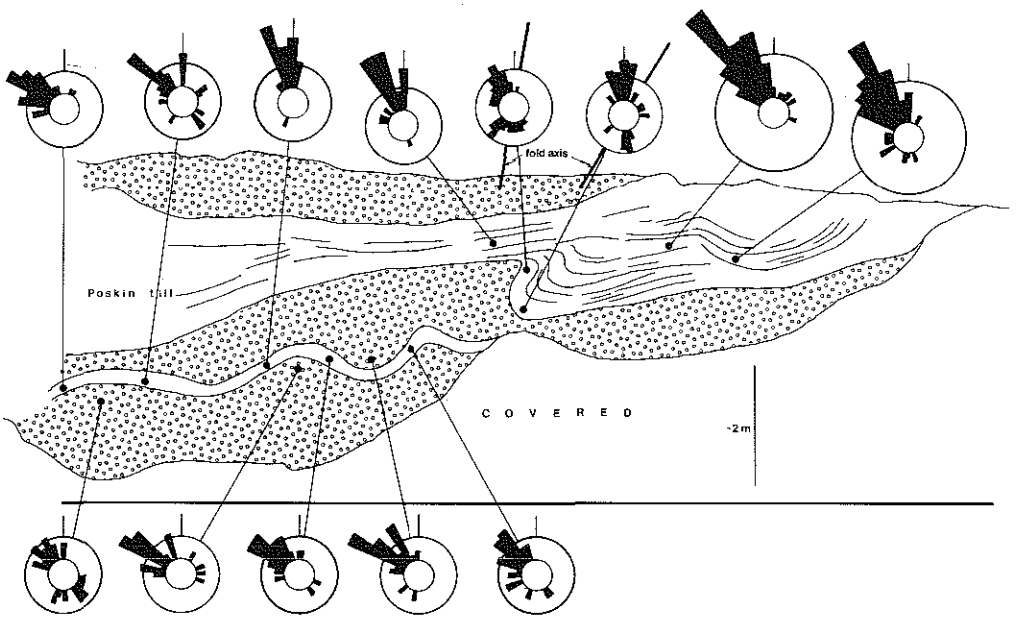

Figure 18. Diagram of the north wall of the excavation at the type section for the Poskin Member (from Johnson, 1984). The patterned area is stream-deposited gravelly sand; the lines represent stratification in the till. The sinuous bed in the stream sediment is till that may have been injected as a clastic dike. The pebble fabric diagrams are based on 25 measurements (50 in the two in the upper right) at each location. The enclosing circle has a radius of 10 percent of the pebbles counted.

Nature of contacts. Where exposed, the lower contact of the till is sharp. The till typically overlies sand and gravel but overlies sandstone in southwest Barron County. The upper contact is generally sharp with overlying loess. The till that is buried beneath sand and gravel of the Chetek Member northwest of Cameron may be till of either the Poskin or Pokegama Creek Members.

Differentiation from other units. The till of the Poskin Member can be easily distinguished from the till of the Pierce Formation on the basis of grain size and color; from till of the River Falls Formation, on the basis of magnetic susceptibility and kaolinite:illite ratio. The respective values for the Poskin Member are 9.3 and 1.4, and for the River Falls Formation, 4.0 and 2.3. The till of the Poskin Member contains less quartzite (1%) than till of the Pokegama Creek Member (19%) or till of the Mikana Member (4%). The till of the Poskin Member is brighter (5YR 4/6) than till of the Sylvan Lake Member (5YR 4/4).

Regional extent and thickness. The till of the Poskin Member occurs in a band parallel to and 10 to 20 km in front of the limit of the Sylvan Lake Member of the Copper Falls Formation (fig. 2). The southeastern limit is not well marked geomorphically but can be confidently placed where it abuts surface till showing characteristics of the Pokegama Creek Member and River Falls Formation. It occurs southwest of Barron County in St. Croix County but has not been mapped accurately.

The till of the Poskin Member is very thick (average thickness, 15 m indicated in well reports). In places it may be as thick as 50 m or as thin as 1 m where it overlies sandstone.

Origin. The till of the Poskin Member was deposited by ice of the Superior Lobe flowing southeast during the early St. Croix Advance.

Age and correlation. The Poskin Member was deposited during the last part of the Wisconsin Glaciation. Ice left by the Poskin Advance was buried by outwash and did not melt until after the late St. Croix

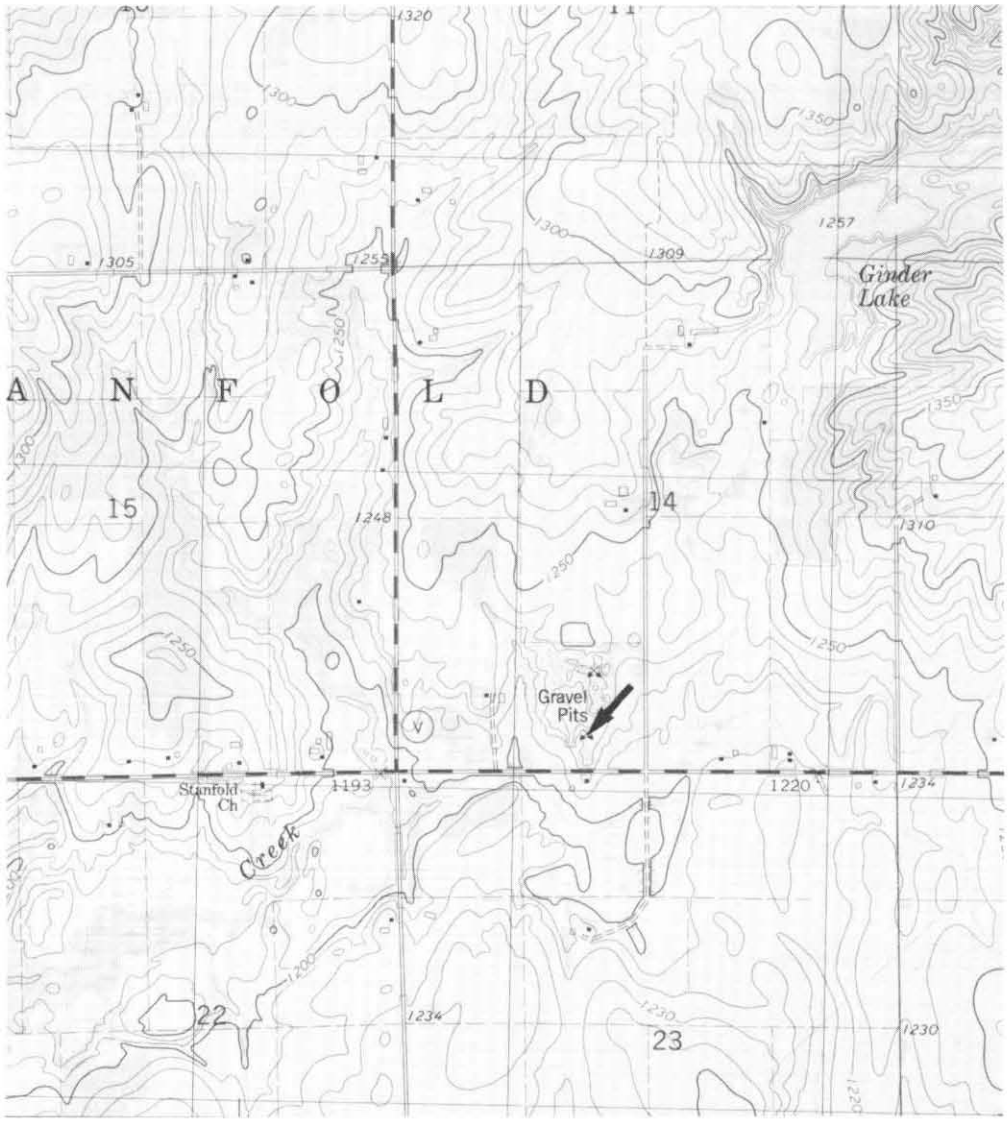

Figure 19. Part of the Haugen Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1982), showing the location of the reference section for the Poskin Member.

and late Chippewa Advances deposited the Sylvan Lake and Mikana Members. The Poskin Member is older than the Sylvan Lake Member (deposited around 15,000 B.P.) and younger than the Pokegama Creek Member (deposited between 25,000 and 15,000 B.P.).

No previously defined units in Wisconsin are known to correlate with the till of the Poskin Member. Till of the "Emerald moraine" near Emerald, Wisconsin (Berg, 1960) may correlate with the till of the Poskin Member. "Extramorainic drift" has been reported flanking the St. Croix moraine in Wisconsin and Minnesota (Leverett, 1928; Schneider, 1961; Hobbs, 1983) and may have been deposited at about the same time as the Poskin Member.

Previous use of name. The name Poskin Member of the Copper Falls Formation was first used by Johnson (1984 and 1986).◆

Mikana Member of the Copper Falls Formation

Mark D. Johnson

Source of name. Community of Mikana, Barron County, Wisconsin.

Location and description of type section. Road cut on west side of a north-south road, NE1/4SE1/4SW1/4 sec. 7, T. 36 N., R. 10 W., on the Rice Lake North Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1981; fig. 20). At this site, several centimetres of loess overlie 3 m of till of the Mikana Member exposed in a hummock. A drill hole at this site encountered 20 m of uniform Mikana till. The hole was abandoned before reaching the base of the unit. The pebble fabric at this site shows that the till was deposited by ice flowing S. 40° W.

Location and description of reference section. Till exposed in a road cut on the inside of a curve on highway W, SW1/4NW1/4SW1/4 sec. 15, T. 33 N., R. 9 W., shown on the Chain Lake Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1972; fig. 21). At this site, 0.5 m of silt overlies at least 5 m of till of the Mikana Member. The pebble fabric at this site shows that the till was deposited by ice that flowed S. 75° W.

Several gravel pits in northeastern Barron County contain stream sediment, predominantly slightly gravelly sand to gravelly sand, of the Mikana Member. The pit in the SE1/4 sec. 5, T. 35 N., R. 10 W., shown on the Mikana Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1981) is typical: at this site, 0.2 to 0.3 m of silt overlies several metres of gravelly sand.

Description of unit. The till of the Mikana Member is slightly gravelly to gravelly sandy loam with an average matrix (less than 2 mm) grain-size distribution of 71 percent sand, 21 percent silt, and 8 percent clay. It is dark reddish brown (5YR 3/6 on the Munsell scale) in the upper oxidized and leached zone and reddish brown (5YR 4/4) below 3.5 to 5.0 m. Where it is unoxidized and not leached of carbonate, the typical clay-mineral composition is 11 percent kaolinite, 35 percent illite, and 54 percent expandable clay. The very-coarse-sand fraction typically contains 50 percent quartz, 11 percent fine-grained mafic rock, 7 percent granite, 13 percent coarse-grained mafic rock, 2 percent Barron quartzite, 4 percent red sandstone, less than 1 percent other sandstone, and 12

to 13 percent other lithologies. Where not leached of carbonate, the very-coarse-sand fraction contains 1 to 2 percent limestone. The pebble fraction contains about 35 percent fine-grained mafic rock, 22 percent coarse-grained mafic rock, 13 percent rhyolite, 10 percent granite and gneiss, 4 percent Barron quartzite, 7 percent Precambrian sandstone, 1 percent Cambrian sandstone, and 8 percent other lithologies. The relative magnetic susceptibility of the till is 9.7 (arbitrary units of University of Wisconsin, Department of Geology and Geophysics Pleistocene laboratory). The till is unbedded and contains unimodally oriented pebbles.

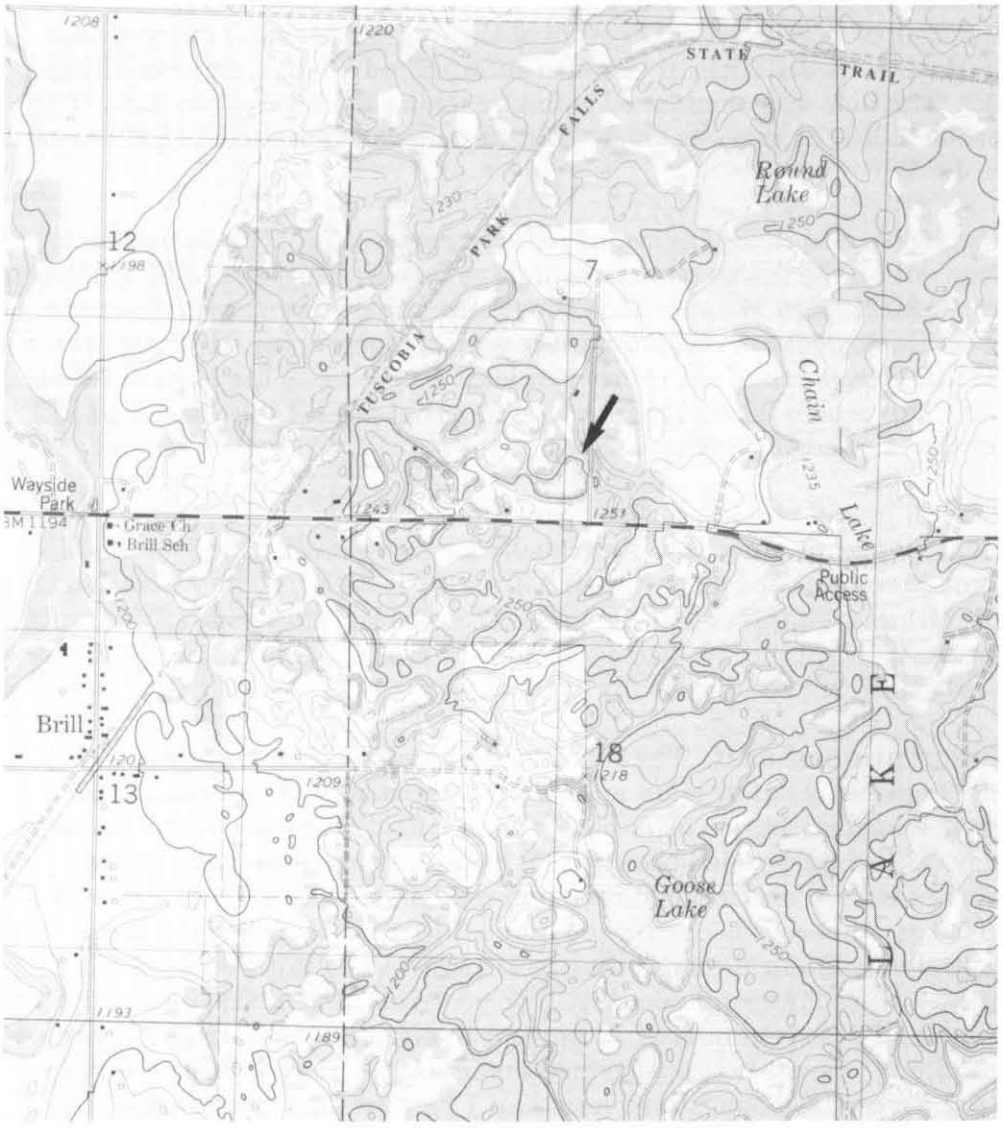

Figure 20. Part of the Rice Lake North Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1981), showing the location of the type section for the Mikana Member.

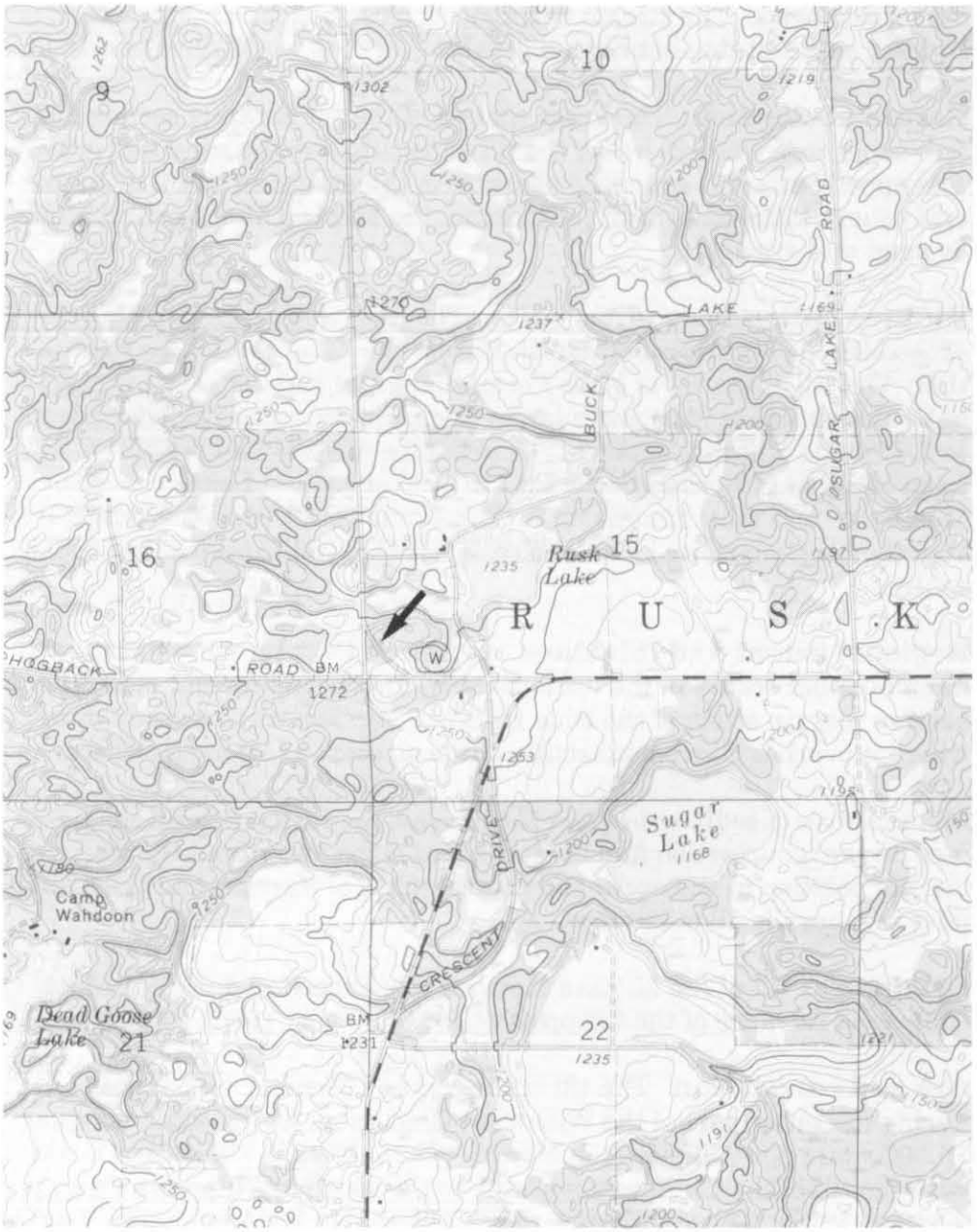

Figure 21. Part of the Chain Lake Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1972), showing the location of the reference section for the Mikana Member.

The character of the stream sediment of the Mikana Member is not well known. It is composed primarily of sand that contains lenses of gravel. Two sites contain pebbles that average 33 percent fine-grained mafic rock, 29 percent coarse-grained mafic rock, 12 percent rhyolite, 7 percent granite and gneiss, 2 to 3 percent Barron quartzite, 9 percent Precambrian sandstone, less than 1 percent Cambrian sandstone, and 5 percent

other lithologies. The stream sediment is cross-bedded and horizontally bedded, and contains imbricated gravel.

Nature of contacts. The lower contact of the till is rarely seen in surface exposures. In drill holes, the till generally overlies sand and gravel. The upper contact is generally sharp with the overlying loess. For several square kilometres south of Mikana, the Mikana Member is overlain by sand and gravel.

Differentiation from other units. The color and grain size of the till of the Mikana Member distinguish it from the till of the Pierce Formation. The till of the River Falls Formation has a smaller relative magnetic susceptibility (4.0) and a larger kaolinite:illite ratio (2.3 compared to 1.0 for the Mikana Member). Quartzite is more abundant in the Mikana Member (4%) than in the Poskin (1%) or Sylvan Lake (1 to 2%) Members. It is most similar to the Pokegama Creek Member, which has slightly more quartzite and a pebble fabric that indicates ice flow to the south.

Regional extent and thickness. In Barron County, the till of the Mikana Member occurs in the northeastern-most township and along the eastern margin south of the Blue Hills (fig. 2). The till is usually thin where it overlies Barron quartzite, but is as thick as 20 m elsewhere.

Mikana stream sediment occurs throughout the region behind the former ice-margin position and in plains that slope away from the ice-margin position in the north and central parts of Barron County. Thickness is generally 10 m or more.

Origin. The till of the Mikana Member was deposited during the late Chippewa Advance of the Chippewa Lobe (Johnson, 1986).

Age and correlation. The till of the Mikana Member was deposited during the latter part of the Wisconsin Glaciation, which occurred about 15,000 years ago (Clayton and Moran, 1982). Mikana till is correlative with the till of the Chippewa moraine to the south in Chippewa County (Cahow, 1976). These tills were deposited at about the same time as the Sylvan Lake and Chetek Members of the Copper Falls Formation and the till of the St. Croix moraine southwest of the county in western Wisconsin and Minnesota.

Previous use of name. The name Mikana Member of the Copper Falls Formation was first used by Johnson (1984 and 1986).◆

Sylvan Lake Member of the Copper Falls Formation

Mark D. Johnson

Source of name. Sylvan Lake, Barron County, Wisconsin.

Location and description of type section. Road cut on south side of an east-west road, SE1/4SW1/4NW1/4 sec. 14, T. 36 N., R. 13 W., shown on the Lower Vermillion Lake Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1982; fig. 22). At this site, silt and 2 m of interbedded till and stream sediment of the Sylvan Lake Member overlie 4 m of unbedded till of the Sylvan Lake Member. The interbedded till and stream sediment is supraglacial sediment and the unbedded till is lodgement or meltout till. The pebble fabric of the unbedded till shows that the till was deposited by ice that flowed S. 35° E.

Location and description of reference sections. Till in a small borrow pit on east side of a north-south road, NW1/4SW1/4SW1/4 sec. 20, T. 36. N., R. 12 W., shown on the Lower Vermillion Lake Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1982; fig. 23). At this site, 1.5 m of till of the Sylvan Lake Member with a pebble fabric showing S. 10° E. ice flow overlies at least 1.0 m of till of the Poskin Member. At the contact a stone line has striations and a fabric parallel to the pebble fabric in the till of the Sylvan Lake Member.

Gravel is mined from several northwest Barron County gravel pits that contain stream sediment of the Sylvan Lake Member. A pit containing Sylvan Lake stream sediment, which is typically gravelly sand, is located in NE1/4SE1/4SE1/4 sec. 36, T. 36 N., R. 13 W., shown on the Lower Vermillion Lake Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1982). At this site, 0.6 m of silt overlies several metres of gravelly sand. This site is less than 1 km from the limit of the late St. Croix Advance.

Lake sediment is exposed in a gravel pit in the SE1/4NW1/4SE1/4 sec. 6, T. 33 N., R. 14 W., shown on Clayton Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1978; fig. 24). At this site a small delta, formed on the edge of an ice-walled lake, is exposed. Slightly gravelly sand occurs in topset, foreset, and bottomset beds. Silt deposited by turbidity currents and a subaqueous debris flow are exposed in the pit. Faults occur near the ice-contact face; folds, which developed shortly after deposition by sediment flow, occur at the delta top.

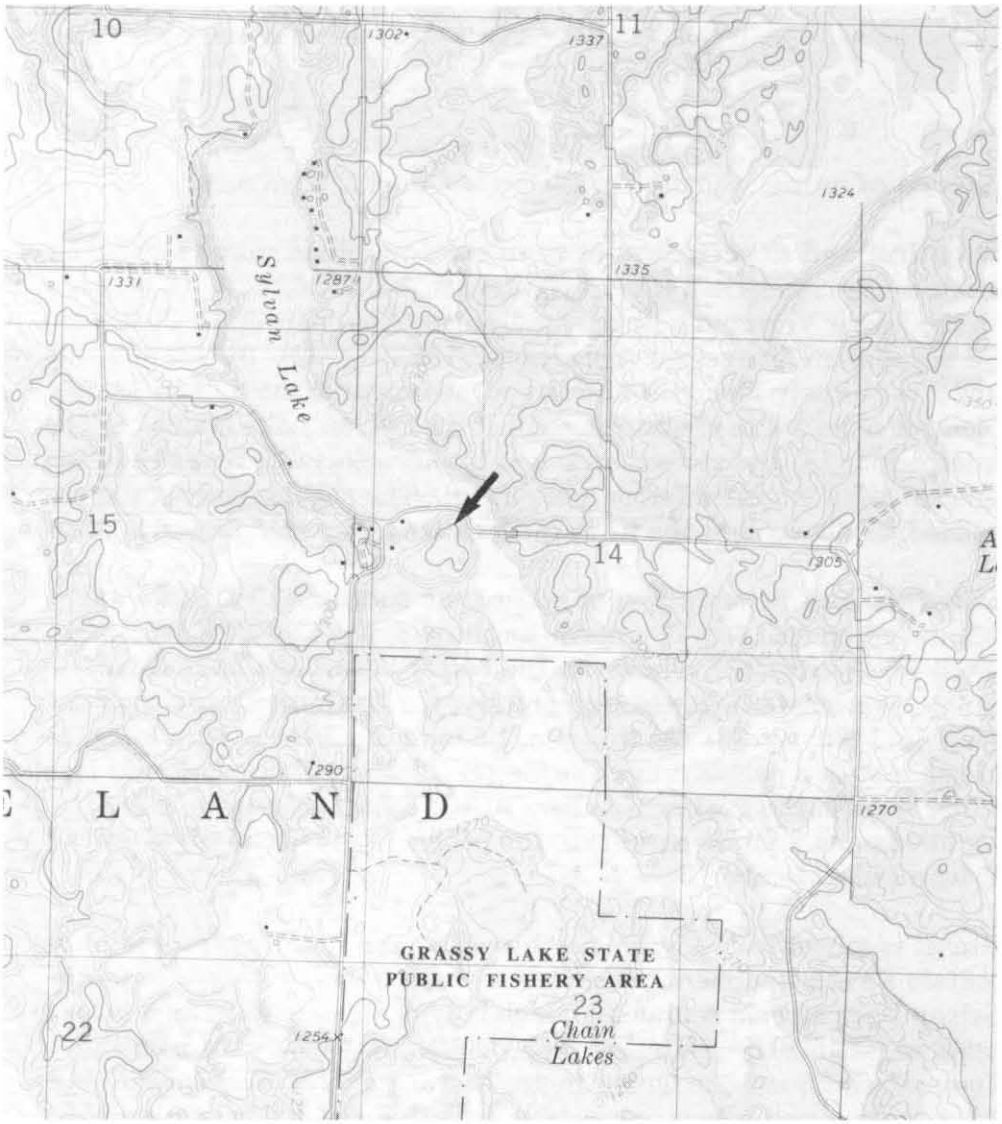

Figure 22. Part of the Lower Vermillion Lake Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1982), showing the location of the type section for the Sylvan Lake Member.

Fine-grained lake sediment occurred in a drill hole in the SW1/4NW1/4 SE1/4 sec. 31, T. 34 N., R. 14 W., on the Turtle Lake Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1978). At this site several metres of silt loam overlies till of the Sylvan Lake Member.

Description of unit. The till of the Sylvan Lake Member is slightly gravelly to gravelly sandy loam; however, part is slightly gravelly to gravelly loamy sand. The typical matrix (less than 2 mm) grain-size distribution is 71 percent sand, 21 percent silt, and 8 percent clay. It is

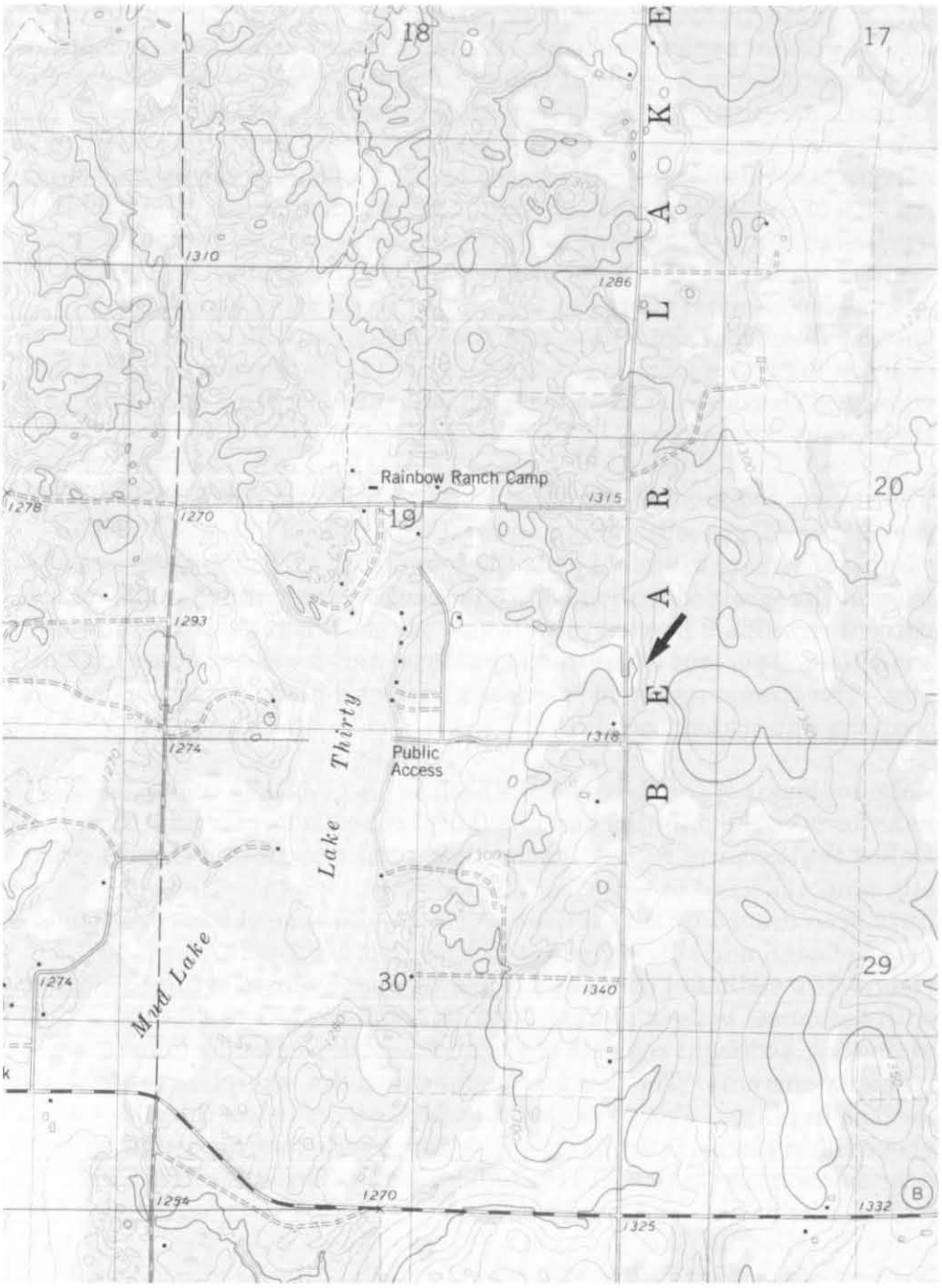

Figure 23. Part of the Lower Vermillion Lake Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1982), showing the location of the reference section for the Sylvan Lake Member.

dark reddish brown (5YR 3/4 to 3/6 on the Munsell scale) at the surface where it is oxidized and leached of carbonate. Below 2.5 to 5.0 m, the till is unoxidized and unleached and is dull reddish brown (5YR 4/4). The

clay minerals typically contain 12 percent kaolinite, 31 percent illite, and 57 percent expandable clay. The very-coarse-sand fraction contains 44 percent quartz, 16 percent fine-grained mafic rock, 6 percent granite, 14 percent coarse-grained mafic rock, 2 percent Barron quartzite, 5 percent red sandstone, less than 1 percent other sandstone, and 12 to 13 percent other lithologies. Below the leached zone, the very-coarse-sand fraction of the till contains less than 1 percent limestone. The pebble fraction contains 42 percent fine-grained mafic rock, 25 percent coarse-grained mafic rock, 9 percent rhyolite, 11 percent granite and gneiss, 1 or 2 percent Barron quartzite, 6 percent Precambrian sandstone, 3 percent Cambrian sandstone, and 1 percent other lithologies. The average relative magnetic susceptibility is 11.8 (arbitrary units of University of Wisconsin at Madison, Department of Geology and Geophysics Pleistocene laboratory).

The stream sediment of the Sylvan Lake member is dominantly slightly gravelly sand, gravelly sand, and sand with beds of gravel. A pebble sample of stream sediment near the community of Turtle Lake has 48 percent fine-grained mafic rock, 25 percent coarse-grained mafic rock, 8 percent rhyolite, 9 percent granite and gneiss, 9 percent Precambrian sandstone, 2 percent Cambrian sandstone, and 2 percent other lithologies. The stream sediment is cross-bedded and horizontally bedded and contains imbricated gravel.

Lake sediment of the Sylvan Lake Member is generally coarse (sandy) near former lake margins and fine (silty) beneath former lake centers. Deltas that occur at former lake-margin positions contain slightly gravelly sand and sand in topset and foreset beds. In places, foreset beds have been draped by silty fallout sediment. Bottomset beds are composed of sand and silty sediment in beds that are 1 to 30 mm thick. Debris-flow sediment composed of gravelly sandy loam is interbedded with bottomset beds in places. Near the centers of ice-walled-lake plains, the sediment consists of silt and sand deposited by fallout and turbidity currents. The fine lake sediment in the lake-plain centers is 10 m thick in places. Coarse sediment, which occurs below the silt and above till in places, is probably supraglacial sediment deposited by debris flow in the lake as ice melted during the formation of the ice-walled-lake basin.

Nature of contacts. The lower contact of the till unit is seldom exposed at the surface but is commonly found over sand and gravel in drill holes. The upper contact with loess is generally sharp. Stream sediment of the Sylvan Lake Member is overlain by a thin layer of loess.

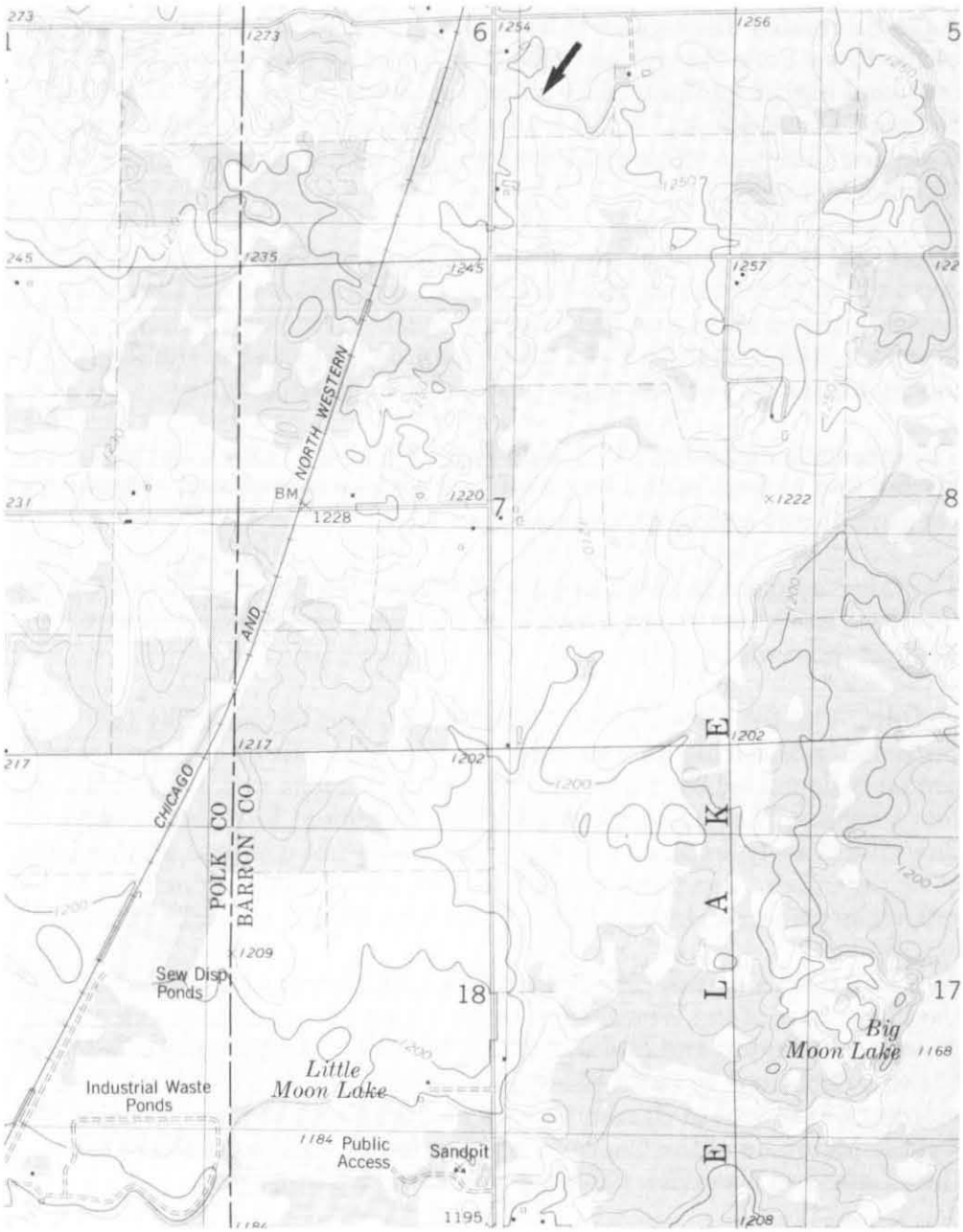

Figure 24. Part of the Clayton Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1978), showing the location of the reference section for the lake sediment of the Sylvan Lake Member.

The lower contact of the stream sediment is seldom observed and may overlie till of the Sylvan Lake or Poskin Members or stream sediment of the Poskin Member. The lower contact of the lake sediment is sharp with till of the Sylvan Lake Member; the upper contact is sharp with the loess but difficult to identify where the lake sediment is silty.

Differentiation from other units. The color and grain size of Sylvan Lake till readily distinguish it from till of the Pierce Formation. The till of the River Falls Formation has a lower relative magnetic susceptibility (4.0) and higher kaolinite:illite ratio (2.3 compared to 1.1 in till of the Sylvan Lake Member). It has less quartzite, more fine-grained mafic rock, and different fabric than the Prairie Farm, Pokegama Creek, or Mikana Members.

Regional extent and thickness. The till of the Sylvan Lake Member occurs behind the former ice-margin position of the late St. Croix Advance in the western and northwestern parts of Barron County (Johnson, 1986). Sylvan Lake till is commonly exposed in the hummocky topography of that region. The till is 5 to 45 m thick.

The stream sediment of the Sylvan Lake Member occurs in pitted plains behind and in front of the Late St. Croix ice-margin position. Thickness varies, but it is commonly greater than 10 m.

The lake sediment is found in ice-walled-lake plains in northwest Barron County. Thickness ranges from 10 to 15 m at the edges of plains to 7 to 10 m at the centers.

Origin. The till of the Sylvan Lake Member was deposited by the Superior Lobe during the late St. Croix Advance. Much of the till was probably deposited by meltout or lodgement because it is unbedded and has a regionally consistent pebble fabric. Sediment interpreted to be flow till is rarely exposed and most likely does not compose a large part of this member. Sand and gravel was deposited by supraglacial and proglacial streams. Lake sediment was deposited in ice-walled lakes.

Age and correlation. The Sylvan Lake Member was deposited during the latter part of the Wisconsin Glaciation, which occurred about 15,000 years ago (Clayton and Moran, 1982). The till of the Sylvan Lake Member was deposited at about the same time as the till in the St. Croix moraine southwest of Barron County and in Minnesota, the Mikana and Chetek Members of the Copper Falls Formation, and most likely the Bass Lake and Nashville till units of eastern Wisconsin.

Previous use of name. The name Sylvan Lake Member of the Copper Falls Formation was first used by Johnson (1984 and 1986).◆

Chetek Member of the Copper Falls Formation

Mark D. Johnson

Source of name. Community of Chetek, Barron County, Wisconsin.

Location and description of type section. Gravel pit on east side of highway SS near Cameron, Wisconsin, in the SW1/4SE1/4 sec. 28, T. 34 N., R. 11 W., shown on the Rice Lake South Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1978; fig. 25). At this site, a few centimetres of loess overlie more than 5 m of stream sediment composed of slightly gravelly sand. Ice-wedge casts are well developed in this pit.

Location and description of reference section. Gravel from the Chetek Member is mined in many pits in the central part of Barron County. Chetek stream sediment occurs, for example, in a gravel pit in the SE1/4 sec. 23, T. 35 N., R. 11 W., shown on Rice Lake North and Rice Lake South Quadrangles, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1981 and 1978, respectively).

Description of unit. The Chetek Member contains sand, slightly gravelly sand, and gravelly sand. Collapse of the sediment during the melting of buried-ice blocks produced faults and folds.

Nature of contacts. The lower contact is not exposed. Chetek sediment is similar to stream sediment that occurs elsewhere in Barron County and differentiation is difficult. A thin layer of loess commonly overlies the Chetek Member, and mixing has produced a gradational contact.

Differentiation from other units. The Chetek Member contains sediment that was transported by the Superior and Chippewa Lobes before deposition in meltwater streams. It is mapped where stream sediment cannot be confidently included in either the Sylvan Lake or Mikana Members.

Regional extent and thickness. The Chetek Member is found in central Barron County in pitted and unpitted plains. The boundaries shown on figure 2 with the Sylvan Lake and Mikana Members are somewhat arbitrary and are based on topographic relationships. The thickness is commonly 10 m.

Origin. The Chetek Member was deposited during the late St. Croix and late Chippewa Advances in streams that carried meltwater from the Superior and Chippewa Lobes.

Age and correlation. The Chetek Member was deposited during the latter part of the Wisconsin Glaciation, which occurred about 15,000 years ago (Clayton and Moran, 1982) about the same time as the Sylvan Lake and Mikana Members of the Copper Falls Formation.

Previous use of name. The name Chetek Member of the Copper Falls Formation was first used by Johnson (1984 and 1986).◆

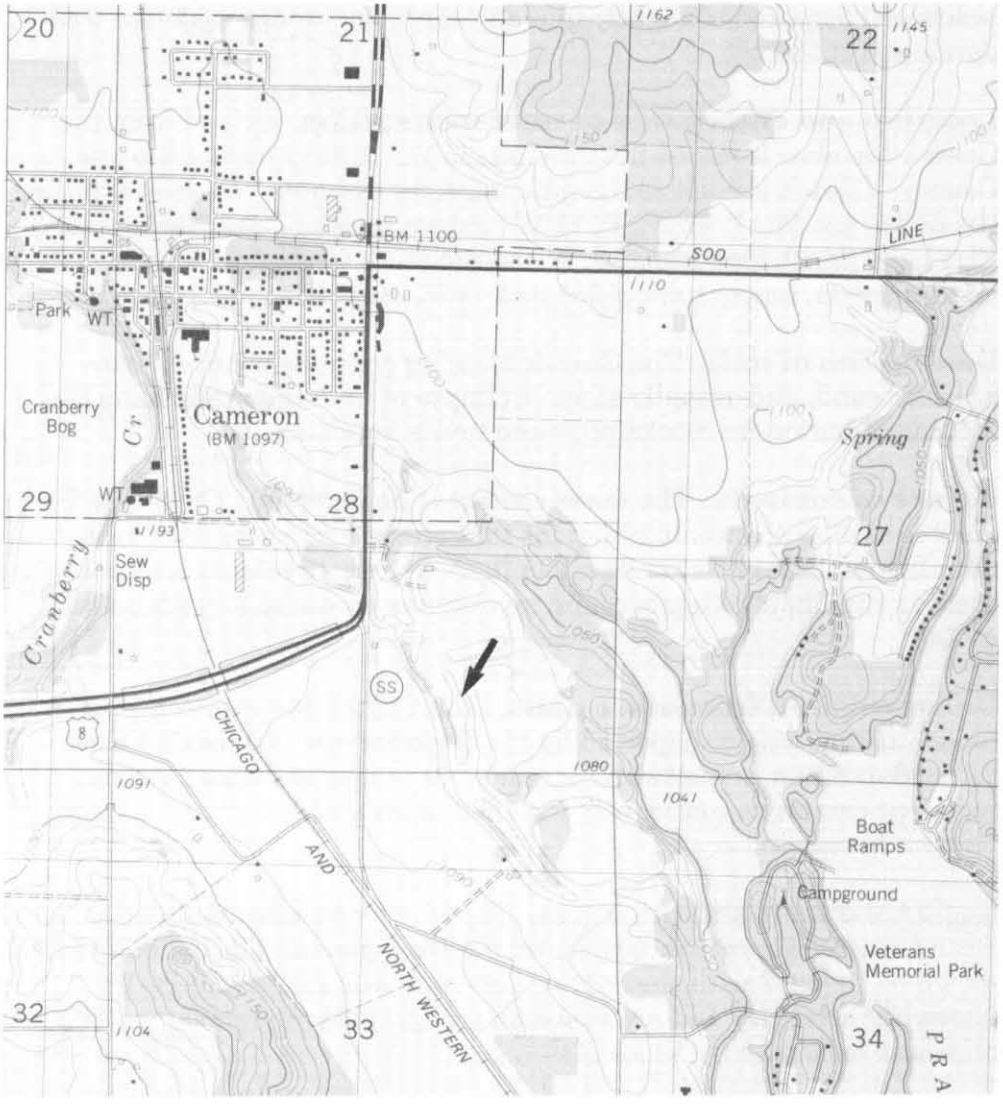

Figure 25. Part of the Rice Lake South Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1978), showing the location of the type section for the Chetek Member.

Wildcat Lake Member of the Copper Falls Formation

John W. Attig

Source of name. Wildcat Lake, Vilas County, Wisconsin.

Location of type section. A gravel pit on the southeast side of highway M about 0.5 km southwest of the intersection of highways B and M. It is located in the NW1/4NW1/4NE1/4 sec. 34, T. 43 N., R. 7 E., an area shown on the Tenderfoot Lake Quadrangle, Wisconsin-Michigan (U.S. Geological Survey, 7.5-minute series, topographic, 1981; fig. 26).

Location of reference section. A power-auger hole near the crest of a drumlin on the south side of North Creek road in the NW1/4NW1/4 NW1/4 sec. 36, T. 42 N., R. 6 E., an area shown on the Boulder Junction Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1981; fig. 27).

Description of unit. The till of the Wildcat Lake Member is slightly gravelly loamy sand to sandy loam. The average sand:silt:clay ratio of 16 samples is 71:21:8. Semiquantitative analysis of clay mineralogy of 11 samples yielded an average expandable clay: illite:kaolinite-plus-chlorite ratio of 44:41:15. Average relative magnetic susceptibility for 16 samples is 14.8 (arbitrary units of University of Wisconsin at Madison, Department of Geology and Geophysics Pleistocene laboratory). Moist field color is typically reddish brown (5YR 5/6 on the Munsell scale). The pebble lithologies in this unit average 8 percent sandstone, 14 percent unaltered, probably Keweenawan volcanic rock, 14 percent argillic and slaty metasedimentary rock, and 64 percent other igneous and metamorphic rock. The pebble fabric in this unit (measured at only one location) is strongly developed with the long axis of most pebbles lying parallel to regional ice flow (north-northeast to south-southwest) and dipping upglacier (north-northeast) (Attig, 1984, 1985).

Nature of contacts. The lower contact of this unit has only been observed in drill holes. In those holes the transition to underlying sand and gravelly sand is abrupt. In many areas the till of the Wildcat Lake Member is overlain by debris-flow sediment and stream-deposited sand and gravel. The contact with the overlying material is typically sharp.

Differentiation from other units. The till of the Wildcat Lake Member is not known to be in contact with the till of any other member. Wildcat Lake till has a higher magnetic susceptibility than till of the

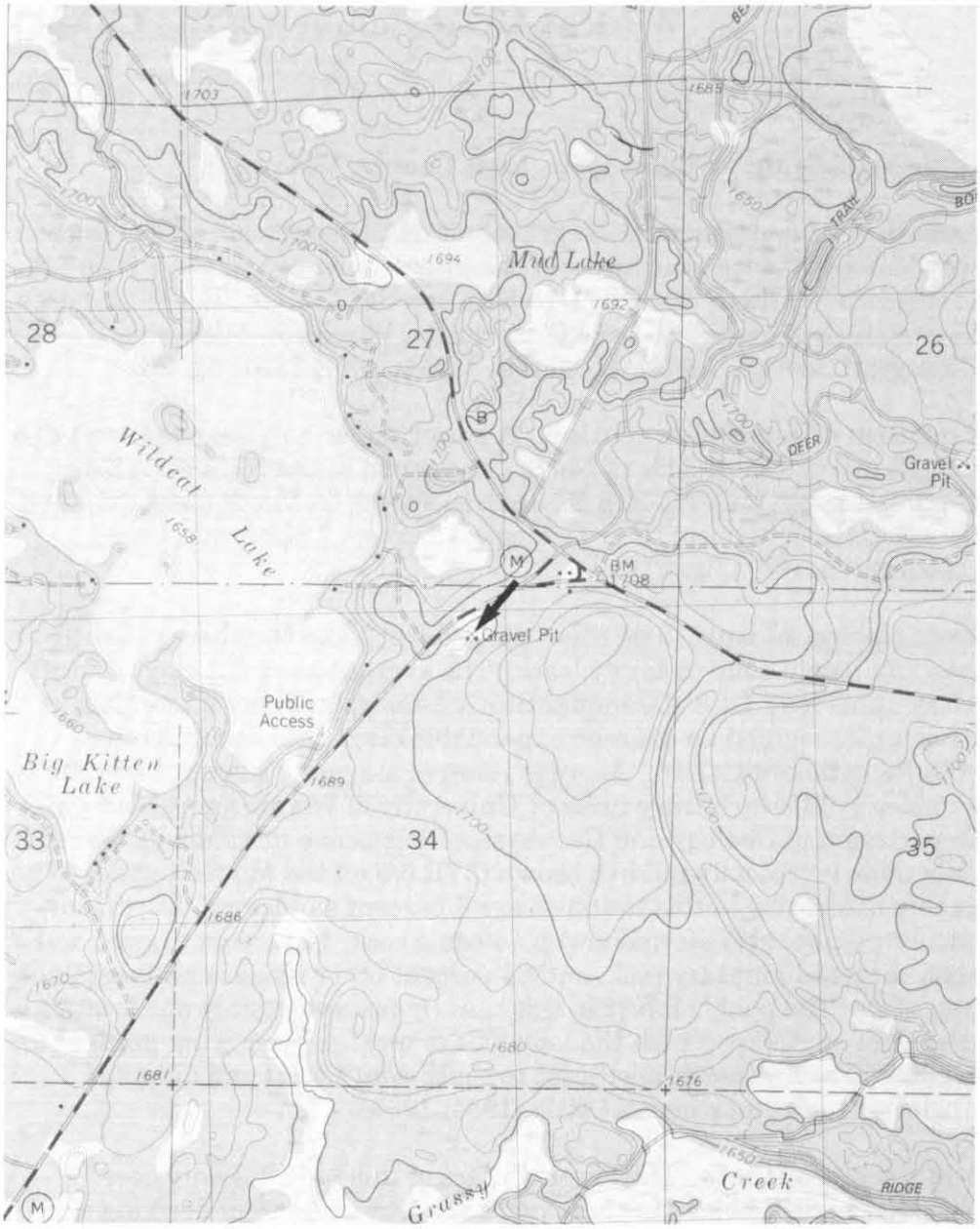

Figure 26. Part of the Tenderfoot Lake Quadrangle, Wisconsin-Michigan (U.S. Geological Survey, 7.5-minute series, topographic, 1981), showing the location of the type section for the Wildcat Lake Member.

Nashville or Crab Lake Members. It is redder, contains more pebbles of sandstone and Keweenawan volcanic rock, and contains more expandable clay than the Nashville Member. It has a higher percentage of sand in the less-than-2-mm fraction, has a higher relative magnetic susceptibility, a lower percentage of expandable clay, and a higher percentage of illite than the Crab Lake Member.

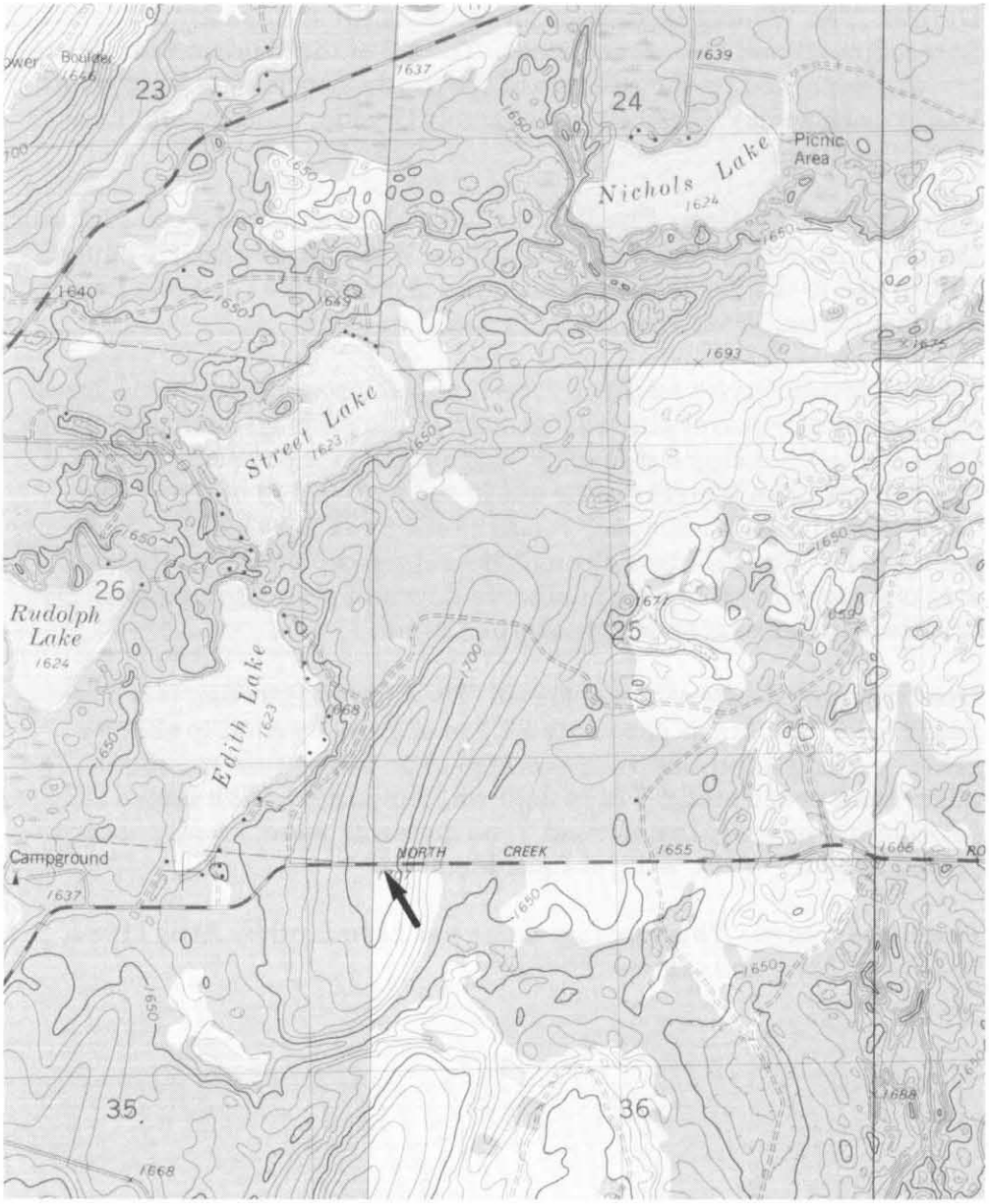

Figure 27. Part of the Boulder Junction Quadrangle, Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1981), showing the location of the reference section for the Wildcat Lake Member.

Regional extent and thickness. The Wildcat Lake Member is the surface unit in western Vilas County south of the Winegar moraine. It presumably extends southward to the terminal moraine of the Wisconsin Valley Lobe, where it is equivalent to the Bass Lake till that was informally named by Nelson (1973). The thickness of the till of the Wildcat Lake Member is not well known. Several power-auger holes show the till of this unit to be up to 6 m thick.

Origin. The Wildcat Lake Member contains till and associated debris-flow sediment and stream sediment. The till of the Wildcat Lake Member was deposited by the advance of the southwest-flowing Wisconsin Valley Lobe across Vilas, and presumably Oneida, Lincoln, and Langlade Counties.

Age and correlation. The Wildcat Lake Member was deposited during the last part of the Wisconsin Glaciation. It is probably nearly equivalent in age to the Nashville Member and is older than the Crab Lake Member (Attig, 1984, 1985; Attig and others, 1985).

Description of type section. The type section is located in the southeast corner of a gravel pit. The location of the pit is given above. Three types of material crop out in what was a fresh face in 1982. The till of the Wildcat Lake Member crops out in the bottom 1 m of the section. The till is a uniform, compact, reddish brown (5YR 5/6), slightly gravelly loamy sand. The till has a strongly developed pebble fabric; the long axis of most pebbles lies parallel to ice flow and plunges upglacier. Debris-flow and stream sediment overlie the till.

Description of reference section. The reference section is a power-auger hole. The auger penetrated 1.5 m of gravelly sand to slightly gravelly loamy sand that is interpreted to be debris-flow sediment. The auger then penetrated 5.7 m of uniform, compact, reddish brown (5YR 5/6) slightly gravelly loamy sand. The material below 1.5 m is interpreted to be till of the Wildcat Lake Member.

Previous usage. This member name has been used by Attig (1984, 1985) and Attig and others (1985).◆

Crab Lake Member of the Copper Falls Formation

John W. Attig

Source of name. Crab Lake, Vilas County, Wisconsin.

Location of type section. A roadcut (fresh in 1981) on the east side of Crab Lake Road about 75 m south of highway B. The type section is located in the NW1/4NW1/4NW1/4 sec. 2, T. 43 N., R. 6 E., an area shown on the Presque Isle Quadrangle, Wisconsin-Michigan, (U.S. Geological Survey, 7.5-minute series, topographic, 1981; fig. 28).

Location of reference section. A small gravel pit on the west side of a dirt road 1 km northwest of the intersection of Helen Creek and highway B. A fresh face was exposed in this pit in 1981. The site is located in the NE1/4SE1/4NW1/4 sec. 19, T. 43 N., R. 9 E., an area shown on the Thousand Island Lake Quadrangle, Michigan-Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1981; fig. 29).

Description of unit. The till of the Crab Lake Member is slightly gravelly sandy loam. The average sand:silt:clay ratio of 19 samples is 61:30:9. Semiquantitative analyses of clay mineralogy in 16 samples yielded an average expandable clay: illite:kaolinite-plus-chlorite ratio of 64:26:9. Average relative magnetic susceptibility for 19 samples is 8.5. Moist field color is typically reddish brown (5YR 4/4 on the Munsell scale). The pebble lithologies in this unit average 11 percent sandstone, 11 percent unaltered, probably Keweenawan, volcanic rock, 16 percent argillic and slaty metasedimentary rock, and 62 percent other igneous and metamorphic rock. The till of this unit has a strongly developed pebble fabric; the long axis of most pebbles lies parallel to ice flow (north-south) and plunges upglacier (north). Attig (1984) interpreted the till of this member to have been deposited by lodging and melting out of material from a debris-rich zone at the base of the glacier.

Nature of contacts. The lower contact of this unit has been observed at few places. Where the contact has been observed, the till of the Crab Lake Member overlies stratified sand and gravel and the contact is sharp. In some areas the stratified sand and gravel underlying the Crab Lake Member is interpreted to belong to the Nashville Member. In other areas, it is undifferentiated.

Differentiation from other units. The till of the Crab Lake Member is not known to be in contact with the till of any other member. Crab

Lake till has a higher percentage of silt in the less-than-2-mm fraction than the tills of the Nashville and Wildcat Lake Members. It has a higher relative magnetic susceptibility, is redder, contains more pebbles of sandstone and Keweenawan volcanic rock, and has more expandable

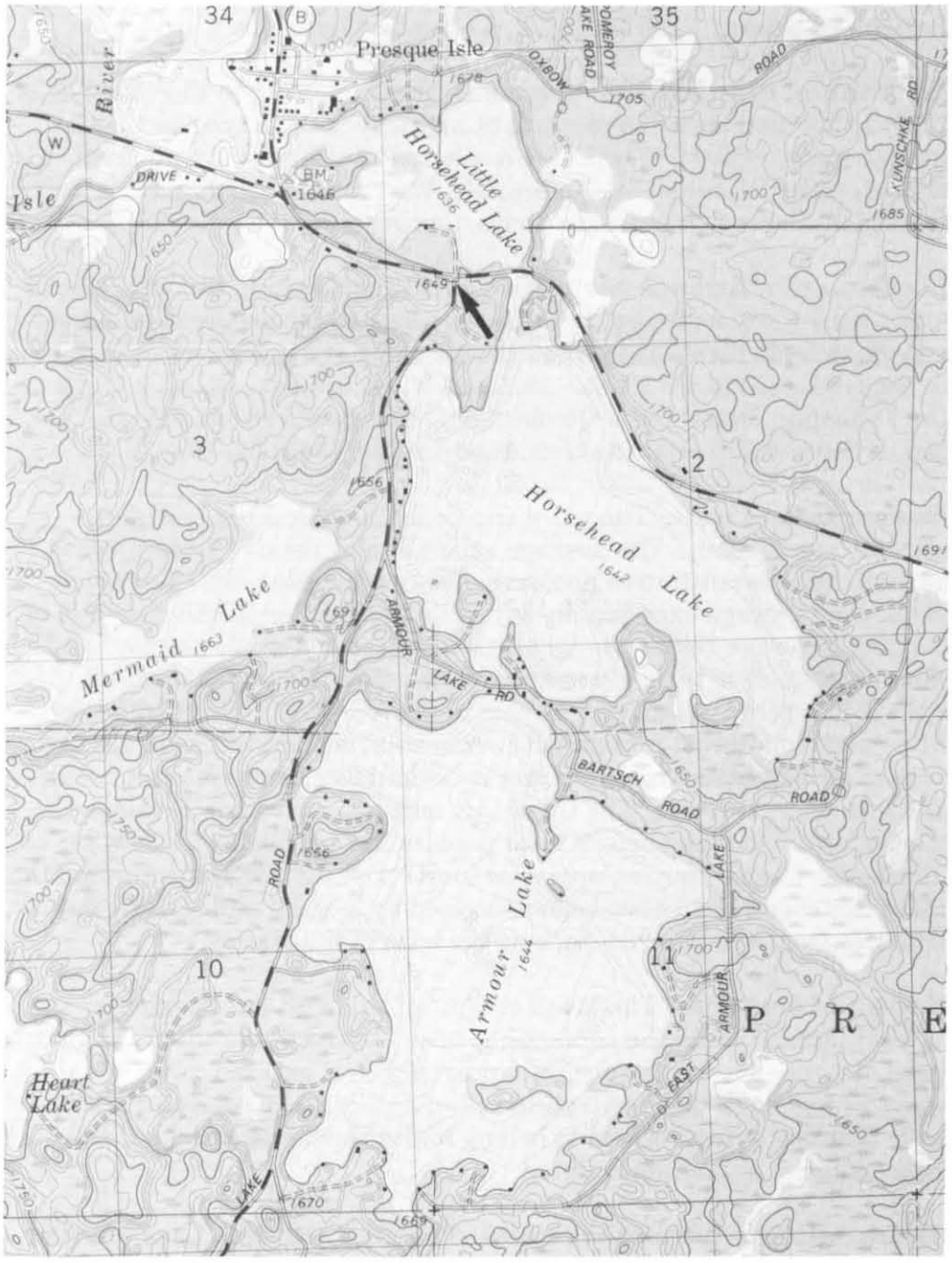

Figure 28. Part of the Presque Isle Quadrangle, Michigan-Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1981), showing the location of the type section for the Crab Lake Member.

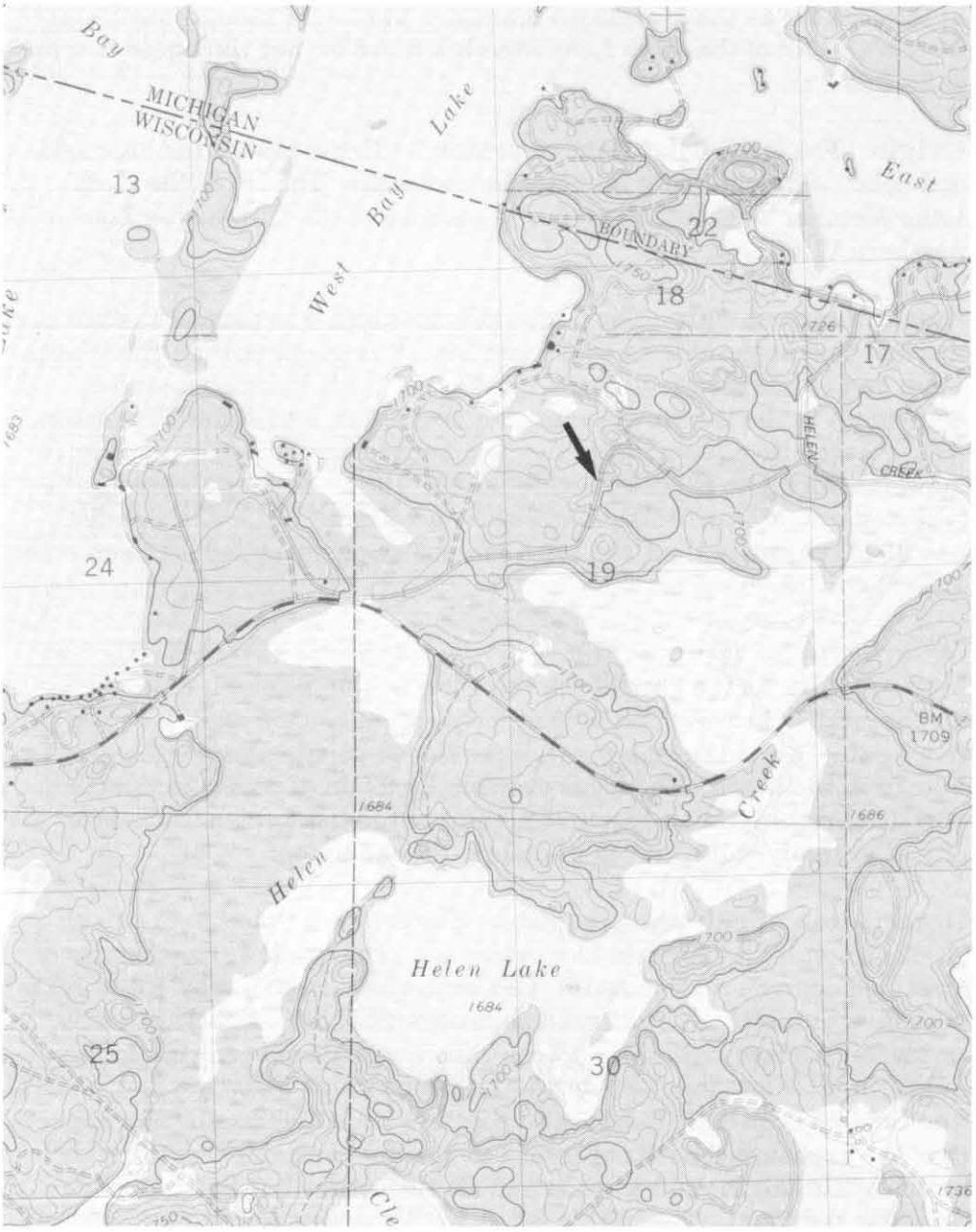

Figure 29. Part of the Thousand Island Lake Quadrangle, Michigan-Wisconsin (U.S. Geological Survey, 7.5-minute series, topographic, 1981), showing the location of the reference section for the Crab Lake Member.

clay than the Nashville Member. It has lower relative magnetic susceptibility and more expandable clay than the Wildcat Lake Member.

Regional extent and thickness. The Crab Lake Member is the surface unit in Vilas County and adjacent Iron County in and north of the Winegar moraine. It presumably extends northward into Michigan

at least as far as the Marenisco moraine. The maximum known thickness of the till of the Crab Lake Member is 8.5 m, but thickness is typically 1 to 3 m.

Origin. The Crab Lake Member contains till and associated supraglacial debris-flow sediment and stream sediment. The till of the Crab Lake Member was deposited by the advance of the Ontonagon Lobe into northern Wisconsin.

Age and correlation. The Crab Lake Member was deposited during the last part of the Wisconsin Glaciation. It is younger than the Wildcat Lake and Nashville Members of the Copper Falls Formation and is equivalent to the informally named Morse till in Iron County (Clayton, 1985). It is also equivalent to the sediment in the Winegar moraine in adjacent Michigan described by Peterson (1982). Regional correlation (Clayton and Moran, 1982; Mickelson and others, 1983; Attig and others, 1985) suggests the Crab Lake Member was deposited between about 12,000 and 13,000 years ago.

Description of type section. The type section is a fresh (1981) 2-m-high roadcut. At the base of the section 1.5 m of compact, uniform, bright reddish brown (5YR 5/6) slightly gravelly, sandy, silty, clayey till crops out. This till contains a well developed pebble fabric indicating ice flow from the north. The till is overlain by 0.5 m of poorly compacted, variable bright reddish brown (5YR 5/6) to reddish brown (5YR 4/6), gravelly, sandy, silty, clayey till debris-flow sediment.

Description of reference section. The reference section is a fresh (1982) 3.5 m high exposure in a gravel pit. The lower 1.0 m consists of stratified coarse and fine sand. This material is overlain by 1.0 to 1.5 m of compact, uniform, bright reddish brown (5YR 5/6) slightly gravelly, sandy, silty, clayey till. The till contains a well developed pebble fabric indicating ice flow from the north. It also contains a 10-cm-thick bank of fine reddish brown (5YR 5/6) sand that has been deformed. The upper 1 m of the exposure consists of poorly compacted, variable bright reddish brown (5YR 5/6) to reddish brown (5YR 4/6), gravelly, sandy-loam debris-flow sediment. The pebble fabric in this upper unit is poorly developed and not related to regional ice flow.

Previous usage. This member name has been used by Attig (1984, 1985) and Attig and others (1985).◆

KEWAUNEE FORMATION

Florence Member of the Kewaunee Formation

Lee Clayton

Source of name. Florence County, Wisconsin.

Location of type section. An auger hole at the southwest corner of sec. 2, T. 38 N., R. 18 E., Florence County, Wisconsin, shown on the Iron Mountain SW Quadrangle, Wisconsin-Michigan (U.S. Geological Survey, 7.5-minute series, topographic, 1962; fig. 30).

Description of unit. The Florence Member is reddish brown (2.5YR 4/4 on the Munsell scale) and is unbedded. It consists of about 1 percent gravel, and samples from the less-than-2-mm fraction consists of 16 percent sand, 45 percent silt, and 39 percent clay. The till is leached of carbonates to a depth of about 1 m; where the till is unleached, it contains about 10 percent dolomite.

Nature of contacts. The Florence Member is the surface unit in the type area, and it overlies sand of the Horicon Formation. To the east of the type area it appears in several water-well logs beneath till or fluvial sediment of the Silver Cliff Member.

Differentiation from other units. The Florence Member is more clayey than the underlying Horicon Formation and the overlying Silver Cliff Member but is similar to the Kirby Lake Member, which overlies the Silver Cliff.

Regional extent and thickness. The unit occurs at the surface in about 25 km^2 of east-central Florence County, in one patch south of the community of Florence, and in one patch west of the community of Homestead, where it is between 8 and 12 m thick. It probably occurs in the subsurface to the north, east, and south, but its extent is unknown.

Origin. It is interpreted to be till deposited during the middle Mountain Advance of the Green Bay Lobe.

Age and correlation. The unit was deposited about 13,000 years ago. Correlation outside Florence County is uncertain. No member of the Kewaunee Formation has previously been defined below the Silver Cliff

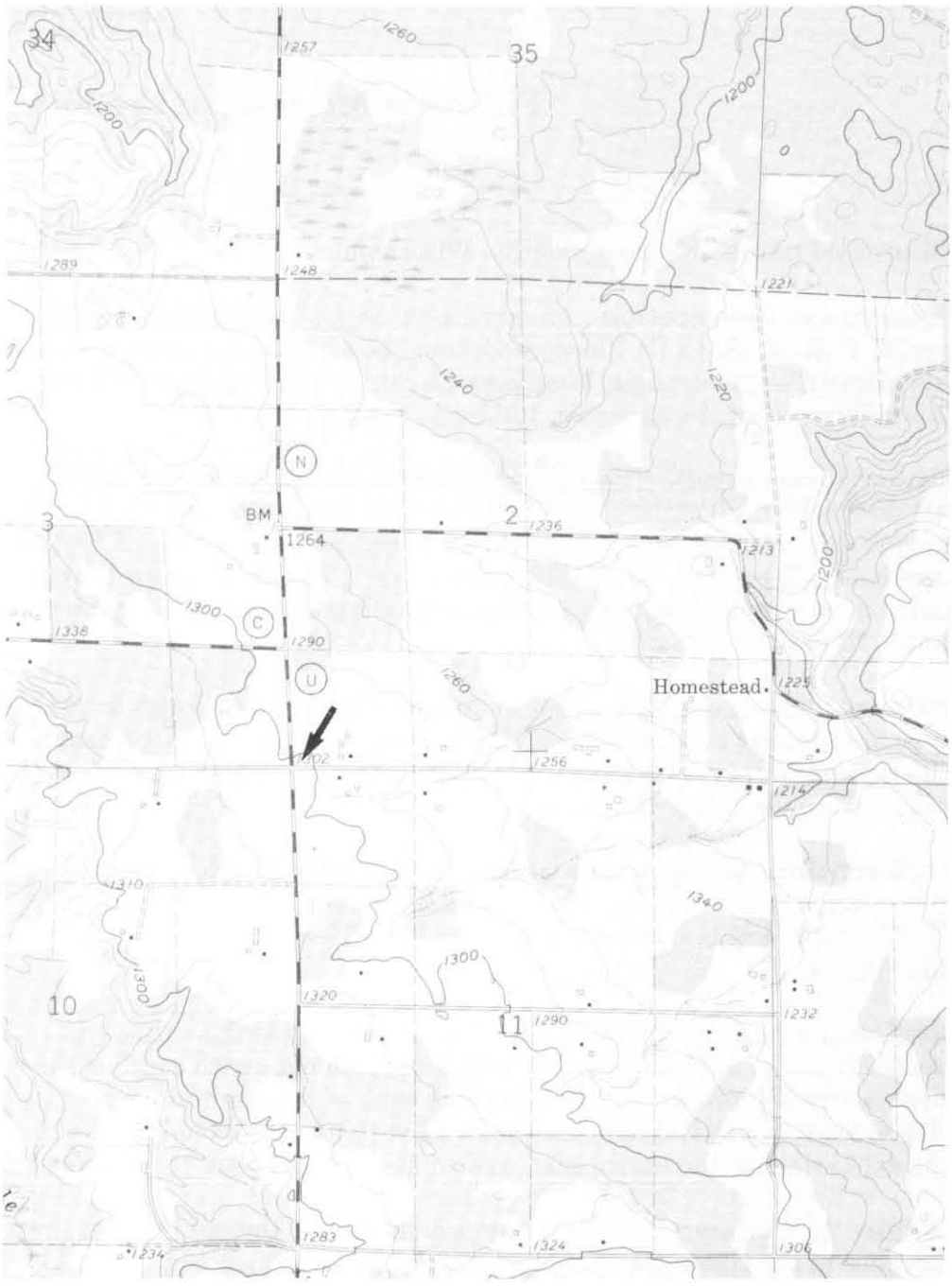

Figure 30. Part of the Iron Mountain SW Quadrangle, Wisconsin-Michigan (U.S. Geological Survey, 7.5-minute series, topographic, 1962), showing the location of the type section for the Florence Member.

Member, but the Silver Cliff has been tentatively correlated with the Ozaukee and Haven Members of southwestern Wisconsin; the Florence might correlate with the Ozaukee. A clayey unit, which might be the

Florence, occurs below the Silver Cliff Member in the Kirby Lake type section in Marinette County (Mickelson and others, 1984, fig. 60).

Description of type section. The type section contains 0 to 10 m of slightly gravelly reddish brown silty clay loam, silty clay, and clay till in addition to 10 to 15 m of sand.

Previous usage. The unit was named and described by Clayton (1986a).◆

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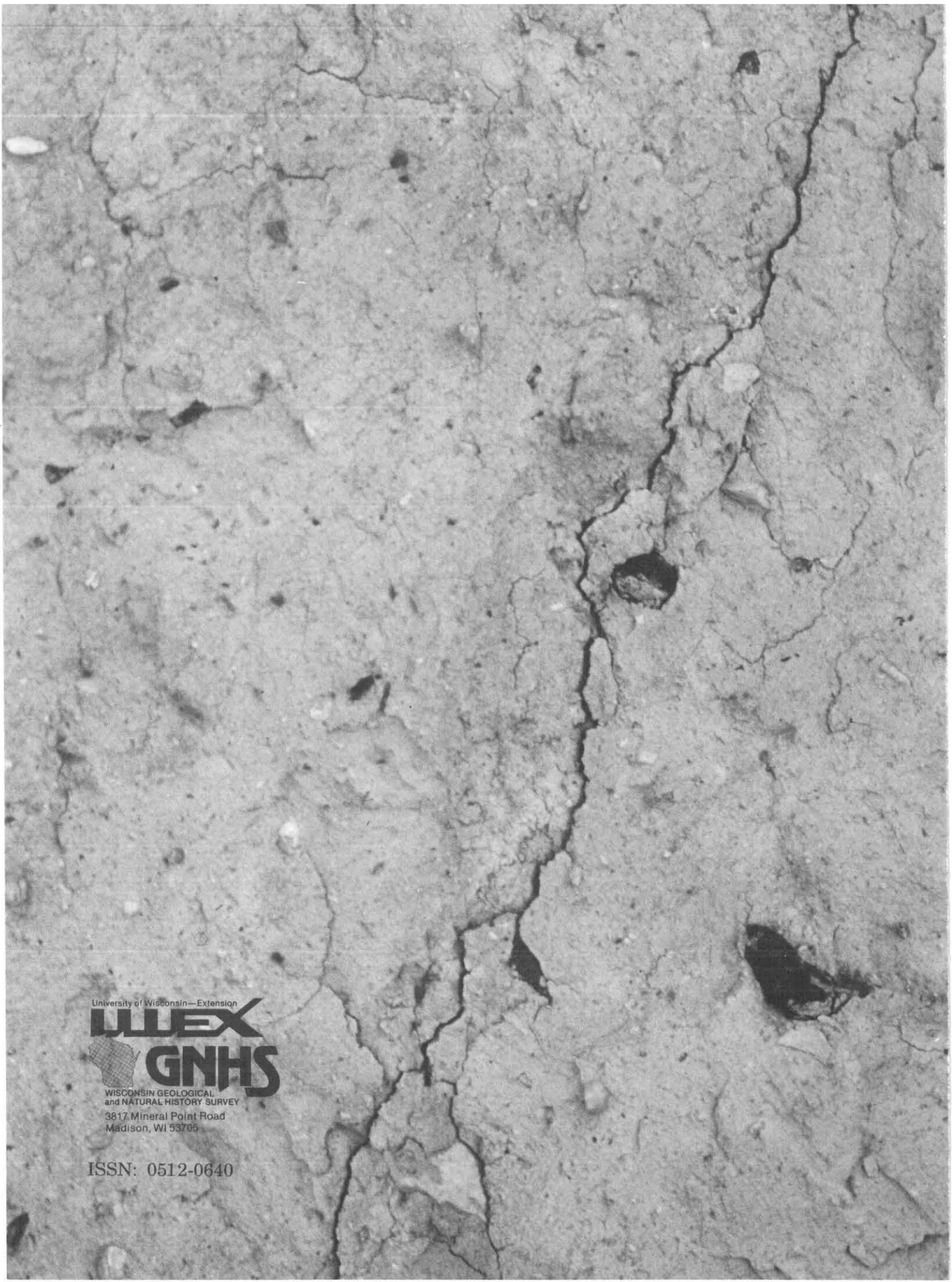

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