Guide to the Geology of the Crystal Lake Area

McHenry County, Illinois

David L. Reinertsen
Ardith K. Hansel
John M. Masters
John Shiel

Field Trip Guidebook 1993C September 11, 1993

Department of Energy and Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY

Cover photo Sand and gravel processing plant operated by Meyer Material Company north of Algonquin. Photo by D.L. Reinertsen

Geological Science Field Trips The Educational Extension Unit of the Illinois State Geological Survey conducts four free tours each year to acquaint the public with the rocks, mineral resources, and landscapes of various regions of the state and the geological processes that have led to their origin. Each field trip is an all-day excursion through one or more Illinois counties. Frequent stops are made to explore interesting phenomena, explain processes that shape our environment, discuss principles of earth science, and collect rocks and fossils. People of all ages and interests are welcome. The trips are especially helpful to teachers preparing earth science units. Grade school students are welcome, but each must be accompanied by a parent or guardian. High school science classes should be supervised by at least one adult for each ten students.

Field trip guide booklets are available for planning class tours and private outings. For a list, contact the Educational Extension Unit, Illinois State Geological Survey, Natural Resources Building, 615 East Peabody Drive, Champaign, IL 61820. Call (217) 333-4747 or 244-2427.

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ILLINOIS STATE GEOLOGICAL SURVEY
Morris W. Leighton, Chief
Natural Resources Building
615 East Peabody Drive
Champaign, Illinois 61820-6964

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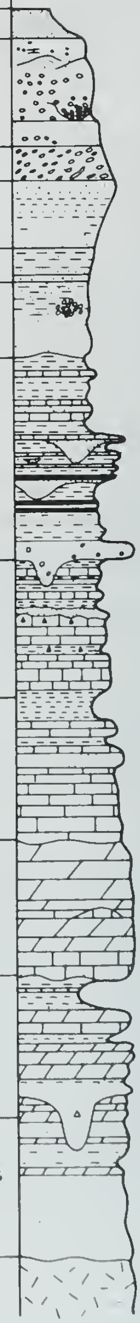
FIGURES

Era		Period or System and Thickness	Epoch	Age (years ago)	General Types of Rocks
CENOZOIC "Recent Life"	Age of Mammals	Quaternary 0-500'	Holocene	10,000	Recent—alluvium in river valleys
			Pleistocene Glacial Age	10,000 – 1.6 m.	Glacial till, glacial outwash, gravel, sand, silt, lake deposits of clay and silt, loess and sand dunes; covers nearly all of state except northwest corner and southern tip
		Tertiary 0-500'	Pliocene	1.6 m. – 5.3 m.	Chert gravel, present in northern, southern, and western Illinois
			Eocene	36.6 m. – 57.8 m.	Mostly micaceous sand with some silt and clay; present only in southern Illinois
			Paleocene	57.8 m. – 66.4 m.	Mostly clay, little sand; present only in southern Illinois
MESOZOIC "Middle Life"	Age of Reptiles	Cretaceous 0-300'		66.4 m. – 144 m.	Mostly sand, some thin beds of clay and, locally, gravel; present only in southern Illinois
PALEOZOIC "Ancient Life"	Age of Amphibians and Early Plants	Pennsylvanian 0-3,000' ("Coal Measures")		286 m. – 320 m.	Largely shale and sandstone with beds of coal, limestone, and clay
		Mississippian 0-3,500'		320 m. – 360 m.	Black and gray shale at base; middle zone of thick limestone that grades to siltstone, chert, and shale, upper zone of interbedded sandstone, shale, and limestone
	Age of Fishes	Devonian 0-1,500'		360 m. – 408 m.	Thick limestone, minor sandstones and shales; largely chert and cherty limestone in southern Illinois; black shale at top
	Age of Invertebrates	Silurian 0-1,000'		408 m. – 438 m.	Principally dolomite and limestone
		Ordovician 500-2,000'		438 m. – 505 m.	Largely dolomite and limestone but contains sandstone, shale, and siltstone formations
		Cambrian 1,500-3,000'		505 m. – 570 m.	Chiefly sandstones with some dolomite and shale; exposed only in small areas in north-central Illinois
ARCHEOZOIC and PROTEROZOIC				570 m.	Igneous and metamorphic rocks; known in Illinois only from deep wells



~~~~ major unconformity

Generalized geologic column showing succession of rocks in Illinois.
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CRYSTAL LAKE AREA

General Setting and History

The field trip area in northeastern Illinois is located some 4 to 23 miles south of the Illinois–Wisconsin state line and about 45 miles northwest of the Chicago Loop. During the early post-World War II years, most communities in McHenry County did not grow as rapidly as did those closer to Chicago. For many years, the Fox River seemed to be a natural barrier to westward expansion of population and industry. Only those communities situated along its western shore grew and prospered. East of the river, however, towns, cities, and counties within relatively easy commuting distance of downtown Chicago became ideal residential localities, known as "bedroom communities." Several towns in the eastern part of McHenry County also fell within this category and nearly doubled their population from the late 1940s to the late 1960s. Since then, not only communities, but also country living has been rapidly expanding.

McHenry County planners were aware by the mid-1960s that they were faced with many of the same environmental problems that the bedroom communities had already confronted, in some cases none too easily. Although the suburban communities had resolved some land-use problems, other problems, such as the interrelationships between the mineral resources of the area, urban sprawl, and waste disposal, were not easily understood. Recognizing that uncontrolled development and population growth would severely stress the economic and natural assets of the area, the McHenry County Regional Planning Commission turned to the Illinois State Geological Survey for assistance in planning for future development.

Two ISGS scientists, J.E. Hackett and M.R. McComas, conducted basic studies of the physical environment and developed an inventory of the natural resources to provide the factual base.The scientists published the results of their work, *Geology for Planning in McHenry County* (ISGS Circular 438), in 1969. They believed that to interpret the collected geologic data properly, researchers and the planning commission must follow a sequential plan, including

> ...(1) detailed surficial mapping and subsurface study, correlated with soil mapping and supported by laboratory analysis, to differentiate all geologic units on the basis of composition and physical properties; (2) evaluation of geologic units in terms of their mineral-resource, engineering, and hydrologic properties; (3) preparation of interpretative maps in which areas are graded for specific land uses; and (4) analysis of terrains in which land units are differentiated on the basis of physiography and earth materials and evaluated in terms of their suitability for various land uses. The data developed in the course of these studies are adequate to establish patterns and relationships among the mineral- and hydrologic-resource factors for application to a regional plan. Individual site or local area plans require more intensive, larger scale investigations, generally involving on-site collection of subsurface data from controlled drilling.

This work was the first of a series of geology-for-planning studies published during the 1970s under the ISGS Environmental Geology Program. The basic procedures that Hackett and McComas developed have undergone numerous refinements, but are still in use today. The ISGS coined the phrase "environmental geology."

Bedrock

Throughout hundreds of millions of years, the McHenry County area has undergone many changes. The ancient Precambrian *basement** comprises granitic igneous, and possibly *metamorphic*, crystalline rocks. The basement lies deeply buried beneath younger *sedimentary* strata

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*Words in *italics* are defined in the glossary at the back of the guidebook. Also please note: although McHenry County, Illinois, and all present localities have only recently appeared within the geologic time frame, we use the present names of places and geologic features because they provide clear reference points for describing the ancient landscape.

(layers) that range in thickness from 2,700 feet in the northwestern part of McHenry County to 3,200 feet in the southeastern part. These sedimentary rocks, deposited in shallow seas that repeatedly covered this part of the continent during the Paleozoic *Era*, range in age from about 523 million to nearly 408 million years old, corresponding to the Cambrian through Silurian *Periods* (fig. 1).

Silurian *dolomite*, which occurs in patches beneath the unlithified surficial materials in the field trip area, crops out in the southwestern part of McHenry County near Garden Prairie, where it was once quarried for crushed stone. Fossiliferous strata of the Maquoketa Shale Group of Ordovician

SYSTEM OR SERIES	Hydrogeologic units and thickness	Graphic log	Rock type	Water-yielding characteristics
PLEISTOCENE	Drift (0 – 400')		Unconsolidated glacial deposits, loess and alluvium	Water yields variable, largest from thick outwash deposits in western part of county
SILURIAN	Niagaran-Alexandrian (0 – 100')		Dolomite, very pure to very silty; cherty; shale partings toward base	Yields moderate to large supplies where creviced and overlain by permeable sand and gravel. Productivity lessens with thinning of dolomite and thickening of shale
ORDOVICIAN	Maquoketa (0 – 200')		Shale, green and blue with limestone and dolomite beds	Yields small to moderate supplies from dolomite and fractured shale
	Galena-Platteville (0 – 300')		Dolomite, with shale in middle, limestone and chert in lower part	Yields moderate to large supplies only in areas where not overlain by Maquoketa, as near Union and Marengo
	Glenwood-St. Peter (200 – 350')		Sandstone, fine- to coarse-grained; shale at top; locally cherty, red shale at base	Yields small to moderate quantities of water
	Prairie du Chien (100'±)		Dolomite, sandy, cherty, interbedded with sandstone	Yields small amounts of water from sandstone and crevices in dolomite
CAMBRIAN	Eminence-Potosi Franconia (200'±)		Dolomite, white, fine-grained Sandstone, fine- to medium-grained	Yields small amounts of water from crevices in dolomite and sandstone
	Ironton-Galesville (100 – 300')		Sandstone, fine- to medium-grained, well sorted	Most productive aquifer in Cambrian-Ordovician Systems; can yield large supplies of water
	Eau Claire (200 – 450')		Shale and siltstone, dolomitic	Shales generally not water-yielding; acts as confining layer at base of Cambrian-Ordovician aquifer system
	Mt. Simon (275' in NW to 950' in SE)		Sandstone, coarse grained, lenses of shale and siltstone	Yields moderate amounts of water; water quality generally good within McHenry County, but deteriorates with depth
PRECAMBRIAN			Granite, red	Not water-yielding

Figure 1 Generalized column of rock formations in McHenry County.

age are exposed under the Silurian dolomite in the quarry and at the *bedrock* surface, wherever the overlying Silurian dolomite is absent (fig. 2). Younger Paleozoic sedimentary rocks, known from outcrops 60 to 70 miles to the south and from subsurface data near Des Plaines about 27 miles to the southeast, may well have been deposited across this region. However, during the nearly 245 million years between the close of the Paleozoic Era and the beginning of the Pleistocene nearly 2 million years ago, there has been ample time to erode perhaps thousands of feet of sedimentary strata from the region and remove all traces of their presence. Indirect evidence from the rank of coal beds and the generation of petroleum from source rocks in the Illinois Basin suggests that a thickness of no more than about 1 mile of latest Paleozoic and younger rocks was ever deposited in northern Illinois.

Structure

Bedrock strata in this area dip very gently (a few feet per mile) to the southeast away from the Wisconsin Arch onto the Kankakee Arch, a broad northwest- to southeast-trending structural feature that connects the Wisconsin and Cincinnati Arches (fig. 3). The Kankakee Arch separates two broad structural basins—the Michigan Basin to the northeast and the Illinois Basin (fig. 4) to the southwest. The slope, considerably less than a 1° dip, is imperceptible to the naked eye (although you could see it if there were a very long, open outcrop). Nearby in northern Illinois are local areas where the rocks have been folded and/or *faulted* into steeper attitudes. Because tilting of the bedrock layers took place several times during the Paleozoic Era, the dips of successive strata are not parallel.

Glacial History

A brief general history of glaciation in North America and a description of the deposits commonly left by glaciers may be found in *Pleistocene Glaciations in Illinois* in the appendix at the back of the guide booklet.

In the field trip area, erosion took place long before glaciers advanced across the region that is now Illinois and carved a network of deep valleys into the bedrock surface. The drainage divide between Lake Michigan (flowing toward the Atlantic Ocean) and the Mississippi River (flowing toward the Gulf of Mexico) extended southwestward from east of Harvard to east of Garden Prairie, where it turned southeastward toward the Elgin area. A bedrock valley trends east–northeast from north of Marengo, where it is buried by 100 to 170 feet of *glacial drift*, toward Fox Lake where the drift is about 200 feet thick. Another bedrock valley trends east–southeast from just south of Marengo toward Algonquin, and then south and east. In this valley, the glacial drift locally ranges from about 300 feet in the west to less than 100 feet in the southeast. Throughout McHenry County, glacial drift is unevenly distributed, partly because of the irregular bedrock surface and partly because of erosion. It ranges from more than 400 feet thick in the northwest to less than 25 feet in the southwest. In the field trip area, thicknesses range from slightly more than 300 feet in the north to somewhat less than 100 feet in the south near Fox River.

Beginning about 1.6 million years ago during the Pleistocene Epoch, massive sheets of ice hundreds of feet thick flowed slowly southward from Canada. The ice sheets, called continental glaciers, covered Illinois several times during the Pleistocene Epoch. The last of the ice melted from northeastern Illinois about 13,500 years before the present (B.P.). During the Illinoian glaciation around 270,000 years B.P., North American continental glaciers reached their southernmost extent, advancing from centers of snow and ice accumulation in Canada as far as the northern part of Johnson County in southern Illinois (about 325 miles south–southwest of the field trip area; see fig. 5). Although the Illinoian glaciers probably built morainic ridges similar to those of the later Wisconsinan glaciers, Illinoian moraines apparently were not so numerous. After exposure to weathering and erosion for thousands of years longer than their younger Wisconsinan counterparts, the older moraines are not as readily discernible.

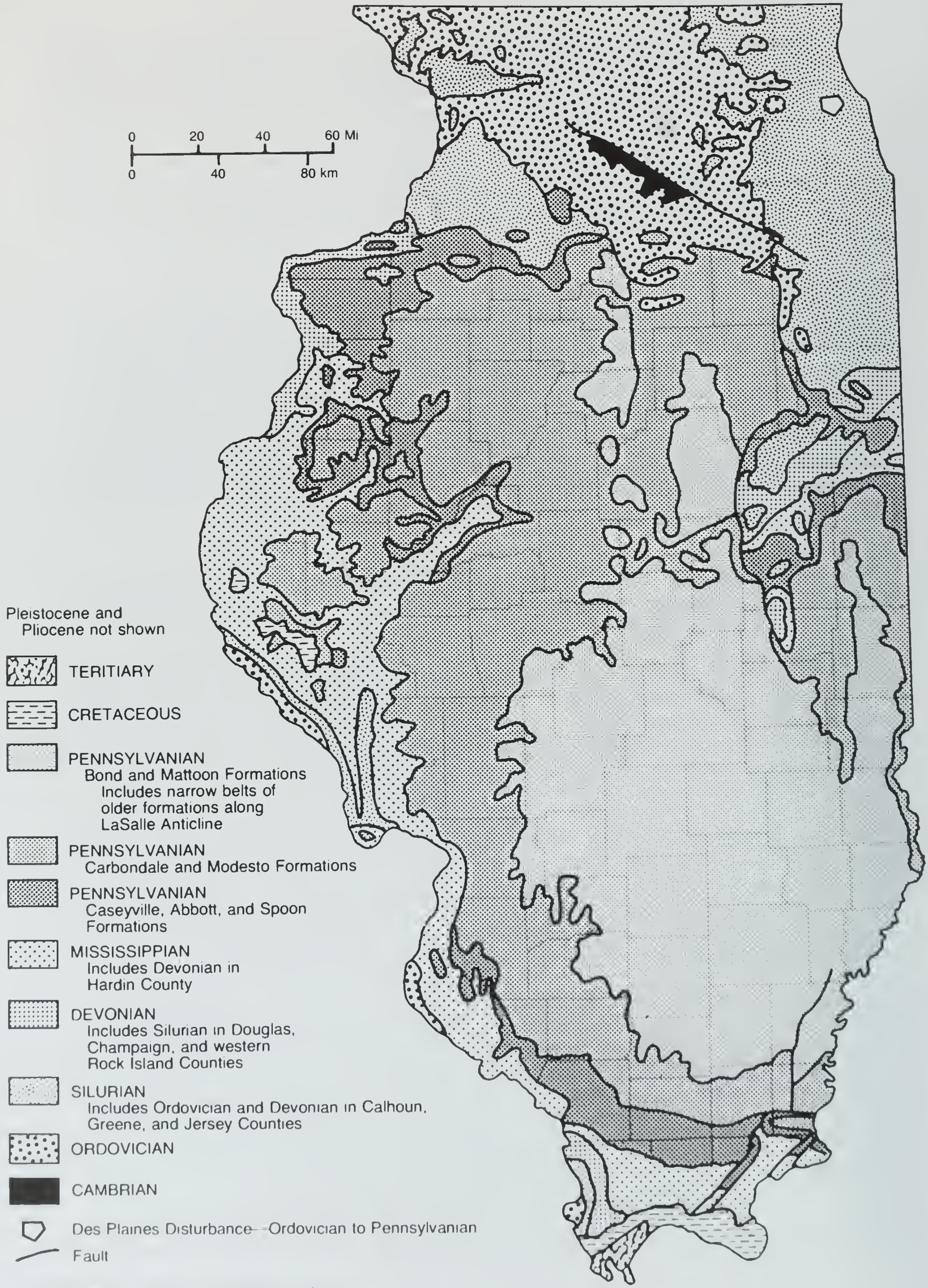


Figure 2 Geologic map of Illinois.

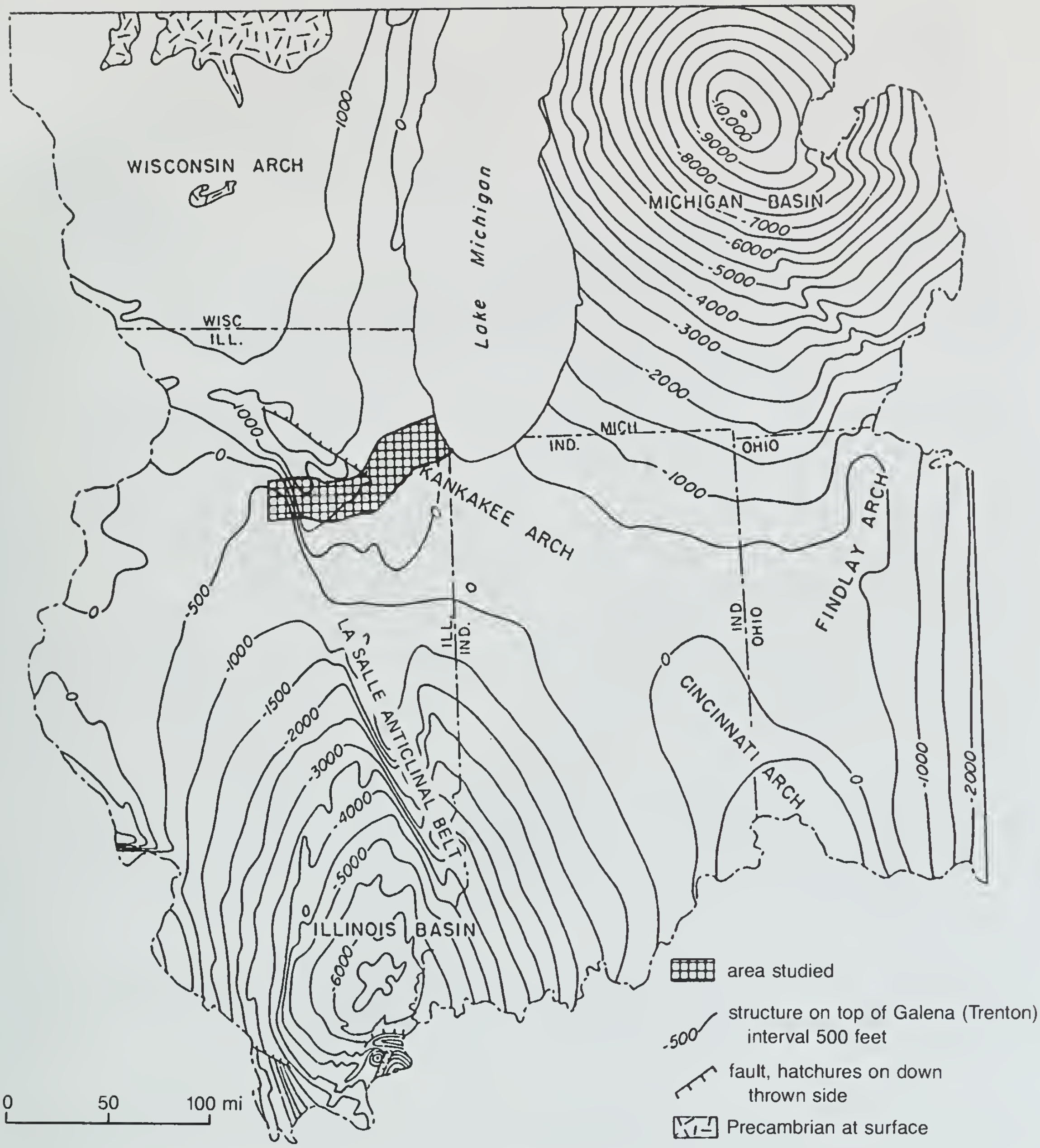


Figure 3 Regional structural features affecting the study area.

Until recently, glaciologists had assumed that ice thicknesses of 1 mile or more were reasonable for these glaciers. However, the ice may have been at most 2,000 feet thick in the Lake Michigan Basin and only about 700 feet thick across most of the land surface. That conclusion is based on several lines of research evidence, including the degree of consolidation and compaction of rock and soil materials that must have been under the ice; comparisons between the inferred geometry and configuration of the ancient ice masses and those of present glaciers and ice caps; comparisons between the mechanics of ice flow in modern glaciers and ice caps and those inferred from detailed studies of the ancient glacial deposits; and the amount of rebound of the Lake Michigan Basin from its depression beneath the mass of glacial ice. The massive ice flows of the different glaciations intensely scoured and removed part of the bedrock surface. Much of the evidence for Illinoian and pre-Illinoian glaciations in the northern part of the state also has been removed by the effects of the subsequent Wisconsinan glaciation. The last major glacial advance occurred

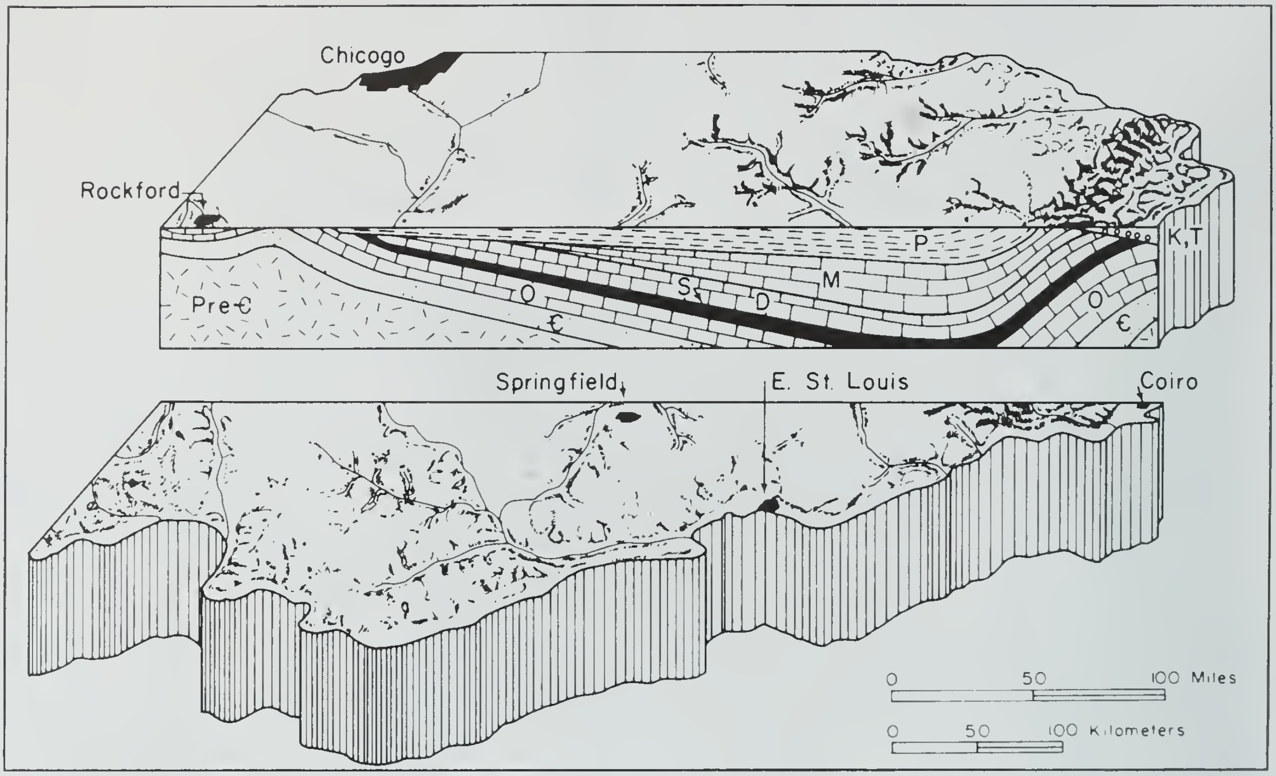


Figure 4 Stylized north-south cross section shows structure of the llinois Basin. To show detail, the thickness of the sedimentary rocks is greatly exaggerated, and the younger, unconsolidated surface deposits have been eliminated. The oldest rocks, Precambrian (Pre-C) granites, form a depression filled with layers of sedimentary rocks of various ages: Cambrian (C), Ordovician (O), Silurian (S), Devonian (D), Mississippian (M), Pennsylvanian (P), Cretaceous (K). and Tertiary (T). The scale is approximate.

during Wisconsinan Woodfordian time about 22,000 years B.P. Ice from an accumulation center in Labrador slowly flowed southward through the Lake Michigan Basin to form the Lake Michigan Glacial Lobe that spread westward and southwestward across northern Illinois. Figure 6 shows the classification of the Pleistocene materials in northeastern Illinois.

That part of the Wisconsinan ice sheet affecting McHenry County is called the Harvard Sublobe, the western edge of which is the Marengo Moraine. This massive ridge extends southward from the Wisconsin border for about 40 miles through the western part of the county. After the moraine formed, the ice front melted eastward an unknown distance before readvancing across part of the area to form another moraine, the Gilberts. As the process was repeated several times, successive moraines (Huntley, Barlina, Woodstock, Cary, and others) formed eastward, producing a layered shingle effect (fig. 7). Irregularities in the bedrock and in the surface topography at least partially controlled successive ice advances.

In many places where the Wisconsinan glaciers scraped across the land, erosion of the earlier glacial deposits was so extensive that only scattered patches of the Illinoian and older drifts remain beneath the younger Wisconsinan drifts. Recent work by ISGS field geologists (Berg et al. 1985, Curry and Krumm 1986, Curry and Follmer 1988, Curry 1988) strongly suggests that the Kane County glacial deposits once thought to be early Wisconsinan in age are actually Illinoian in age. Furthermore, it now appears that no early Wisconsinan glacial drift is present anywhere in Illinois.

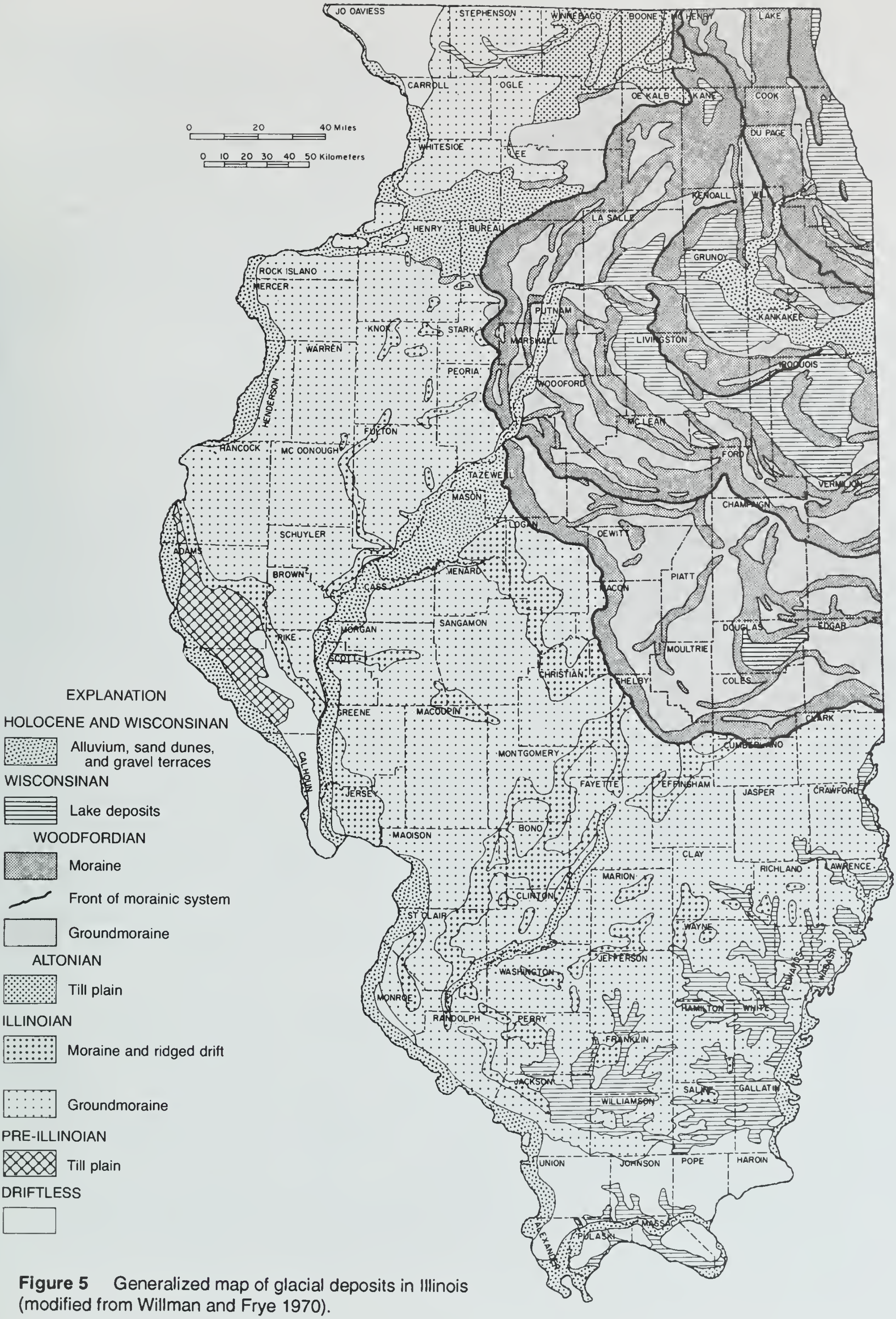


Figure 5 Generalized map of glacial deposits in Illinois (modified from Willman and Frye 1970).

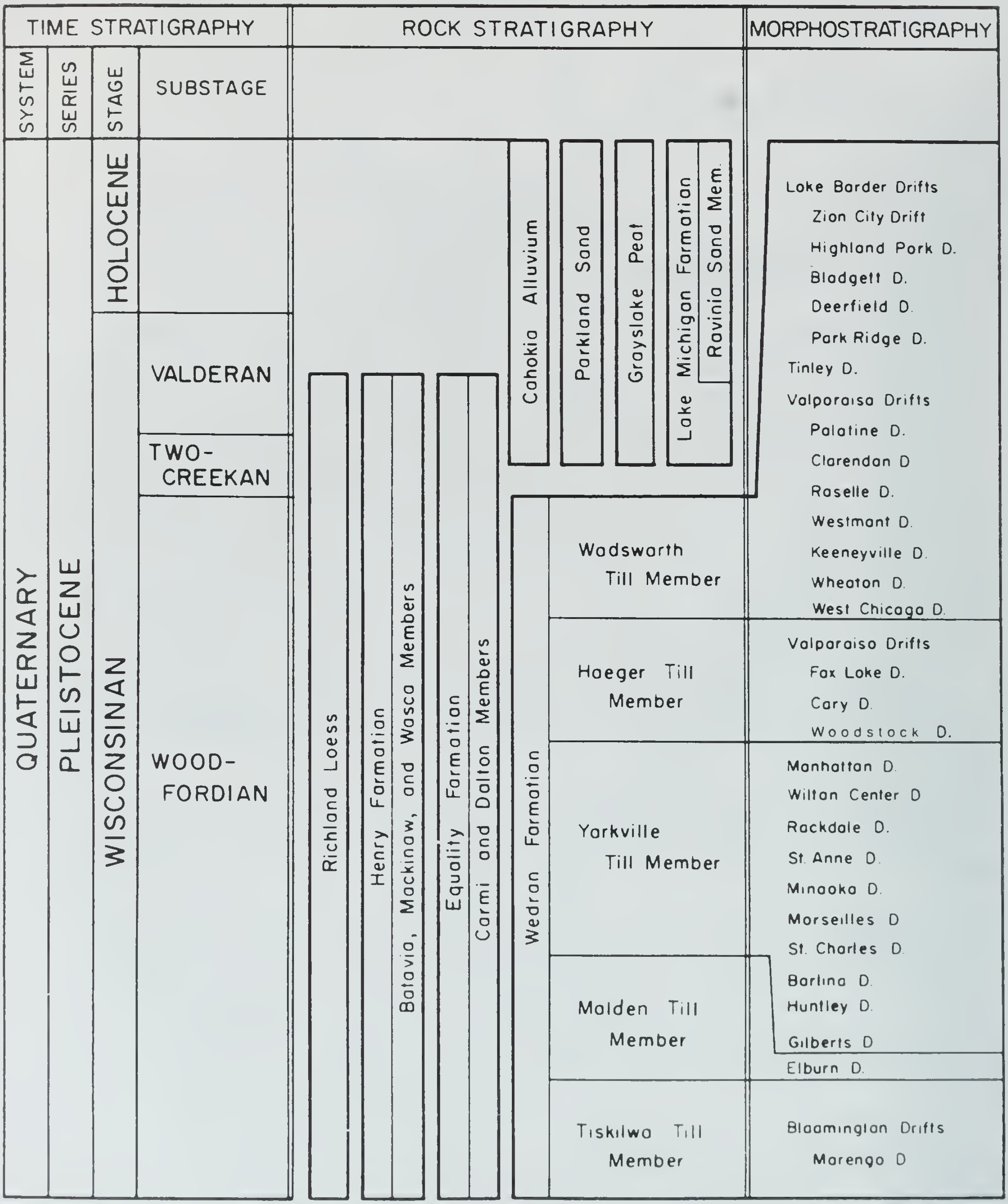


Figure 6 Classification of the Pleistocene rocks of northeastern Illinois (modified from Willman and Frye 1970).

Physiography

The landscape of northeastern Illinois is dominated by the landforms produced by Wisconsinan continental glaciers that flowed west and southwestward out of the Lake Michigan Basin between 22,000 and about 13,500 years ago. The Crystal Lake field trip area lies within the Wheaton Morainal Country in the Great Lake Section of the Central Lowland Province (fig. 8). The Wheaton Morainal Country is distinguished from the Till Plains Section of the Central Lowland Province to the west and south by many pronounced, roughly concentric, discontinuous, morainal ridges surrounding the Lake Michigan basin. Elongated hills, mounds, basins, sags, and valleys that formed in the thick glacial deposits further complicate the details of the regional topography. Various ice-contact and meltwater features, such as kames, kame terraces, kettles, basins, and eskers, although not abundant, occur more frequently here than elsewhere in Illinois. The lakes, marshes, and bogs characteristic of the hummocky topography formed by melting glaciers are common.

Drainage

Drainage in the northern part of the field trip area is through Nippersink, Boone, and Dutch Creeks and their tributaries that flow north and east to the Fox River. In the southern part, smaller creeks and ditches drain south and east toward the Fox River.

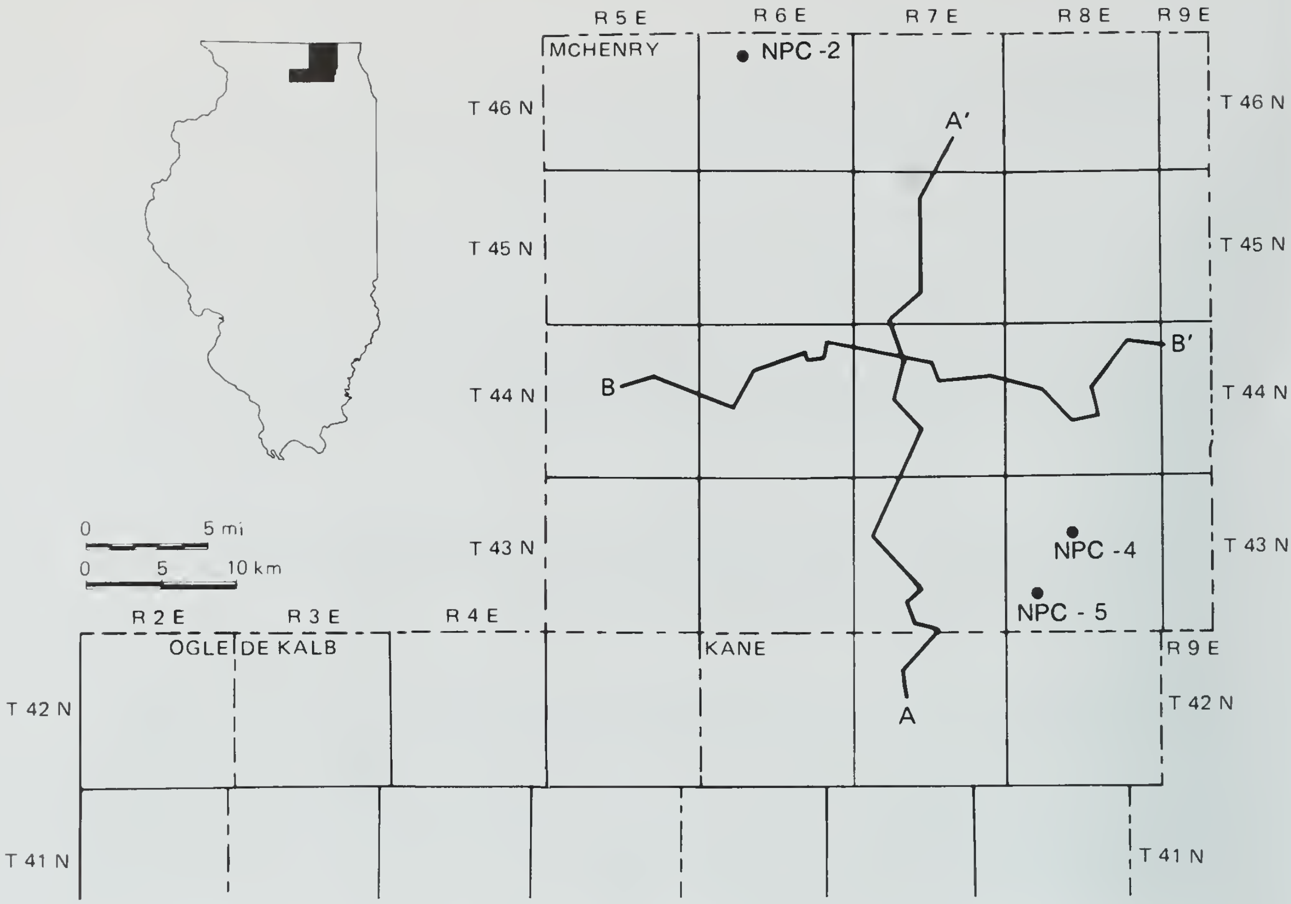
Relief

McHenry County probably has the most rugged topography of the glaciated counties in Illinois. The highest land surface in the Crystal Lake field trip area is slightly more than 950 feet above mean sea level (msl) 0.6 mile west of the Activities Center at Veterans Acres Park; the Activities Center is about 920 feet msl. The lowest elevation is 731 feet msl, which is the normal pool elevation of the Fox River at Algonquin. Therefore, the regional relief (difference in elevation between the highest and lowest surfaces) is approximately 220 feet. Local relief is most pronounced along Fox River and Boone Creek where it is nearly 145 feet.

MINERAL PRODUCTION

Of the 102 counties in Illinois, 98 reported mineral extraction during 1990, the last year for which complete records are available. (Note: stone production is reported for the odd-numbered years, and sand and gravel production is reported for the even-numbered years.) Estimates for the total stone production for 1989 are included in the total value given for mineral production. The total value of all minerals extracted, processed, and manufactured in Illinois during 1990 was $2,915,000,000, a 2.5% increase over the total value recorded in 1989 (Samson 1992). In Illinois, the leading commodity continued to be coal, followed by oil, stone, sand and gravel, and clays. Illinois maintained its lead over other states in production of fluorspar, industrial sand, and tripoli.

In 1990, Illinois ranked fifth in the nation in coal production; 61.7 million tons of coal, valued at $1,709.8 million, was mined. Production of nearly 20 million barrels of crude oil, valued at $406.5 million, placed Illinois 13th among the oil-producing states. The less than 0.7 million cubic feet of natural gas produced in the state during 1990 was valued at nearly $1.5 million. In 1989, the latest year for which data are available, total Illinois stone production was estimated to be 62.7 million tons, valued at $283.1 million; reported tonnage placed Illinois fourth among 48 states reporting production of crushed and broken stone. In the 54 Illinois counties that produced stone, 103 companies operated 178 quarries. Stone is used primarily for construction aggregate, especially as road-base stone, but it is also used in chemical and agricultural production. Illinois ranked seventh in the production of sand and gravel during 1990; total extraction amounted to 32.4 million tons valued at $104.7 million at the pit, equivalent to an average estimated unit value of $3.23 per ton. Because of its relatively low unit price, it is not economical to ship most construction sand and gravel more than about 50 miles from the pit, although operations along navigable



LEGEND FOR FOLLOWING CROSS SECTIONS

Till
Outwash, sand and gravel
Lacustrine, bedded silt and clay
Ice-contact; unsorted sand, gravel, silt and clay; may be stratified, variable
Peat or organic silt
Buried soil, leached or oxidized zone
55500 Well log or boring; number refers to identification number

County abbreviation followed by a number and letter:

McH - McHenry County
Kne - Kane County
Ken - Kendall County
DeK - De Kalb County
Lee - Lee County
Ogl - Ogle County
} highway, bridge or foundation borings

SCS - Soil Conservation Service test hole
S - test borings drilled specifically for this study
JB - test borings drilled specifically for Kendall County study
LW - Landfill Study borings

Unit abbreviations

ri - Richland Loess
h - Henry Formation, undifferentiated
ec - Equality Formation, Carmi Member
c - Cahokia Alluvium
py - Peyton Colluvium
wh - Wedron Formation, Haeger Till Member
wy - Wedron Formation, Yorkville Till Member
wy-m - Wedron Formation, Yorkville Till Member-mixed composition
wm - Wedron Formation, Malden Till Member
wm-m - Wedron Formation, Malden Till Member-mixed composition
wt - Wedron Formation, Tiskilwa Till Member
ot - older till and outwash, undifferentiated
ou - outwash, undifferentiated
ro - Robein Silt
-m - unit mixed with older units
-o - outwash, related to till unit
-l - lacustrine materials related to till unit
-s - supraglacial till
br - bedrock

Boring identification

NPC - Northeastern Illinois Planning Commission test hole
ISGS - Illinois State Geological Survey test hole
NWT - North-west Tollway test hole
EWT - East-west Tollway test hole
12211 - sample set number for water well or test boring

Figure 7 Location map (above) for McHenry County cross sections (right). Cross section A–A' shows Pleistocene materials from central northern McHenry County southward into northern Kane County. Cross section B–B' shows Pleistocene materials from central western McHenry County eastward to the Fox River. Modified from Wickham et al. 1988.

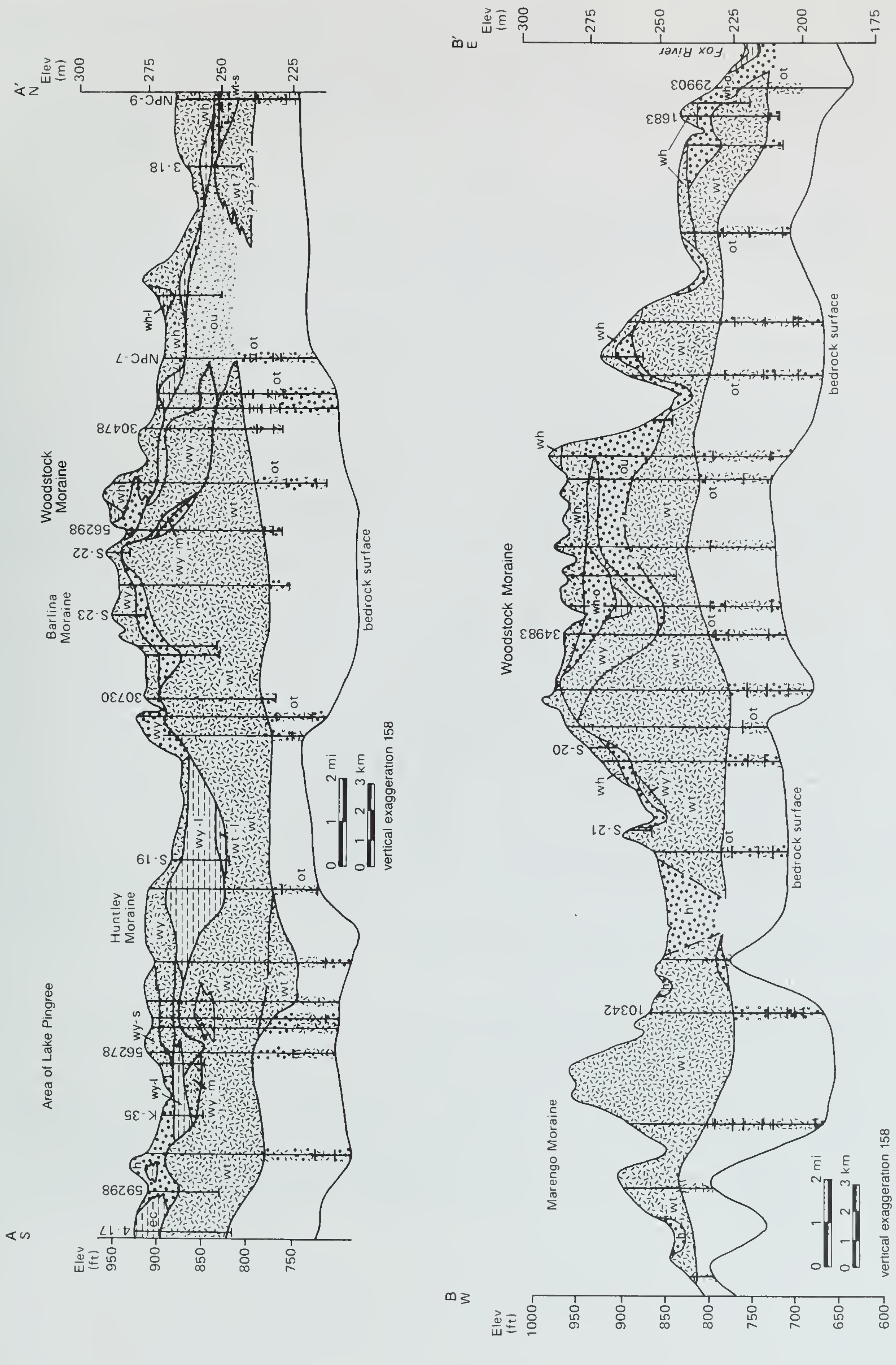

A
S
A′
N
Elev (ft)
Elev (m)
Area of Lake Pingree
Huntley Moraine
Barlina Moraine
Woodstock Moraine
4-17
59298
K-35
56278
S-19
30730
S-23
S-22
56298
30478
NPC-7
3-18
NPC-9
bedrock surface
vertical exaggeration 158
2 mi
3 km
B
W
B′
E
Marengo Moraine
Woodstock Moraine
10342
S-21
S-20
34983
1683
29903
Fox River
bedrock surface
vertical exaggeration 158
2 mi
3 km

Figure 8 Physiographic divisions of Illinois.

rivers may permit shipment for much greater distances. In 1990, 105 companies operated 144 sand and gravel pits at 143 operations in 55 counties.

McHenry County ranked 25th among Illinois counties in the value of its mineral production, although sand and gravel was the only mineral commodity produced here during 1990. Construction sand and gravel sources are found mainly in glacial deposits, chiefly *valley trains* and *outwash* plains. For reporting purposes, the state has been divided into four districts. The northernmost District 1 comprises 16 producing counties, of which McHenry, Kane, Lake, and Du Page accounted for more than 53.7% of the state's production of sand and gravel during 1990. McHenry County ranked first among the 16 counties producing in District 1. Meyer Material Company at McHenry ranked sixth among U.S. sand and gravel plants, but first among those in Illinois. The Vulcan Materials Company's plant at Crystal Lake ranked 12th nationally and second in Illinois (Samson 1992).

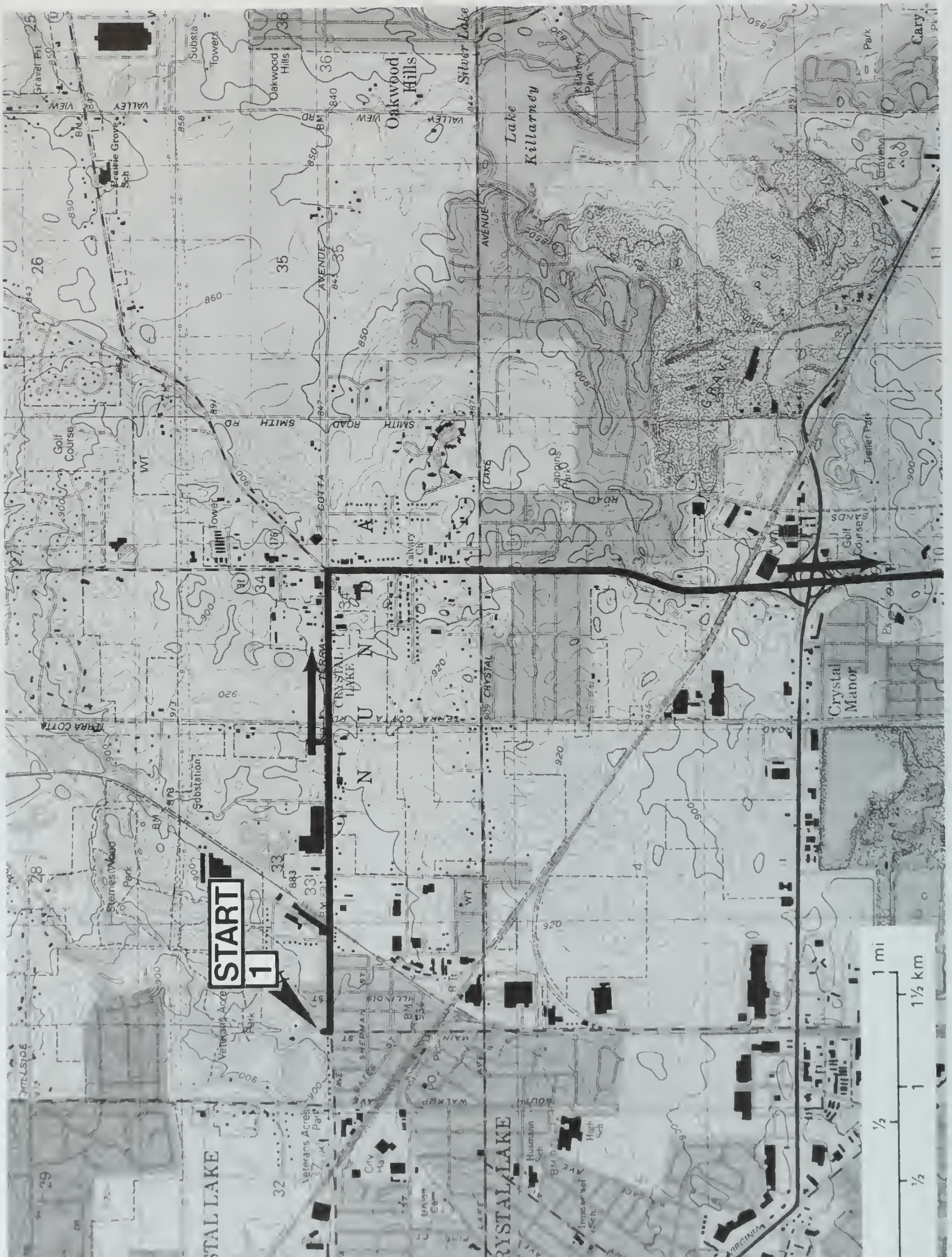
GROUNDWATER

Groundwater is a mineral resource frequently overlooked in assessing the natural resource potential of an area. The availability of this mineral resource is essential for orderly economic and community development. More than 48% of the state's 11 million citizens depend on groundwater for their water supply.

Groundwater is derived from underground formations called aquifers, located in the zone of saturation. An aquifer is a body of water-bearing materials porous and permeable enough to release usable quantities of water into an open well or spring. The water-yielding capacity of an aquifer can only be evaluated by constructing wells into it. After construction, the wells are pumped to determine the quality and quantity of groundwater available for use.

Aquifers occur as deep as 2,000 feet under McHenry County and are the sources of water supply for municipal, industrial, and agricultural purposes. County wells tap into three types of water-yielding deposits: (1) sand and gravel aquifers in the glacial drift, (2) shallow dolomite bedrock aquifers less than 300 feet below the surface, and (3) deep sandstone aquifers, generally more than 500 feet below the surface. Sand and gravel aquifers in the glacial outwash deposits occur throughout the county, but they are not evenly distributed. The aquifers are particularly thick, highly permeable, and extensive along the major drainageways. The water-yielding potential of the underlying shallow Ordovician dolomite bedrock is affected by its thickness and the extent of its fracturing. Wells may be drilled to any or all three of the deep sandstone aquifers: the Ordovician Glenwood–St. Peter, Cambrian Ironton–Galesville (most productive), and Mt. Simon.

Data on available groundwater sources in the county indicate that not only are the glacial sand and gravel deposits the most productive and accessible of the various systems, but they also have a high natural recharge rate because they extend to the land surface in many areas. These shallow sand and gravel aquifers also have a high potential for artificial recharging. Aquifers, especially those exposed at the surface or overlain by very thin cover, are susceptible to pollution from agricultural and urban land use and waste-disposal activities. Increased irrigation from shallow aquifers in areas of thick surficial sands and gravels in combination with heavy fertilizer applications can lead to degradation of these aquifers. As Hackett and McComas noted in ISGS Circular 438 (1969, p. 14), "The development pattern of the region with the associated elements of land drainage, storm-water drainage, septic-system disposal, land-fill waste disposal, etc., can be a significant factor in the deterioration of the prime groundwater resource areas. If development is allowed to proceed without consideration of the measures required for protection, progressive deterioration and eventual loss of the resources will result."


START
1
CRYSTAL LAKE
Crystal Manor
Oakwood Hills
Lake Killarney
Silver Lake
Cary
1 mi
1½ km

GUIDE TO THE ROUTE

Line up heading south in the parking lot of Veterans Acres Park, 330 North Main Street, Crystal Lake (E edge SE SE SE NE, Section 32, T44N, R8E, 3rd P.M., McHenry County; Crystal Lake 7.5-Minute Quadrangle [42088B3]*).

You must travel in the caravan. *Do not drive ahead of the caravan!* Please keep your headlights on while in the caravan. Drive safely but stay as close as you can to the car in front of you. Please obey all traffic signs. If the road crossing is protected by an emergency vehicle with flashing lights and flags, then obey the signals of the ISGS staff directing traffic. When we stop, park as close as possible to the car in front of you and turn off your lights.

Some stops on the field trip are on private property. The owners have graciously given us permission to visit on the day of the field trip only. Please conduct yourselves as guests and obey all instructions from the trip leaders. So that we may be welcome to return on future field trips, please do not litter or climb on fences. Leave all gates as you found them. These simple rules of courtesy also apply to public property. If you use this booklet for a field trip with your students, youth group, or family, you must (because of trespass laws and liability constraints) get permission from property owners or their agents before entering private property.

STOP 1 Veterans Acres Park: we'll view some glacial features and the vegetation. Assemble near the Activities Building at the north end of the parking area.

The large depression west of the parking lot is a "kettle" that resulted from the slow melting of a large block of glacial ice that became buried in debris of the melting glacier. As melting progressed, the surrounding materials gradually collapsed into the depression. This kettle is deep enough to intersect the groundwater surface, so it has a perennial pond at the bottom. Maps indicate that the pond is about 600 feet long from northwest to southeast and about 400 feet at right angles to that orientation. Depending on rainfall and the height of the groundwater surface, the pond may spread an additional 100 feet or more. To get some idea of the size of this kettle, use the 900-foot contour, the easiest contour line to identify on the route map (Terra Cotta Avenue on the south and 15 feet or so below the Activities Center on the east side of the depression). The kettle is more than 25 feet deep and 0.5 mile long from roughly north to south and 0.2 mile wide from roughly east to west. The northern part of this kettle is not as deep as the southern part and does not intersect the groundwater surface.

This type of feature, along with kames, eskers, and end moraines, forms near the margin of glaciers that are wasting back. Likely, this part of the glacier had ceased to flow; otherwise, these landforms would have been destroyed.

A short walk to the east and north from the Activities Center will take you into some smaller kettles. Boulders are scattered throughout the area. Look at the large boulder near the Center. What kind of rock is it? On this walk, you can see quite a number of wild flowers during the warmer seasons of the year. Do you see much evidence of animals? What kinds?

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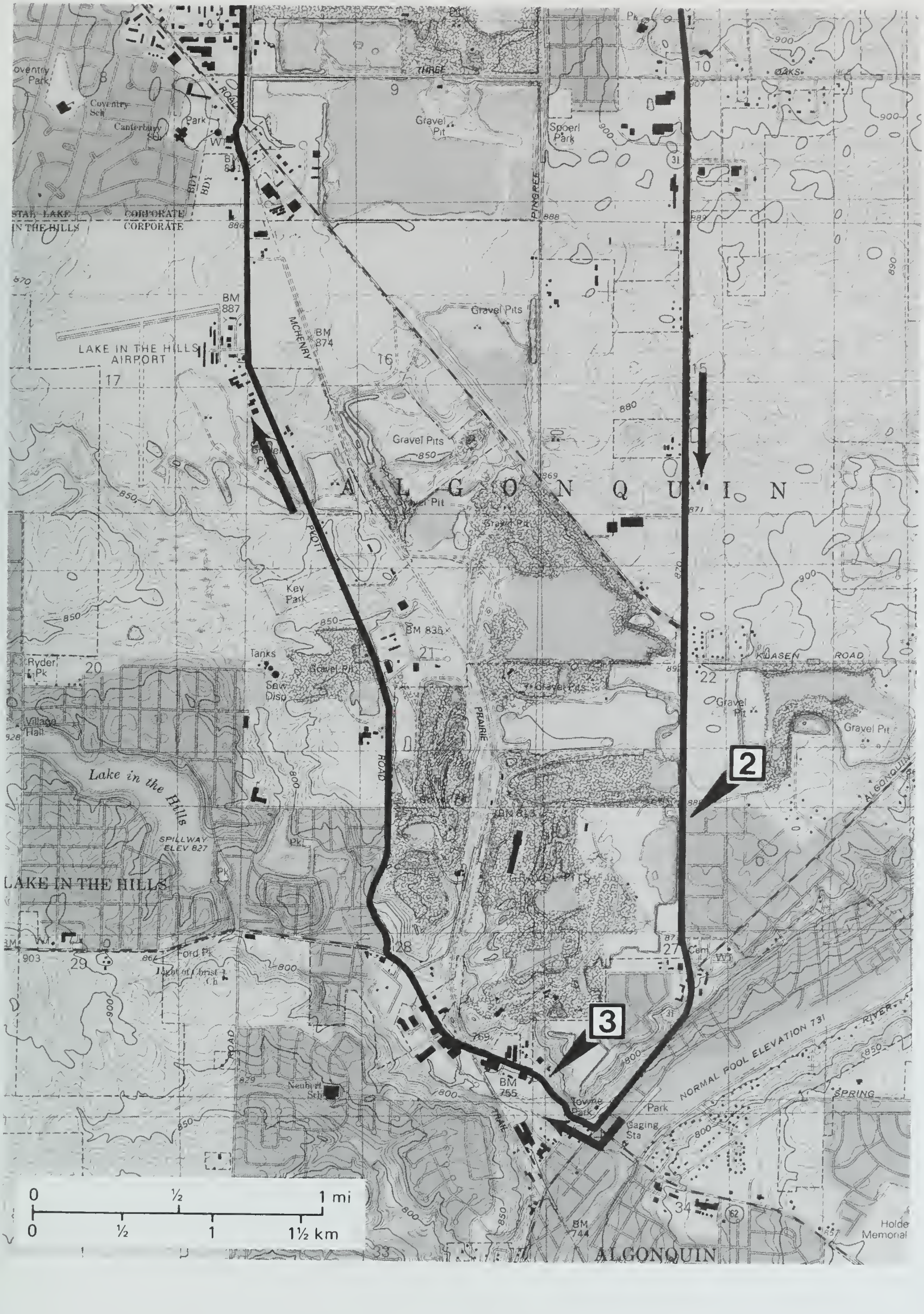
* The number in brackets [42088B3] after the topographic map name is the code assigned to that map as part of the National Mapping Program. The state is divided into 1°blocks of latitude and longitude. The first two numbers refer to the latitude of the southeast corner of the block; the next three numbers designate the longitude. The blocks are divided into sixty-four 7.5-minute quadrangles; the letter refers to the east-west row from the bottom and the last digit refers to the north-south column from the right.

Miles to next point	Miles from start	
0.0	0.0	Begin calculating mileage at the gate onto Main Street at the southeast corner of the parking lot. TURN RIGHT (south) on Main Street.
0.05	0.05	STOP: 2-way at Terra Cotta Avenue. CAUTION:TURN RIGHT (east).
0.3+	0.35+	CAUTION: single guarded Chicago & Northwestern (C&NW) railroad track.
0.2+	0.6+	Fence posts to the right are constructed of glacial cobbles (erratics).
0.9+	1.5+	CAUTION: stop light at 5-point intersection with State routes (SR) 31 and 176. TURN RIGHT (south) on SR 31.
0.5	2.0+	CAUTION: stop light at Crystal Lake Avenue. CONTINUE AHEAD (south).
0.8+	2.85+	Overpass above C&NW.
0.15	3.0+	CAUTION: Enter US 14 intersection traffic pattern.
0.1+	3.1+	Underpass below US 14. CONTINUE AHEAD (south).
0.45+	3.55+	CAUTION: stop light at Three Oaks Road. CONTINUE AHEAD (south).
1.9+	5.4+	CAUTION: Virginia Road intersection on the right. CONTINUE AHEAD (south).
0.1+	5.55+	Klasen Road on the left. CONTINUE AHEAD (south).
0.1+	5.7	Entrance to Meyer Material Company, Pit 4, to the right. CONTINUE AHEAD (south).
0.15+	5.85+	Entrance to Material Service Corporation sand and gravel pit to the right. CONTINUE AHEAD (south) and prepare to park.
0.2	6.05+	CAUTION: entrance to Meyer Material Company, Pit 2, to the right. CONTINUE AHEAD (south) and PARK off the highway as far as you safely can. Do NOT BLOCK the entrance to this pit. WATCH OUT for trucks entering and leaving this drive. BEWARE of fast traffic on SR 31. ASSEMBLE on the south side of the entrance gate at the break in the foliage.

STOP 2 Meyer Material Company: we'll view the sand and gravel deposit in their Algonquin Pit on the east side of SR 31 (SE, Section 22, T43N, R8E, 3rd P.M., McHenry County; Crystal Lake 7.5-Minute Quadrangle [42088B3]). Meyer's processing plant stands on the west side of SR 31. Our discussion will also include the Fox River drainage (E edge NE NE NE NW, Section 27).

- ***Please follow all directions for reaching the pit*** on the east side of the highway, whether you're approaching in your car or on foot.
- You must have permission to enter this property.
- Stay away from the pit highwalls and equipment. ***Look, but do not touch!*** The highwalls are unstable and a given section could collapse at any time.



ALGONQUIN
LAKE IN THE HILLS AIRPORT
Lake in the Hills
LAKE IN THE HILLS
Gravel Pits
Key Park
Village Hall
Spoerl Park
Coventry Park
Canterbury Sch
Neubert Sch
Towne Park
Gaging Sta
NORMAL POOL ELEVATION 731
SPILLWAY ELEV 827
KLASEN ROAD
PRAIRIE
MCHENRY
PINGREE
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3
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1 mi
0
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1
1½ km

Algonquin Pit The sand and gravel being mined from this pit was carried into this area by glaciers of Woodfordian (late Wisconsinan) age. This deposit is part of an extensive series of outwash deposits that formed along the western margin of the Woodfordian moraines in this part of northeastem Illinois. The material is called outwash because it was flushed out or carried beyond the glacier by meltwater torrents issuing from channels cut into the surface of the glacier, or from tunnels within or beneath the ice. Sometimes the flow was released in great bursts that often created new valleys and water-sculpted landforms. The glacier itself acted as a huge conveyor belt, bringing forward a continuous supply of rock and soil debris that was incorporated into the ice or dragged along beneath the glacier. The source of the debris might be from anywhere along the ice flow path. Some material came from as far north as Canada; some also may have been pushed along in front of the massive ice sheet.

This sand and gravel deposit, classified as the Batavia Member of the Henry Formation, originated when the margin of a northwest-southeast-trending lobe of Woodfordian ice was 1 mile or so northeast of here at the Woodstock Moraine. Glacial meltwater floods spread as they left the ice front and formed braided streams that were overloaded with glacial debris consisting of clay, silt, sand, gravel, cobbles, and boulders. These streams, as they continually shifted their channels back and forth across the outwash fan, deposited and reworked the sand and gravel into relatively thin horizontal beds. The coarse materials fell out fairly close to the ice front along or just beyond the moraine; whereas the finer materials were carried outside of this area. Some of the finest eventually reached the Gulf of Mexico. The outwash plain, formed here of the coarse debris from the Woodstock glacier, is confined to a relatively narrow area of lower land about 2.5 miles wide at a maximum between the older Barlina Moraine to the southwest and the Woodstock Moraine to the northeast and north. As we continue on the route, you will have the opportunity to see more deposits of outwash debris.

This pit was examined by ISGS geologists, Cobb and Fraser (1981), as part of their study of the sedimentology of the heterogeneous mixture of materials in the large outwash plain deposits of sand and gravel in southeastern McHenry and northeastern Kane Counties. They studied the distribution of sand and gravel in the outwash and compared it with modern glacial outwash fans. Their objective was to determine the possibility of predicting the textures and distribution of the various materials in the deposit. These predictions are valuable to pit operators wishing to locate the most desirable type of extractable material, landowners wanting general information about their property in outwash plain areas, and land-use planners needing to allocate land for specific purposes.

Cobb and Fraser noted that different areas of the deposit are characterized by certain combinations of sediments, which include (1) a coarse grained, highly heterogeneous marginal assemblage found on the eastern margin of the outwash deposit (fig. 9); (2) a coarse grained, but somewhat less heterogeneous, proximal assemblage occurring in a band paralleling the marginal assemblage; (3) a relatively finer grained and better sorted medial assemblage occurring in a band paralleling the west edge of the proximal assemblage; and (4) a fine grained distal assemblage found beneath the proximal and medial assemblages (fig. 10).

Our knowledge of these sediments agrees with their model, which indicates in general that the glacier moved into the area from the east and was probably preceded by an extensive erosional event, as regional drainage was diverted around the outer edge of the ice lobe. When the glacier was still some distance away, sediment accumulation began with the deposition of beds of clay, silt, and sand (distal assemblage). Further advancement of the glacier caused the deposition of progressively coarser material and resulted in a coarsening-upward sequence of sediments (medial, proximal, and marginal assemblages).

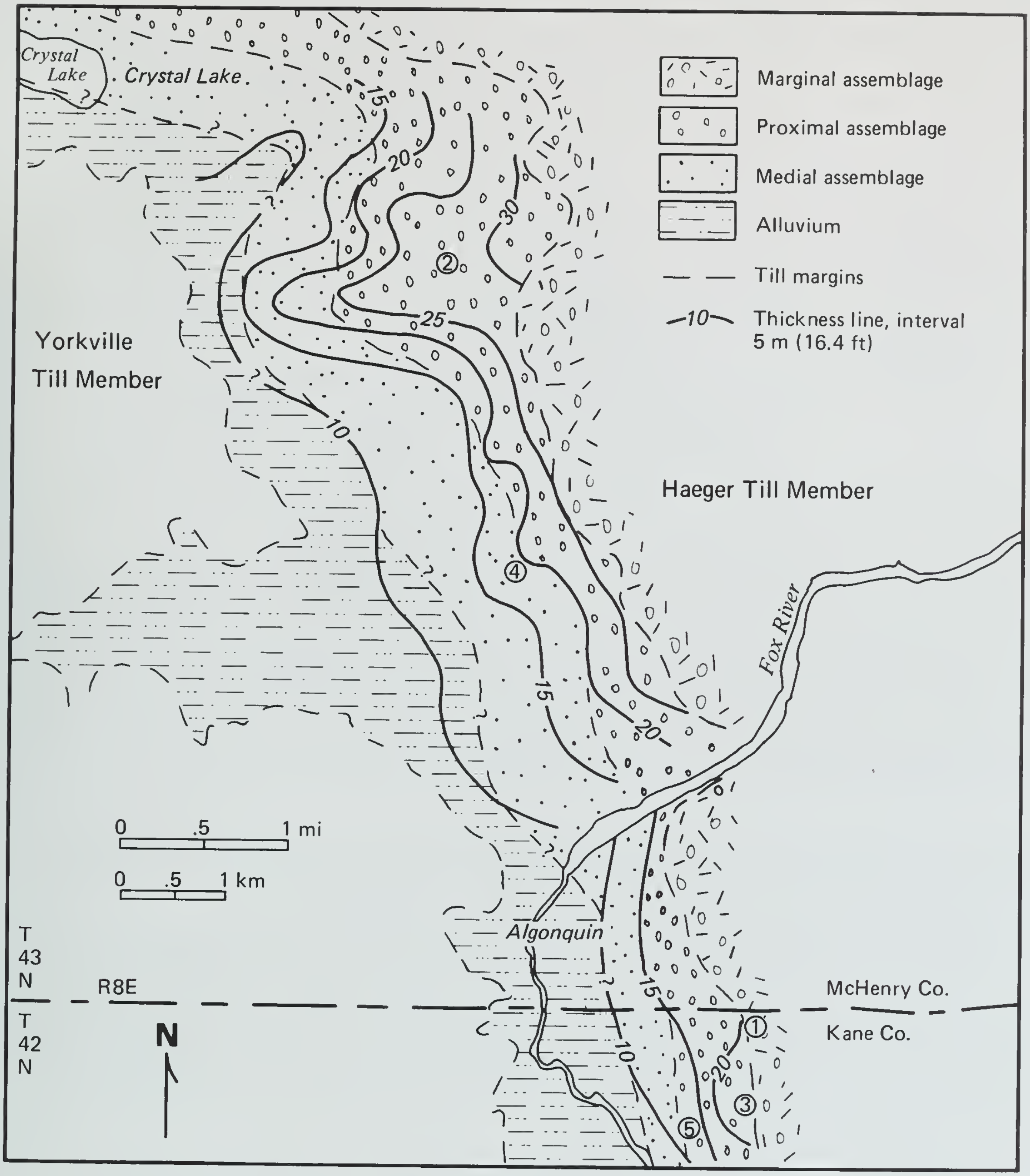


Figure 9 Distribution of outwash assemblages in McHenry County (from Cobb and Fraser 1981).

This sand and gravel deposit, a chief source of aggregate for construction materials in the Chicago metropolitan area, has been mined for many years. Sand and gravel from this pit has been excavated mainly from above the water table after about 5 feet of soil and fine grained clayey overburden has been removed from the top of the exposure. Material is scooped by front-end loaders from the base of a face 20 to 40 feet high and then carried to a nearby primary jaw crusher. A conveyor belt then carries the product under the highway (SR 31) to the processing plant located in a previously worked part of the deposit. Several years ago, a large field of boulders lay near to where the jaw crusher stands. The jaw crusher in use then was not large enough to break any of those boulders. The new crusher has larger jaws and it has been able to handle

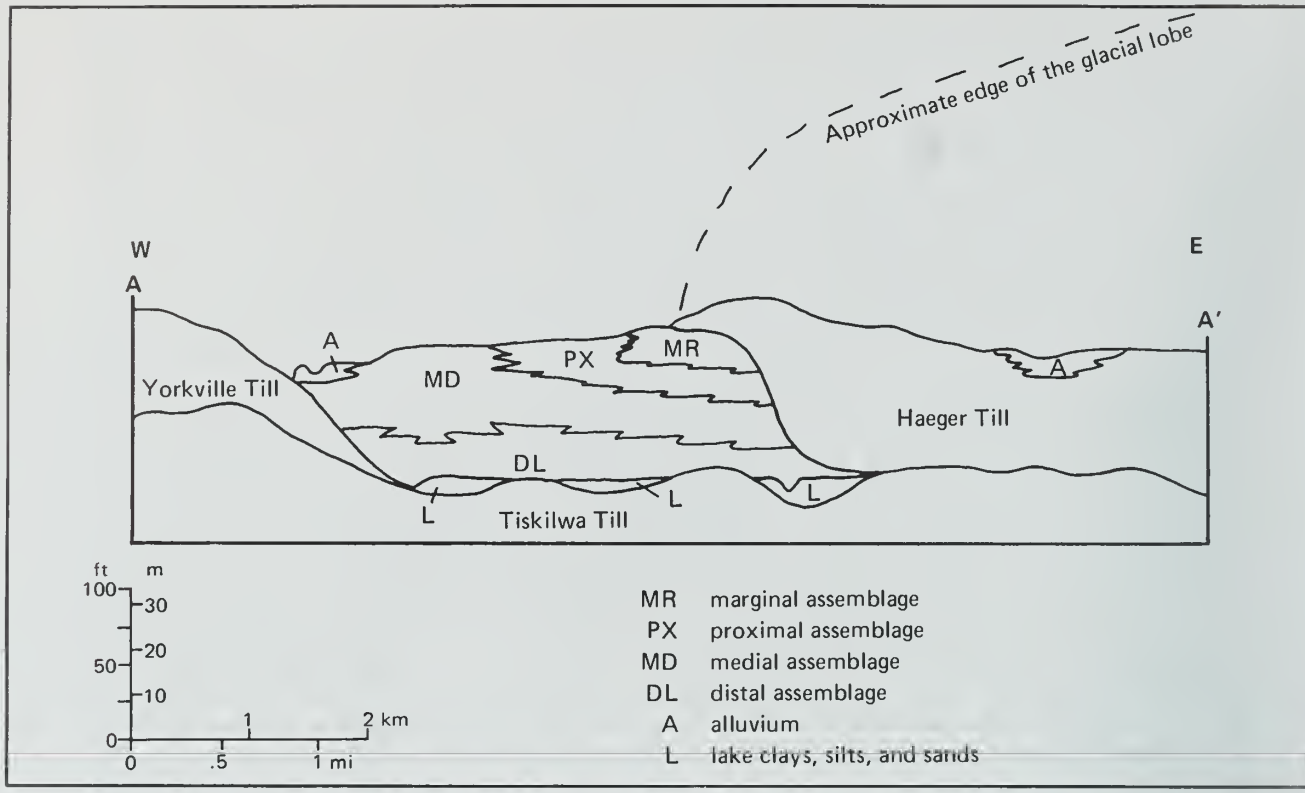


Figure 10 Generalized east-west cross section of the outwash deposit near Crystal Lake (from Cobb and Fraser 1981).

most of the boulders. The dragline beyond the conveyor belt has recently begun extracting sand and gravel from below the water table. This dragline can dig down about 35 feet, which may be sufficient to reach the bottom of the commercial portion of the deposit.

The pit faces closest to the pit access road are being knocked down and buried as part of the reclamation of the pit. These faces show Cobb and Fraser's proximal and marginal assemblages. The proximal assemblage is the lower 20 to 30 feet of material, consisting of several cobble and boulder gravel layers up to 6 feet thick separated by fine gravel and sand layers up to 2 feet thick. The marginal assemblage, the upper 7 to 15 feet, consists of a massive layer with a matrix of mostly silt and sand with floating cobbles and boulders. It also contains sand and gravel lenses up to 2 feet thick and 50 feet long.

Processing plant Located on the west side of the highway (SR 31) is the processing plant, which crushes, washes, and sizes the material into all grades of coarse to fine construction aggregates. The coarse products from this pit and others in the extensive upland outwash plains of McHenry and adjacent counties are the highest quality gravel aggregate available in Illinois. Furthermore, these are the largest outwash plain deposits in the state.

In the past, some of Illinois' highways constructed with portland cement-based concrete containing gravel aggregate failed prematurely. Masters and Evans (1987) studied the rock types present in gravels produced from different areas of the state. One sample came from this pit. Gravel from this pit is not a source of problems with pavement durability, probably because it contains a very high percentage of dolomite and a very low percentage of low specific gravity (S.G.) chert. The following summarizes the rock types in the sample from this pit:

rock type	percentage
dolomite	67.6
limestone	4.4
cherty carbonate	4.9
weathered carbonate	3.8
chert (low S.G)	6.3 (0.2)
ironstone	0.2
sandstone and siltstone	1.7
mafic igneous	2.9
felsic igneous	0.5
quartz	0.5
gneissic metamorphics	3.2
metasedimentary	2.2
metagraywacke	1.7
tillite	0.2
total	100.1

Fox River drainage We will get our first glimpses of the Fox River as we descend its valley wall into Algonquin on the way to Stop 3. This river controls the drainage in the Crystal Lake field trip area. About 35 miles north of the Illinois–Wisconsin state line are the headwaters of the Fox River, which drains an area of about 2,580 square miles. The river is abrading its channel throughout its course, except where influenced by dams that maintain pool depths sufficient for general boating. Downcutting has progressed slowly since glacial times and the channel base is only 15 to 20 feet below outwash terraces along its sides. Although the valley walls are kept steep by lateral erosion of the river, according to Willman (1942), the valley has been widened very little since glacial time. The river has a narrow floodplain and at some places occupies almost the entire area of the valley floor.

The Fox River, which flows south through the eastern part of McHenry County, did not exist before Wisconsinan glaciation. As noted earlier, the bedrock surface in this part of Illinois shows a well-developed drainage network that has no relation to the present drainage pattern. As the glaciers advanced repeatedly across an area, they destroyed many of the earlier stream networks partly by filling the valleys with drift. Rapid melting of these massive glaciers frequently gave rise to meltwater torrents that eroded new channels and valley systems in front of the ice sheets. The Fox River changed its course several times because of the advances and melting back of the Woodfordian glaciers.

0.0	6.05+	Leave Stop 2 and CONTINUE AHEAD (south).
0.3+	6.35+	CAUTION: enter City of Algonquin.
0.1+	6.5	CAUTION: entrance to Meyer Material Company, Preco Yard 12, lies to the right. Watch for heavy truck traffic. CONTINUE AHEAD (south).
0.1+	6.6+	Algonquin–Cary Road to the left. CONTINUE AHEAD (southwest) down the hill. CAUTION: *watch for slow-moving or stalled traffic* because of the stop light nearly ½ mile away.
0.6	7.25	CAUTION: stop light at the intersection of Algonquin–Huntley Road. TURN RIGHT (west). CAUTION: narrow, crooked road.

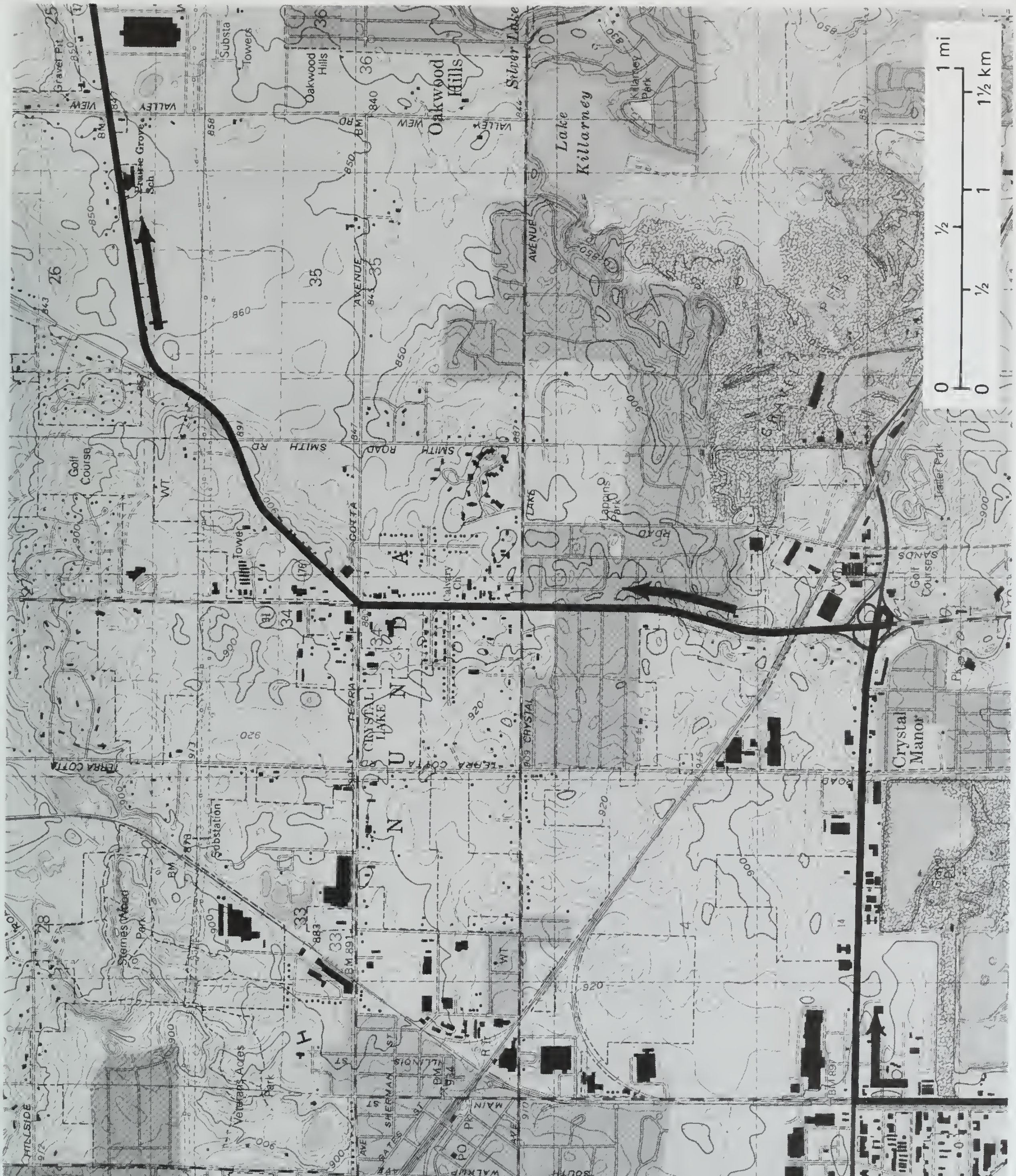
0.25	7.5	TURN RIGHT (north) into the lower, southeast corner of the Coach's Inn parking lot. Follow directions for parking. ***Do not obstruct access for paying customers!*** We will cross the small drainage ditch on the east side of the parking lot and walk north about 500 feet along the lane to the exposure. ***You must have permission to park here*** to examine the exposures.

STOP 3 Langos Construction Company: we'll examine the Tiskilwa Till Member and overlying Henry Formation of Wisconsinan age exposed at this site (NW SW SW, Section 27, T43N, R8E, 3rd P.M., McHenry County; Crystal Lake 7.5-Minute Quadrangle [42088B3]).

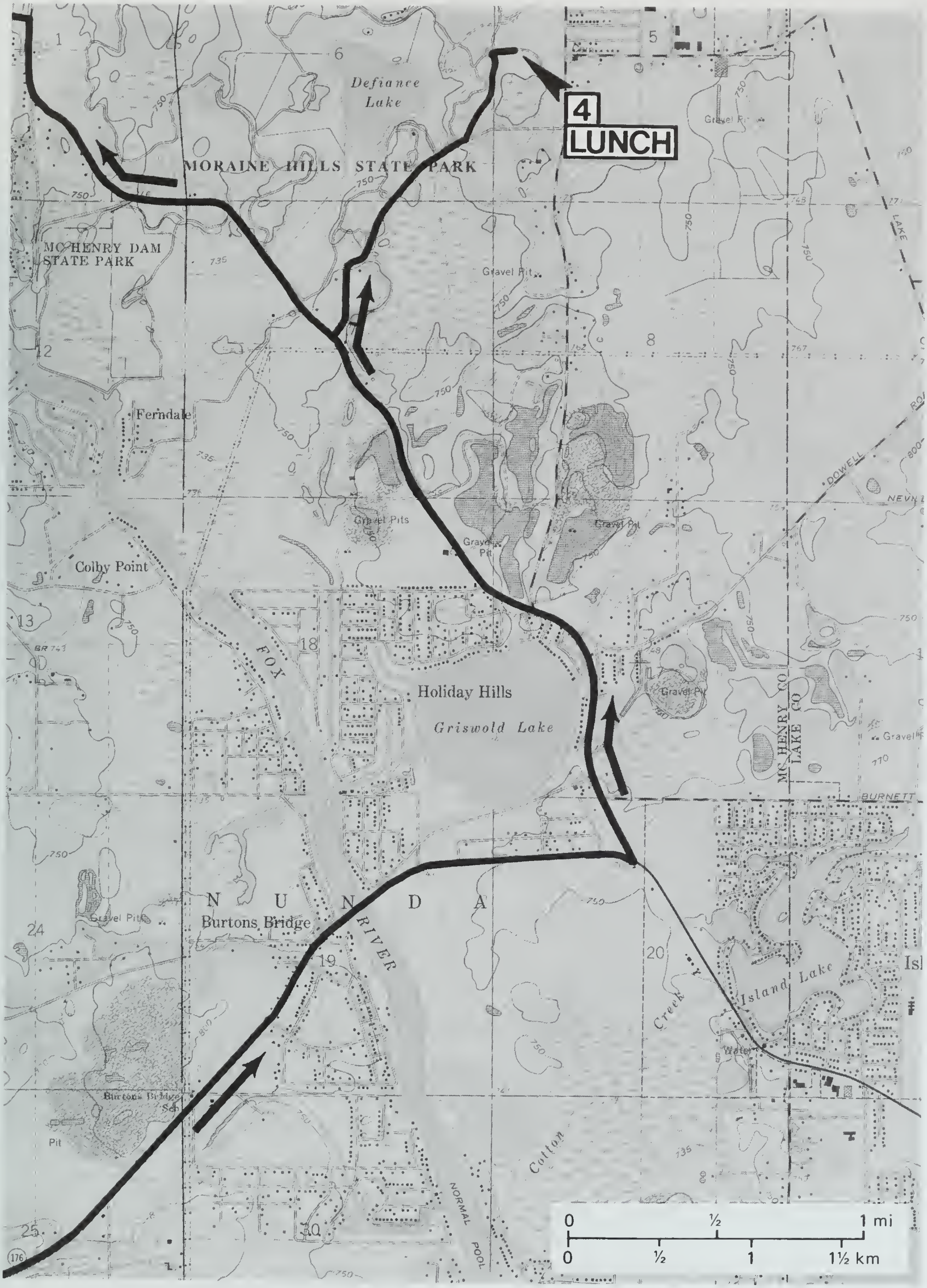
The Tiskilwa Till, the lowermost member of the Wedron Formation, makes up the lower part of the exposure. Here it consists of relatively compact and uniform, pinkish gray till with a matrix of about equal parts of sand, silt, and clay in which pebbles, cobbles, and an occasional boulder up to 2 1/2 feet in diameter are dispersed. Many of the rocks are dolomite and frequently show good striations on their flattened surface. Some pebbles and cobbles may be slumped from above. The top 9 inches is weathered and a slightly deeper color. The till is quite slick and sticky when wet. Some 35 feet is exposed here. The base is concealed, but another 30 to 40 feet has been observed in exposures closer to downtown Algonquin. Drill holes in this area indicate that the Tiskilwa may be some 180 feet thick.

The overlying Batavia Member of the Henry Formation consists of outwash sand and gravel similar in appearance to that observed at Stop 2 about 1 mile to the north-northeast. Here the outwash is finer grained and thinner, ranging from about 20 to 25 feet thick. In several places, carbonate-enriched groundwater percolating through the deposit has cemented the gravel.

0.0	7.5	Leave Stop 3. CAUTION: TURN RIGHT (west) on the Algonquin–Huntley Road (McHenry County [McH] A48).
0.25+	7.75+	Former railroad overpass that is now part of McHenry Prairie Trail.
0.3	8.05+	Prepare to turn right on Pyott Road.
0.1+	8.2	CAUTION: STOP LIGHT. TURN RIGHT (north) on Pyott Rd.
0.2	8.4	Tiskilwa Till exposed to the right above the concrete gutter liner.
0.15+	8.55+	The area to the right, the site of a former sand and gravel pit, is being reclaimed for use as home building sites. To the right, near the top of the hill, you can see remnants of some concrete structures of the abandoned sand and gravel processing plant. This area shows several examples of multiple land use; that is, the original farmland was mined for its construction materials, and now it's being put to some other use.
0.45	9.0+	To the left, a former sand and gravel pit has been converted to a recreational area. An industrial complex is located in an abandoned pit to the right.
0.25	9.25+	To the left, another former sand and gravel pit is apparently being prepared for building sites.
0.5	9.75+	To the right and left are abandoned sand and gravel pits.


CRYSTAL LAKE
Lake Killarney
Oakwood Hills
Crystal Manor
Veterans Acres Park
City Hall
High Sch
Golf Course
0 ½ 1 mi
0 ½ 1 1½ km

0.7	10.45+	Crystal Lake Airport lies to the left.
0.65+	11.15	CAUTION: stop light at Virginia Road. CONTINUE AHEAD (northeast and north) on Main Street.
0.15+	11.3+	STOP: 4-way. CONTINUE AHEAD (north).
0.5	11.8+	CAUTION: stop light at Virginia Street (US 14). TURN RIGHT (east) on US 14.
0.15	11.95+	CAUTION: stop light at Crystal Point Drive. CONTINUE AHEAD (east).
0.2	12.15+	CAUTION: stop light. CONTINUE AHEAD (east).
0.6+	12.8	CAUTION: stop light at Pingree Road. CONTINUE AHEAD (east).
0.3+	13.1+	CAUTION: enter SR 31 interchange. CONTINUE AHEAD (east) over SR 31 and then TURN RIGHT at sign pointing to SR 31 and McHenry.
0.25+	13.35+	STOP: 1-way. TURN RIGHT (north) on SR 31.
0.05+	13.45	Highway underpass below US 14. CONTINUE AHEAD (north) retracing route to Terra Cotta Avenue.
0.25	13.7	Overpass above C&NW Railway. CONTINUE AHEAD (north).
0.85+	14.55	CAUTION: stop light at Crystal Lake Avenue. CONTINUE AHEAD (north).
0.5	15.05	CAUTION: stop light at intersection with Terra Cotta Avenue and SR 176. BEAR RIGHT (northeast) on SR 176 for several miles and cross the Fox River.
0.9+	15.95+	BEAR RIGHT (east–northeast) at intersection with northbound Barreville Road.
0.35	16.25+	CAUTION: enter community of Prairie Grove.
0.55+	16.8+	CAUTION: Silver Lake Road (south) and Valley View Road (north) intersection. CONTINUE AHEAD (northeast).
2.1	18.9+	CAUTION: cross Fox River.
0.9	19.8+	Prepare to turn left.
0.1+	19.9+	CAUTION: stop light at River Road. TURN LEFT (north). BE ALERT for heavy, fast traffic.
0.95+	20.9	Lily Lake Road to the right. CONTINUE AHEAD (west and north) on River Road. Note that some abandoned and active sand and gravel pits are located between here and Moraine Hills State Park.
1.05	21.95	Prepare to turn right.
0.1+	22.05+	TURN RIGHT (northeast) and enter Moraine Hills State Park. We will travel more than 1 mile to Whitetail Prairie (Stop 4). You will note several kettle lakes between the entrance and Stop 4.


4
LUNCH
Defiance Lake
MORAINE HILLS STATE PARK
MC HENRY DAM STATE PARK
Ferndale
Colby Point
Gravel Pits
Gravel Pit
FOX
Holiday Hills
Griswold Lake
MC HENRY CO
LAKE CO
BURNETT
DOWELL
N U N D A
Burtons Bridge
RIVER
Island Lake
Creek
Cotton
NORMAL POOL
Burtons Bridge Sch
0 ½ 1 mi
0 ½ 1 1½ km

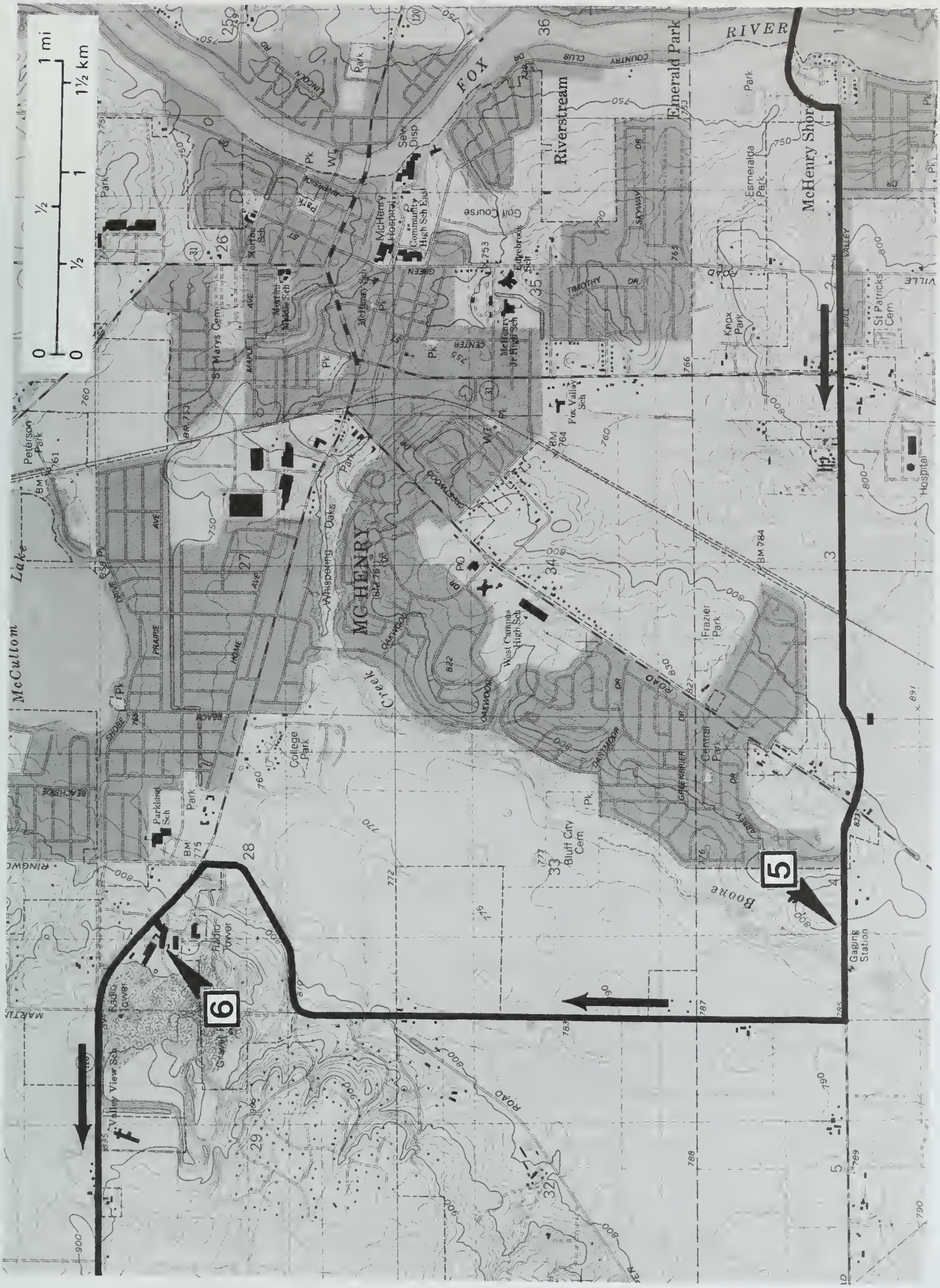
1.25+	23.35	TURN RIGHT (east) at the entrance road to Whitetail Prairie. Mileage figures will resume from this intersection. PARK according to posted directions.

STOP 4 Whitetail Prairie: let's have lunch, while we look over the glacial geology and biology of this area (NW SW NW, Section 5, T44N, R9E, 3rd P.M.. McHenry County: Wauconda 7.5-Minute Quadrangle [42088C2]). Two staff members of the Illinois Natural History Survey, Rick Phillippe and John Houseman, are available to talk with you. Rick is a field botanist in the Center for Biodiversity, and John is an entomologist in the Center for Economic Entomology. Feel free to ask them questions about the flora, fauna, and ecology of this region. Also turn to the section, "Northeastern Illinois: A Biological Perspective," which appears after the References.

The park is situated along the outer edge of the Fox Lake Moraine, a special type called a kame moraine. Unlike many moraines in Illinois that are made up predominantly of till, the Fox Lake consists predominantly of sand and gravel. It was probably deposited by glacial meltwaters issuing from an ice margin that consisted of thick slabs of debris-rich ice that became stacked by glacial flow and stagnated in the area of the present chain of lakes just to the east and north. Because the surface of the outwash plain to the west of the Fox Lake Moraine is higher than most of the kames in the moraine, it is likely that the gravel and sand in the moraine was deposited on stagnant ice along the ice margin. Slow melting of the dead ice blocks resulted in the hummocky kame and kettle topography associated with this moraine, and the deep kettles that form the chain of lakes to the east.

Many kettles in this area contain thick deposits of organic peat that has accumulated in place. Just south of Whitetail Prairie is a large marsh where you can see many of the plant species that flourish in peat bogs.

0.0	23.35	Leave Stop 4 and resume mileage figures from the intersection with the main park road. • You can turn right and go to park headquarters about 0.6 mile away to see some displays on the geology and biology of the area. • Some roadcuts in that direction show that sand and gravel material does indeed compose the knobs and hills in this park. TURN LEFT (southwest) at the Whitetail Prairie road intersection and retrace your route to the park entrance.
1.25+	24.6+	STOP: 1-way at park entrance. TURN RIGHT (north) on River Road.
0.9	25.5+	Entrance to McHenry Dam State Park to the left. CONTINUE AHEAD and CURVE RIGHT (north).
0.75+	26.25+	STOP: 3-way. TURN LEFT (west) toward Fox River.
0.1+	26.4+	CAUTION: cross Fox River bridge.
0.35	26.75+	STOP: 1-way. TURN RIGHT (west) on Bull Valley Road (McH A32). (No bull!)
0.6+	27.35	STOP: 4-way at Green Street. CONTINUE AHEAD (west) on Bull Valley Road.
0.3+	27.65+	CAUTION: stop light at SR 31. CONTINUE AHEAD (west).
0.8	28.5	CAUTION: C&NW Railway crossing.



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1½ km
McCullom Lake
MC HENRY
FOX RIVER
Riverstream
Emerald Park
McHenry Shores
Whispering Oaks
College Park
Bluff City Cem
St Marys Cem
St Patricks Cem
Frazier Park
Knox Park
Esmeralda Park
Peterson Park
Central Park
Boone Creek
West Campus High Sch
McHenry Hospital
Community High Sch East
McHenry Jr High Sch
Fox Valley Sch
Parkland Sch
Valley View Sch
Hospital
Golf Course
Gaging Station
Radio Tower
5
6

0.6+	29.1	CAUTION: stop light at Crystal Lake–McHenry Road. CONTINUE AHEAD (west).
0.4	29.5+	PARK along the roadway as far off the pavement as you safely can. Use EXTREME CAUTION here because of fast traffic and narrow road.

STOP 5 North side of the Bull Valley Road: we'll discuss underfit streams such as Boone Creek just to the west (S edge SW SW SE NW, Section 4, T44N, R8E, 3rd P.M., McHenry County; McHenry 7.5-Minute Quadrangle [42088C3]).

The valley before us here appears to have been cut by the ancestral Fox River. When the glacier melted back from the Marseilles Moraine (fig. 6) toward the present Fox Valley, meltwater draining away from the glacier eroded this ancestral valley. Other channels were cut during later ice readvances when parts of the ancestral valley were temporarily blocked by the glaciers. The glacier that formed the Woodstock and Cary Moraines covered this area and at least partially filled the old valley. As the ice melted, part of the ancestral valley was reexcavated. When the ice melted back, east of the present valley, the large glacial Lake Wauconda developed to the north and east behind a morainal dam near the place that is now the town of Cary. When meltwater in the lake spilled over the moraine, it quickly cut into part of the older Fox Valley and the lake drained.

The meltwater lake extended southward into this valley to about 3 miles northwest of here where a natural dam of glacial deposits controlled the level of the lake, which was about 25 feet higher than manmade Wonder Lake. Drainage from this glacial lake was south and then north through this area toward McHenry and then south toward Barreville. Part of the natural dam remains. The present lake, Wonder Lake, has a manmade dam at its north end and a natural drift dam about 30 feet higher than the north spillway and the location here. On the route map, you will note a network of valleys in several nearby areas, where glacial meltwater streams once flowed for a brief time. It would be difficult to establish any order for them. Boone Creek is an underfit stream, a stream that is too small to have eroded the valley in which it flows. Small, intricate meanders are incised into valley fill just to the west and north of this vantage point.

Reeds, sedges, and cattails growing along the valley bottom here are the types of plants that produced the peat resources in northern Illinois.

0.0	29.5+	Leave Stop 5 and CONTINUE AHEAD (west). BE ALERT when pulling back onto Bull Valley Road.
0.1+	29.65+	Cross Boone Creek.
0.15+	29.85+	TURN RIGHT (north) on Curran Road.
0.65	30.45+	To the right is a sod farm. The slightly rolling surface underlain by peaty soils makes an excellent place for sod production. The high organic content helps to retain moisture to support good sod formation.
0.8+	31.3	Note large, decorative boulders on both sides of the road.
0.1	31.4	STOP: 1-way at Draper Road. TURN RIGHT (north).
0.9+	32.3+	CAUTION: stop light at intersection with Elm Street (SR 120). TURN LEFT (northwest) and prepare to turn left.

0.25	32.55+	CAUTION: TURN LEFT (southwest and then south) at Dots Street intersection.
0.05	32.6+	TURN RIGHT (west) toward the gate of the Meyer Material Company.
0.05	32.65	CAUTION: heavy truck traffic. Proceed through Meyer's gate and PARK to the right in the visitor's area. ***You must have permission to enter this operation.*** PLEASE HEED the following instructions:

- Follow the vehicle in front of yours.
- No shortcuts!
- Do not climb on any equipment or large stock piles.
- Highwalls are dangerous. *Stand back!*
- Collect only from designated areas.

Mileage figures resume from the entrance gate.

STOP 6 West Pit of Meyer Material Company: we'll view outwash sand and gravel of the Wisconsinan Henry Formation (entrance gate, SE SE NW NW, Section 28, T45N, R8E, 3rd P.M., McHenry County; McHenry 7.5-Minute Quadrangle [42088C3]).

This operation is the former West Pit of the McHenry Sand and Gravel Company. It has expanded from east to west as additional reserves were acquired. Sand and gravel is excavated from above the water table by large front-end loaders after 5 to 20 feet of fine grained overburden has been removed. Material is scooped from the base of faces 30 to 60 feet high and carried to conveniently located primary jaw crushers. Boulders larger than 15 inches in diameter are scalped out of the raw material by steel bars set above the primary crushers. The crushed material is transported by conveyor belt about 1 mile to the processing plant. There are no present plans for dredging any material from below the water table because the material is too fine grained for saleable aggregate products.

A generalized geologic section for the pit area follows:

Richland Loess — About 2 feet of silt contains top soil.
Henry Formation (Batavia Member) — Upper 15 feet, dominantly silt and sand but contains some clay, gravel, and boulders; tan. Coarsening-upward sequence of sand and gravel with the upper 60 feet or so predominantly coarse to fine gravel and sand with some boulders; the lower 30 feet or so is fine gravel and sand.
Wedron Formation (Tiskilwa Till Member) — Perhaps more than 100 feet thick, predominantly clay and sand, but with some silt, gravel, and boulders; pinkish tan to gray.

Depth to Silurian Niagaran Dolomite is some 250 to 300 feet.

According to U.S. Bureau of Mines data for 1988 and 1990, more construction aggregate was produced from this pit than from any other in Illinois. Although the gravel here is not as coarse as that at Meyer's Algonquin Pit (Stop 2), this plant also produces all grades of fine and coarse construction aggregate. The gravel here appears to have about the same rock type content as in the Algonquin deposit.

Most of the sand and gravel being excavated at Meyer's West Pit best fits Cobb and Fraser's "medial assemblage." Beds comprising most of the face contain a ratio of about 1:1 sand to gravel and are usually less than 2 feet thick, discontinuous, slightly wavy, and separated by thin sandy zones. Internally they contain few bedding features.

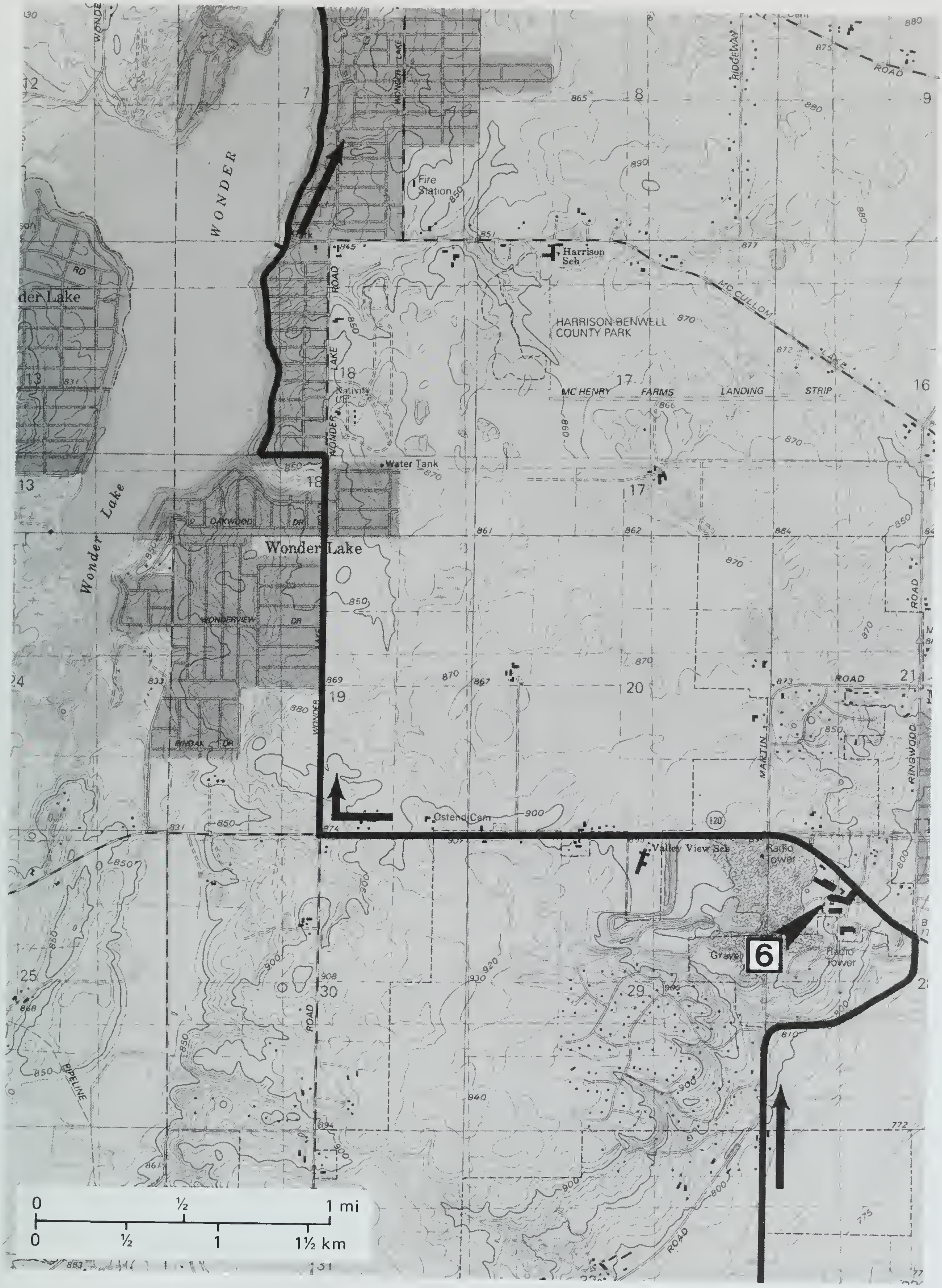
Most of the gravel is less than 6 inches in diameter. The material generally is well sorted, containing very little silt or clay, and is a prime material for making both fine and coarse construction aggregate products.

The upper 10 feet or so of the face contains much more of the gravel coarser than 6 inches in diameter than is present below, thus it is best described as the proximal assemblage, as seen at Stop 2. As this is the coarsest of the four assemblages, it usually contains about 85% gravel, but also more silt and clay than the medial assemblage. Not seen at the face is about 10 to 20 feet of massive, very gravelly sand and silt that has been stripped away and stockpiled for reclamation or to be used as separate feed into the processing system as needed. This material is best described as the mudflow portion of the marginal assemblage. It can also be described as a *diamicton* or a matrix-supported heterogeneous muddy gravel.

Formation of the outwash fan began with the deposition of *fluvial* channel sands, silts and clays of the distal assemblage, succeeded by the deposition of the medial assemblage from high to moderate energy *braided streams*. This was followed by the deposition of the proximal assemblage from extremely high energy braided streams, and then capped by the deposition of the marginal assemblage, predominantly as mud flows.

In the northeastern part of the pit, we may be able to see highly disturbed beds of sand and gravel associated with variously inclined, tabular bodies of diamicton that trend N20 – 30°E. This deformation probably occurred shortly after the beds of sand and gravel were deposited. It was probably the result of horizontal compression of the material as an advancing ice lobe shoved it westward. The details of how this occurred are not clear.

0.0	32.65	Leave Stop 6 and return to SR 120.
0.05	32.7–	STOP: 1-way at Dots Street. TURN LEFT (north).
0.05	32.7+	STOP: 1-way at SR 120. TURN LEFT (northwest) up the hill. CAUTION: fast traffic and limited visibilty to the left.
1.75	34.45+	Prepare to turn right.
0.1+	34.55+	CAUTION: stop light at Wonder Lake Road. TURN RIGHT (north) toward Wonder Lake.
1.15	35.7+	As you start uphill, prepare to turn left.
0.1+	35.85	TURN LEFT (west) on Beaver Road.
0.2+	36.05+	STOP: 1-way at East Lakeshore Drive. CURVE RIGHT (north).
0.05+	36.1+	The Shore Hills Private Park to the left beyond the next intersection provides a view of a portion of Wonder Lake. Notice the homes on both sides of the drive, especially the use of glacial erratics for ornamental purposes in chimneys, steps, foundations, etc.
0.2+	36.35+	STOP: 2-way at T-intersection.


WONDER
Wonder Lake
Wonder Lake
Fire Station
Harrison Sch
HARRISON-BENWELL COUNTY PARK
MC HENRY FARMS LANDING STRIP
MC CULLOM LAKE ROAD
RIDGEWAY
Nativity Ch
Water Tank
OAKWOOD DR
WONDERVIEW DR
Ostend Cem
Valley View Sch
Radio Tower
Gravel
Radio Tower
6
MARTIN
RINGWOOD
ROAD
PIPELINE
0 ½ 1 mi
0 ½ 1 1½ km

0.45	36.8+	This small triangular park is at the foot of the street through the business district. There is another good view to the left of part of Wonder Lake. CONTINUE AHEAD (north) along the shore.
0.7+	37.5+	Notice the wall and garage constructed of glacial erratics on the right side.
0.1+	37.6+	Road is divided. Keep to the right and ascend bluff on Back Bay Road.
0.2+	37.85+	STOP at Hilltop Drive—for your protection! Visibility is quite limited. Look carefully in *both* directions. TURN LEFT (north) on Hilltop Drive.
0.15+	38.0+	STOP: 4-way at Boston Road. TURN RIGHT (east) on Boston Road.
0.1+	38.1+	STOP: 1-way at East Wonderlake Road. CAUTION: visibility is somewhat restricted in both directions by hills and shrubbery. TURN LEFT (north).
0.55+	38.7+	STOP: 1-way at Barnard Mill Road. TURN LEFT (northwest).
0.6+	39.35	Cross Nippersink Creek.
0.05-	39.35+	BEAR RIGHT (north-northwest) at Y-intersection.
0.25+	39.65	BEAR RIGHT (north-northeast) on Keystone Road.
0.05	39.7	Picnic area and Keystone Landing for the Nippersink Creek Canoe Trail to the right.
0.75+	40.5+	PARK along the roadside as far off the road as you safely can. Please do not block gates or driveways. CAUTION: road is narrow and traffic is fairly fast. BE ALERT!

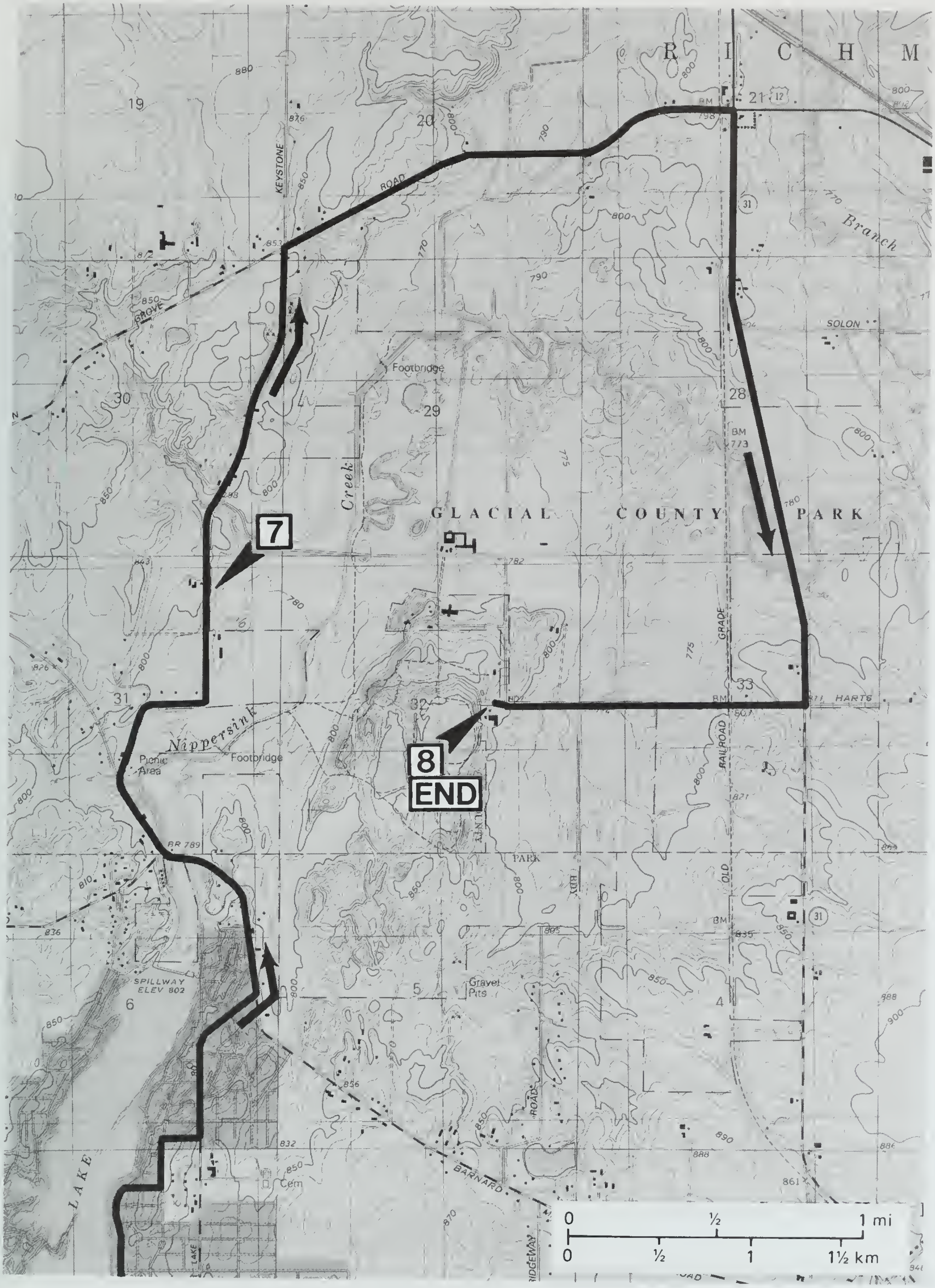
STOP 7 Nippersink Creek Valley and the kame complex in Glacial County Park (SW cor. NW NE NE, Section 31, T46N, R8E, 3rd P.M., McHenry County; Richmond 7.5-Minute Quadrangle [42088D3]).

To the right (southeast when facing the valley), you can see the kame complex on the far side of Nippersink Creek. This feature is the result of many kames that have formed together (coalesced), producing a distinct type of topography along the front of the moraine. The largest kame in McHenry County is situated about 0.7 mile southeast of here; it is somewhat more than 0.1 mile long and stands slightly more than 90 feet above Nippersink Valley.

A single large kame is situated about 1.2 miles east–northeast. It is about 0.1 mile long from northeast to southwest and stands nearly 50 feet above the valley floor. A smaller kame composed of sand lies 0.25 mile southeast of here.

Note that the valley, about 0.75 mile across here, is pretty wide for such a small stream, which is 30 to 50 feet wide—another example of an underfit stream. Note the extensive marshy areas along the valley bottom.

0.0	40.5+	Leave Stop 7 and CONTINUE AHEAD (north).
0.8	41.3+	CAUTION: truck entrance to Glacier Lakes Sand and Gravel Company is on the left.


RICHM
GLACIAL COUNTY PARK
Footbridge
Creek
Nippersink
Picnic Area
Footbridge
KEYSTONE
ROAD
GROVE
Branch
SOLON
GRADE
RAILROAD
OLD
HARTS
PARK
Gravel Pits
SPILLWAY ELEV 802
LAKE
Cem
BARNARD
RIDGEWAY
ROAD
7
8
END
0 ½ 1 mi
0 ½ 1 1½ km

0.35+	41.7+	STOP: 2-way at Tryon Grove Road intersection. CAUTION: fast cross traffic does NOT stop. TURN RIGHT (east) on McH A16.
1.65+	43.35+	CAUTION: stop light at SR 31 S. and US 12 E. TURN RIGHT (south) on SR 31.
1.55	44.9+	Cross Nippersink Creek.
0.35	45.25+	Prepare to turn right.
0.1+	45.4	TURN RIGHT (west) on Harts Road.
0.25	45.65	Cross McHenry County Prairie Trail, former C&NW Railway track.
0.45	46.1	Cross culvert.
0.25+	46.35+	CAUTION: T-road from right. CONTINUE AHEAD (west).
0.05	46.4	TURN RIGHT at parking lot entrance and PARK near the Wiedrich Barn Nature Center, Glacial Park (McHenry County Conservation District).

STOP 8 Glacial Park: we'll look at some kames and kettles as well as the plants and animals in this natural setting (SE SE SW NE, Section 32, T46N, R8E, 3rd P.M., McHenry County; Richmond 7.5-Minute Quadrangle [42088D3]).

The park, which started in 1986 with 600 acres and grew to 2,800 acres, serves as headquarters for the McHenry Conservation District. It is situated in a kame complex. The kames or knobs are separated by many kettles. Some of the kettles are dry, while others containing water are marshes or bogs. The several large marshy kettles that occur here are fairly easy to hike to. Kettles are the sites of blocks of glacial ice, buried in the glacial drift and left behind as the glacier retreated. As the ice blocks slowly melted, the sands and gravels surrounding the blocks collapsed and slumped into the voids. The hills or knolls left between kettles are called knobs. Knob and kettle topography produces a sharply rolling, distinctive landscape.

We will view the movie, "Night of the Sun," produced under the guidance of the Wisconsin Department of Natural Resources for use at their Kettle Moraine State Park. If time permits, you may wish to do some hiking to enjoy the park and its natural wonders.

End of field trip

REFERENCES

Anderson, R.A., and D.A. Block, 1962, Sand and Gravel Resources of McHenry County, Illinois: Illinois State Geological Survey, Circular 336, 15 p.

Bannister, H.M., 1870, Geology of McHenry and Lake Counties, *in* A.H. Worthen, Geology and Palaeontology: Geological Survey of Illinois, v. IV, p. 126-135.

Berg, R.C., J.P. Kempton, and D.L. Reinertsen, 1982, A Guide to the Geology of the Capron–Rockford area: Illinois State Geological Survey, Geological Science Field Trip Guide Leaflet 1982B, 44 p.

Berg, R.C., J.P. Kempton, L.R. Follmer, D.P. McKenna, R.J. Krumm, J.M. Masters, R.C. Anderson, R.L. Meyers, J.E. King, H.E. Canfield, and D.M. Mickelson, 1985, Illinoian and Wisconsinan Stratigraphy and Environments in Northern Illinois: the Altonian Revisited: Midwest Friends of the Pleistocene 32nd Field Conference: Illinois State Geological Survey, Guidebook 19, 177 p.

Cobb, J.C., and G.S. Fraser, 1981, Applications of Sedimentology to Development of Sand and Gravel Resources in McHenry and Kane Counties, Northeastern Illinois: Illinois State Geological Survey, Illinois Mineral Notes 82, 17 p.

Curry, B.B., 1989, Absence of Altonian glaciation in Illinois: Quaternary Research, v. 31, p. 1–13.

Curry, B.B., and R.J. Krumm, 1986, Altonian (early Wisconsinan) deposits in northern Illinois: a review: American Quaternary Association Ninth Biennial Meeting, Program and Abstracts, p. 75.

Hackett, J.E., and M.R. McComas, 1969, Geology for Planning in McHenry County: Illinois State Geological Survey, Circular 438, 31 p.

Hansel, A.K., and W.H. Johnson, 1986, Ice marginal sedimentation in a late Wisconsinan end moraine complex, northeastern Illinois, USA: Illinois State Geological Survey, Reprint 1988A, p. 97–104.

Hansel, A.K., W.H. Johnson, K.L. Cole, T.A. Thompson, P. Clark, R.D. Gergen, J.E. King, K.A.Nelson, and J.S. Oliver, 1986, Quaternary Records of Northeastern Illinois and Northwestern Indiana: American Quaternary Association Ninth Biennial Meeting, Trip 5, 106 p.

Horberg, C.L., 1950, Bedrock Topography of Illinois: Illinois State Geological Survey, Bulletin 73, 111 p.

Johnson, W.H., A.K. Hansel, B.J. Socha, L.R. Follmer, and J.M. Masters, 1985, Depositional Environments and Correlation Problems of the Wedron Formation (Wisconsinan) in northeastern Illinois: Nineteenth Annual Meeting, North-Central Section of the Geological Society of America: Illinois State Geological Survey, Guidebook 16, 91 p.

Johnson, W.H., and L.R. Follmer, 1989, Source and origin of Roxana silt and middle Wisconsinan midcontinent glacial activity: Quaternary Research, v. 31, p. 319-331.

Kempton, J.P., 1963, Subsurface Stratigraphy of the Pleistocene Deposits of Central Northern Illinois: Illinois State Geological Survey, Circular 356, 43 p.

Leighton, M.M., 1925, The glacial history of the Elgin region: Illinois Academy of Sciences Transactions (1914), v. 17, p. 65–71.

Leighton, M.M., P. MacClintock, L.E. Workman, and W.E. Powers, 1931, Geology and mineral resources of the Barrington, Elgin, and Geneva quadrangles: Illinois State Geological Survey, unpublished manuscript, MML-252, 207 p.

Leighton, M.M., G.E. Ekblaw, and C.L. Horberg, 1948, Physiographic Divisions of Illinois: Illinois State Geological Survey, Report of Investigations 129, 19 p.

Leverett, F., 1899, The Illinois Glacial Lobe: U.S. Geological Survey, Monograph 38, 817 p.

Lineback, J.A., and others, 1979, Quaternary Deposits of Illinois: Illinois State Geological Survey, map (scale 1:500,000).

Masters, J.M., 1978, Sand and Gravel and Peat Resources in Northeastern Illinois: Illinois State Geological Survey, Circular 503, 11 p.

Piskin, K., and R.E. Bergstrom, 1975, Glacial Drift in Illinois: Thickness and Character: Illinois State Geological Survey, Circular 490, 35 p.

Powers, W.E., 1938, Earth History Field Conference Crystal Lake Region: Illinois State Geological Survey, Geological Science Field Trip Guide Leaflet 1938B, 5 p.

Powers, W.E., and G.E. Ekblaw, 1940, Glaciation of the Grays Lake, Ilinois, quadrangle: Geological Society of America Bulletin, v. 51, p. 1329–1336.

Raasch, G.O., 1952, Barrington–Fox Lake Area: Illinois State Geological Survey, Geological Science Field Trip Guide Leaflet 1952D, 15 p.

Reinertsen, D.L., 1983, A Guide to the Geology of the Crystal Lake–Richmond Area: Illinois State Geological Survey, Geological Science Field Trip Guide Leaflet 1983B [Guide to the Route], 9 p. plus attachments.

Reinertsen, D.L., and J.M. Masters, 1989, Guide to the Geology of the Woodstock Area, McHenry County: Illinois State Geological Survey, Geological Science Field Trip Guide Leaflet 1989C, 34 p. plus attachments.

Reinertsen, D.L., and L.R. Smith, 1990, Guide to the Geology of the Joliet Area, Cook, Grundy, and Will Counties: Illinois State Geological Survey, Geological Science Field Trip Guide Leaflet 1990B, 41 p. plus attachments.

Samson, I.E., 1992, Ilinois Mineral Industry in 1990 and Review of Preliminary Mineral Production Data for 1991: Illinois State Geological Survey, Illinois Mineral Notes 110, 43 p.

Treworgy, J.D., 1981, Structural Features in Illinois: a Compendium: Illinois State Geological Survey, Circular 519, 22 p.

Wickham, S.S., W.H. Johnson, and H.D. Glass, 1988, Regional Geology of the Tiskilwa Till Member, Wedron Formation, Northeastern Illinois: Illinois State Geological Survey, Circular 543, 35 p.

Willman, H.B., 1971, Summary of the Geology of the Chicago Area: Illinois State Geological Survey, Circular 460, 77 p.

Willman, H.B., 1973, Rock Stratigraphy of the Silurian System in Northeastern and Northwestern Illinois: Illinois State Geological Survey, Circular 479, 55 p.

Willman, H.B., and J.C. Frye, 1970, Pleistocene Stratigraphy of Illinois: Illinois State Geological Survey, Bulletin 94, 204 p.

Willman, H.B., and others 1967, Geologic Map of Illinois: Illinois State Geological Survey, map (scale 1:500,000).

Willman, H.B., E. Atherton, T.C. Buschbach, C.W. Collinson, J.C. Frye, M.E. Hopkins, J.A. Lineback, and J.A. Simon, 1975, Handbook of Illinois Stratigraphy: Illinois State Geological Survey, Bulletin 95, 261 p.

Willman, H.B., J.N. Payne, and W.H. Voskuil, 1942, Geology and Mineral Resources of the Marseilles, Ottawa, and Streator Quadrangles: Illinois State Geological Survey, Bulletin 66, 388 p.

Willman, H.B., J.A. Simon, B.M. Lynch, and V.A. Langenheim, 1968, Bibliography and Index of Illinois Geology Through 1965: Illinois State Geological Survey, Bulletin 92, 373 p.

Wilson, G.M., I.E. Odom, and G. Dow, 1960, Woodstock Area: Illinois State Geological Survey, Geological Science Field Trip Guide Leaflet 1960C, 16 p.

NORTHEASTERN ILLINOIS: A BIOLOGICAL PERSPECTIVE

Rick Phillippe and John Houseman, Illinois Natural History Survey

Natural Divisions

The 14 natural divisions of Illlinois are distinguished from each other by bedrock, glacial history, topography, soils, and distribution of plants and animals. Subdivision of these natural environments results in 33 sections based on differences similar to but less significant than those used to delimit the divisions (see map). The areas we are visiting today are in the Northeastern Morainal Division.

Northeastern Morainal Division

The Northeastern Morainal Division experienced the most recent glaciation in Illinois. Glacial landforms are common and contribute to the rough topography of most of the area. Lakebed deposits, beach sands, dunes, and bogs are common features. Unlike the soils through most of Illinois, these soils are derived from glacial drift rather than windblown loess. Drainage is poorly developed and many natural lakes are found. Among its distinctive floral elements are such members of the bog community as pitcher plant, winterberry, and dwarf birch. Animals restricted to this division are the pigmy shrew, spotted turtle, and blue-spotted salamander.

Noteworthy Sites

Two sites to be visited today possess significant biological features: Moraine Hills State Park (Stop 4) and Glacial Park (Stop 8). An Illinois nature preserve, Kettle Moraine, is found in Moraine Hills State Park. This preserve contains a variety of natural features that owe their origins to the last glacial epoch approximately 12,000 years ago. Pike Marsh is a peat-filled basin lying at the base of the Valparaiso moraine, which contains marsh and fen vegetation. The marsh vegetation contrasts sharply with the fen vegetation. Fens are alkaline in nature. The outer fen zone has such plants as Ohio Goldenrod, Kalm's lobelia, dwarf birch, and hoary willow. The inner marsh zone contains mostly cattails and bulrushes. Several species of state endangered plants, including beaked rush, bladderwort, and pitcher plant are present here. A boardwalk leads into the marsh. Leatherleaf Bog is a 120-acre bog that contains the shrub leatherleaf, St. John's wort, sphagnum moss, marsh fern, marsh marigold, and several species of willow.

Glacial Park contains five distinct plant communities (more than 420 plant species) on a topography characterized by glacial knolls, ridges, kames, and eskers.

Tallgrass savanna The rugged uplands are largely tallgrass savanna dominated by bur oak. White, black oak, Hill's oak, and shagbark hickory area also present, but less frequent. The understory of the savanna varies considerably and contains Pennsylvania sedge, shooting star, yellow star grass, wild columbine, Robin's plantain, Culver's root, and elm-leaved goldenrod.

Dry hill prairies Small patches of dry hill prairies dominated by sideoats gramma and little bluestem occur in openings in the timber on the kames.

Low shrub bog The central kettle is occupied by a 10-acre bog dominated by sphagnum moss and leatherleaf. Poison sumac, cinnamon fern, rusty cotton grass, and smooth white violet are also present. The bog is enriched by a moat dominated by sphagnum, blue joint grass, swamp marigold, buckbean, and three-way sedge.

Fen/sedge meadow communities Two fen/sedge meadow community complexes occur in areas receiving large amounts of mineralized groundwater. These areas are dominated by a great bulrush, tussock sedge, blue joint grass, lake sedge, turtlehead, Joe Pye

1 Wisconsin Driftless Division

2 Rock River Hill Country Division
- a Freeport Section
- b Oregon Section

3 Northeastern Morainal Division
- a Morainal Section
- b Lake Michigan Dunes Section
- c Chicago Lake Plain Section
- d Winnebago Drift Section

4 Grand Prairie Division
- a Grand Prairie Section
- b Springfield Section
- c Western Section
- d Green River Lowland Section
- e Kankakee Sand Area Section

5 Upper Mississippi River and Illinois River Bottomlands Division
- a Illinois River Section
- b Mississippi River Section

6 Illinois River and Mississippi River Sand Areas Division
- a Illinois River Section
- b Mississippi River Section

7 Western Forest-Prairie Division
- a Galesburg Section
- b Carlinville Section

8 Middle Mississippi Border Division
- a Glaciated Section
- b Driftless Section

9 Southern Till Plain Division
- a Effingham Plain Section
- b Mt Vernon Hill Country Section

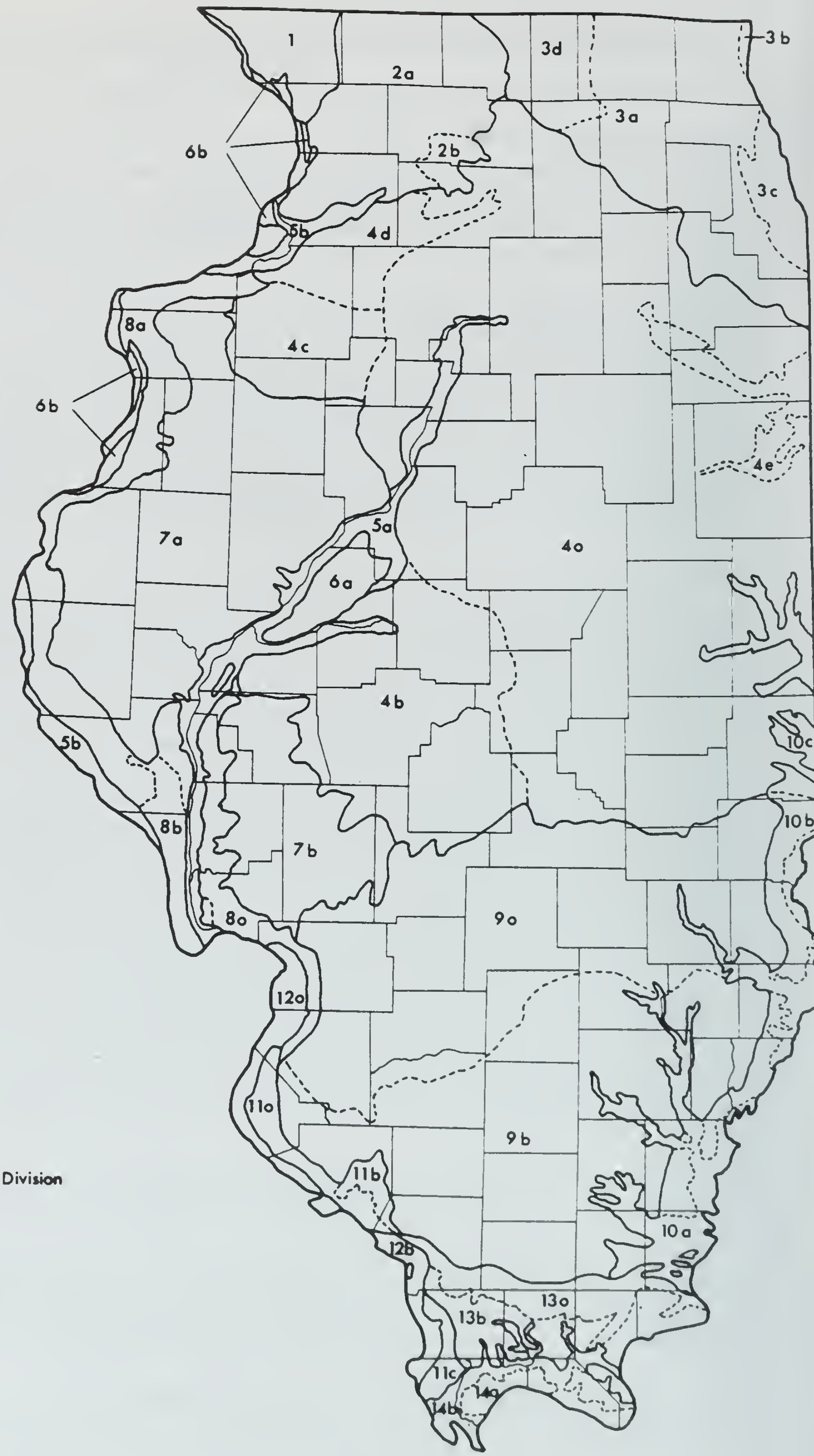
10 Wabash Border Division
- a Bottomlands Section
- b Southern Uplands Section
- c Vermilion River Section

11 Ozark Division
- a Northern Section
- b Central Section
- c Southern Section

12 Lower Mississippi River Bottomlands Division
- a Northern Section
- b Southern Section

13 Shawnee Hills Division
- a Greater Shawnee Hills Section
- b Lesser Shawnee Hills Section

14 Coastal Plain Division
- a Cretaceous Hills Section
- b Bottomlands Section



weed, Michigan lily, and swamp thistle. Also present are three alkaline-loving species (calcophiles)—brook lobelia, smooth fringed gentian, and grass-of-parnassus.

Marsh A 20-acre marsh lies in the largest kettle. Although somewhat disturbed by siltation and previous attempts at cultivation, this wetland remains dominated by a mixture of cattails, bulrushes, rice cut grass, a variety of sedges, common arrowhead, and water plantain.

The fauna of Glacial Park is equally diverse. To date, more than 40 species of butterflies have been recorded (table 1), including the European skipper and Baltimore checkerspot. Twenty-eight species of reptiles and amphibians (table 2), 24 species of mammals, and 58 species of birds (table 3) have also been recorded.

Table 1 Species of butterflies

Common name	Savanna/ prairie	Sedge meadow
Dion skipper		x
Black dash		x
Dunn skipper	x	
Mulberry wing		x
Delaware skipper	x	
Little glassy wing	x	
Peck"s skipper		x
Tawny edged skipper		x
Long dash		x
European skipper	x	x
Least skipper	x	x
Common sooty wing	x	
Black swallowtail	x	
Giant swallowtail		
Tiger swallowtail	x	
Cabbage white	x	x
Alfafa butterfly	x	
Clouded sulfur	x	x
Banded hairstreak	x	
Edward's hairstreak	x	
Acadian hairstreak		x
Purplish copper		x
American copper	x	
Eastern tailed blue	x	
Spring azure	x	x
Red spotted purple	x	x
Viceroy	x	x
Red admiral	x	
American painted lady	x	
Mourning cloak	x	
Question mark	x	x
Comma	x	
Pearl crescent	x	x
Baltimore checkerspot		x
Silver bordered fritillary		x
Great spangled fritillary	x	x
Aphrodite		x
Monarch	x	x
Pearly eye	x	
Northern eyed brown		x
Little wood satyr	x	
Common wood nymph	x	x
Species richness by habitat	30	24
Total species richness	42	

Table 2 Species list of herpetofauna from McHenry County

Scientific name	Common name	No. observed Proposed preserve	Glacial park
Ambystoma laterale	Blue-spotted salamander	–	–
Ambystoma tigrinum	Eastern tiger salamander	6	2
Necturus maculosus	Mudpuppy	–	–
Bufo americanus	American toad	7	10
Acris crepitans	Blanchard's cricket frog	–	–
Pseudocris triseriata	Western chorus frog	1	30
Hyla chrysoscelis	Gray tree frog	3	P[a]
Rana catesbeiana	Bullfrog	–	–
Rana clamitans	Green frog	5	5
Rana pipiens	Northern leopard frog	5	11
Chelydra serpentina	Snapping turtle	–	1
Sternotherus odoratus	Musk turtle	–	–
Emydoidea blandingii	Blandings turtle	3	P
Chrysemys picta	Painted turtle	2	P
Grapteyms geographica	Map turtle	–	–
G. pseudogeographica	False map turtle	–	–
Apalone spinifer	Spiny softshell turtle	–	P
Opheodrys vernalis	Smooth green snake	4	3
Elaphe vulpina	Western fox snake	2	3
Lampropeltis triangulum	Eastern milk snake	–	–
Thamnophis r. radix	Plains garter snake	1	–
Thamnophis sirtalis	Chicago garter snake	3	2
Storeria dekayi	Midland brown snake (also known as DeKay's snake)	1	2
S. occipitomaculata	Red-bellied snake	2	P
Regina septemvittata	Queen snake	–	–
Neorida sipedon	Northern water snake	2	–

Table 3 Avian species

Scientific Name	Common Name
Ardea herodias	Great Blue Heron
Butorides striatus	Green-backed Heron
Branta canadensis	Canada Goose
Anas platyrhynchos	Mallard
Buteo jamaicensis	Red-tailed Hawk
Falco sparverius	American Kestrel
Phasianus colchicus	Ring-necked Pheasant
Charadrius vociferus	Killdeer
Philohela minor	American Woodcock
Zenaida macroura	Mourning Dove
Coccyzus americanus	Yellow-billed Cuckoo
Coccyzus erythropthalmus	Black-billed Cuckoo
Bubo virginianus	Great Horned Owl
Colaptes auratus	Common Flicker
Menanerpes carolinus	Red-bellied Woodpecker
Menanerpes erythrocephalus	Red-headed Woodpecker
Picoides villosus	Hairy Woodpecker
Picoides pubescens	Downy Woodpecker
Tyrannus tryannus	Eastern Kingbird
Myiarchus crinitus	Great-crested Flycatcher
Empidonax traillii	Willow Flycatcher
Contopus virens	Eastern Wood Peewee
Eremophila alpestris	Horned Lark
Tridoprocne bicolor	Tree Swallow
Hirundo rustica	Barn Swallow
Cyanocitta cristata	Blue Jay
Corvus brachyrhynchos	Common Crow
Parus atricapillus	Black- capped Chickadee
Sitta carolinensis	White-breasted Nuthatch
Troglodytes aedon	House wren
Dumetella carolinensis	Gray Catbird
Toxostoma rufum	Brown Thrasher
Turdus migratorius	American Robin
Hylocichla mustelina	Wood Thrush
Sialis sialis	Eastern Bluebird
Vireo griseus	White-eyed Vireo
Vireo olivaceus	Red-eyed Vireo
Dendroica petechia	Yellow Warbler
Geothlypis trichas	Common Yellowthroat
Dolichonyx oryzivorus	Bobolink
Sturnella magna	Eastern Meadowlark
Agelaius phoeniceus	Red-winged Blackbird
Iceterus spurius	Orchard Oriole
Icterus galbula	Northern Oriole
Quiscalus quiscula	Common Grackle
Molothrus ater	Brown-headed Cowbird
Piranga olivacea	Scarlet Tanager
Cardinalis cardinalis	Northern Cardinal
Pheucticus ludovicianus	Rose-breasted Grosbeak
Passerina cyanea	Indigo Bunting
Carduelis tristis	American Goldfinch
Pipilo erythrophthalmus	Rufous-sided Towhee
Ammodramus savannarum	Grasshopper Sparrow
Pooecetes gramineus	Vesper Sparrow
Spizella passerina	Chipping Sparrow
Spizella pusilla	Field Sparrow
Melospiza georgiana	Swamp Sparrow
Melospiza melodia	Song Sparrow

Species richness: 58 species

GLOSSARY

Several sources were used for the definitions, but the main reference is the *Glossary of Geology*, edited by Robert L. Bates and Julie A. Jackson (American Geological Institute 1987).

Age — An interval of geologic time; a division of an epoch.

Alluviated valley — One that has been at least partly filled with sand, silt, and mud by flowing water.

Alluvium — A general term for clay, silt, sand, gravel, or similar unconsolidated detrital material deposited during comparatively recent time by a stream or other body of running water as a sorted or semisorted sediment in the bed of a stream or on its floodplain or delta.

Anticline — A convex upward rock fold in which strata have been bent into an arch; the strata on each side of the core of the arch are inclined in opposite directions away from the axis or crest; the core contains rocks older than those on the perimeter of the structure.

Aquifer — A geologic formation that is water-bearing and transmits water from one point to another.

Argillaceous — Largely composed of clay-sized particles or clay minerals.

Bed — A naturally occurring layer of earth material of relatively greater horizontal than vertical extent; it is characterized by a change in physical properties from overlying and underlying materials. It also is the ground upon which any body of water rests or has rested; the land covered by the waters of a stream, lake, or ocean; or the bottom of a watercourse or stream channel.

Bedrock — The solid rock underlying the unconsolidated (non-indurated) surface materials such as soil, sand, gravel, and glacial till.

Bedrock valley — A drainageway eroded into the solid bedrock beneath the surface materials. It may be completely filled with unconsolidated (non-indurated) materials and hidden from view.

Braided stream — A low gradient, low volume stream flowing through an intricate network of interlacing shallow channels that repeatedly merge and divide, and are separated from each other by branch islands or channel bars. Such a stream may be incapable of carrying all of its load.

Calcarenite — Limestone composed of sand-sized grains consisting of more or less worn shell fragments or pieces of older limestone; a clastic limestone.

Calcareous — Containing calcium carbonate ($CaCO_3$); limy.

Calcite — A common rock-forming mineral consisting of $CaCO_3$; it may be white, colorless, or pale shades of gray, yellow, and blue; it has perfect rhombohedral cleavage, appears vitreous, and has a hardness of 3 on the Mohs' scale; it effervesces (fizzes) readily in cold dilute hydrochloric acid. It is the principal constituent of limestone.

Chert — Silicon dioxide (SiO_2); a compact, massive rock composed of minute particles of quartz and/or chalcedony; it is similar to flint but lighter in color.

Clastic — Fragmental rock composed of detritus, including broken organic hard parts as well as rock substances of any sort.

Closure — The difference in altitude between the crest of a dome or anticline and the lowest contour that completely surrounds it.

Concretion — A hard, compact, commonly rounded (but also disk-shaped or irregular in form) mass or aggregate of mineral matter; usually of a composition widely different from that of the rock in which it is found.

Crystalline — Said of a rock consisting wholly of crystals or fragments of crystals; esp. said of an igneous rock developed through cooling from a molten state and containing no glass, or of a metamorphic rock that has undergone recrystallization.

Cuesta — An asymmetrical hill or ridge with a long, gentle (back or dip) slope conforming with the resistant bed(s) that form it on one side, and a steep (scarp) slope or cliff on the other; formed by the outcrop of the resistant bed(s).

Delta — A low, nearly flat, alluvial land deposited at or near the mouth of a river where it enters a body of standing water; commonly a triangular or fan-shaped plain sometimes extending beyond the general trend of the coastline.

Detritus — Material produced by mechanical disintegration.

Diamictite — A comprehensive, nongenetic term for a nonsorted or poorly sorted, noncalcareous, terrigenous sedimentary rock that contains a wide range of particle sizes, such as a rock with sand and/or larger particles in a muddy matrix; e.g. a tillite or a pebbly mudstone.

Diamicton — A general term for the nonlithified equivalent of a diamictite; e.g. a till.

Disconformity — An *unconformity* marked by a distinct erosion-produced, irregular, uneven surface of appreciable relief between parallel strata below and above the break; sometimes represents a considerable interval of nondeposition.

Dolomite — A mineral, calcium-magnesium carbonate ($CaMg(CO_3)_2$; applied to those sedimentary rocks that are composed largely of the mineral dolomite; it is also precipitated directly from seawater. It is white, colorless, or tinged yellow, brown, pink, or gray, and has perfect rhombohedral cleavage; it appears pearly to vitreous, and effervesces feebly in cold dilute hydrochloric acid.

Drift — All rock material transported by a glacier and deposited either directly by the ice or reworked and deposited by meltwater streams and/or the wind.

End moraine — A ridge-like or series of ridge-like accumulations of drift that develop along the margin of an actively flowing glacier at any given time; a moraine that has been deposited at the lower or outer end of a glacier.

Eon — The largest division of geologic time; it consists of two or more eras.

Epoch — An interval of geologic time; a division of a period.

Era — A unit of geologic time that is next in magnitude beneath an eon; consists of two or more periods.

Fault — A fracture surface or zone in earth materials along which there has been vertical and/or horizontal displacement or movement of the strata on both sides relative to one another.

Ferruginous — Pertaining to or containing iron, e.g., a sandstone that is cemented with iron oxide.

Floodplain — The surface or strip of relatively smooth land that lies adjacent to a stream channel and has been produced by stream erosion and deposition; the area covered with water when the stream overflows its banks at times of high water; it is built of alluvium carried by the stream during floods and deposited in the sluggish water beyond the influence of the swiftest current.

Fluvial — Of or pertaining to a river or rivers.

Fluviolacustrine — Pertains to sedimentation partly in lake water and partly in streams, or to sediments deposited under alternating or overlapping lacustrine and fluvial conditions.

Formation — The basic rock unit distinctive enough to be readily recognizable in the field and widespread and thick enough to be plotted on a map. It describes the strata, such as limestone, sandstone, shale, or combinations of these and other rock types; formations have formal names, such as Joliet Formation or St. Louis Limestone (Formation), which are usually derived from geographic localities.

Geologic column — a chart that shows the subdivisions of part or all of geologic time or the sequence of stratigraphic units (oldest at the bottom and youngest at the top) of a given place or region.

Geophysics — Study of the earth by quantitative physical methods.

Glacier — A large, slow-moving mass of ice at least in part on land.

Graben — An elongate, relatively depressed crustal unit or block that is bounded by faults on its long sides. It is a structural form that may or may not be geomorphologically expressed as a rift valley.

Gradient — A part of a surface feature of the earth that slopes upward or downward; a slope, as of a stream channel or of a land surface.

Ground moraine — A sheet-like accumulation of glacial drift, principally till, deposited beneath a glacier to form an extensive area of low relief devoid of transverse linear features.

Groundwater — Water that is present below the ground surface in the soil and rocks of the earth's outer crust.

Group — A geologic rock unit consisting of two or more formations.

Hydrogeology — The science that deals with subsurface waters and related geologic aspects of surface waters.

Ice sheet — A glacier of considerable thickness and more than 50,000 square kilometers in area, forming a continuous cover of ice and snow over a land surface...and not confined by the underlying topography; a *continental glacier.*

Igneous — Said of a rock or mineral that solidified from molten or partly molten material, i.e., from magma.

Indurated — A compact rock or soil hardened by the action of pressure, cementation, and especially heat.

Joint — A fracture or crack in rocks along which there has been no movement of the opposing sides.

Lacustrine — Produced by or belonging to a lake.

Laurasia — A combination of Laurentia, a paleogeographic term for the Canadian Shield and its surroundings, and Eurasia. It is the protocontinent of the Northern Hemisphere, corresponding to Gondwana in the Southern Hemisphere, from which the present continents of the Northern Hemisphere have been derived by separation and continental displacement. The hypothetical supercontinent from which both were derived is *Pangea.* The protocontinent included most of North America, Greenland, and most of Eurasia, excluding India. The main zone of separation was in the North Atlantic, with a branch in Hudson Bay; geologic features on opposite sides of these zones are very similar.

Limestone — A sedimentary rock consisting primarily of calcium carbonate (the mineral, calcite).

Lithify — To change to stone, or to petrify; esp. to consolidate from a loose sediment to a solid rock.

Lithology — The description of rocks on the basis of color, structures, mineral composition, and grain size; the physical character of a rock.

Local relief — The vertical difference in elevation between the highest and lowest points of a land surface within a specified horizontal distance or in a limited area.

Loess — A homogeneous, unstratified deposit of silt deposited by the wind.

Member — A rock-stratigraphic unit of subordinate rank, comprising some specially developed part of a varied formation (e.g., a subdivision of local extent only, or a unit with the same color, hardness, composition, and other rock properties that distinguish it from adjacent units in the formation). It may be formally defined and named, informally named, or unnamed; it is not necessarily mappable.

Metamorphic rock — Any rock derived from preexisting rocks by mineralogical, chemical, and structural changes, essentially in the solid state, in response to marked changes in temperature, pressure, shearing stress, and chemical environment at depth in the earth's crust (gneisses, schists, marbles, quartzites, etc.).

Moraine — A mound, ridge, or other distinct accumulation of...glacial drift, predominantly till, deposited...in a variety of topographic landforms that are independent of control by the surface on which the drift lies.

Outwash — Stratified drift (clay, silt, sand, gravel) deposited by meltwater streams in channels, deltas, and glacial lakes, and on outwash plains and floodplains.

Outwash plain — The surface of a broad body of outwash formed in front of a glacier.

Overburden — The upper part of a sedimentary deposit, compressing and consolidating the material below; or barren rock material overlying a mineral deposit.

Pangea — A hypothetical supercontinent supposed by many geologists to have existed very early in the geologic past, and to have combined all the continental crust from which the present continents were derived by fragmentation and movement away from each other by means of some form of continental displacement. During an intermediate stage of the fragmentation, between the existence of Pangea and that of the present, widely separated continents, Pangea was supposed to have split into two large fragments, *Laurasia* on the north and *Gondwana* on the south. The proto-ocean around Pangea has been termed *Panthalassa.* Other geologists, while accepting the former existence of Laurasia and Gondwana, are reluctant to concede the existence of an original Pangea; in fact, the early (Paleozoic or older) history of continental displacement remains largely undeciphered.

Period — An interval of geologic time; a division of an era.

Physiography — The study and classification of the surface features of Earth on the basis of similarities in geologic structure and the history of geologic changes.

Physiographic province (or division) — (a) A region, all parts of which are similar in geologic structure and climate and which has consequently had a unified geologic history; (b) a region whose pattern of relief features or landforms differs significantly from that of adjacent regions.

Rank — A coal classification based on degree of metamorphism.

Relief — (a) A term used loosely for the actual physical shape, configuration, or general uneveness of a part of the earth's surface, considered with reference to variations of height and slope or to irregularities of the land surface; the elevations or differences in elevation, considered collectively, of a land surface (frequently confused with topography). (b) The vertical difference in elevation between the hilltops or mountain summits and the lowlands or valleys of a given region: "high relief" has great variation; "low relief" has little variation.

Sediment — Solid fragmental material, either inorganic or organic, that originates from weathering of rocks and is transported by, suspended in, or deposited by air, water, or ice, or that is accumulated by other natural agents, such as chemical precipitation from solution or secretion from organisms, and that forms in layers on the earth's surface at ordinary temperatures in a loose, unconsolidated form; e.g, sand, gravel, silt, mud, till, loess, alluvium.

Sedimentary rock — A rock resulting from the consolidation of loose sediment that has accumulated in layers.

Series — A geologic time-stratigraphic unit; the strata deposited during an epoch; a division of a system.

Sluiceway — An overflow channel.

Stage, substage — Geologic time-stratigraphic units; the strata formed during an age or subage, respectively.

Stratigraphy — the study, definition, and description of major and minor natural divisions of rocks, especially the study of the form, arrangement, geographic distribution, chronologic succession, classification, correlation, and mutual relationships of rock strata.

Stratigraphic unit — A stratum or body of strata recognized as a unit in the classification of the rocks of the earth's crust with respect to any specific rock character, property, or attribute or for any purpose such as description, mapping, and correlation.

Stratum, plural strata — A tabular or sheet-like mass, or a single and distinct layer, of homogeneous or gradational sedimentary material of any thickness, visually separable from other layers above and below by a discrete change in character of the material deposited or by a sharp physical break in deposition, or by both; a sedimentary *bed.*

Stylolite — A surface or contact, usually occurring in homogeneous carbonate rocks...that is marked by an irregular and interlocking penetration of the two sides; the columns, pits, and teeth-like projections on one side fit into their counterparts on the other. As usually seen in cross section, it resembles a suture or the tracing of a stylus. The seam is characterized by a concentraion of insoluble constituents of the rock...and is commonly parallel to the bedding.

System — the largest, fundamental geologic time-stratigraphic unit; the strata of a system were deposited during a period of geologic time.

Tectonic — pertaining to the global forces involved in, or the resulting structures or features of the earth's movements.

Till — Unconsolidated, nonsorted, unstratified drift deposited by and underneath a glacier and consisting of a heterogenous mixture of different sizes and kinds of rock fragments.

Till plain — The wavey surface of low relief in the area underlain by ground moraine.

Topography — The natural or physical surface features of a region, considered collectively as to form; the features revealed by the contour lines of a map.

Unconformity — A surface of erosion or nondeposition that separates younger strata from older strata; most unconformities indicate intervals of time when former areas of the sea bottom were temporarily raised above sea level.

Valley trains — The accumulations of outwash deposited by rivers in the valleys downstream from a glacier.

PLEISTOCENE GLACIATIONS IN ILLINOIS

Origin of the Glaciers

During the past million years or so, an interval of time called the Pleistocene Epoch, most of the northern hemisphere above the 50th parallel has been repeatedly covered by glacial ice. The cooling of the earth's surface, a prerequisite for glaciation, began at least 2 million years ago. On the basis of evidence found in subpolar oceans of the world (temperature-dependent fossils and oxygen-isotope ratios), a recent proposal has been made to recognize the beginning of the Pleistocene at 1.6 million years ago. Ice sheets formed in sub-arctic regions many times and spread outward until they covered the northern parts of Europe and North America. In North America, early studies of the glacial deposits led to the model that four glaciations could explain the observed distribution of glacial deposits. The deposits of a glaciation were separated from each other by the evidence of intervals of time during which soils formed on the land surface. In order of occurrence from the oldest to the youngest, they were given the names Nebraskan, Kansan, Illinoian, and Wisconsinan Stages of the Pleistocene Epoch. Work in the last 30 years has shown that there were more than four glaciations but the actual number and correlations at this time are not known. Estimates that are gaining credibility suggest that there may have been about 14 glaciations in the last one million years. In Illinois, estimates range from 4 to 8 based on buried soils and glacial deposits. For practical purposes, the previous four glacial stage model is functional, but we now know that the older stages are complex and probably contain more than one glaciation. Until we know more, all of the older glacial deposits, including the Nebraskan and Kansan will be classified as pre-Illinoian. The limits and times of the ice movement in Illinois are illustrated in the following pages by several figures.

The North American ice sheets developed when the mean annual temperature was perhaps 4° to 7°C (7° to 13°F) cooler than it is now and winter snows did not completely melt during the summers. Because the time of cooler conditions lasted tens of thousands of years, thick masses of snow and ice accumulated to form glaciers. As the ice thickened, the great weight of the ice and snow caused them to flow outward at their margins, often for hundreds of miles. As the ice sheets expanded, the areas in which snow accumulated probably also increased in extent.

Tongues of ice, called lobes, flowed southward from the Canadian centers near Hudson Bay and converged in the central lowland between the Appalachian and Rocky Mountains. There the glaciers made their farthest advances to the south. The sketch below shows several centers of flow, the general directions of flow from the centers, and the southern extent of glaciation. Because Illinois lies entirely in the central lowland, it has been invaded by glaciers from every center.

Effects of Glaciation

Pleistocene glaciers and the waters melting from them changed the landscapes they covered. The glaciers scraped and smeared the landforms they overrode, leveling and filling many of the minor valleys and even some of the larger ones. Moving ice carried colossal amounts of rock and earth, for much of what the glaciers wore off the ground was kneaded into the moving ice and carried along, often for hundreds of miles.

The continual floods released by melting ice entrenched new drainageways, deepened old ones, and then partly refilled both with sediments as great quantities of rock and earth were carried beyond the glacier fronts. According to some estimates, the amount of water drawn from the sea and changed into ice during a glaciation was enough to lower the sea level from 300 to 400 feet below present level. Consequently, the melting of a continental ice sheet provided a tremendous volume of water that eroded and transported sediments.

In most of Illinois, then, glacial and meltwater deposits buried the old rock-ribbed, low, hill-and-valley terrain and created the flatter landforms of our prairies. The mantle of soil material and the buried deposits of gravel, sand, and clay left by the glaciers over about 90 percent of the state have been of incalculable value to Illinois residents.

Glacial Deposits

The deposits of earth and rock materials moved by a glacier and deposited in the area once covered by the glacier are collectively called **drift**. Drift that is ice-laid is called **till**. Water-laid drift is called **outwash**.

Till is deposited when a glacier melts and the rock material it carries is dropped. Because this sediment is not moved much by water, a till is unsorted, containing particles of different sizes and compositions. It is also stratified (unlayered). A till may contain materials ranging in size from microscopic clay particles to large boulders. Most tills in Illinois are pebbly clays with only a few boulders. For descriptive purposes, a mixture of clay, silt, sand and boulders is called **diamicton**. This is a term used to describe a deposit that could be interpreted as till or a mass wasting product.

Tills may be deposited as **end moraines**, the arc-shaped ridges that pile up along the glacier edges where the flowing ice is melting as fast as it moves forward. Till also may be deposited as **ground moraines**, or **till plains**, which are gently undulating sheets deposited when the ice front melts back, or retreats. Deposits of till identify areas once covered by glaciers. Northeastern Illinois has many alternating ridges and plains, which are the succession of end moraines and till plains deposited by the Wisconsinan glacier.

Sorted and stratified sediment deposited by water melting from the glacier is called **outwash**. Outwash is bedded, or layered, because the flow of water that deposited it varied in gradient, volume, velocity, and direction. As a meltwater stream washes the rock materials along, it sorts them by size—the fine sands, silts, and clays are carried farther downstream than the coarser gravels and cobbles. Typical Pleistocene outwash in Illinois is in multilayered beds of clays, silts, sands, and gravels that look much like modern stream deposits in some places. In general, outwash tends to be coarser and less weathered, and alluvium is most often finer than medium sand and contains variable amounts of weathered material.

Outwash deposits are found not only in the area covered by the ice field but sometimes far beyond it. Meltwater streams ran off the top of the glacier, in crevices in the ice, and under the ice. In some places, the cobble-gravel-sand filling of the bed of a stream that flowed in the ice is preserved as a sinuous ridge called an **esker**. Some eskers in Illinois are made up of sandy to silty deposits and contain mass wasted diamicton material. Cone-shaped mounds of coarse outwash, called **kames**, were formed where meltwater plunged through crevasses in the ice or into ponds on the glacier.

The finest outwash sediments, the clays and silts, formed bedded deposits in the ponds and lakes that filled glacier-dammed stream valleys, the sags of the till plains, and some low, moraine-diked till plains. Meltwater streams that entered a lake rapidly lost speed and also quickly dropped the sands and gravels they carried, forming deltas at the edge of the lake. Very fine sand and silts were commonly redistributed on the lake bottom by wind-generated currents, and the clays, which stayed in suspension longest, slowly settled out and accumulated with them.

Along the ice front, meltwater ran off in innumerable shifting and short-lived streams that laid down a broad, flat blanket of outwash that formed an **outwash plain**. Outwash was also carried away from the glacier in valleys cut by floods of meltwater. The Mississiippi, Illinois, and Ohio Rivers occupy valleys that were major channels for meltwaters and were greatly widened and deepened during times of the greatest meltwater floods. When the floods waned, these valleys were partly filled with outwash far beyond the ice margins. Such outwash deposits, largely sand and gravel, are known as **valley trains**. Valley train deposits may be both extensive and thick. For instance, the long valley train of the Mississippi Valley is locally as much as 200 feet thick.

Loess, Eolian Sand and Soils

One of the most widespread sediments resulting from glaciation was carried not by ice or water but by wind. **Loess** is the name given to windblown deposits dominated by silt. Most of the silt was derived from wind erosion of the valley trains. Wind action also sorted out **eolian sand** which commonly formed **sand dunes** on the valley trains or on the adjacent uplands. In places, sand dunes have migrated up to 10 miles away from the principle source of sand. Flat areas between dunes are generally underlain by eolian **sheet sand** that is commonly reworked by water action. On uplands along the major valley trains, loess and eolian sand are commonly interbedded. With increasing distance from the valleys, the eolian sand pinches out, often within one mile.

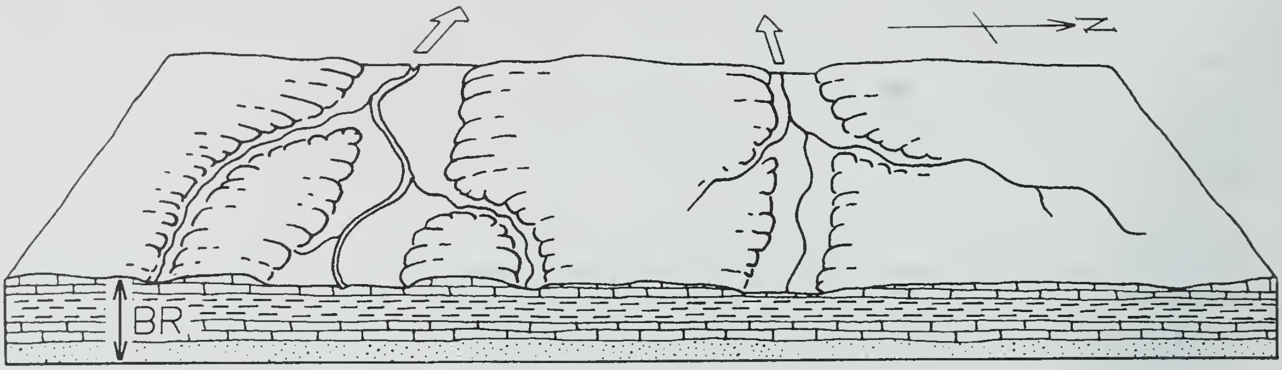
Eolian deposition occurred when certain climatic conditions were met, probably in a seasonal pattern. Deposition could have occurred in the fall, winter or spring season when low precipitation rates and low temperatures caused meltwater floods to abate, exposing the surfaces of the valley trains and permitting them to dry out. During Pleistocene time, as now, west winds prevailed, and the loess deposits are thickest on the east sides of the source valleys. The loess thins rapidly away from the valleys but extends over almost all the state.

Each Pleistocene glaciation was followed by an interglacial stage that began when the climate warmed enough to melt the glaciers and their snowfields. During these warmer intervals, when the climate was similar to that of today, drift and loess surfaces were exposed to weather and the activities of living things. Consequently, over most of the glaciated terrain, soils developed on the Pleistocene deposits and altered their composition, color, and texture. Such soils were generally destroyed by later glacial advances, but some were buried. Those that survive serve as "key beds," or stratigraphic markers, and are evidence of the passage of a long interval of time.

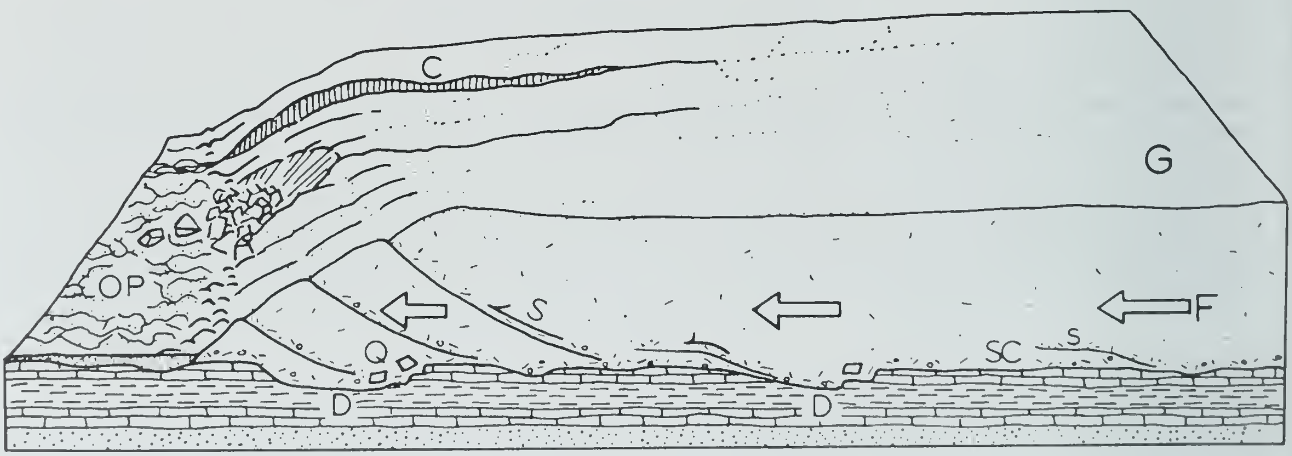
Glaciation in a Small Illinois Region

The following diagrams show how a continental ice sheet might have looked at various stages as it moved across a small region in Illinois. They illustrate how it could change the old terrain and create a landscape like the one we live on. To visualize how these glaciers looked, geologists study the landforms and materials left in the glaciated regions and also the present-day mountain glaciers and polar ice caps.

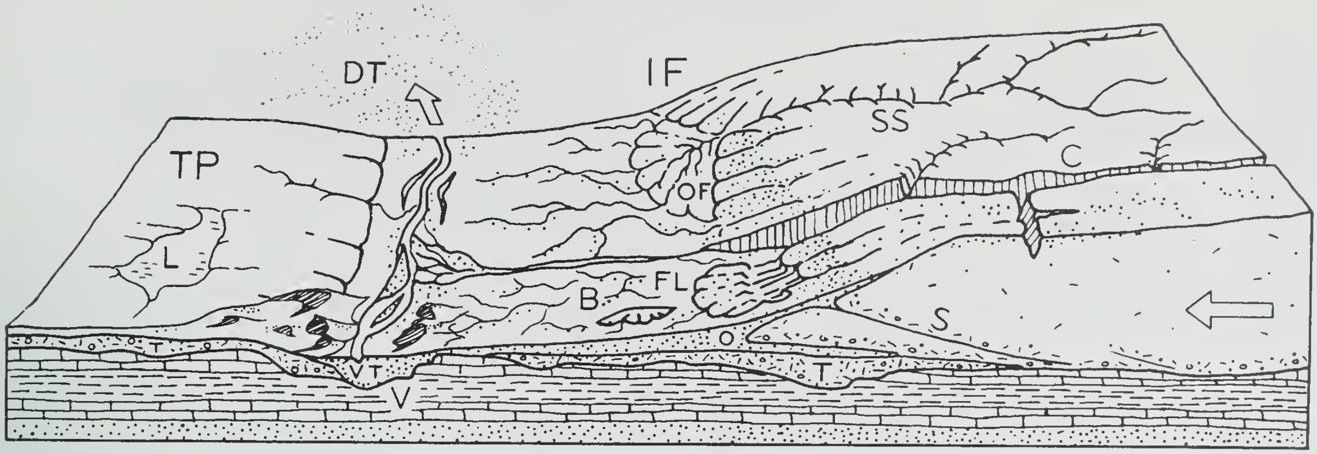
The block of land in the diagrams is several miles wide and about 10 miles long. The vertical scale is exaggerated—layers of material are drawn thicker and landforms higher than they ought to be so that they can be easily seen.



1. **The Region Before Glaciation** — Like most of Illinois, the region illustrated is underlain by almost flat-lying beds of sedimentary rocks—layers of sandstone ( ), limestone ( ), and shale ( ). Millions of years of erosion have planed down the bedrock (BR), creating a terrain of low uplands and shallow valleys. A residual soil weathered from local rock debris covers the area but is too thin to be shown in the drawing. The streams illustrated here flow westward and the one on the right flows into the other at a point beyond the diagram.



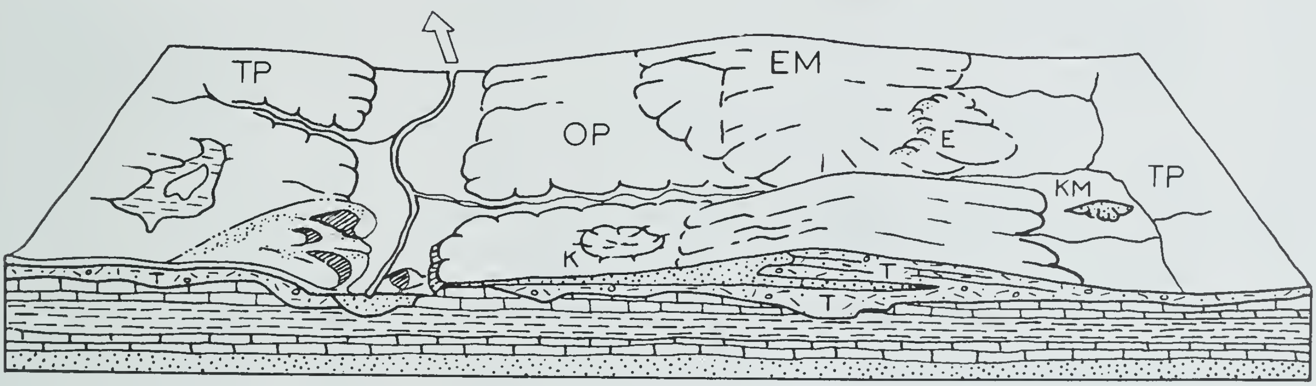
2. **The Glacier Advances Southward** — As the Glacier (G) spreads out from its ice snowfield accumulation center, it scours (SC) the soil and rock surface and quarries (Q)—pushes and plucks up—chunks of bedrock. The materials are mixed into the ice and make up the glacier's "load." Where roughnesses in the terrain slow or stop flow (F), the ice "current" slides up over the blocked ice on innumerable shear planes (S). Shearing mixes the load very thoroughly. As the glacier spreads, long cracks called "crevasses" (C) open parallel to the direction of ice flow. The glacier melts as it flows forward, and its meltwater erodes the terrain in front of the ice, deepening (D) some old valleys before ice covers them. Meltwater washes away some of the load freed by melting and deposits it on the outwash plain (OP). The advancing glacier overrides its outwash and in places scours much of it up again. The glacier may be 5000 or so feet thick, and tapers to the margin, which was probably in the range of several hundred feet above the old terrain. The ice front advances perhaps as much as a third of a mile per year.



3. **The Glacier Deposits an End Moraine** — After the glacier advances across the area, the climate warms and the ice begins to melt as fast as it advances. The ice front (IF) is now stationary, or fluctuating in a narrow area, and the glacier is depositing an end moraine.

As the top of the glacier melts, some of the sediment that is mixed in the ice accumulates on top of the glacier. Some is carried by meltwater onto the sloping ice front (IF) and out onto the plain beyond. Some of the debris slips down the ice front in a mudflow (FL). Meltwater runs through the ice in a crevasse (C). A supraglacial stream (SS) drains the top of the ice, forming an outwash fan (OF). Moving ice has overridden an immobile part of the front on a shear plane (S). All but the top of a block of ice (B) is buried by outwash (O).

Sediment from the melted ice of the previous advance (figure 2) remains as a till layer (T), part of which forms the till plain (TP). A shallow, marshy lake (L) fills a low place in the plain. Although largely filled with drift, the valley (V) remains a low spot in the terrain. As soon as the ice cover melts, meltwater drains down the valley, cutting it deeper. Later, outwash partly refills the valley: the outwash deposit is called a valley train (VT). Wind blows dust (DT) off the dry floodplain. The dust will form a loess deposit when it settles. Sand dunes (D) form on the south and east sides of streams.



4. **The Region after Glaciation** — As the climate warms further, the whole ice sheet melts, and glaciation ends. The end moraine (EM) is a low, broad ridge between the outwash plain (OP) and till plains (TP). Run-off from rains cuts stream valleys into its slopes. A stream goes through the end moraine along the channel cut by the meltwater that ran out of the crevasse in the glacier.

Slopewash and vegetation are filling the shallow lake. The collapse of outwash into the cavity left by the ice block's melting has made a kettle (K). The outwash that filled a tunnel draining under the glacier is preserved in an esker (E). The hill of outwash left where meltwater dumped sand and gravel into a crevasse or other depression in the glacier or at its edge is a kame (KM). A few feet of loess covers the entire area but cannot be shown at this scale.

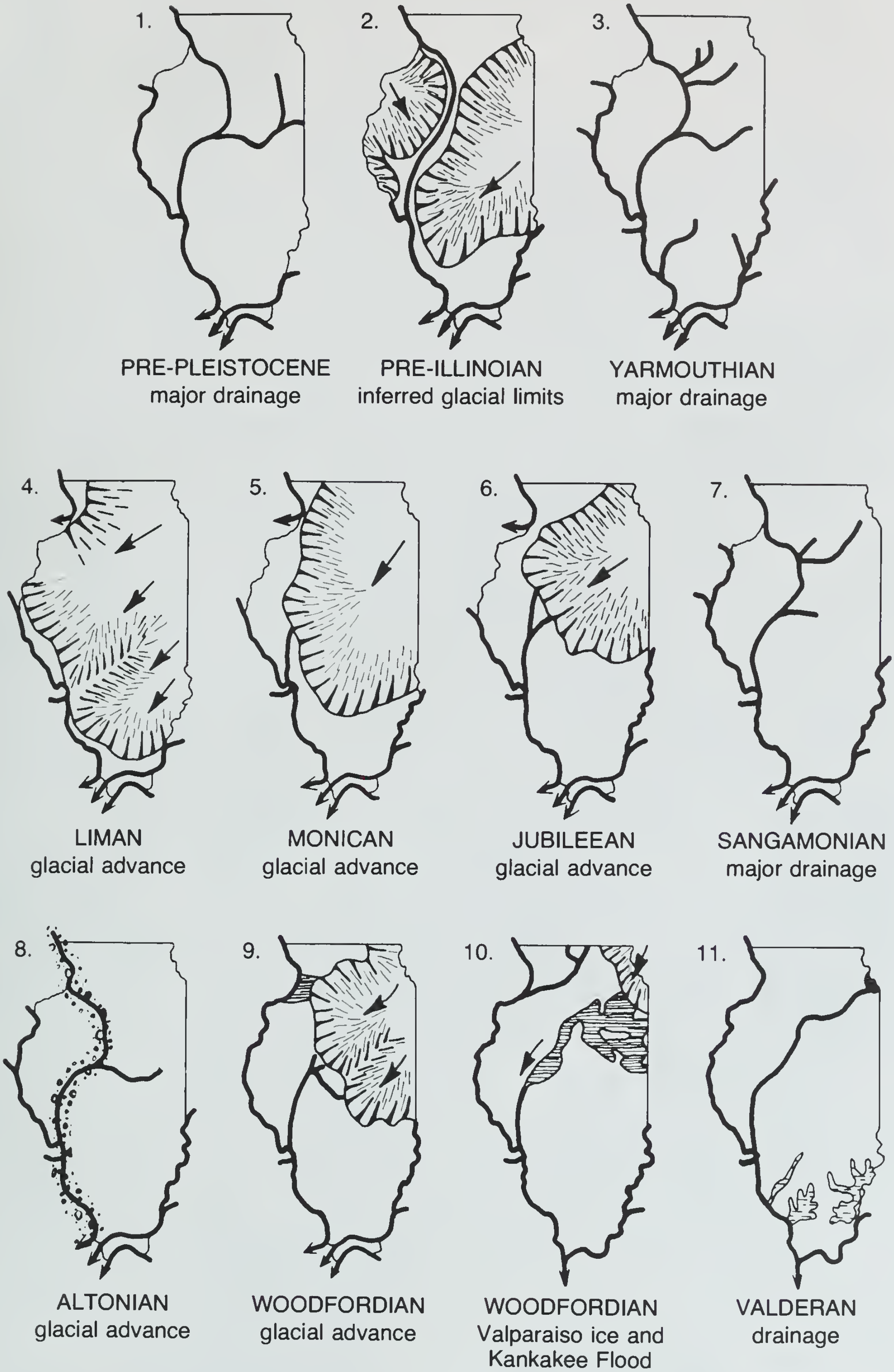
TIME TABLE OF PLEISTOCENE GLACIATION

		STAGE		SUBSTAGE	NATURE OF DEPOSITS	SPECIAL FEATURES
QUATERNARY		HOLOCENE (interglacial)		Years Before Present	Soil, youthful profile of weathering, lake and river deposits, dunes, peat	
				10,000		
	Pleistocene	WISCONSINAN (glacial)	late	Valderan	Outwash, lake deposits	Outwash along Mississippi Valley
				11,000		
				Twocreekan	Peat and alluvium	Ice withdrawal, erosion
				12,500		
				Woodfordian	Drift, loess, dunes, lake deposits	Glaciation; building of many moraines as far south as Shelbyville; extensive valley trains, outwash plains, and lakes
				25,000		
			mid	Farmdalian	Soil, silt, and peat	Ice withdrawal, weathering, and erosion
				28,000		
			early	Altonian	Drift, loess	Glaciation in Great Lakes area, valley trains along major rivers
				75,000		
		SANGAMONIAN (interglacial)			Soil, mature profile of weathering	Important stratigraphic marker
				125,000		
		ILLINOIAN (glacial)		Jubileean	Drift, loess, outwash	Glaciers from northeast at maximum reached Mississippi River and nearly to southern tip of Illinois
				Monican	Drift, loess, outwash	
				Liman	Drift, loess, outwash	
				300,000?		
		YARMOUTHIAN (interglacial)			Soil, mature profile of weathering	Important stratigraphic marker
				500,000?		
		Pre-Illinoian: KANSAN* (glacial)			Drift, loess	Glaciers from northeast and northwest covered much of state
				700,000?		
		Pre-Illinoian: AFTONIAN* (interglacial)			Soil, mature profile of weathering	(hypothetical)
				900,000?		
		Pre-Illinoian: NEBRASKAN* (glacial)			Drift (little known)	Glaciers from northwest invaded western Illinois
				1,600,000 or more		

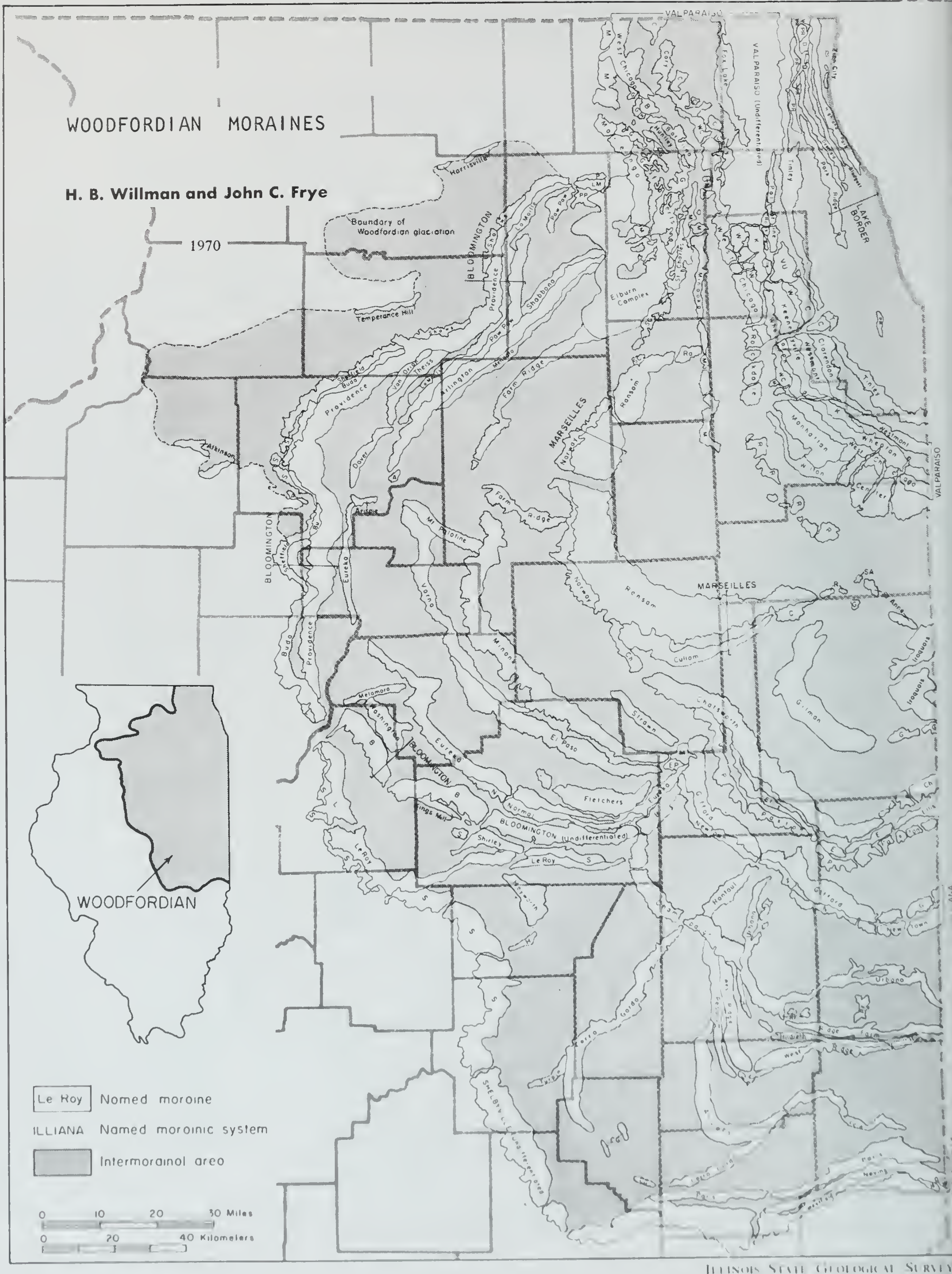
*Old oversimplified concepts, now known to represent a series of glacial cycles.

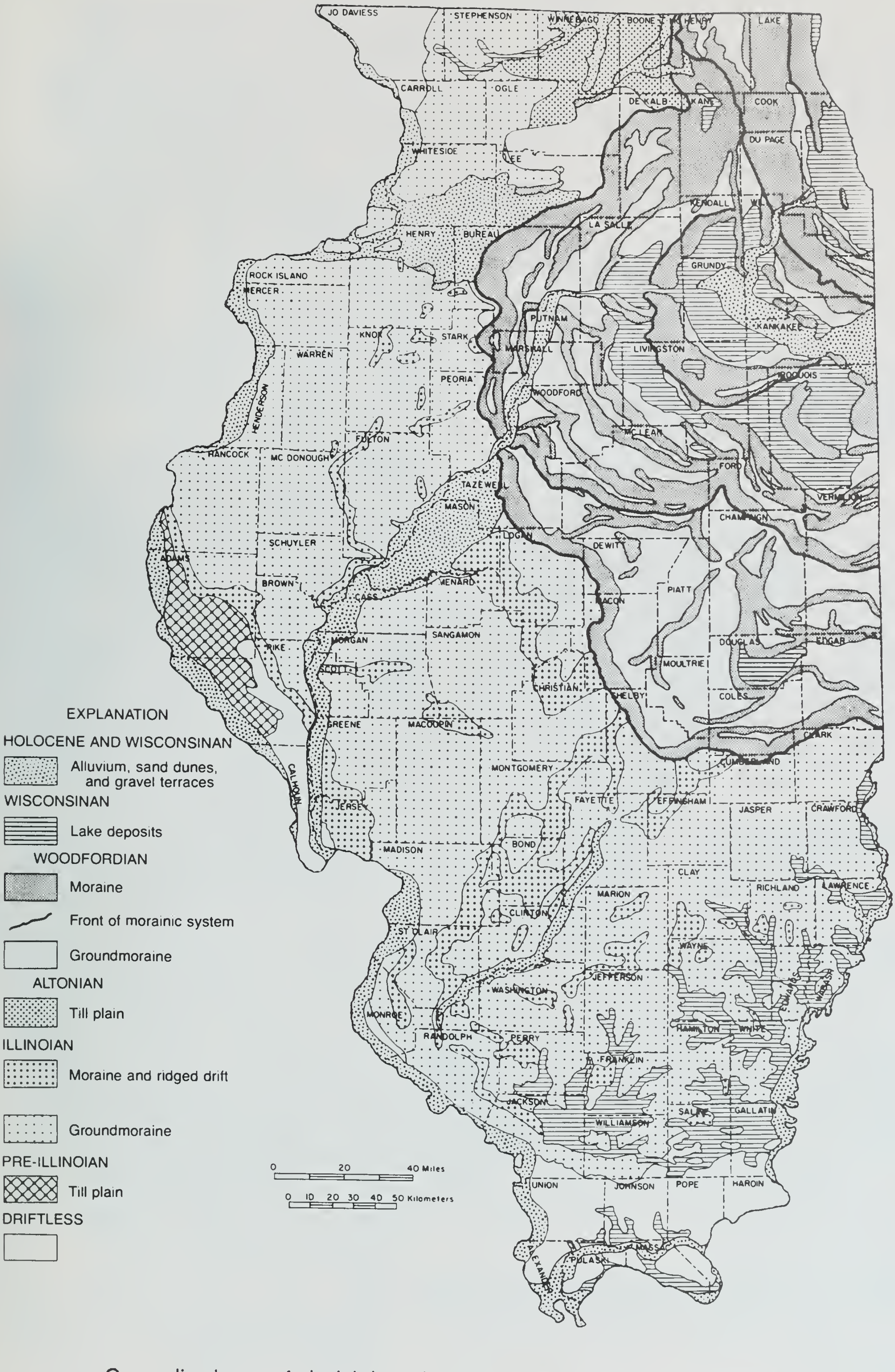
(Illinois State Geological Survey, 19

SEQUENCE OF GLACIATIONS AND INTERGLACIAL DRAINAGE IN ILLINOIS

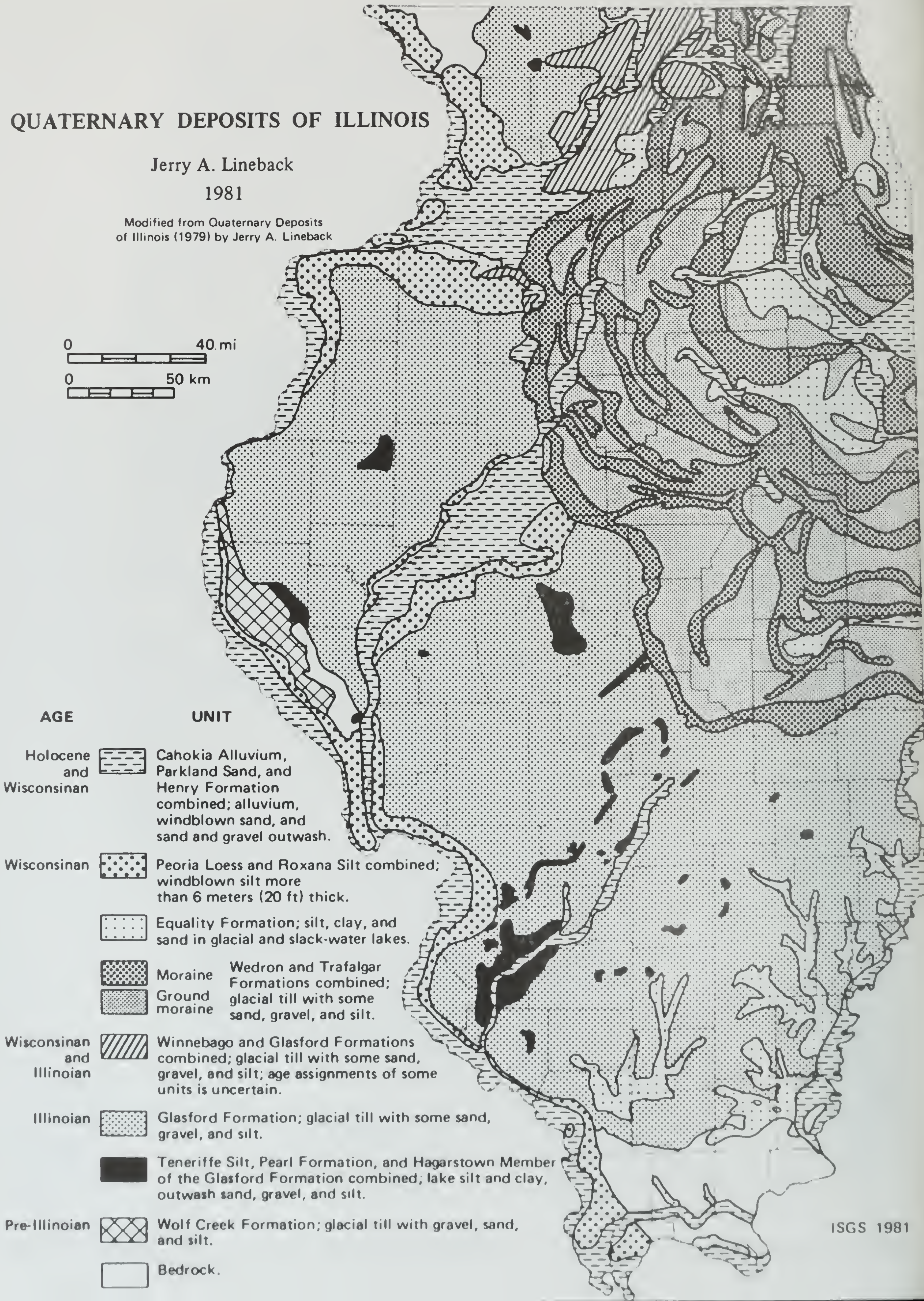


(Modified from Willman and Frye, "Pleistocene Stratigraphy of Illinois," ISGS Bull. 94, fig. 5, 1970.)


WOODFORDIAN MORAINES
H. B. Willman and John C. Frye
1970
Boundary of Woodfordian glaciation
VALPARAISO
VALPARAISO (Undifferentiated)
LAKE BORDER
BLOOMINGTON
MARSEILLES
Elburn Complex
Harrisville
Temperance Hill
Shabbona
Providence
Paw Paw
Arlington
Mendota
Farm Ridge
Theiss
Van Orin
Sheffield
Buda
Dover
Atkinson
Eureka
Mt Palatine
Varna
Minonk
Norway
Ransom
Cullom
Chatsworth
Gilman
Iroquois
Streator
El Paso
Fletchers
Normal
BLOOMINGTON (Undifferentiated)
Shirley
Le Roy
Kings Mill
Metamora
Washington
Heyworth
Cerro Gordo
Rantoul
Gifford
Urbana
West Ridge
Nevins
Paris
SHELBYVILLE (Undifferentiated)
West Chicago
Fox Lake
Minooka
Chicago
Rockdale
Keeneyville
Clarendon
Tinley
Park Ridge
Manhattan
Wilton
Westmont
Le Roy Named moraine
ILLIANA Named morainic system
Intermorainal area
0 10 20 30 Miles
0 20 40 Kilometers
WOODFORDIAN



Generalized map of glacial deposits in Illinois (modified from Willman and Frye 1970).



QUATERNARY DEPOSITS OF ILLINOIS
Jerry A. Lineback
1981
Modified from Quaternary Deposits of Illinois (1979) by Jerry A. Lineback
0 40 mi
0 50 km
AGE
UNIT
Holocene and Wisconsinan
Cahokia Alluvium, Parkland Sand, and Henry Formation combined; alluvium, windblown sand, and sand and gravel outwash.
Wisconsinan
Peoria Loess and Roxana Silt combined; windblown silt more than 6 meters (20 ft) thick.
Equality Formation; silt, clay, and sand in glacial and slack-water lakes.
Moraine
Ground moraine
Wedron and Trafalgar Formations combined; glacial till with some sand, gravel, and silt.
Wisconsinan and Illinoian
Winnebago and Glasford Formations combined; glacial till with some sand, gravel, and silt; age assignments of some units is uncertain.
Illinoian
Glasford Formation; glacial till with some sand, gravel, and silt.
Teneriffe Silt, Pearl Formation, and Hagarstown Member of the Glasford Formation combined; lake silt and clay, outwash sand, gravel, and silt.
Pre-Illinoian
Wolf Creek Formation; glacial till with gravel, sand, and silt.
Bedrock.
ISGS 1981

ILLINOIS STATE GEOLOGICAL SURVEY
Urbana, Illinois 61801

GEOGRAM 5
October 1975

ANCIENT DUST STORMS IN ILLINOIS

Myrna M. Killey

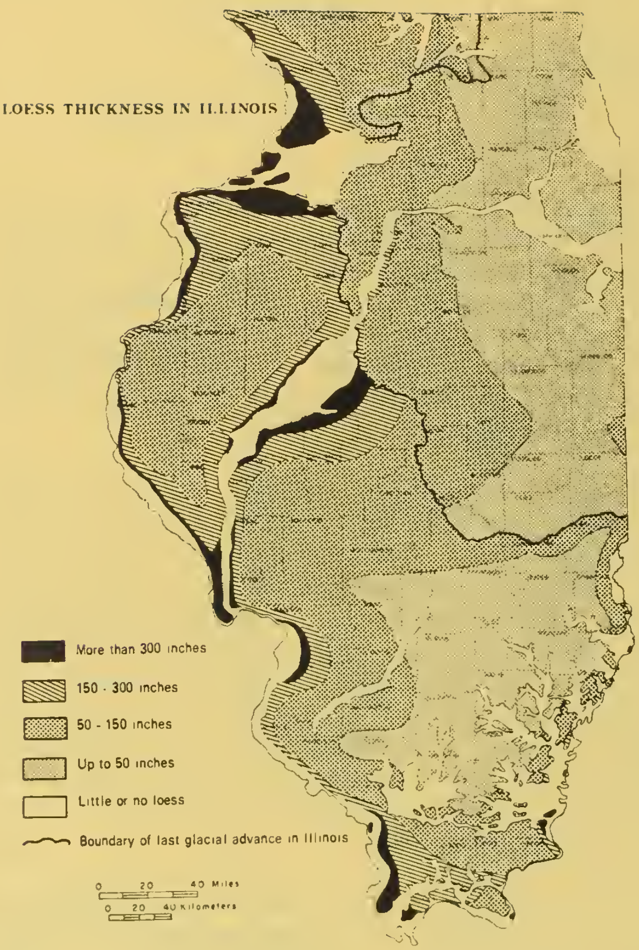
Fierce dust storms whirled across Illinois long before human beings were here to record them. Where did all the dust come from? Geologists have carefully put together clues from the earth itself to get the story. As the glaciers of the Great Ice Age scraped and scoured their way southward across the landscape from Canada, they moved colossal amounts of rock and earth. Much of the rock ground from the surface was kneaded into the ice and carried along, often for hundreds of miles. The glaciers acted as giant grist mills, grinding much of the rock and earth to "flour"—very fine dust-sized particles.

During the warm seasons, water from the melting ice poured from the glacier front, laden with this rock flour, called silt. In the cold months the meltwater stopped flowing and the silt was left along the channels the water had followed, where it dried out and became dust. Strong winds picked up the dust, swept it from the floodplains, and carried it to adjacent uplands. There the forests along the river valleys trapped the dust, which became part of the moist forest soil. With each storm more material accumulated until the high bluffs adjacent to major rivers were formed. The dust deposits are thicker along the eastern sides of the valleys than they are on the western sides, a fact from which geologists deduce that the prevailing winds of that time blew from west to east, the same direction as those of today. From such clues geologists conclude that the geologic processes of the past were much like those of today.

The deposits of windblown silt are called loess (rhymes with "bus"). Loess is found not only in the areas once covered by the glaciers but has been blown into the nonglaciated areas. The glaciers, therefore, influenced the present land surface well beyond the line of their farthest advance.

Loess has several interesting characteristics. Its texture is so fine and uniform that it can easily be identified in roadcuts—and because it blankets such a vast area many roads are cut through it. Even more noticeable is its tendency to stand in vertical walls. These steep walls develop as the loess drains and becomes tough, compact, and massive, much like a rock. Sometimes cracks develop in the loess, just as they do in massive limestones and sandstones. Loess makes good highway banks if it is cut vertically. A vertical cut permits maximum drainage because little surface is exposed to rain, and rainwater tends to drain straight down through it to the rock underneath. If the bank is cut at an angle more water soaks in, which causes the loess to slump down. Along Illinois roads the difference between a loess roadcut and one in ordinary glacial till is obvious. The loess has a very uniform texture, while the till is composed of a random mixture of rock debris, from clay and silt through cobbles and boulders.

Many loess deposits are worth a close look. Through a 10-power hand lens separate grains can be seen, among them many clear, glassy, quartz grains. Some loess deposits contain numerous rounded, lumpy stones called concretions. Their formation began when water percolating through the loess dissolved tiny



limestone grains. Some of the dissolved minerals later became solid again, gathering around a tiny nucleus or along roots to form the lumpy masses. A few such concretions are shaped roughly like small dolls and, from this resemblance, are called "loess kindchen," a German term meaning "loess children." They may be partly hollow and contain smaller lumps that make them rattle when shaken.

Fossil snails can be found in some loess deposits. The snails lived on the river bluffs while the loess was being deposited and were buried by the dust. When they are abundant, they are used to determine how old the loess is. The age is found by measuring the amount of radioactive carbon in the calcium carbonate of their shells.

Some of the early loess deposits were covered by new layers of loess following later glacial invasions. Many thousands of years passed between the major glacial periods, during which time the climate was as warm as that of today. During the warm intervals, the surface of the loess and other glacial deposits was exposed to weather. Soils developed on most of the terrain, altering the composition, color, and texture of the glacial material. During later advances of the ice, some of these soils were destroyed, but in many places they are preserved under the younger sediments. Such ancient buried soils can be used to determine when the materials above and below them were laid down by the ice and what changes in climate took place.

The blanket of loess deposited by the ancient dust storms forms the parent material of the rich, deep soils that today are basic to the state's agriculture. A soil made of loess crumbles easily and has great moisture-holding capacity. It also is free from rocks that might complicate cultivation. Those great dust storms that swirled over the land many thousands of years ago thus endowed Illinois with one of its greatest resources, its highly productive soil.

ERRATICS ARE ERRATIC

Myrna M. Killey

You may have seen them scattered here and there in Illinois—boulders, some large, some small, lying alone or with a few companions in the corner of a field, at the edge of a road, in someone's yard, or perhaps on a courthouse lawn or schoolyard. Many of them seem out of place, like rough, alien monuments in the stoneless, grassy knolls and prairies of our state. Some—the colorful and glittering granites, banded gneisses, and other intricately veined and streaked igneous and metamorphic rocks--are indeed foreign rocks, for they came from Canada and the states north of us. Others—gray and tan sedimentary rocks—are native rocks and may be no more than a few miles from their place of origin. All of these rocks are glacial boulders that were moved to their present sites by massive ice sheets that flowed across our state. If these boulders are unlike the rocks in the quarries and outcrops in the region where they are found, they are called erratics.

The continental glaciers of the Great Ice Age scoured and scraped the land surface as they advanced, pushing up chunks of bedrock and grinding them against each other or along the ground surface as the rock-laden ice sheets pushed southward. Hundreds of miles of such grinding, even on such hard rocks as granite, eventually rounded off the sharp edges of these passengers in the ice until they became the rounded, irregular boulders we see today. Although we do not know the precise manner in which erratics reached their present isolated sites, many were probably dropped directly from the melting front of a glacier. Others may have been rafted to their present resting places by icebergs on ancient lakes or on the floodwaters of some long-vanished stream as it poured from a glacier. Still others, buried in the glacial deposits, could have worked their way up to the land surface as the surrounding loose soil repeatedly froze and thawed. When the freezing ground expands, pieces of rock tend to be pushed upward, where they are more easily reached by the farmer's plow and also more likely to be exposed by erosion.

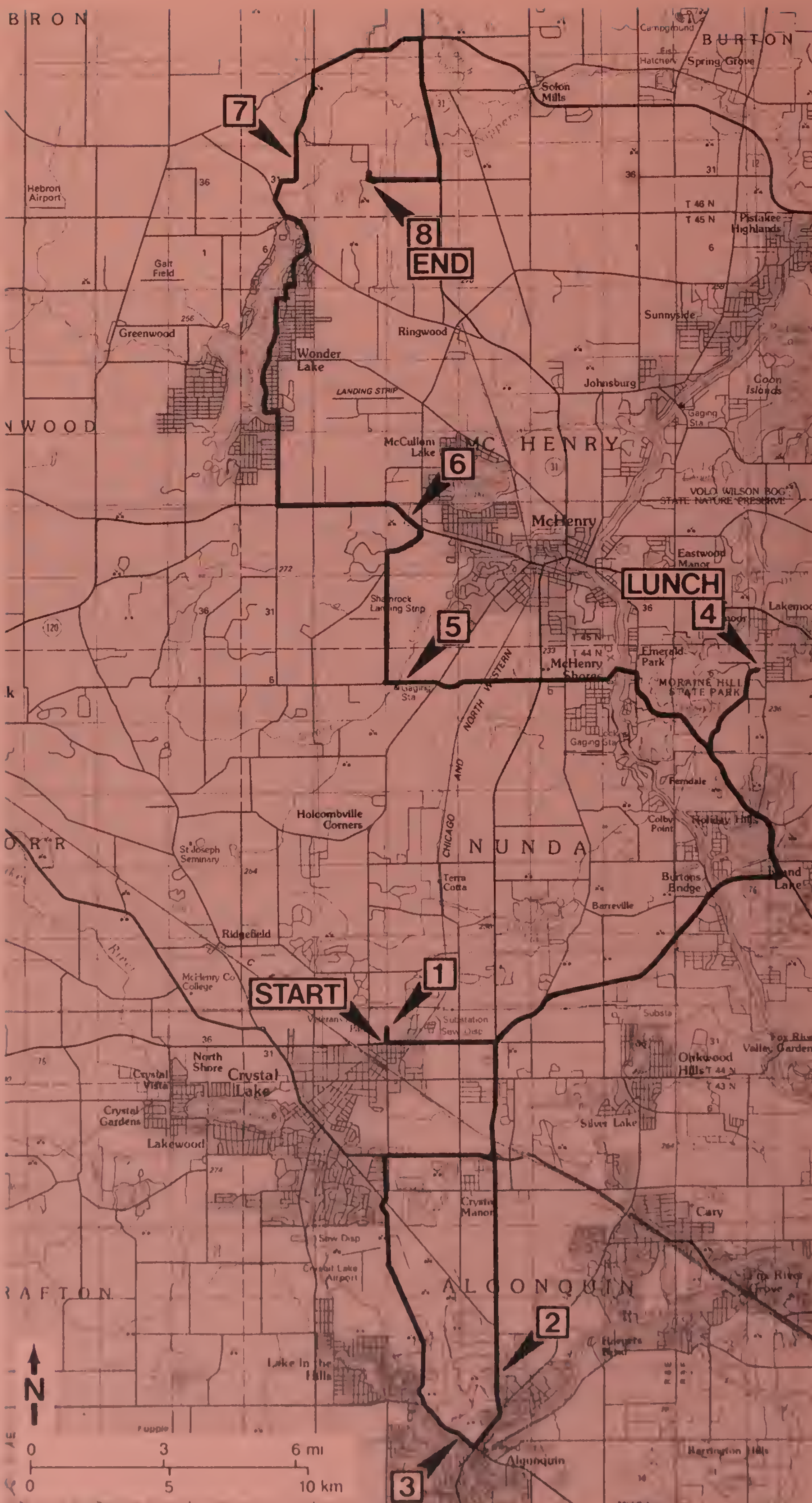
An eight-foot boulder of pink granite left by a glacier in the bed of a creek about 5 miles southwest of Alexis, Warren County, Illinois. (From ISGS Bulletin 57, 1929.)

Generally speaking, erratics found northeast of a line drawn from Freeport in Stephenson County, southward through Peoria, and then southeastward through Shelbyville to Marshall at the east edge of the state were brought in by the last glacier to enter Illinois. This glaciation, called the Wisconsinan, spread southwestward into Illinois from a center in eastern Canada, reaching our state about 75,000 years ago and (after repeated advances and retreats of the ice margin) melting from the state about 12,500 years ago. Erratics to the west or south of the great arc outlined above were brought in by a much older glacier, the Illinoian, which spread over most of the state about 300,000 to 175,000 years ago. Some erratics were brought in by even older glaciers that came from the northwest.

You may be able to locate some erratics in your neighborhood. Sometimes it is possible to tell where the rock originally came from by determining the kind of rock it is. A large boulder of granite, gneiss, or other igneous or metamorphic rock may have come from the Canadian Shield, a vast area in central and eastern Canada where rocks of Precambrian age (more than 600 million years old) are exposed at the surface. Some erratics containing flecks of copper were probably transported here from the "Copper Range" of the upper peninsula of Michigan. Large pieces of copper have been found in glacial deposits of central and northern Illinois. Light gray to white quartzite boulders with beautiful, rounded pebbles of red jasper came from a very small outcrop area near Bruce Mines, Ontario, Canada. Purplish pieces of quartzite, some of them banded, probably originated in the Baraboo Range of central Wisconsin. Most interesting of all are the few large boulders of Canadian tillite. Tillite is lithified (hardened into rock) glacial till deposited by a Precambrian glacier many millions of years older than the ones that invaded our state a mere few thousand years ago. Glacial till is an unsorted and unlayered mixture of clay, sand, gravel, and boulders that vary widely in size and shape. Tillite is a gray to greenish gray rock containing a mixture of grains of different sizes and scattered pebbles of various types and sizes.

Many erratics are of notable size and beauty, and in parts of Illinois they are commonly used in landscaping. Some are used as monuments in courthouse squares, in parks, or along highways. Many are marked with metal plaques to indicate an interesting historical spot or event. Keep an eye out for erratics. There may be some of these glacial strangers in your neighborhood that would be interesting to know.

ORDOVICIAN FOSSILS



START
1
2
3
LUNCH
4
5
6
7
8
END
Crystal Lake
McHenry
Wonder Lake
Ringwood
Johnsburg
Greenwood
Solon Mills
Spring Grove
Sunnyside
Pistakee Highlands
Coon Islands
McCullom Lake
Eastwood Manor
Emerald Park
McHenry Shores
MORAINE HILLS STATE PARK
VOLO WILSON BOG STATE NATURE PRESERVE
Lakemoor
Ferndale
Colby Point
Holiday Hills
Burtons Bridge
Barreville
Terra Cotta
Holcombville Corners
St Joseph Seminary
Ridgefield
McHenry Co College
North Shore
Crystal Vista
Crystal Gardens
Lakewood
Silver Lake
Oakwood Hills
Fox River Valley Gardens
Cary
Fox River Grove
Crystal Manor
Crystal Lake Airport
Lake In the Hills
Algonquin
Barrington Hills
Hebron Airport
Galt Field
Shamrock Landing Strip
LANDING STRIP
CHICAGO AND NORTH WESTERN
MC HENRY
NUNDA
ALGONQUIN
BURTON
N
0
3
6 mi
0
5
10 km