Guide to the Geology of Kankakee River State Park Area, Kankakee County, Illinois

Wayne T. Frankie

Field Trip Guidebook 1997C
Field Trip Guidebook 1998B

September 20, 1997
May 30, 1998

Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY

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Natural Resources Building
615 E. Peabody Drive
Champaign, IL 61820-6964

Cover photo View of Rock Creek from suspension bridge looking north *(photo by Joel M. Dexter).*

Geological Science Field Trip The Geoscience Education and Outreach unit of the Illinois State Geological Survey (ISGS) 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 formed them. Each trip is an all-day excursion through one or more Illinois counties. Frequent stops are made to explore interesting phenomena, explain the 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.

A list of guidebooks of earlier field trips, useful for planning class tours and private outings, can be obtained by contacting the Geoscience Education and Outreach unit, Illinois State Geological Survey, Natural Resources Building, 615 East Peabody Drive, Champaign, IL 61820-6964. Telephone: (217) 244-2427 or 333-4747.

Four U.S. Geogical Survey 7.5-Minute Quadrangle maps (Bonfield, Bradley, Bourbonnais, and Peotone) cover this field trip area.

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

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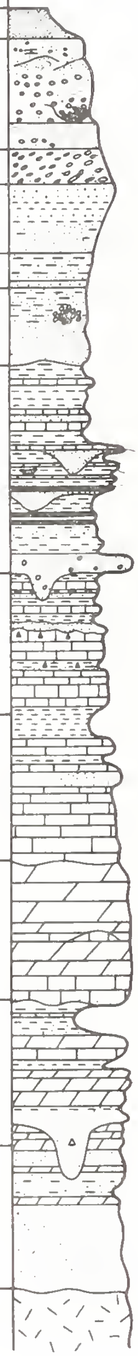
CONTENTS

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	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	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	66.4 m.	Mostly clay, little sand; present only in southern Illinois
MESOZOIC "Middle Life"	Age of Reptiles	Cretaceous 0-300'		144 m. – 286 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")		320 m.	Largely shale and sandstone with beds of coal, limestone, and clay
		Mississippian 0-3,500'		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'		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'		438 m.	Principally dolomite and limestone
		Ordovician 500-2,000'		505 m.	Largely dolomite and limestone but contains sandstone, shale, and siltstone formations
		Cambrian 1,500-3,000'		570 m.	Chiefly sandstones with some dolomite and shale; exposed only in small areas in north-central Illinois
		Precambrian			Igneous and metamorphic rocks; known in Illinois only from deep wells



Generalized geologic column showing succession of rocks in Illinois.

KANKAKEE RIVER STATE PARK AREA

The Kankakee River State Park area geological science field trip will acquaint you with the *geology**, landscape, and mineral resources for part of Kankakee County, Illinois. Kankakee River State Park is located in northeastern Illinois along the Kankakee River. It is approximately 60 miles south of Chicago, 150 miles northeast of Springfield, 245 miles northeast of East St. Louis, and 314 miles north of Cairo.

HUMAN HISTORY: LIFE ALONG THE TI-YAR-AC-KE

According to several sources, the Potawatomi Indians called the Kankakee River Tiyaracke (Ti-yar-ac-ke). Some of the meanings are Wolf, Swampy Place, and Wonderful Land. The French had a variety of names for it, including Theakiki (The-a-ki-ki) and Quinqueque (Quin-que-que), and the name Kankakee appears to be an English version of the latter French word.

The first Europeans to descend the Kankakee River were the French explorers La Salle and Father Hennepin in December 1679. They explored its entire length, and the river they found looked far different from the one that exists today.

After portaging from the St. Joseph River, La Salle's party entered the river near present-day South Bend, Indiana. From there, down to what is now Momence, Illinois, they wound their way through some 250 miles of a marshy, sandy maze of meanders, oxbows, and sloughs teeming with a variety of wildlife. This area would later become known as the "Grand Marsh." Downstream, below a limestone outcropping at Momence, the river has a steeper gradient and probably appeared much the same as it does today below the dam at Kankakee. Farther downstream, the Kankakee River converges with the Des Plaines River to form the Illinois River.

Settlers first came to Kankakee County in March 1853. The City of Kankakee grew in the shadow of Bourbonnais, a French settlement nearby. Kankakee nonetheless became the seat of government for Kankakee County, and in 1855 became the site of a depot on the Illinois Central Railroad.

GEOLOGIC FRAMEWORK

Precambrian Era Through several billion years of geologic time, Kankakee County and the surrounding areas have undergone many changes (see the rock succession column, facing page). The oldest rocks beneath the field trip area belong to the ancient Precambrian *basement complex*. We know relatively little about these rocks from direct observations because they are not exposed at the surface anywhere in Illinois. Only about 35 drill holes have reached deep enough for geologists to collect samples from the Precambrian rocks of Illinois. From these samples, however, we know that these ancient rocks consist mostly of granitic and rhyolitic *igneous*, and possibly *metamorphic*, crystalline rocks formed about 1.5 to 1 billion years ago. From about 1 billion to about 0.6 billion years ago, these Precambrian rocks were exposed at the Earth's surface. During this long period, the rocks were deeply weathered and eroded, and formed a landscape that was probably quite similar to that of the present Missouri Ozarks. We have no rock record in Illinois for the long interval of *weathering* and erosion that lasted from the time the Precambrian rocks were formed until the first Cambrian-age *sediments* accumulated, but that interval is almost as long as the time from the beginning of the Cambrian Period to the present.

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*Words in italics are defined in the glossary at the back of the guidebook. Also please note: although 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.

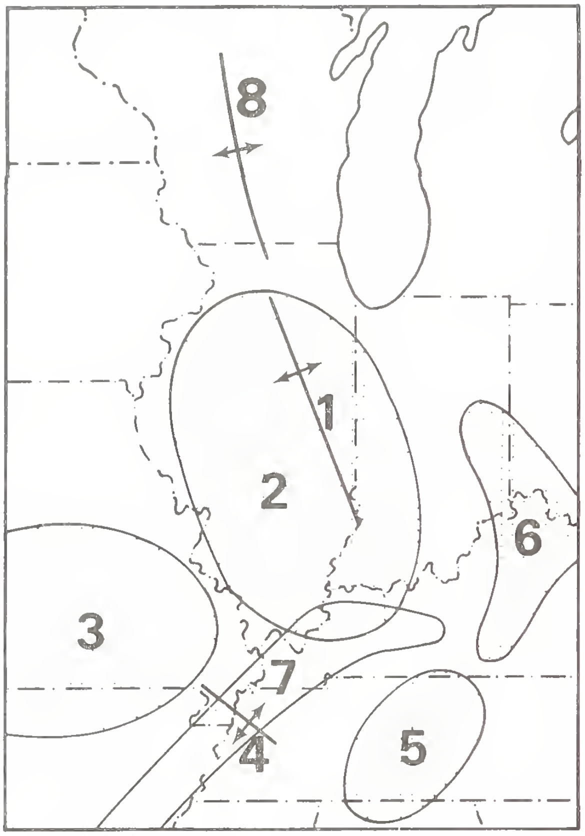

Figure 1 Location of some of the major structures in the Illinois region. (1) La Salle Anticlinorium, (2) Illinois Basin, (3) Ozark Dome, (4) Pascola Arch, (5) Nashville Dome, (6) Cincinnati Arch, (7) Rough Creek Graben-Reelfoot Rift, and (8) Wisconsin Arch.

Because geologists cannot see the Precambrian basement rocks in Illinois except as cuttings and cores from boreholes, they must use other various techniques, such as measurements of Earth's gravitational and magnetic fields, and seismic exploration, to map out the regional characteristics of the basement complex. The evidence indicates that in southernmost Illinois, near what is now the historic Kentucky–Illinois Fluorspar Mining District, *rift* valleys like those in east Africa formed as the movements of crustal plates (plate *tectonics*) began to rip apart the Precambrian North American continent. These rift valleys in the midcontinent region are referred to as the Rough Creek Graben and the Reelfoot Rift (fig. 1).

Paleozoic Era After the beginning of the Paleozoic Era, about 520 million years ago in the late Cambrian Period, the rifting stopped and the hilly Precambrian landscape began to sink slowly on a broad regional scale, allowing the invasion of a shallow sea from the south and southwest. During the 280 million years of the Paleozoic Era, the area that is now called the Illinois Basin continued to accumulate sediments deposited in the shallow seas that repeatedly covered it. The region continued to sink until at least 15,000 feet of sedimentary strata were deposited. At various times during this era, the seas withdrew and the deposits were weathered and eroded. As a result, there are some gaps in the sedimentary record in Illinois.

In the field trip area, *bedrock* strata range in age from more than 520 million years (the Cambrian *Period*) to less than 438 million years old (the Silurian Period). Figure 2 shows the succession of rock strata a drill bit would penetrate in this area if the rock record were complete and all the *formations* were present.

Missing—eroded from area (Pennsylvanian through Devonian)

SYSTEM	SERIES	GROUP	FORMATION
QUATERNARY	PLEISTOCENE		
PENNSYLVANIAN		Mc LEANSBORO	Shelburn
			Carbondale
		RACCOON CREEK	Tradewater
MISSISSIPPIAN	VALMEYERAN		Keokuk-Burlington
	KINDERHOOKIAN	NEW ALBANY	Hannibal
DEVONIAN	UPPER		Grassy Creek
	MIDDLE		Sylamore
SILURIAN	NIAGARAN		Racine
			Sugar Run
			Joliet
			Kankakee
	ALEXANDRIAN		Elwood
			Wilhelmi
ORDOVICIAN	CINCINNATIAN	MAQUOKETA	Neda
			Brainard Sh
			Ft. Atkinson Ls
			Scales Sh
	CHAMPLAINIAN	GALENA	
		PLATTEVILLE	
		ANCELL	Glenwood
			St. Peter Ss
	CANADIAN	PRAIRIE DU CHIEN	Shakopee Dol
			New Richmond Ss
			Oneota Dol
			Gunter Ss
CAMBRIAN	CROIXAN		Eminence
			Potosi Dol
			Franconia
			Ironton Ss
			Galesville Ss
			Eau Claire
			Mt. Simon Ss
PRECAMBRIAN			

Figure 2 Generalized stratigraphic column of the Kankakee Area. Unconformities are indicated by wavy lines.

The elevation of the top of the Precambrian basement rocks within the field trip area ranges from 4,200 feet below sea level in northern Kankakee County to 4,600 feet below sea level in southern Kankakee County. The thickness of the Paleozoic sedimentary strata deposited on top of the Precambrian basement ranges from about 4,800 feet in northern Kankakee County to about 5,100 feet in southern Kankakee County.

STRUCTURAL AND DEPOSITIONAL HISTORY

As noted previously, the Rough Creek Graben and the Reelfoot Rift (figs. 1 and 3) were formed by tectonic activity that began in the latter part of the Precambrian Era and continued until the Late Cambrian. Toward the end of the Cambrian, rifting ended and the whole region began to subside, allowing shallow seas to cover the land.

Paleozoic Era From the Late Cambrian to the end of the Paleozoic Era, sediments continued to accumulate in the shallow seas that repeatedly covered Illinois and adjacent states. These inland seas connected with the open ocean to the south during much of the Paleozoic, and the area that is now southern Illinois was like an embayment. The southern part of Illinois and adjacent parts of Indiana and Kentucky sank more rapidly than the areas to the north, allowing a greater thickness of sediment to accumulate. During the Paleozoic and Mesozoic Eras, the Earth's thin crust was periodically flexed and warped in places as stresses built up in response to tectonic forces (plate movement and mountain building). These movements caused repeated invasions and withdrawals of the seas across the region. The former sea floors were thus periodically exposed to erosion, which removed some sediments from the rock record.

Many of the sedimentary units, called formations, have *conformable* contacts—that is, no significant interruption in deposition occurred as one formation was succeeded by another (figs. 2 and 4). In some instances, even though the composition and appearance of the rocks change significantly at the contact between two formations, the *fossils* in the rocks and the relationships between the rocks at the contact indicate that deposition was virtually continuous. In contrast however, in some places, the top of the lower formation was at least partially eroded before deposition of the next formation began. In these instances, fossils and other evidence in the two formations indicate that there is a significant age difference between the lower unit and the overlying unit. This type of contact is called an *unconformity* (fig. 4). If the *beds* above and below an unconformity are parallel, the unconformity is called a *disconformity.* However, if the lower beds were tilted and eroded prior to deposition of overlying beds, the contact is called an angular unconformity.

Unconformities occur throughout the Paleozoic rock record and are shown in the generalized stratigraphic column (fig. 2) as wavy lines. Each unconformity represents an extended interval of time for which there is no rock record in this area.

Near the close of the Mississippian Period, gentle arching of the rocks in eastern Illinois initiated the development of the La Salle Anticlinorium (figs. 1 and 5). This is a complex structure having smaller structures such as domes, *anticlines*, and *synclines* superimposed on the broad upwarp of the anticlinorium. Further gradual arching continued through the Pennsylvanian Period. Because the youngest Pennsylvanian strata are absent from the area of the anticlinorium (either because they were not deposited or because they were later eroded away), we cannot determine just when folding ceased—perhaps by the end of the Pennsylvanian or during the Permian Period a little later, near the close of the Paleozoic Era.

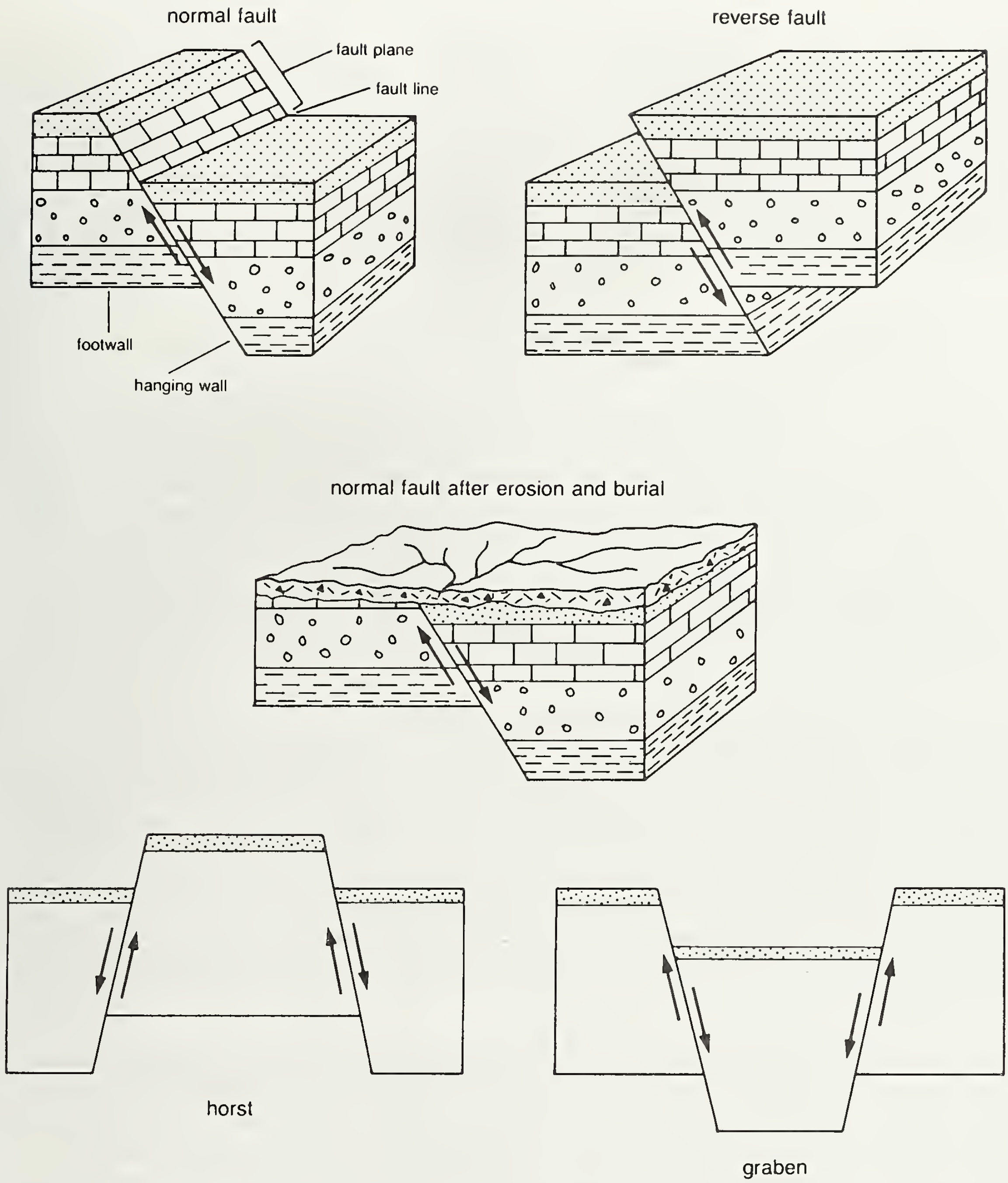

Figure 3 Diagrammatic illustrations of fault types that may be present in the field trip area (arrows indicate relative directions of movement on each side of the fault).

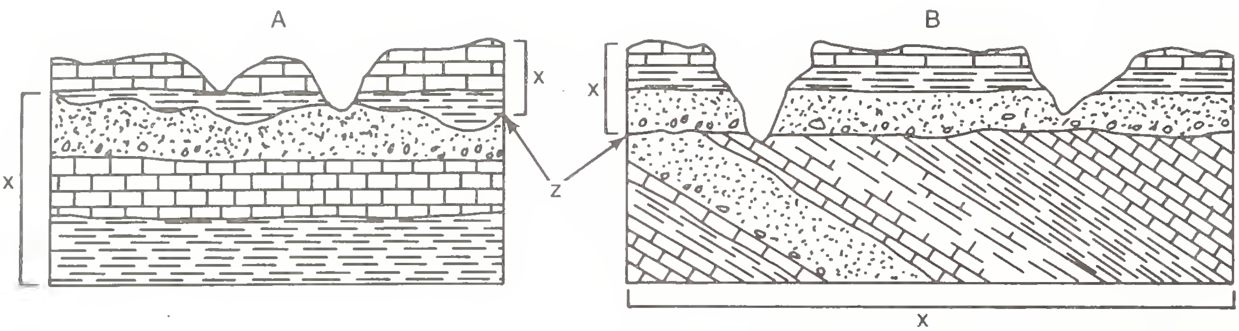

Figure 4 Schematic drawings of (A) a disconformity and (B) an angular unconformity (x represents the conformable rock sequence and z is the plane of unconformity).

Mesozoic Era During the Mesozoic Era, the rise of the Pascola Arch (fig. 1) in southeastern Missouri and western Tennessee produced a structural barrier that helped form the current shape of the Illinois *Basin* by closing off the embayment and separating it from the open sea to the south. The Illinois Basin is a broad, subsided region covering much of Illinois, southwestern Indiana, and western Kentucky (fig. 1). Development of the Pascola Arch, in conjunction with the earlier sinking of the deeper portion of the basin to the north, gave the basin its present asymmetrical, spoon-shaped configuration (fig. 6). The geologic map (fig. 7) shows the distribution of the rock *systems* of the various geologic time periods as they would appear if all the glacial, wind-blown, and surface materials were removed.

The Kankakeee River State Park field trip area is located along the southwestern flank of the Kankakee Arch on the northeastern edge of the Illinois Basin. The arch, which trends northwest–southeast through northeastern Illinois and north-central Indiana, forms a broad divide, or saddle, that connects the Wisconsin Arch and the Cincinnati Arch (fig. 5) and separates the Illinois Basin from the Michigan Basin. The limits of the Kankakee Arch are not precisely defined because dips on its flanks are extremely gentle. The Kankakee Arch was formed during the Early Ordovician. The lower Ordovician rocks of the Prairie du Chien Group are arched and truncated by erosion (fig. 2). The overlying Ordovician St. Peter Sandstone and the middle Ordovician rocks of the Platteville Group thin across the arch (Nelson 1995). The axis of the Ordovician Kankakee Arch lay slightly northeast of the present arch.

During the Silurian Period, reefs developed in the shallow seas covering the arch, and the position of the reefs helps determine the boundary between the shallow sea and the deeper seas to the north and south. By the Middle Devonian Epoch, the division became almost complete between the Illinois and Michigan Basins. Not much is known about subsequent development because post-Devonian rocks have been eroded from the arch. Mississippian and Pennsylvanian sediments at least partially overlapped the Kankakee Arch, as shown by the presence of rocks of that age in the Des Plaines Disturbance, which lies on the north flank of the arch (fig. 5) (Nelson 1995). Silurian strata form the crest of the arch and are exposed along the Kankakee River, its tributaries, and in the quarries in the field trip area. The highest elevations reached by this bedrock occur on the crests of the Silurian reefs, 650 feet above sea level in north-central Kankakee County. The Silurian rocks are overlain by early Pennsylvanian rocks in western Kankakee County.

Younger rocks of the latest Pennsylvanian Period, and perhaps the Permian (the youngest rock systems of the Paleozoic), may at one time have covered the Silurian strata throughout Kankakee County. Mesozoic and Cenozoic rocks (see the generalized geologic column) were also possibly deposited here. Indirect evidence, based on the stage of development (rank) of coal deposits and the

Figure 5 Structural features of Illinois (modified from Buschbach and Kolata 1991).

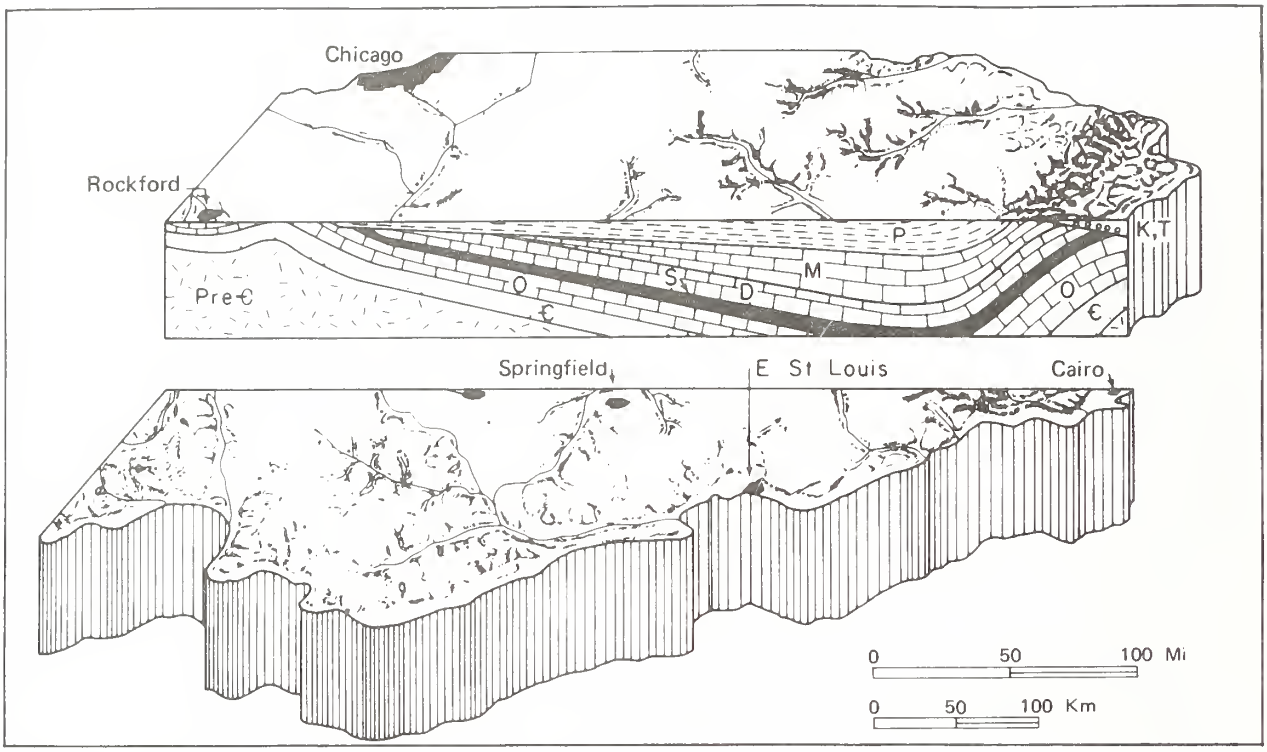

Figure 6 Stylized north–south cross section shows the structure of the Illinois Basin. To show detail, the thickness of the sedimentary rocks has been greatly exaggerated and younger, unconsolidated surface deposits have been eliminated. The oldest rocks are Precambrian (Pre-Є) granites. They form a depression filled with layers of sedimentary rocks of various ages: Cambrian (Є), Ordovician (O), Silurian (S), Devonian (D), Mississippian (M), Pennsylvanian (P), Cretaceous (K), and Tertiary (T). Scale is approximate.

generation and maturation of petroleum from source rocks (Damberger 1971), indicates that perhaps as much as 1.5 miles of additional sedimentary rocks of latest Pennsylvanian age and younger once covered southern Illinois. During the more than 240 million years since the end of the Paleozoic Era (and before the onset of *glaciation* 1 to 2 million years ago), however, several thousands of feet of strata may have been eroded. Nearly all traces of any post-Pennsylvanian bedrock that may have been present in Illinois were removed. During this extended period of erosion, deep valleys were carved into the gently tilted bedrock formations (fig. 8). Later, the topographic *relief* was reduced by repeated advances and melting back of continental *glaciers* that scoured and scraped the bedrock surface. This glacial erosion affected all the formations exposed at the bedrock surface in Illinois. The final melting of the glaciers left behind the nonlithified deposits in which our Modern Soil has developed.

Cenozoic Era: Glacial History As stated above, erosion that took place long before the glaciers advanced across the state left a network of deep valleys carved into the bedrock surface. Prior to glaciation, the Kankakee Arch served as a drainage divide, controlling drainage towards the north and northeast into the Michigan Basin and to the west and southwest into the Illinois Basin. The southeastern, southwestern, and northwestern portions of Kankakee County were drained by unnamed tributaries flowing into the Onarga, Kempton, and Ticona Bedrock Valleys respectively (fig. 8). Drainage in the northeastern part of the county was towards the Michigan Basin.

As glaciation began, the streams probably stopped eroding and began to aggrade. That is, their channels began to build up and fill in because the streams did not have sufficient volumes of water to carry and move the increased volumes of sediment.

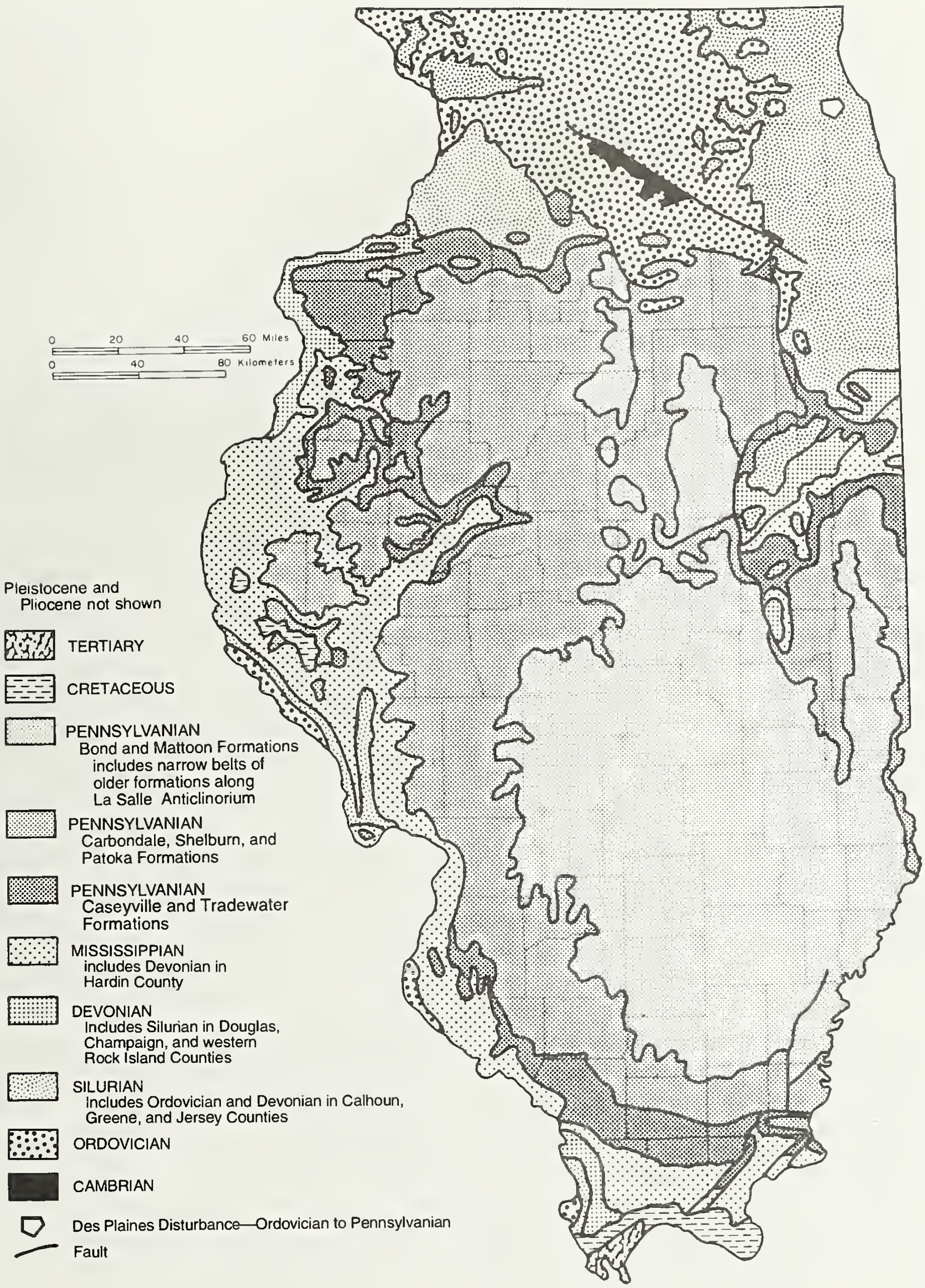

Figure 7 Bedrock geology beneath surficial deposits in Illinois.

Figure 8 Bedrock valleys of Illinois (modified from Bristol and Buschbach 1973).

These ancient stream valleys were completely filled by the outwash from later glaciations. The present Kankakee River Valley was subsequently formed by glacial meltwater that cut a new channel that now flows east–west. It is of interest to note that most of the sediment that filled the older stream valleys was sand and gravels. These sands and gravels serve as major aquifers in part of southeastern Kankakee County. Because of the irregular bedrock surface formed by erosion, glacial *drift* is unevenly distributed across Kankakee County.

During the Pleistocene *Epoch*, beginning about 1.6 million years ago, massive sheets of ice (called continental glaciers), built up to thousands of feet thick and flowed slowly southward from Canada. During the Illinois Episode, which began around 300,000 years B.P., North American continental glaciers reached their southernmost position, approximately 290 miles south of here, in the northern part of Johnson County (fig. 9). The last of these glaciers retreated (melted) from northeastern Illinois about 13,500 years before the present (B.P.). The maximum thickness of these later Wisconsin Episode glaciers in Illinois was about 2,000 feet in the Lake Michigan Basin, but the ice was only about 700 feet thick over most of Illinois' land surface (Clark et al. 1988).

The *topography* of the bedrock surface throughout much of Illinois is largely hidden by glacial deposits, except along the major streams. In many areas, the glacial drift is thick enough to completely mask the underlying bedrock surface. Studies of mine shafts, water-well logs, and other drill-hole information, in addition to the scattered bedrock exposures in some stream valleys and roadcuts, show that the present land surface in the areas of Illinois where the glacial deposits are thickest does not reflect the underlying bedrock surface. The topography of the preglacial surface has been significantly modified by glacial erosion and subdued by glacial deposits. Within the field trip area, the thickness of the glacial drift ranges from 0 feet, where it has been removed by erosion and the bedrock is exposed, to more than 200 feet, where moraines formed.

Although the Illinois Episode glaciers probably built morainic ridges similar to those formed by the later Wisconsin Episode glaciers, the Illinois Episode moraines apparently were not as numerous and have been exposed to weathering and erosion for approximately 280,000 years longer than their younger counterparts. For these reasons, Illinoian glacial features generally are not as conspicuous as the younger Wisconsinan features.

Overlying the glacial deposits is a thin cover of material called the Peoria *Loess* (pronounced "luss"), which has now been renamed the Peoria Silt (Hansel and Johnson 1996). These sediments were deposited by the wind during the Wisconsin Episode from 25,000 to 12,500 years ago, and mantle the glacial drift throughout the field trip area. (See *Ancient Dust Storms in Illinois* at the back of the guidebook.) In Kankakee County, the loess is generally thinner than 2 feet and thins from west to east. This fine grained dust, which covers most of Illinois, reaches thicknesses exceeding 15 feet west of the field trip area along the Illinois River. Soils in this area have developed in the loess, in the wind-blown sand, in the underlying weathered silty and clayey Wisconsin till, and in exposed Silurian dolomite.

GEOMORPHOLOGY

Physiography The field trip area is located in the Kankakee River Basin, which is in the Kankakee Plain of the *Till Plains* Section of the Central Lowland Physiographic Province (fig. 10). The present landforms were formed during the Wisconsin Episode (the last major glaciation), but subsequent erosion by wind and rain has continued to modify the lanscape. A large part of the Kankakee Plain

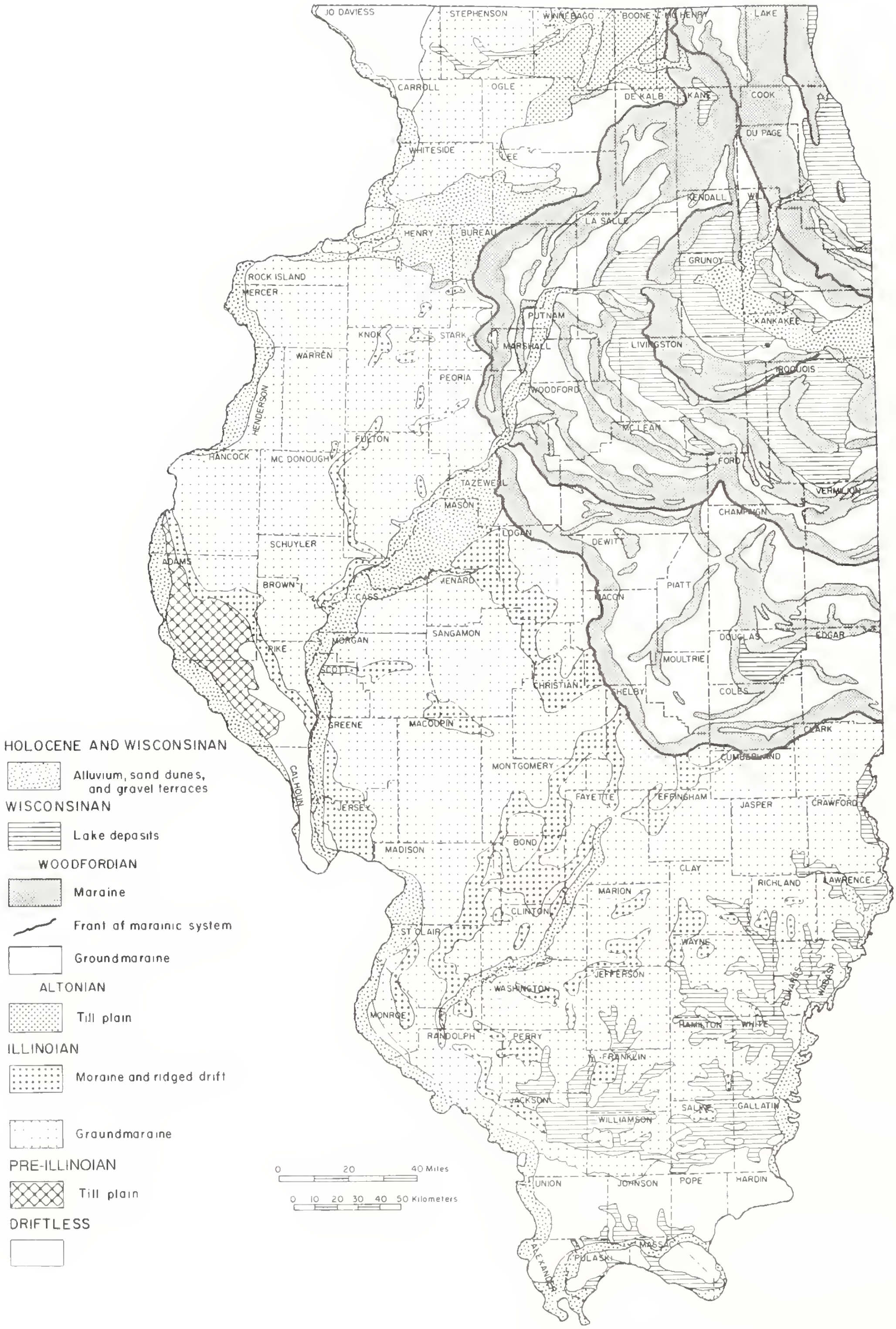

Figure 9 Generalized map of glacial deposits in Illinois (modified from Willman and Frye 1970).

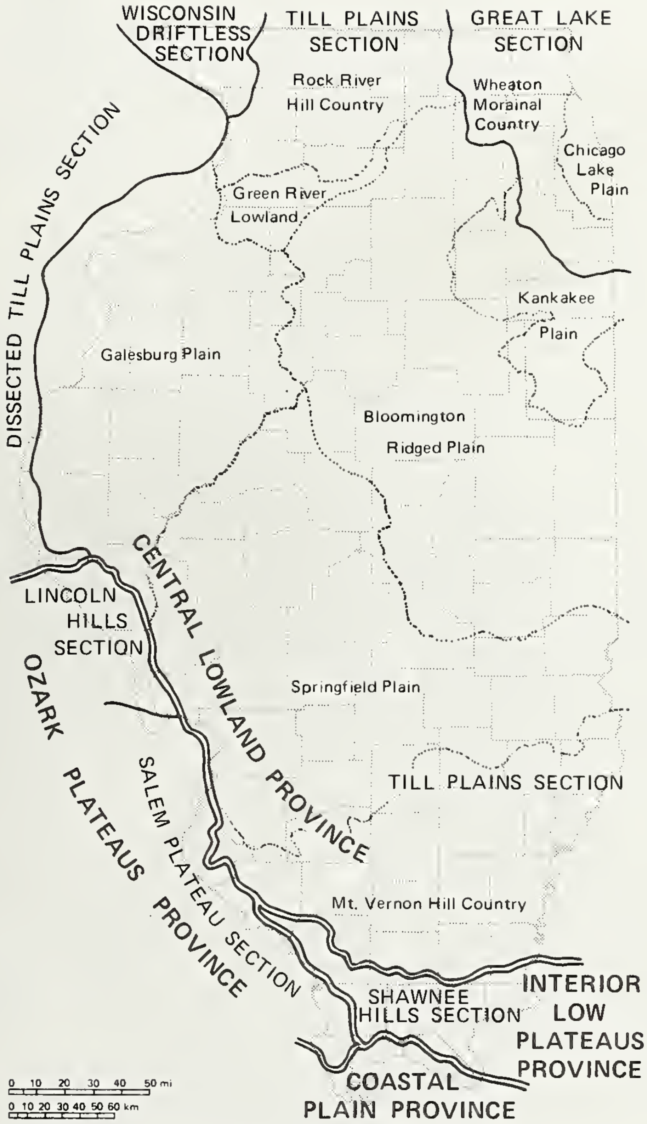

Figure 10 Physiographic divisions of Illinois.

and the lower part of the Kankakee River basin was originally a prairie before settlers turned it into farmland.

Kankakee Plain The Kankakee Plain, according to Leighton et al. (1948), is characterized by a level to gently undulatory plain, with low morainic islands, glacial terraces, torrent bars, and sand dunes. It was partly *fluviolacustrine* (formed by rivers and lakes), but it differs from the lake plains of the Great Lake section in that the lakes that covered it were temporary expansions of glacial floods and did not extensively alter its surface by deposition or erosion, except along the courses of strong currents. The plain can be considered a modified intermorainic basin, floored largely with ground moraine and bedrock in a topographically low area encompassed by a number of large moraines.

The Kankakee Plain is enclosed by a series of large moraines, including the Iroquois Moraine to the southeast, the Marseilles Morainic System to the south and southwest, and the Manhattan Moraine and the Valparaiso Morainic System on the north (fig. 11).

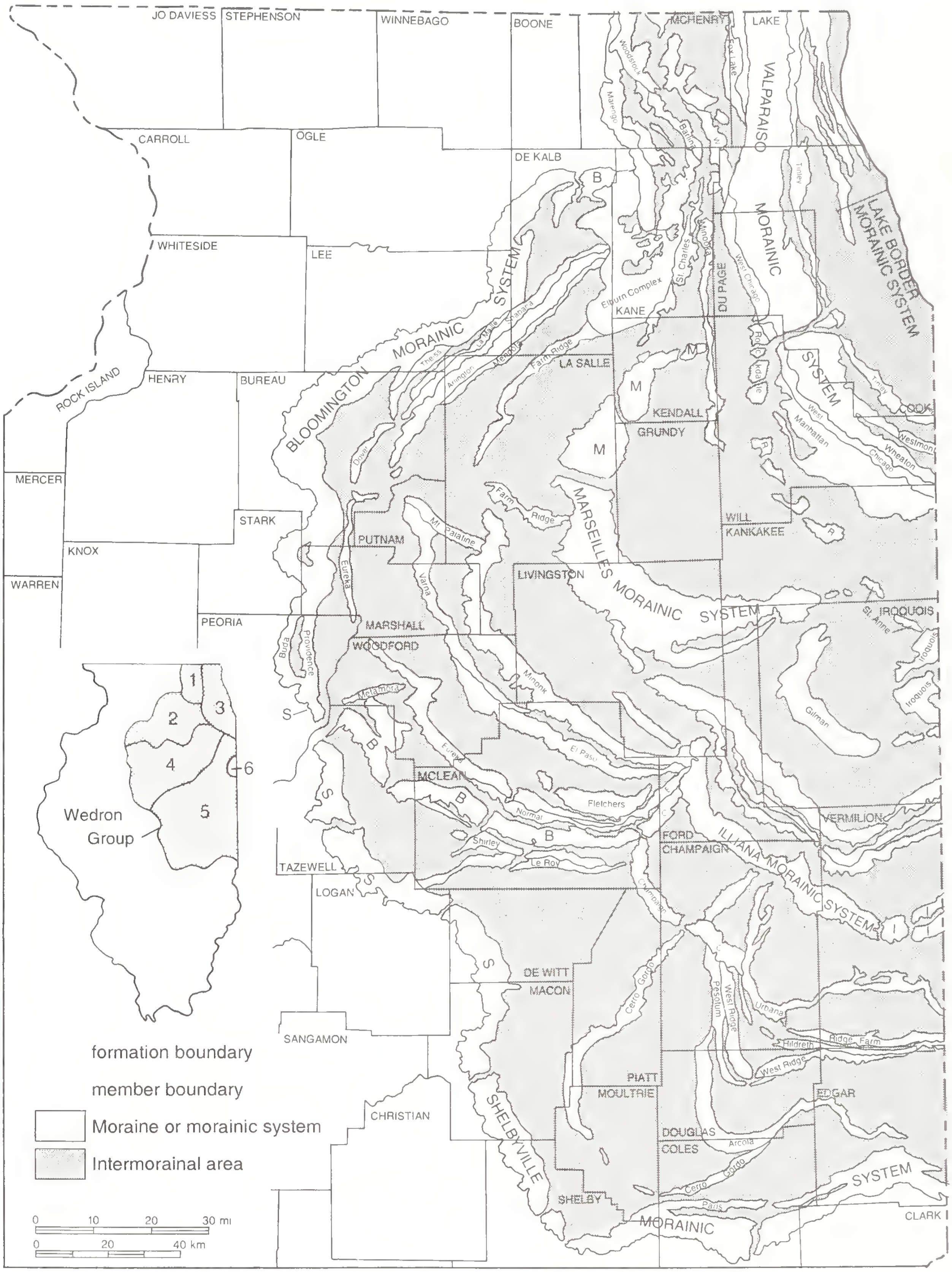

Figure 11 Areal distribution of moraines of the Wedron Group and the Trafalgar Formation in Illinois (modified from Hansel and Johnson 1996).

Most of the region is poorly drained by shallow low-gradient streams that follow glacially constructed depressions. The Kankakee and Des Plaines rivers occupy former sluiceways created by glacial meltwater, which, near Kankakee and Joliet, are entrenched in Silurian dolomites. The drift thickness varies from place to place, and in the Kankakee region, it is so thin that it scarcely conceals the bedrock surface.

Drainage Within the field trip area, drainage is controlled by the Kankakee River, Rock Creek, Davis Creek, and their tributaries. The Kankakee River is a major tributary of the Illinois River. The rivers have incised through the relatively thin cover of unconsolidated materials overlying the Silurian dolomite bedrock, and their courses are now largely controlled by *joint* patterns in the bedrock, which most likely reflect the effects of tectonic stresses related to the development of the Kankakee Arch. Sedimentary rocks of the Silurian, and in some places the Upper Ordovician systems, are exposed along the waterways throughout the field trip area.

Relief The highest land surface on the field trip route is on the crest of the Rockdale Moraine (near the intersection of 500N and Route 45/52 at the SE quarter of Section 6, Township 31 North, Range 12 East), where the surface elevation is slightly more than 710 feet above mean sea level (msl). The lowest elevation is about 550 feet above msl along the Kankakee River at the Warner Bridge. The surface relief of the field trip area, calculated as the difference between the highest and lowest points, is about 160 feet. *Local relief* is most pronounced along Rock Creek in Kankakee River State Park where the Silurian dolomite forms sheer vertical bluffs that reach more than 40 feet above the river.

NATURAL RESOURCES

Mineral production Of the 102 counties in Illinois, 98 reported *mineral* production during 1995, the last year for which complete records are available. The total value of all minerals extracted, processed, and manufactured in Illinois during 1995 was $2,202,300,000, which is 10.9% lower than the 1994 total. Minerals extracted accounted for 87.6% of this total; processed crude minerals and manufactured minerals accounted for the remaining 12.4%. Coal continued to be the leading commodity, accounting for 64% of the total. Illinois is the fifth largest producer of coal in the nation and is ranked 13th among the 31 oil-producing states, and 16th among the 50 states in total production of nonfuel minerals, but leads all other states in the production of sand and gravel, industrial sand, and tripoli (microcrystalline silica).

Economic minerals currently mined in Kankakee County include crushed stone, sand and gravel, and clay. Although no coal mines are currently active in Kankakee County, cumulative production equals 19,192,105 tons. Coal has been mined from the Colchester and the Houchin Creek seams. The Houchin Creek was formerly called the Summum and/or Lowell Coal.

Groundwater Groundwater is a mineral resource frequently overlooked in assessments of an area's natural resource potential. The availability of this mineral resource is essential for orderly economic and community development. More than 35% of the state's 11.5 million citizens and 97% of those who live in rural areas depend on groundwater for their water supply. Groundwater is derived from underground formations called *aquifers*. 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.

Because glacial deposits occur in this area, sand and gravel deposits are common throughout most of the county. However, most of these deposits are thin and do not yield vast amounts of water.

Throughout Kankakee County, small municipal and farm water supplies are obtained from the shallow Silurian dolomite bedrock and, in some places, the Ordovician St. Peter Sandstone.

Aquifers in the Kankakee River Basin are either in the unconsolidated glacial deposits or the carbonate and sandstone bedrock. The Cambrian-Ordovician aquifer is heterogeneous, but the water-bearing units behave as a single aquifer. The Maquoketa Shale, which overlies the Cambrian-Ordovician rocks, is a confining unit. The Silurian-Devonian aquifer is the uppermost bedrock aquifer and is a heavily pumped aquifer in the basin.

Aquifers in the unconsolidated glacial deposits consist of sands and gravels. These aquifers supply a large portion of the water for the rural areas in eastern Kankakee County, where a large number of farms grow specialty crops, which are irrigated from groundwater. An unconfined aquifer, formed from glacial outwash sands and gravels, underlies much of the Kankakee River Basin in Indiana.

KANKAKEE RIVER STATE PARK*

On land treasured for centuries—first by Native Americans, later by traders and farmers, and as early as the 1890s by recreation seekers—Kankakee River State Park offers a proud heritage in an unspoiled setting. Anglers, canoeists, hunters, campers, hikers, bicyclists, and other outdoor enthusiasts find the park's recreational opportunities unsurpassed. The naturally channeled Kankakee River, listed on the federal Clean Streams Register, is one of the main reasons for the park's popularity.

Spreading along both sides of the Kankakee River for 11 miles, in an area 6 miles northwest of Kankakee, the park consists of approximately 4,000 acres. Illinois Routes 102 on the north and 113 on the south frame the park, with Interstates 55 and 57 both providing convenient access.

The park's past Several prehistoric sites are documented in Kankakee River State Park. The park is in a region used by Illini and Miami Indians at the time of the first European contact in the 1670s and 1680s. By 1685 the Miami were sufficiently numerous that the Kankakee River was called the River of the Miami. Kickapoo and Mascouten Indians were also in the region from 1679 until the 1760s; by the 1770s, the Potawatomi, Ottawa, and Chippewa nations—"The Three Fires"—dominated the area. The most extensive village was Rock Village, or Little Rock Village, inside the present-day park near the mouth of Rock Creek. In 1830 it was the site of the last great Indian Council. Following the Black Hawk War in 1832, the Potawatomi ceded all of their land along the Kankakee and Illinois rivers to the United States. Most Potawatomi left the area by the end of the decade, except for Chief Shaw-waw-nas-see, whose grave is marked by a boulder along the nature trail at Rock Creek.

Noel Le Vasseur and other fur traders, including Hubbard, Chabare, and Bourbonnais, traded with the Potawatomi along the Kankakee and Iroquois Rivers in the 1820s. When the Potawatomi left the area in 1838, Le Vasseur persuaded a number of his fellow French Canadians to emigrate from Quebec to the Bourbonnais Township area. Because of his settlement efforts, he is called "the father of Kankakee."

A marker on the west bank of Rock Creek Bridge commemorates the log cabin village of Rockville. It was begun in 1840, nine years after William Baker and other Euro-Americans first began farming along the Kankakee River.

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* This historical information on the park is adapted from the DNR Kankakee State Park brochure.

The Kankakee & Iroquois Navigation Company—later known as the Kankakee Company—was chartered in 1847 to provide water power and a navigable waterway from the Illinois & Michigan Canal to Warner's Landing, along the site of the present-day Warner Bridge Road. The company failed in the early 1880s, shortly after the Wabash Railroad came through. At the Chippewa Campground, hand-cut limestone pillars mark the place where a railway bridge was to have been built before financiers ran out of money.

Just inside the park's main entrance is the Smith Cemetery with the graves of several family members, most of whom died of yellow fever at the turn of the century.

A major industry in the area in the 1890s was the Custer Bowery Amusement Park, which frequently drew crowds from Chicago. The park was gone by the 1920s, but by then the river had become a popular spot for summer cottages. The area became more accessible to vacationers in 1928 when concrete roads were built along both sides of the river. In 1938 Chicago resident Ethel Sturges Dummer donated 35 acres of land for a state park. Commonwealth Edison turned over another 1,715 acres to the state in 1956. With the company's additional grants in 1989, the park now contains approximately 4,000 acres.

Wildlife From badgers and beavers to turtles and wild turkeys, Kankakee River State Park teems with wildlife. Some of the birds you could see are red-winged blackbirds, herons, and bluebirds. Fox, coyote, and deer roam the park's bluffs and timbered areas, while frogs and nonpoisonous snakes keep close to the riverbanks.

GUIDE TO THE ROUTE

The field trip starts at the Kankakee River State Park, Rock Creek Hiking Trail Access area (SW SE, Sec. 32, T32N, R11E, 3rd P.M., Kankakee County, Bourbonnais 7.5-minute Quadrangle).

You must travel in the caravan Please drive with 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 Illinois State Geological Survey (ISGS) vehicle with flashing lights and flags, please 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.

Private property 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, follow these simple rules of courtesy:

- Do not litter the area.
- Do not climb on fences.
- Leave all gates as you found them.
- Treat *public* property as if you were the owner—which you are!

When using this booklet for another field trip with your students, a youth group, or family, remember that *you must get permission from property owners or their agents before entering private property.* No trespassing please.

Four U.S. Geological Survey 7.5-Minute Quadrangle maps (Bonfield, Bradley, Bourbonnais, and Peotone) cover this field trip area.

STOP 1 Rock Creek Gorge The trail to Rock Creek is located west of the middle parking lot.

Miles to next point	Miles from start	
0.0	0.0	Exit the middle parking lot and TURN RIGHT heading south onto the main loop at the Rock Creek Access area.
0.1	0.1	T-intersection. TURN RIGHT onto main access road heading toward Route 102.
0.2	0.3	STOP (1-way). T-intersection with Route 102. TURN RIGHT onto Route 102.
0.1	0.4	Main entrance to Kankakee River State Park on the left. CONTINUE AHEAD.
0.35	0.75	Cross Rock Creek. Notice the suspension bridge to the left.
0.45	1.2	T-intersection from the right (6000W/4-H Road). CONTINUE AHEAD.
0.9	2.15	Approaching Warner Bridge Road intersection. Prepare to turn left.

0.15	2.25	Intersection (7000W/Warner Bridge Road and Route 102/6510N). TURN LEFT onto Warner Bridge Road. This is Kankakee County Highway 20.
0.05	2.35	Begin descent into the Kankakee River Valley.
0.15	2.45	Kankakee River State Park, Fisherman's Entrance.
0.05	2.5	Center of the bridge. The five stone pillars to the right were for a railroad that was never built. The railroad went bankrupt before they laid tracks across the river.
0.3	2.8	Begin ascent out of the Kankakee River Valley.
0.1	2.9	STOP (2-way). Intersection (7000W and Route 113). TURN LEFT onto Route 113, heading east. CAUTION: Fast moving traffic from the right and left does not stop.
0.2	3.1	Hunting Area parking lot access area to the left.
0.6	3.7	Hunting Area 3 access to the left. CONTINUE AHEAD. Notice the rolling landscape to the left. You are following the path of the Kankakee Torrent.
0.9	4.6	T-intersection from the right (5500W). CONTINUE AHEAD.
0.1	4.7	Prepare to turn left.
0.1	4.8	T-intersection from the left; entrance to Hunting Area 2. TURN LEFT. Follow the gravel road on the right-hand side of the parking lot to the lower parking lot.
0.3	5.1	Road jogs to the right and then immediately jogs to the left.

0.1	5.2	**STOP 2 Devils Hole, Kankakee River State Park** Enter the lower parking lot of the Shotgun Trap Shooting Range.

0.0	5.2	Leave Stop 2 and retrace route back to Route 113.
0.5	5.6	STOP (1-way). Intersection with Route 113. TURN LEFT. Directly across from the Hunting Area 2 access is a log cabin with a fireplace made from local dolomite. Landscaping in front also uses local dolomite. Note: Road is marked as Kankakee 113-3.
0.65	6.25	Entrance to Hunting Area 1 to the left. CONTINUE AHEAD.
0.55	6.8	Pass under high-tension lines.
0.1	6.9	Approaching T-intersection from the right; prepare to turn right.

0.2	7.1	T-intersection from the right (4000N and Route 113). TURN RIGHT onto 4000N.
0.2	7.3	Note the small hills to the left and right. These hills are some of the rubble bars and sand dunes formed by the Kankakee Torrent.
0.35	7.65	T-intersection from the left (5000W). TURN LEFT heading south.
0.10	7.75	Note large glacial erratic in the yard to the right.
0.75	8.5	Cross underground gas pipeline of the Natural Gas Pipeline Company of America.
0.15	8.65	STOP (2-way). Intersection (5000W and 3000N). CONTINUE AHEAD. CAUTION: Cross traffic does not stop.
0.75	9.4	Cross two small rubble bars covered with oak forest.
0.25	9.65	T-intersection from the right (2000N and 5000W). TURN RIGHT. This is Kankakee County Highway 6. Note the large grove of trees to the right and straight ahead. These trees are growing on rubble bars and sand dunes left by the Kankakee Torrent
1.0	10.65	T-intersection from the right (6000W). CONTINUE AHEAD. Note the rise in the road directly ahead. This is another of the rubble bar/sand dune complexes.
0.2	10.85	Road cuts through one of the rubble bars.
0.05	10.9	T-intersection from the left (6250W). CONTINUE AHEAD. Notice again the rolling landscape.
0.5	11.4	Road ascends to the top of a rubble bar/sand dune complex.
0.2	11.6	Approaching intersection; prepare to stop.
0.05	11.65	Crossroad intersection (7000W and 2000N). TURN RIGHT onto 7000W and prepare to pull over and stop on the shoulder of the road.

0.05	11.7	**STOP 3 Rubble Bar and Sand Dune Complex** Use extreme caution when exiting your vehicles. Exit on the passenger side if possible.

0.0	11.7	Leave Stop 3 and CONTINUE AHEAD.
0.95	12.65	Crossroad intersection (3000N and 7000W). CONTINUE AHEAD. Notice the large groups of wooded areas scattered across the landscape. These trees are generally growing on the rubble bar/sand dune complexes. Unlike in most parts of the state, where, when you see trees growing, they are

		along creeks or small streams, here they point to the location of these sand dunes.
1.0	13.65	Crossroad intersection (4000N and 7000W). CONTINUE AHEAD.
0.2	13.85	Pass under high-tension lines.
0.25	14.1	Pass Shreffler Cemetery on right side of the road. Note the large erratic as a marker in the center of the cemetery.
0.3	14.4	Crossroad intersection (4740N). CONTINUE AHEAD.
0.9	15.3	Approaching stop; cross a small rubble bar exposed in the roadcut south of the intersection of the blacktop road and State Route 113. This is an excellent exposure of a rubble bar created by the Kankakee Torrent. The rubble is extremely coarse and consists of angular to sub-rounded rock fragments composed predominantly of dolomite. The dolomite was ripped from the valley bottom by the swift-moving currents of the Kankakee Torrent. Deposits left behind by the receding floodwaters are essentially unsorted, and the material ranges in size from silt and sand to boulders—all attesting to the swiftness and muddiness of the water. Less than 10% of the material contained in the bar is igneous, metamorphic, or sedimentary rock from outside of Illinois (erratics). Even though these erratics are much harder than the dolomite, they are more rounded than the dolomite because most of them were already rounded when picked up and transported by the glaciers and then were further rounded by the torrent. Generally, the rubble is thin and rests directly on the bedrock. In this cut, a maximum of about 12 feet of debris is exposed and thinly covered by sand and soil at the top. The top of the bedrock (Joliet Dolomite) is exposed in the ditch just to the north of the roadcut.
0.15	15.45	STOP (2-way). Crossroad intersection (IL Route 113/5830N and 7000W). We are following Kankakee County Highway 20. CONTINUE AHEAD.
0.25	15.7	Fisherman's Parking Access Area to the right.
0.1	15.8	Re-cross the Kankakee River and Warner Bridge. Note the small gravel islands with grass in the middle of the river to the right and left.
0.1	15.9	Access area to the left: Kankakee River State Park Fisherman's Parking and Class D Camping. After crossing the Kankakee River, you will ascend out of the valley and climb to the top of the bluffs, which are composed of Silurian dolomite bedrock.
0.2	16.1	STOP (2-way). Intersection (7000W and Route 102/6510N). TURN RIGHT onto Route 102. CAUTION: Cross traffic does not stop.

0.4	16.5	To the left, the large tree line on the landscape outlines part of Rock Creek and the Rockdale Moraine.
0.5	17.0	T-intersection from the left (6000W) leads to Camp Shaw-waw-nas-see. CONTINUE AHEAD.
0.45	17.45	Cross Rock Creek. On the west side of the suspension bridge is a trail. As you cross Rock Creek, the concession stand is on the right.
0.35	17.8	Entrance to Kankakee State Park; main entrance is to the right.
0.35	18.15	T-intersection from the left (Deselm Road). CONTINUE AHEAD. Approaching park entrance.
0.15	18.3	Kankakee River State Park Potawatomi Campground Entrance to the right. CONTINUE AHEAD.
0.6	18.9	T-intersection from the right (Altorf Road/4370W). CONTINUE AHEAD.
0.6	19.5	The road begins to climb a slight rise, which is also visible to the left in the field.
		Several physiographic features are visible from here. Toward the south is the Kankakee Torrent area. You are driving up onto the Rockdale Moraine. The slope of the moraine rises gently toward the northeast. The outer slope of the moraine in this area, from the southwest to the southeast, has been modified and steepened by the erosive force of the Kankakee Torrent. The lower tree line, to the right in the foreground, a little over 1 mile away, borders the Kankakee River. Across the river to the south, there is a well developed tree-cover on the sand dunes and rubble bars that were built by the torrent. The entire area to the south was covered by the rushing waters of the torrent. Deposits of the Kankakee Torrent in this vicinity occur below elevations of about 650 feet (see route map). On the horizon, about 12 miles to the south, portions of the Marseilles Moraine are faintly visible, which gives some impression of how vast an area was inundated by the torrent.
1.0	20.5	Ahead, the road rises to the crest of the moraine.
0.1	20.6	Prepare to turn right just past the brown park sign for the Kankakee River State Park Youth Group Camping and Bike Trail.
0.2	20.8	Crossroad intersection (3000W and Route 102). TURN RIGHT onto 3000W.
0.55	21.35	Road jogs to the left and then back to the right.
0.6	21.95	T-intersection (3000W and 3100N). TURN LEFT onto 3100N.
0.4	22.35	Road gently curves to the right and then back to the left.
0.15	22.5	T-intersection from the right; Davis Creek Area Youth Group Camping and Bike Trail (brown sign). TURN RIGHT.

0.05	22.55	Road gently curves to the left and then back to the right.
0.15	22.7	Road straightens out.

0.1	22.8	**STOP 4 Lunch: David Creek Area** Enter parking lot at Davis Creek area. Lunch stop. Are you hungry? Reset odometer to 0.0 before leaving the lunch stop.

Miles to next point	Miles from start	
0.0	0.0	Leave Stop 4 and retrace your route to 3100N.
.0	0.3	T-intersection (Davis Creek area entrance and 3100N). TURN RIGHT.
0.05	0.35	T-intersection from the left (2320W). TURN LEFT onto 2320W.
0.55	0.9	Road makes a sharp 90° turn to the right. This intersection is marked 2320W and 3630N.
0.05	0.95	Road makes a sharp 90° turn to the left. This intersection is marked 3630N and 2250W.
0.15	1.1	STOP (1-way). Intersection of (Route 102 and 2250W). TURN RIGHT onto Route 102.
0.3	1.4	Cross Davis Creek. Davis Creek follows a topographic low that marks the position of a subglacial flow path and one of the flow paths of the Kankakee Torrent.
0.5	1.9	T-intersection from the right (Glen Road). CONTINUE AHEAD.
0.1	2.0	T-intersection from the right (Sportsman Club). CONTINUE AHEAD.
0.2	2.2	Entering the City of Bourbonnais.
0.35	2.55	Stoplight. Intersection (Briar Cliff Lane 1000W and Route 102/3000N). TURN LEFT onto 1000W heading north.
0.45	3.0	T-intersection from the right (3500N). CONTINUE AHEAD.
0.5	3.5	T-intersection from the right (Tremont Street). CONTINUE AHEAD.
0.05	3.55	Kankakee Area Career Center to the right.
0.35	3.9	Cross small tributary of Davis Creek.

0.6	4.5	T-intersection from the right (5000N and 1000W). TURN RIGHT onto 5000N, heading east.
0.8	5.3	You are on the crest of the Rockdale Moraine.
0.2	5.5	STOP (2-way). Intersection (5000N and Route 45-52/0000E). TURN LEFT onto Route 45-52. CAUTION: Cross traffic does not stop. Indian Oaks Sale Center is on the northeast corner of the intersection.

An exposure of Rockdale *till* occurs in the ditch on the northeast corner of the intersection. This exposure is near the top of the Rockdale Moraine. Mottled gray-brown, calcareous till is exposed beneath a thin brown soil zone in this area. Till is an ice-laid deposit, characterized by its lack of sorting and lack of stratification. Note the wide range of particle sizes—from clay to pebbles and cobbles—in the till. Some of the rock fragments are faceted and striated (scratched) from having been abraded during transport by the ice.

Most of the rock fragments in the till are dolomite and chert, which the glacier gouged from the Silurian dolomites exposed at the bedrock surface in northeastern Illinois. Careful inspection will also reveal a variety of igneous, metamorphic, and other sedimentary rock types. The igneous and metamorphic rock fragments are not indigenous to Illinois but were transported by the ice from eastern Canada where they are exposed. Also abundant are sedimentary rock fragments eroded from the southern Michigan peninsula and the Lake Michigan Basin. Especially distinctive are fragments of dark shale from the Devonian Antrim Shale, which underlies the axis of the Lake Michigan Basin.

1.0	6.5	Intersection (6000N and Route 45-52/0000E). TURN RIGHT onto 6000N.
0.5	7.0	Cross overpass of I-57.
0.5	7.5	T-intersection from the left (1000E). CONTINUE AHEAD.
0.4	7.9	Azzarelli Cement Plant to the left.
0.05	7.95	Cross dual set of Illinois Central Railroad tracks with lights and guard gates. CONTINUE AHEAD.
0.05	8.0	STOP (2-way). Intersection (6000N and Route 50/1450E). TURN LEFT onto Route 50 and prepare to turn right into the Vulcan Materials Quarry, Manteno Plant #10.

0.15	8.15	**STOP 5 Vulcan Materials Company, Manteno Quarry** TURN RIGHT and enter the quarry. After leaving the quarry, retrace your route back to the entrance.

0.05	8.2	Leave Stop 5. Use exit north of the scale house. TURN LEFT onto Route 50 and immediately prepare to turn right. CAUTION: Fast moving traffic from both directions.
0.2	8.4	Intersection (6000N and Route 50/1450E). TURN RIGHT onto 6000N.

0.05	8.45	Cross Illinois Central Railroad dual tracks with lights and signal gates.
0.40	8.85	T-intersection from the right (1000E). TURN RIGHT onto 1000E.
0.8	9.65	View of North Central Materials, Manteno Quarry ahead and to the left.
0.2	9.85	T-intersection from the left (7000N). TURN LEFT onto 7000N. After making the turn, the South Branch of Rock Creek is to the right. You are now following one of the flow paths of the Kankakee Torrent, which is outlined by the South Branch of Rock Creek.
0.45	10.3	Cross over I-57. A borrow pit is to the right on the west side of the interstate.
0.3	10.6	Cross small drainage ditch. There are a large number of glacial erratics and concrete blocks in the ditch on either side of the road.
0.2	10.8	STOP (2-way). Intersection (Route 45-52/0000W and 7000N). TURN RIGHT onto Route 45-52, heading north.
0.45	11.25	Cross South Branch of Rock Creek.
0.55	11.8	Cross a small channelized drainage ditch; prepare to turn right at the T-intersection.

0.2	12.0	**STOP 6 North Central Materials, Manteno Quarry** TURN RIGHT and enter North Central Quarry, Yard 95. After leaving the quarry, retrace your route back to the entrance.

0.1	12.1	Leave Stop 6 and TURN RIGHT onto Route 45-52.
0.2	12.3	The ditch on the right side of the road contains a large number of glacial erratics and locally derived dolomite mixed with clay, sand, and silt. This exposure is a ground moraine that was deposited by the retreating glacier that formed the Rockdale Moraine to the south. CAUTION: This ditch also contains a lot of concrete, bricks, broken glass, and other trash. South and east of the quarry entrance is a large deposit of overburden from the quarry operation, which is being used as fill material. This is a good location to collect glacial erratics.
0.5	12.8	Sign for Kankakee River State Park, Manteno, and Deselm.
0.1	12.9	STOP (4-way). Intersection (North 45/West 52 and 9000N/ Kankakee County Highway 9). TURN RIGHT onto 9000N .
1.0	13.9	Intersection (Spruce Street/1000E and 9000N/Kankakee County Highway 9). TURN RIGHT onto 1000E heading south.
0.2	14.1	Entrance to K-Mart distribution center. Use the entrance to turn around and head back north and park along the road.

0.1 14.2 **STOP 7 Silurian Dolomite, Refuse Pile** Pull over and park along the right side of the road. The field on the right contains a large refuse pile of Silurian dolomite. This is a good fossil collecting locality. End of trip.

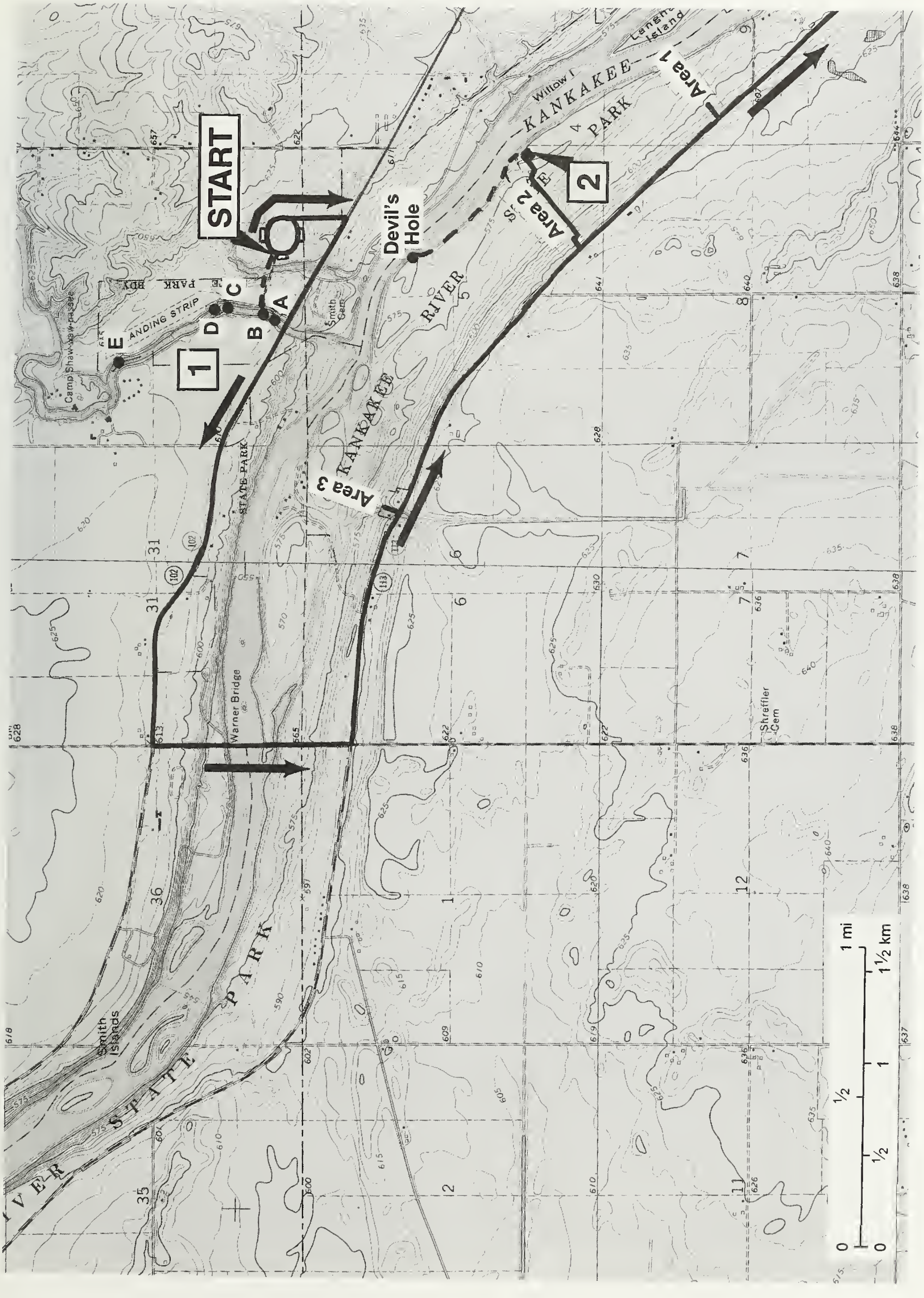
Interstate I-57 can be seen to the right. The Manteno water tower can also be seen. Manteno is east of the interstate.

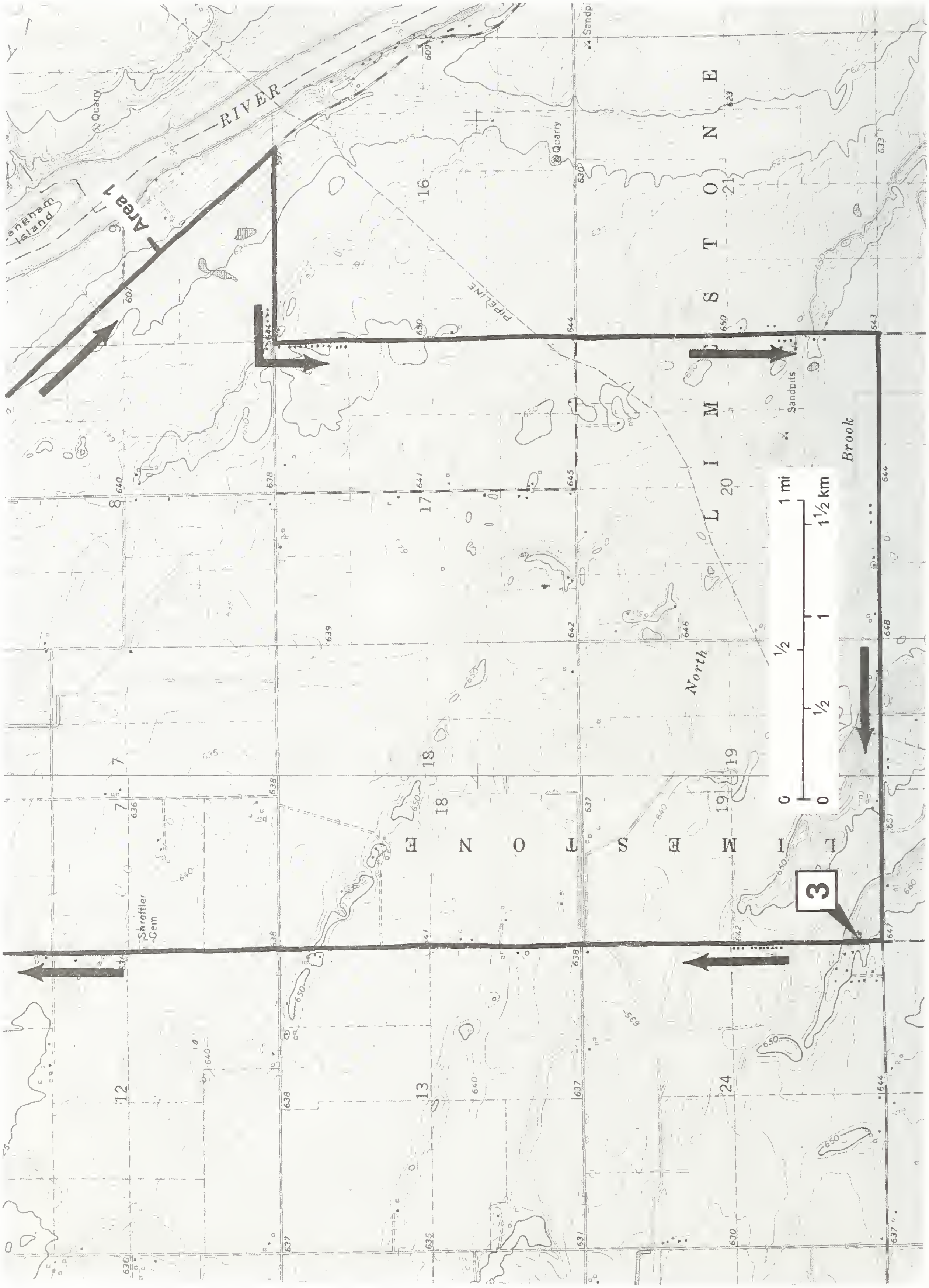
Have a safe trip home and join us November 1 at the Cache Valley area near Ullin, Illinois.

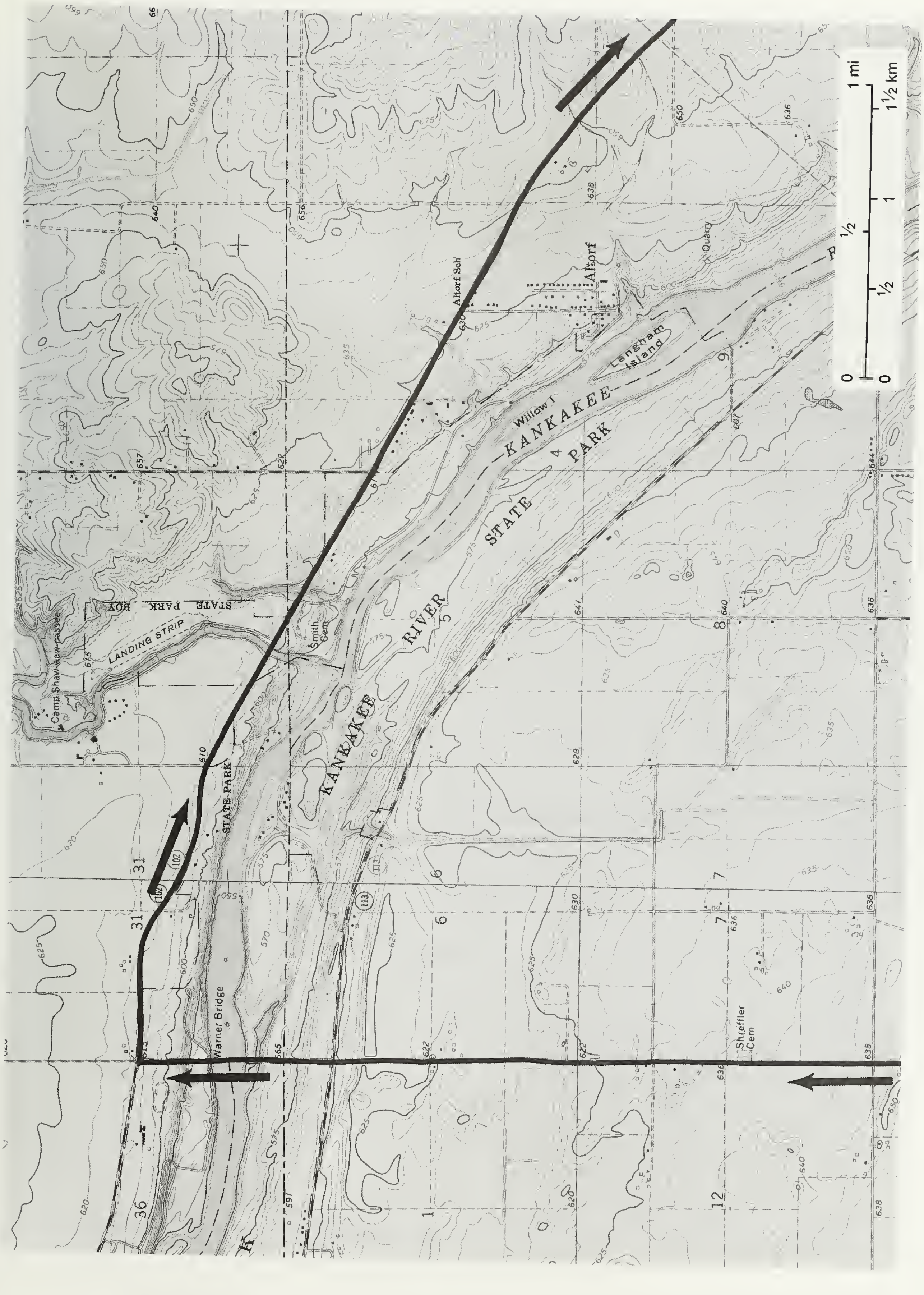
0.0 14.2 Leave Stop 7.

0.1 14.3 Stop (2-Way). Intersection (9000N/Kankakee County Highway 9 and Spruce Street/1000E). TURN RIGHT.

0.1 14.45 South bound entrance ramp of I-57; Kankakee is south. The north bound entrance ramp to I-57 is on the east side of the overpass.


START
Devil's Hole
Area 1
Area 2
Area 3
1
2
A
B
C
D
E
Warner Bridge
Smith Islands
Smith Cem
Shreffler Cem
Willow I
KANKAKEE RIVER
STATE PARK
1 mi
1½ km


RIVER
Area 1
Quarry
Sandpits
PIPELINE
LIMESTONE
North
Brook
Shreffler Cem
3
1 mi
1½ km


KANKAKEE RIVER STATE PARK
KANKAKEE
Altorf
Altorf Sch
Langham Island
Willow I
Quarry
STATE PARK BDY
LANDING STRIP
Camp Shaw-waw-nassee
Smith Cem
STATE PARK
Warner Bridge
Shreffler Cem
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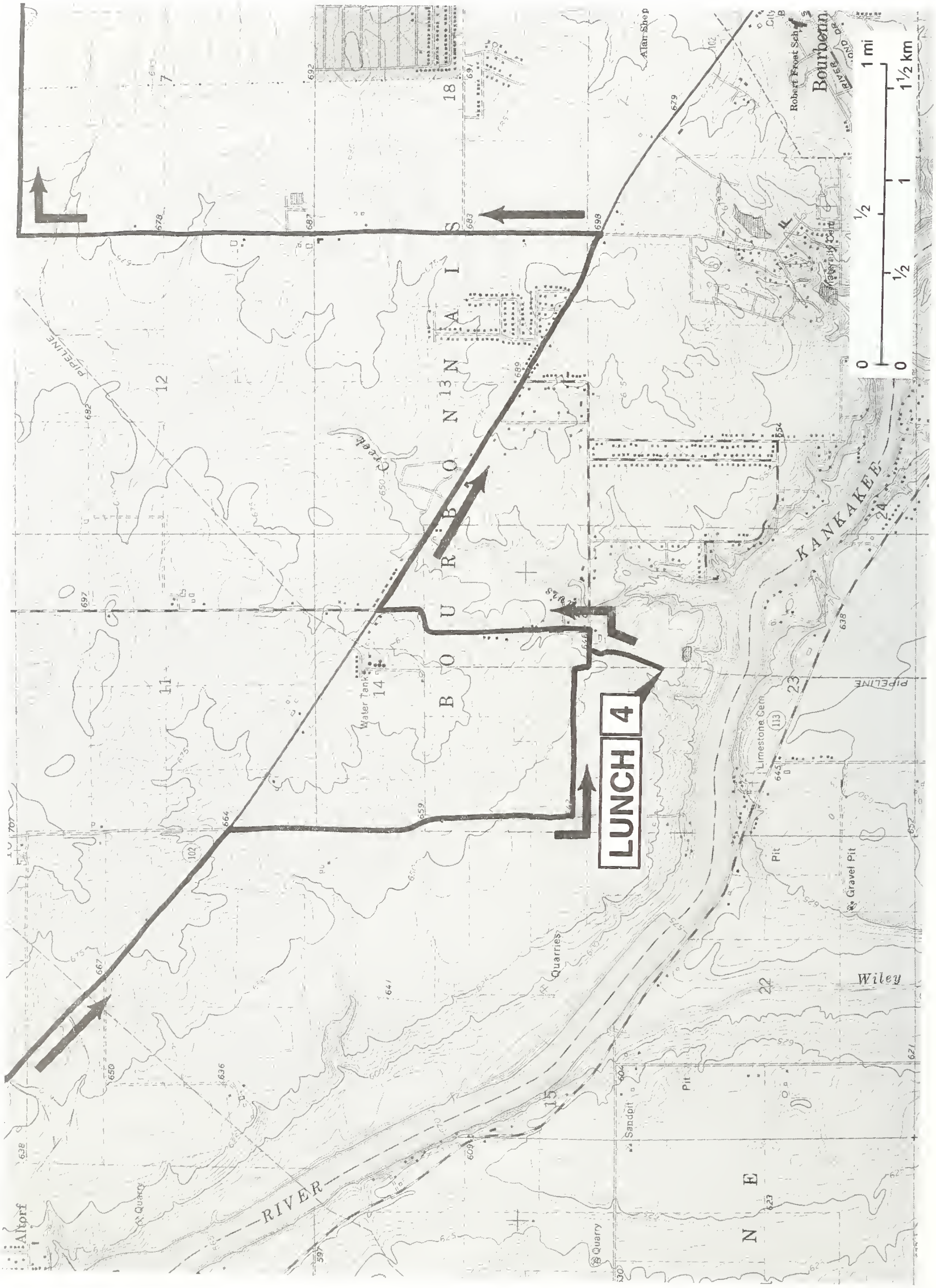
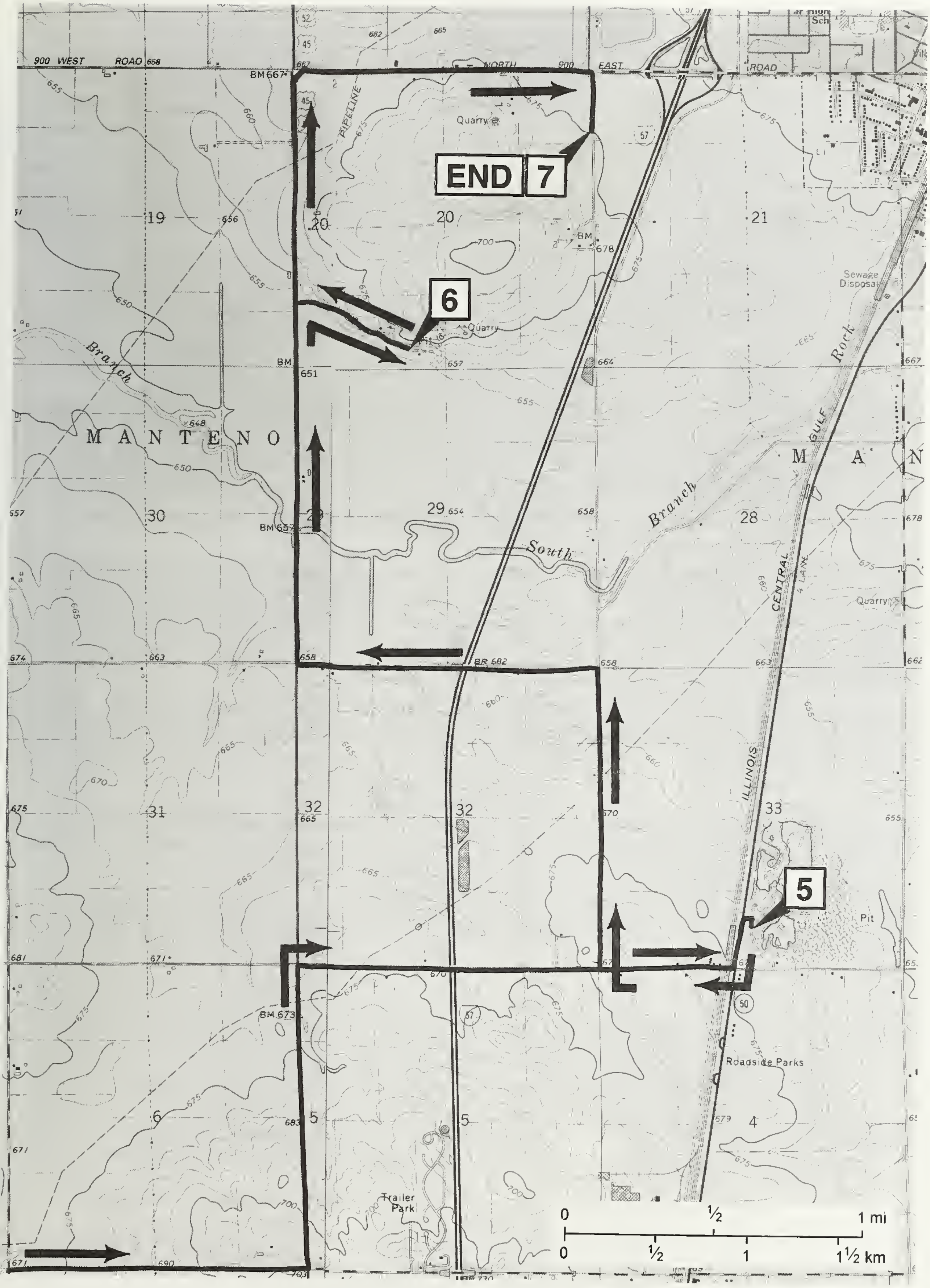
1
1½ km



LUNCH 4
B O U R B O N N A I S
KANKAKEE
RIVER
Altorf
Quarries
Quarry
Water Tank
Limestone Cem
Gravel Pit
Sandpit
Pit
Wiley
PIPELINE
Robert Frost Sch
Bourbonnais
0 ½ 1 mi
0 ½ 1 1½ km


END
7
6
5
900 WEST ROAD
NORTH 900 EAST ROAD
Quarry
PIPELINE
MANTENO
Branch
South Branch
Sewage Disposal
Rock
GULF
ILLINOIS CENTRAL
4 LANE
Quarry
Pit
Roadside Parks
Trailer Park
0
½
1 mi
0
½
1
1½ km

STOP DESCRIPTIONS

STOPS 1A–E Rock Creek Gorge, Kankakee State Park (fig. 12) (W½ of Section 32, T32N, R11E, 3rd P.M., Kankakee County, Bourbonnais 7.5-Minute Quadrangle). Note: The parking lot is located in the SW/SE quarter of Section 32.

From the middle parking lot, the trail leading to Rock Creek is approximately 200 feet to the west. Follow the trail to the north-northwest approximately 250 feet and cross the small wooden bridge over an unnamed creek. The trail now heads west; continue on the trail for another 150 feet, to where the trail crosses an equestrian trail. Continue ahead on the small trail for another 250 feet, where you will cross a second equestrian trail. Continue ahead for another 150 feet to the Rock Creek trail, which at this point follows an old blacktop road.

On the day of the field trip, stops 1A–E will be marked by orange flagging, and an ISGS staff member will be stationed at each stop. The distances for these stops are given to assist users of the guidebook after today's field trip. The distances are measured from the guard rail located north of IL Route 102, and have been paced off following the trail along the east side of Rock Creek. From the guard rail, face north and follow the trail, which along this portion is the blacktop service road.

For those not familiar with the use of the term "pace," one pace is marked off by starting with both feet together and—starting with either the right or left foot—counting off the number of times the same foot hits the ground (that is, count only the number of times either the right or left foot hits the ground). The distance of each pace will vary according to each hiker's stride. A pace length of 5 feet was used to calculate the distances given in the guidebook.

	Paces	Total paces	Feet	Description
	9	9	45	Blacktop begins
	10	19	95	Gravel service road to the right
	17	36	180	Old trail to Rock Creek to the left
Stop 1A	10	46	230	View of cave on west side of Rock Creek
	16	62	310	View of riffles in stream to the north
Stop 1B	29	91	455	View of small stack
	10	101	305	Trail coming in from the right (leads to parking lot)
	5	106	530	View to the left steep cliffs & small cave to the north along Rock Creek
	50	156	780	View of small cave to the south
	5	161	805	Trail coming in from the right
	8	169	845	Steep cliffs
	48	217	1,085	Steep cliffs and view of stream
	13	230	1,150	End of blacktop service road
Stop 1C	11	241	1,205	Trail sign; path to the left leads to clay pit
	7	248	1,240	Second path leading to clay pit
Stop 1D	19	267	1,335	View of small arch to the left
	95	362	1,810	High bluffs; old 300+ year old cedar trees growing in rocky bluffs
	78	440	2,200	Path to base of creek; small riffles in creek bed
	10	450	2,250	Trail marker
	46	496	2,480	Path to creek
Stop 1E	113	609	3,045	Path to waterfall
	40	649	3,245	Second path to waterfall
				End of Trail

Figure 12 Large boulders of Silurian dolomite near the mouth of Rock Creek, looking upstream from a point south of the suspension bridge. Route 102 bridge is in the background (photo by W. Frankie).

STOP 1A Horsethief Cave (fig. 13) (NW SE SE SW, Sec. 32, T32N, R11E, 3rd P.M., Kankakee County, Bourbonnais 7.5-Minute Quadrangle) The cave is located approximately 230 feet north of Route 102).

The Rock Creek gorge has been cut into the Silurian-age Sugar Run and Joliet Formations of the Niagaran Series. The stratigraphic section on page 34 describes the exposure on the west side of Rock Creek and south of the bridge; it is taken from ISGS Circular 479, *Rock Stratigraphy of the Silurian System in Northeastern and Northwestern Illinois*, by H.B. Willman (1973) (see also fig. 24). To reach the bottom of Rock Creek gorge, carefully climb down the riprap spillway located just north of the suspension bridge south of Route 102.

Horsethief Cave

The only known caves in the Silurian rocks in northeastern Illinois are located along the Kankakee River Valley west of Kankakee. Most of these caves are small, and only one, Horsethief Cave (sometimes called Indian Cave), has enough room to stand up. The longest enterable cavity does not exceed 30 feet (Bretz and Harris 1961). Several small caves or cavities occur in the Silurian dolomitic rocks along Rock Creek. According to Bretz and Harris (1961), there are two types of cavities here. Both were formed by groundwater (phreatic) solution, but under quite different and specific conditions.

The first type of cavity developed as a result of normal soil-water solution processes. In this type of solution feature, the reactions of normal acidic rainwater, enhanced by the acids in the overlying

Figure 13 Horsethief Cave along Rock Creek, located north of Route 102 bridge at stop 1A. Note the vertical joints and blocky nature of the bluffs adjacent to the cave (photo by W. Frankie).

Rock Creek Canyon Section

Outcrops on the west side of Rock Creek and south of the bridge of IL Route 102

SILURIAN SYSTEM

Sugar Run Formation (12′6″)

Dolomite, argillaceous, silty, yellowish brown, very fine grained, dense; in 4″ to 1′ beds	3′8″
Dolomite, as above, but weathers shaley	7″
Dolomite, as above, but less argillaceous and silty; a few beds slightly vesicular	4′6″
Dolomite, brownish gray to brown, fine grained, slightly vesicular; in 3″ to 1′ beds; contains a few slightly argillaceous beds; prominent bedding plane at base	3′9″

Joliet Formation (40′1″)

Romeo Member

Dolomite, pure, light gray, fine grained, vesicular, vuggy; in 2″ to 8″ beds	5′8″
Dolomite, as above but light brownish gray, less vuggy, and more massive	4′9″
Dolomite, light brownish gray; less vesicular and slightly less pure than above; chert nodules 1′ below top	7′6″

Markgraf Member

Dolomite, slightly argillaceous, light brownish gray, very fine grained, dense to slightly vesicular; in weak 8″ to 1′6″ beds	7′6″
Dolomite, slightly argillaceous, light brownish gray, very fine grained, dense to slightly vesicular; in weak 8″ to 1′6″ beds	7′6″
Dolomite, slightly argillaceous, very light gray, very fine grained, dense to slightly vesicular; in 4″ to 1′ beds; faint light green and light pink mottling in lower 1′; prominent bedding plane at base	4′9″

Brandon Bridge Member

Dolomite, light greenish gray, very fine grained, dense; contains a few coarse grained, pinkish lenses	6″
Dolomite, as above, but more shaley and contains bright green shale partings	7″
Dolomite, gray, green and pink mottled, very fine grained, dense; in 2″ to 8″ beds with green shale partings; base concealed at low water level	1′4″

The section is cut by a fault at the south side of the bridge; the north side of the fault is down about 6′.

The first type of cavity developed as a result of normal soil-water solution processes. In this type of solution feature, the reactions of normal acidic rainwater, enhanced by the acids in the overlying soils, have dissolved the dolomitic rocks. As in most caves elsewhere in Illinois, dissolution of these cavities is fairly conventional in that the cavities occur along the joints (vertical cracks) and the bedding planes in the rocks. These types of cavities are generally younger and smaller than the second type in this area.

Horsethief Cave, however, is an example of the second, somewhat unusual type of cavity that occurs along Rock Creek. These cavities formed by an artesian circulation beneath an impervious shale cover. The circulation and dissolution within the Silurian carbonates occurred at the contact of the insoluble, impermeable, unjointed shale overlying the Silurian rocks.

This second type of cavity, which is generally larger and deeper (up to 30 feet) than the first type, formed long before Rock Creek Canyon was cut. In cross section, these cavities resemble sinkholes in their downward taper and general lack of present roofs. Horsethief Cave is the only one visible along Rock Creek that has a surviving roof. All of them are filled with clayey, sandy, or cherty debris derived from a former overlying cover of Pennsylvanian rocks. The mechanical weakness of this overlying cover rock allowed it to subside under its own weight into the enlarging joint cavities below. Bretz and Harris (1961) cited the following evidence supporting an interpretation of collapse of overlying roof rock into a cavity during solution. The Pennsylvanian-age shale filling these types of cavities consistently exhibits deformed stratification that fills the varied cross-sectional shapes of the cavities. Brecciation in the shale is common and drag-folding is known. Slickolite-marked surfaces (vertical striations produced by slippage and shearing on strongly dipping beds of limestone or dolomite that form the molding on the wall of a solution cavity) occur on walls at the contact with the fill. Cavities of this type have been discovered in many of the quarries in Silurian rocks near Kankakee, Joliet, and other places in northeastern Illinois, and commonly are called “filled sinks.” Horsethief Cave appears to be a lateral toe of such a filled sink. The erosion and down-cutting by Rock Creek has destroyed the larger and probably roofless part and has allowed the fill in this toe to escape. Vertical slikolite markings on the walls of Horsethief Cave indicate downward movement of material along the walls of the cavity.

STOP 1B View of Small Stack (SE NE SE SW, Sec. 32, T32N, R11E, 3rd P.M., Kankakee County, Bourbonnais 7.5-Minute Quadrangle) Site is approximately 455 feet north of Route 102.

Formation of the small “stack” is a chance happening. The course followed by Rock Creek is heavily controlled by the natural joint patterns in the Silurian dolomite. Two sets of vertical joints can easily be seen in the bluffs along the creek. The small stack (a monolith) located along the east side of Rock Creek Canyon is an erosional remnant that was carved from the bluffs as Rock Creek was down-cutting in this area. The falls, which have now migrated upstream, were once located near the small stack. During times of high water flow over the falls, water preferentially followed zones of weakness—in this case, joints on either side of the stack. Erosion first occurred along one joint (say, the east side of the stack) and then changed its course to follow a second joint on the west side of the stack. Remember mother nature has a right to change her mind whenever she feels like it.

STOP 1C Clay Pit (SE SE NE SW, Sec. 32, T32N, R11E, 3rd P.M., Kankakee County, Bourbonnais 7.5-Minute Quadrangle) The site is located approximately 1,250 feet north of Route 102. Be careful! Extremely slippery when wet.

The clay pit is a filled sink, the same type of cavity as Horsethief Cave. The material in this sink is Pennsylvanian-age clay. Slikolite-marked surfaces are visible in the southern wall of this cavity (fig. 14). Given enough time, the fill in this cavity may be removed by erosion during high flow in Rock Creek or by the small spring located near the base of the clay pit. The clay material in some of the local Native American pottery found in the archeological excavations in the area of Kankakee River State Park may have been mined from this spot. A rusted iron pipe driven into the clay just south of the current spring suggests that someone may have used this spring as a source of drinking water at some time in the not-too-distant past, probably during the "iron age."

Figure 14 Slikolite-marked surface (vertical striations) on southern wall of clay pit at stop 1C (lens cap is for scale) (photo by W. Frankie).

STOP 1D Small Arch (fig. 15) (SW NE NE SW, Sec. 32, T32N, R11E, 3rd P.M., Kankakee County, Bourbonnais 7.5-Minute Quadrangle) The arch is located approximately 1,345 feet north of Route 102. Be careful! Watch your head.

The small arch located on the west side of Rock Creek is the world's smallest Silurian dolomite arch. This arch may have initially started as a small dissolution cavity within the bedrock. One possible explanation for its creation is that water flowed through the cavity and left the overlying roof of the cavity in place as Rock Creek was down-cutting through the rocks.

Figure 15 Small Silurian dolomite arch at stop 1D. The wider angle at the base of the opening below the arch than at the top possibly indicates that development the of arch was created by flowing water (photo by W. Frankie).

STOP 1E Waterfalls (fig. 16) (SW NW SE NW, Sec. 32, T32N, R11E, 3rd P.M., Kankakee County, Bourbonnais 7.5-Minute Quadrangle) The falls are located approximately 3,100 feet north of Route 102.

As described above, the Rock Creek gorge has been cut into the Silurian-age Sugar Run and Joliet Formations of the Niagaran Series (p. 34). Rock Creek cut this gorge after the Kankakee Torrent receded about 12,000 years ago. As the flood waters from the melting glaciers receded, they became more concentrated along the principal axis of flow and cut the Kankakee Valley. Down-cutting was much more rapid along the Kankakee Valley than along the valley of Rock Creek, a much smaller stream. Rock Creek became perched above the Kankakee River, forming a small waterfall near its mouth. As a result, Rock Creek is in disequilibrium with respect to the Kankakee River, and has been trying to establish an equilibrium by down-cutting. This down-cutting action is the result of the water plunging over the falls; the plunging water erodes a deep pool at its base, called a "plunge pool," that undermines the step from which the water falls. The original waterfall may have been

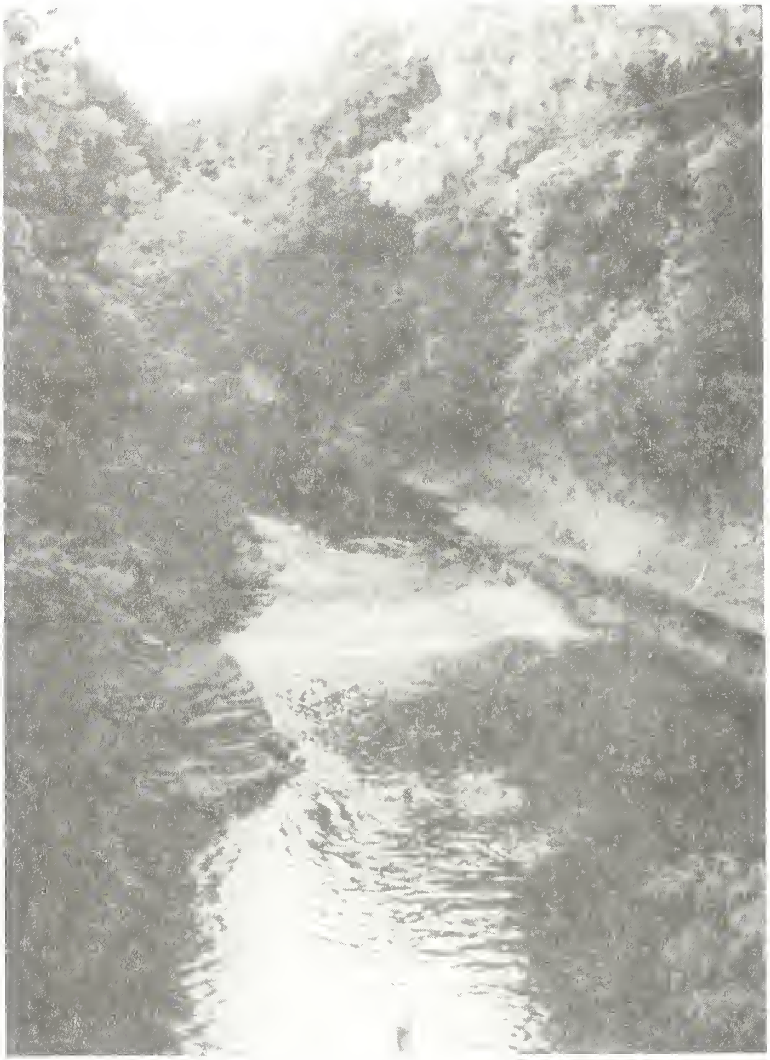


Figure 16 Waterfall at stop 1E along Rock Creek. The sharp contact between the falls and the rock bluffs on the left side of the falls is controlled by joint patterns in the Silurian bedrock (photo by W. Frankie).

40 to 50 feet high when it first formed near the mouth of Rock Creek. As the step is progressively eroded back, the waterfall migrates upstream. The height of the waterfall decreases as it migrates upstream, until the falls no longer exists and the stream reestablishes an equilibrium with a steep, but uniform, gradient. During the past 12,000 years, the falls have since migrated upstream about 0.75 mile. This distance gives an average rate of upstream migration of about 4 inches per year.

Of special note: The ISGS ran a geological science field trip 30 years ago (Bourbonnais 1967C), and Rock Creek Falls was one of the stops. Given the above calculations, the waterfall that they visited was approximately 10 feet farther downstream than the one you see today. Eventually, as stated above, upstream migration and down-cutting will eliminate the falls.

The elevation of Rock Creek drops from 600 feet above sea level near Camp Shaw-waw-nas-see to 560 feet where it empties into the Kankakee River, a drop of 40 feet within a distance of 1.5 miles (see route map). The gradient of a stream refers to the steepness of its slope and is expressed as a ratio (vertical to horizontal) or a fraction (feet/mile). The gradient of Rock Creek from the waterfalls to where it joins the Kankakee River is 20 feet per mile. The base elevation of Rock Creek at the waterfalls is approximately 575 feet above sea level, and the base elevation near the mouth of Rock Creek is 560 feet, equaling a drop of 15 feet within a distance of 0.75 miles. The gradient of the Kankakee River near the mouth of Rock Creek is only 5 feet per mile. The gradient of the lower portion of Rock Creek is 4 times greater than the gradient of the Kankakee River near the mouth of Rock Creek. However, the gradient of the upper reach of Rock Creek is significantly less than the lower portion where it is actively down-cutting to the base level of the Kankakee River. The gradient of a portion of upper Rock Creek, calculated from the Deselm Bridge to where county road 7940N crosses the Rock Creek (north of Flickerville), is 2.5 feet per mile—just half as steep as that of the Kankakee River (see route maps).

STOP 2 Devils Hole, Kankakee River State Park (SE NE SE, Sec. 5, T31N, R11E, 3rd P.M., Kankakee County, Bourbonnais 7.5-Minute Quadrangle).

A number of studies have been conducted on the Kankakee River, and the following were used as major references for writing this stop description: Ivens et al. (1981) and Gross and Berg (1981). In addition, two Web sites contain some useful information on the Kankakee River: (1) the Upper Illinois River Basin National Water Quality Assessment (NAWQA) Program home page

http://www.dwimdn.er.usgs.gov/nawqa/uirb/basin_desc/genrl_char/genrl.html

and (2) the Illinois Environmental Protection Agency (EPA) home page

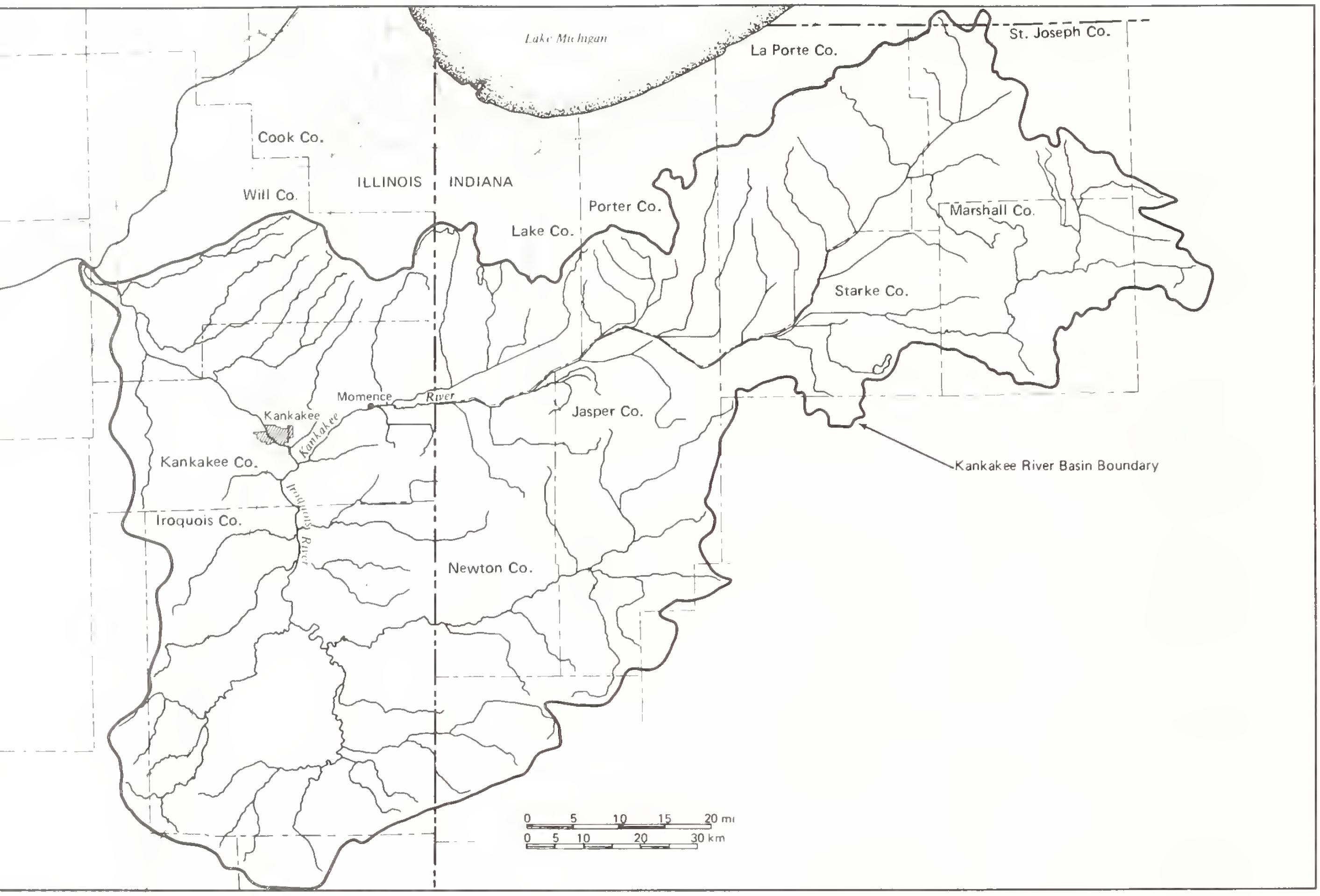
http://www.epa.state.il.us/org/bow/water-quality/fact-sheet-10.html

Kankakee River The Kankakee River flows westward from Indiana into Illinois. The headwaters are near South Bend, Indiana, and the mouth is the confluence of the Kankakee with the Des Plaines River near Morris, where the two rivers merge and become the Illinois River (fig. 17). Of the 5,165 square miles in the Kankakee River drainage basin, 2,169 are in Illinois and 2,996 are in Indiana. The river has a total length of about 150 miles, with 59 miles in Illinois. The climate of the Kankakee River Basin is classified as humid continental. In general, summers are hot and humid and winters are cold. The average annual precipitation, calculated for the period 1951–80 at the headwaters of the Kankakee River, is 40 inches.

Beginning in the late nineteenth century and essentially complete by 1918, almost all the main channel of the Kankakee River in Indiana was channelized (straightened). Today, the Kankakee River in Indiana is a man-made ditch, extending straight east from the Illinois–Indiana state line for many miles. In Indiana, all the natural meanders were eliminated.

In Illinois, a very small dam exists at Momence, a larger dam at Kankakee, and an overflow dam at Wilmington, but most of the river remains a naturally meandering stream. A major tributary of the Kankakee River in Illinois is the Iroquois River, which joins the Kankakee just below Aroma Park. Most of the Iroquois drainage basin also is in Indiana.

Before channelization, much of the drainage area of the river in Indiana was wetlands (swamps and marshes) called the "Grand Marsh." About 100 years ago, the Grand Marsh encompassed approximately 400,000 acres, ranged from 3 to 5 miles in width, and had a water depth of 1 to 4 feet for 8 or 9 months of the year. The marsh plain was only about 85 miles long and had a gentle slope of 5 to 6 inches per mile. The river course, however, was about 250 miles in length and wound slowly along



igure 17 Kankakee River basin (modified from Gross and Berg 1981).

through some 2,000 bends. The nature of the marsh caused the Kankakee River to alter its course continuously, resulting in the formation of a variety of meanders, oxbow lakes, sloughs, and bayous (Ivens et al. 1981).

In Indiana, the river system has been constructed and managed as an agricultural drainage project; the wetlands were drained and converted into very productive agricultural land. River management in Indiana has been focused on the economics of agricultural production. In Illinois, however, and especially in Kankakee County, the river has been used as a scenic, cultural, and recreational resource. The Kankakee River from the Illinois state line to Momence is a naturally meandering, sandy bottomed stream that traverses an area of timber and relatively undisturbed wetlands, commonly called the "Momence Wetlands" (Ivens et al. 1981).

Prior to the 1830s, the Kankakee River basin was inhabited primarily by the Potawatomi and a few French fur traders. Since both groups were directly dependent on the wildlife resources provided by this marsh, neither group had a compelling reason to alter it. As more and more settlers arrived in Indiana and Illinois, however, the economy of the Kankakee basin turned toward agriculture. Unlike the Potawatomi and the French fur traders, these settlers saw the Kankakee wetlands as a hindrance and were quick to drain ("reclaim") them for agriculture. Most of the trees in the area were logged off, and the river itself was channelized, which made shipping these logs to sawmills downstream easier.

Today, fewer than 30,000 acres of wetland can be found within the Kankakee basin. In Indiana, channelization projects have compressed the Kankakee River's original meandering 250 mile course into a fast and straight channel some 90 miles in length. Although this basin supported nearly a million acres of cropland by 1970, this productivity has come at considerable cost. Approximately one-fifth of this land is regularly flooded, and losses of wetland habitat have caused substantial regional declines in fish and wildlife populations.

In the late 1980s, efforts were begun to restore some of the lost wetlands of the Kankakee River basin. The levees that once constricted the Kankakee into its straight and narrow channel are being strategically widened to allow the river access to parts of its former flood plain. It is hoped this strategy will both reduce flooding and siltation as well as increase wildlife habitat with minimal losses to existing agricultural lands.

Geology of the Kankakee River basin Our rivers and streams are the product not only of flowing water and land use activities but also, most importantly, of the geologic foundation and land forms on which they evolved. The Illinois State Geological Survey's detailed study of the Kankakee basin (Gross and Berg 1981) describes the geologic history and the geology of the sediments of the river and its basin. The study focused on the part of the Kankakee River between the City of Kankakee and the Illinois–Indiana state line.

The geologic materials of the Kankakee River basin consist of a mantle of glacial deposits overlying Paleozoic bedrock. In Illinois, most of the bedrock in the basin is Silurian-age dolomite, whereas in Indiana much of the bedrock is Devonian-age shale. The geologic events responsible for the present topography and surface materials took place during the melting of the last continent glaciers. That melting occurred during the interval from approximately 16,000 to 13,000 years ago during the latter part of the Wisconsin Glacial Episode. The distribution of the surface materials is shown in figure 18. During this period, the retreating glacial lobes constructed numerous moraines.

Kankakee Torrent The most important geologic event shaping the landscape and the character of the deposits in the basin was the ancient Kankakee Torrent, also known as the "Kankakee Flood."

The Wisconsin episode glaciers did not make a single advance and retreat, but advanced, retreated, and re-advanced over the Kankakee area many times in response to alternately warmer and cooler climatic conditions. How far the ice melted back at the end of each recession cannot be determined, but the marginal outline of each re-advance, marked by an end moraine, was different from the preceding one.

The front of the glacier that built the Marseilles Morainic System extended across western Grundy County, northeastern Livingston County, and southern Kankakee County about 13,000 years ago (fig. 19). After the glacier had retreated from the Marseilles Moraine to the north and northeast, cooling of the climate caused the ice to re-advance during Rockdale time. There is some doubt about the exact location of the ice front because some of the front of the moraine has been removed by subsequent erosion, particularly by the Kankakee Torrent. The glacier may have advanced farther to the south than is now apparent. A slight warming of the climate caused the Rockdale glacier to melt back. Another chilling of the climate caused the ice to re-advance to the position of the Wilton Center Moraine. Retreat of the glacier from the Wilton Center Moraine was followed by a re-advance to the position of the Manhattan Moraine. Warming once again caused a retreat of the Manhattan glacier, which was followed by a major re-advance, leading to the development of the Valparaiso Moraine.

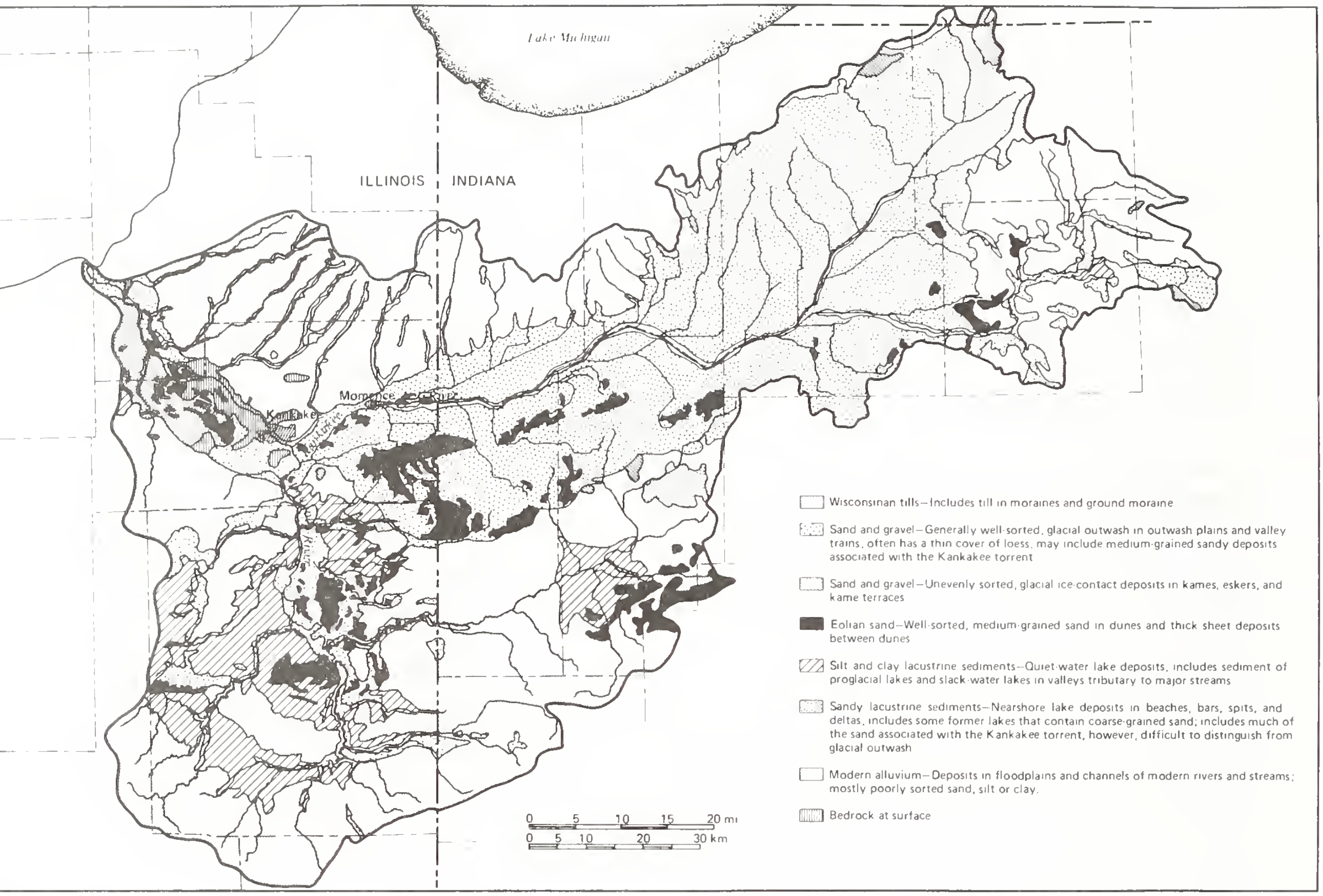


Figure 18 Kankakee River basin showing the distribution of surface materials (modified from Gross and Berg 1981).

The Valparaiso Moraine represents a major re-advance of the Wisconsin episode glacier into northeastern Illinois about 12,000 years ago. During melting of the Valparaiso ice, conditions were different from earlier times in that ice lobes from the Lake Michigan, Saginaw, and Huron-Erie basins in Illinois, Michigan, and Indiana coalesced in such a manner that the only drainageway for meltwater from the three glacial lobes was down the Kankakee Valley (fig. 20). The meltwater first flooded the Kankakee Valley because there was no outlet, and later because the only outlet was through a narrow constriction in the Marseilles Morainic System, in the Illinois River Valley to the west (figs. 19 and 20).

At the height of the flood (peak flow), the volume of in-flowing meltwater was so great that it could not escape through the narrow outlet in the Marseilles Moraine. As a result, the water spilled over the uplands into adjacent low areas and formed numerous glacial lakes (Lake Wauponsee, Lake Watseka, Lake Ottawa, and Lake Pontiac) (fig. 21). The deposits associated with these lakes consist mostly of fine grained lacustrine sediment (clays).

As the river of meltwater flowing from the glaciers entered the flooded Kankakee Valley, its velocity and load carrying capacity were sharply decreased. Much of the coarse rock debris being carried by the meltwater was deposited in the eastern part of the Kankakee Valley. Finer materials—sand, silt, and clay—were deposited in quieter waters of the lake away from the main flowing currents.

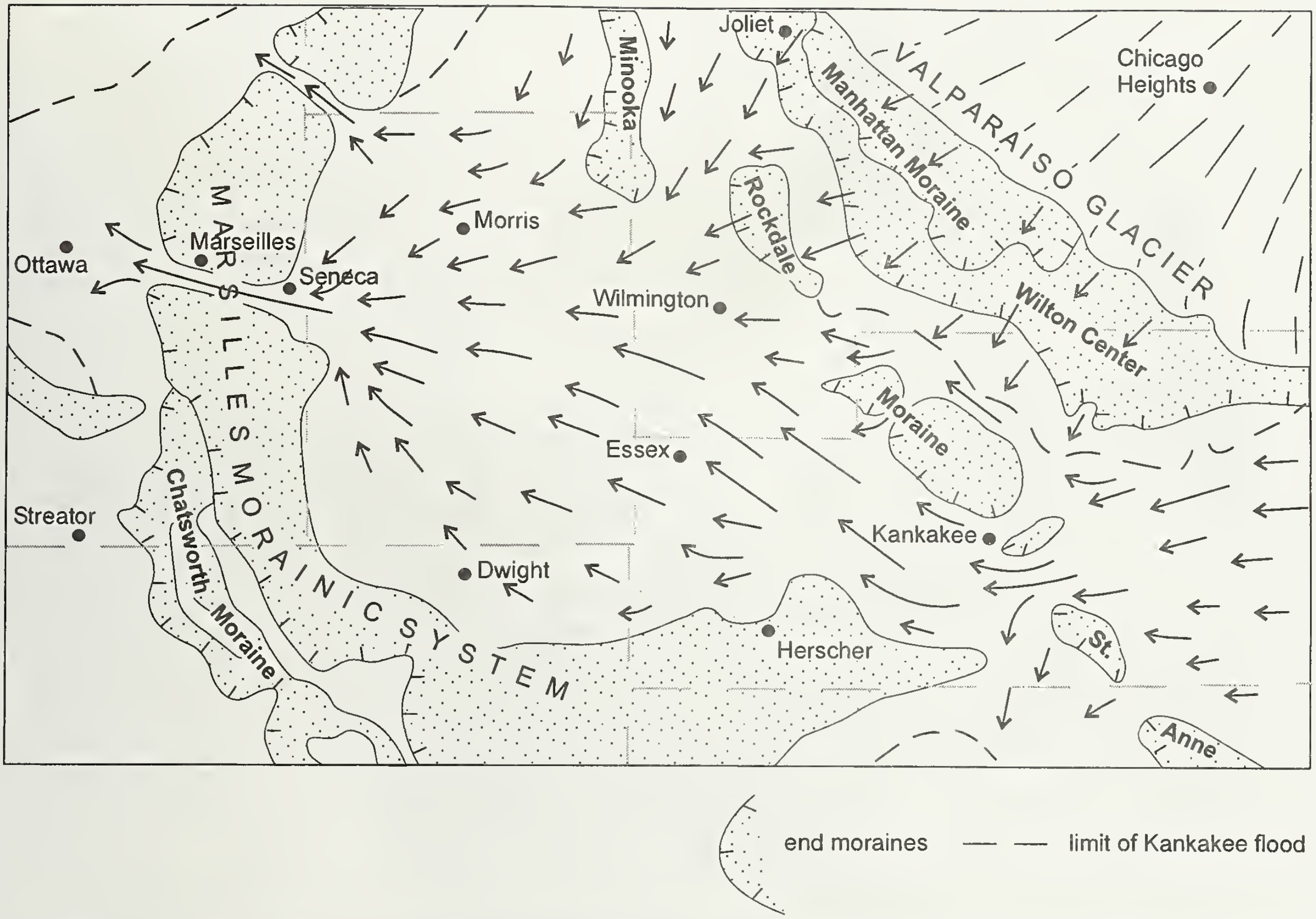


Figure 19 Areal extent of the Kankakee Torrent in the Morris-Kankakee Basin. Length of arrows indicates intensity of currents (modified from Cote, Reinertsen, and Wilson 1967).

To understand the mechanics of the Kankakee Torrent, it is important to realize that the vast quantities of meltwater flowing from the conjunction of these three glacial lobes and being discharged through the Kankakee Valley caused a great number of recurring floods, which are collectively referred to as the Kankakee Torrent.

After the gap in the Marseilles Moraine was eventually eroded, the base level of the flood waters fell considerably. Thereafter, the water flow was more concentrated in the central part of the Kankakee River Valley, and the river scoured broad areas down to the bedrock surface, like the bedrock exposed here at stop 2. Bedrock is exposed at the surface from the city of Kankakee to several miles past the Kankakee River State Park. The erosive force of the currents deposited numerous bars of angular, bouldery rubble, as well as relatively flat-lying bouldery material. A rubble bar is located at stop 3.

The gradient of the river and the water volume were great enough to give the torrent a velocity capable of carrying rock slabs up to 2 feet in diameter. Boulders were concentrated as the till deposits were scoured out of the valley. The swift currents also eroded the Silurian bedrock and ripped up blocks and slabs of dolomite. This erosion was most active in the early stages of the torrent as the large volume of the flood water quickly drained through the Marseilles Moraine. The inner margin of the Marseilles Moraine and the outer portions of the Rockdale Moraine were also cut away and perhaps straightened by this erosion. Great bars of rubble, sand, and gravel were built up; a general

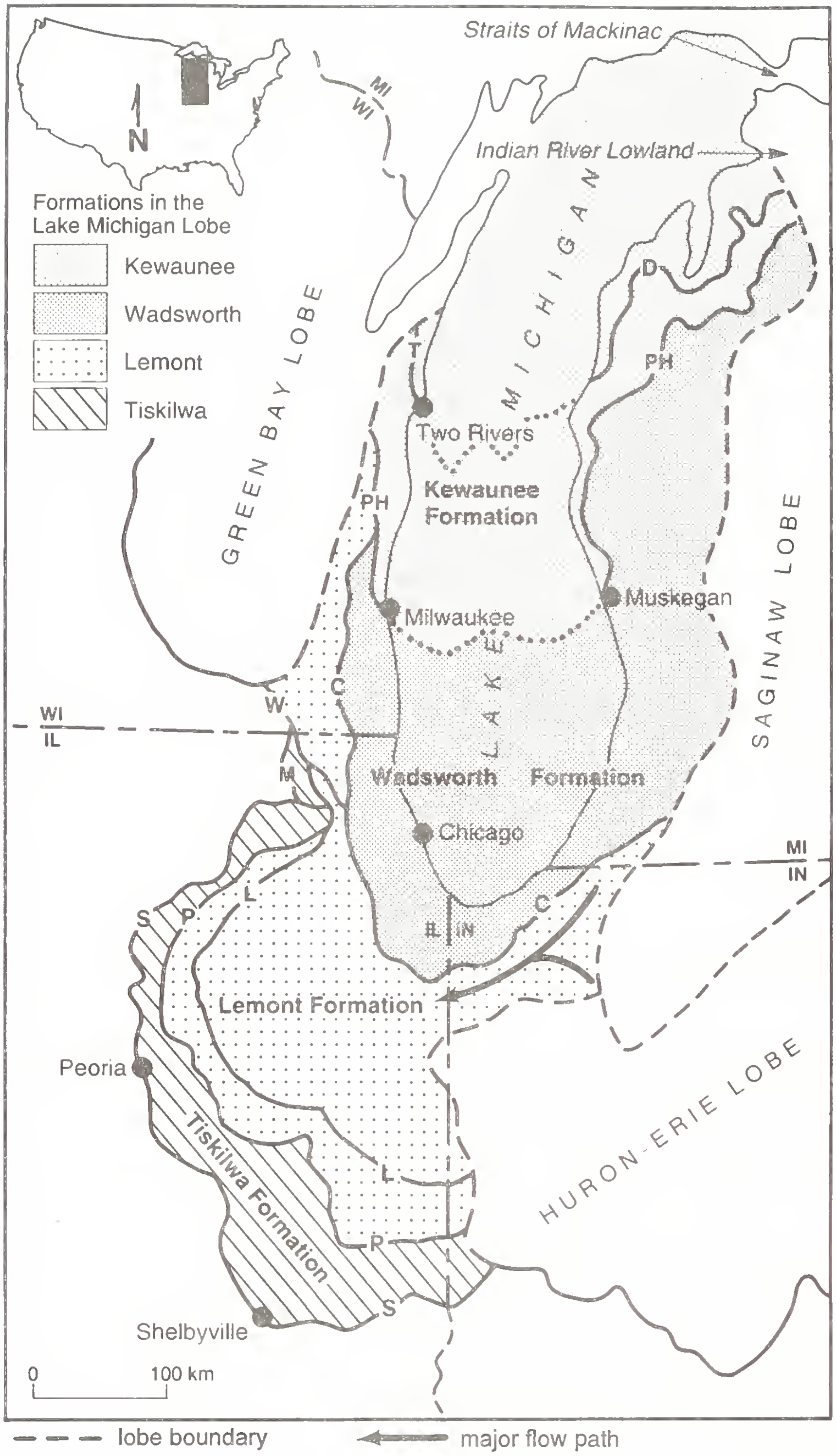


Figure 20 Position of the Green Bay, Lake Michigan, Saginaw, and Huron-Erie glacial lobes. Heavy arrow indicates flow path of glacial meltwaters during the Kankakee Torrent. Shown are the surface distribution of the Tiskilwa, Lemont, Wadsworth, and Kewanee Formations of the Wedron Group. Also shown are the maximum ice-margin positions during the glacial phases in the Lake Michigan Lobe: Marengo (M), Shelby (S), Putnam (P), Livingston (L), Woodstock (W), Crown Point (C), Port Huron (PH), and Two Rivers (T) (modified from Hansel and Johnson 1996).

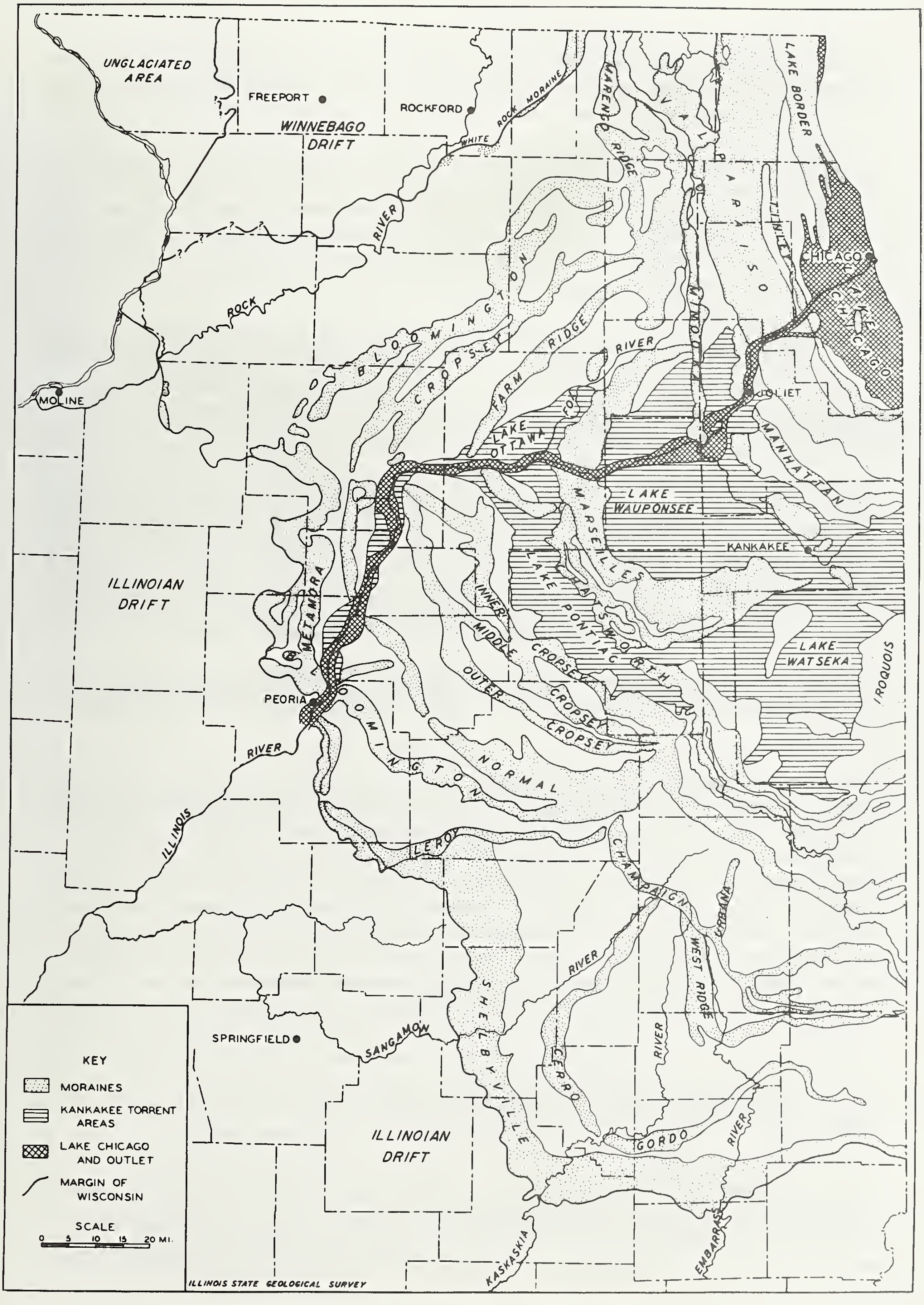


Figure 21 Moraines and glacial lakes created by the Kankakee Torrent.

decrease in coarseness from east to west reflects a slackening of the currents in that direction. As the torrent subsided, the flood became divided into several channels that assumed a braided pattern among the rock ridges and rubble bars on the relatively flat floor of the Kankakee Valley.

As the Kankakee Torrent continued to subside, rivers became entrenched and large thick expanses of sandy outwash sediments left behind by the receding flood waters were deposited in a wide belt along the Kankakee Valley. As a result, a large tract of sandy sediments extends from an area just west of the city of Kankakee to South Bend, Indiana. This extensive sandy deposit is the primary source area for the sediments now lying in the Kankakee River Basin. In addition, the sand deposits were exposed to eolian (wind) activity that built sand dunes. Stop 3 is at one of these sand dunes.

Eventually, as the Valparaiso glacier melted back, an eastern outlet to the south was opened along the Wabash Valley and meltwater was diverted from the Lake Erie lobe, decreasing the volume of flow into the Kankakee Valley. Continued retreat of the glaciers allowed other rivers to drain the region north and east of this locality, and eventually most of the meltwater was deflected away from the Kankakee Valley, marking the end of the Kankakee Torrent.

The final episode shaping the character of the geological materials in the Kankakee basin is the modern deposition of silt, sand, and gravel adjacent to the Kankakee River and its tributaries. In Illinois this modern material is referred to as Cahokia Alluvium. It consists of materials transported down the valley and deposited in flood plains during intervals of flooding and also includes sediments deposited directly by tributary streams. The alluvium generally rests unconformably on bedrock and glacial deposits. Along the Kankakee River, the material is primarily medium grained sand that commonly occurs on top of the coarser sandy and gravelly materials of the Kankakee Torrent.

Devils Hole Devils Hole is located west of the parking lot in the SE SW NE quarter of Section 5. Follow the trail west of the parking lot along the Kankakee River for approximately 0.5 mile (see route map).

Devils Hole is a whirlpool feature in the Kankakee River. It formed along the outside of a meander, where a small bluff protrudes into the Kankakee River. This protruding bluff is called a nick point and is developed along a joint within the bedrock. The swirling action seen in the water is the result of differences in stream velocities—fast flowing water is being diverted past the nick point, and slow moving water is trapped behind the nick point. The faster moving water creates a hydraulic drag (a suction) pulling the slower moving water into the main flow. As this happens, however, the water being pulled out exerts a second hydraulic drag on a portion of the main flow to replace the water that is being lost to the main current. This is very similar to a dog chasing his own tail. Is the tail or the head leading the chase? In any case, the swirling action of the water has eroded into the bed of the river creating a deep scour hole, which is reported to be a great fishing spot.

STOP 3 Rubble Bar and Sand Dune Complex (SW SW SW, Sec. 19, T31N, R11E, 3rd P.M., Kankakee County, Bonfield 7.5-Minute Quadrangle).

Numerous elongate ridges of sand and coarse rock debris (rubble bars) that trend roughly parallel to the Kankakee River occur in a broad band some 8 to 10 miles in width. The rubble bars range from 15 to 150 feet wide and are up to 3 miles long. Some bars are straight, others are sinuous. The rock fragments in the bars are angular and composed mostly of local Silurian-age dolomite, which indicates a comparatively short distance of transport. Also present are some fragments of igneous and metamorphic rock types that were eroded from the glacial drift. Sorting or apparent bedding structures are absent in the coarse rubble. The rubble here is overlain by about 7 feet of fine to medium sand. On the east side of the road, little rubble is found and the section is almost entirely sand. The sand consists predominantly of quartz, with abundant dolomite and minor amounts of other minerals. The sand is well sorted and stratified—typical dune sand. The sand was blown from the torrent deposits after the water receded; in some areas it formed well, defined dunes, whereas in others, it mantled rubble bars, such as this one.

STOP 4 Lunch: Davis Creek Area (SW NW NE, Sec. 23, T31N, R11E, 3rd P.M., Kankakee County, Bourbonnais 7.5-Minute Quadrangle).

Pull into the parking lot, grab your lunch, and jump out of your vehicle. After you have finished your lunch, take a leisurely walk around the large open areas of the campground. An excellent view of the Kankakee River and the valley cut by the Kankakee Torrent can be seen from the parking lot. A trail along the river, east of the canoe/boat launching area, leads to Davis Creek where an exposure of the Silurian Racine Formation crops out near its mouth. Davis Creek flows in a subglacial channel through the Rockdale Moraine. Scattered throughout the campground, especially west of the parking lot, are several large glacial erratics. The large pit located southeast of the parking lot is an abandoned sand and gravel operation. The campground is located on the edge of the Rockdale Moraine, and the steep slope leading to the Kankakee River was carved by the Kankakee Torrent.

Of special note: It is reported that the first permanent habitation of a white man in the Kankakee area was along the east side of Davis Creek, just north of Route 102 (Ekblaw and Wilson 1957).

STOP 5 Vulcan Materials Company, Manteno Quarry (fig. 22) (SW and NW, Sec. 33, T32N, R12E, 3rd P.M., Kankakee County, Bradley 7.5-Minute Quadrangle).

This quarry is in one of the many reefs that characterize the Silurian Racine Formation in northeastern Illinois (figs. 23 and 24). Several types of carbonate rock occur in the reef, depending on the part of the reef in which they formed. The kinds of fossils that may be found vary for the same reason.

The core of the reef was built up by the accumulation in place of stony skeletons of such animals as corals, stromatoparoids, and associated phyla, supplemented by finely fragmented fossil debris. On the flanks of the reef, debris that was swept off the crest of the growing reef by waves and currents accumulated in the forereef and backreef zones in beds deposited parallel to the slope. Between the reefs, the beds are horizontal. In some places, the interreef rocks consist of clean dolomites, but at others they are very argillaceous (clay-rich). These Silurian reefs tend to protrude above the surrounding bedrock because the rocks of the core of the reef are more resistant to erosion than the surrounding flank and interreef rocks. Several Silurian reefs have been located on the basis of their topographic expression. One notable occurrence is at the Chicago suburb of Blue Island, where a Silurian reef pokes through the muds deposited on the bed of Lake Michigan when the water level was much higher. Silurian reefs beneath the water of modern Lake Michigan provide the bedrock substrate essential for spawning lake trout.

Figure 22 Vulcan Materials Company, Manteno Quarry, at stop 5 (photo by M. Jeffords).

The core of this reef is located near the center of the quarry, but cores of smaller reefs occur in the northwest part of the quarry. Beds that dip noticeably are visible in the quarry face. Individual beds can be traced from the flanks of the reef core, where they have a significant dip, southward to where they are nearly horizontal. Thin, shaley, horizontal interreef beds can be seen in the southwest part of the quarry. The character of the rocks changes from the reef core, to the flanks, to the interreef zone. The distinctive characteristics of the rocks deposited in those three zones are called "facies."

Also prevalent in the Silurian bedrock in northeastern Illinois are deposits of Pennsylvanian siltstone and clay, which fill sinkholes in the dolomite. These are "buried" sinks, which formed after deposition of the Pennsylvanian-age sediments. The following steps explain their origin. After deposition of the Silurian rocks and subsequent erosion, the Pennsylvanian-age rocks were deposited. These lower

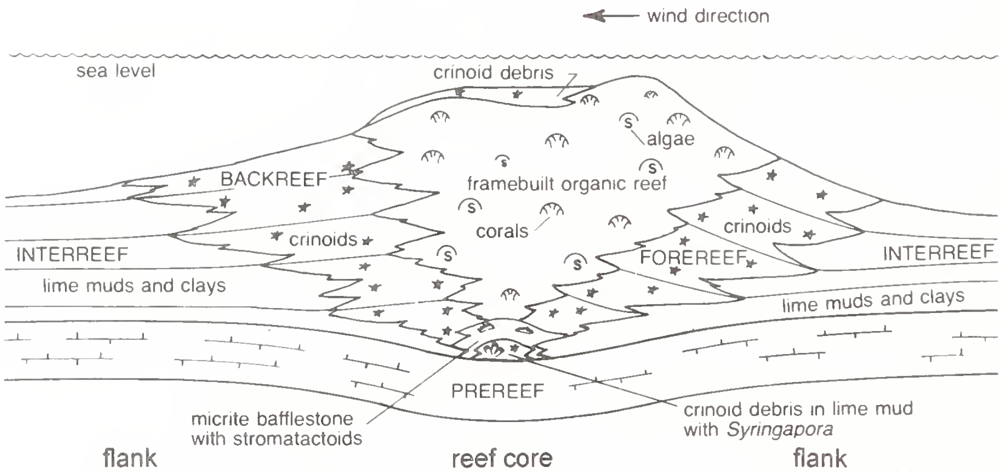
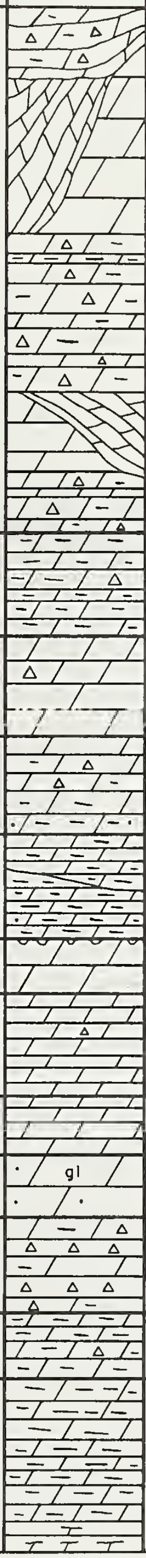


Figure 23 Idealized Silurian reef showing typical geometry of various facies. Steeper fore-reef and backreef facies (beds on the flanks) and the sag of prereef strata are due to compaction under the reef (modified from Whitaker 1988).

SERIES	FORMATION	MEMBER	COLUMN	THICK.* (ft)	GENERAL CHARACTER
NIAGARAN	Racine			300	Dolomite, pure, gray, vuggy, in reefs; and argillaceous, silty, brownish gray and greenish gray, cherty dolomite with beds of relatively pure dolomite, between the reefs
	Sugar Run			10–30	Dolomite, slightly argillaceous and silty, light greenish gray, brown-weathering; in smooth-surfaced medium beds; building-stone beds
	Joliet 40′-80′	Romeo		18–34	Dolomite, pure, light gray to white, mottled gray and pink; in faint thin stylotic beds
		Markgraf		12–28	Dolomite, silty at base to slightly argillaceous at top, very light gray, cherty, medium-bedded
		Brandon Bridge		11–25	Dolomite, argillaceous to shaly, gray, red, green; contains a few pure beds; siliceous foraminifera abundant
ALEXANDRIAN	Kankakee 20′–50′	Plaines		1.5–3	Dolomite, pure, white, massive; contains Microcardinalia and Pentamerus; pitted smooth surface on top
		Troutman		11–29	Dolomite, pure, pinkish gray to greenish gray; in thin wavy beds with green clay partings; corals common
		Offerman		2.5–11	Dolomite, as above, but slightly argillaceous
		Drummond		1–11	Dolomite, as above, but massive, vuggy, glauconitic, locally sandy; contains Platymerella at base
	Elwood			0–30	Dolomite, slightly argillaceous, brownish gray; contains many layers of white chert
	Wilhelmi 0–100′	Birds		0–20	Dolomite, argillaceous, gray, slightly cherty
		Schweizer		0–80	Dolomite, very argillaceous, gray, and dolomitic shale

*Where overlain by next younger unit.

Figure 24 Silurian strata in northeastern Illinois (modified from Willman 1973).

Pennsylvanian rocks consisted mostly of clays and fine grained siltstones that created an impermeable layer above the Silurian carbonates. Some time later, groundwater flowed through and dissolved the more permeable Silurian carbonate rocks and created cavities. The overlying Pennsylvanian rocks, which may have been hundreds of feet thick, exerted downward pressure that squeezed the softer Pennsylvanian shales down into the cavities (molds) within the Silurian bedrock. One of these filled sinks was visible in the east highwall of the quarry during field work for this trip (fig. 25). See the description at stop 1A for a detailed explanation.

Racine Formation The Racine Formation overlying the Sugar Run Formation (fig. 24) consists of the reef and interreef dolomite. This uppermost Silurian formation was named for exposures in quarries at Racine, Wisconsin, and is a maximum of about 300 feet thick. Although the reef and interreef strata are very dissimilar lithologically, they are not separable as rock-stratigraphic units (fig. 23). The reefs that make up the Racine Formation are of all sizes, extend through several stratigraphic intervals, and in places have complex overlapping relations.

Figure 25 Filled sink in a highwall of Vulcan Materials Company, Manteno Quarry, at stop 5 (photo by W. Frankie).

The reefs consist of pure dolomite that is medium to light gray, mottled dark gray, gray weathering, medium grained, and vesicular to highly vuggy (containing small cavities). Some of the reefs are more than 1 mile across, and the reef at Thornton is at least 150 feet thick. The central parts, or cores, of the larger reefs are irregularly bedded to massive in structure. The marginal, or reef-flank, rocks have well defined beds generally 4 inches to 1 foot thick, although some beds are 2 to 3 feet thick. The reef-flank beds dip away from the central core at angles as steep as 30°. They represent lateral growth of the reef and consist partly of storm debris from higher parts of the reef. Smaller reefs are massive and do not have well defined reef-flank deposits. The reef cores are remarkably free of clay and silt impurities. The insoluble residues are generally less than 1%, and many samples contain essentially no residue other then pellets of the asphaltum that fills the vugs in some reef rock. Chert has not been found in any of the reef cores. It is almost never found in the high-purity rocks and only rarely in the highly silty or argillaceous rocks in the core of the reef (Willman 1973).

The interreef rocks in northeastern Illinois are largely silty, argillaceous, cherty, light gray to brownish gray dolomite that weathers brown. They have prominent beds, but the beds vary in thickness. Near the reefs, the interreef strata are highly varied in composition. Some massive, silty, argillaceous, greenish gray beds contain 30% to 40% insoluble residue, and some beds grade into nodules of carbonate rocks surrounded by a clay matrix. The clay-rich beds are separated by pure, vesicular, gray dolomite like that in the reefs. Before they were converted to dolomite, these beds may have consisted of sand-sized fragments of the shells or marine animals washed from the reefs. The interreef rocks farther from the reefs are more uniform and are commonly slightly argillaceous or argillaceous, dense, brownish gray, cherty dolomite (Willman 1973).

Reefs that have a base low in the Racine Formation occur along the lower part of Davis Creek (SE NW NE Sec. 23, T31N, R11E, Bourbonnais 7.5-Minute Quadrangle) and in a small deeply incised ravine at the southwest corner of Bourbonnais (N½ NW NW Sec. 30, T31N, R12E, 7.5-Minute Quadrangle). Reefs in the middle of the formation occur in quarries near Manteno, Kankakee County (NE SE SE Sec. 28, and SW SW SE Sec. 33, T31N, R12E).

The Racine reefs contain a large and varied fauna in which corals, stromatoporoids, bryozoans, brachiopods, and crinoids are most common, and trilobites, gastropods, and pelecypods are not rare (see fossil plate at the back of the guidebook). Fossils are not common in the interreef beds, but they are present locally in reef detritus, in which sponges, crinoids, and brachiopods are most abundant. The large brachiopod *Kirkidium* is abundant on the south slope of a hill 1.5 miles southwest of Manteno, Kankakee County (SW SW SE Sec. 20, T32N, R12 E, Bradley 7.5-Minute Quadrangle), which is near or below the middle of the formation.

The Silurian Period The following information about the Silurian Period was modified from the Milwaukee Public Museum's Web page at

http://www.mpm.edu/collect/geology/geosec-noframes.html

This Web site contains an informative section on Silurian reefs, including a large number of graphics.

The Silurian Period is the geologic time between 438 and 408 million years ago, and is preceded by the Ordovician and followed by the Devonian Periods. The term "Silurian" comes from Silures, the name of a tribe of people who lived along the border of England and Wales before the time of the Romans. In the early 1800s, British geologists recognized rocks in this area that contained a distinctive assemblage of fossils that differed from the fossils in both the underlying (or older) strata and overlying (or younger) strata. Silurian was applied to the period represented by this fossil assemblage.

Silurian fossils, identical to those in Britain, were subsequently discovered in many other regions of the world, including the Great Lakes region of North America.

Changing environments The Silurian world was vastly different in many ways from the world of today. The shapes and distribution of the continents differed from those of today, and shallow seas covered much of the present continental areas. For example, the equator passed through North America, and a nearly continuous inland sea stretched between New York and Nevada. Although the Silurian seas were populated by a variety of marine life, the land was inhabited only by a few types of small plants and animals.

Ancient and modern reefs A reef is a structure built by marine organisms that rises above the surrounding seafloor. Throughout geologic history, reefs share a common set of environmental features. They are built in warm, shallow seawater in the tropics and subtropics, and they occur only in water that is relatively free of suspended, land-derived sediment; such clear water allows sunlight to penetrate to the reef surface and permits photosynthetic organisms to live.

Reefs are characterized by their high biodiversity and the complex interdependencies of the plants and animals that formed them. Reefs are formed by five major types of organisms:

1. Reef constructors, such as corals, help to build the reef by forming a framework of hard skeletons.
2. Reef bafflers, such as crinoids, have upright fronds or stick-like growth forms that interfere with currents and trap sediment on the reef surface.
3. Reef binders, such as algae, grow over and around loose sediment and skeletons of reef organisms and literally bind them together.
4. Reef dwellers are a variety of species (trilobites, brachiopods, and cephalopods) that live in and among the constructors and binders, but they do not directly build the reef framework.
5. Reef destroyers (certain bivalves, sponges, worms, and sharks) bore into or scrape away parts of the reef surface and convert hard reef framework into loose particles of sediment.

The 425-million-year-old Silurian reefs have many features in common with those of today, including tropical to subtropical distribution, growth in shallow water, and relatively high biodiversity. Silurian and modern reefs, however, are different in important ways. Binders appear to have been more important in Silurian reefs, and destroyers less important, than in present-day reefs. The actual groups of organisms that occupy various functional roles in the reef community are also different. For example, stromatoporoids, an extinct type of sponge, were important constructors in Silurian reefs but are unknown in today's reefs .

Biodiversity refers to the variety of organisms on earth. It is commonly expressed as the number of species in a given area or environment, and is commonly compared between different environments. Silurian reefs contain more species than non-reef Silurian environments—a contrast also seen in the modern marine world. Biodiversity can also be compared through time. The species diversity of reefs has increased from Ordovician to modern times.

Fossil preservation and diagenesis A fossil is any feature preserved in a rock that indicates the presence of ancient life. Body fossils are parts of organisms, such as shells, bones, and leaves.

Trace fossils (footprints, trails, and burrows) in rocks also demonstrate the presence of ancient life, even though no part of the body is preserved.

Diagenesis refers to the chemical and physical changes that occur in sedimentary geologic materials after their initial deposition or formation. During the Silurian Period, reefs consisted of shells and soft mud composed of calcium carbonate. The shells and mud eventually were cemented together into a rock called limestone. Sometime later, they were altered by magnesium-rich waters flowing through the deposits, which changed them into a rock called dolostone (dolomite) consisting of calcium-magnesium carbonate.

Although some fossils have not been changed from their original composition, most fossils have undergone some degree of diagenesis. Petrification occurs when tiny spaces in bone or wood are filled by new minerals. Silicification is the alteration of a shell composed of calcium carbonate into a fossil shell composed of silica (SiO_2).

Shells may also be dissolved during diagenesis, which leaves only their impression in the rock. Most Silurian reef fossils are preserved in this way. The external mold is an impression that preserves the appearance of the outer surface of a shell. The internal mold is an impression of the inner surface of a shell. External and internal molds of the same shell are often very different in appearance.

STOP 6 North Central Materials, Manteno Quarry (fig. 26) (NW and SW quarters of SW SE, Sec. 20, T32N, R12E, 3rd P.M., Kankakee County, Bradley 7.5-Minute Quadrangle). Entrance to the quarry is in the NW SW SW of Sec. 20, located on the Bourbonnais 7.5-Minute Quadrangle.

This quarry is also in the Silurian Racine Formation (fig. 24). At a first glance at the Bradley 7.5-Minute Quadrangle topographic map (see route map), the topographic contour lines may lead

Figure 26 North Central Materials, Manteno Quarry, at stop 6 (photo by M. Jeffords).

Figure 27 Large slide plane in the north highwall of North Central Materials, Manteno Quarry. The angle of the dipping beds in the highwall indicates that these sediments were deposited on the flank of the reef (photo by W. Frankie).

you to believe that this structure is a glacial moraine or kame. However, the reef at this quarry forms a topographic high on the bedrock surface. The Racine is often exposed in low hills that project through the glacial drift in northeastern Illinois. Many of the hills (called klintar or, individually, a klint) are reefs. The reef rock is more resistant to weathering than the surrounding interreef rock, which has been more deeply eroded, in part by glacial scour. Along the Kankakee River, the Racine is exposed from 3 miles northwest of Kankakee to Momence. It is also exposed in a large upland area from Kankakee north to Manteno. Silurian reefs are generally more resistant to erosion than the surrounding non-reef rocks and sometimes form topographic highs.

While field work was being conducted for this field trip, a large bedrock slump had occured in the north highwall of the quarry (fig. 27). The slide was triggered by a shot (an explosive charge used to break the rock) and occurred along a layer of shale that had become saturated with water; the saturated shale layer created a glide plane along which the mass of rocks slid down into the pit. The quarry is temporarily by-passing this area. Such rock slides as seen in this quarry are an all-too-common feature along many roads built in mountainous areas.

STOP 7 Silurian Dolomite, Refuse Pile (NW NW, Sec. 21, T32N, R12E, 3rd P.M., Kankakee County, Bradley 7.5-Minute Quadrangle).

The pile of rocks in the field was deposited during the construction of the K-Mart truck distribution center located to the south. This material is from the Racine Formation and contains many fossils, especially the large brachiopod *Kirkidium*. Have fun collecting, and remember to leave some for the next collector.

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GLOSSARY

The following definitions are from several sources in total or in part, but the main reference is: Bates, R.L., and J.A. Jackson, editors, 1987, Glossary of Geology: American Geological Institute, Alexandria, VA, 3rd edition, 788 p.

Ablation Separation and removal of rock material and formation of deposits, especially by wind action or the washing away of loose and soluble materials.

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

Aggrading stream One that is actively building up its channel or floodplain by being supplied with more load than it can transport.

Alluviated valley One that has been at least partially 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, etc.

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 older rocks than does the perimeter of the structure.

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

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

Arenite A relatively clean quartz sandstone that is well sorted and contains less than 10% argillaceous material.

Base level Lowest limit of subaerial erosion by running water, controlled locally and temporarily by water level at stream mouths into lakes or more generally and semipermanently into the ocean (mean sea level).

Basement complex Largely crystalline igneous and/or metamorphic rocks of complex structure and distribution that underlie a sedimentary sequence.

Basin A topographic or structural low area that generally receives thicker deposits of sediments than adjacent areas; the low areas tend to sink more readily, partly because of the weight of the thicker sediments; this also denotes an area of deeper water than found in adjacent shelf areas.

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

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

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.

Calcined The heating of limestone to its temperature of dissociation so that it loses its water of crystalization.

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 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.

Columnar section A graphic representation in a vertical column of the sequence and stratigraphic relations of the rock units in a region.

Conformable Layers of strata deposited one upon another without interruption in accumulation of sediment; beds parallel.

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.

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 ($Ca,Mg[CO_3]_2$); applied to those sedimentary rocks that are composed largely of the mineral dolomite; it also is precipitated directly from seawater. It is white, colorless, or tinged yellow, brown, pink, or gray; has perfect rhombohedral cleavage; appears pearly to vitreous; 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.

Driftless Area A 10,000-square-mile area in northeastern Iowa, southwestern Wisconsin, and northwestern Illinois where the absence of glacial drift suggests that the area may not have been glaciated.

End moraine A ridge-like or series of ridge-like accumulations of drift built 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.

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.

Escarpment A long, more or less continuous cliff or steep slope facing in one general direction, generally marking the outcrop of a resistant layer of rocks.

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.

Flaggy Tending to split into layers of suitable thickness for use as flagstone.

Floodplain The surface or strip of relatively smooth land adjacent to a stream channel that has been produced by the stream's erosion and deposition actions; 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.

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), usually derived from geographic localities.

Fossil Any remains or traces of an once living plant or animal specimens that are preserved in rocks (arbitrarily excludes Recent remains).

Friable Said of a rock or mineral that crumbles naturally or is easily broken, pulverized, or reduced to powder, such as a soft and poorly cemented sandstone.

Geology The study of the planet Earth. It is concerned with the origin of the planet, the material and morphology of the Earth, and its history and the processes that acted (and act) upon it to affect its historic and present forms.

Geophysics Study of the Earth by quantitative physical methods.

Glaciation A collective term for the geologic processes of glacial activity, including erosion and deposition, and the resulting effects of such action on the Earth's surface.

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

Gradient(s) 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.

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.

Karst Area underlain by limestone having many sinkholes separated by steep ridges or irregular hills. Tunnels and caves resulting from solution by groundwater honeycomb the subsurface.

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, and 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; especially 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.

Magma Naturally occurring mobile rock material or fluid, generated within Earth and capable of intrusion and extrusion, from which igneous rocks are thought to have been derived through solidification and related processes.

Meander One of a series of somewhat regular, sharp, sinuous curves, bends, loops, or turns produced by a stream, particularly in its lower course where it swings from side to side across its valley bottom.

Meander scars Crescent-shaped, concave marks along a river's floodplain that are abandoned meanders, frequently filled in with sediments and vegetation.

Metamorphic rock Any rock derived from pre-existing 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 Earth's crust (gneiss, schist, marble, quartzite, etc.).

Mineral A naturally formed chemical element or compound having a definite chemical composition and, usually, a characteristic crystal form.

Monolith (a) A piece of unfractured bedrock, generally more than a few meters across. (b) A large upstanding mass of rock.

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.

Morphology The scientific study of form, and of the structures and development that influence form; term used in most sciences.

Natural gamma log These logs are run in cased, uncased, air, or water-filled boreholes. Natural gamma radiation increases from the left to the right side of the log. In marine sediments, low radiation levels indicate non-argillaceous limestone, dolomite, and sandstone.

Nickpoint A place of abrupt inflection in a stream profile; A sharp angle cut by currents at base of a cliff.

Nonconformity An unconformity resulting from deposition of sedimentary strata on massive crystalline rock.

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

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

Oxbow lake A crescent-shaped lake in an abandoned bend of a river channel.

Pangea A hypothetical supercontinent; supposed by many geologists to have existed at an early time in the geologic past, and to have combined all the continental crust of the Earth, 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 believing in 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.

Ped A naturally formed unit of soil structure, e.g., granule, block, crumb, or aggregate.

Peneplain A land surface of regional proportions worn down by erosion to a nearly flat or broadly undulating plain.

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 strucure 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.

Point bar A low arcuate ridge of sand and gravel developed on the inside of a stream meander by slow accumulation of sediment as the stream channel migrates toward the outer bank.

Radioactivity logs Logs of bore holes obtained through the use of gamma logging, neutron logging, or combinations of the several radioactivity logging methods.

Relief (a) A term used loosely for the actual physical shape, configuration, or general unevenness of a part of 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 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 (e.g., sandstone, siltstone, limestone).

Shoaling The effect of a near-costal sea bottom on wave height; it describes the alteration of a wave as it proceeds from deep water into shallow water. The wave height increases as the wave arrives on shore.

Sinkholes Small circular depressions that have formed by solution in areas underlain by soluble rocks, most commonly limestone and dolomite.

Slip-off slope Long, low, gentle slope on the inside of a stream meander.

Stage, substage Geologic time-rock 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 Earth's crust with respect to any specific rock character, property, or attribute or for any purpose such as description, mapping, and correlation.

Stratum 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*.

Subage An interval of geologic time; a division of an age.

Syncline A downfold of strata which dip inward from the sides toward the axis; youngest rocks along the axis; the opposite of anticline.

System The largest and fundamental geologic time-rock 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 Earth's movements.

Tectonics The branch of geology dealing with the broad architecture of the upper (outer) part of Earth's crust; a regional assembling of structural or deformational features, their origins, historical evolution, and mutual relations.

Temperature-resistance log This log, run only in water, portrays the earth's temperature and the quality of groundwater in the well.

Terrace An abandoned floodplain formed when a stream flowed at a level above the level of its present channel and floodplain.

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 undulating 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.

Unconformable Having the relation of an unconformity to underlying rocks and separated from them by an interruption in sedimentation, with or without any accompanying erosion of older rocks.

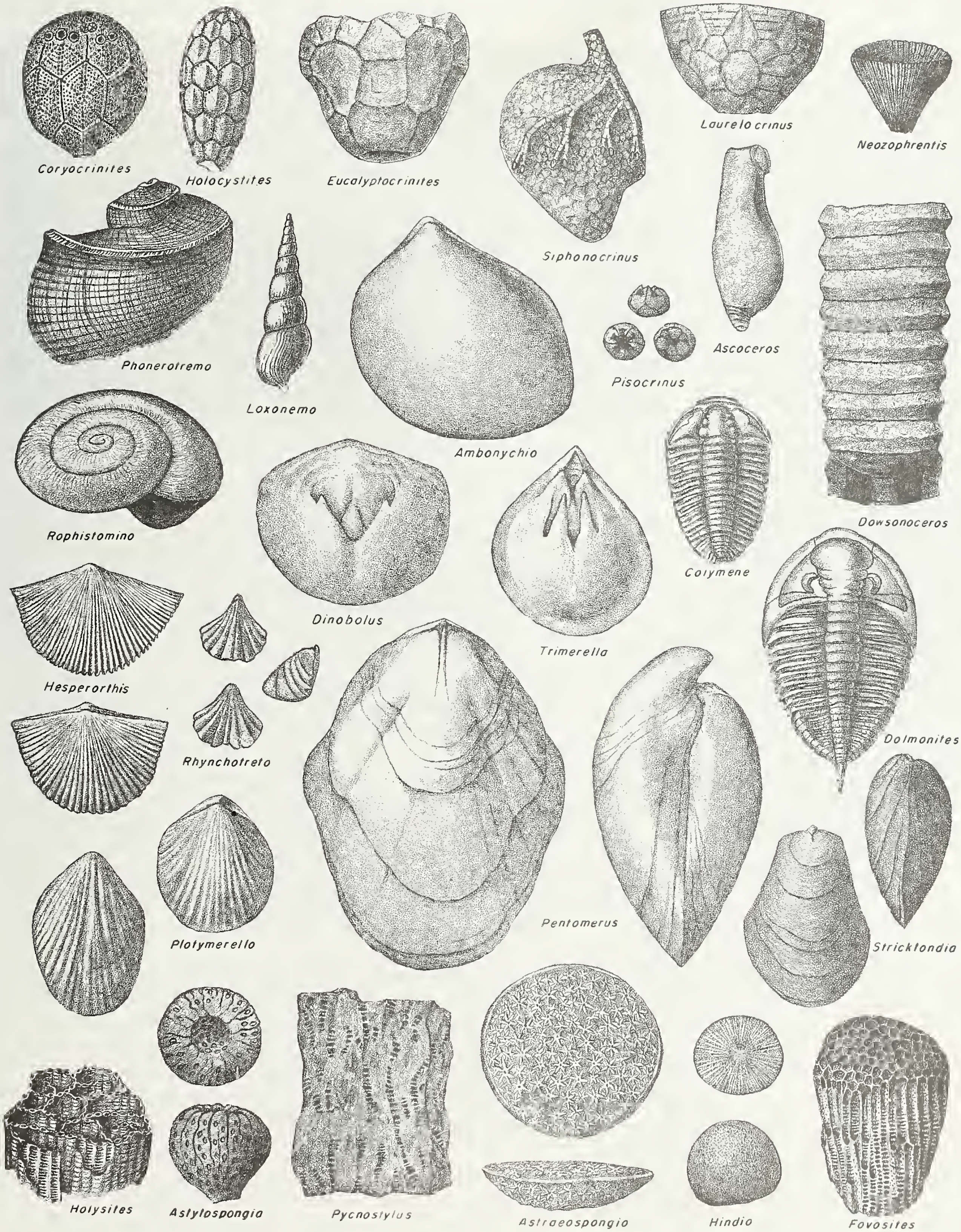
Unconformity A surface of erosion or nondeposition that separates younger strata from older strata; most unconformities indicate intervals of time when former areas of the sea bottom were temporarily raised above sea level.

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

Water table The upper surface of a zone of saturation.

Weathering The group of processes, chemical and physical, whereby rocks on exposure to the weather change in character, decay, and finally crumble into soil.

REPRESENTATIVE SILURIAN FOSSILS FROM ILLINOIS



EXOTIC ROCKS or Erratics Are Erratic

A piece of Canada sitting in central Illinois (photo by D. Reinertsen).

Here and there in Illinois are boulders lying alone or with companions in the corner of a field or someone's yard, on a courthouse lawn or a schoolyard. Many of them—colorful and glittering granites, banded gneisses, and other intricately veined and streaked igneous and metamorphic rocks—seem out of place in the stoneless, grassy knolls and prairies of our state. Their "erratic" occurrence is the reason for their interesting name.

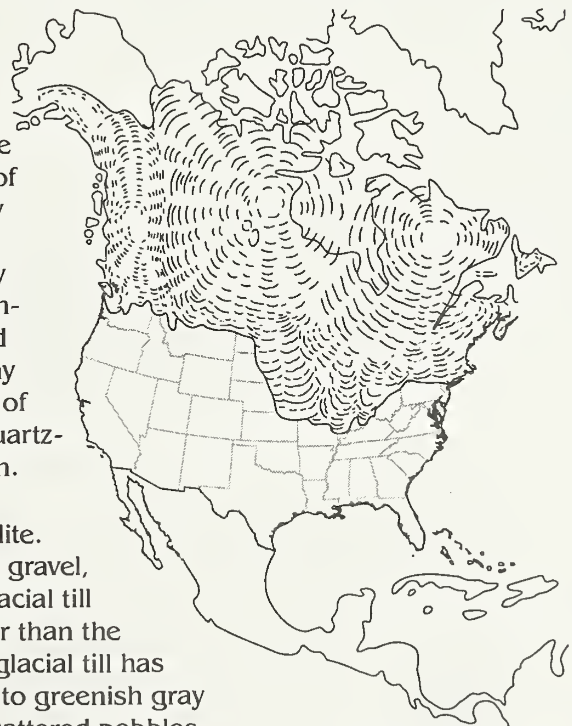
Where did erratics come from?

These exotic rocks came from Canada and the states north of us. 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.

Sometimes you can tell where the erratic 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 Canada.

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 Ontario, Canada. Purplish pieces of quartzite, some of them banded, probably originated in Wisconsin.

Most interesting are the few large boulders of Canadian tillite. Glacial till is an unsorted and unlayered mixture of clay, sand, gravel, and boulders that vary widely in size and shape. Tillite is glacial till that was deposited by a glacier many millions of years older than the ones that invaded our state during the Great Ice Age. This glacial till has been around so long that it has been hardened into a gray to greenish gray rock containing a mixture of grains of different sizes and scattered pebbles of various types and sizes.



Glaciers spread southward into the Midwest from two centers of ice accumulation in western and eastern Canada.

How did erratics get here?

Many boulders were probably dropped directly from the melting front of the glacier. Others may have been rafted to their present resting places by icebergs in ancient lakes or on 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.

*Keep an eye out for erratics.
You may find some of these glacial strangers in your neighborhood.*

Many erratics are of notable size and beauty. Some are used as monuments in courthouse squares and parks, or along highways. Many are marked with metal plaques to indicate an interesting historical spot or event.

Contributed by M.M. Killey

While on a drive through central Illinois, you may catch a glimpse of an erratic (photo by J. Dexter).

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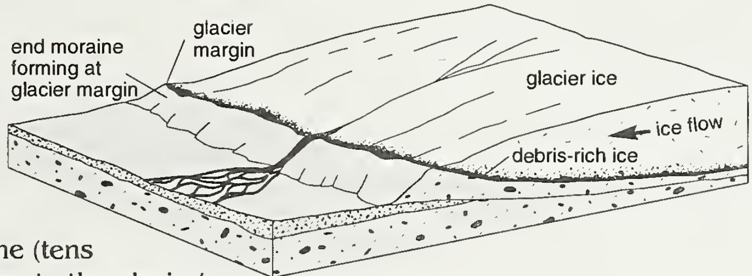
END MORAINES—*the end of the glacial ride*

Satellite photo of central Illinois shows broad curved ridges.

We tend to think of Illinois as very flat, but bike riders and joggers know that our landscape has many subtle hills, ridges, and long uphill slopes. From a satellite or the space shuttle high above the earth, large broad ridges can be seen that arc across northeastern Illinois.

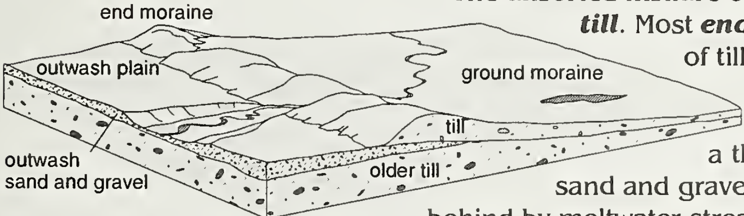
These ridges, left behind when the last Ice Age glaciers melted away, are called end moraines; they formed between about 25,000 and 14,000 years ago during the Wisconsin glacial episode. Although these ridges are easy to see from space, they are so broad and rounded you may sometimes overlook them when you drive across Illinois.

How do end moraines form?

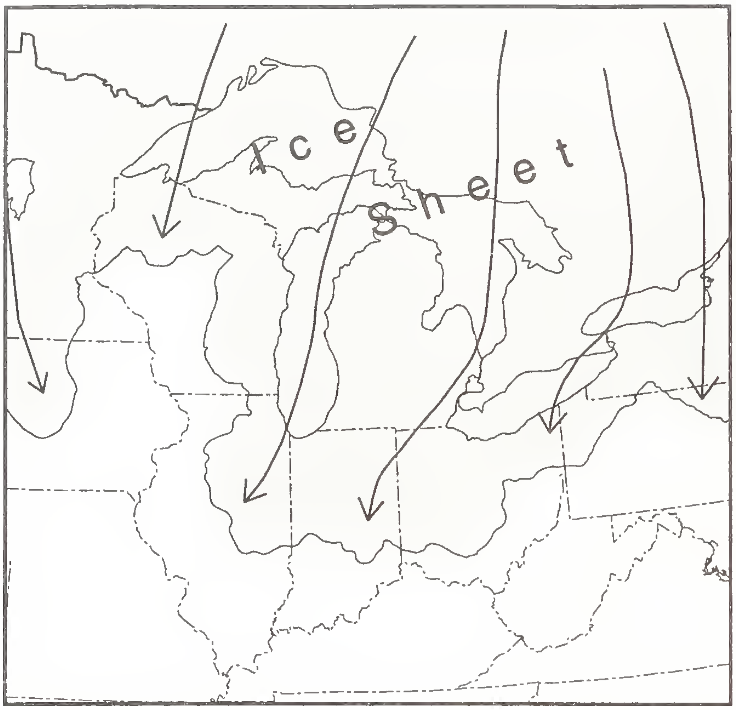


Melting at a glacier margin causes the ice to thin, and ground-up rock debris carried in the base of the ice or dragged along beneath the glacier is deposited. When the ice margin remains in the same place for a relatively long time (tens to hundreds of years), enough debris flows to the glacier's leading edge and piles up to form a large ***end moraine*** on the landscape.

What are end moraines made of?

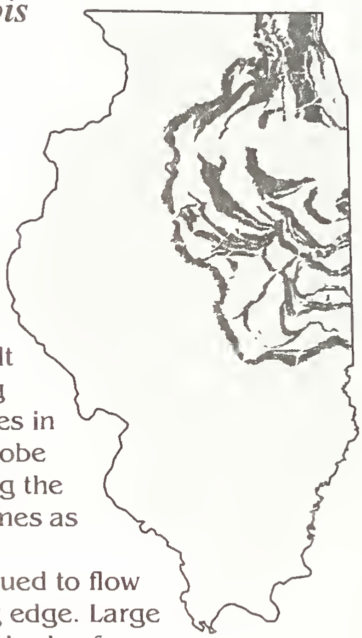


The unsorted mixture of debris deposited by a glacier is called ***till***. Most ***end moraines*** in Illinois are thick ridges of till. A ***ground moraine***, the relatively flat, low-lying landscape across which the melting glacier retreated, consists of a thinner layer of till. Sheetlike deposits of sand and gravel, called ***outwash plains***, were left behind by meltwater streams flowing away from the glacier.



During the Wisconsin glacial episode, a vast sheet of ice formed over most of Canada. Glaciers flowed away from the center of the ice sheet. The glacier that flowed through the Lake Michigan basin and into northeastern Illinois reached its southernmost extent at Shelbyville about 20,000 years ago.

End moraines in northeastern Illinois



The glacier did not just flow into Illinois and then gradually melt away. Its overall retreat was interrupted by many pauses during which moraines formed. Most of the more than 30 end moraines in Illinois (shown as dark arcs on the map) formed as the glacial lobe was "retreating" from its southernmost position. At times during the overall retreat, the ice margin temporarily readvanced, sometimes as much as 50 miles.

Even as the lobe was retreating, however, the glacier continued to flow toward its outer margin, delivering ice and debris to its leading edge. Large moraines mark positions where the ice margin paused for hundreds of years.

Try to spot end moraines the next time you take a drive. *Their rounded crests form the highest parts of the landscape. Radio and TV towers are commonly located atop these moraine ridges*

contributed by A.K. Hansel

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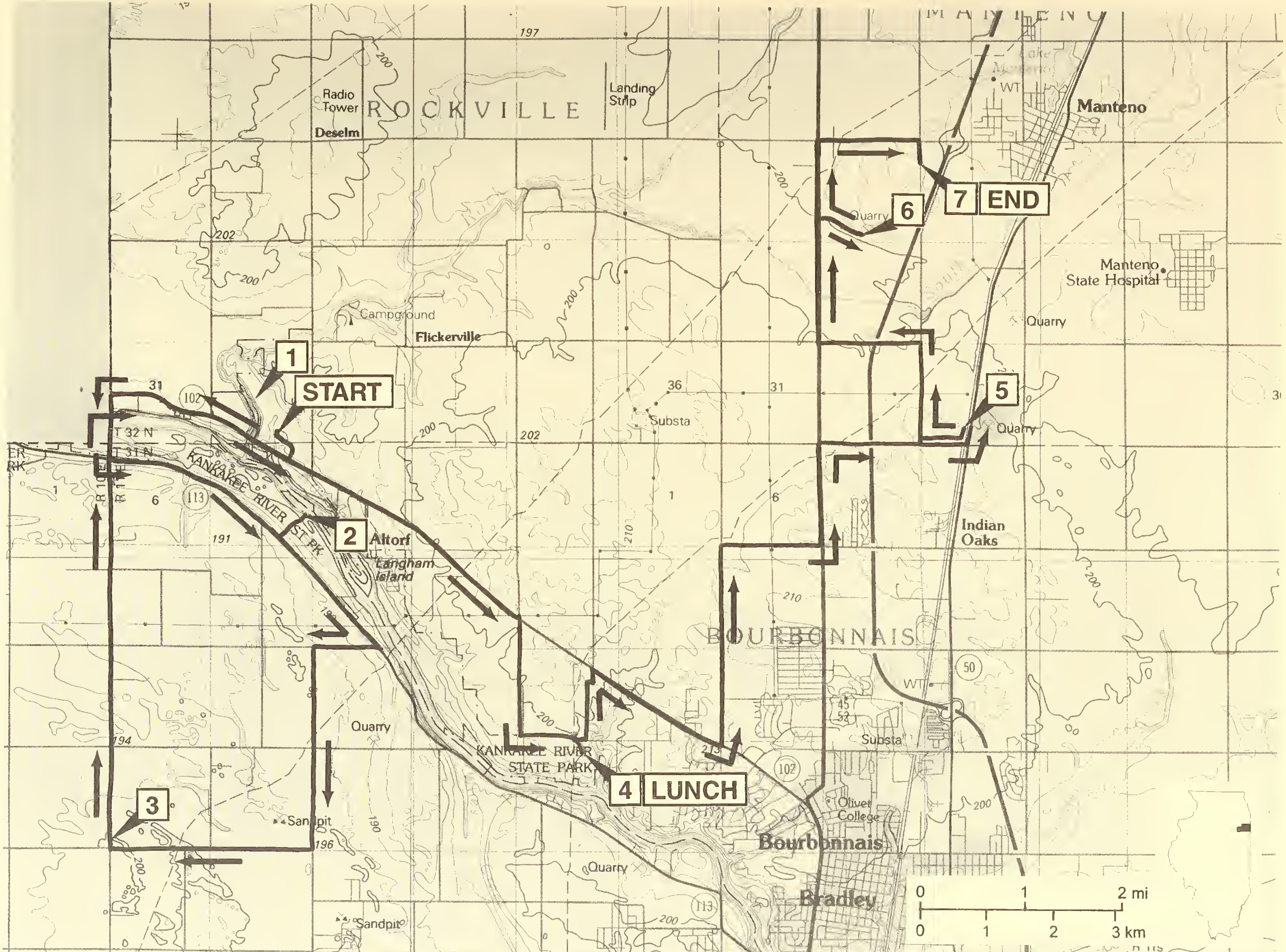
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Deselm
Landing Strip
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Manteno State Hospital
Campground
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Substa
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