a guide to the geology of the Danvers-Normal area

Field Trip Guide Leaflet 1982C
October 23, 1982

Department of Energy and Natural Resources
State Geological Survey Division
Champaign, Il 61820

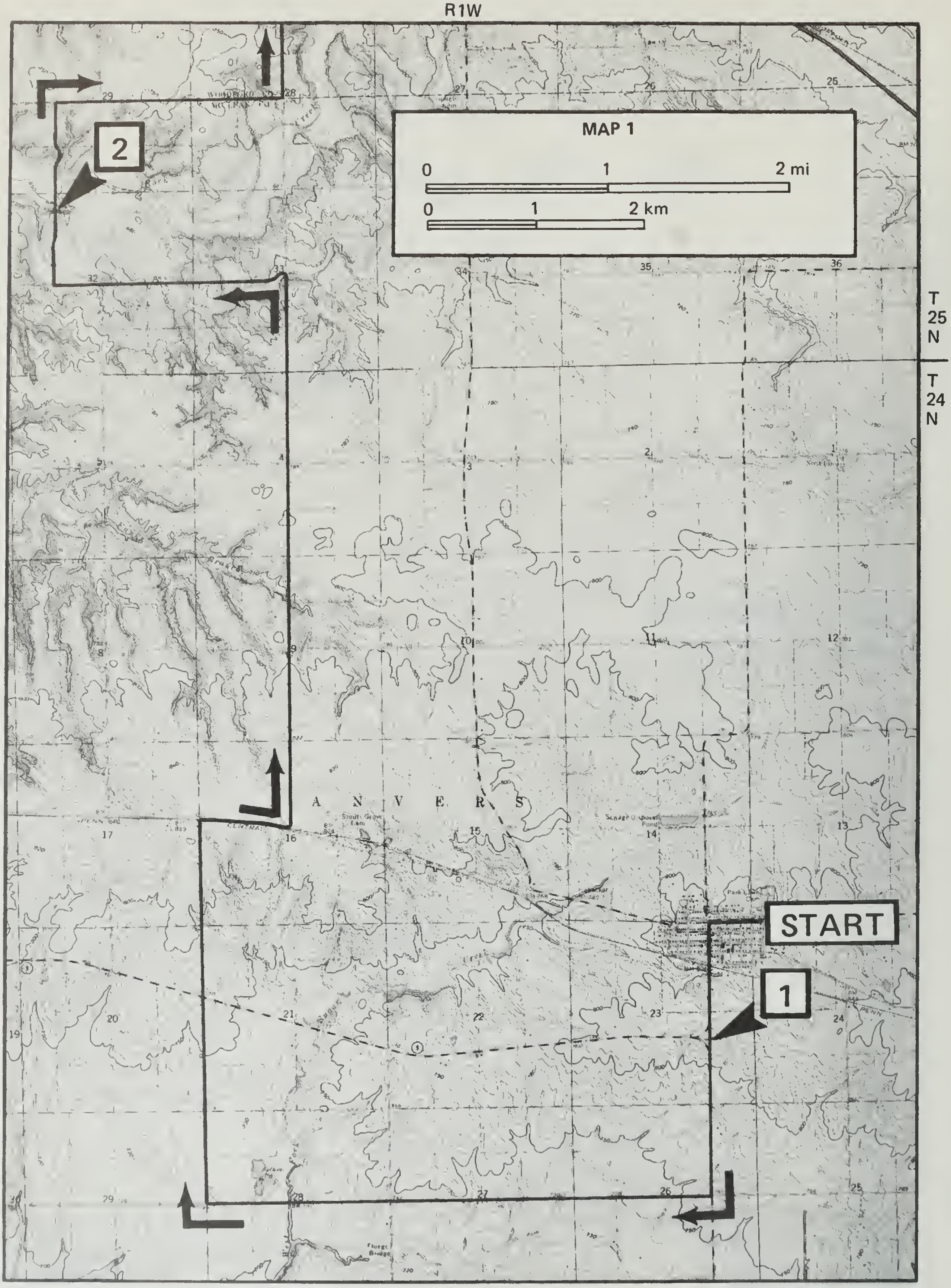
David L. Reinertsen
Robert S. Nelson

a guide to the geology of the Danvers-Normal area

David L. Reinertsen
Robert S. Nelson

ILLINOIS STATE GEOLOGICAL SURVEY
Robert E. Bergstrom, Chief
Natural Resources Building
615 East Peabody Drive
Champaign, IL 61820

FIELD TRIP GUIDE LEAFLET 1982C
October 23, 1982


R1W
MAP 1
0
1
2 mi
0
1
2 km
T 25 N
T 24 N
START
1
2
A N V E R S

guide to the route

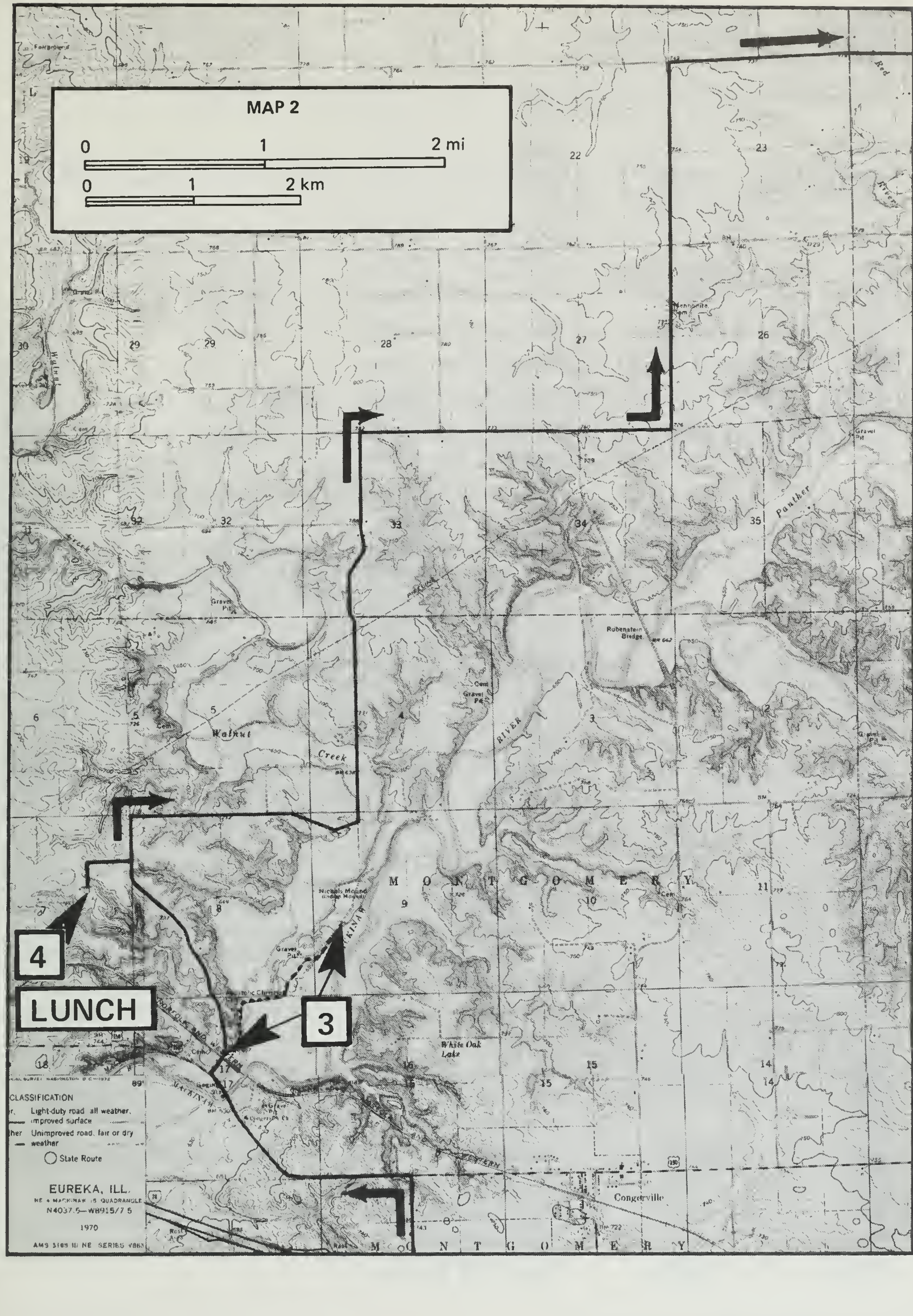
Miles to next point	Miles from starting point	
		Line up facing north on State Street in front of Danvers Elementary School. State Street is one-way north.
0.0	0.0	STOP (2-way); North Street. TURN LEFT (west).
0.3	0.3	STOP (3-way); West Street. TURN LEFT (south).
0.1+	0.4+	STOP (4-way). CONTINUE AHEAD STRAIGHT (south).
0.15-	0.55	CAUTION: Conrail railroad crossing.
0.35-	0.9-	CAUTION: Y-intersection. CONTINUE STRAIGHT AHEAD (south).
0.05+	0.95	STOP 1. Discussion of glacial geology and the the Bloomington Morainic System in the field trip area. CAUTION: cross the road and ascend the embankment on the east side of the road for a better view of the moraine and the land to the south.
0.0	0.95	Leave Stop 1. CONTINUE AHEAD (south).
0.05	1.0	STOP (1-way) at curve in State Route (SR) 9. CAUTION—CONTINUE AHEAD (south); visibility on the right side is poor!
0.1	1.1	Note the view ahead and toward either side of the highway as you come down off the moraine.
0.6	1.7	Prepare to turn right.
0.1	1.8	TURN RIGHT (west) at crossroad.
0.75	2.55	View to the right (north) is up the outwash plain toward the Bloomington Moraines. A thin cover of loess blankets the sand and gravel of the outwash plain here.
0.3-	2.85-	CAUTION; narrow culvert not well marked. Stay toward middle of road.
0.7+	3.55	STOP (2-way). CONTINUE AHEAD (west) on gravel.
0.55	4.1	CAUTION. Cross West Fork of Sugar Creek. To the right (north) about ¼ mile or so is an abandoned sand and gravel pit.
0.45	4.55	STOP (1-way): T-road intersection. TURN RIGHT (north).

Miles to next point	Miles from starting point	
0.1	4.65	View ahead (north) of the Bloomington Moraines in the distance. The trees on the crest of the moraine accentuate the moraine, from this viewpoint.
0.5	5.15	From here the front of the Bloomington Morainic System rises 110 feet in 1.5 miles.
0.5+	5.65+	STOP (2-way); SR 9. CONTINUE AHEAD (north) across SR 9. USE EXTREME CAUTION as the view to the right is very poor.
0.4	6.05+	Notice that streams have cut into the moraine front on both sides of the road.
0.6-	6.65	CAUTION: Unguarded Conrail crossing with a STOP (1-way) on the other side. DO NOT STOP ON THE TRACKS! T-road intersection. TURN RIGHT (east) along the crest of the moraine. Here the moraine is not as spectacular as at STOP 1 because the moraine in this area has been dissected by streams.
0.45+	7.1+	CAUTION: T-road intersection and Conrail crossing. CONTINUE AHEAD (east) and immediately TURN LEFT (north) *away* from the railroad.
0.8-	7.9	The route here crosses stream-dissected ground moraine composed of the Tiskilwa Till Member.
0.45	8.35	Cross Funks Branch just short of the T-road intersection. CONTINUE AHEAD (north).
0.35	8.7	Route crosses a soil boundary between a brown forest soil to the left (west) and a dark gray to black prairie soil to the right (east).
0.4	9.1	STOP (2-way). CONTINUE AHEAD (north).
0.95	10.05	CAUTION; steep hill. Prepare to turn left at the bottom.
0.05-	10.1-	The exposure to the right (east) is Tiskilwa Till that weathers to a pinkish cast.
0.05	10.15-	Cross a small stream and immediately TURN LEFT (west) at the T-road intersection.
0.2+	10.35	To the left (south) across the creek is a good exposure that, although somewhat slumped, is bare and shows loess at the top—above the pink weathered Tiskilwa Till that overlies the grayer, unweathered portion of the till.
0.35	10.7	To the right is another roadcut in Tiskilwa Till. Here the till is being eroded by a number of small gullies. Unless this slope gets some type of cover, it will be rapidly dissected.

Miles to next point	Miles from starting point	
0.5-	11.2-	CAUTION: T-road intersection. JOG LEFT slightly and CONTINUE AHEAD (straight). To the right at the jog is a grass waterway to control erosion through the fields on either side of it. Part of this waterway may mark a former position of Rock Creek. The hill immediately to the north may be an abandoned meander core.
0.25	11.45-	TURN RIGHT (north).
0.1	11.55-	Cross the grass waterway again. CONTINUE AHEAD (north).
0.25	11.8-	CAUTION: descend hill and prepare to stop. Do NOT block driveway.
0.05+	11.85	Cross Rock Creek bridge and park on the right side of the road. Leave room for approaching traffic to pass the caravan.
		STOP 2. Danvers (Rock Creek) Pleistocene Section exposed on the south side of Rock Creek cut bank.
0.0	11.85	Leave Stop 2. CONTINUE AHEAD (north).
0.25	12.1	Ascend the north valley wall of Rock Creek. KEEP TO RIGHT.
0.35	12.45	STOP (1-way): T-road intersection. CAUTION: poor visibility to the left. TURN RIGHT (east) on Woodford County Highway (50N/1525E).
		NOTE (after the turn): Headward erosion by Rock Creek tributaries has cut back into the upland exposing weathered Tiskilwa Till and the overlying loess.
0.5	12.95	Here the upland soils are very thin. These light-colored soils, forest soils, frequently result in bare spots in row-crop fields.
0.75	13.7	STOP (1-way): T-road intersection. TURN LEFT (north) on Irons Street (50N/1650E).
0.75	14.45	To the left the soil in the field is considerably darker than that noted previously. This is probably a prairie soil.
0.25	14.7	Cross I-74 overpass. CONTINUE AHEAD (north). The town visible to the right (northeast) is Congerville.
0.5	15.2	STOP (1-way): T-road intersection, US 150 (Kauffman Road, 200N/1650E). CAUTION: poor visibility to the right. TURN LEFT (west) on US 150.

Mile to next point	Miles from starting point	
0.65	15.85	CURVE RIGHT (northwest) and descend the Mackinaw River valley wall.
0.6	16.45	CAUTION: Cross bridge over Mackinaw River and prepare to turn right. NOTE the stream gauging station to the left on the southwest corner of the bridge.
0.15	16.6	TURN RIGHT (north) at T-road intersection (250N/1550E).
0.1	16.7	CAUTION: Low, narrow Norfolk and Western (N & W) Railroad underpass. CONTINUE AHEAD (north) and BEAR RIGHT into the Cullinan Asphalt Company property.
0.1-	16.8-	STOP: Office to the left. You MUST have permission to enter this property and continue ahead to Stop 3. After leaving the office CONTINUE AHEAD through the gate that MUST be left as you found it, unless instructed otherwise.
0.25+	17.05	CAUTION: TURN RIGHT (east and cross the bridge).
0.2-	17.25-	CAUTION: Y-intersection from left. CONTINUE AHEAD (east) and then BEAR LEFT (northerly and then northeasterly) along the east side of the pit.
0.55	17.8-	STOP 3. Exposure of Illinoian glacial deposits in the Nichols Mound Gravel Pit of Cullinan Asphalt Company. CAUTION: Some storm rivulets cross the roadway that are quite deep and a car may get stuck. Also, because of the loose outwash materials, be VERY CAUTIOUS about where you stand and what you try to pull from the exposed face. DO NOT CLIMB on steep slopes and DO NOT STAND too close to the edge of newly cut work faces.
0.0	17.8-	Leave Stop 3 and retrace route to main road beyond office.
1.05+	18.85	STOP (1-way); T-road intersection. TURN RIGHT (north) and ascend hill. CAUTION: road has many blind curves.
1.2	20.05	CAUTION: crossroads (375N/1500E). Poor visibility from the left. TURN LEFT (west).
0.25	20.3	TURN LEFT (south).
0.2	20.5	CAUTION: TURN LEFT (east) at entrance to Timberline Campground. LUNCH STOP. There is a fee for camping and picnicing here.
		STOP 4. Discussion of land surveys in Illinois.

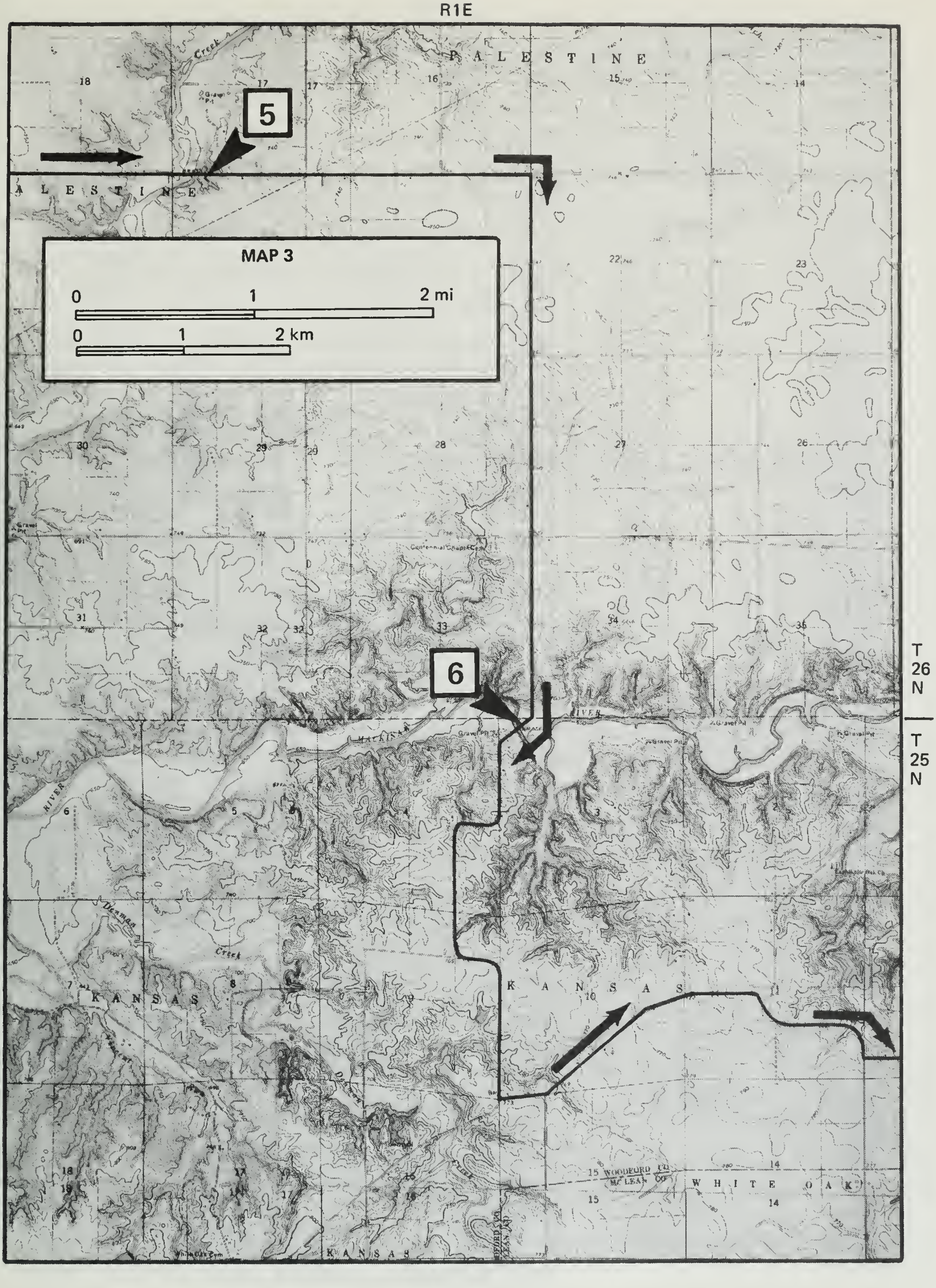
R1W


MAP 2
0
1
2 mi
0
1
2 km
4
LUNCH
3
T
26
N
T
25
N
MONTGOMERY
Walnut
Creek
RIVER
Panther
Rubenstein Bridge
Nichols Mound (Indian Mound)
White Oak Lake
Congerville
Gravel Pit
CLASSIFICATION
Light-duty road, all weather, improved surface
Unimproved road, fair or dry weather
State Route
EUREKA, ILL.
N4037.5—W8915/7.5
1970

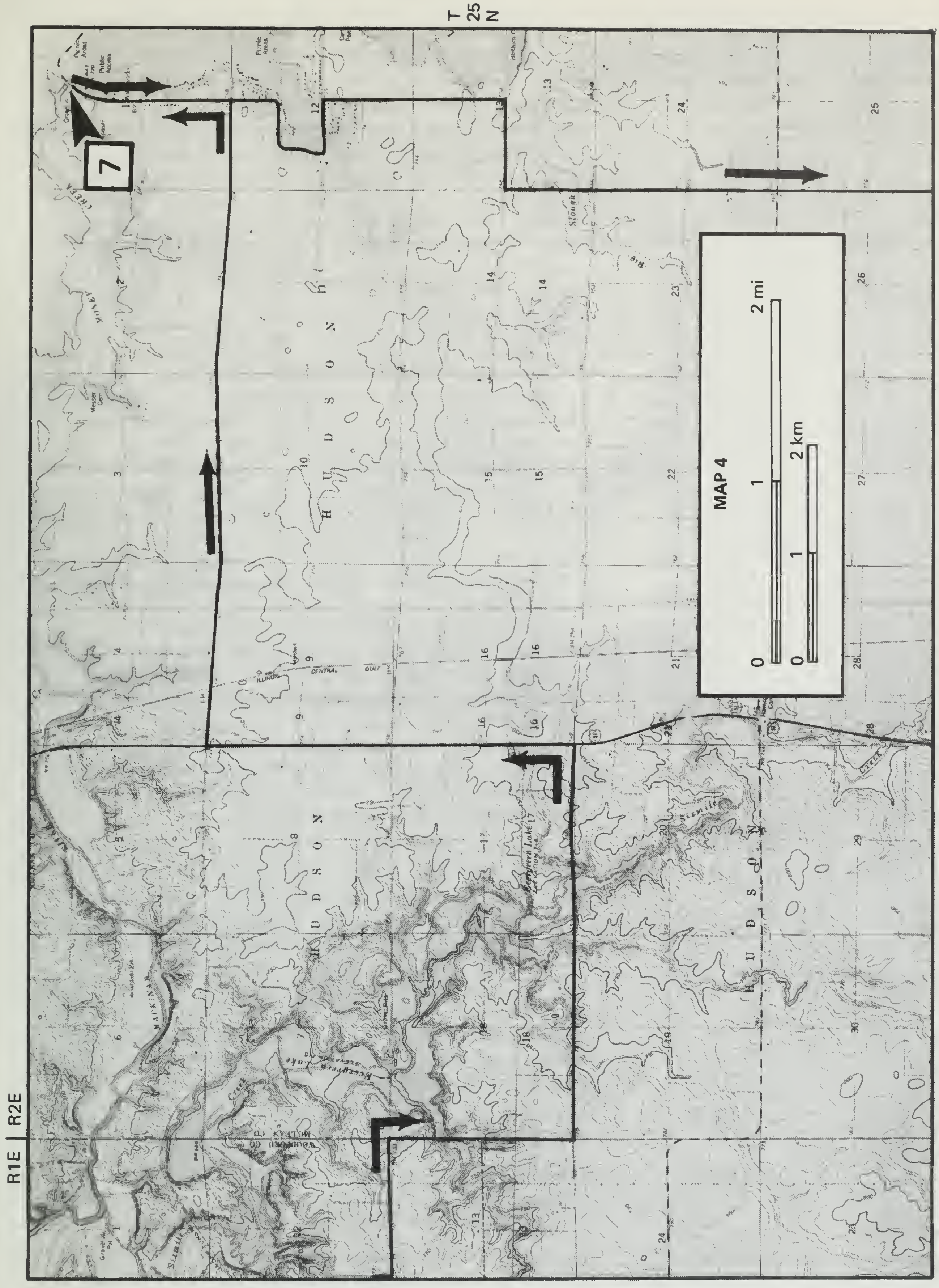
Miles to next point	Miles from starting point	
0.0	20.5	Leave Stop 4. Return to campground entrance. STOP (1-way). TURN RIGHT (north).
0.2	20.7	TURN RIGHT (east).
0.25	20.95	CAUTION: crossroads (375N/1500E). Poor visibility from the right. TURN LEFT (north).
0.25	21.2	CAUTION: T-road from the right (400N/1500E). TURN RIGHT (east).
1.2-	22.4-	Note glacial erratics in the yard to the right.
0.1	22.5-	TURN LEFT (north).
0.3	22.8	Cross Walnut Creek.
0.2	23.0-	Radnor Till Member exposed in the roadcut.
0.6+	23.6	CAUTION: JOG LEFT AND THEN RIGHT onto the gravel road.
0.3	23.9	Here the route passes through part of a relict gallery forest.
0.5	24.4	To the right is a Christmas-tree farm that is located here because of the sandy soil. This soil developed in the sandy Snyder Member of the Wedron Formation.
0.3-	24.7-	CAUTION: unguarded T-road intersection (600N/1620E). TURN RIGHT (east).
0.45-	25.15-	CAUTION: T-road intersection (600N/1675E) from left. CONTINUE AHEAD (east).
0.7+	25.85±	CAUTION: YIELD right-of-way; T-road (600N/1750E) from the right. CONTINUE AHEAD (east).
0.55+	26.4	TURN LEFT (north) (600N/1800E).
1.0	27.4	CAUTION: YIELD right-of-way at crossroads (700N/1800E). CONTINUE AHEAD (north). This is the area in which the Eureka Moraine overrides the Normal Moraine. However, it is very difficult to pick the exact contact between the two moraines here.
1.0	28.4	CAUTION: YIELD right-of-way at T-road intersection (800N/1800E). TURN RIGHT (east).
0.05	28.45	The route here crosses an area that has not been dissected by streams. Drainage is into low sags on the hummocky glaciated surface.
0.45	28.9	CAUTION: T-road (800N/1850E) from the left. CONTINUE AHEAD (east).
0.5	29.4	CAUTION: crossroads (800N/1900E). CONTINUE AHEAD (east).
0.05-	29.45-	Cross Red River.

Miles to next point	Miles from starting point	
0.4	29.85-	About ¼ mile to the left is a small isolated mound that may be a kame, an ice-contact feature.
0.55+	30.4	STOP (1-way); T-road intersection (800N/2000E). TURN RIGHT (south) and prepare to turn left. The route here is along the Third Principal Meridian discussed at Stop 4.
0.05-	30.45-	TURN LEFT (east) at T-road intersection (800N/2000E).
1.0	31.45-	Cross Panther Creek and prepare to stop.
0.2+	31.65	STOP 5. Panther Creek Pleistocene Section exposed in north roadcut east of Panther Creek. CAUTION: Park to the right as far as safety permits—AND SET YOUR BRAKES! The shoulder is narrow and rutted—and the ditch is deep. LOOK OUT for traffic.
0.0	31.65	Leave Stop 5. CONTINUE AHEAD (east).
0.5-	32.15-	CAUTION: crossroads (800N/2175E). CONTINUE AHEAD (east).
0.75	32.9-	CAUTION: T-road intersection (800N/2250E) from the left. CONTINUE AHEAD (east).
0.5	33.4-	CAUTION: T-road intersection (800N/2300E) from the right. TURN RIGHT (south).
0.2+	33.6	The large field to the right contains a swale (sag) near the center.
0.8	34.4	CAUTION: T-road intersection (700N/2300E) from the left. CONTINUE AHEAD (south).
1.0	35.4	STOP (2-way); crossroads (600N/2300E). CONTINUE AHEAD (south).
0.15	35.55	Another gallery forest is present to the right along a tributary to the Mackinaw River.
0.65	36.2	Descend Mackinaw River valley wall. Note roadcuts exposing till on both sides of the road.
0.25	36.45	STOP 6. Discussion of geomorphic features along the Mackinaw River valley as seen from the bridge. DO NOT PARK ON THE BRIDGE.
0.0	36.45	Leave Stop 6. CONTINUE AHEAD (southerly) and cross Mackinaw River.
0.4	36.85	Roadcut exposes Malden Till Member.
1.15	38.0	T-road intersection (375N/2275E). BEAR LEFT (east) and then CURVE RIGHT (south).
0.95	38.95	T-road intersection (300N/2300E). TURN LEFT (east).

Miles to next point	Miles from starting point	
0.25	39.2	T-road intersection (300N/2325E). BEAR LEFT (northeast).
0.95	40.15	T-road intersection (350N/2400E) from the left. BEAR RIGHT (east).
0.35+	40.5+	Y-intersection (350N/2440E). BEAR RIGHT (southerly).
0.85	41.35+	T-road intersection (315N/2500E) from the left. TURN LEFT (east) onto a gravel road.
0.25	41.6+	T-road intersection (315N/2525E). TURN RIGHT (south) and then TURN LEFT (east).
0.85-	42.45	T-road intersection (300N/2600E). The water ahead and to the south is the western part of Lake Evergreen. TURN RIGHT (south); the route is along the boundary between Woodford and McLean Counties. The McLean County Department of Parks and Recreation has developed Comlara Park around the lake. The park consists of some 1450 acres of land. The lake, nearly 700 acres of water, has a 22-mile shoreline and a maximum depth of 50 feet.
0.25	42.7	Cross inlet of Evergreen Lake.
0.25	42.95	Enter McLean County. CONTINUE AHEAD (south).
0.5	43.45	T-road from the left. TURN LEFT (east).
1.15	44.6	Roadcut to left shows Malden Till Member. To the right is a parking area for the Shady Hollow Nature Trail.
0.15	44.75	Start of Shady Hollow Nature Trail.
0.15	44.9	Cross Six-mile Creek, which is dammed to form Evergreen Lake. This is the southern limit of Evergreen Lake.
0.1	45.0	The field to the left has been replanted to native prairie grasses.
0.6	45.6	STOP (1-way); T-road intersection, US 51. USE EXTREME CAUTION: fast traffic and poor visibility to the right. TURN LEFT (north) on US 51.
1.75	47.35	Prepare to turn right.
0.3-	47.65-	TURN RIGHT (east) toward East Bay Camp and Lake Bloomington.
0.3+	47.95	CAUTION: Illinois Central Gulf (ICG) Railroad crossing.
1.25	49.2	Route crosses the ground moraine of Malden Till of the Eureka Moraine.


R1E
PALESTINE
5
MAP 3
0
1
2 mi
0
1
2 km
6
T 26 N
T 25 N
KANSAS
WHITE OAK

Miles to next point	Miles from starting point	
2.0-	51.2-	STOP (4-way): crossroads. TURN LEFT (north).
0.65	51.85-	Bloomington Municipal Water Works to the right.
0.1	51.95-	Crossing dam across Money Creek, the stream that was dammed to make Lake Bloomington.
0.1+	52.05	TURN RIGHT (east) into parking lot.
		STOP 7. Environmental geology of a dump site and the Lake Bloomington Spillway Pleistocene Section.
		USE EXTREME CAUTION in crossing the road: fast traffic and poor visibility. After crossing the road, proceed to the left down the road to the dump site. After that discussion has been completed, return to this location on your way to the spillway section to the right.
0.0	52.05	Leave Stop 7. STOP (1-way). USE EXTREME CAUTION: fast traffic and poor visibility. TURN LEFT (south) and retrace route to the 4-way stop.
0.9-	52.95-	STOP (4-way): crossroads. CONTINUE AHEAD (south). Route becomes somewhat crooked because of the configuration of the lake.
0.55+	53.5	The old iron tower to the left looks similar to the early airmail route beacons.
0.2-	53.7-	STOP (2-way): T-road intersection. TURN RIGHT (east).
0.05	53.75-	Cross arm of Lake Bloomington.
0.25	54.0-	STOP (4-way): crossroads. TURN RIGHT (south).
1.0	55.0-	STOP (1-way): T-road intersection. TURN RIGHT (west).
0.5	55.5-	CAUTION: T-road from left. TURN LEFT (south) on Pipeline Road.
0.2	55.7-	The ground moraine of the Eureka Moraine here exhibits a broad swell and swale (rolling) topography. The bottoms of the swales frequently are marshy and the area has been extensively tiled to facilitate farming.
1.3	57.0-	STOP (4-way): crossroads. CONTINUE AHEAD (south).
1.3+	58.3	The route enters the Northern Illinois Gas Company's Hudson Gas Storage Field. Underground storage of natural gas in Illinois is important. With population increases, greater amounts of gas are needed for heating, cooking, and industrial purposes. Consumer demand for gas varies


T
25
N
R1E | R2E
MAP 4
0
1
2 mi
0
1
2 km
7
HUDSON
Hudson
HUDSON
ILLINOIS CENTRAL GULF
Evergreen Lake
MACKINAW

Miles to next point	Miles from starting point	
		markedly from summer to winter because of fluctuating seasonal requirements, mainly for heating purposes. It is neither economically feasible nor efficient to construct enough pipelines to meet peak demands during the winter. However, by operating existing pipelines at capacity on a year-round basis, the excess gas transmitted from southern gas fields during the summer can be pumped into large underground storage facilities and stored until needed in large metropolitan centers.
		A gas storage facility must be located in a suitable geologic structure in which porous and permeable strata are overlain by impermeable caprock to trap and hold the gas. The gas is pumped under high pressure into the void spaces in the reservoir rock, which may be spaces between sand grains in a sandstone, the openings between mineral particles in limestone or dolomite, fractures in the rock, and solution cavities. Pore or void space in a typical reservoir rock is 15 to 25 percent of its total volume. Permeability of the reservoir is extremely important because the voids must be interconnecting so that gas can easily pass into and out of the rock. As gas is forced into the rock, it displaces fluids that already occupy the voids and eventually forms a bubble. As gas is withdrawn, the pressure within the storage bubble is reduced, and the fluids reoccupy the void spaces.
		The Hudson Gas Storage Field (fig. 1) was discovered in 1968. The first gas was injected into the Cambrian Mt. Simon Sandstone Formation, the reservoir rock, at a depth of 3,790 feet, in August 1970. The field became operational in 1971. The average porosity is 11 percent, and the average permeability is 48 millidarcies (md). The original reservoir pressure was 1650 pounds per square inch (psiA). There are 32 injection/withdrawal wells and 9 observation wells. Three compressors total 9,320 horsepower (hp).
0.25	58.55	To the left is the main compressor station and field office of the Hudson Gas Storage Field.
0.2	58.75	The small, green metal buildings with blue and yellow pipes connecting to them are the combination injection/withdrawal wells for this field.
1.1	59.85	To the left, near the south end of the storage field is an observation well. Note: It does not have any pipes leading to it.

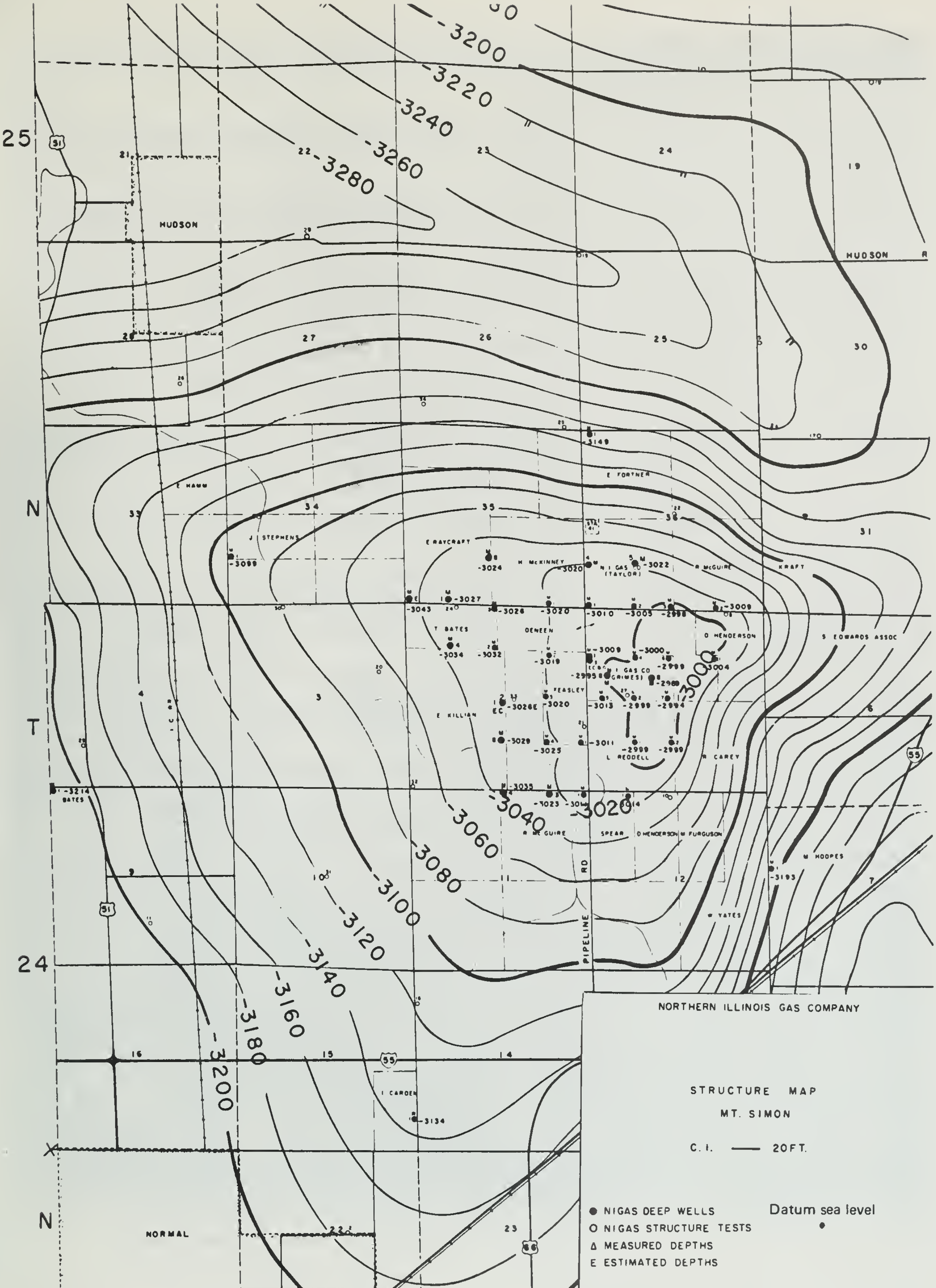
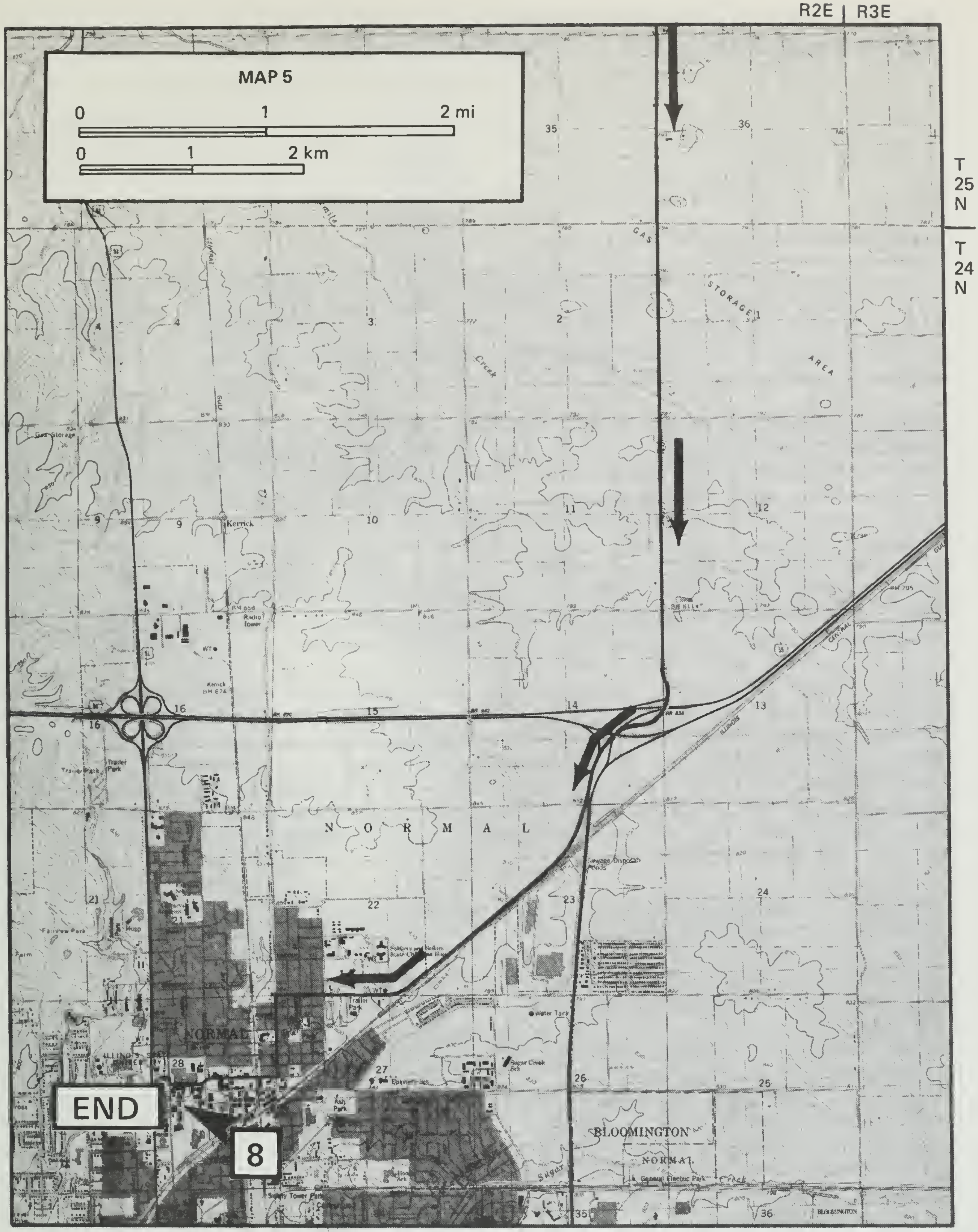


Figure 1
Hudson gas storage field.

Miles to next point	Miles from starting point	
1.65-	61.5-	STOP (1-way): T-road intersection with I-55 westbound exit ramp. CONTINUE AHEAD (south) and cross I-55.
0.3	61.8-	CAUTION: MERGE RIGHT into the traffic and IMMEDIATELY MOVE TO THE RIGHT on Veteran's Parkway.
0.35+	62.15	CURVE RIGHT (southwest) at NORMAL EXIT for Illinois State University.
0.45	62.6	CAUTION: merging traffic and 2-way traffic.
0.3	62.9	The tall buildings in the distance are Illinois State University dormitories.
0.8+	63.7+	CAUTION: CURVE RIGHT (west). Congested area because of athletic fields on the right side of the highway. Normal City limits.
0.35	64.05+	STOP (4-way). CONTINUE AHEAD (west) on Pine Street.
0.25	64.3+	STOP (1-way): Pine and Linden T-intersection. TURN LEFT (south) on Linden.
0.25	64.55+	STOP (4-way). CONTINUE AHEAD (south).
0.2-	64.75	STOP (3-way). TURN RIGHT (west) on Mulberry Street (one way west).
0.1+	64.85+	CAUTION: ICG Railroad crossing, 2 tracks.
0.15	65.0+	STOP (3-way): Fell Avenue. CONTINUE AHEAD (west).
0.1+	65.1+	STOPLIGHT: School Street. CONTINUE AHEAD (west) on Mulberry Street and BEAR LEFT.
0.05-	65.15+	BEAR RIGHT: Mulberry Street becomes College Ave.
0.15+	65.3+	STOPLIGHT: TURN RIGHT (north) on University Ave.
0.05	65.35+	CAUTION: TURN LEFT into parking lot.
0.05	65.4+	PARK where possible.

STOP 8. Walk approximately 300 feet southeast and cross to the southeast corner of College and University Avenues. Then walk about 450 feet south and then 250 feet east to the northeast corner of Cook Hall, the building that looks like a castle. Walk south to the southeast entrance of this building. The Funk Mineral Museum is located in the basement of Cook Hall.

End of trip. Have a safe journey home.


R2E
R3E
MAP 5
0
1
2 mi
0
1
2 km
T 25 N
T 24 N
35
36
4
3
2
1
GAS
STORAGE
AREA
Creek
9
10
11
12
Kerrick
Radio Tower
16
15
14
13
N O R M A L
21
22
23
24
NORMAL
28
27
26
25
END
8
BLOOMINGTON
NORMAL
Sugar
Creek
35
36

the geologic framework

A GEOLOGIC PICTURE OF THE AREA

In the Danvers-Normal area, there are no surface exposures of Paleozoic bedrock strata. These strata are known, however, from mine shafts, water wells, and test wells penetrating the thick drift deposited by massive Pleistocene glaciers that slowly flowed across this region during the last 700,000 years or so. In some locations, the drift is nearly 500 feet thick.

Available data indicate that Wisconsinan, Illinoian, and pre-Illinoian glaciers covered the region (appendix: Pleistocene Glaciations in Illinois). Ice sheets, advancing from Canada, flowed south and southwestward through river valleys that became enlarged and eventually formed into the Great Lakes. Drainage systems that had developed before and between each glaciation were altered—some were expanded, such as the Great Lakes, and others were filled with thick outwash sands and gravels. Later, tremendous floods of meltwater from receding ice fronts partially excavated former drainage networks. However, most of the old bedrock valleys, such as the Danvers and Mahomet Valleys (fig. 2), were completely buried by Wisconsinan glacial deposits.

Pre-Illinoian glaciation, occurring between 700,000 and 600,000 years ago, partially filled the deep bedrock valleys with outwash—the Sankoty and Mahomet Sands. An additional one third of the drift resulted from Illinoian glacial advances between 300,000 and 175,000 years ago. From 22,000 to about 16,000 years ago, Woodfordian advances of Wisconsinan age produced several tills that finally buried the Danvers and Mahomet Bedrock Valleys. Then loess blown from Wisconsinan outwash was distributed across the area in deposits up to 8 feet thick.

Beneath the unconsolidated Pleistocene sediments are nearly 6,500 feet of older consolidated sedimentary bedrock deposited during the Paleozoic Era, about 550 million to about 270 million years ago (fig. 3). The sediments, which formed these strata, settled out of shallow seas that repeatedly inundated the midcontinent during the Paleozoic Era. Locally, terrestrial sediments were deposited by streams. The Illinois Basin (fig. 4) accumulated more than 17,000 feet of Paleozoic sediments.

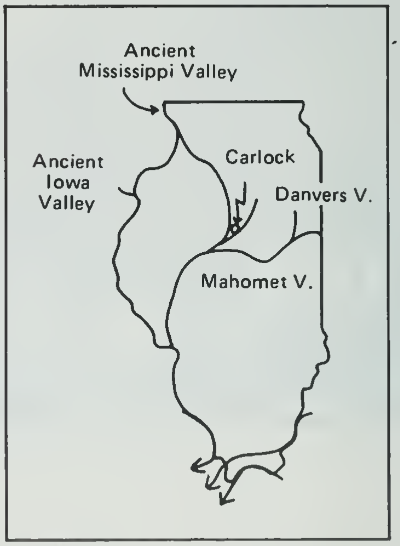


Figure 2.
Early Pleistocene major drainage.

SYSTEM	SERIES	GROUP, FORMATION	ROCK UNIT	THICKNESS (feet)	GENERAL DESCRIPTION
QUAT.	Pleistocene			0-400	Till; gravel; sand
PENN.		Kewanee-McLeansboro		350-800	Alternating strata of sandstone, shale, underclay, coal, and limestone
MISSISSIPPIAN	Chesterian			0-100	Sandstone
	Valmeyeran	Ste. Genevieve		60-100	Limestone
		St. Louis-Salem		180-200	Limestone
		Sonora		40-60	Sandstone
		Warsaw		90-180	Shale
		Keokuk-Burlington		120-220	Limestone, cherty
		Fern Glen		40-70	Shale
	Kinderhookian	Chouteau		15-40	Limestone
DEV.	Upper	New Albany		80-220	Shale
	Middle	Cedar Valley (Hunton Megagroup)		0-50	Limestone, dolomitic, sandy
		Wapsipinicon (Hunton Megagroup)		0-40	Limestone, cherty
SILURIAN	Cayugan-Niagaran	(Hunton Megagroup)	reef	275-700	Dolomite, cherty, limy, shaly; reef dolomite
	Alexandrian	(Hunton Megagroup)		25	Limestone, cherty, dolomitic
ORDOVICIAN	Cincinnatian	Maquoketa		200	Shale; limestone
	Champlainian	Galena		150-180	Limestone, dolomitic, shaly at base
		Platteville		200-250	Limestone
		Joachim		40	Dolomite, sandy, shaly
		St. Peter		230±	Sandstone
	Canadian	Shakopee		300±	Dolomite, cherty
		New Richmond		150-275	Sandstone
		Oneota		425±	Dolomite, cherty
CAMBRIAN	Croixan	Eminence		75±	Dolomite, sandy, cherty
		Potosi		250±	Dolomite
		Franconia		275±	Dolomite, shaly, sandy
		Ironton-Galesville		150±	Sandstone, dolomitic in part
		Eau Claire		575±	Sandstone; siltstone; shale; dolomite
		Mt. Simon		2,000 est.	Sandstone
PRECAMBRIAN					Granite; other igneous and metamorphic rocks

ISGS 1982

Figure 3.
Generalized geologic column for the area (modified from Illinois State Geological Survey Circular 369, 1964); not to scale.

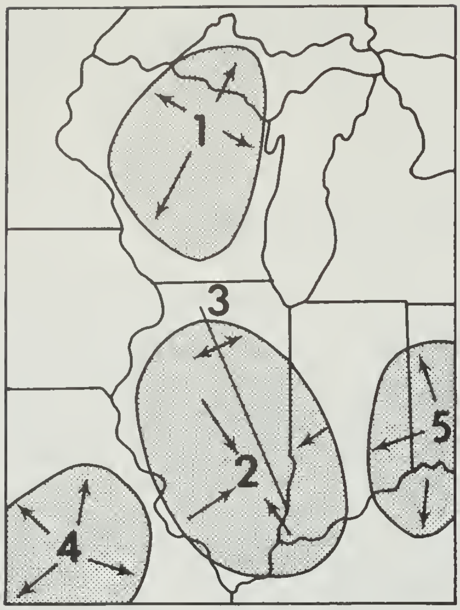


Figure 4.
Map showing locations of (1) the Wisconsin Arch, (2) the Illinois Basin, (3) the axis of the La Salle Anticlinal Belt, (4) the Ozark Dome, and (5) the Cincinnati Arch.

Precambrian igneous and metamorphic rocks as much as 1.5 billion years old underlie the Paleozoic strata in this area (fig. 5; cross section). Long before the Paleozoic Era began, these ancient rocks were exposed to weathering processes above sea level. At the dawn of the Paleozoic, however, the Earth's crust gradually sagged until shallow seas covered the midcontinent. The Illinois Basin sank repeatedly, though at different rates in different locations, and thick layers of sediment accumulated. Mud and sand washed from the land into nearshore areas and later compacted into shale and sandstone layers. In deeper offshore water, limey oozes and shell debris developed into limestones.

PHYSIOGRAPHY

The Danvers-Normal area lies within the Till Plains Section of the Central Lowland Province, an extensive region of nearly level land with only slight relief in the continental interior (appendix: Physiographic Divisions of Illinois). The Till Plains Section is characterized by broad, relatively uneroded, youthful till plains. It is the largest physiographic division in Illinois, covering about 80 percent of the state.

Seven subdivisions, including the Bloomington Ridged Plain, are recognized in Illinois. The Bloomington Ridged Plain is characterized by low, broad, older Woodfordian morainic ridges (the oldest is about 22,000 years) separated by wide stretches of relatively flat or gently rolling ground moraine. Although the major moraines are very conspicuous at a distance, their gentle slopes are less obvious close at hand.

During the long interval between the close of the Pennsylvanian Period about 270 million years ago (fig. 3) and the beginning of the Pleistocene glaciations, perhaps 2 to 3 million years ago, the Danvers-Normal area appears to have been above sea level. Erosion produced a somewhat hilly terrain. According to borehole records, the area had a surface relief of some 325 feet from the deepest parts of the Danvers and Mahomet Bedrock Valleys to the adjacent bedrock uplands.

As noted previously, although early Pleistocene glaciations partially buried the bedrock valleys, later Wisconsinan glaciers finally buried the last traces of bedrock surface. Irregularities on the till plain, however, provide evidence of the buried bedrock topography. The Bloomington Morainic System and Eureka Moraine cross the area on the crests of the highest bedrock hills, which suggests that these hills slowed the advancing glaciers and caused drift to pile up behind them. From its west-flowing course north of Congerville, the Mackinaw River turns southwest and aligns over a small bedrock valley that was a tributary to the Ancient Mississippi Valley lying a short distance to the west. The change in course is probably due to a slight sag that developed in the till plain over the buried bedrock valley.

The northwest-southeast trending Bloomington Morainic System and Normal and Eureka Moraines are well drained. Sugar Creek and its tributaries, which flow southward several miles to the Sangamon River, drain the area south and east of Danvers. The Mackinaw River and its tributaries, which flow west and southwestward to the Illinois River, drain the rest of the area. Generally, the courses of these streams have developed as a direct result of the original slope created by the glaciers. In this area, streams eroding headward into the moraine fronts and along the backslopes of the ground moraine have increased the surface relief to more than 270 feet. This is the difference between the lowest elevation of less than

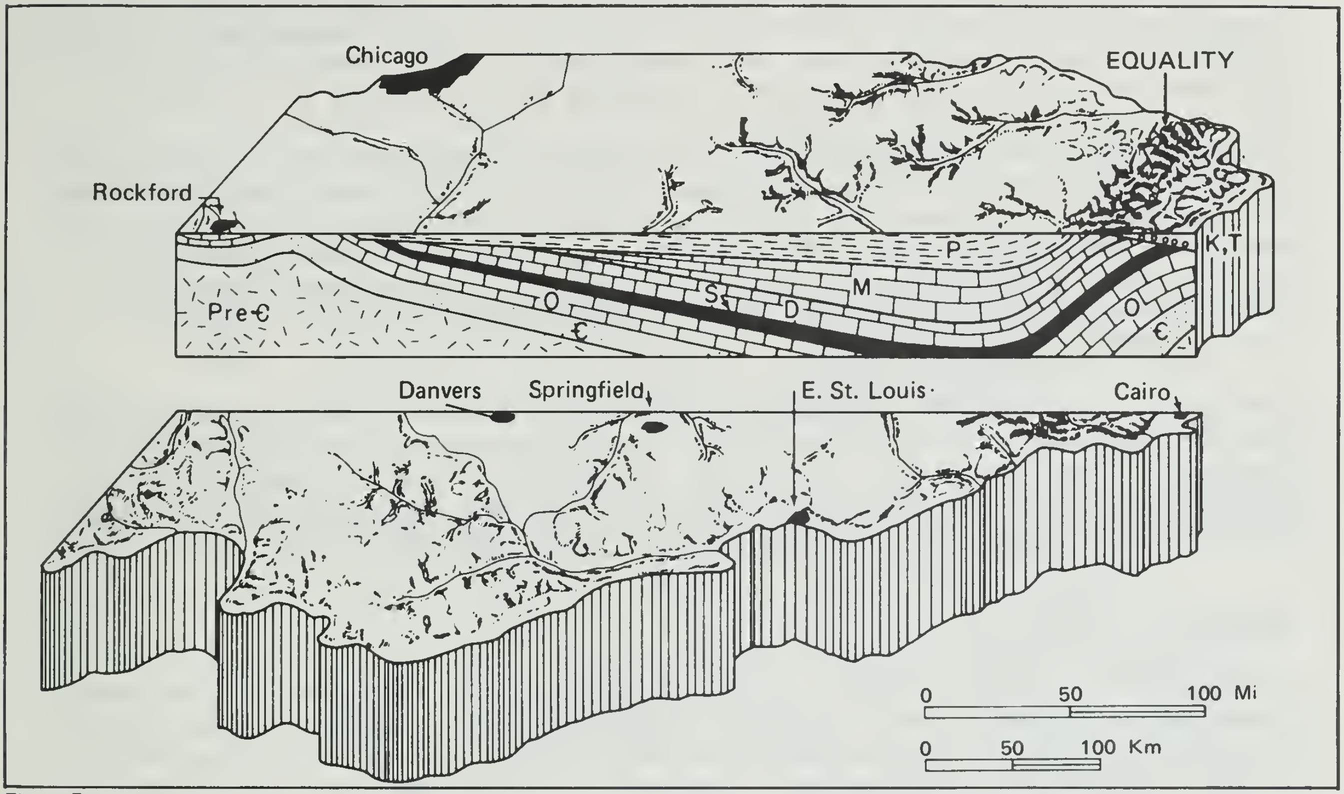


Figure 5.

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

610 feet along the Mackinaw River south of Stop 4 and the highest elevation of more than 880 feet (mean sea level) along the Eureka Moraine north and northwest of Normal.

ECONOMIC GEOLOGY

During 1980 production of sand (243,000 tons) and gravel (378,000 tons) in McLean County amounted to 621,000 tons, for a value of $1,991,000. In Woodford County, production of sand (343,000 tons) and gravel (570,000 tons) totaled 913,000 tons, for a value of $3,248,000. These construction materials were produced mainly from Pleistocene sand and gravel outwash deposits.

---

1 STOP 1. Glacial moraine overlook and discussion of bedrock valleys. (Near center of west line of SW¼NE¼SE¼ Sec. 23, T. 24 N., R. 1 W., 3rd P.M.; McLean County; Danvers 7.5-minute Quadrangle.)

This stop, which gives one of the best views from a moraine in the field trip area, is slightly south of the crest of the Woodfordian Bloomington Morainic System—a prominent morainic feature in Illinois. Named for the city of Bloomington situated on the moraine about 10 miles to the southeast, this morainic system is more than 100 miles in length and locally about 150 feet high. In the field trip area, the highest elevation is 880 feet (mean sea level) at a spot slightly more than 2 miles east. Here, the moraine has an elevation of more than 830 feet (msl) and rises a little over 90 feet above the low crest of the older Kings Mill Moraine almost 2 miles to the south.

The Bloomington Morainic System was deposited when Woodfordian (Wisconsinan Stage) glaciers stood in this area some 16,000 to 17,000 years ago. When the ice front melted at about the same rate as new ice flowed into the area from the north, the glacier was in equilibrium and a moraine formed at the ice margin. Rock debris frozen in the ice melted out, the coarser material was deposited very close to the ice front, and the finer material was carried away by meltwater streams.

During the time that the Bloomington Morainic System was being deposited here, the ice front was not static, with the result that several ridges are now discernible. However, because of complex relationships and the need for more detailed study in this area, the various ridges have not been differentiated and named. Elsewhere in Illinois the system has been subdivided.

BURIED VALLEYS

Illinois has a network of buried valleys that were incised into bedrock sometime in the geologic past. It seems likely that buried bedrock valleys are the result of pre-Illinoian glaciations because they contain thick accumulations of pre-Illinoian deposits. Apparently, the valleys were completely filled with sediments by the close of the Illinoian glaciation because the Sangamon Soil horizon—the weathered top of the Illinoian drift—extends unbroken across them. There is no surface expression of these old buried valleys in this region, and thus, modern streams cut across their old courses.

The Danvers Bedrock Valley, a tributary of the buried Mackinaw Bedrock Valley a few miles to the west, is more than 40 miles long, extending north and northeastward toward Leeds and Pontiac, respectively. The valley appears to range from 3 to 10 miles wide. Although it is about 150 feet below the adjacent bedrock uplands, a bedrock high about 2.5 miles north of Danvers indicates a bedrock valley relief of approximately 240 feet.

2

STOP 2. Danvers (Rock Creek) Pleistocene Section exposed along the south side of Rock Creek cut bank. (S½NW¼NE¼NW¼ Sec. 32, T. 25 N., R. 1 W., 3rd P.M.; McLean County; Danvers 7.5-minute Quadrangle.)

This is a good location to examine deposits produced by several processes during two glacial stages. The Radnor Till, exposed just above the creek at the west end of the cut (fig. 6), is the youngest till member of the Illinoian Stage (Jubileean Substage). Overlying the glacial till is a soft clay (Berry Clay Member), which may be slope wash and slump derived from the Radnor Till. After the Berry Clay was deposited, the Sangamon Soil developed. The Sangamon Soil represents 50,000 to 100,000 years of weathering and soil formation during the warm and possibly wet interval between the glacial Illinoian and Wisconsinan Stages. The Roxana Silt and Morton Loess are windblown deposits accumulated over about 50,000 years during the early part of the Wisconsinan Stage. These were overridden by the Woodfordian Substage glacier; however, at this location very little of the silt sequence was removed. The glacier deposited the Delavan Till (gray) and the Tiskilwa Till (pink) with only a brief pause, represented by the sand and gravel between them. The sand and gravel was derived from both of these members, and thus, does not belong exclusively to either till member.

Note that the sand and gravel, partially cemented by calcium carbonate ($CaCO_3$), has become a conglomerate. The cement derived from the minerals and rocks—calcite, limestone, and dolomite—in the overlying till.

3

STOP 3. Exposure of Illinoian glacial deposits in Nichols Mound Gravel Pit. (Office: NW¼NW¼SW¼NE¼ Sec. 17, T. 25 N., R. 1 W., 3rd P.M.; Woodford County; Secor 7.5-minute Quadrangle. Pit: (SW¼NE¼ and SE¼NW¼) NW¼SW¼ Sec. 9, T. 25 N., R. 1 W., 3rd P.M.; Woodford County; Secor 7.5-minute Quadrangle.)

Here is an opportunity to examine Illinoian Stage materials (fig. 7). The sands and gravels at this stop were deposited in a broad valley. The cross-bedded nature of the lower unit suggests a valley train deposit with numerous, shallow, rapidly shifting channels. Choked with debris from a melting glacier, this material is overlain by a layer characterized by boulders, which may have been deposited by a large flood. Note the rounded boulders. The upper sand and gravel may represent a partially ponded condition just beyond an advancing glacier. The Radnor Till marks the advance of a glacier over the area. The silt may be a slack-water deposit that developed when water backed up the broad valley from the old Teays (Mahomet) River.

This stop is interesting because the sand and gravel being mined in this part of Illinois is not from recent deposits along streams but rather from exhumed deposits of Illinoian age.

Cut Bank, South Side of Rock Creek

NW¼, NE¼, NW¼, Sec. 32, T. 25 N., R. 1 W., McLean County

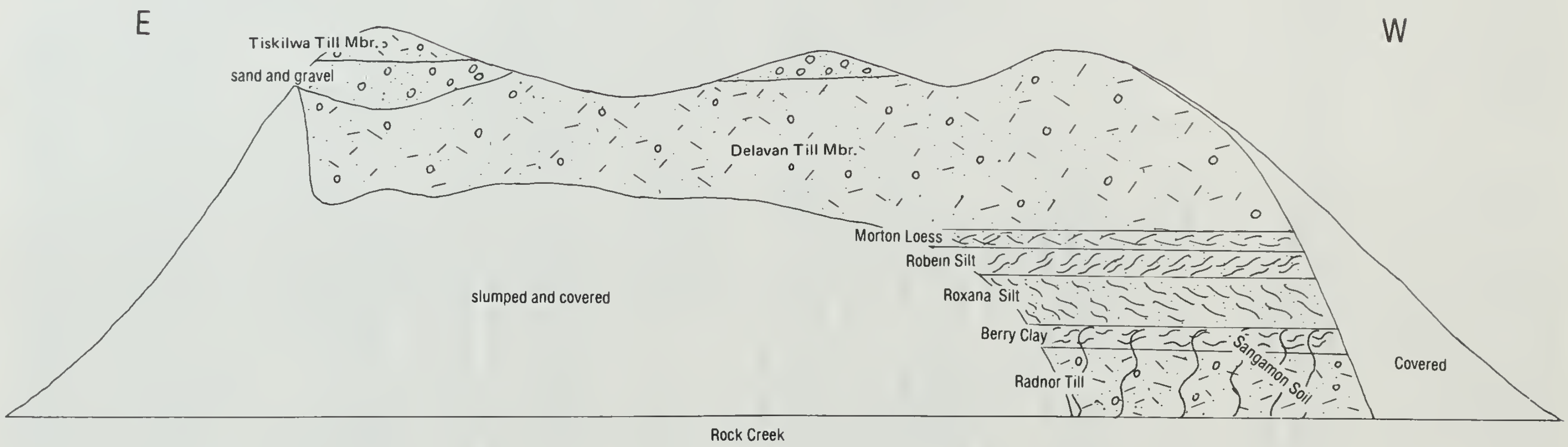


Figure 6. Stop 2.

North End, Nichols Mound Gravel Pit

NW ¼, SW ¼, Sec. 9, T. 25 N., R. 1 W.,

Woodford County

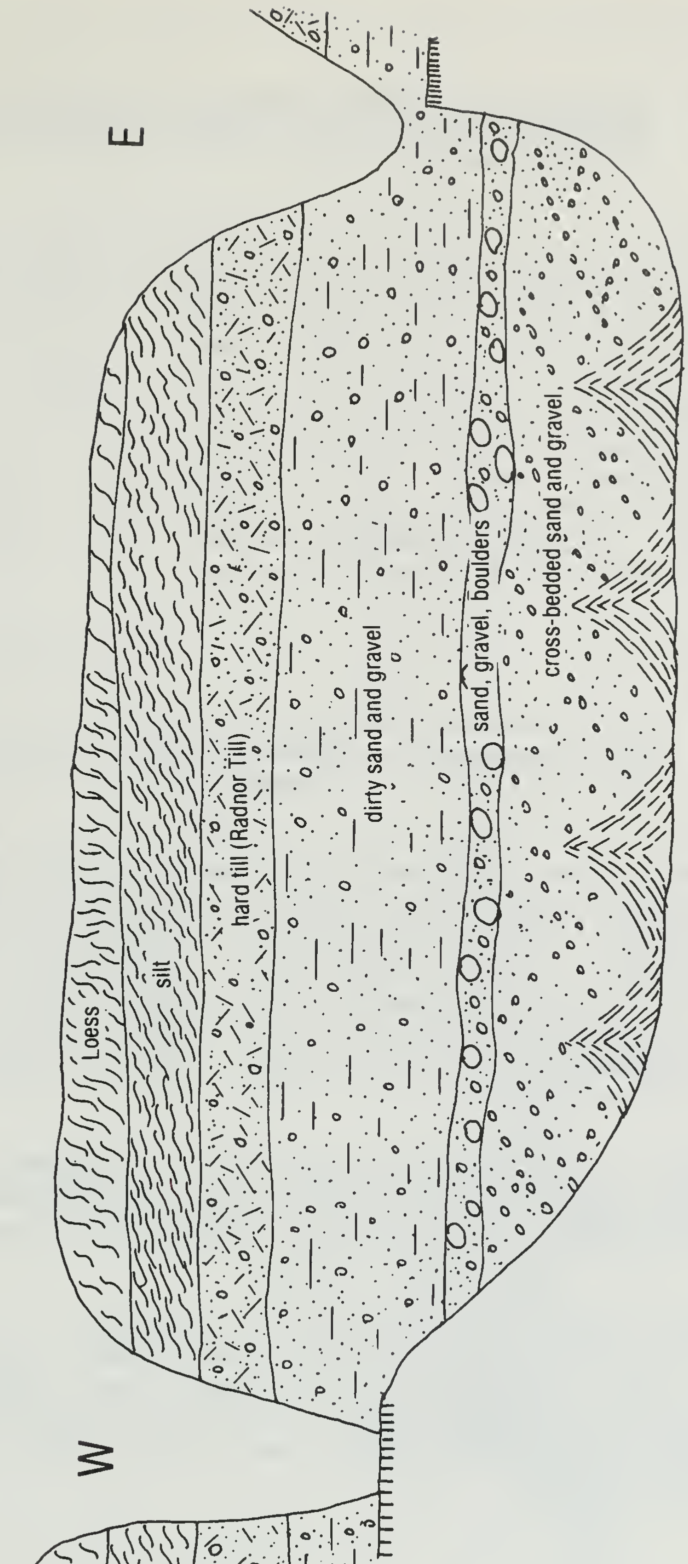


Figure 7. Stop 3.

4 STOP 4. Lunch at Timberline Campground and discussion of land surveys in Illinois. (Office: W½SW¼SE¼NE¼ Sec. 7, T. 25 N., R. 1 W., 3rd P.M.; Woodford County; Eureka 7.5-minute Quadrangle.)

The Danvers-Normal field trip area lies astride the Third Principal Meridian (3rd P.M.). A first examination of the 7.5- and 15-minute quadrangles of this part of central Illinois shows that the section lines form a rather even grid over the whole area. A closer look, however, reveals that some sections are elongated (north to south) and others are shortened (east to west), and the sections do not line up evenly on either side of the 3rd P.M. The discrepancies have resulted from adjustments that had to be made due to the curvature of the Earth, and to a lesser extent, due to small errors made in surveying 150 to 200 years ago. Note the jog in the itinerary at mileage 30.4 and 30.45-. The route between these two closely spaced turns along the 3rd P.M. illustrates the foregoing discussion.

5 STOP 5. Panther Creek Pleistocene Section exposed in the north roadcut east of the creek. (Near center of S line SE¼SW¼SW¼ Sec. 17, T. 26 N., R. 1 E., 3rd P.M.; Woodford County; Secor 7.5-minute Quadrangle.)

There are several interesting features to observe at this location. The sand and gravel lens between the Malden and the Tilkilwa Tills is more permeable than the tills (fig. 8). Water penetrates the Malden Till slowly, then flows into the sand and gravel. Since the underlying Tiskilwa Till is relatively compact, water accumulates in the sand and gravel, forming a small aquifer. Next it drains into the roadcut from seeps along the base of the sand and gravel. A line of weeds across the exposure marks these seeps.

The Tiskilwa Till shows a color change—from the original gray at the base to a pinkish gray in the weathered zone. The Sangamon Soil is well developed in the Radnor Till, which is evidenced by its strong brown color. Note that there is no Berry Clay.

Sand with gravel underlying silt with shell fragments is a common association in the Illinoian Stage of McLean and Woodford Counties, indicating that numerous lakes and marshes lay just beyond the margins of a melting glacier. An analysis of heavy minerals in the silt zones suggests that because of decaying vegetation, the water in these lakes and marshes had little dissolved oxygen.

STOP 5

Road Cut, North Side of Road
SE 1/4, SW 1/4, SW 1/4, Sec. 17, T. 26 N., R. 1 E.,
Woodford County

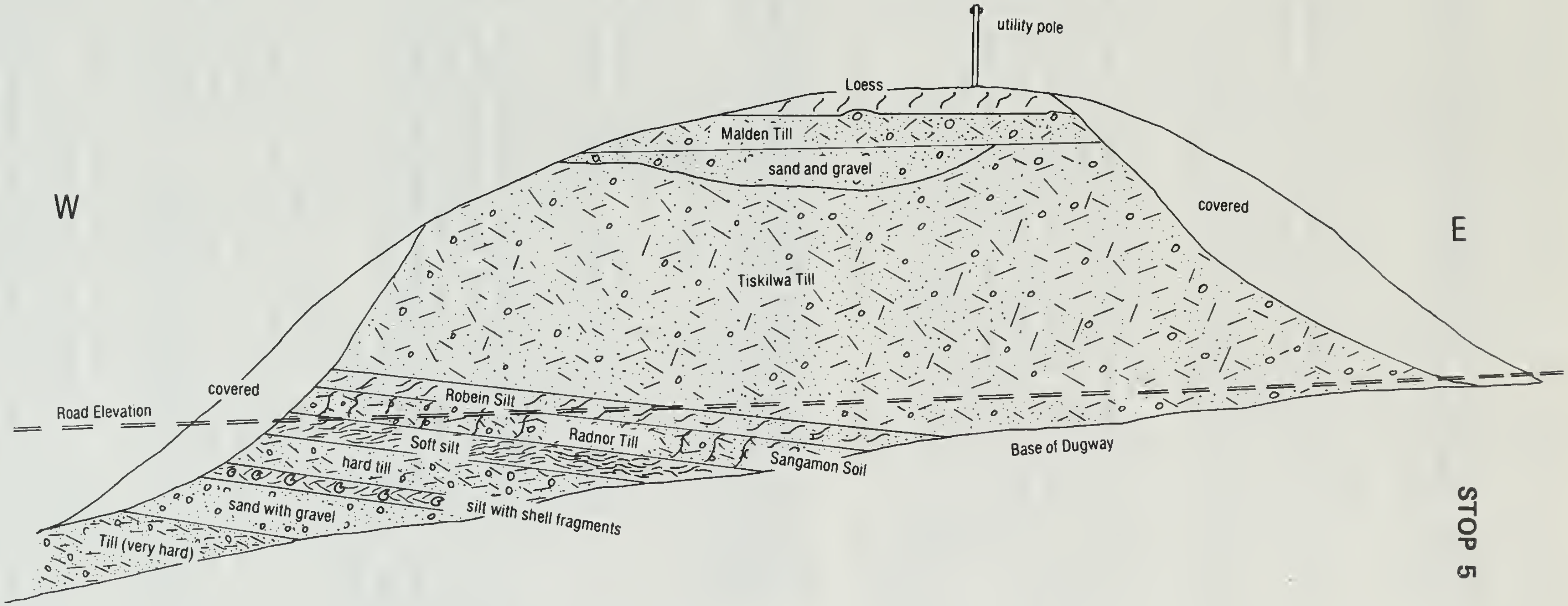


Figure 8. Stop 5.

6

STOP 6. Discussion of geomorphic features in the vicinity of the Mackinaw River bridge. (NW¼ [extended] NW¼NW¼NW¼ Sec. 3, T. 25 N., R. 1 E., 3rd P.M.; Woodford County; El Paso 7.5-minute Quadrangle.)

The bridge is located ¼ mile northwest of an abandoned meander of the Mackinaw River. From the bridge the cutbank of this meander is visible to the southeast. It was probably abandoned when the river incised the floodplain to create paired terraces (elevation 650 feet). Look to the west of the bridge where this terrace is best developed.

Note the break in slope along the valley walls of the Mackinaw River. When the river was cutting downward through Wisconsinan Stage materials the stream could easily meander; but when harder Illinoian Stage tills were encountered, the river had a more difficult time cutting its course. The harder Illinoian Stage tills support the steep to near vertical slopes of the cutbanks. The softer Wisconsinan Stage materials form less steep upper slopes. Near this stop the change from Illinoian to overlying Wisconsinan Stage deposits occurs between elevations of 680 feet and 710 feet (mean sea level).

7

STOP 7. (A) Environmental geology of a dump site along an abandoned valley, and (B) a Pleistocene section exposed along the south side of the Lake Bloomington Spillway. (NE¼NE¼NW¼ and NW¼NW¼NE¼ Sec. 1, T. 25 N., R. 2 E., 3rd P.M.; McLean County; Gridley 7.5-minute Quadrangle.)

7A. To the left beyond the gate, a road leads southwestward to an overview of the valley once occupied by Money Creek. When an earthen dam was constructed across Money Creek, the impounded waters formed Lake Bloomington.

Most of the water on the abandoned part of the valley floor is seepage from the straight, grassy slope to the south and southeast of the dam. Water-loving vegetation, such as cattails and sedges occurring along the toe (base) of the dam, indicates that water is continually seeping through and under the dam. The low levee to the west, down the abandoned part of the valley, protects the main dam from any floodwater backup in the Mackinaw River valley just a short distance to the west.

The slope in the foreground is covered by waste piles of white to gray exchange salt used in softening water in the nearby municipal water treatment plant, the brick building on the south bank of Lake Bloomington (southeast of this spot). The used or spent salt is mostly calcium carbonate ($CaCO_3$) removed from the water in the softening process. If this deposit were buried, it would slowly change into limestone (something to puzzle future geologists). The upper 5 to 10 inches of this waste material has dried out, forming a crust across the surface. The material below the crust, however, is still soft and would not support a person walking across it. The waste material is so soft, in fact, that it frequently slumps and flows downslope to form lobes extending onto the valley floor. Clearly, the deposit is active; that is, the weight of the waste material dumped on the upper slopes causes the weaker, partially dewatered older material to slump. Conditions here are hazardous.

To the west is a pond that collects much of the water from dewatering of this deposit, thus it has a high pH—it is alkaline. This situation is unusual because pollution is generally produced by acid run-off conditions. At the present time, it appears that the alkaline pollution of Money Creek and the Mackinaw River is somewhat beneficial to downstream life. Note the lush algal growth on the pond surface.

Return to the gate area and follow the footpath to STOP 7B. Do not cut across the area to the north, as some parts may be quite soft.

7B. To the right of the gate is a footpath that leads north and west to the top of the cutbank above the present course of Money Creek. It serves as the spillway for Lake Bloomington.

The man-made spillway here exposes five tills, one of the largest sections known in the field trip area (fig. 9). The Smithboro Till Member observed to the northwest along the spillway bottom, is the oldest till of Illinoian age in this part of Illinois. Between the overlying Vandalia Till Member and the Radnor Till Member, the youngest Illinoian till here, is a zone of organic silt composed of sand, marl, clay, and peat. This zone appears to represent one principal ice-free period during Illinoian time. Although other tills of Illinoian age have been identified elsewhere in McLean and Woodford Counties, either scour from succeeding glaciers removed all traces of them, or they were never deposited here.

After the Radnor Till was laid down, the climate warmed and the Illinoian Stage ended. During the long time between the end of Illinoian glaciation and the start of Wisconsinan glaciation, deep weathering produced thick soils throughout the region. These soils were collectively termed the Sangamon Soil, which is represented in this location by the rusty brown zone in the top of the Radnor Till.

The overlying Wisconsinan Tiskilwa and Malden Till Members are not as hard and not as resistant to stream erosion as the older Illinoian tills. Just south of the spillway is an abandoned borrow pit that dug into these softer materials, which were then used to cover some of the spent exchange salt observed at Stop 7A. Ponding of water in this pit finally created a problem when a low place in the divide between the pit and the spillway was overtopped by the rising water level. Rapid downcutting followed and produced the notch seen on the north side of the pit. The pit had been dug to the level of the harder Illinoian tills, which limited the depth of downcutting here. A deeper pit could have caused serious problems with the spillway sides.

---

8 STOP 8. Funk Gem and Mineral Museum, Cook Hall, Illinois State University.

Lafayette Funk, a well-known private collector, donated a large part of his personal gem and mineral collection to Illinois State University in 1968. This donation served as the nucleus of the collection of the museum, which opened in April of 1969.

To aid in its research and teaching capabilities, the University has continued to develop comprehensive mineral suites from historic Midwest mineral localities. The Illinois and Missouri collections are now quite extensive, although not complete. Collections from other Midwestern states are being developed.

Visiting hours of the Funk Gem and Mineral Museum:

Tuesday, Thursday, and Sunday
1:00-5:00 p.m.
when the University is in session.

Group tours of 10 or more persons may be arranged by reservation for any weekday between 9:00 a.m. and 5:00 p.m. Contact:

Reservations Secretary
The University Museums
Illinois State University
Normal, Illinois 61761
(309) 829-6331

Cut Bank, Southwest Side of Lake Bloomington Spillway

SW ¼, NE ¼, Sec. 1, T. 25 N., R. 2 E.,

McLean County

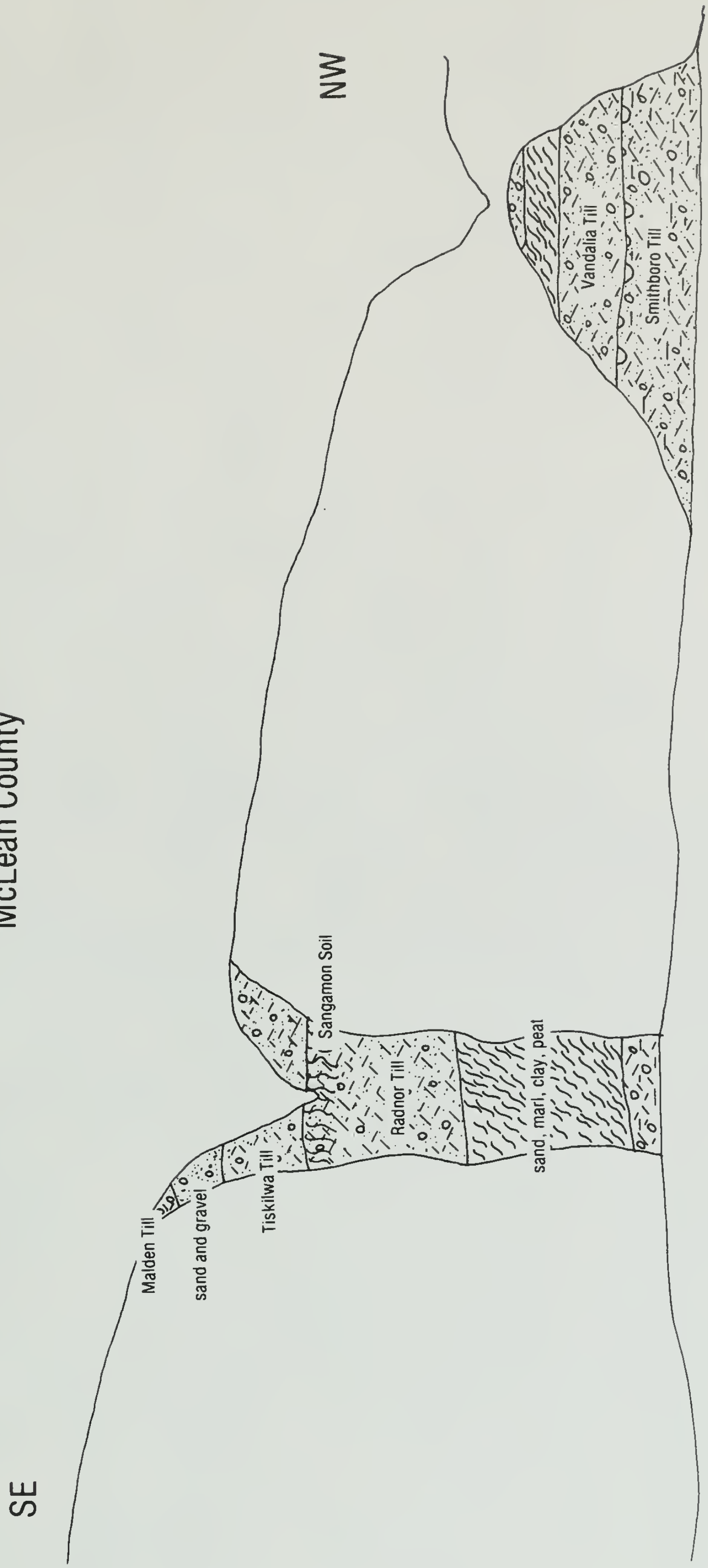


Figure 9. Stop 7.

PLEISTOCENE GLACIATIONS IN ILLINOIS

Origin of the Glaciers

During the past million years or so, the period of time called the Pleistocene Epoch, most of the northern hemisphere above the 50th parallel has been repeatedly covered by glacial ice. Ice sheets formed in sub-arctic regions four different times and spread outward until they covered the northern parts of Europe and North America. In North America the four glaciations, in order of occurrence from the oldest to the youngest, are called the Nebraskan, Kansan, Illinoian, and Wisconsinan Stages of the Pleistocene Epoch. The limits and times of the ice movement in Illinois are illustrated in the following pages by several figures.

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

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

Effects of Glaciation

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

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

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

Glacial Deposits

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

Till is deposited when a glacier melts and the rock material it carries is dropped. Because this sediment is not moved much by water, a till is unsorted, containing particles of different sizes and compositions. It is also unstratified (unlayered). A till may contain materials ranging in size from microscopic clay particles to large boulders. Most tills in Illinois are pebbly clays with only a few boulders.

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

Sorted and stratified sediment deposited by water melting from the glacier is called outwash. Outwash is bedded, or layered, because the flow of water that deposited it varied in gradient, volume, velocity, and direction. As a meltwater stream washes the rock materials along, it sorts them by size--the fine sands, silts, and clays are carried farther downstream than the coarser gravels and cobbles. Typical Pleistocene outwash in Illinois is in multilayered beds of clays, silts, sands, and gravels that look much like modern stream deposits.

Outwash deposits are found not only in the area covered by the ice field but sometimes far beyond it. Meltwater streams ran off the top of the glacier, in crevices in the ice, and under the ice. In some places, the cobble-gravel-sand filling of the bed of a stream that flowed in the ice is preserved as a sinuous ridge called an esker. Cone-shaped mounds of coarse outwash, called kames, were formed where meltwater plunged through crevasses in the ice or into ponds along the edge of the glacier.

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

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

Loess and Soils

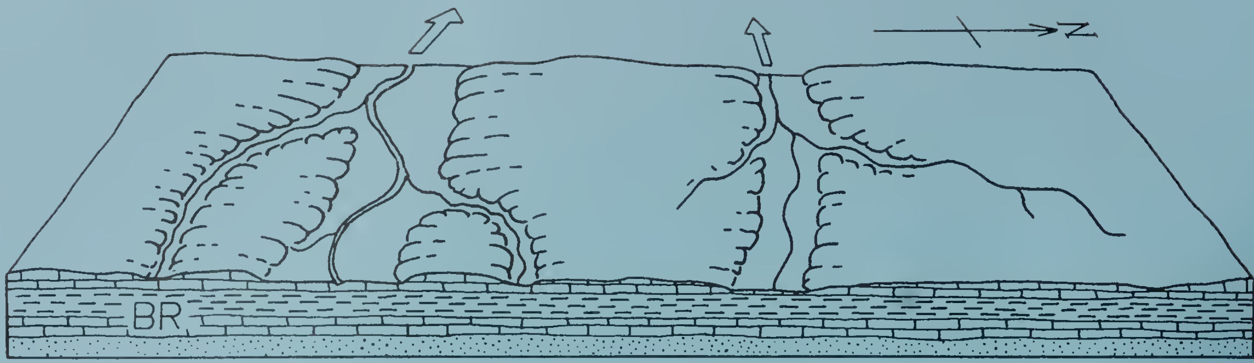
One of the most widespread sediments resulting from glaciation was carried not by ice or water but by wind. Loess is the name given to such deposits of windblown silt and clay. The silt was blown from the valley trains on the floodplains. Most loess deposition occurred in the fall and winter seasons when low temperatures caused meltwater floods to abate, exposing the surfaces of the valley trains and permitting them to dry out. During Pleistocene time, as now, west winds prevailed, and the loess deposits are thickest on the east sides of the source valleys. The loess thins rapidly away from the valleys but extends over almost all the state.

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

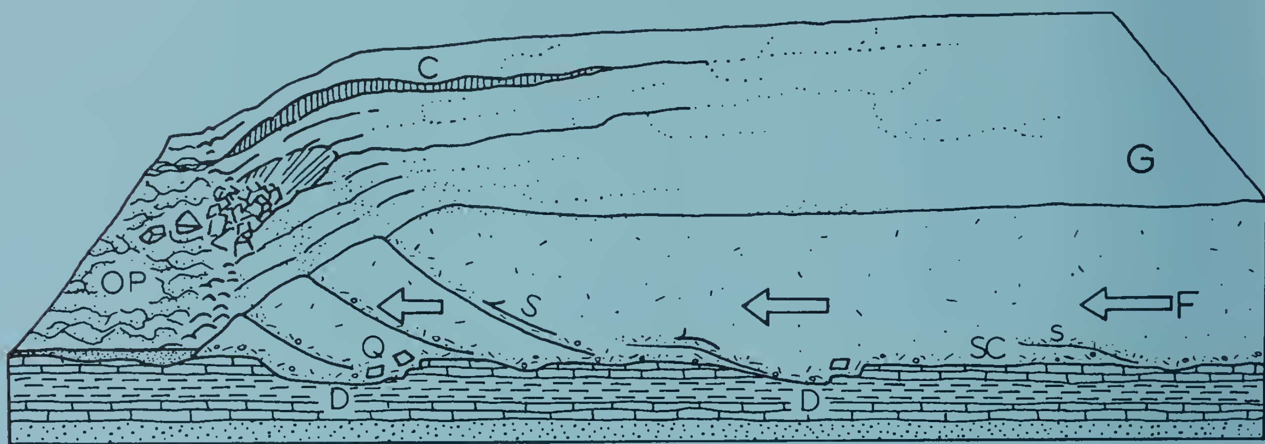
Glaciation in a Small Illinois Region

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

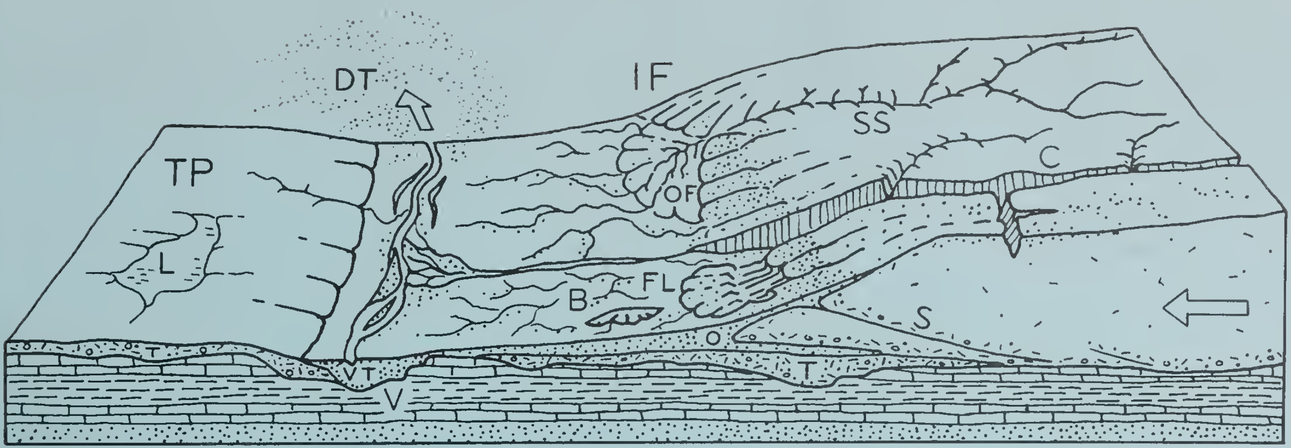
The block of land in the diagrams is several miles wide and about 10 miles long. The vertical scale is exaggerated--layers of material are drawn thicker and landforms higher than they ought to be so that they can be easily seen.



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



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



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

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

Sediment from the melted ice of the previous advance (figure 2) was left as a till layer (T), part of which forms the till plain (TP). A shallow, marshy lake (L) fills a low place in the plain. Although largely filled with drift, the valley (V) remained a low spot in the terrain. As soon as its ice cover melted, meltwater drained down the valley, cutting it deeper. Later, outwash partly refilled the valley--the outwash deposit is called a valley train (VT). Wind blows dust (DT) off the dry floodplain. The dust will form a loess deposit when it settles.

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

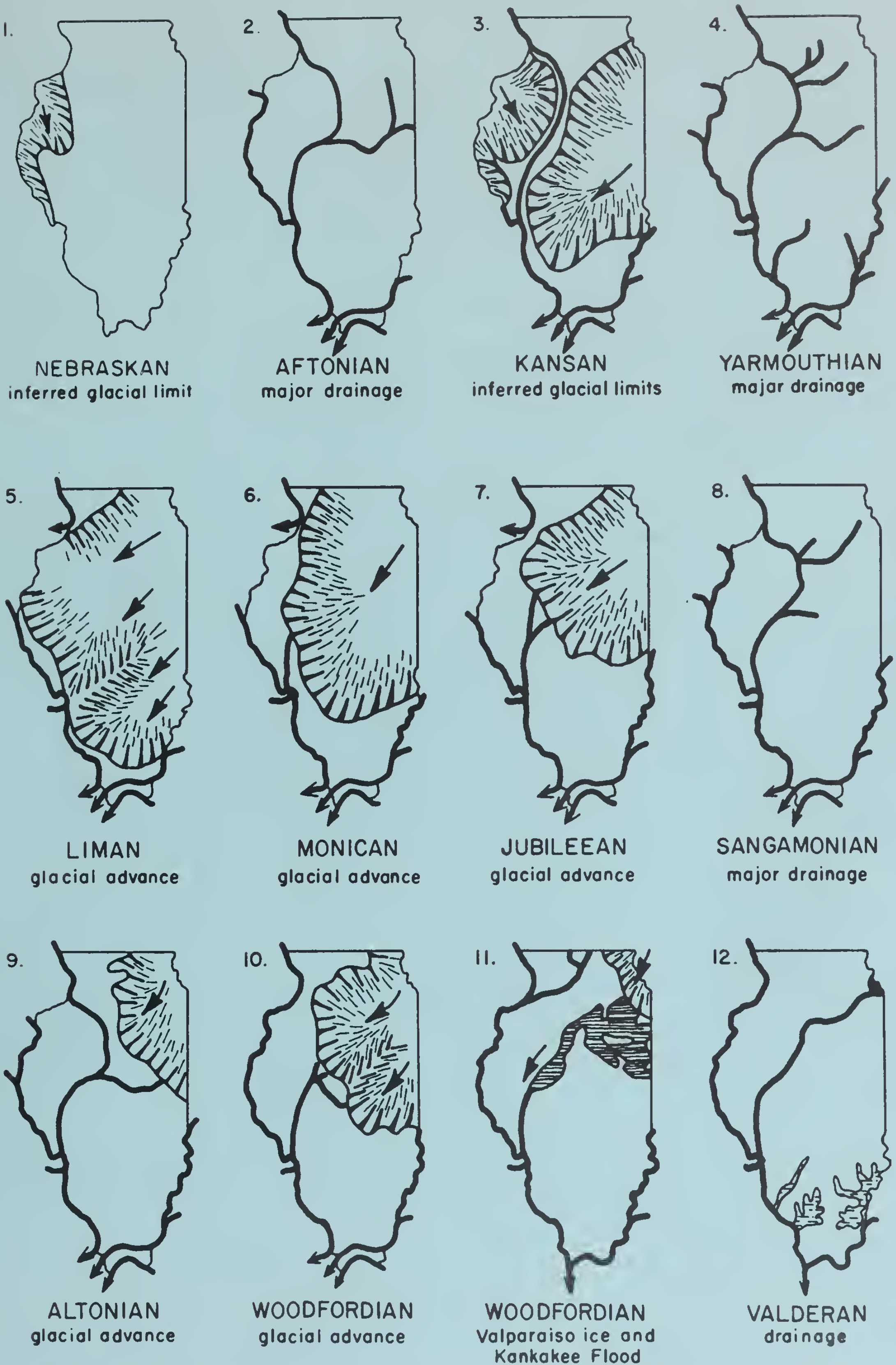
Slopewash and vegetation are filling the shallow lake. The collapse of outwash into the cavity left by the ice block's melting has made a kettle (K). The outwash that filled a tunnel draining under the glacier is preserved in an esker (E). The hill of outwash left where meltwater dumped sand and gravel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

TIME TABLE OF PLEISTOCENE GLACIATION

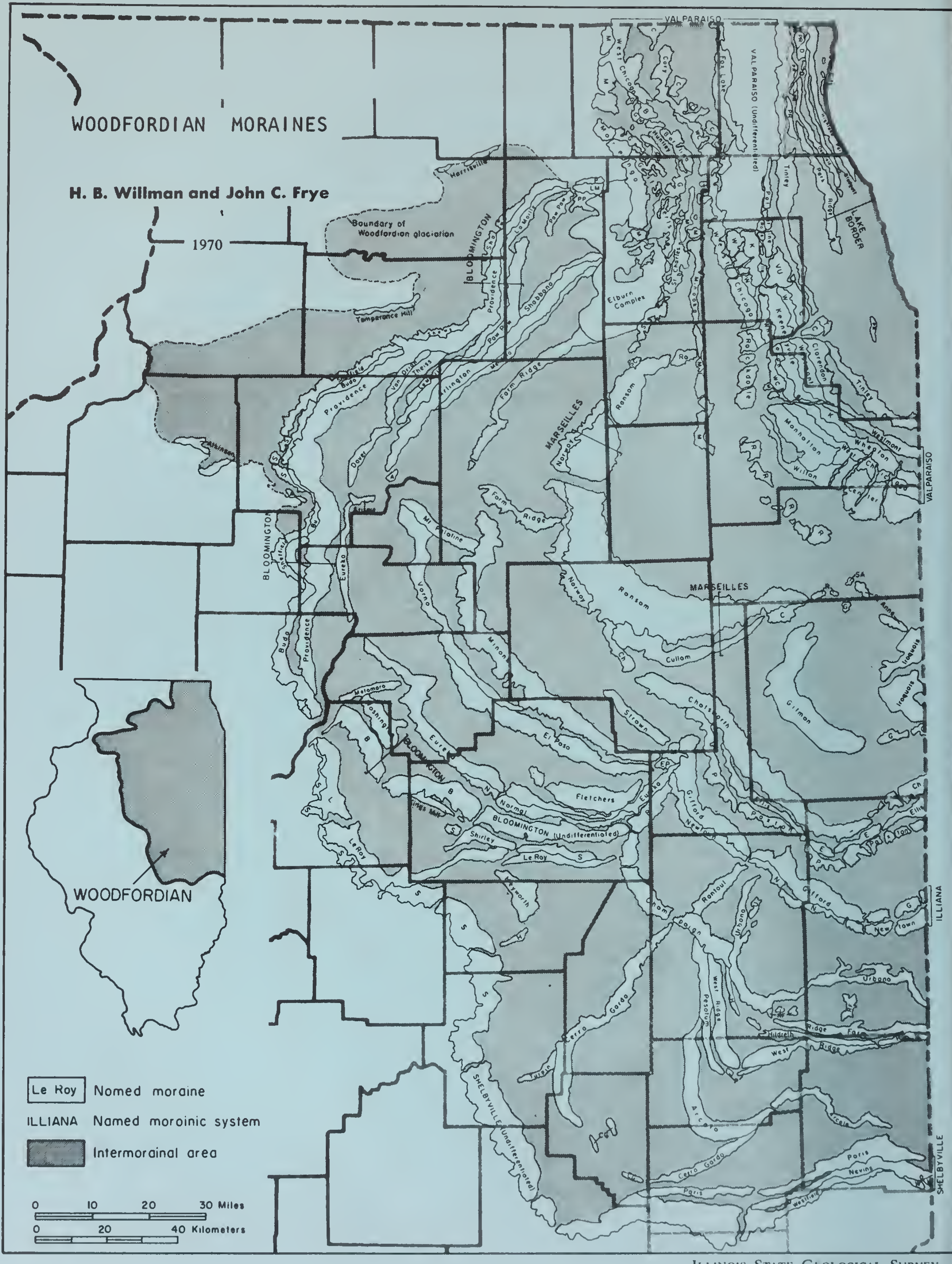
STAGE	SUBSTAGE	NATURE OF DEPOSITS	SPECIAL FEATURES
HOLOCENE	Years Before Present	Soil, youthful profile of weathering, lake and river deposits, dunes, peat	
	7,000		
	Valderan	Outwash, lake deposits	Outwash along Mississippi Valley
	11,000		
	Twocreekan	Peat and alluvium	Ice withdrawal, erosion
	12,500		
WISCONSINAN (4th glacial)	Woodfordian	Drift, loess, dunes, lake deposits	Glaciation; building of many moraines as far south as Shelbyville; extensive valley trains, outwash plains, and lakes
	22,000		
	Farmdalian	Soil, silt, and peat	Ice withdrawal, weathering, and erosion
	28,000		
	Altonian	Drift, loess	Glaciation in northern Illinois, valley trains along major rivers
	75,000		
SANGAMONIAN (3rd interglacial)		Soil, mature profile of weathering	
	175,000		
ILLINOIAN (3rd glacial)	Jubileean	Drift, loess	Glaciers from northeast at maximum reached Mississippi River and nearly to southern tip of Illinois
	Monican	Drift, loess	
	Liman	Drift, loess	
	300,000		
YARMOUTHIAN (2nd interglacial)		Soil, mature profile of weathering	
	600,000		
KANSAN (2nd glacial)		Drift, loess	Glaciers from northeast and northwest covered much of state
	700,000		
AFTONIAN (1st interglacial)		Soil, mature profile of weathering	
	900,000		
NEBRASKAN (1st glacial)		Drift	Glaciers from northwest invaded western Illinois
	1,200,000 or more		

(Illinois State Geological Survey, 1973)

SEQUENCE OF GLACIATIONS AND INTERGLACIAL
DRAINAGE IN ILLINOIS



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


WOODFORDIAN MORAINES
H. B. Willman and John C. Frye
1970
Boundary of Woodfordian glaciation
WOODFORDIAN
Le Roy Named moraine
ILLIANA Named morainic system
Intermorainal area
0 10 20 30 Miles
0 20 40 Kilometers
VALPARAISO
VALPARAISO (Undifferentiated)
LAKE BORDER
BLOOMINGTON
MARSEILLES
ILLIANA
SHELBYVILLE
SHELBYVILLE (Undifferentiated)
BLOOMINGTON (Undifferentiated)
Elburn Complex
Temperance Hill
Providence
Shabbona
Farm Ridge
Ransom
Cullom
Chatsworth
Gilman
Iroquois
Strawn
El Paso
Fletchers
Normal
Shirley
Le Roy
Champaign
Rantoul
Urbana
Gifford
Newtown
West Ridge
Pesotum
Cerro Gordo
Arcola
Paris
Nevins
Westfield
Tuscola
Minonk
Varna
Eureka
Metamora
Washington
Mt Palatine
Norway
Manhattan
Wilton
Tinley
Valparaiso
Chicago
Rockdale
Minooka
Clarendon
Wheaton
Westmont
Budo
Dover
Arlington
Paw Paw
Marengo
Harrisville
Atkinson
Sheffield
Hildreth
Ridge Farm

ILLINOIS STATE GEOLOGICAL SURVEY

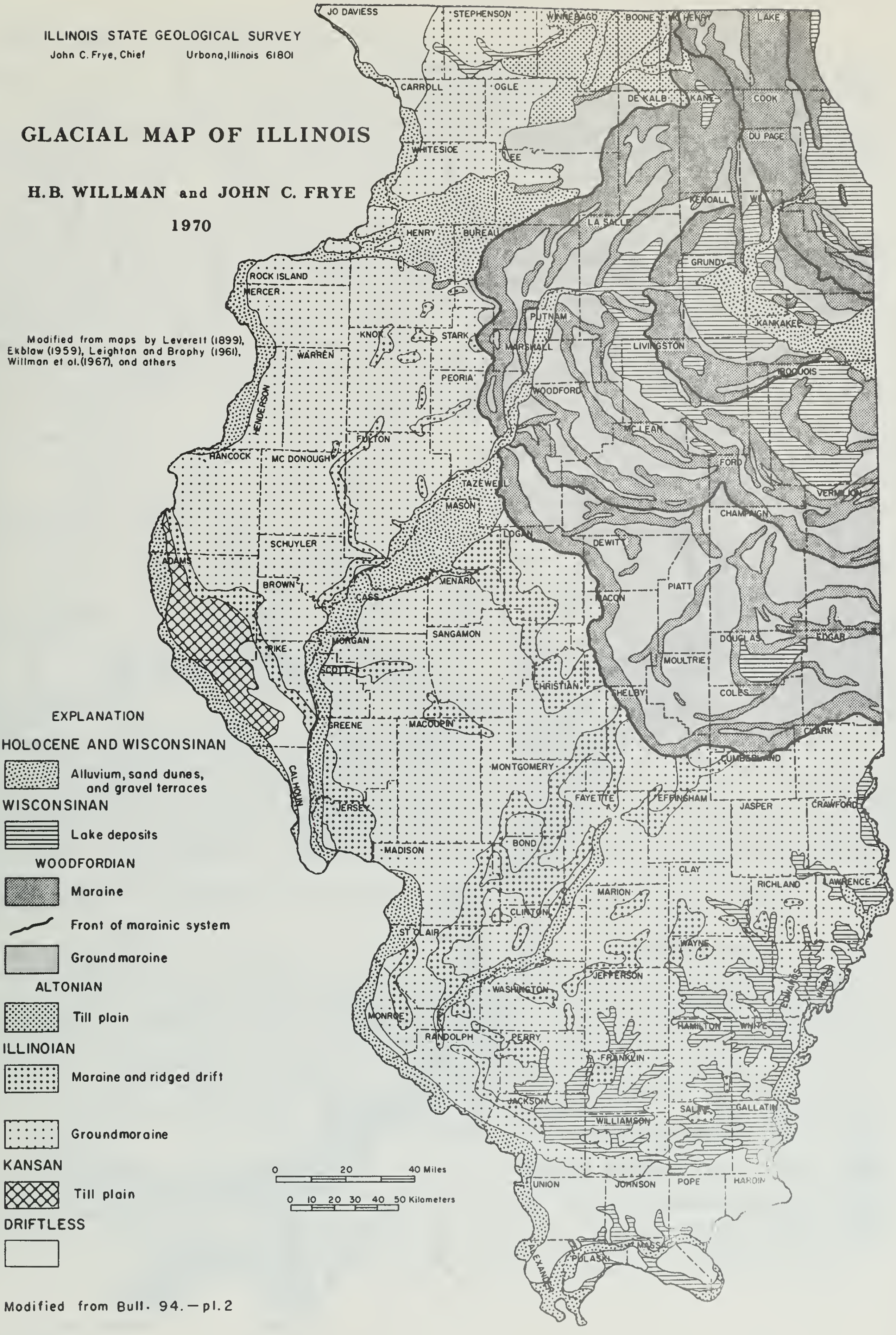
John C. Frye, Chief   Urbana, Illinois 61801

GLACIAL MAP OF ILLINOIS

H.B. WILLMAN and JOHN C. FRYE

1970

Modified from maps by Leverett (1899), Ekblaw (1959), Leighton and Brophy (1961), Willman et al. (1967), and others



EXPLANATION

HOLOCENE AND WISCONSINAN

Alluvium, sand dunes, and gravel terraces

WISCONSINAN

Lake deposits

WOODFORDIAN

Moraine

Front of morainic system

Groundmoraine

ALTONIAN

Till plain

ILLINOIAN

Moraine and ridged drift

Groundmoraine

KANSAN

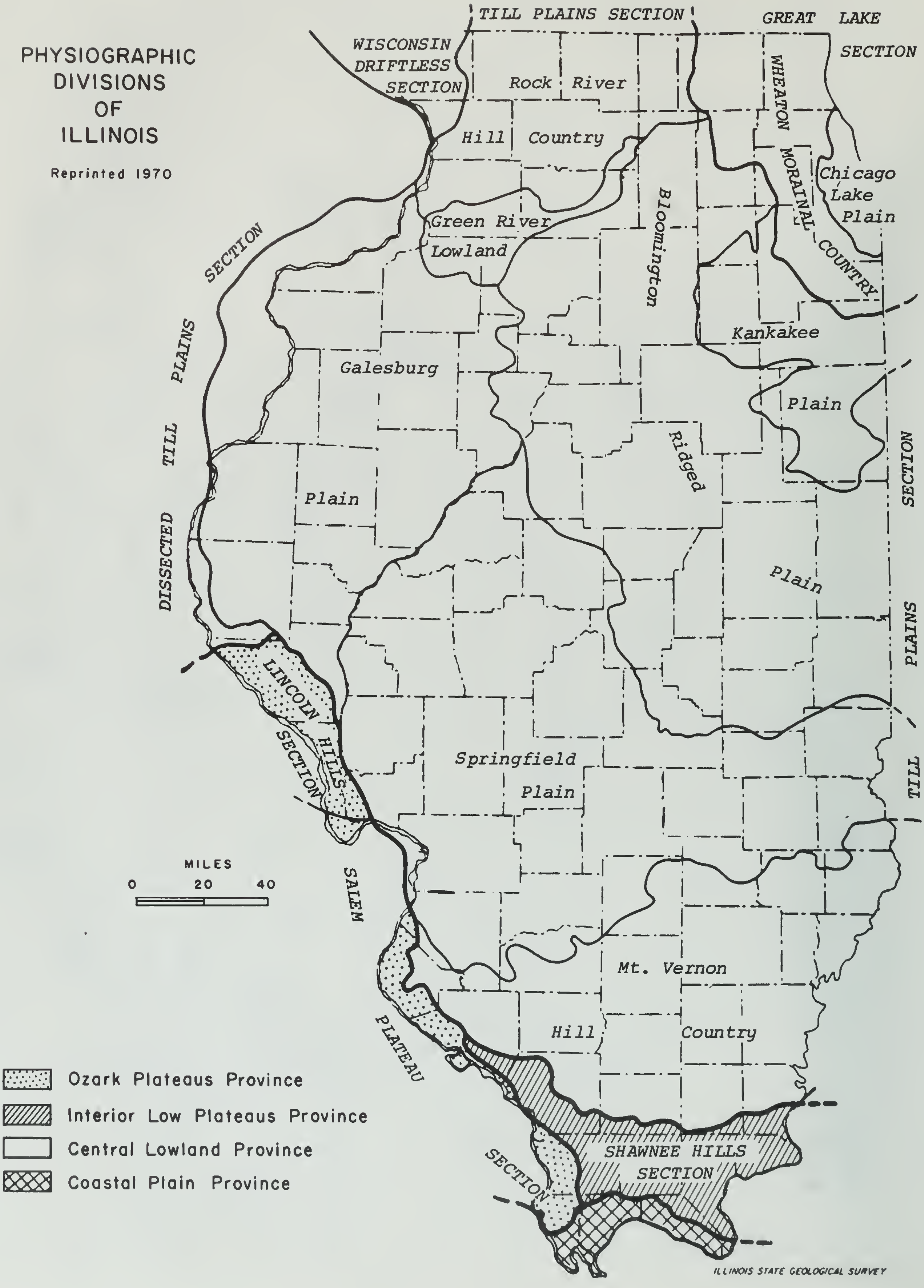
Till plain

DRIFTLESS

Modified from Bull. 94.—pl. 2

PHYSIOGRAPHIC DIVISIONS OF ILLINOIS

Reprinted 1970



THE OCCURRENCE OF GROUND WATER

(The following quotation is from Circular 248: <u>Groundwater Geology in East-Central Illinois</u>... (1958) by Lidia F. Selkregg and John P. Kempton, pp. 3-9. Two figures are omitted.)

Because groundwater occurs beneath the earth, hidden from view, it is often regarded as somewhat mysterious, and throughout human history many fanciful explanations have been presented to describe its source, movement, and occurrence. Scientific study has shown, however, that groundwater obeys physical laws or principles that are relatively simple and easily understood, although they may be complex in detail. Figure 2 shows diagrammatically the basic fundamentals of our present understanding of the source, movement, and occurrence of groundwater.

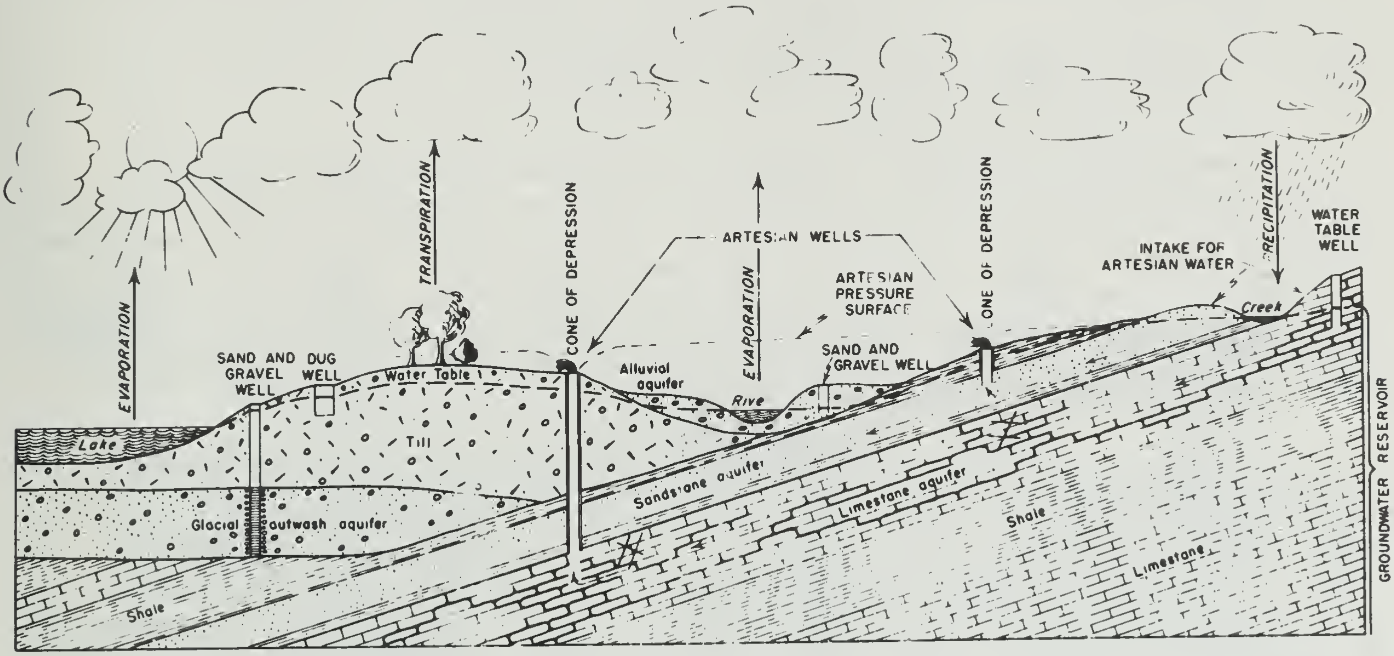


Fig. 2. - Source, movement, and occurrence of groundwater.

The source of groundwater is seepage into the earth of some of the moisture that falls as rain, snow, and ice. The tremendous quantity of water that falls on the land surface by precipitation is seldom fully realized; one inch of rainfall distributed over one square mile amounts to nearly 18 million gallons. However, only a small part of the precipitation actually enters the groundwater reservoir. Most of it falls into lakes and oceans, runs off in streams, or is returned to the atmosphere by evaporation and transpiration. The remainder filters slowly into the ground to a level below which all available openings are filled with water.

The top of this zone of saturation is called the water table. Under water-table conditions, a well drilled or dug remains dry until it penetrates the zone of saturation; the position of the water table is then shown by the level at which water stands in the well. The water table is not level but conforms more or less to the features of the land surface. Where the water table intersects the land surface, groundwater is discharged in the form of springs which feed perennial streams, lakes, and swamps. The water table rises or falls in response to the gain or loss of groundwater in the reservoir, so the water level in a well that penetrates the saturated zone (a "water-table" well) rises or falls with the water table. During extended dry periods shallow wells go dry when the water table drops below the bottom of the well.

Groundwater moves, under the influence of gravity or in response to other pressure differentials, toward points of lower pressure, such as springs or discharging wells. The movement is slow because of friction between water and the walls of the small pores or other openings in the rocks. Under such conditions groundwater moves slowly by gravity flow in the direction of the slope of the water table.

Groundwater is said to be confined or under artesian conditions where a saturated aquifer is overlain by a less permeable material that restricts the upward movement of the water. Under such conditions the water in the confined layer has a hydrostatic pressure that causes the water in a well to rise above the top of the aquifer. Where pressures sufficient to cause the water to rise above the land surface are encountered in an artesian well, the well will flow.

To supply a pumped or flowing well, groundwater must move through the aquifer toward the well. Under water-table conditions, pumping lowers the water table in the vicinity of the well and gravity induces groundwater to flow toward the well from adjacent areas. Under artesian conditions, pumping reduces the hydrostatic pressure in the vicinity of the well, and induces the flow of groundwater toward the well. The depression in the water table, or in the artesian pressure surface resulting from discharge, is in the form of an inverted cone with the well at the center and is called the cone of depression (fig. 2).

Water is to be found everywhere below the top of the zone of saturation, but successful wells can be constructed only where strata that will transmit water easily are present. The capacity of earth materials to accept, store, and yield water depends on the type, size, number, and degree of interconnections that can store and conduct groundwater. Sand and gravel aquifers store considerable water and transmit it readily. Other earth materials, such as clay and shale, may contain as much or more water per cubic foot as sand and gravel, but they hold water in pores so small that it cannot be transmitted in usable quantities to wells.

Sand and gravel deposits are water-yielding because the openings between the grains are large enough to allow relatively free movement of water. The most permeable water-yielding sand or gravel deposits are composed of grains that are nearly all the same size and coarser than granulated sugar. If large amounts of silt and clay are present in the spaces between the larger particles of sand and gravel they retard the flow of water. Sand and gravel deposits in the area of this report are from a few inches to about 200 feet thick. Deposits a few feet or more thick are generally suitable aquifers for drilled wells. Thinner deposits of sand and gravel may be suitable only for large-diameter dug or augered wells.

Sandstone formations also transmit groundwater through the openings between sand grains. The water-yielding capacity of sandstone depends upon the degree of cementation, size, and sorting of the sand grains. Any material in the openings between the sand grains reduces the water-transmitting capacity of the sandstone. Some sandstones are so thoroughly cemented that any water present moves through joints and fractures rather than between grains.

Relatively few wells have been completed in sandstone in the area of this report. Locally, however, the St. Peter sandstone of Ordovician age and thin fine-grained Pennsylvanian sandstones are groundwater sources (figs. ... 5, ...).

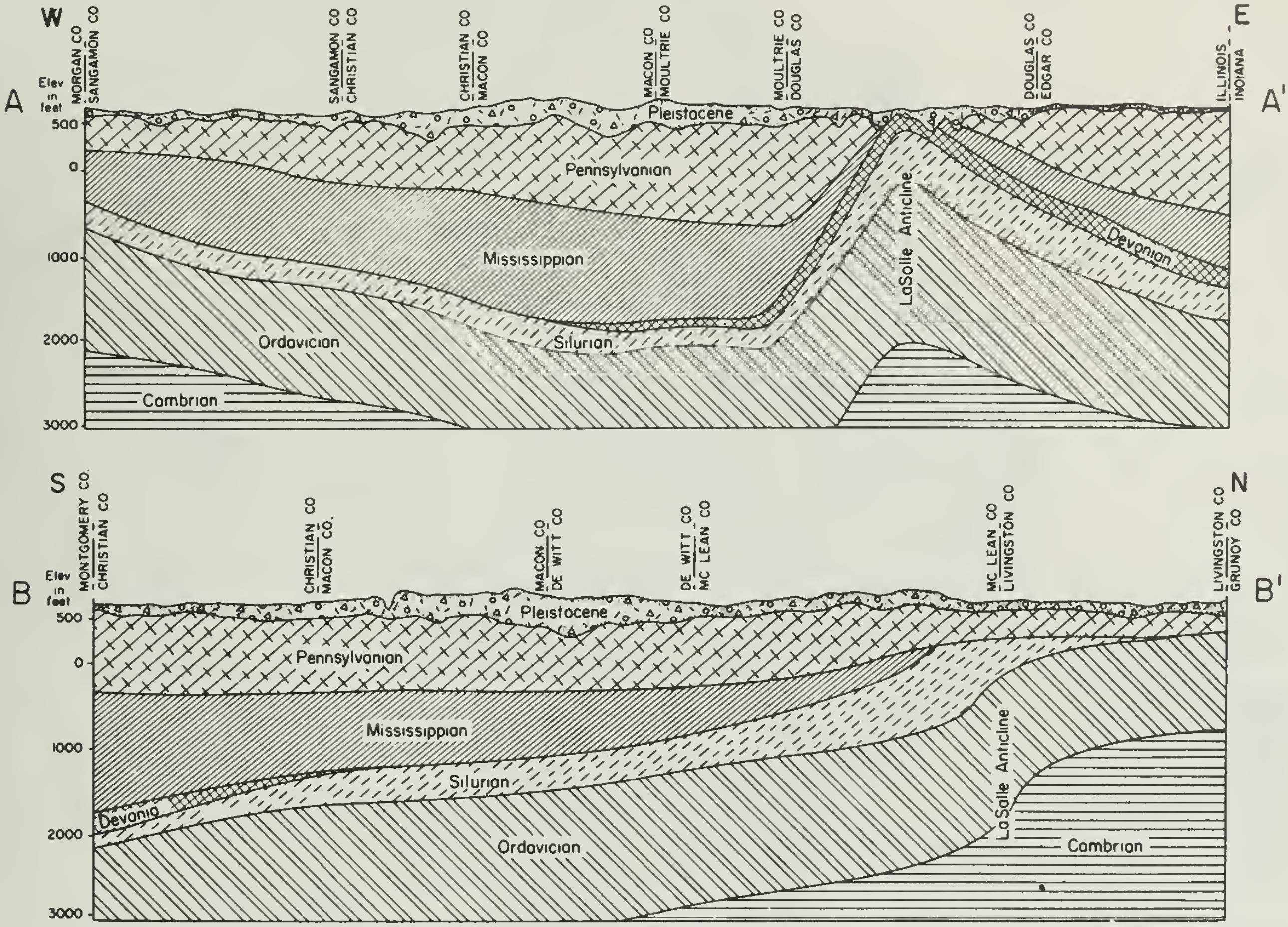
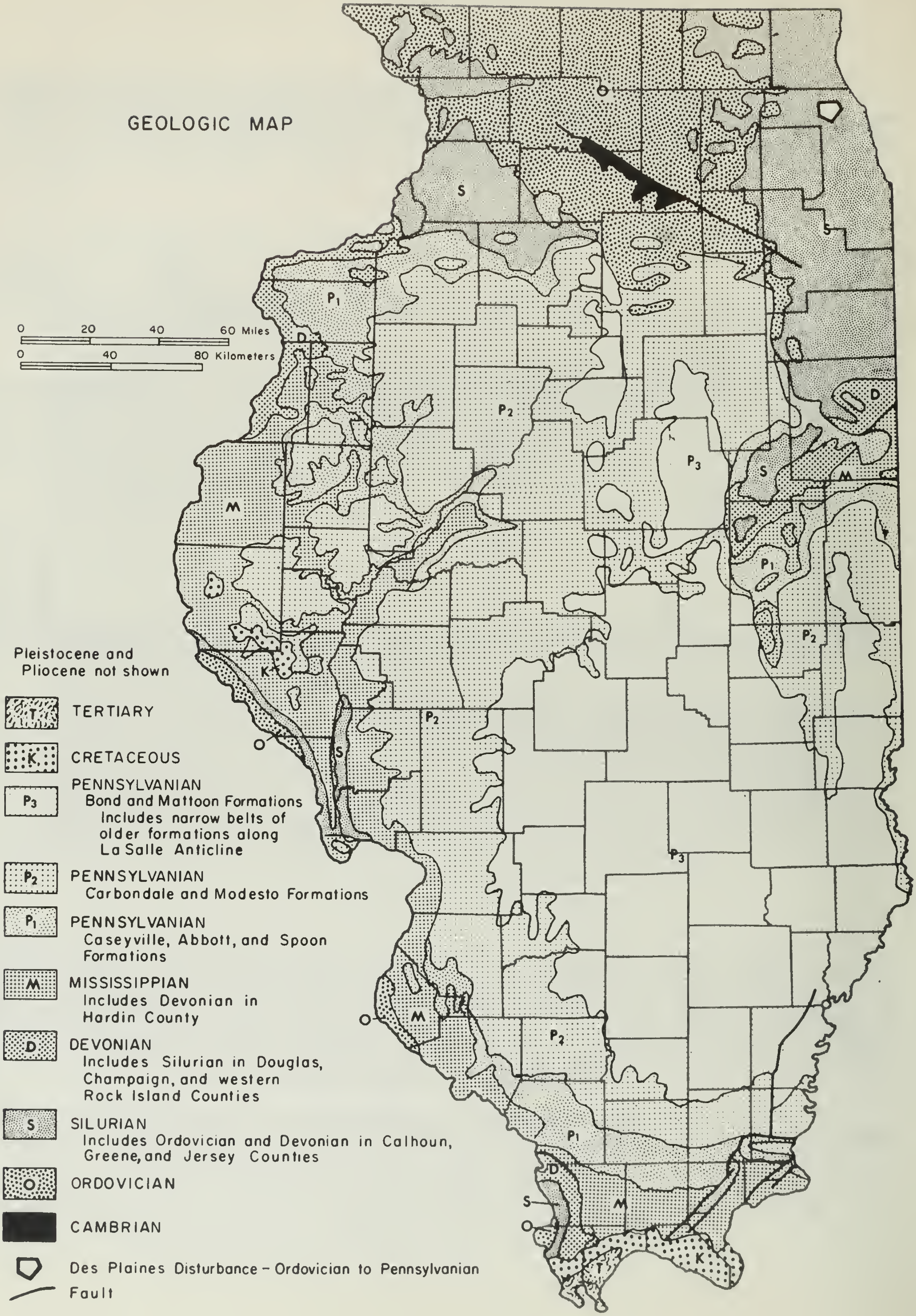
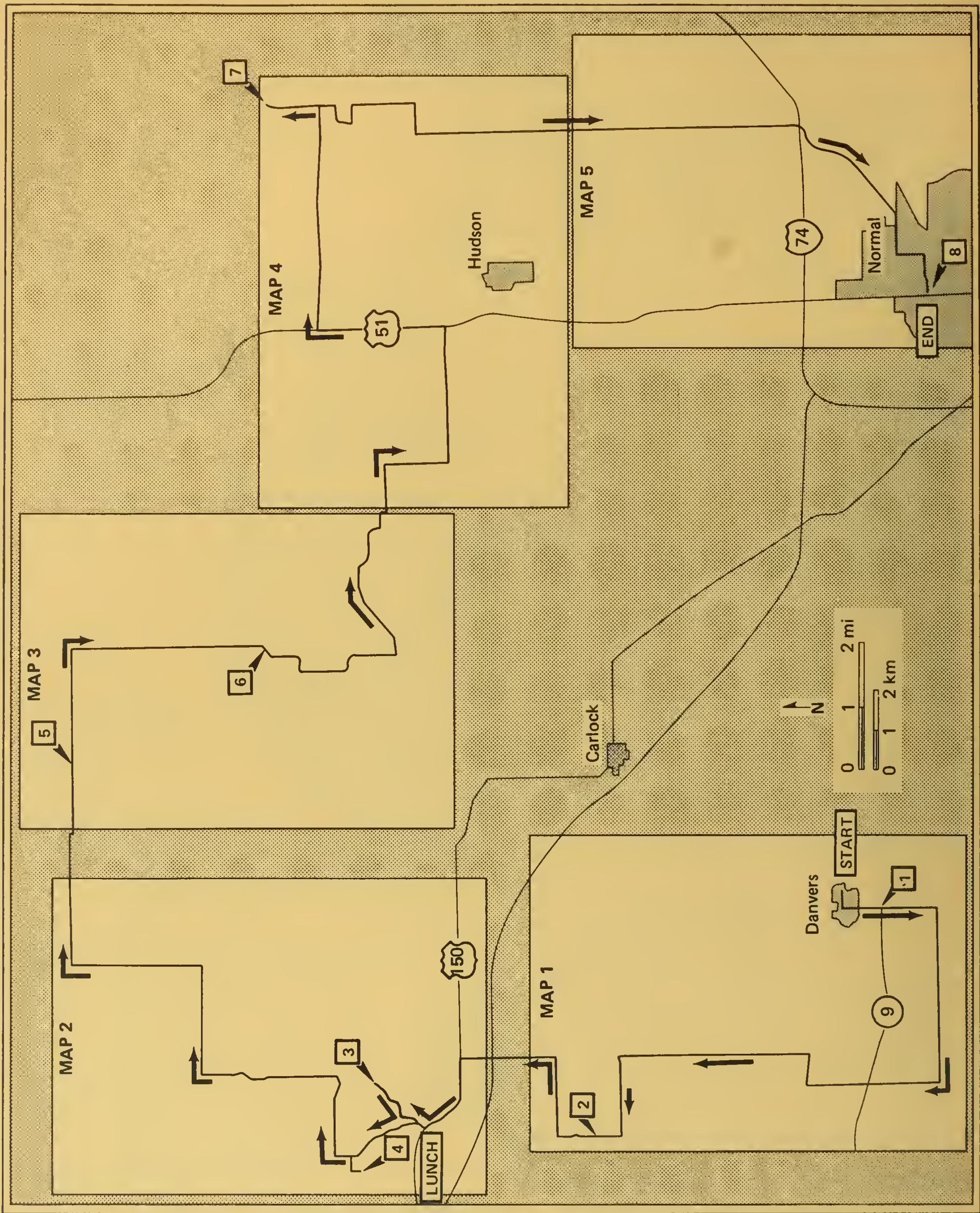


Fig. 5. - Cross sections of formations from west to east and from south to north in east-central Illinois

Limestone and dolomite rocks are generally tight and compact, and groundwater moves only through cracks and solution channels. Wells drilled into these rocks are successful if the well penetrates water-bearing crevices. The presence and extent of these openings at any specific location are not readily predictable. The Niagaran-Alexandrian dolomite (Silurian) is a source of groundwater in the northern part of the area where the dolomite is encountered at a shallow depth.

Silurian and Devonian dolomite and limestone are the source of groundwater along the LaSalle anticlinal belt, where present below the drift (figs. ... 5, ...).


GEOLOGIC MAP
0 20 40 60 Miles
0 40 80 Kilometers
Pleistocene and Pliocene not shown
TERTIARY
CRETACEOUS
PENNSYLVANIAN
Bond and Mattoon Formations
Includes narrow belts of older formations along La Salle Anticline
PENNSYLVANIAN
Carbondale and Modesto Formations
PENNSYLVANIAN
Caseyville, Abbott, and Spoon Formations
MISSISSIPPIAN
Includes Devonian in Hardin County
DEVONIAN
Includes Silurian in Douglas, Champaign, and western Rock Island Counties
SILURIAN
Includes Ordovician and Devonian in Calhoun, Greene, and Jersey Counties
ORDOVICIAN
CAMBRIAN
Des Plaines Disturbance – Ordovician to Pennsylvanian
Fault



Printed by authority of the State of Illinois/1982/300