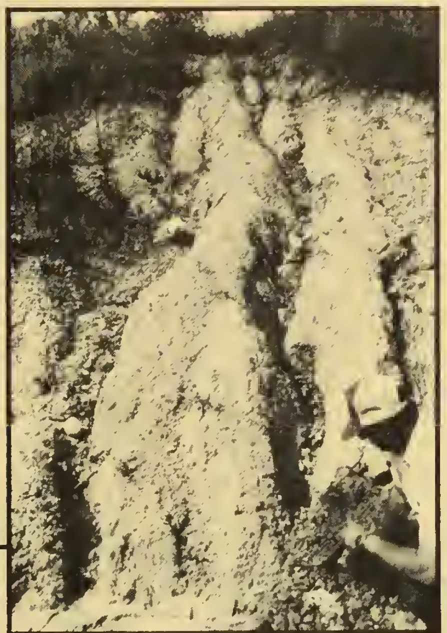

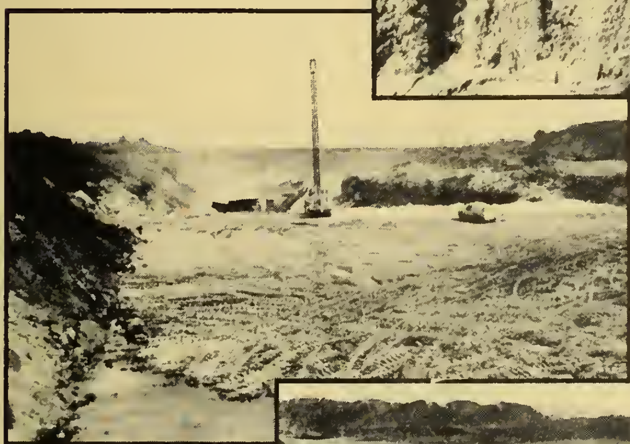

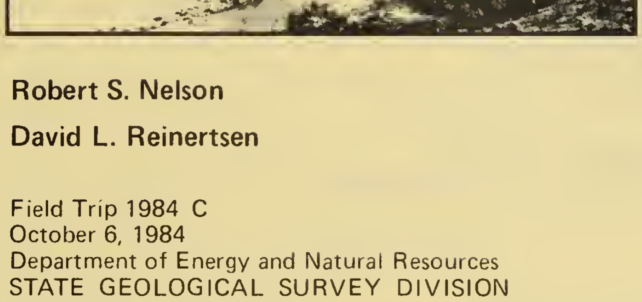

A Guide to the Geology of the Pontiac-Streator Area

Robert S. Nelson

David L. Reinertsen

Field Trip 1984 C
October 6, 1984
Department of Energy and Natural Resources
STATE GEOLOGICAL SURVEY DIVISION
Champaign, Illinois 61820

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the geologic framework

The Pontiac-Streator area lies south of the Illinois River in north-central Illinois in an elongate basin situated between morainal ridges that are part of the Bloomington Ridged Plain (see The Physiographic Divisions of Illinois, appendix). The field trip highlights some features of the glacial deposits that surround and cover the area as well as bedrock features that occur just beneath the land surface.

Thick, slow-moving continental glaciers covered the Pontiac-Streator area repeatedly during the "Great Ice Age" (Pleistocene Epoch) that lasted more than one million years and ended only about 10,000 years ago in Illinois. Glacial ice and the meltwater from it left various deposits that cover the much older bedrock surface. Glacial drift in this area ranges in thickness from just a few feet along the crest of the La Salle Anticlinal Belt to more than 200 feet along the higher parts of moraines that lie just a few miles beyond the field trip area. Although early glaciers (Kansan and Illinoian) (see Pleistocene Glaciations in Illinois, appendix) doubtless covered the area, glacial deposits visible at the surface in Livingston and La Salle Counties are between about 22,000 and perhaps 13,000 years old and were deposited by glaciers of the Wisconsinan Stage.

Glacial lakes occupied a fairly large part of the field trip area during the latter part of this time (about 12,000 years ago) and are responsible for the general flatness here. In the northwestern part of the area, meltwater ponded to form Lake Ancona between the Minonk Moraine and the eastward melting Wisconsinan ice front. The elevation of this lake was 650 feet, mean sea-level (msl). Apparently, little meltwater ponding occurred during the advance and melting back of the Wisconsinan glacier that formed the Chatsworth Moraine to the east. However, as noted on previous field trips in northeastern Illinois, large lakes did form across the region as a vast ice mass covering the Lake Michigan Basin and parts of Indiana, Michigan, and northeastern Illinois began to melt rapidly. A tremendous quantity of meltwater ponded between the ice front and encircling morainal ridges. When lake levels rose enough, water poured out across low sags in the morainal ridges to form the Chicago Outlet, the Sag Channel, and the Kankakee River. This outpouring of meltwater, termed the Kankakee Flood, formed the large Lake Wauponsee in the Morris area. Water that poured out from this lake through the outlet across the Marseilles Morainic System backed up into the Vermilion River Basin beyond Pontiac to form Lake Pontiac between the Minonk, Farm Ridge, Chatsworth, Norway, and Ransom Moraines, at about 650 feet msl. Rich prairie soils have formed in the lake sediments here in contrast to the coarse rock debris scattered across the plain of Lake Wauponsee.

Era	System	Series	Group or Stage	Formation	Material
CENOZOIC	Quatern-ary	Pleistocene			Wisconsinan till, gravel, sand, and lake clays and silts
PALEOZOIC	Pennsyl-vanian		McLeansboro	Bond Modesto	Sandstone, shale, clay, limestone, Colchester (No. 2), Herrin (No. 6), and Danville (No. 7) Coals
			Kewanee	Carbondale Spoon	
	Silurian	Niagaran		Port Byron Racine Waukesha Joliet	Dolomite and/or some limestone
		Alexandrian		Kankakee Edgewood	Dolomite and sandstone
	Ordovician	Cincinnatian	Maquoketa		Shale and some dolomite or limestone
		Champlainian	Galena-		Dolomite and/or limestone, light brown
			Platteville		Dolomite and/or limestone with streaks of shale Dolomite and/or limestone
			Ancell	Glenwood St. Peter Sandstone	Sandstone, shale, and dolomite Sandstone, sometimes conglomeratic at base
		Canadian	Prairie du Chien	Shakopee Dolomite	Dolomite and some thin sandstone beds
				New Richmond Sandstone	Sandstone and some dolomite
				Oneota Dolomite	Dolomite, usually cherty
	Cambrian	St. Croixan	Trampealeauan		Dolomite, sandstone, and shale Dolomite
			Franconian		Sandstone, dolomite, and shale; very glauconitic
			Dresbachian		Sandstone and some dolomite Sandstone, shale, and dolomite Sandstone, arkosic in lower part; some shale and conglomerate
Pre-Cambrian					Crystalline rocks

Figure 1. Generalized geologic column of Pontiac-Streator area.

In the Pontiac-Streator field trip area, glacial deposits consist of mixed clay, silt, sand, pebbles, and boulders laid down directly by the ice. This material is called till. Another common glacial deposit, transported and laid down by flowing meltwater, is outwash—sorted sand and gravel. Outwash is commonly found along glacial valleys as valley trains and in front of moraines where meltwater flowed away from the ice across outwash plains. In this area, a thin cover (less than two feet) of wind-blown silt, called loess (rhymes with bus) mantles the ground surface.

The bedrock that underlies the glacial deposits in the Pontiac-Streator area consists of 4,200 to 5,100 feet of sedimentary strata (figs. 1 and 2). These strata are mostly shale, limestone, dolomite, and sandstone deposited as loose sediments, layer upon layer, in shallow seas that covered the Midcontinent Region during the Paleozoic Era between 570 and 225 million years ago. The Paleozoic is divided into major subdivisions of rocks known as systems, each of which was deposited during a specific period of geologic time. The systems are further subdivided into many formations.

Bedrock exposed along streams and in roadcuts and quarries in this area belongs to the Pennsylvanian System of rocks. Older formations of Silurian, Ordovician, and Cambrian age are present in the subsurface. The Cambrian strata rest on ancient Precambrian igneous and metamorphic rocks that are more than one billion years old. In northern Illinois there is no record in the rocks of the time between the formation of the youngest bedrock (Pennsylvanian age—more than 270 million years ago here) and the beginning of continental glaciation (Pleistocene age—more than one million years ago). The region was apparently above sea level and erosion prevailed over deposition.

The Pennsylvanian rocks (sometimes called the Coal Measures) were formed in shallow seas and bordering deltaic swamps that repeatedly occupied much of Illinois (see Depositional History of the Pennsylvanian Rocks, appendix). Lush forest vegetation, which thrived in the warm, moist Pennsylvanian climate, covered the area and accumulated beneath the quiet waters of long-lived extensive swamps. Over a period of geologic time, these accumulations of plant debris were converted to coal in the Pennsylvanian rocks. In nearby areas plant fossils are commonly associated with the coal.

The Pontiac-Streator area along the Vermilion River lies diagonally across the La Salle Anticlinal Belt, the largest structure in the Illinois Basin (figs. 2 and 3). The La Salle Anticlinal Belt is 10 to 50 miles wide and can be traced from north-central Illinois about 200 miles south-southeastward into southwestern Indiana.

The Illinois Basin contains more than 14,000 feet of Paleozoic strata and encompasses most of Illinois and adjacent parts of Indiana and Kentucky. The basin is the product of vertical tectonics (deformation). Recent structural research indicates that vertical fractures have broken the Earth's crust in the Midcontinent Region into irregular polygons. Usually these fractures are restricted to the basement (Precambrian igneous and metamorphic rocks) but occasionally the faults may extend into the overlying Paleozoic strata.

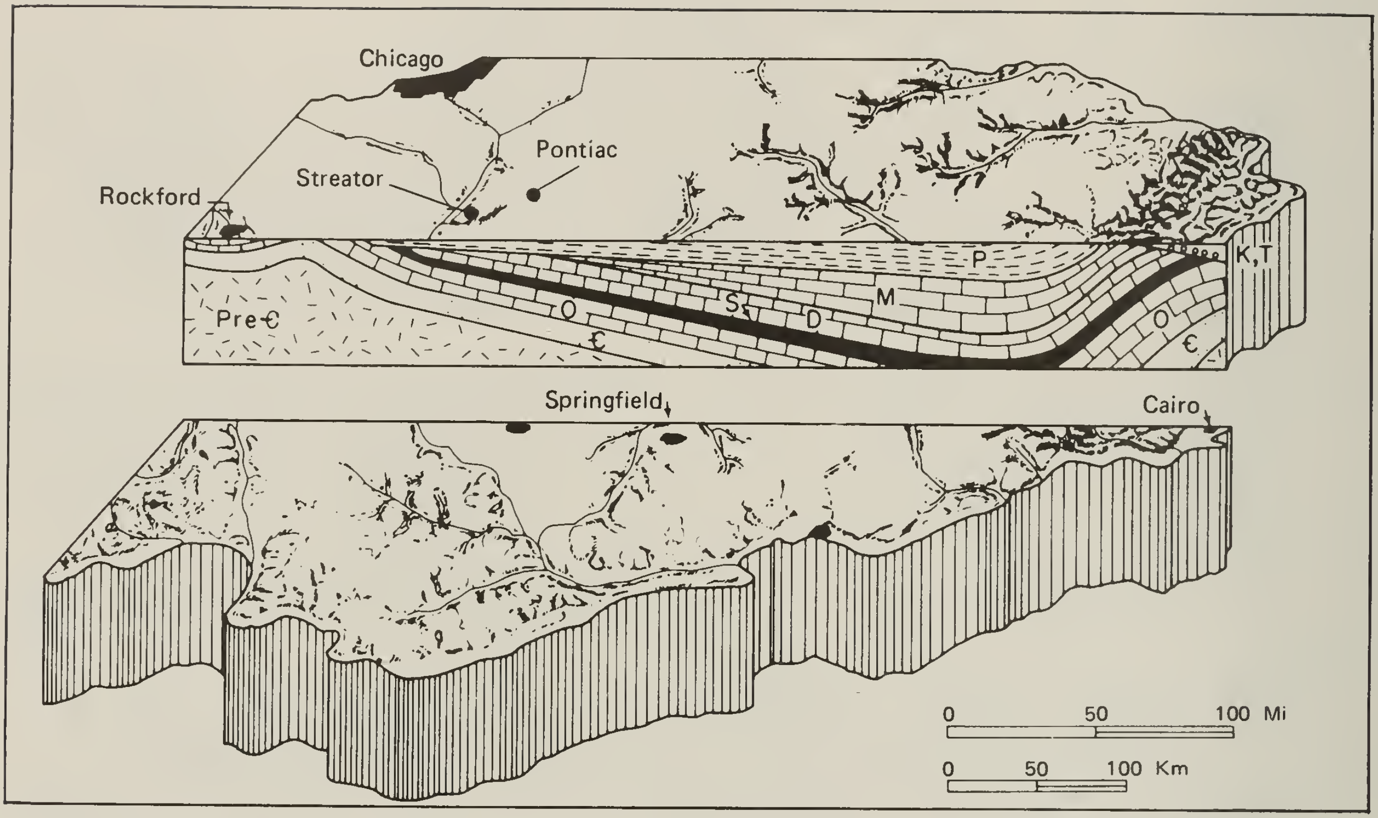


Figure 2. Stylized north-south cross section shows the structure of the Illinois Basin. In order to show detail, the thickness of the sedimentary rocks has been greatly exaggerated and the younger, unconsolidated surface deposits have been eliminated. The oldest rocks are Precambrian (Pre-C) granites. 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.

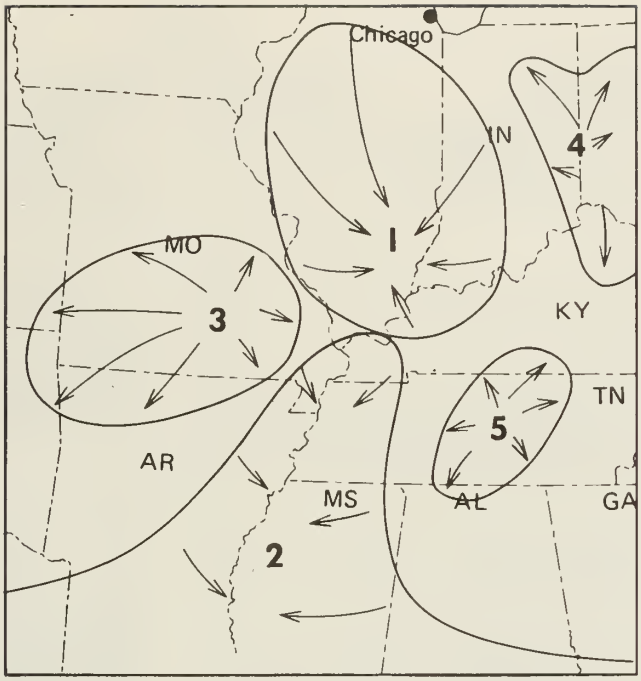
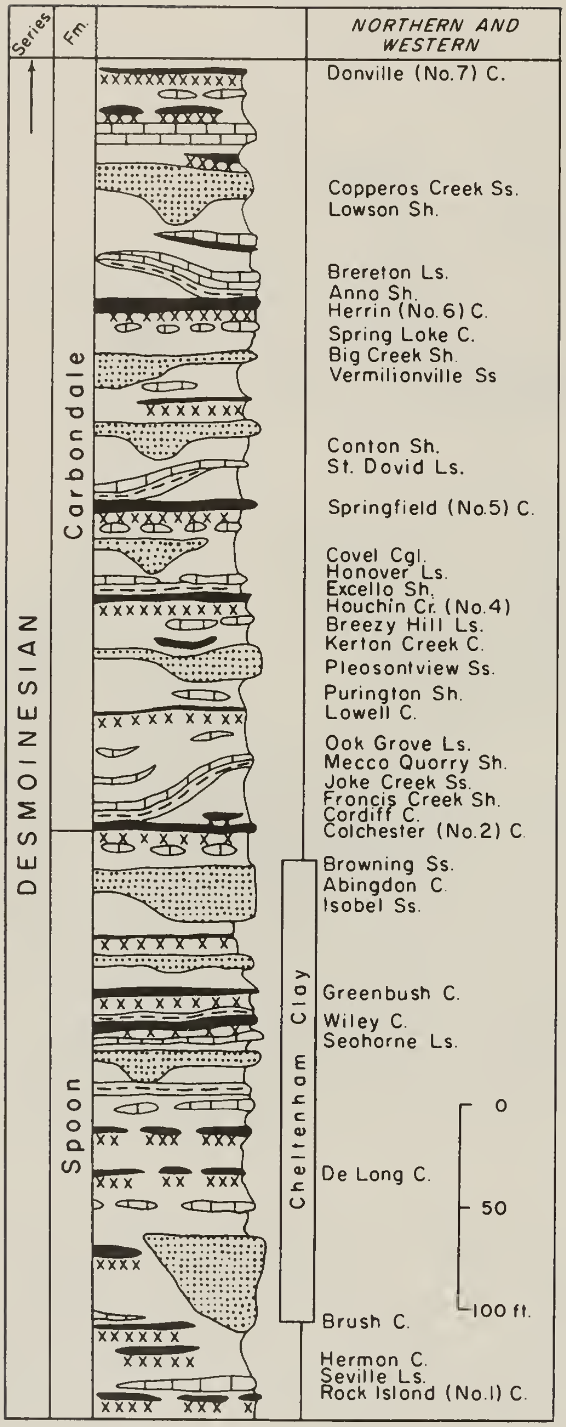


Figure 3. The location of the Illinois Basin and adjacent major structures: (1) Illinois Basin, (2) Mississippi Embayment, (3) Ozark Dome, (4) Cincinnati Arch, and (5) Nashville Dome.

Most large features of the Illinois Basin are the result of differential vertical movement of fault-bounded blocks. The La Salle Anticlinal Belt marks a hinge line separating blocks that uplifted differentially. The west block was stable; the east block was uplifted and tilted slightly eastward, forming the asymmetrical La Salle Anticlinal Belt along its western edge. From late Mississippian time (about 325 million years ago) through at least Pennsylvanian time, tilting of the east block continued sporadically. By Pennsylvanian time, enough relief was present along the northern part of the La Salle Anticlinal Belt to influence the transport of sediment and the lateral distribution of many stratigraphic intervals in adjacent areas. Thus, there are sediment-draped structures as well as primary bedrock structures.

Mineral resources of the field trip area—sand and gravel, stone, and clay—contributed nearly $10,000,000 to the economy of the area in 1982. Coal of Pennsylvanian age was also mined in this area. The most widespread and persistent is the Colchester Coal Member of the Carbondale Formation (fig. 4), which was mined on a small scale north of Streator in the longwall district. It is about two feet thick across the crest of the La Salle Anticlinal Belt, but thickens to 3.5 to 4 feet to the east and to 4 feet or more to the west. The Herrin Coal Member (Carbondale Formation) is generally thin east of the La Salle Anticlinal Belt except near Streator where it is 4 to 5 feet or more in thickness and was extensively mined underground. The Danville Coal Member (Carbondale Formation) is either absent or too thin to mine in the field trip area.

Kewanee Group



McLeansboro Group

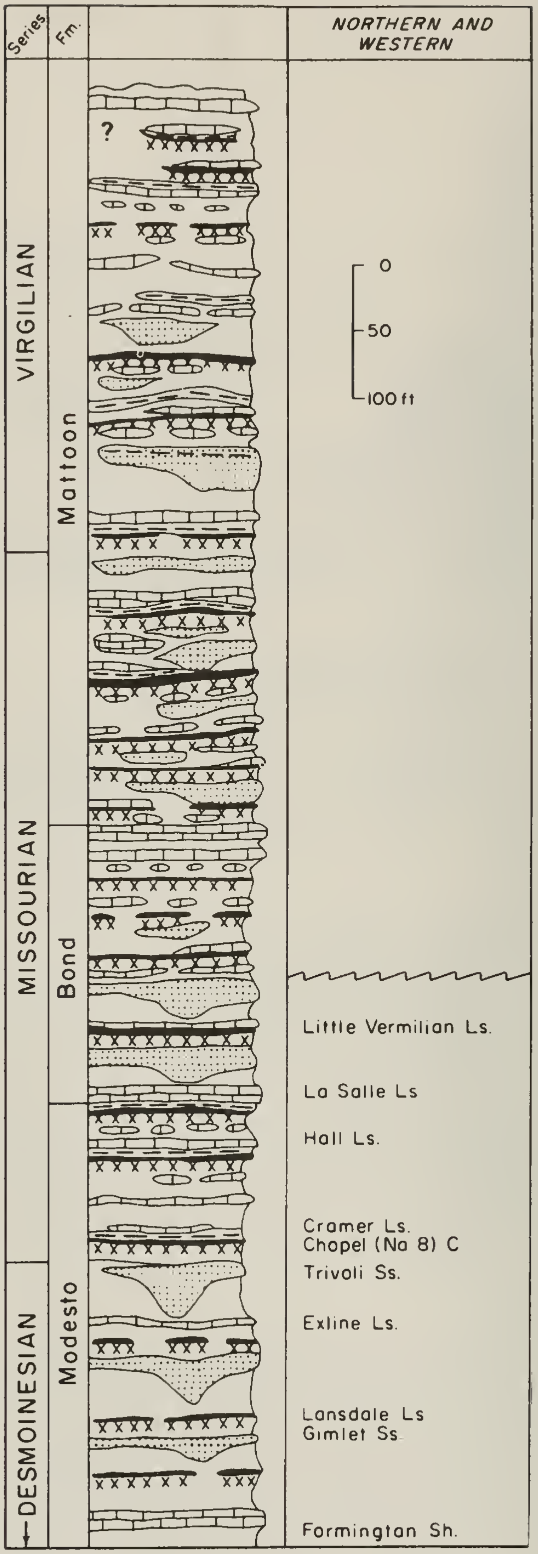


Figure 4. Generalized geologic column of Kewanee and McLeansboro Group strata for northern and western Illinois. (Not all units are present in the field trip area.)

guide to the route

Miles to next point	Miles from starting point	
0.0	0.0	Line up on Elm Street at the west side of Pontiac Township High School, heading north just south of the T-intersection with Indiana Avenue.
0.0	0.0	STOP (3-way); T-intersection. TURN LEFT (west) from Elm Street onto Indiana Avenue.
0.5+	0.5+	STOP (1-way); T-intersection. TURN LEFT (south) on North Main Street.
0.5-	1.0+	CAUTION: stoplight. TURN RIGHT (west) on Howard Street [State Route (SR) 116].
0.05	1.05+	CAUTION: stoplight. CONTINUE AHEAD STRAIGHT (west).
0.3	1.35+	CAUTION: guarded railroad crossing (two-tracks). Main Line, ICG and Amtrack. CONTINUE AHEAD (west).
0.15-	1.5-	STOP (4-way). CONTINUE AHEAD (west).
0.3+	1.8	STOP (2-way); crossroads. TURN LEFT (south) on the west side of the divided highway (old U.S. Route 66).
0.15	1.95	Cross Vermilion River. Limestone is exposed in the Vermilion River bed adjacent to the bridge.
0.35+	2.3+	CAUTION: stoplight. Leave SR 116 and CONTINUE AHEAD (south) on Old Route 66.
0.65	2.95+	The route is across the relatively flat floor of glacial Lake Pontiac.
1.05-	4.0	Illinois State Police Headquarters District 6 on the right.
1.35	5.35	Livingston Manor Nursing Home on the right. The low rise here offers a good view of the old lake plain. To the left (southeast) notice some of the nearby quarries. CONTINUE AHEAD (south).

Miles to next point	Miles from starting point	
1.4	6.75	Cross Rooks Creek
0.7	7.45	To the left is the hamlet of Ocoya.
0.9	8.35	To the right is the abandoned Wagner's Stone Quarry. CONTINUE AHEAD (south).
0.25	8.6	To the left is the Ocoya Quarry.
0.2	8.8	CAUTION: move to the inside lane and prepare to turn left. ·Just before the turn on the right in the abandoned Wagner Quarry, the glacial till is only 3 feet thick.
0.2	9.0	CAUTION: TURN LEFT (east) across the northbound two lanes.
0.05-	9.05-	USE EXTREME CAUTION in crossing the Illinois Central Gulf railroad track (fast trains).
0.05+	9.1	To the left is a Valley View Industries quarry. Across the road to the right (south) is a reclaimed portion of an abandoned quarry that has been turned into some beautiful home sites.
0.4-	9.5-	CAUTION: narrow bridge.
0.1	9.6-	To the left, present-day quarrying operations have stockpiled topsoil and glacial material east of the access road to be used later in reclaiming the area.
0.25+	9.85+	USE EXTREME CAUTION: unguarded crossroad (1300E-1100N). CONTINUE AHEAD (east).
0.05+	9.9+	Cross Rooks Creek.
0.4	10.3	Note that the lake plain is flat for a distance of nearly two miles.
0.55+	10.85+	CAUTION: unguarded crossroad (1100N-1400E). CONTINUE AHEAD (east).
1.0	11.85+	STOP (2-way); crossroads. TURN LEFT (north) from 1100N to 1500E.
0.5	12.35+	STOP 1a. Operating pit of Weston Quarry, Vulcan Materials Company to the right. Do NOT climb down the face—it is slippery and dangerous.

Miles to next point	Miles from starting point	
0.0	12.35+	Leave Stop 1a. CONTINUE AHEAD (north).
0.5	12.85+	STOP (2-way); crossroads. TURN RIGHT (east) on 1200N.
0.5	13.35+	TURN RIGHT (south) at the <u>west</u> entrance gate to the Weston Quarry Plant area. You MUST have permission to enter this property.
0.0	13.35+	STOP 1b. Study La Salle Limestone Member and see some of the stone preparation area.
0.0	13.35+	Leave Stop 1b. Retrace route to the <u>west</u> entrance gate and resume mileage count from there. STOP (1-way); west entrance gate. TURN LEFT (west) on 1200N.
2.35+	15.7+	Cross Rooks Creek.
0.45+	16.2	CAUTION: guarded ICG railroad crossing. CONTINUE AHEAD (west).
0.05-	16.25-	STOP (2-way); crossroads—old U.S. 66 (1260E). CONTINUE AHEAD (west).
0.7	16.9+	STOP 2. Discussion of Lake Pontiac from the center of the 1200N/I-55 overpass.
0.0	16.9+	Leave Stop 2. CONTINUE AHEAD (west) and prepare to turn right.
0.15	17.05+	TURN RIGHT (northerly).
0.35+	17.4+	Material from the borrow on the right was used to construct the overpass at Stop 2. CONTINUE AHEAD (north).
1.7+	19.1+	STOP (2-way); crossroads (1400N-1200E). CONTINUE AHEAD (north).
1.0+	20.15-	CAUTION: unguarded crossroads (1500N). CONTINUE AHEAD (north).
1.0	21.15-	STOP (1-way); T-intersection. TURN LEFT (west) on 1600N.
0.05-	21.15+	TURN RIGHT (north) on 1200E.
0.25+	21.45-	Cross Rooks Creek.

Miles to next point	Miles from starting point	
0.8-	22.2+	STOP (2-way); crossroads (1700N = SR 116). USE CAUTION in crossing SR 116. CONTINUE AHEAD (north) on 1200E.
1.75	23.95	CAUTION: T-road from right. TURN RIGHT (east) on 1875N.
1.1	25.05	CAUTION: one-lane bridge ahead.
0.1+	25.15+	CAUTION: narrow bridge across Vermilion River. Bedrock is exposed north of the bridge, low in the bank.
0.05+	25.25	BEAR RIGHT (southeast) around the curve toward the overpass.
0.25+	25.5+	I-55 overpass.
0.6-	26.1	Livingston County Fairgrounds to the left; Vermilion River just to the right. CONTINUE AHEAD (southeast).
0.35	26.45+	CAUTION: enter Pontiac.
0.8+	27.3-	STOP (1-way); T-road intersection (1800N-1500E). CAUTION: TURN LEFT (north) on SR 23.
1.1	28.4-	Prepare to turn right.
0.15+	28.55	TURN RIGHT (east) into pit of Vulcan Materials Company. STOP 3. La Salle Limestone Member and Quaternary deposits. You MUST have permission to enter this property.
0.0	28.55	Leave Stop 3. Return to entrance gate and resume mileage. STOP (2-way); crossroads. CAUTION: TURN RIGHT (north) on SR 23.
0.45	29.0	CAUTION: entering I-55 interchange area.
0.35	29.35	Cross I-55 overpass. The low hills to the right in the distance are part of the Chatsworth Moraine, which formed part of the eastern shore of glacial Lake Pontiac.
0.7-	30.05-	Cross Wolfe Creek and prepare to turn left.

Miles to next point	Miles from starting point	
0.25+	30.3	CAUTION: TURN LEFT (west) at crossroad (2100N). Till is exposed in the ditch alongside the road just after the turn to the west.
0.2	30.5	Note the petroleum tank farm to the right. CAUTION: the road is quite bumpy here.
0.25+	30.75+	Landfill entrance to the left. From what we have seen so far today, this would appear to be an unlikely site for a sanitary landfill. Thin glacial till and thin lake sediments over a highly jointed limestone are not ideal requisites for a landfill site. However, Pleistocene surficial materials in this locality are about 40 feet thick and the till, being relatively tight and impervious, provides a good seal to contain the waste materials to the site.
0.8	31.55+	Abandoned railroad right-of-way. Enter hamlet of Rowe. CONTINUE AHEAD (west).
1.7-	33.25	Cross Wolfe Creek. CONTINUE AHEAD (west).
0.35	33.6	Entrance to small quarry on left. CONTINUE AHEAD (west).
0.5+	34.1+	CAUTION: entrance to Humiston Woods Nature Center to right. TURN RIGHT (north). STOP 4. Lunch, followed by discussion of Vermilion River and glacial deposits at the overlook platform.
0.0	34.1+	Leave Stop 4. Retrace route to entrance and resume mileage. STOP (1-way); T-intersection. TURN RIGHT (west) on 2100N.
0.1	34.2+	Cross Vermilion River.
0.05	34.25+	Till exposure to left. CONTINUE AHEAD (west).
0.7	34.95+	Pennington grass landing strip to left. CONTINUE AHEAD (west).
0.15	35.1+	CAUTION: narrow bridge across Rooks Creek. Just beyond the bridge to the west is an excellent example of terrace level development along the creek. To the right a slip-off slope on the inside of a stream meander shows well, as does the steep cut-bank on the outside of the meander curve.

Miles to next point	Miles from starting point	
0.2	35.3+	STOP 5. Discussion of abandoned channel of Rooks Creek.
0.0	35.3+	Leave Stop 5. CONTINUE AHEAD (west).
0.25+	35.55+	CAUTION: T-road from right. TURN RIGHT (north) on 975E.
1.5	37.05+	STOP (1-way); T-intersection (2250N). TURN RIGHT (east) and cross Rooks Creek. To the southeast in the distance, just below the barn, is another abandoned meander of Rooks Creek. The tree line on the lower level is along that abandoned meander.
0.05+	37.15-	To the left (north) is a small, more recent, abandoned meander loop of Rooks Creek on the east side of the valley. It appears to be more shallow than the one to the southeast. Just to the east of this on the north side of the road is a higher abandoned meander that shows up on the terrace level. CAUTION: end of pavement just ahead.
0.1+	37.25	To the right are several ponds and marshy areas in the abandoned meander of Rooks Creek.
0.05	37.3	T-road from left. CONTINUE AHEAD (east) and then BEAR LEFT (northerly).
0.3	37.6	Cross Vermilion River, which serves as the base level for Rooks Creek. That is, Rooks Creek will erode its channel no lower than the Vermilion River at their confluence (slightly more than 0.5 mile northwest of this point. The Vermilion is straighter here and does not have discernible terrace levels.
0.45-	38.05-	Crossroads (2300N-1040E). About 0.2 mile to the left is a low, poor exposure of the Pennsylvanian Lonsdale Limestone Member that is barely above water level.
0.15+	38.2+	Cross Baker Run. The Lonsdale Limestone is exposed upstream to the right of the bridge, especially along the northeast bank. Here the glacial till is thin again above the Lonsdale Limestone.
0.75	38.95	Cross Ida Creek.

Miles to next point	Miles from starting point	
0.85	39.8	CAUTION: enter village of Cornell.
0.25+	40.05+	STOP (2-way); crossroads (2500N). TURN LEFT (west) on SR 23.
1.85	41.9+	Cross Vermilion River; bedrock exposed in the west bank.
0.9	42.8+	Cross Short Point Creek.
0.1	42.9+	Abandoned shale pits occur along the left side of the highway.
0.25+	43.2-	CAUTION: TURN RIGHT (easterly) into Valley View Industries office area. Do NOT block traffic lanes. You MUST have permission to enter this property. STOP 6. Open pit mine in the Farmington Shale Member, Modesto Formation.
0.0	43.2-	Leave Stop 6. Retrace route to SR 23 and resume mileage. STOP (1-way). CAUTION: TURN RIGHT (northwesterly and then west) on SR 23.
1.45+	44.65	Cross Mole Creek.
2.1	46.75	Rubbly Lonsdale Limestone with overlying sand and gravel is exposed in the bed of Long Point Creek west of the T-road. Lacustrine deposits overlain by gray, pebbly till also occur above the limestone. The till contains pieces of black shale and coal. Some of the relationships are not very clear because of the construction work that has taken place here. This shallow stream has been channelized here in an attempt to straighten its course and cause fewer problems with the highway.
0.05+	46.8+	Cross Long Point Creek.
0.6-	47.4	Note that we have returned to the level, uneroded lake plain here.
1.85+	49.25+	Cross Prairie Creek.
1.05-	50.3	STOP (4-way); crossroads (SR 17). CONTINUE AHEAD (north) on SR 23.
1.8	52.1	Prepare to turn left.

Miles to next point	Miles from starting point	
0.1	52.2	USE EXTREME CAUTION: TURN LEFT (westerly) on 3190N from 500E; BEWARE of fast traffic approaching from the railroad overpass just ahead.
0.25	52.45	STOP 7. Channel sandstone that occurs in the Farmington Shale is exposed in the ditch along the right side of the road on the curve.
0.0	52.45	Leave Stop 7. CONTINUE AHEAD (west).
0.05	52.5	Cross Moon Creek.
0.75	53.25	CAUTION: T-road from right. TURN RIGHT (north) on 400E.
0.4	53.65	Old clay pits on both sides of the road. The area to the left is being converted to a landfill.
0.65	54.3	BEAR LEFT (northwesterly) onto North 12th Road.
0.1	54.4	CAUTION: T-intersection from right. TURN RIGHT (north) on East 16th Road and enter La Salle County.
0.5	54.9	CAUTION: enter city of Streator.
0.15+	55.05+	STOP (4-way); crossroads next to Kimes School. CONTINUE AHEAD (north) on Columbus Street.
0.15-	55.2	STOP (4-way); Sundown Street. CONTINUE AHEAD (north).
0.05+	55.25+	CAUTION: T-intersection from right. TURN RIGHT (east) on Bridge Street.
0.25-	55.5	STOP (2-way); North Fourth Street. CONTINUE AHEAD (east).
0.15	55.65	BEAR LEFT and THEN RIGHT and descend hill.
0.05+	55.7+	STOP (2-way); North First Street and SR 18. CONTINUE AHEAD (east) and begin one-way traffic on SR 18.
0.2-	55.9	National Guard Armory to the right. CONTINUE AHEAD (east) and move to the left lane when safe.
0.05+	55.95+	Cross Vermilion River and ascend hill toward business district.

Miles to next point	Miles from starting point	
0.15+	56.1+	CAUTION: STOPLIGHT; Bloomington Street. CONTINUE AHEAD (east) and prepare to turn left.
0.05+	56.2	CAUTION: STOPLIGHT; TURN LEFT (north) on North Park Street (SR 23).
0.1	56.3	CAUTION: STOPLIGHT; Main Street. CONTINUE AHEAD (north).
0.05+	56.35+	CAUTION: STOPLIGHT; Hickory Street. CONTINUE AHEAD (north).
0.2	56.55+	CAUTION: abandoned rough rail crossing.
0.05-	56.6+	CAUTION: rough railroad crossing.
0.85+	57.5-	CAUTION: STOPLIGHT; school crossing.
0.1	57.6-	CAUTION: Conrail crossing.
0.3	57.9-	CAUTION: STOPLIGHT. CONTINUE AHEAD (north).
0.45+	58.35	CAUTION: STOPLIGHT; Marilla Park Road. CONTINUE AHEAD (north).
0.8	59.15	Cross Wolfe Creek.
1.4+	60.55+	CAUTION: road narrows from four to two lanes. The rise ahead and to the right is the Farm Ridge Moraine.
0.8-	61.35	Leonore Road. The break in slope here represents the shoreline of glacial Lake Pontiac. Just beyond the road intersection, the route ascends the outer slope of the Farm Ridge Moraine.
0.5	61.85	T-road from right marks the crest of the Farm Ridge Moraine. Prepare to turn left in 0.5 mile.
0.5	62.35	CAUTION: TURN LEFT (west) on 19N. The route westward is across the gently undulating morainal surface. Sags in the crest to the left show old Lake Pontiac bottoms.
1.45	63.8	To the right (north) of the road and west of the old barn is a boggy, cropless area. This is a kettle hole that developed in the moraine when a block of ice that was buried by glacial till melted. There are a couple of larger ones farther to the west of it.

Miles to next point	Miles from starting point	
0.25	64.05	To the right (north) is another kettle just beyond the break in slope and before the metal storage buildings.
0.3+	64.35+	STOP (1-way); crossroads. TURN LEFT (south) on the blacktop (E 15th Road).
0.2-	64.55	Overlook to the south at farm lane to the right. We are about 0.35 miles southwest of the Farm Ridge Moraine crest and about 20 feet lower. View south is across the bed of glacial Lake Pontiac. The conical spoil pile about two miles south marks the location of an abandoned coal shaft mine. CONTINE AHEAD (south).
0.8+	65.35+	STOP (2-way); crossroads, Leonore Road. TURN RIGHT (west) on N 18th Road.
1.3-	66.65	CAUTION: Park as far off the road as you can safely—the ditch is deep. BE ALERT—traffic is fast and visibility is limited! There is no convenient, safe parking closer to the bridge. STOP 8. Cyclic sedimentation of Pennsylvanian rocks is shown at the base of the hill north of the bridge along the Vermilion River and in a small tributary from the east.

--End of Trip--

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

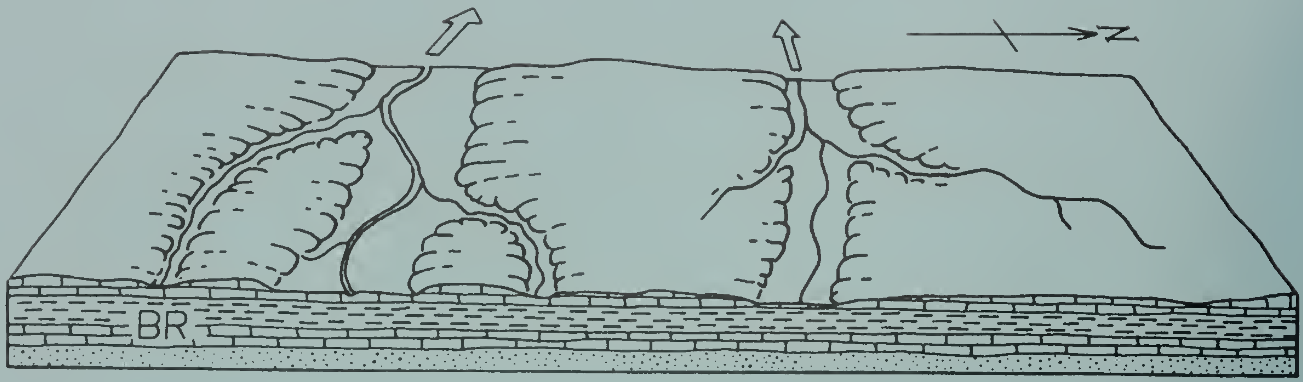
One of the most widespread sediments resulting from glaciation was carried not by ice or water but by wind. Loess is the name given to such deposits of windblown silt and clay. The silt was blown from the valley trains on the floodplains. Most loess deposition occurred in the fall and winter seasons 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.

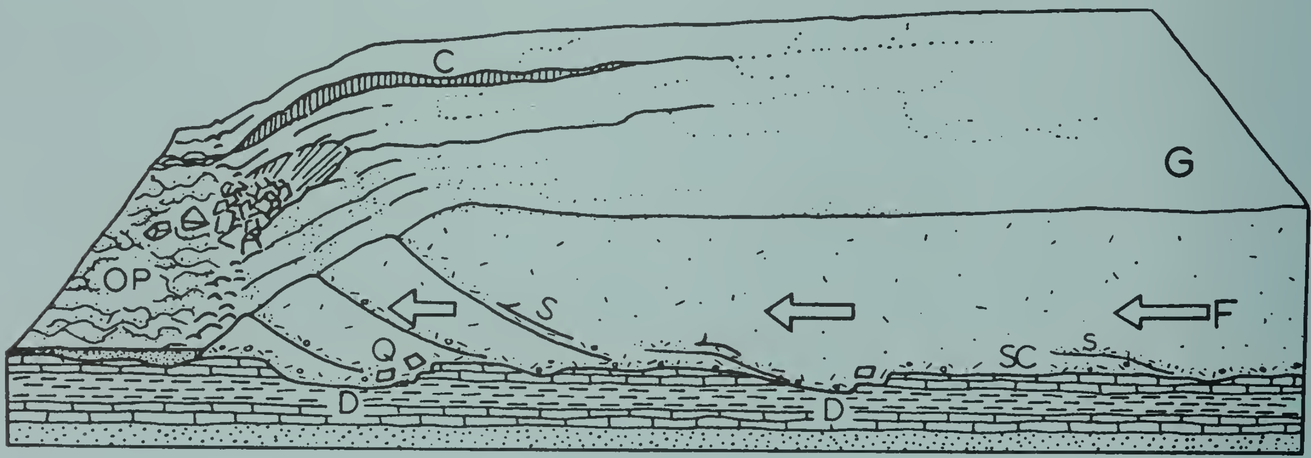
Glaciation in a Small Illinois Region

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.

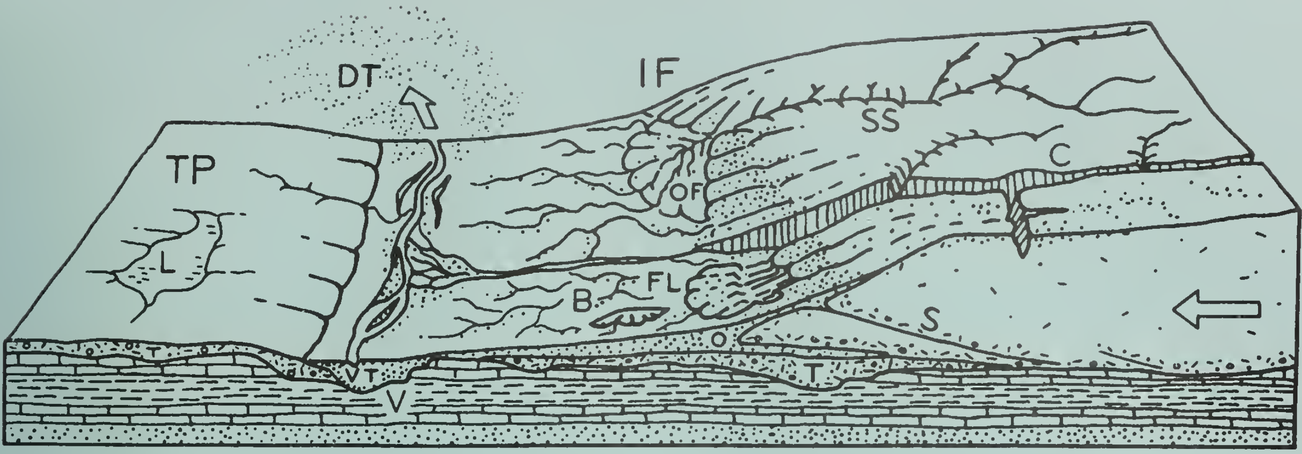
The block of land in the diagrams is several miles wide and about 10 miles long. The vertical scale is exaggerated--layers of material are drawn thicker and landforms higher than they ought to be so that they can be easily seen.



1. <u>The Region Before Glaciation</u> - 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.



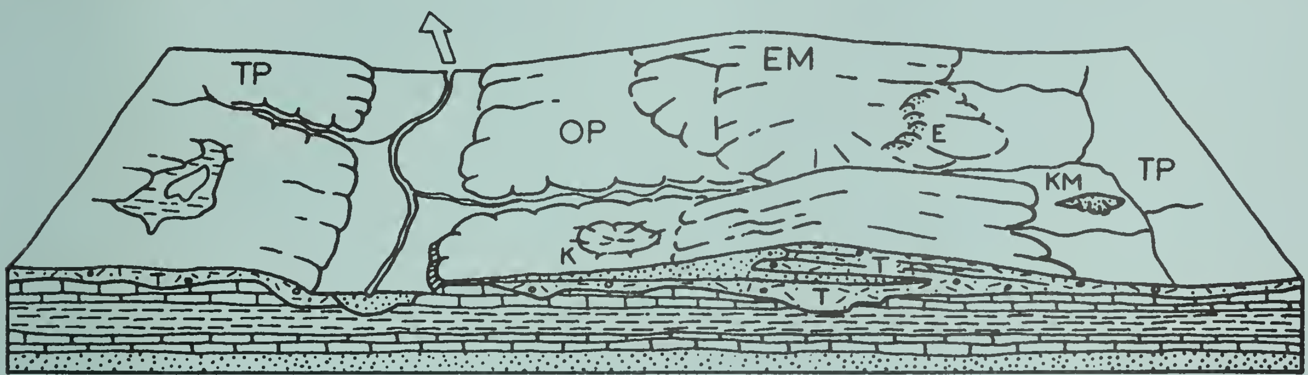
2. <u>The Glacier Advances Southward</u> - As the glacier (G) spreads out from its snowfield, it scours (SC) the soil and rock surface and quarries (Q)--pushes and plucks up--chunks of bedrock. These materials are mixed into the ice and make up the glacier's "load." Where roughnesses in the terrain slow 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.

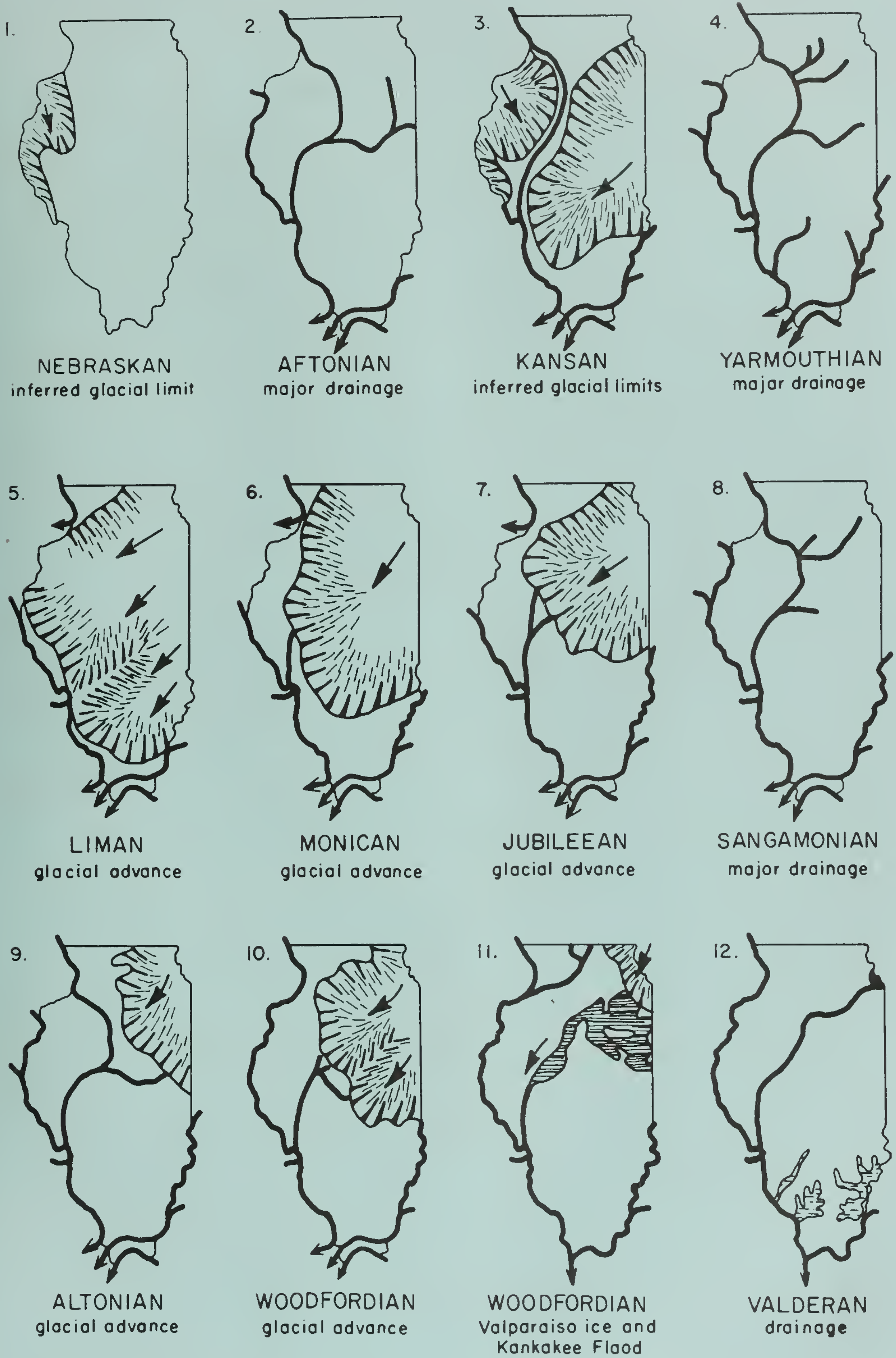
Slopewash and vegetation are filling the shallow lake. The collapse of outwash into the cavity left by the ice block's melting has made a kettle (K). The outwash that filled a tunnel draining under the glacier is preserved in an esker (E). The hill of outwash left where meltwater dumped sand and gravel 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		
WISCONSINAN (4th glacial)	Valderan	Outwash, lake deposits	Outwash along Mississippi Valley
	11,000		
	Twocreekan	Peat and alluvium	Ice withdrawal, erosion
	12,500		
	Woodfordian	Drift, loess, dunes, lake deposits	Glaciation; building of many moraines as far south as Shelbyville; extensive valley trains, outwash plains, and lakes
	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 Monican Liman	Drift, loess Drift, loess Drift, loess	Glaciers from northeast at maximum reached Mississippi River and nearly to southern tip of Illinois
	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.)

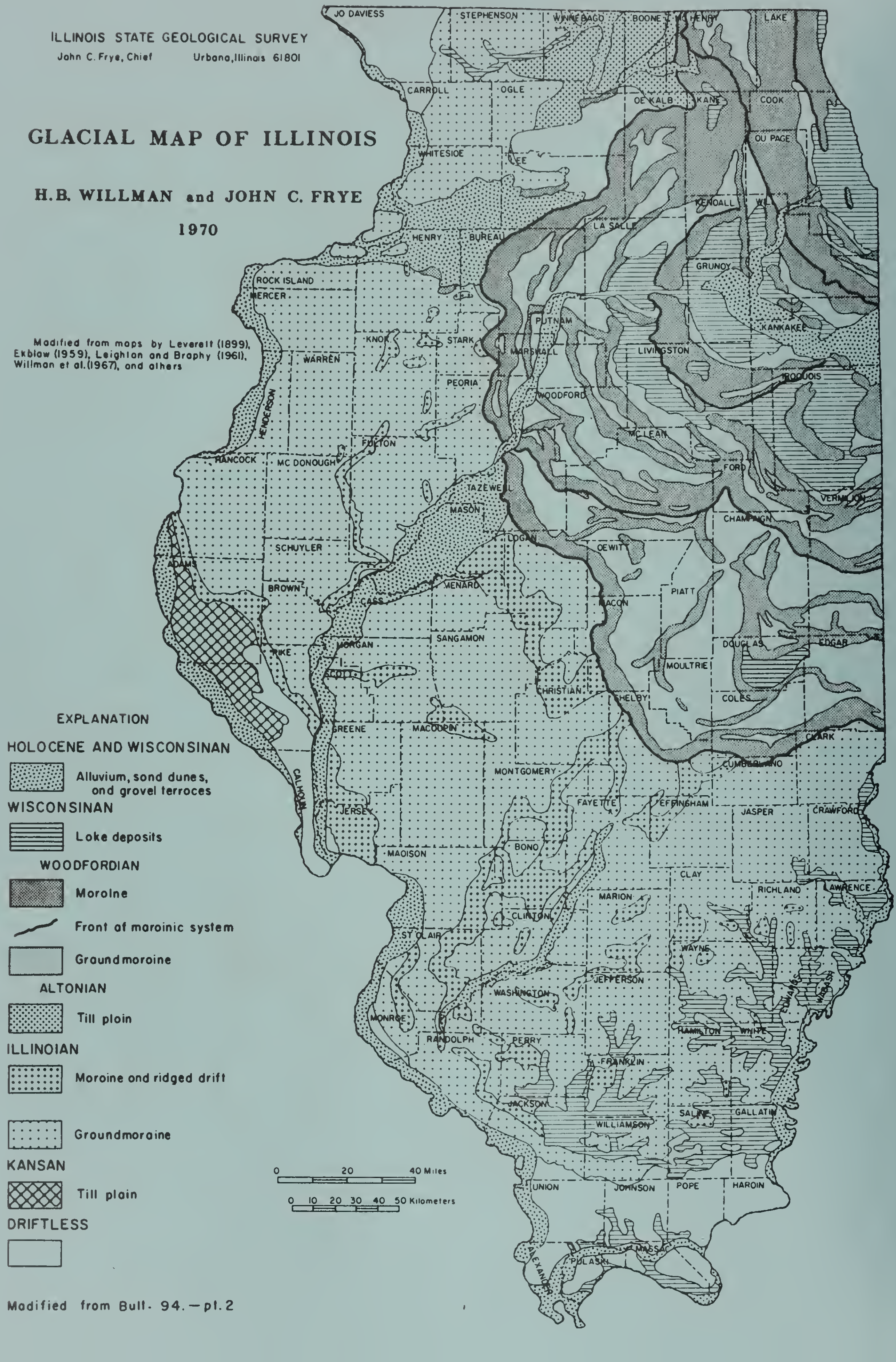
ILLINOIS STATE GEOLOGICAL SURVEY
John C. Frye, Chief   Urbana, Illinois 61801

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



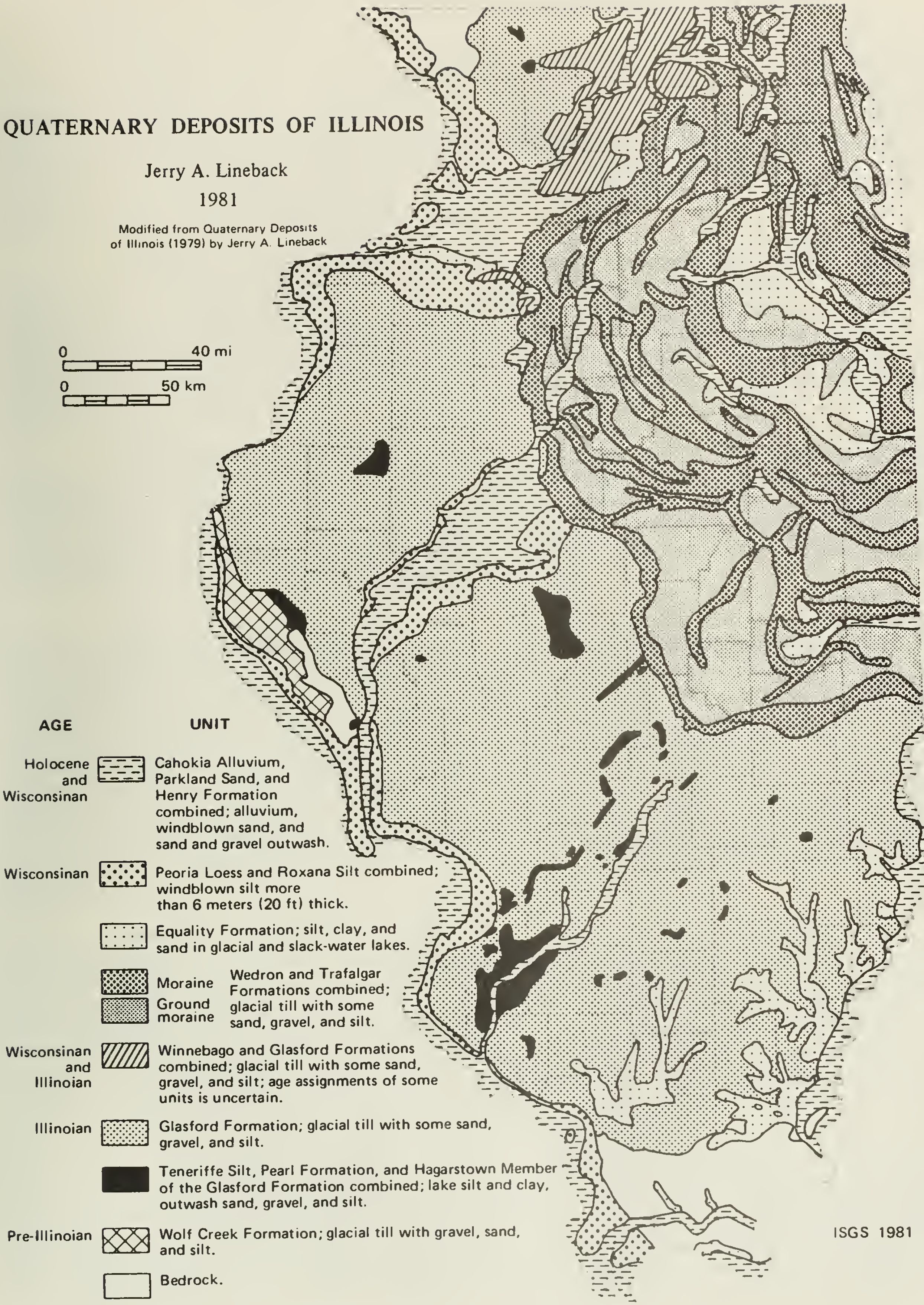
Modified from Bull. 94.—pl. 2

QUATERNARY DEPOSITS OF ILLINOIS

Jerry A. Lineback

1981

Modified from Quaternary Deposits of Illinois (1979) by Jerry A. Lineback



DEPOSITIONAL HISTORY OF THE PENNSYLVANIAN ROCKS

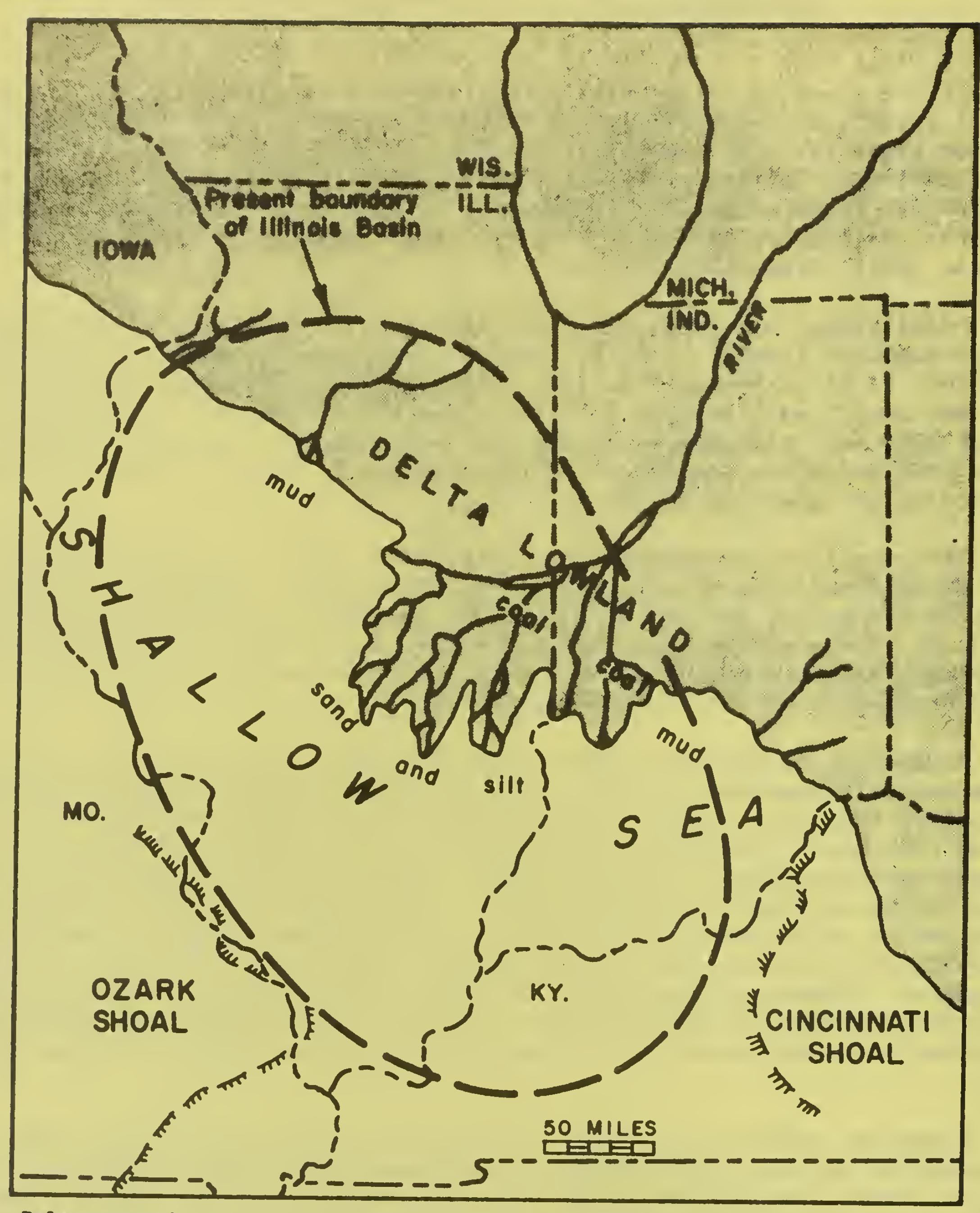
At the close of the Mississippian Period, about 310 million years ago, the Mississippian sea withdrew from the Midcontinent region. A long interval of erosion took place early in Pennsylvanian time and removed hundreds of feet of the pre-Pennsylvanian strata, completely stripping them away and cutting into older rocks over large areas of the Midwest. An ancient river system cut deep channels into the bedrock surface. Erosion was interrupted by the invasion of the Morrowan (early Pennsylvanian) sea.

Depositional conditions in the Illinois Basin during the Pennsylvanian Period were somewhat similar to those that existed during Chesterian (late Mississippian) time. A river system flowed southwestward across a swampy lowland, carrying mud and sand from highlands in the northeast. A great delta was built out into the shallow sea (see paleogeography map on next page). As the lowland stood only a few feet above sea level, only slight changes in relative sea level caused great shifts in the position of the shoreline.

Throughout Pennsylvanian time the Illinois Basin continued to subside while the delta front shifted owing to worldwide sea level changes, intermittent subsidence of the basin, and variations in the amounts of sediment carried seaward from the land. These alternations between marine and nonmarine conditions were more frequent than those during pre-Pennsylvanian time, and they produced striking lithologic variations in the Pennsylvanian rocks.

Conditions at various places on the shallow sea floor favored the deposition of sandstone, limestone, or shale. Sandstone was deposited near the mouths of distributary channels. These sands were reworked by waves and spread as thin sheets near the shore. The shales were deposited in quiet-water areas—in delta bays between distributaries, in lagoons behind barrier bars, and in deeper water beyond the nearshore zone of sand deposition. Most sediments now recognized as limestones, which are formed from the accumulation of limey parts of plants and animals, were laid down in areas where only minor amounts of sand and mud were being deposited. Therefore, the areas of sandstone, shale, and limestone deposition continually changed as the position of the shoreline changed and as the delta distributaries extended seaward or shifted their positions laterally along the shore.

Nonmarine sandstones, shales, and limestones were deposited on the deltaic lowland bordering the sea. The nonmarine sandstones were deposited in distributary channels, in river channels, and on the broad floodplains of the rivers. Some sand bodies, 100 or more feet thick, were deposited in channels that cut through many of the underlying rock units. The shales were deposited mainly on floodplains. Freshwater limestones and some shales were deposited locally in fresh-water lakes and swamps. The coals were formed by the accumulation of plant material, usually where it grew, beneath the quiet waters of extensive swamps that prevailed for long intervals on the emergent delta lowland. Lush forest vegetation, which thrived in the warm, moist Pennsylvanian climate, covered the region. The origin of the underclays beneath the coals is not precisely known, but they were probably deposited in the swamps as slackwater muds before the formation of the coals. Many underclays contain plant roots and rootlets that appear to be in their original places. The formation of coal marked the end of the nonmarine portion of the depositional cycle, for resubmergence of the borderlands by the sea interrupted nonmarine deposition, and marine sediments were then laid down over the coal.



Paleogeography of Illinois-Indiana region during Pennsylvanian time. The diagram shows the Pennsylvanian river delta and the position of the shoreline and the sea at an instant of time during the Pennsylvanian Period.

Pennsylvanian Cyclothems

Because of the extremely varied environmental conditions under which they formed, the Pennsylvanian strata exhibit extraordinary variations in thickness and composition, both laterally and vertically. Individual sedimentary units are often only a few inches thick and rarely exceed 30 feet thick. Sandstones and shales commonly grade laterally into each other, and shales sometimes interfinger and grade into limestones and coals. The underclays, coals, black shales, and limestones, however, display remarkable lateral continuity for such thin units (usually only a few feet thick). Coal seams have been traced in mines, outcrops, and subsurface drill records over areas comprising several states.

The rapid and frequent changes in depositional environments during Pennsylvanian time produced regular or cyclical alternations of sandstone, shale, limestone, and coal in response to the shifting front of the delta lowland. Each series of alternations, called a cyclothem, consists of several marine and nonmarine rock units that record a complete cycle of marine invasion and retreat. Geologists have determined, after extensive studies of the Pennsylvanian strata in the Midwest, that an ideally complete cyclothem consists of 10 sedimentary units. The chart on the next page shows the arrangement. Approximately 50 cyclothems have been described in the Illinois Basin, but only a few contain all 10 units. Usually one or more are missing because conditions of deposition were more varied than indicated by the ideal cyclothem. However, the order of units in each cyclothem is almost always the same. A typical cyclothem includes a basal sandstone overlain by an underclay, coal, black sheety shale, marine limestone, and gray marine shale. In general, the sandstone-underclay-coal portion (the lower 5 units) of each cyclothem is nonmarine and was deposited on the coastal lowlands from which the sea had withdrawn. However, some of the sandstones are entirely or partly marine. The units above the coal are marine sediments and were deposited when the sea advanced over the delta lowland.

Origin of Coal

It is generally accepted that the Pennsylvanian coals originated by the accumulation of vegetable matter, usually in place, beneath the waters of extensive, shallow, fresh-to-brackish swamps. They represent the last-formed deposits of the nonmarine portions of the cyclothems. The swamps occupied vast areas of the deltaic coastal lowland, which bordered the shallow Pennsylvanian sea. A luxuriant growth of forest plants, many quite different from the plants of today, flourished in the warm Pennsylvanian climate. Today's common deciduous trees were not present, and the flowering plants had not yet evolved. Instead, the jungle-like forests were dominated by giant ancestors of present-day club mosses, horsetails, ferns, conifers, and cycads. The undergrowth also was well developed, consisting of many ferns, fernlike plants, and small club mosses. Most of the plant fossils found in the coals and associated sedimentary rocks show no annual growth rings, suggesting rapid growth rates and lack of seasonal variations in the climate. Many of the Pennsylvanian plants, such as the seed ferns, eventually became extinct.

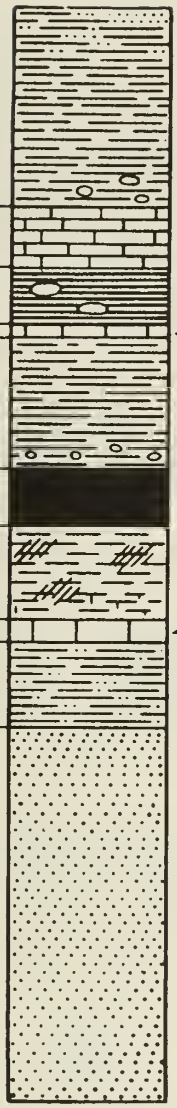
Plant debris from the rapidly growing swamp forests—leaves, twigs, branches, and logs—accumulated as thick mats of peat on the floors of the swamps. Normally, vegetable matter rapidly decays by oxidation, forming water, nitrogen, and carbon dioxide. However, the cover of swamp water, which was probably stagnant and low in oxygen, prevented the complete oxidation and decay of the peat deposits.

The periodic invasions of the Pennsylvanian sea across the coastal swamps killed the Pennsylvanian forests and initiated marine conditions of deposition. The peat deposits were buried by marine sediments. Following burial, the peat deposits were gradually transformed into coal by slow chemical and physical changes in which pressure (compaction by the enormous weight of overlying sedimentary layers), heat (also due to deep burial), and time were the most important factors. Water and volatile substances (nitrogen, hydrogen, and oxygen) were slowly driven off during the coalification process, and the peat deposits were changed into coal.

Coals have been classified by ranks that are based on the degree of coalification. The commonly recognized coals, in order of increasing rank, are (1) brown coal or lignite, (2) sub-bituminous, (3) bituminous, (4) semibituminous, (5) semianthracite, and (6) anthracite. Each increase in rank is characterized by larger amounts of fixed carbon and smaller amounts of oxygen and other volatiles. Hardness of coal also increases with increasing rank. All Illinois coals are classified as bituminous.

Underclays occur beneath most of the coals in Illinois. Because underclays are generally unstratified (unlayered), are leached to a bleached appearance, and generally contain plant roots, many geologists consider that they represent the ancient soils on which the coal-forming plants grew.

The exact origin of the carbonaceous black shales that occur above many coals is uncertain. The black shales probably are deposits formed under restricted marine (lagoonal) conditions during the initial part of the invasion cycle, when the region was partially closed off from the open sea. In any case, they were deposited in quiet-water areas where very fine, iron-rich muds and finely divided plant debris were washed in from the land. The high organic content of the black shales is also in part due to the carbonaceous remains of plants and animals that lived in the lagoons. Most of the fossils represent planktonic (floating) and nektonic (swimming) forms—not benthonic (bottom dwelling) forms. The depauperate (dwarf) fossil forms sometimes found in black shales formerly were thought to have been forms that were stunted by toxic conditions in the sulfide-rich, oxygen-deficient waters of the lagoons. However, study has shown that the "depauperate" fauna consists mostly of normal-size individuals of species that never grew any larger.



10 Shale, gray, sandy at top; contains marine fossils and ironstone concretions, especially in lower part.

9 Limestone; contains marine fossils.

8 Shale, black, hard, laminated; contains large spheroidal concretions and marine fossils.

7 Limestone; contains marine fossils.

6 Shale, gray; pyritic nodules and ironstone concretions common at base; plant fossils locally common at base; marine fossils rare.

5 Coal; locally contains clay or shale partings.

4 Underclay, mostly medium to light gray but dark gray at top; upper part noncalcareous, lower part calcareous.

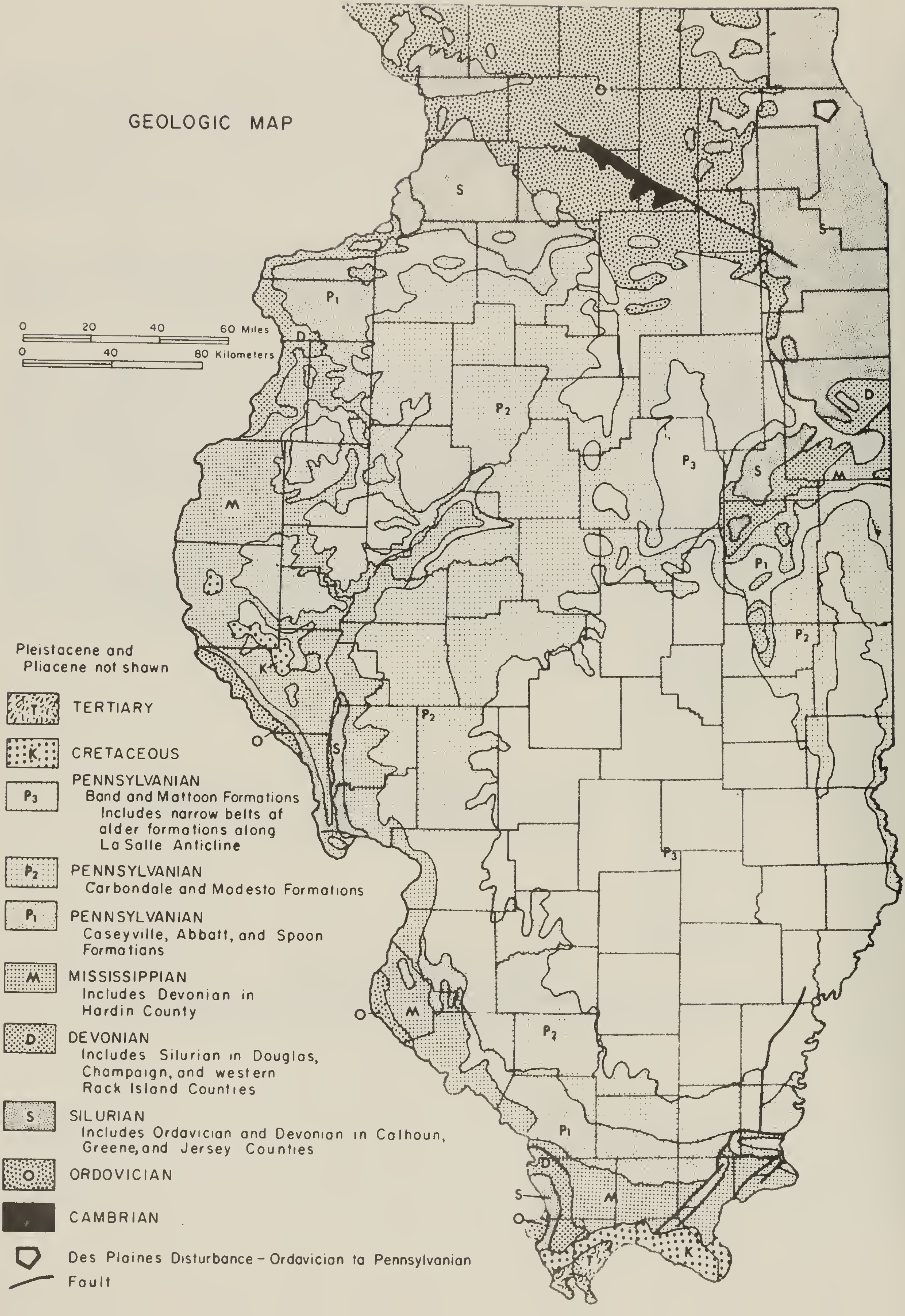
3 Limestone, argillaceous; occurs in nodules or discontinuous beds; usually nonfossiliferous.

2 Shale, gray, sandy.

1 Sandstone, fine grained, micaceous, and siltstone, argillaceous; varies from massive to thin bedded; usually has an uneven lower surface.

AN IDEALLY COMPLETE CYCLOTHEM

(Reprinted from Fig. 42, Bulletin No. 66, Geology and Mineral Resources of the Marseilles, Ottawa, and Streator Quadrangles, by H. B. Willman and J. Norman Payne)

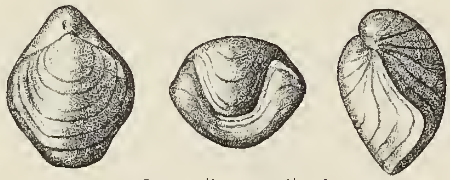

GEOLOGIC MAP
0 20 40 60 Miles
0 40 80 Kilometers
Pleistacene and Pliacene not shawn
TERTIARY
CRETACEOUS
PENNSYLVANIAN
Band and Mattoon Formations
Includes narrow belts af alder formations along La Salle Anticline
PENNSYLVANIAN
Carbondale and Modesto Formations
PENNSYLVANIAN
Caseyville, Abbatt, and Spoon Formatians
MISSISSIPPIAN
Includes Devonian in Hardin County
DEVONIAN
Includes Silurian in Douglas, Champaign, and western Rack Island Counties
SILURIAN
Includes Ordavician and Devonian in Calhoun, Greene, and Jersey Counties
ORDOVICIAN
CAMBRIAN
Des Plaines Disturbance – Ordavician ta Pennsylvanian
Fault

BRACHIOPODS

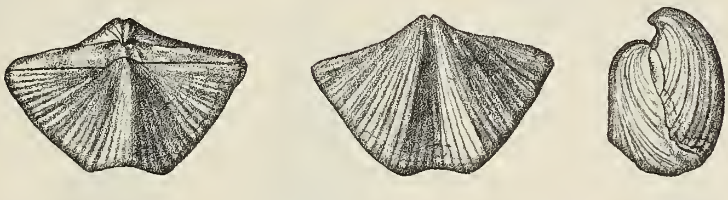
Juresania nebrascensis 2/3 x

Wellerella tetrohedra 1 1/2 x

Derbya crosso 1x



Composita argentia 1x

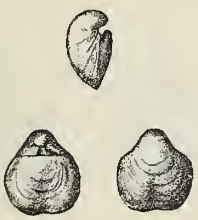


Neospirifer comeratus 1x

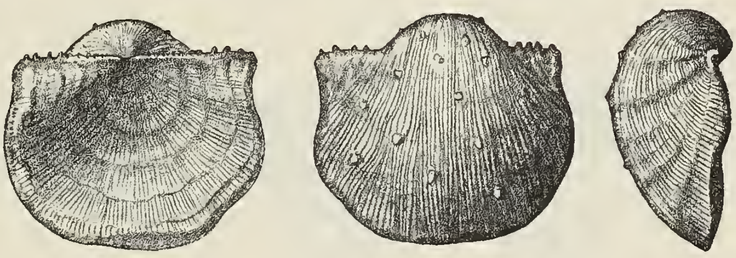
Chonetes granulifer 1 1/2 x

Mesalabus mesalobus var. *evompygus* 2x

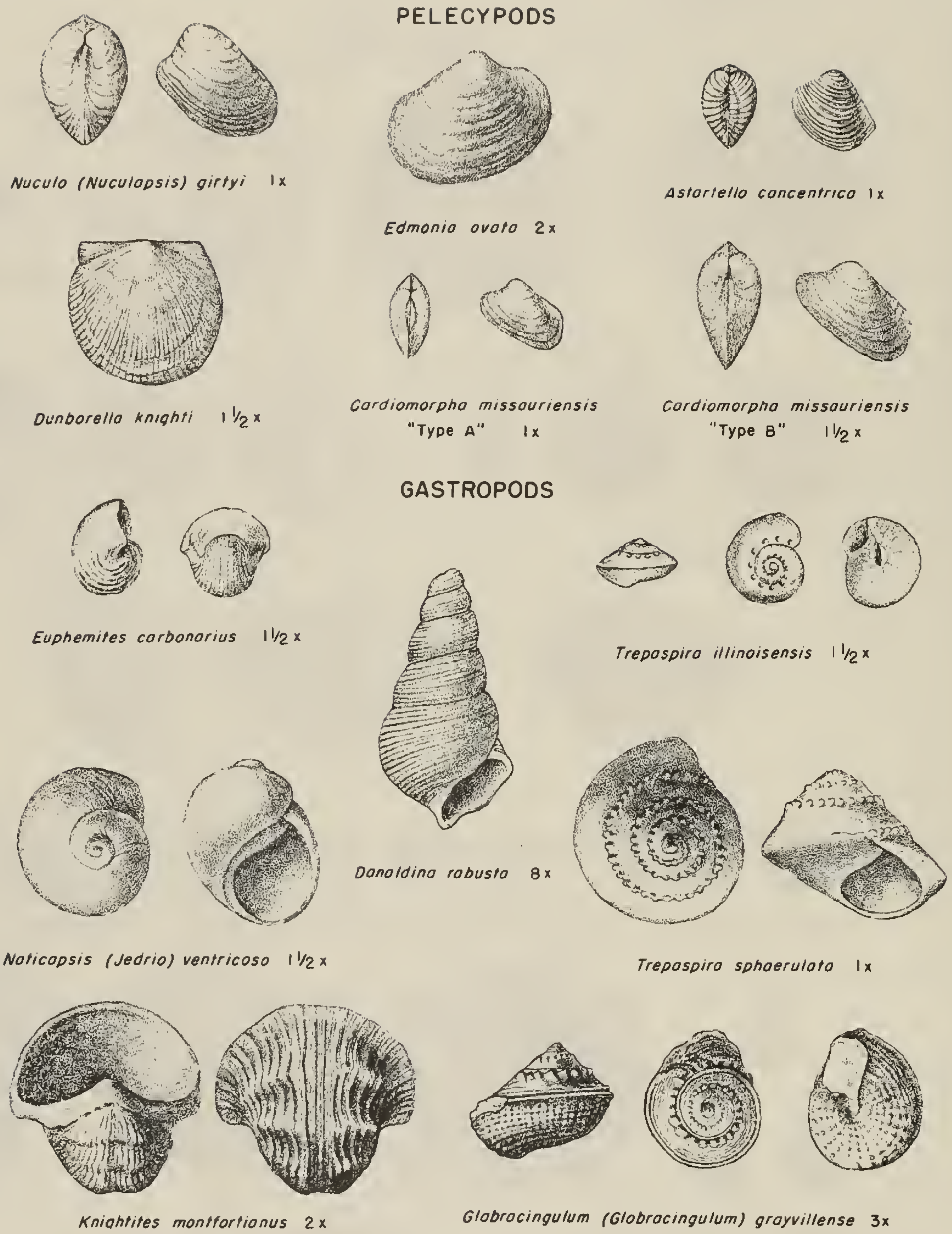
Marginifera splendens 1x

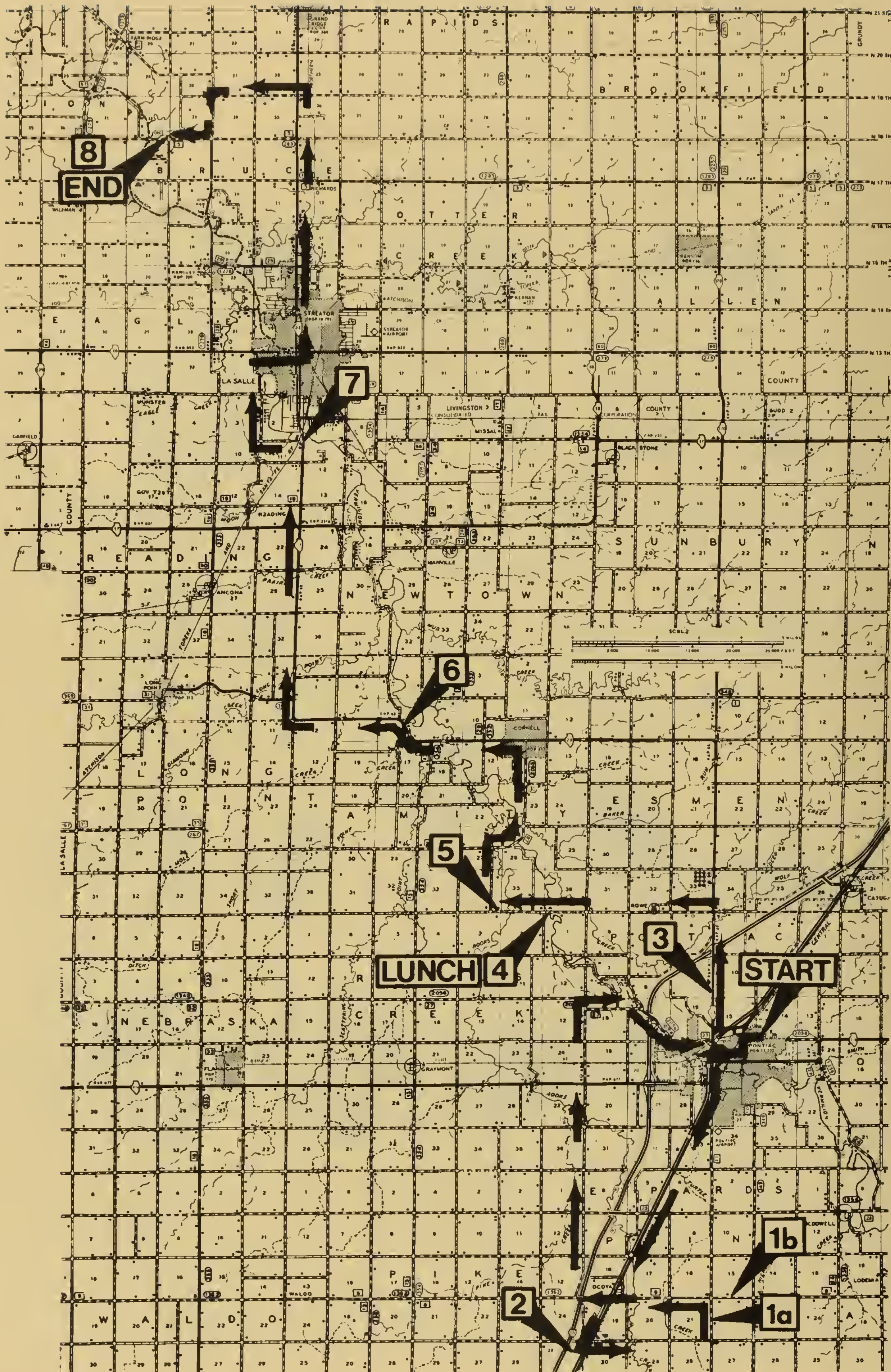


Crurithyris planoconvexa 2x



Linoproductus "cora" 1x


PELECYPODS
Nucula (Nuculopsis) girtyi 1x
Edmonia ovata 2x
Astartella concentrica 1x
Dunbarella knighti 1 1/2 x
Cardiomorpha missouriensis "Type A" 1x
Cardiomorpha missouriensis "Type B" 1 1/2 x
GASTROPODS
Euphemites carbonarius 1 1/2 x
Trepospira illinoisensis 1 1/2 x
Donaldina robusta 8x
Naticopsis (Jedria) ventricosa 1 1/2 x
Trepospira sphaerulata 1x
Knightites montfortianus 2x
Glabrocingulum (Glabrocingulum) grayvillense 3x



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