GUIDE LEAFLET
GEOLOGICAL SCIENCE FIELD TRIP

SPRINGFIELD AREA
Sangamon County Illinois
New City, Springfield East, Springfield West, and Williamsville
7.5-minute quadrangles

David L. Reinertsen, Leon R. Follmer, and Kemal Piskin

Host-Illinois State Fairgrounds
April 29, 1978

Sponsored by the
ILLINOIS STATE GEOLOGICAL SURVEY
Urbana, IL 61801
TO THE PARTICIPANTS:

The Geological Science Field Trip program is designed to acquaint Illinois residents with the landscape, the rock and mineral resources, and the geological processes that have led to their origin. With this program, we hope to stimulate a general interest in the geology of Illinois and a greater appreciation of the state's vast mineral resources and their importance to the over-all economy.

We encourage you to ask the tour leaders any questions that may occur to you during the trip. Discussion often clarifies points that otherwise would remain confused to many of the participants. We also invite your written comments upon the conduct of the trips so that we might improve them as much as possible.

Additional copies of this guide leaflet, as well as itineraries for field trips that have been held in the past, may be obtained free of charge by writing to the Illinois State Geological Survey. The itinerary maps for each field trip can be purchased for 10 cents each.

Several of the stops along this itinerary are located on private property whose owners have graciously given us permission to visit their lands. Please obey the instructions of your trip leaders and conduct yourselves in a manner that will show respect for the property owners' cooperation. Please do not litter, or climb on fences, and leave all gates as found, so that we may be welcome to return on future field trips. These simple rules of courtesy also apply to public property as well. For the convenience of those persons who may use this itinerary at some future time, the names and addresses of every private property owner are listed for the respective stops on a page at the back of this guide leaflet. Whenever possible, always attempt to obtain permission when visiting private property.

We hope that you enjoy today's field trip and will attend others in the future.

THE STAFF
EDUCATIONAL EXTENSION SECTION
ILLINOIS STATE GEOLOGICAL SURVEY
Springfield Geological Science Field Trip
April 29, 1978

- Dotted line indicates approximate boundary of Illinois
- Green line indicates field trip site
- Black line indicates geologic science field trip
SPRINGFIELD GEOLOGICAL SCIENCE FIELD TRIP

INTRODUCTION

The Springfield field trip area lies within a rectangular area about 14 miles long from north to south and 8 miles wide from east to west in Sangamon County, west central Illinois. The field trip includes portions of the city of Springfield, which was settled in 1818 to 1819 by immigrants from South Carolina, Kentucky, and Virginia. In 1821 Springfield became the county seat of Sangamon County, the 22nd Illinois county to be established. Springfield was incorporated as a town in 1831 and was designated the state capitol in 1837, partly through the efforts of Abraham Lincoln.

Geologic Setting

The Springfield area is on the northern part of the Springfield Plain, a region of broad, relatively flat upland plain that is dissected by numerous shallow valleys (see attached map of the Physiographic Divisions of Illinois). The mean sea level (msl) elevation of the upland is about 600 feet. Elevation between the upland and the Sangamon River valley, the deepest valley, differs about 100 feet. Land-surface features (topography) here and in immediately adjoining areas can be grouped as: 1) upland interstream areas; 2) erosion belts bordering the larger streams; 3) flood-plain areas of variable width along the main streams (especially those bordering the Sangamon and South Fork Sangamon Rivers and the Sugar and Spring Creeks); and 4) isolated morainic hills to the east and northeast. The Sangamon River, which generally flows northwesterly here, controls the drainage of this region. In its 32-mile course across the area mapped in the Springfield 15-minute quadrangle, the river drops 28 feet from about 519 to 491 feet (msl).

During the last million years or so, huge, slow-moving continental ice sheets called glaciers flowed southward from Canada across the area, scraping away hills and filling in valleys on an ancient land surface that was more rugged than the present land surface (see attached Pleistocene Glaciations in Illinois). Although glaciers of Kansan Age, the second major glaciation of the Pleistocene Epoch, advanced across this region from the northeast, evidence of their passing has been removed by subsequent erosion except for some deposits in the deeper parts of buried bedrock valleys nearby. Later, between about 300,000 to 175,000 years ago, glaciers again crossed this region—a time when nearly 90 percent of the state was covered by the ice sheet. This glacier, which extended into southern Illinois, reached farther south than all Pleistocene continental glaciers during the glacial Illinoian Age. The Illinoian glacier left a mixture of pebbles, sand, silt and clay, called till, mantling the upland areas and filling in pre-existing valleys. In some areas the Illinoian glacier formed lakes, in which laminated silt and clay were deposited on top of the till. After the Illinoian glacier melted
away from this region, the interglacial Sangamonian Age followed. Deep weathering of the Illinoian deposits produced the Sangamon Soil, which can be seen at many localities here.

About 75,000 years ago, early Wisconsinan glaciers advanced into northeastern Illinois. Outwash from the melting glaciers flushed down the Ancient Mississippi into the Havana area, where winds picked up the fine silts and clays from the dried surface of the outwash and carried them across the uplands to the east and southeast and formed the Roxana Silt. From about 28,000 to about 22,000 years ago, during the Farmdalian Substage, the Wisconsinan glacier melted back northward an unknown distance, and the Farmdale Soil developed in the Roxana Silt.

Between about 22,000 and 12,500 years ago, glaciers of Wisconsinan Age advanced into northeastern Illinois. These glaciers stopped just west of Decatur, about 20 miles east of the field trip area. Although Wisconsinan ice sheets did not bring glacial till into the Springfield area, sand and gravel were carried from the ice by meltwater and were flushed down streams draining the melting ice front. As the quantity of meltwater diminished, tremendous quantities of these outwash materials were deposited along the valleys. The Sangamon River valley has abundant quantities of these sands and gravels that are not only important sources of building material but also serve as large reservoirs for underground water.

As the surface of outwash deposits dried out, wind picked up and carried the fine sand and silt, called dune sand and loess [lūs], across the neighboring uplands. Most of the loess in this area was derived from extensive outwash deposits to the northwest along the Illinois River valley near Havana, but the dune sand was derived from the neighboring Sangamon River valley. These wind-blown materials blanketed and filled in many minor surface irregularities across the Sangamon Soil surface. The rich modern soils of the region are developed in the loess. Less desirable soils have formed in the dune sand.

Glacial deposits range from 0 to 60 feet thick in the field trip area, although thicknesses in excess of 100 feet have been reported in borings locally. Loess generally ranges from 8 to about 12 feet thick across the uplands, but it is missing across the floodplains, where alluvium overlies outwash gravels.

The loess and glacial deposits are very important to man—he farms them; builds on, in, and with them; extracts water from them; and disposes of his sewage and refuse in and on them. These materials must be used judiciously, however, to avoid polluting ground-water sources. Soils developed in loess are crumbly; they are easily eroded by rain and by wind when dry and the sod cover has been broken. Care must be exercised in selecting and maintaining building sites on these materials. Proper drainage is essential for their stability—too much watering of sod and shrubbery and/or poor drainage can lead to slumping, even on rather gentle slopes, and thus to building failure.
The larger streams in the area have eroded down through the glacial materials to expose firm bedrock strata. These strata are derived from limy muds, silts, and sands that were deposited layer upon layer in shallow seas that repeatedly covered the midcontinent region beginning about 625 million years ago. Millions of years of deep burial consolidated these sediments into the limestones, dolomites, sandstones, and shales presently found in bedrock exposures and well borings (fig. 1). Some coal and clay also are found in this sequence of consolidated rocks. About 5,000 feet of bedrock strata occur between the surficial materials and the ancient, uneven surface of Precambrian rocks, which are composed largely of crystalline granitic materials. Bedrock strata dip southeastward toward Hamilton County and the deepest part of the Illinois Basin (figs. 2 and 3), a large saucer-shaped depression in the Earth's crust that has become filled with thick sediments over millions of years.

The shallowest and youngest consolidated sedimentary rocks to crop out in the area are Pennsylvanian in age and were deposited about 290 million years ago. These strata are about 500 feet thick but thicken to 1,200 to 1,300 feet in the deepest part of the Illinois Basin. In addition to rich coal deposits, clay and shale from the Pennsylvanian rock strata were the basis of a large brick and tile industry in Springfield and surrounding communities until the early 1970s. Pennsylvanian limestones have been used for building stone, as in the Old State Capitol, and as crushed stone for roads and agricultural lime.

Although petroleum occurs in Pennsylvanian and underlying Mississippian strata elsewhere in Illinois, these rocks are not productive in Sangamon County. Petroleum production here is from the deeper (1,590 to 1,750 feet) Silurian and Devonian strata.

Mineral Production

Ninety-nine of Illinois' 102 counties reported mineral production during 1976, and the estimated total value of all mineral production in Illinois was more than $1,500,000,000. Mineral resources in Sangamon County include sand and gravel, coal, and oil and had a total value of more than $23,000,000. Only one coal mine, near Pawnee, is now active in the county, but it is one of the world's largest underground coal mines. During 1976, this mine produced from Sangamon County more than 1.1 million tons from the Herrin (No. 6) Coal Member at a value of more than $17,800,000. Thus Sangamon County ranks 15th among the 20 coal-producing counties in the state. During 1976, 11 oil fields and parts of 2 others that lie within Sangamon County produced 155,667 barrels of crude oil valued at $1,584,690 and ranked the county as 24th among the 43 oil-producing counties. Five sand and gravel operations produced more than two million tons valued in excess of $3,800,000. The tonnage figures rank Sangamon County fifth among the 61 sand and gravel producing counties. In addition to the mineral resources produced here, iron oxide pigments are brought into the county for processing.
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<th>SYSTEM</th>
<th>SERIES</th>
<th>GROUP OR FORMATION</th>
<th>THICKNESS (ft)</th>
<th>DESCRIPTION</th>
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Figure 1. Unconsolidated deposits and bedrock in the Springfield-Decatur region.
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.
Field trip area

Deep part of Illinois basin

Figure 3. Index map showing location of the field trip area and its relation to the deep part of the Illinois Basin.
Assemble heading west on the west side of the Main Gate of the Illinois State Fairgrounds, corner of Sangamon Avenue and 11th Street (SE~SE~SW~SW~ Sec. 15, T. 16 N., R. 5 W., 3rd P. M., Springfield West 7.5' quadrangle).

PROCEED AHEAD (west) on Sangamon Avenue.

STOP; 2-way. TURN RIGHT (north) on 5th Street and prepare to turn left at the bottom of the hill.

TURN LEFT (west) at T-road intersection and prepare to turn left for Stop 1.

TURN LEFT (south) and enter large vacant lot.

Pleistocene sediments (State Fairground Section) exposed on the west and south sides of lot (NE~NE~SW~SW~ Sec. 15, T. 16 N., R. 5 W., 3rd P. M.; Springfield West 7.5' quadrangle). See figure 4.

The surficial materials exposed in this cut are essentially those that underlie most of the upland area of Springfield. However, because of erosion and slumping of overlying materials, the sequence of materials will vary from place to place, especially along valley walls.

The oldest material exposed here is the shale of Pennsylvanian age, deposited nearly 295 million years ago in a shallow sea that covered this part of the country. Elsewhere in the area, the uppermost bedrock strata may be sandstone or limestone.

The irregular contact between the shale and the overlying Illinoian glacial deposits represents a time interval of nearly 280 million years, from the close of the Pennsylvanian until Illinoian glaciers flowed across this area. During this long time span, erosion may have removed tens or hundreds of feet of still younger sediments that may have been deposited on the youngest Pennsylvanian strata that are known here.

The Illinoian Vandalia Till was deposited on top of the uneven Pennsylvanian bedrock surface throughout this area. The Sangamon Soil developed in the Vandalia Till during the long interglacial Sangamonian Stage. Later during Wisconsinan Altonian time, the Roxana Silt was carried across the area and deposited. Then, during the Farmdalian Substage when temperatures moderated, the Farmdale Soil developed in the Roxana. Still later during Wisconsinan Woodfordian time, the Peoria Loess was deposited across the area above the Roxana Silt. Here the Modern Soil has developed in the Peoria Loess.

Leave Stop 1. TURN RIGHT (east).

STOP; 1-way. TURN LEFT (north) on 5th Street.

Vertical exposure of Peoria Loess to left. CONTINUE AHEAD (north) and curve east.
Peoria Loess

Roxana Silt

till

Peoria Loess—Modern Soil (Hapludalf) developed in the top; poorly exposed because of earth work and slumping; silty with moderate amount of clay; weathered. A horizon—grayish brown. B horizon (lower 3 ft)—yellowish brown; very smooth when wet; very low sand content; blocky at top but becomes massive downward; 3½ ft.

FARMDAlian SUBSTAGE

ROXANA SILT—Farmdale Soil developed in Roxana Silt; yellowish brown to brown with reddish tint; silty but contains slightly more clay and sand than Peoria; tends to be weak with platy to granular structure; weathered; 1½ ft.

SANGAMONIAN STAGE

ILLINOIAN STAGE

MONICAN SUBSTAGE

GLASFORD FORMATION

VANDALIA TILL MEMBER—Sangamon Soil developed in Vandalia Till.

A horizon (upper 1 ft)—brown but lighter than Roxana; loam texture is porous, granular, and compact within a weak platy structure.

B horizon (middle 9 ft)—dark grayish brown; changes to yellowish brown downward; contains brownish yellow mottling; clay coatings and iron-manganese concretions common throughout; has clay loam (clayey) texture but clay decreases downward; upper part firm and plastic with blocky tendency; lower part tends to be crumbly (friable); coarse sand lenses in lower part; base marked by large round calcareous concretions.

C horizon (lower 6 ft ±)—dull brown changing to gray downward; loam texture, has lenses of sand and gravel; firm and hard; tends to break in angular plates and blocks; calcareous, irregular base; contains about 40% sand, 40% silt, 20% clay.

PENNSYLVANIAN SYSTEM

MCLEANsBoro GROUP

MODESTO FORMATION

Shale—gray, soft, silty, plastic when wet; base not exposed; 4 ft +.

Figure 4. Generalized section of Pleistocene and Pennsylvanian strata exposed in the west wall of the lot excavation.
1.15 2.15 STOP; 2-way. End of SR 4. CAUTION: 4-lane highway. TURN LEFT (northeast) on I-55 Business Loop.

0.25 2.4 Chicago & Illinois Midland (C&IM) Railroad underpass.

1.2 3.6 CAUTION: T-road from right (Dirksen Parkway). CONTINUE AHEAD (northeast and north) on I-55 Business Loop.

0.2 3.8 Bluff top to left (west) is capped by Parkland Sand. In the Springfield area, the Parkland Sand was derived from the nearby Sangamon River valley and was wind blown a relatively short distance to the neighboring bluff tops. Locally it is called "bluff sand."

0.3 4.1 East entrance to Riverside Park. About 1.5 miles west of the park entrance is an earthen dam built across the Sangamon River in 1868 to provide a water supply for Springfield. As the dam was not high enough to impound a very large reservoir, low stream flow during dry periods curtailed the public water supply. In 1884 a well was dug in the valley bottom, and for several years it was the sole supply of water. However, by 1888, water demand had increased and two water infiltration galleries were constructed. Within a couple of years the galleries were connected to the river to increase the water supply. Just downstream from the old earthen dam, a newer slightly higher concrete dam was built in the early 1900s to provide water for cooling at the nearby power plant. As a result of recent erosion around the ends of the concrete dam, the old earthen dam is visible during times of low water levels on the river. Beginning in 1902, a series of nearly 40 production wells were drilled into 35 to 40 feet of thick sand in the river bottom in Sections 1, 2, 3, 10, and 11, T. 16 N., R. 5 W. These wells and the galleries were able to meet the municipal water demands that averaged more than 6.8 million gallons per day (mgd) by 1925. It was realized, however, that this supply was being utilized nearly to its maximum potential, and the city began to look elsewhere for water. After a lengthy search and considerable geological investigation, the Lake Springfield site was selected. The history of that lake will be discussed at Stop 5. CONTINUE AHEAD (north) and move to the inside lane.

0.4 4.5 Cross Sangamon River bridge. Note bedrock exposure to left (west). Prepare to turn left.

0.25 4.75 TURN LEFT (west) on SR 124. CAUTION: fast cross traffic.

0.05 4.8 LEAVE SR 124 and CONTINUE STRAIGHT AHEAD (west). SR 124 curves right.

0.05 4.85 CAUTION: cross road. CONTINUE AHEAD (west) and enter Carpenters Park. NOTE: mileage figures will resume from the entrance when we leave. Follow lane to the southwest to the parking area. Park car and walk to the south-southeast about 0.25 mile to the Sangamon River.

Exposure of Pennsylvanian Trivoli Sandstone Member in north valley wall of Sangamon River (NE4 Sec. 2 and N2W2 Sec. 1, T. 16 N., R. 5 W., 3rd P. M.; Springfield East 7.5' quadrangle).
The Pennsylvanian sandstone exposed here is the basal unit of the Trivoli Cyclothem (No. 1 of "An Ideally Complete Cyclothem" in attached DEPOSITIONAL HISTORY OF THE PENNSYLVANIAN ROCKS). The sandstone is light gray with a greenish cast and brownish spots, contains medium- to fine-grained mica flakes on bedding surfaces, is thin to thick bedded, has some cross bedding and ripple marks, and is 30 to 35 feet thick. This exposure appears to be a sandstone filling of an ancient Pennsylvanian stream channel that had cut down into somewhat older Pennsylvanian strata. Figure 5 shows the relationship of this exposure to the succession of Pennsylvanian rocks in Illinois.

According to Survey field notes from the 1920s, a portion of the sandstone used in the Old State Capitol came from these bluffs.

0.0 4.85 Leave Stop 2. Return to park entrance. STOP; 1-way. RESUME MILEAGE. TURN LEFT (north) at cross road.

0.05 4.9 STOP; 1-way, SR 124. CONTINUE AHEAD (north) on SR 124.

1.35 6.25 BEAR RIGHT (easterly) at Y-intersection.

0.1 6.35 STOP; 1-way. CONTINUE AHEAD (east) on County Road (CR) 6.5N.

0.45 6.8 Enter town of Sherman.

0.25 7.05 STOP; 2-way, I-55 Business Loop. CAUTION: 4-lane highway; cross traffic does not stop. CONTINUE AHEAD (east). NOTE: itinerary is now crossing an area that once was a shallow lake extending westward from in front of the melting Illinoian Buffalo Hart ice sheet, which stood 8 or 9 miles to the east. See route map.

0.1 7.15 CAUTION: high-speed Illinois Central Gulf (ICG) railroad crossing. CONTINUE AHEAD (east) and jog left on the blacktop.

0.25 7.4 Cross I-55 overpass.

0.5 7.9 Cross Fancy Creek and ascend east valley wall.

0.55 8.45 Note the even upland surface in this area. This is part of the Illinoian lake bottom that has since been mantled with Roxana Silt and Peoria Loess. Tributaries to the Sangamon River are cutting headward into the upland and are producing the small amount of irregularities in its surface near the margins of the Sangamon River.

1.35 9.8 Cross Little Wolf Creek.

0.55 10.35 STOP; 4-way. TURN RIGHT (south) on CR-6E toward Spaulding.

1.25 11.6 Descend north valley wall of Wolf Creek.

0.25 11.85 Cross Wolf Creek.

0.2 12.05 Park along shoulder on west side of road—do NOT block drive to right. Pleistocene sediments exposed in roadcut on east side of road (W line SW 1/2 SW 1/2 Sec. 3, T. 16 N., R. 4 W., 3rd P. M.; Springfield East 7.5' quadrangle). See figure 6.
Figure 5. Simplified stratigraphic column of the Pennsylvanian rocks of the Springfield area, showing their relation to the Pennsylvanian System of Illinois (modified from Clegg, 1961).
QUATERNARY SYSTEM
PLEISTOCENE SERIES

HOLOCENE STAGE—Modern Soil developed in Parkland Sand and in Peoria Loess.

PARKLAND SAND—Modern Soil developed in Parkland, loam to sand texture; A horizon—grayish brown. B horizon—yellowish brown; 4 ft ±.

WISCONSINAN STAGE

WOODFORDIAN SUBSTAGE

PEORIA LOESS—Modern Soil developed in Peoria Loess; grayish yellow to gray silt (probably silt loam texture); very soft and smooth; nearly massive; lower part calcareous; 3 ft ±.

FARMDALIAN SUBSTAGE

ALTONIAN SUBSTAGE

ROXANA SILT—Farmdale Soil developed in Roxana Silt; pinkish brown silt (probably a silt loam); more firm than Peoria (because Roxana has slightly more clay and is more compact); weak platy to granular structure, leached; 3 ft.

SANGAMONIAN STAGE—Sangamon Soil developed in Teneriffe Silt and Vandalia Till.

ILLINOIAN STAGE

JUBILEEAN SUBSTAGE

TENERIFFE SILT—Sangamon Soil developed in Teneriffe Silt (lake deposits).

A horizon (upper 1 ft)—grayish brown, lower part light gray when dry; granular silt loam.

B horizon (lower 5 ft)—dark greenish gray brown in upper 2 ft, becomes lighter downward; slight mottling; silty (silty clay loam), very clayey near top, less clayey downward; blocky to massive structure.

MONICAN SUBSTAGE

VANDALIA TILL MEMBER—lower part of Sangamon Soil developed in upper part.

C horizon (upper 2 ft +)—gray; loam texture; high silt and sand content; low clay content; hard; contains noticeable pebbles; calcareous in lower part.

NOTE: 0 to 14 ft exposed in road cut and ditch on east side of road; 14 to 18 ft ± sampled with hand auger; calcareous till was exposed in west road ditch and about 100 feet north of described section.

Figure 6. Pleistocene sediments exposed in road cut on east side of road north of Spaulding.
The early geologic history of this site is essentially the same as that of Stop 1. However, after the Vandalia Till was deposited, a shallow lake formed in front of the Illinoian Buffalo Hart Moraine that stands 5 to 6 miles east of here. Silt, sand, and clay were deposited in the lake to form the Teneriffe Silt. After the lake drained, the A and B horizons of the Sangamon Soil developed down through the Teneriffe Silt. As weathering continued during the long interglacial Sangamonian Age, soil formation continued downward into the underlying Vandalia Till. During Wisconsinan glacial time, the Farmdale Soil developed on the Roxana Silt that was also deposited here. Later, after Peoria Loess was deposited, windblown sand (Parkland Sand) was carried a short distance from the nearby Sangamon River valley outwash and was deposited along the upper parts of the valley walls, especially along the east valley wall. The Modern Soil developed in the Parkland Sand and the Peoria Loess. As soil formation continued, vegetation encroached on the dune areas and stabilized them before they were able to migrate from the valley bluffs. The itinerary will pass other deposits of the Parkland Sand later.

0.0 12.05 Leave Stop 3. CONTINUE AHEAD (south).
0.1 12.15 Enter village of Spaulding.
0.2 12.35 CAUTION: ICG railroad crossing. Do NOT stop on tracks.
0.05 12.4 STOP; 2-way, US 54. TURN RIGHT (southwest) on US 54. NOTE: the shaft site of the Spaulding Coal Company was just to the southwest of the intersection. The mine was abandoned in 1915.
0.75 13.15 To the left is an example of multiple land use. The land was pastured for many years before a sand pit was opened to remove the Parkland Sand. Now the area is being developed for home sites.
0.25 13.4 Cross Sangamon River bridge. This bridge shows severe damage to the concrete from the use of deicing salt.
1.25 14.65 To the right across the ICG railroad tracks and just beyond the concrete wall and loading dock is the shaft site of the Utility Coal Corporation. This mine was abandoned in 1936. Figure 7 shows the extent of abandoned underground mines adjacent to Springfield. In addition, notice that coal has been produced principally from two coals, the Herrin (No. 6) Coal Member in the southern part of the county and the deeper Springfield (No. 5) Coal Member in the north. The map indicates that the No. 5 Coal is probably thin or absent south of the heavy solid line representing 3-foot thickness. The No. 6 Coal is probably thin or absent north of the heavy dashed line representing 3-foot thickness. The map also shows depths to the two coals. More than 244.4 million tons of coal have been produced from Sangamon County mines since records were first kept in 1882. This tonnage ranked the county ninth among the 71 coal-producing counties. Total estimated coal produced from Illinois since 1833 amounts to more than 4.6 billion tons. During 1976, the last date for which production figures are available, Illinois produced more than 58 million tons of coal valued at $924.3 million.
Figure 7. Coal thickness and depth data, mined-out areas, and oil field locations in the Springfield area (taken from Plate 4, Circular 497).
CAUTION: begin section of 4-lane divided highway. Move to inside (left) lane to facilitate upcoming left turn. Note flatness of lake plain.

BEAR LEFT (southeasterly) toward Camp Butler.

CAUTION: DANGEROUS INTERSECTION—STOP LIGHTS. BEAR LEFT (east) through green light.

CAUTION: rough crossing, two tracks. Norfolk and Western (N&W) Railroad.

CAUTION: begin section of divided highway near entrance to Camp Butler National Cemetery. BEAR RIGHT (southeasterly and then easterly) toward US 36.

CAUTION: merge with US 36 traffic from right.

CAUTION: end of divided highway; begin two-lane traffic.

Cross Sangamon River bridge.

BEAR LEFT (northeasterly) on US 36 at spur junction to Riverton.

Riverton water treatment plant to left.

CAUTION: cross road. TURN RIGHT (southerly) on I-72 access road.

CAUTION: entering I-72 interchange. CONTINUE AHEAD (south) over I-72 and on to gravel road (CR-7EO).

Excellent view to right of broad flat Sangamon River terrace, which is about 10 to 15 feet above the Sangamon River floodplain. The farm house in the distance is close to the west edge of the terrace.

T-road intersection. TURN RIGHT (west) on CR-1AN.

Itinerary crosses the terrace noted previously.

TURN LEFT (south) at entrance to Clear Lake Sand and Gravel Company. Mileage figures will resume from this point after leaving Stop 4. Follow the company road southeasterly for about 0.3 mile to the office. You MUST get permission to enter this property.

The Clear Lake Sand and Gravel Company operating pit and screening plant (SE4, NE4, SW4, Sec. 22, T. 16 N., R. 4 W., 3rd P. M.; Springfield East 7.5' quadrangle).

Tremendous quantities of outwash sand and gravel from the melting Woodfordian Shelbyville ice front, when it stood in the Decatur area, were flushed down the Sangamon River. As the meltwater volume and velocity decreased, the river also lost its ability to transport large quantities of coarse materials, and they were dropped out as valley train deposits along the valley walls. Later erosion removed much of this material except for that contained in local terrace remnants.
The deposit underlying the terrace at the Clear Lake Sand and Gravel Company is predominantly sand with comparatively little gravel that is more coarse than 1-inch in diameter. Here the deposit is covered with 5 to 10 feet of silt and clay overburden, which must be removed before dredging can begin. As the upper part of this sand and gravel is very close to the water table, dredging is the most economical recovery method. Here the terrace deposit is 35 to 40 feet thick.

Sand and gravel are important construction materials. Because these are bulky and heavy, transportation costs are high. Therefore, the community that has adequate supplies of these construction materials close at hand is fortunate indeed.

The dredging equipment is located on the barge in the distance. There is a large chain cutter head that is part of an extensible, submersible dredging tool used to disaggregate the terrace deposit. Large electric motors, up to 200 hp, power the pumps, which operate the 10-inch suction line from the cutter head and pump the material through the tail pipe to the screening plant. The tail pipe is 1,300 to 1,400 feet long and 8 inches in diameter. The material goes through several vibrating screens to separate out the gravel, before it goes through a sluice tank to further separate the material by gravity. Screw classifiers then clean and separate the material into the various size fractions, which are then carried by conveyor belts to the different storage piles.

Although some gravel is produced here, the main products are:
1) Torpedo Sand—coarse; used for concrete ready-mix and blacktop.
2) Mason Sand—medium grained; for masonry work.
3) Blend Sand—very fine; used for blacktop mix mainly.

Please do not:
1) Climb on the sand piles.
2) Throw rocks into the water or into other piles.
3) Mix materials from one pile into another.

Please do:
1) Collect some good specimens for your rock, mineral, and fossil collection.
2) Ask questions.

Total sand and gravel production for Illinois during 1976 amounted to nearly 38.8 million tons, valued at more than $87.1 million.

0.0 21.6 Leave Stop 4. Resume mileage and TURN LEFT (west) at the entrance and descend to the Sangamon River floodplain.
0.15 21.75 Riverton town water well about 50 feet north of road to right.
0.1 21.85 Riverton town water well about 250 feet south of road to left.
0.05 21.9 Riverton town water well about 100 feet north of road to right.
Two of these wells were completed in 1961, and the third was finished in 1972. Water is taken from 10 to 20 feet of sand and gravel in the wells, which range from 47 to 54 feet deep. Water production from each of these wells is about 280 to 300 gallons per minute. The water is then piped to the water treatment plant noted earlier on the south side of Riverton. Spaulding gets its water from Riverton.

0.35 22.25 Cross Coal Bank Bridge over Sangamon River. During low water levels, the roof shale of the Chapel (No. 8) Coal Member is exposed in the west bank of the river north of the bridge. The No. 8 Coal is only about 18 inches thick in the Springfield area, but it was mined locally for many years.

0.3 22.55 T-road from left. TURN LEFT (south).
0.85 23.4 Cross Sugar Creek bridge.
0.6 24.0 STOP; 2-way. TURN LEFT (east) on blacktop.
0.6 24.6 Cross South Fork Sangamon River bridge.
0.3 24.9 Prepare to turn right.
0.1 25.0 TURN RIGHT (south). CAUTION: CR-6.25E very narrow at intersection.
1.0 26.0 T-road intersection. TURN RIGHT (west) on CR-1S.
0.65 26.65 CAUTION: cross road; no stops. TURN LEFT (east and then south) on CR-1.25S from CR-5.75E.
0.85 27.5 The tank batteries and pump jacks to the east of the road here are in the Riverton South oil field, which was discovered in 1965. This small field had 3 producing wells at the end of 1976 and 40 proved acres of production. Oil is from 8 feet of Silurian dolomite at a depth of 1,590 feet. Oil production from the Riverton South field in 1976 was 1,600 barrels; total production from this field since its discovery is 89,200 barrels. Total oil production from Sangamon County since 1888 is more than 3 million barrels. During 1976, oil production from Illinois totaled more than 26.2 million barrels, valued at more than $267.4 million. CONTINUE AHEAD (south and then east).

0.3 27.8 T-road intersection. TURN RIGHT (south) on CR-6.5E.
0.15 27.95 CAUTION: unguarded Baltimore and Ohio (B&O) Railroad crossing.
1.5 29.45 CAUTION: enter town of Rochester.
0.15 29.6 STOP; 1-way, East Main Street. TURN RIGHT (west).
0.4 30.0 CAUTION: Rochester Business District. Prepare to turn left.
0.1 30.1 CAUTION: TURN LEFT (south) at sign to SR 29.
0.05 30.15 STOP; 2-way. TURN RIGHT (northwest) on 4-lane highway and move immediately to inside lane to facilitate upcoming left turn.
0.05 30.2 CAUTION: LEFT TURN at STOP LIGHT and then proceed (westerly) through B&O Railroad underpass.
1.55 31.75 Cross South Fork Sangamon River bridge.
1.2  32.95  STOP; 1-way. TURN RIGHT (north) on East Lake Drive.
0.35  33.3  Prepare to turn left.
0.1  33.4  CAUTION:  TURN LEFT (west) into Forest Park East.  CONTINUE AHEAD to parking area.  Mileage figures will resume from entrance.

**STOP 5**

LUNCH in picnic area (near center of E5SW4 Sec. 7, T. 15 N., R. 4 W., 3rd P. M.; Springfield East 7.5' quadrangle) and discussion of Lake Springfield and the City Water, Light and Power Company plants on the west side of the lake (NW4SE4 and NE4NE4SW4 Sec. 13, T. 15 N., R. 5 W., 3rd P. M.; Springfield East 7.5' quadrangle).

Springfield's growth in the 1920s necessitated procuring a dependable and adequate water supply. As the old well field north of town (discussed at Stop 2) was no longer adequate, the decision was made in 1928 to build a surface reservoir for the city. The geology of the three proposed reservoir locations was the most important factor in selecting the best dam site. A site on the Sangamon River at Peabody, just upstream from Stop 2, was rejected, because thick sand and gravel deposits in the valley bottom would have caused serious seepage problems beneath the dam. Another site on the South Fork Sangamon River near Rochester was rejected, because the thick sand, silt, and clay sediments in the valley bottom would have presented problems for the foundation of the dam. A third site, on Sugar Creek two miles east of Mildred, finally was chosen when test borings of the valley showed it to have the most favorable conditions.

Although the test borings showed about 40 feet of silt in the Sugar Creek valley bottom, penetration tests indicated that the silt had a high enough bearing strength to be satisfactory for a dam foundation. The silt rested on bedrock of Pennsylvanian sandstone, which would make an excellent natural base for the spillway. However, in order to build the reservoir at this site, two dams would be necessary: 1) Spaulding Dam, the main structure across Sugar Creek; and 2) a smaller dam across a low sag in the divide between Sugar and Horse Creeks, about two miles to the southeast. The lake has a watershed of about 265 square miles, extending west and southwest close to New Berlin, Waverly, and Virden. Water storage was begun in January 1934 and was completed to the normal pool elevation of 560 feet (msl) during 1935. Five spillway gates maintain the normal pool elevation within close tolerances. An increase in lake level would cause erosion of the relatively stable shoreline and increase the siltation rate in the lake. The original capacity of the reservoir was nearly 20 billion gallons. Siltation of the reservoir has reduced its capacity by slightly less than 2.5 billion gallons in the 42 years since impoundment was completed. If the rate of capacity loss were to remain constant in the future, it would take the reservoir nearly 300 years to fill with silt.
Water Treatment Plant

The water treatment plant for the city of Springfield was constructed in 1933 just west of the new Lakeside Power Plant. Water is pumped from the lake into the plant, where it is filtered and treated chemically for use. Lime is added to induce precipitation of carbonate, thus reducing the hardness of the water; iron salts and several polymers, to coagulate suspended matter; chlorine and ammonia, as disinfectants; and activated charcoal, to control the taste and odor of the water. Once the treatment is completed, the water flows by gravity into large underground clear wells from which it is pumped into the approximately 500 miles of distribution lines to more than 38,000 water customers (meters, that is). The system serves a population greater than 140,000, including several of the smaller surrounding communities.

This plant is capable of treating about 40 million gallons of water per day (mgpd); there have been occasions during extended hot, dry summer periods when the peak hourly demand for several hours has been close to the plant's capacity. Although the population of this area has increased over the past several years, water consumption has remained relatively constant at about 20 mgpd for about the last 12 years; perhaps people are not as wasteful with water as they were formerly.

City Light and Power Company

The two large buildings with the tall smokestacks on the west side of the lake are the power generating plants for the city of Springfield. The red brick building on the right is the Lakeside Plant constructed in the early 1930s when Spaulding Dam was under construction. It has 7 electrical generating units capable of producing 146 megawatts (Mw) of electricity; 4 are coal-fired and 3 are oil-fired units. The larger stack and the silver building to the left is the V. Y. Dallman Power Station which came on stream in 1968 with one coal-fired 80 Mw unit. Another unit of the same size was added later. The plant capacity is being more than doubled with the addition of a coal-fired 200 Mw unit that is scheduled for completion in mid-1978.

Coal for these plants comes from two Illinois mines, one about 25 miles to the southwest in Macoupin County, and the other about 80 miles to the east in Douglas County. Presently the plants use about 800,000 tons of Herrin (No. 6) Coal annually, but it is anticipated that consumption will increase to about 1 million tons within a couple of years.

Top size of the purchased coal is 2 inches in diameter. After arriving at the plant, this coal is crushed to a ½ inch top size and some is pulverized depending on which coal-fired unit it is to be used in. The coal is blown into the furnaces where it is burned in the air stream. The ash is collected before it can be expelled through the smokestacks into the air. Ash from these plants is flushed through pipelines into the settling pits on the north side of Spaulding Dam. Some of the ash is being used for backfilling around sewer lines and as base material for some roads and driveways.
Water from the lake is used for cooling in the power plants where it is heated about 15°F at a maximum before it is returned to the lake. During times of peak power demand, these two plants will circulate 220,000 to 240,000 gallons of water per minute.

0.0  33.4  Leave Stop 5 and resume mileage figures at the park entrance. TURN RIGHT (south) on East Lake Drive.

0.45 33.85  CAUTION: Rochester Road to left. CONTINUE AHEAD (south) on East Lake Drive.

1.25  35.1  Cross auxiliary dam.

0.3  35.4  Pumping station to left below road. Water can be pumped from Horse Creek into Lake Springfield during times of low water levels.

0.05  35.45  South end of auxiliary dam.

0.45  35.9  Lake Park area to right. BEAR LEFT (southerly) on East Lake Drive.

1.35  37.25  TURN LEFT (south) on CR-3.25E at signs pointing to Lake Services Offices and KOA Camp Ground.

0.35  37.6  Lake Services Office to right. CONTINUE AHEAD (south).

0.65  38.25  Cotton Hill Farm to left, home of Joseph Roy Brunk. The part of the home facing the road is constructed of stone from the quarry at Stop 6. The home was built in 1829 and has walls 18 to 24 inches thick. In the early 1900s concrete was plastered over the stone and scored to resemble concrete block construction. CONTINUE AHEAD (south).

0.1  38.35  T-road intersection. TURN LEFT (east) on CR-7.25S at sign pointing to KOA Camp Ground.

0.25  38.6  Park on right side of the road. Do not block drive to farm on right (south) side of road. Proceed through gate to left. MAKE SURE THAT THIS GATE IS LOCKED BOTH AFTER YOU ENTER AND AFTER YOU LEAVE! You will be walking through a large pasture containing many registered horses.

Pennsylvanian Shoal Creek Limestone Member and Pleistocene sediments (WANNEC Sec. 6, T. 14 N., R. 4 W., 3rd P. M.; New City 7.5' quadrangle). Walk about 700 feet north along the rock road toward the Brunk Cemetery, and then go down the slope to the east into the abandoned quarry.

This rock is a sandy dolomite that was used mainly for roadstone. The slabby character of the rock permitted it to be split readily in suitable thicknesses for use as a building stone. The stone was used in the Brunk residence and in other old buildings in the vicinity. Several small quarries operated in this vicinity to produce mostly building stone. Shoal Creek Limestone from some of these quarries was used in constructing the first State Capitol building in Springfield in 1837. This building has recently been completely dismantled and rebuilt to its original plan.
During the summer of 1942, this quarry was operated by the Works Project Administration (WPA) as a source of roadstone. In addition, building stone for many of the bridge abutments in the area was produced here.

This rock is the youngest bedrock exposed in the field trip area. It is the Pennsylvanian Shoal Creek Limestone Member of the Bond Formation, which was deposited in a shallow sea that spread across this region about 290 million years ago. Two intersecting sets of open joints can be seen on the upper surface of the limestone in the west and north sides of the quarry. On the north side of the quarry on the top surface are numerous scratches and gouges, called glacial striations, which were made by glaciers as they moved across the bare rock surface. The Illinoian Monican glaciers moved slowly across this area perhaps 200,000 years ago. The striations indicate that the glacier was moving toward the southwest. The geological section exposed here is as follows:

QUATERNARY SYSTEM
PLEISTOCENE SERIES
WISCONSINAN STAGE
WOODFORDIAN SUBSTAGE
PEORIA LOESS—grayish brown podsolic surface soil, brown, massive leached; 10 ft.
SANGAMONIAN STAGE
ILLINOIAN STAGE
MONICAN SUBSTAGE
VANDALIA TILL MEMBER—Sangamon Soil developed in Vandalia Till.
A horizon—absent
B horizon—dark reddish brown clayey silt; blocky; iron and manganese pellets; chert pebbles, leached; 2 ft. Grades downward to:
C horizon—reddish brown till, changing to gray downward; leached in upper part, which is also iron and manganese stained; lower part is a good pebbly till; 19 ft.

PENNSYLVANIAN SYSTEM
MCLEANSBORO GROUP
BOND FORMATION
SHOAL CREEK LIMESTONE MEMBER—tan to reddish brown; sandy; coarse grained; slabby, fossiliferous, dolomitic limestone; about 1 foot from top is a prominent zone of crinoid fragments; base concealed; 4 ft+.

Gastropods, pelecypods, crinoids, trilobites, and brachiopods can be collected from the Shoal Creek, but the brachiopods are most abundant and include the following partial list:

<table>
<thead>
<tr>
<th>Brachiopod</th>
<th>Genus and Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beecheria bordens</td>
<td>Linoproductus prattenianus</td>
</tr>
<tr>
<td>Chonetes granulifer</td>
<td>Marginifera splendens</td>
</tr>
<tr>
<td>Composita subtilita</td>
<td>Neospirifer cameratus</td>
</tr>
<tr>
<td>Crurithyris planoconvexa</td>
<td>Phricodothyris perplexa</td>
</tr>
<tr>
<td>Derbyia crassa</td>
<td>Wellerella osagensis</td>
</tr>
<tr>
<td>Juresania nebrascensis</td>
<td>Wellerella tetrahedra</td>
</tr>
</tbody>
</table>

0.0  38.6  Leave Stop 6.  LOCK GATE.  TURN AROUND and retrace itinerary west and north.
0.25 38.85  STOP; 1-way.  TURN RIGHT (north) on CR-3.25E.
1.1  39.95  STOP; 1-way.  TURN RIGHT (northeast) on East Lake Drive.
1.8  41.75  Cross auxiliary dam.
1.6 43.35 CAUTION: Rochester Road intersection. CONTINUE AHEAD (northerly) on East Lake Drive.

0.9 44.25 Enter Spaulding Dam road. Ash settling ponds to right. This earth fill dam is 1,900 feet long.

0.3 44.55 CAUTION: narrow bridge over spillway. Chapel (No. 8) Coal is exposed to the upper right in the cut bank below the spillway.

0.35 44.9 Cross I-55. CONTINUE AHEAD (west) on Stevenson Drive.

0.2 45.1 CAUTION: STOP LIGHT. TURN RIGHT (north) on Dirksen Parkway.

0.6 45.7 BEAR LEFT into inside lane of the 4-lane divided highway.

0.25 45.95 To the left beyond the fence is an abandoned shale pit. A Pennsylvanian shale was used along with overlying Pleistocene materials for the manufacture of bricks and tiles. Eventually, this area will also be converted into a landfill site.

0.2 46.15 To the left is the landfill site that will be Stop 7.

0.05 46.2 To the upper right is the Illinois Department of Transportation Office Building.

0.2 46.4 CAUTION: fast traffic. TURN LEFT (west). This road is quite rough.

0.15 46.55 TURN LEFT (south).

0.05 46.6 STOP. Office and entrance to Merle Buerkett's landfill site. You must get permission to enter this property (SW 1/4 Sec. 1, T. 15 N., R. 5 W., 3rd P. M.; Springfield East 7.5' quadrangle).

Discussion of landfills and multiple land-use ideas.

This stop affords an opportunity to study a multiple land-use site. For a number of years the shale above the Chapel (No. 8) Coal and the overlying Pleistocene materials were mined for the manufacture of bricks and tiles. This is the site of the former Poston Brick and Concrete Products Company—part of their processing plant was located just to the east of the landfill office and the shale pits to the south. This company developed a special large square paving brick that used external steel reinforcing rods in two directions for support. The test roads using this pavement were of exceptional quality and durability. Recently there has been renewed interest in this paving process. The company closed in the early 1970s.

Mr. Buerkett assumed control of the property on March 1, 1975, and drained two of the former shale pits for use as landfills. Generally, some 200 trucks will bring an average of 1,500 cubic yards of refuse here each day of operation. Each day the refuse must be compacted by the special tractors and then covered with 6 inches of soil. The sloped area to the south of the office building has about 50 feet of compacted fill material. Within a short time, when filling of this site is completed, the area will receive a final 2-foot soil cover to aid in establishing a good vegetative cover over the site. Cover material is brought in from an area just beyond the cut bank of
soil west of the office. There are two other former shale pits in this immediate vicinity that will probably be used for landfills when this site is full. After landfilling operations cease here, tentative plans are to convert the area for some recreational purpose, perhaps a park.

Shale pits make good landfill sites, because the shale left around the pit is fine grained and tight. Liquids from the decomposition of the refuse do not move through the shale readily to contaminate ground water resources. It also appears that some of the clay minerals adsorb substances in the leachates. Another advantage of this landfill site is that it does not receive large amounts of surface water, which could percolate through the compacted refuse and cover materials and cause seeps and springs along its downslope end.

In 1977 the Environmental Protection Agency (EPA) estimated that each person in the country will generate an average of four pounds of refuse per day, about one-fifth of which is food scrap. Our nation spends several billion dollars each year to dispose of our refuse materials. There are alternatives to burying this waste. Much of it can and should be recycled, such as paper products, metals, and glass. Even the organic wastes can be used for generating combustible gases that could help to alleviate some of the fuel shortages. However, some of these alternative methods of handling refuse also are expensive.

0.0 46.6 Leave Stop 7.

0.05 46.65 STOP; 1-way. CONTINUE AHEAD (north, west, and north) on Shale Street. The large brick building to the left (west) is one of the remaining buildings near the shaft site of the Brewerton Coal Company, No. 81 Mine. This mine in the No. 5 Coal was abandoned in 1939.

0.3 46.95 TURN LEFT (west) on Ash Street and go 2.4 miles to Spring Street.

0.3 47.25 CAUTION: unguarded Illinois Terminal (IT) railroad crossing.

0.05 47.3 CAUTION: STOP LIGHT. CONTINUE AHEAD (west) on Ash Street through 4 stop lights and over 3 railroad crossings.

1.95 49.25 TURN RIGHT (north) on Spring Street. The 5th stop light to the north will be on Edwards Street.

1.2 50.45 CAUTION: STOP LIGHT. Edwards Street. The Illinois State Museum is on the northeast corner of Spring and Edwards Streets. Parking is available along the streets and in one of the state parking lots just west of the Museum.

Illinois State Museum (near center of the S line, NW 1/4 SE 1/4 NE 1/4 Sec. 33, T. 16 N., R. 5 W., 3rd P. M.; Springfield West 7.5' quadrangle).

This stop will afford you the opportunity to compare some of the specimens you have collected today with museum display specimens. You will also see dioramas showing some of the early life forms of Illinois.
Legislation was enacted on May 25, 1877, to establish a state museum of natural history. The former state geologist from the Geological Survey of Illinois became the first curator of the Illinois State Museum.

At first the Museum consisted only of a sorted, well-labeled, boxed collection of Illinois fossils, rocks, and minerals, collected by the State Geological Survey and stored in the basement of the State Capitol. In December 1854 the collection had been shipped from the initial location of the Survey in New Harmony, Indiana, 300 miles via the Wabash, Ohio, and Mississippi Rivers to St. Louis and then by railroad to Springfield; the collection arrived in April 1855. Before the Geological Survey was discontinued in 1875, the collection had been moved to several locations and was finally stored in the basement of the State Capitol. The collection was moved from place to place within the Capitol, sometimes suffering damage, then to the State Arsenal, and eventually to the Centennial Building, where it remained for nearly 40 years. Donations to the Museum and increased programs and services made the need for more space urgent.

Although plans were formulated in the late 1930s, the present museum building at the corner of Spring and Edwards Streets, south of the Capitol, was not opened until February 1963. The geology exhibits in the main hall contain many excellent specimens of rocks, minerals, and fossils. The museum also has exhibition halls for anthropology, biology, and fine arts.

END OF FIELD TRIP

DRIVE CAREFULLY

SELECTED BIBLIOGRAPHY


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.
<table>
<thead>
<tr>
<th>STAGE</th>
<th>SUBSTAGE</th>
<th>NATURE OF DEPOSITS</th>
<th>SPECIAL FEATURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOLOCENE</td>
<td>Years Before Present</td>
<td>Soil, youthful profile of weathering, lake and river deposits, dunes, peat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7,000</td>
<td>Outwash, lake deposits</td>
<td>Outwash along Mississippi Valley</td>
</tr>
<tr>
<td></td>
<td>11,000</td>
<td>Peat and alluvium</td>
<td>Ice withdrawal, erosion</td>
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<td>Valderan</td>
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<tr>
<td></td>
<td>12,500</td>
<td>Drift, loess, dunes, lake deposits</td>
<td>glaciers; building of many moraines as far south as Shelbyville; extensive valley trains, outwash plains, and lakes</td>
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<td>WISCONSINAN</td>
<td>Woodfordian</td>
<td>Soil, silt, and peat</td>
<td>Ice withdrawal, weathering, and erosion</td>
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<td>(4th glacial)</td>
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<td></td>
<td>Farmdalian</td>
<td>Soil, silt, and peat</td>
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<td></td>
<td>28,000</td>
<td>Drift, loess</td>
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<td>Altonian</td>
<td>Soil, mature profile of weathering</td>
<td>Glaciation in northern Illinois, valley trains along major rivers</td>
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<td></td>
<td>75,000</td>
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<td>SANGAMONIAN</td>
<td>Jubileean</td>
<td>Drift, loess</td>
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<td>(3rd interglacial)</td>
<td>175,000</td>
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<td>Monican</td>
<td>Drift, loess</td>
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<tr>
<td></td>
<td>Liman</td>
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<td>ILLINOIAN</td>
<td>300,000</td>
<td>Soil, mature profile of weathering</td>
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<td>(3rd glacial)</td>
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<td>YARMOUTHIAN</td>
<td>600,000</td>
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<td>(2nd interglacial)</td>
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<tr>
<td>KANSAN</td>
<td>700,000</td>
<td>Soil, mature profile of weathering</td>
<td></td>
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<td>(2nd glacial)</td>
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<tr>
<td>AFTONIAN</td>
<td>900,000</td>
<td>Soil, mature profile of weathering</td>
<td></td>
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<tr>
<td>NEBRASKAN</td>
<td>1,200,000 or more</td>
<td>Soil, mature profile of weathering</td>
<td></td>
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<tr>
<td>(1st glacial)</td>
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SEQUENCE OF GLACIATIONS AND INTERGLACIAL DRAINAGE IN ILLINOIS

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

H.B. WILLMAN and JOHN C. FRYE

1970

Modified from maps by Leverett (1899), Ekblaw (1959), Leighton and Brophy (1960), 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
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.
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 non-marine 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.
<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Shale, gray, sandy at top; contains marine fossils and ironstone concretions, especially in lower part.</td>
</tr>
<tr>
<td>9</td>
<td>Limestone; contains marine fossils.</td>
</tr>
<tr>
<td>8</td>
<td>Shale, black, hard, laminated; contains large spheroidal concretions and marine fossils.</td>
</tr>
<tr>
<td>7</td>
<td>Limestone; contains marine fossils.</td>
</tr>
<tr>
<td>6</td>
<td>Shale, gray; pyritic nodules and ironstone concretions common at base; plant fossils locally common at base; marine fossils rare.</td>
</tr>
<tr>
<td>5</td>
<td>Coal; locally contains clay or shale partings.</td>
</tr>
<tr>
<td>4</td>
<td>Underclay, mostly medium to light gray but dark gray at top; upper part noncalcareous, lower part calcareous.</td>
</tr>
<tr>
<td>3</td>
<td>Limestone, argillaceous; occurs in nodules or discontinuous beds; usually nonfossiliferous.</td>
</tr>
<tr>
<td>2</td>
<td>Shale, gray, sandy.</td>
</tr>
<tr>
<td>1</td>
<td>Sandstone, fine grained, micaceous, and siltstone, argillaceous; varies from massive to thin bedded; usually has an uneven lower surface.</td>
</tr>
</tbody>
</table>

**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)
BRACHIOPODS

Wellerella tetrahedra $\frac{1}{2} x$

Juresania nebrascensis $\frac{2}{3} x$

Derbya crossa $1x$

Composita argentia $1x$

Neospirifer cameratus $1x$

Chonetes granulifer $\frac{1}{2} x$

Mesolobus mesolobus var. evampygus $2x$

Marginifera splendens $1x$

Crurithyris planoconvexa $2x$

Linopoductus "cora" $1x$
Springfield Geological Science Field Trip
April 29, 1978

Glaciolacustrine deposit—approximate boundary of Illinoian Teneriffe Silt; stratified silt and clay