A guide to the geology of the Farmer City area, De Witt County, Illinois

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Field trip Guide Leaflet 1979B
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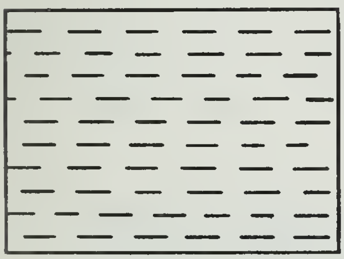
Cover photograph—A land shaped by two glaciations. The view is to the west overlooking the Illinoian glacial plain from the top of the Shelbyville Moraine at Route Mile 30.5. The Illinoian glacial plain was formed by the glaciation that ended perhaps 175,000 years ago. The Shelbyville Moraine is a younger landform constructed by a glacier about 20,000 years ago.

The geologic framework

A picture of the area. If a long, deep trench were dug across De Witt County, we could see in its sides the different layers of earth and rock that lie under the land surface. Figure 1 shows just such a trench-side view extending about 30 miles between the northeast and southwest corners of the county. This kind of drawing is called a geologic section. Different patterns in the geologic section represent end views of the earth and rock layers that lie within about 400 feet of the land surface.

We can summarize what the geologic section shows us about De Witt County in this way. A thick layer of drift, generally between 200 and 400 feet thick, forms the land surface and covers bedrock. The land surface is a nearly level plain that is a little roughened by shallow creek valleys and broad, low ridges called moraines. Glaciers and their meltwater streams deposited the drift and shaped the land surface.

The surface of the bedrock was the land surface until the glaciers covered it with drift. Comparing the present land surface and the old bedrock land surface, we can see that the glaciers buried a rougher landscape and left a smoother one behind. Now let us look at the picture of the area a piece at a time.



Bedrock: the Pennsylvanian rocks. In the field trip area, the solid rock (bedrock) under the glacial drift consists of thick layers of mudstone and sandstone with thinner layers of coal and limestone between them. These are sedimentary rocks, which were once sediments—loose, soft muds and sands. The sediments were deposited during the Pennsylvanian Period, the time between about 320 and 280 million years ago.

During the Pennsylvanian Period, Illinois and most of the midwest were part of a tropical region that was covered by shallow seas bordering swampy, forested river deltas and river floodplains. The region was in a part of the Earth's crust that was sinking very slowly, in such a way that areas in it were repeatedly and alternately covered by shallow seas and by swampy land. Muds, chalky muds, and shell sands that accumulated on the sea bottoms became mudstone (shale) and limestone beds. The muds, sands, and thick peat beds that accumulated in the deltas and floodplains became mudstone, sandstone, and coal beds. Sets of marine beds alternate with sets of lowland beds.

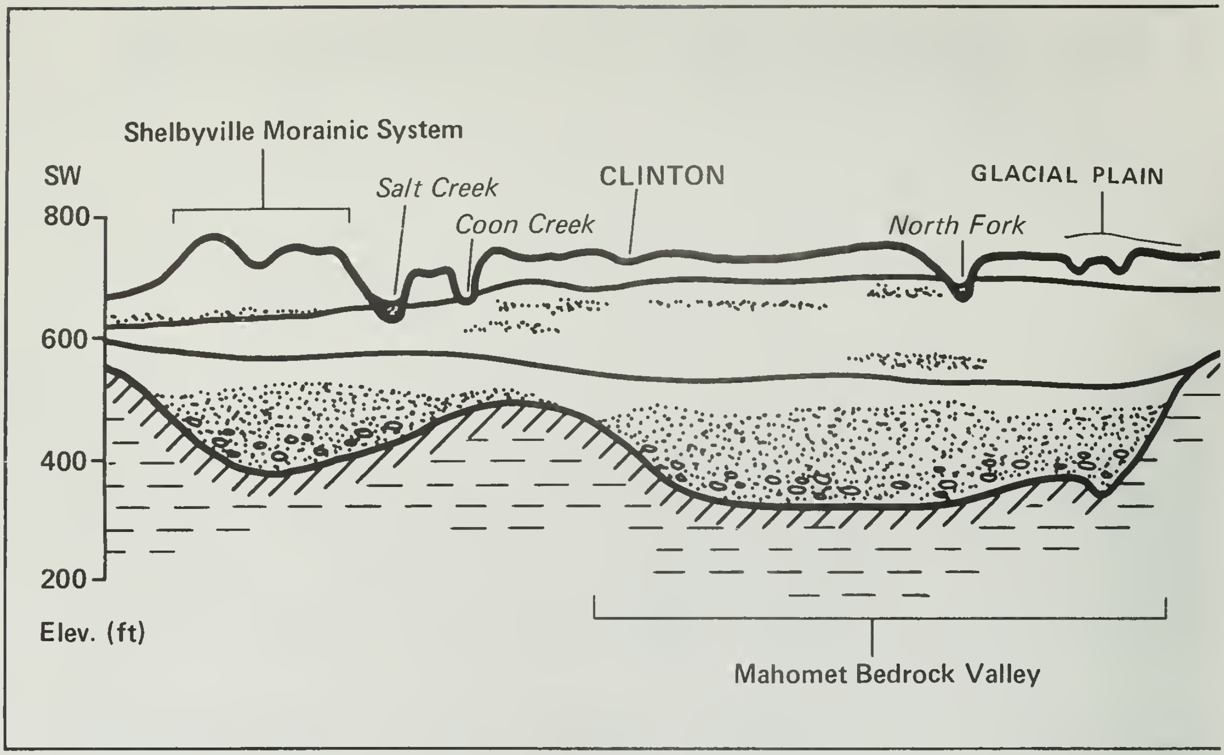
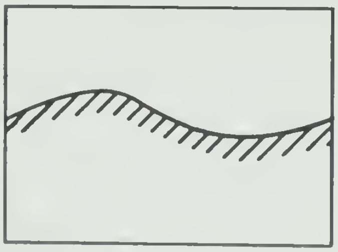


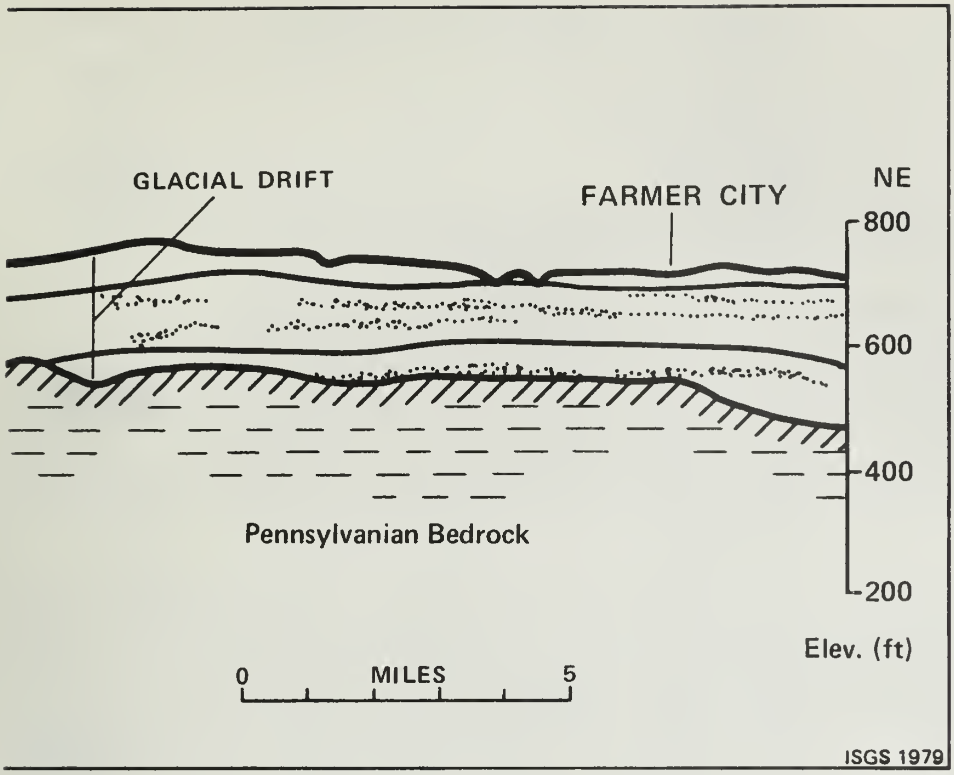
Figure 1. Geologic section across the field trip area. (Adapted from Hunt and Kempton, 1977, figure 7.)

In De Witt County, the Pennsylvanian bedrock has not provided significant resources. To date, its coal seams have been too thin to mine underground. Only a few wells pump ground water from the bedrock.

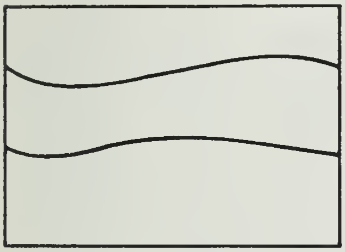
The older rocks. Below the Pennsylvanian beds are older layers of mudstone, limestone, dolostone, and sandstone, which are shown in figure 2. The sediments that formed these rocks accumulated on the floors of Paleozoic seas that began to cover the midcontinent during the early part of the Paleozoic Era, which began about 570 million years ago. The Paleozoic rocks covered a landscape carved by millions of years of erosion in Precambrian granites that were formed between about 1.5 and 1.2 billion years ago. Near Farmer City, the Paleozoic bedrock is about 6400 feet thick. Two oil fields pump petroleum from the Paleozoic rocks below the Pennsylvanian System in the county. The water from these rocks is too salty to use.



Pennsylvanian-Pleistocene unconformity. The cross-hatched line on top of the Pennsylvanian bedrock represents an ancient land surface that was buried by the glaciers. After the Paleozoic Era, Illinois and the rest of the midcontinent rose above sea level. From this time onward, over a period of possibly 200 million years, stream erosion cut away a several-thousand-foot thickness of bedrock and created the landsurface in the bedrock. The major feature in the bedrock surface is the Mahomet Bedrock Valley, which was cut by a great river that ran from the Appalachians to central Illinois. The cross-hatched line also represents an unconformity—the surface of contact between glacial deposits a million or so years old and bedrock about 300 million years old. If we think of the layers of sediment and rock in the



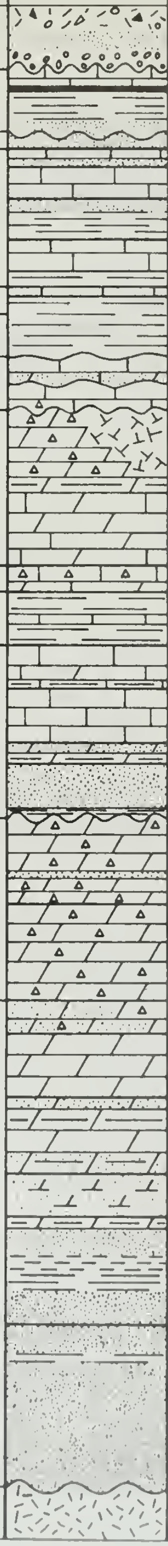
Earth's crust as pages in a book telling the geologic history of the Earth, then unconformities are missing pages that were never written or pages that were torn out of the book by erosion.



Glacial drift: till. Till is the sandy, gravelly mud carried and deposited by glaciers. Till can be laid down under a glacier or it can accumulate on the melting ice and be let down to the ground. A typical till is a hard, compact mixture of all sediment sizes: mostly clay, silt, and sand with smaller quantities of pebbles, cobbles, and boulders. Often each glacier left a till sheet that has a distinctive and identifiable color and composition.

The glaciers that entered Illinois and the Middle West at different times during the past several million years were the broad flowing edges of continental ice sheets that grew across Canada whenever the world climate cooled sufficiently. The southern margins of the ice sheets flowed into Illinois from the northwest and the northeast. The glaciers in Illinois are estimated to have been 3,000 to 5,000 feet thick.

In De Witt County, drift deposited by three different glacial stages of the Pleistocene—or Ice Age—covers the bedrock. The deposits of the oldest glacial stage known to be present are represented as the lowest layer of drift in figure 1. This stage is named the Kansan. The Kansan glaciation was followed by the Illinoian (the middle layer). The last glaciation, the Wisconsinan, deposited the upper drift layer and formed the present land surface. The ridgeline of the Shelbyville Morainic System. marks the outer limit of the Wisconsinan glaciation in this region.

SYSTEM	SERIES	GRAPHIC COLUMN	FORMATION OR GROUP	THICKNESS (FEET)
QUATERNARY	PLEISTOCENE			0 - 400
PENNSYLVANIAN				350 - 800
MISSISSIPPIAN	CHESTERIAN			0 - 100
	VALMEYERAN		Ste Genevieve	60 - 100
			St Louis – Salem	180 - 200
			Sonora	40 - 60
			Warsaw	90 - 180
			Keokuk – Burlington	120 - 220
			Fern Glen	40 - 70
	KINDERHOOKIAN		Chouteau	15 - 40
DEVONIAN	UPPER		New Albany	80 - 220
	MIDDLE		Cedar Valley (Hunton Megagroup)	0 - 50
			Wapsipinicon (Hunton Megagroup)	0 - 40
SILURIAN	NIAGARAN		(Hunton Megagroup)	275 - 700
	ALEXANDRIAN		(Hunton Megagroup)	25
ORDOVICIAN	CINCINNATIAN		Maquoketa	200
	CHAMPLAINIAN		Galena	150 - 180
			Platteville	200 - 250
			Joachim	40
			St. Peter	230 ±
	CANADIAN		Shakopee	300 ±
			Oneota	425 ±
CAMBRIAN	CROIXAN		Eminence	75 ±
			Potosi	250 ±
			Franconia	275 ±
			Ironton – Galesville	150 ±
			Eau Claire	575 ±
			Mt. Simon	2000 est
PRECAMBRIAN				

EXPLANATION

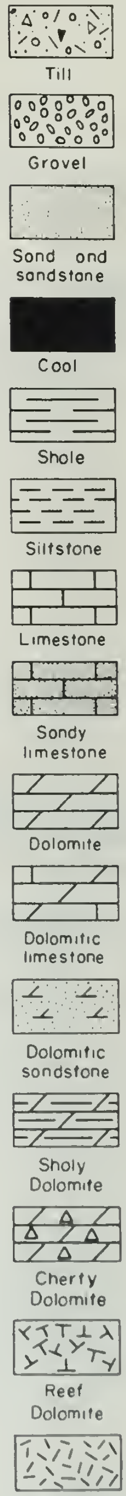
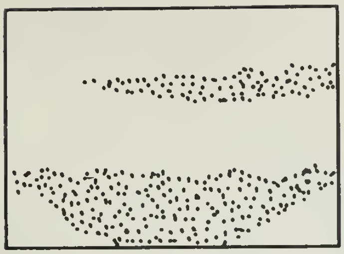


Figure 2. The rock units under De Witt County. (Howard, 1964, figure 2.)



Glacial drift: outwash sand and gravel. Buried in the till sheets and partly filling the larger stream valleys are bodies of sand and gravel deposited by meltwater streams running from the glaciers. The great volumes of meltwater eroded rock debris and mud from the ice. The streams washed and winnowed these sediments and deposited them, roughly sorted by size, in the watercourses draining the icefields.

The sand and gravel deposits buried in the drift by the glaciers provide the county's important water supplies. The deposits left on the surface by drainage from the last glacier supply construction materials. Below depths of a few feet or tens of feet in this area, the earth is saturated with ground water, which is snow water and rain that has soaked into the ground. Thus all types of drift contain water, but only the cleaner and coarser sand and gravel deposits yield large volumes of water quickly to wells.

Resources from drift. Natural gas is often produced by water wells that penetrate black mucky silt zones buried in the drift. Some wells yield enough "drift gas" to supply home needs. Most producing drift gas wells are in the western part of the county along the Shelbyville Morainic System. Generally, the source of the gas is the Robein Silt at the base of the Wisconsinan drift (Meents, 1960).

The glacial drift that covers De Witt County and about 90 percent of Illinois is a vital resource. Drift supports our constructions and supplies much of our water, sand, gravel, and brick clays. It is the fertile parent material for much of our soil and the container for our wastes. The level terrain that the glaciers formed made Illinois farm land easy to cultivate.

Alluvium, loess, and other sediments. A number of different sediments have been deposited on the field trip area since the last glacier melted off this county about 20,000 years ago. These deposits are too thin or small to show on figure 1. Flooding rivers and streams deposit sediment on their floodplains. This material, alluvium, is largely mud.

A deposit of wind-blown dust called loess covers the uplands. This drift deposit is as much as 8 feet thick on the west side of the county but thins eastward to about 4 feet on the east side. The dust was rock flour, or silt, pulverized by the glaciers. As long as glacial meltwater drained across Illinois, it carried rock flour into the state's large rivers and deposited it across their wide floodplains. In the winter, when the melting of the glaciers slowed, meltwater flooding abated in the rivers, and winds blew dust off the dry floodplains across the state.

Guide to the route

at mile	go	
		Begin at the Farmer City-Mansfield High School on North John Street opposite its intersection with West Richardson Street. The route and stops are marked on topographic maps on the following pages.
0.0	0.4 mile	Go south on John Street to the stop on Clinton Avenue (U.S. Route 54).
0.4	3.9	Turn right (southwest) on Route 54 and follow it to Parnell.

Valley and plain. For several miles, the highway follows the stream-notched side of the Salt Creek Valley. Look to the left and notice the wide, flat-bottomed, shallow creek valley. To the right is the nearly flat glacial plain with its slight sags and swells. As the last glacier to cover De Witt County flowed and melted, it left the mud and rock it carried as the blanket of till that forms the plain. Water off the melting glacier cut the Salt Creek Valley down into the plain.

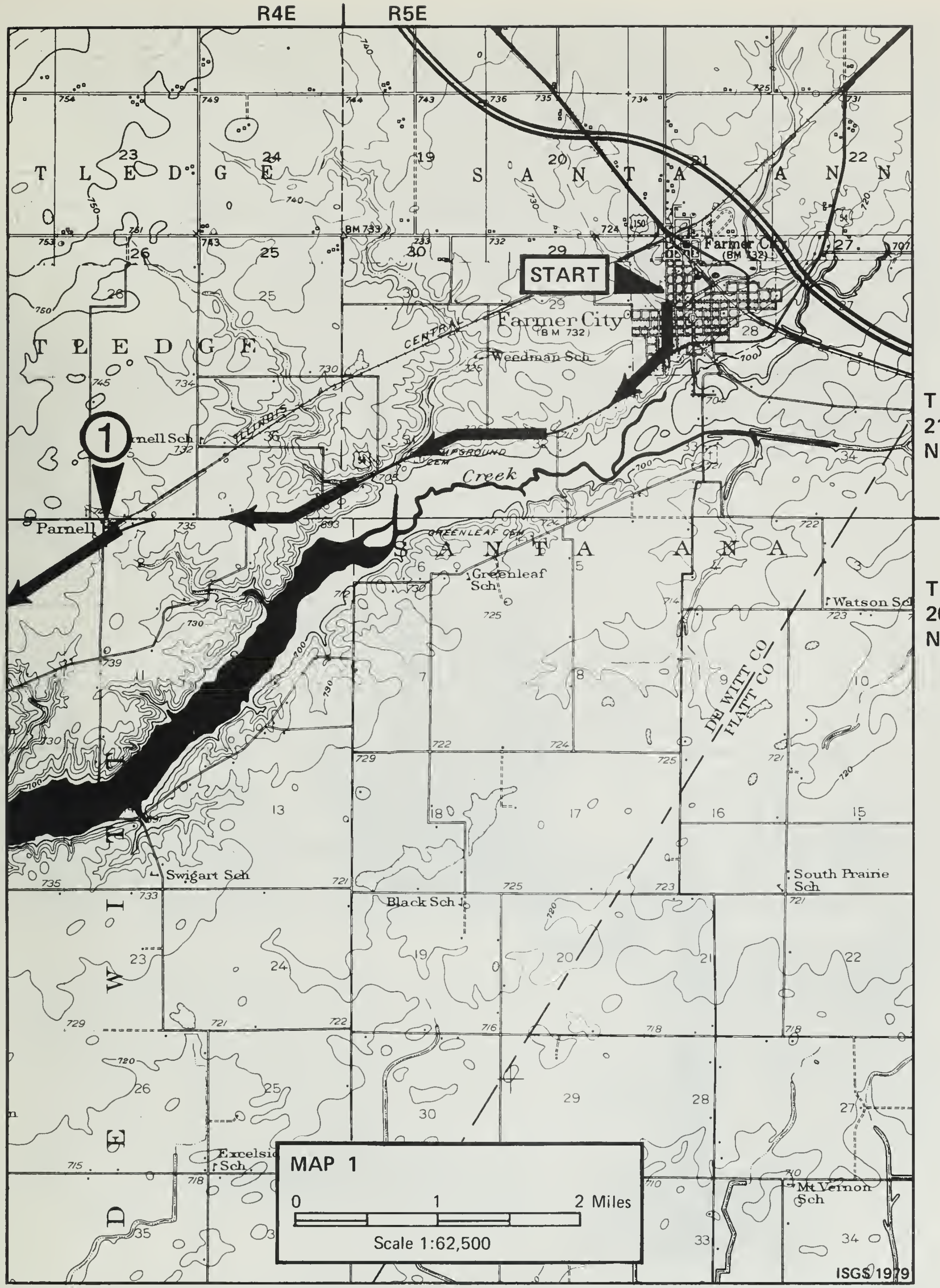
The Parnell oil field. After passing the Campground Cemetery, just before the highway curves west to Parnell, we enter the Parnell oil field. The first oil pump and storage tank we see are on the left, just beside the road.

4.3	0.3	Approaching Parnell, turn right (west) at the first turnoff on the curve. Cross the railroad and stop just before the second street past the railroad crossing. Wells of the Parnell oil field are in view north of the road.

STOP ①

The Parnell Oil Field. SW ¼ SE ¼ SW ¼ Sec. 35, T. 21 N., R. 4 E. (the southwest quarter of the southeast quarter of the southwest quarter of Section 35, Township 21 North, Range 4 East), De Witt County, Monticello 15-minute Quadrangle.

The wells we see pumping oil out of the ground are also pumping fossil sunshine—sunshine that struck the Earth several hundred million years ago. How is this possible? Oil and natural gas are the fluid remains of ancient sea plants and animals. In the distant past, as now, all living things were fed by


R4E
R5E
T
21
N
T
20
N
START
Farmer City
(BM 732)
Weedman Sch
Parnell Sch
Parnell
Creek
Greenleaf Sch
Watson Sch
DE WITT CO
PIATT CO
Swigart Sch
Black Sch
South Prairie Sch
Excelsior Sch
Mt Vernon Sch
SANTA ANA
MAP 1
0
1
2 Miles
Scale 1:62,500
ISGS 1979

the plants that used the energy of the Sun's rays to grow their own tissues. So it is that when we burn fuel oil, gasoline, and natural gas in our cars and homes, we complete a chemical cycle that living things began million of years ago. Burning a fossil fuel changes it into water and carbon dioxide—the substances that the ancient plants made into tissue. Moreover, the heat energy released by burning is a portion of the radiant energy the plants absorbed.

The origin of petroleum. How did petroleum and natural gas find their way into the pools that oil wells tap? The evidence for the favored theory comes from the location and composition of the deposits. The world's oil and gas fields are found in layered sea muds and sands and in the rocks such sediments form. Typically, oil-bearing sediments and rock are part of deposits that have collected for millions of years in sea-filled sags in the Earth's crust. These sags can be several hundred miles wide and long.

Chemical evidence points to plants and animals as the source of petroleum and natural gas. These fluids are mixtures of many different carbon- and hydrogen-rich chemicals. Some of the chemicals resemble or could be made from the substances living things produce.

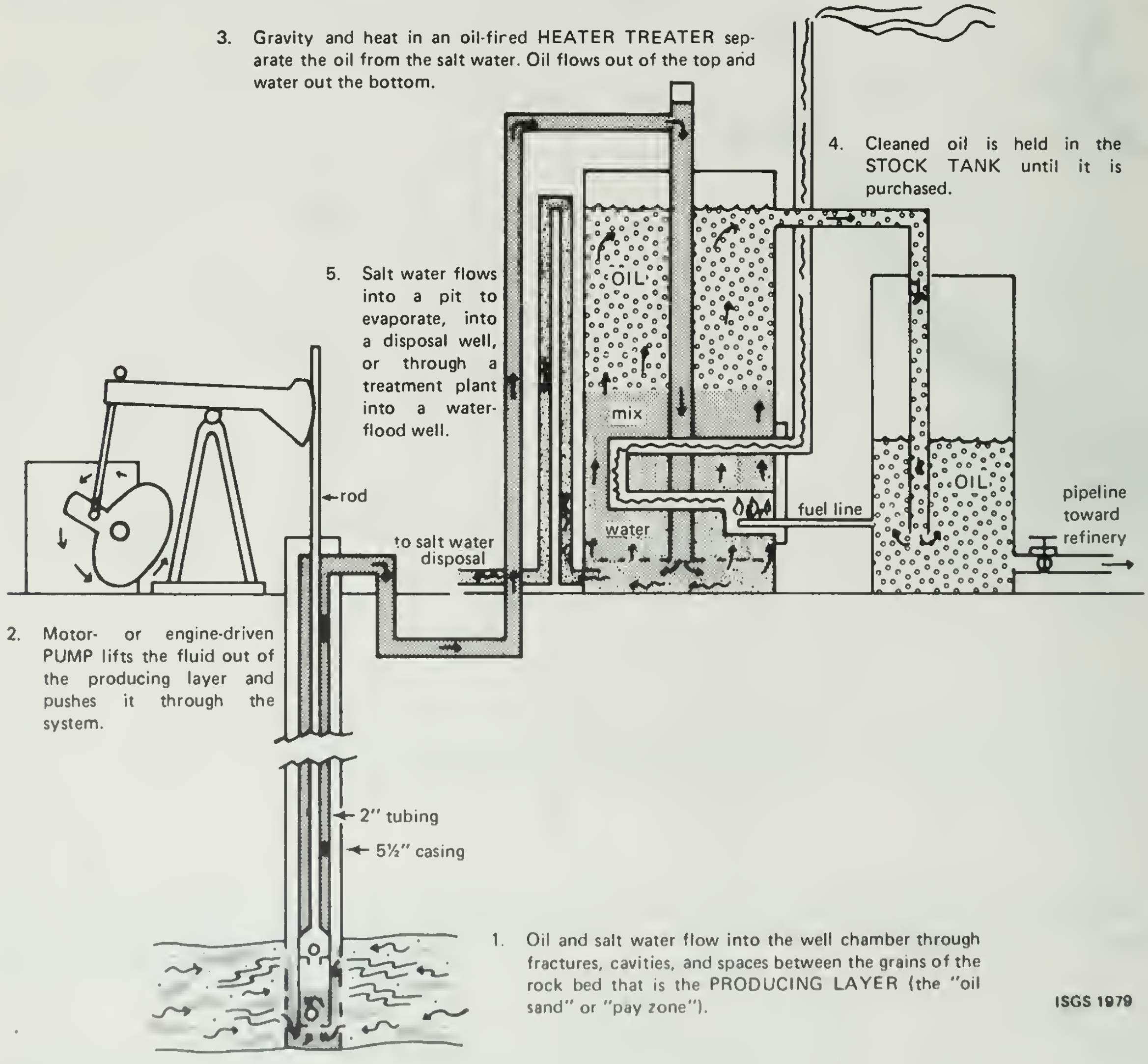


Figure 3. Schematic diagram of a common type of oil production unit in Illinois.

In addition to these facts, the theory observes that from the very distance past to the present, the seas have been flourishing gardens that nurture immense quantities of life—the bulk of it organisms that are hardly visible or microscopic. To the sea floors fall the dead and the waste of the living. Though scavengers eat most of this organic matter, some of it is mixed with the bottom muds and sands collecting on the sea floors and is buried. In the crust's sediment-collecting depressions, organic matter is buried deeper and deeper as more sediment accumulates. Over long periods, then, the pressure of thousands of feet of overlying sediment and the internal heat of the Earth are thought to pressure-cook the organic matter into the gases, oils, waxes, and tars that make up petroleum and natural gas.

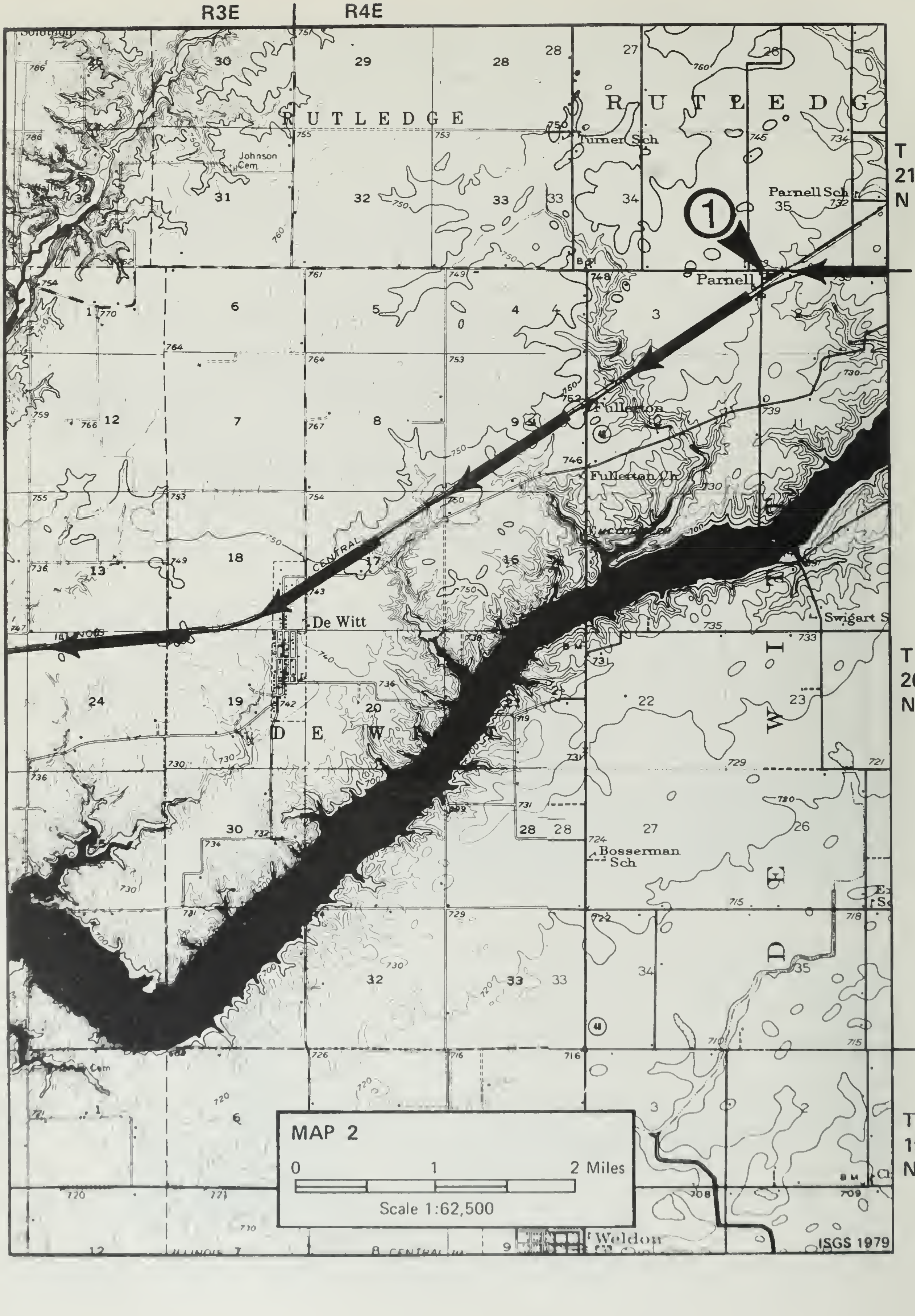
When petroleum and natural gas form, they are thought to be tiny droplets and bubbles scattered through the sediments. After forming, the droplets and bubbles move up through the sediment layers—floated up by the heavier brines in the sediments with them and squeezed up by the weight of the overlying beds that press the sediment grains closer together. The fluids move upward through tiny spaces between grains and along cracks and other connected openings in the coarser sediment and rock layers. Much of the gas and oil leaks out to the surface and is lost. But some of it floats up into traps—that is, arched or broken rock layers that are roofed and sided by very fine-grained rock layers that the fluids cannot pass through. In these traps of reservoir rock, oil and gas accumulate, filling the little holes in fossils and between rock grains. Oil-saturated rock forms the "pools" sought by oil-well drillers.

The Parnell oil field. Most of the oil produced here comes from cracks and spaces between grains in the Sonora Sandstone of Mississippian age at depths of about 670 feet. (Three wells produce from Devonian limestone bed at a depth of about 1100 feet.) The Parnell field's 38 producing wells yielded 12,300 barrels of crude oil in 1977 and a total of 193,700 barrels since its discovery in 1963 (Van Den Berg and Lawry, 1977).

The Wapella East oil field. The county's other oil field, Wapella East, is located about 11 miles west of here, 4 miles northeast of Wapella. Discovered in 1962, it has since yielded 2,848,400 barrels of oil—about 15 times the total production of the Parnell field. Its 1977 production was 99,700 barrels from 36 wells. In 1977 all Illinois oil fields produced a total of 25,608,000 barrels of crude oil valued in excess of $300 million.

Wapella East is a small field little more than a quarter-mile square. Its 36 wells produce from porous Silurian dolomite layers at depths of about 1100 feet. The pool is in a small dome. One of the most productive fields discovered in recent years, it is all the more remarkable because it is about 25 miles north of what had been considered the limit of the oil-producing area of Illinois. Mr. Lloyd A. Harris, a consulting petroleum geologist, was studying the well and test records in the Geological Survey's public files when he found the evidence of the Wapella East dome that led him to drill there. The field's discovery excited a great deal of exploration in the De Witt and McLean County area that unfortunately found only one other oil field, Parnell.

at	go	
4.6	0.1	Leave Stop 1 and turn left (south) into Parnell on the second street. Go to the stop at U.S. Route 54.
4.7	3.9	Turn right (southwest) onto Route 54 and go to De Witt.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ILLINOIS
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Weldon
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View. On the way to Stop 2 there are long views across the glacial plain (if the corn isn't too tall). The plain's surface has much the same contour that it had when the glacier melted off it. Only a few streams are cutting narrow valleys across it.

8.6	2.4	Enter the village of De Witt. Follow Route 54 to its intersection with the railroad track entering the Clinton Power Station, which will be visible in the next mile.
11.0	0.7	Crossing the railroad track, follow Route 54 past the station's construction entrance (at the traffic light) and descend into the valley of the North Fork.
11.7	0.3	After crossing the bridge over the North Fork arm of Clinton Lake, turn left into the parking lot of the Clinton Power Station Visitors Center.

Clinton Lake and the Visitors Center at the Clinton Power Station. SE corner SW ¼ NE ¼ Sec. 22, T. 20 N., R. 3 E., De Witt County, Maroa 15-minute Quadrangle.

STOP 2

Clinton Lake with its two branches lies across the county like a doubled crumpled ribbon. Its sinuous, tapered, spikey outline is characteristic of lakes filling stream valleys that have been dammed by such forces as landslides, lava flows, glaciers, human beings, and beavers. Notice that the lake's shoreline is a contour line—the water traces a near-level line along the sides of the two stream valleys and their tributaries. Clinton Lake has a 5000-acre area and contains about 24 billion gallons of water—about 1/46 of a cubic mile in volume. In contrast, the Great Lakes together hold about 6,000 cubic miles of water.

By geologic standards, lakes—especially small ones—are short-lived features. They sometimes drain when they overflow and cut outlets through the sides of their basins. They fill with mud that their tributaries carry in and that their waves wash off their shores. Their shallows harbor plants that gradually fill them in with peat.

Lakes are important sources of water. An estimated 97.2 percent of the world's water is in the oceans. Another 2.15 percent is frozen in glaciers and icecaps. Less than one percent of the world's estimated water supply is suitable for human use. Of this fraction of a percent, only about .009 percent is contained in freshwater lakes, but this small amount is more than 98 percent of the fresh surface water that is available (Nace, 1977).

The power station. Illinois Power Company is building a nuclear power station here to generate electricity. The station, visible to the east across the lake, will operate two power-generating units by late 1982. In each unit, the heat from fissioning Uranium-235 in a boiling water reactor will produce steam to drive a turbine turning a generator. Each unit will be capable of generating 950,000 kilowatts.

The lake in the power system. Clinton Lake is to the power station what a radiator is to a car. Water from the lake is the coolant circulated to absorb heat energy from the power-generating cycle, and the lake acts as a heat sink to absorb and dilute waste heat and conduct it to the air. The amount of heat the water will carry is very great. Between 60 and 67 percent of the heat energy produced in a power station by burning fossil fuels or by fissioning uranium must be removed from the generating equipment to cool it. Only about 33 to 40 percent of the heat energy obtained from the fuels can be used to generate electricity.

At this power station, pumps force lake water into the condenser tubes to cool the steam after it has passed through the turbines. The water condensed from the steam is pumped back—in a separate closed system—to the reactor. The lake water heated by the steam is discharged from the condenser into a 3.5 mile long flume. Partially cooled by its contact with the air and the flume, the water is finally discharged into the lake at a maximum temperature of 96°F.

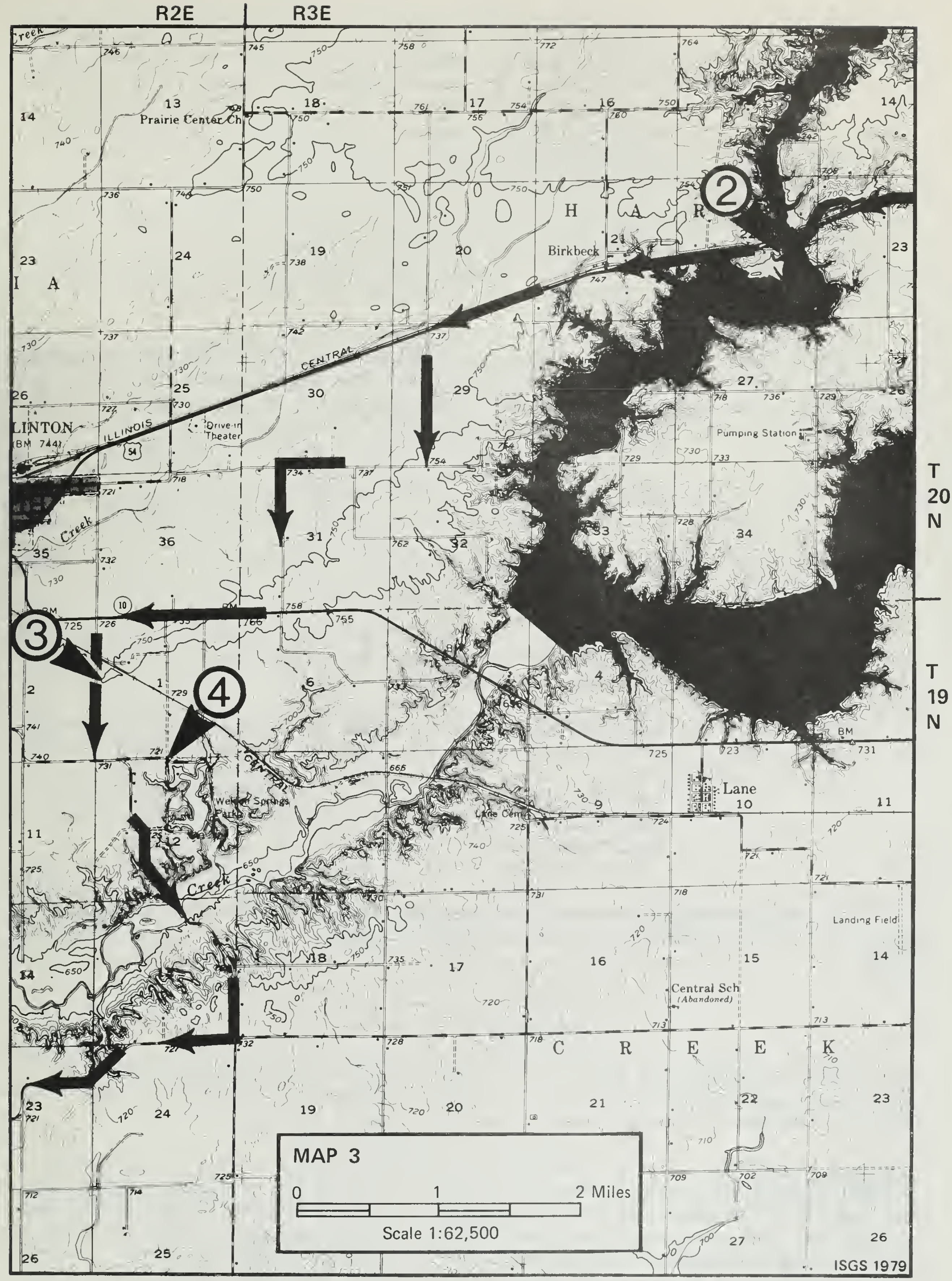
Three pumps impel water through the station's cooling system at a rate of 565,800 gallons per minute—about 34 million gallons per hour. At this rate the cooling system pumps a volume of water equal to the volume of the lake—an estimated 24 billion gallons—about every 29 days. Another way of looking at the pumping rate is to observe that the power plant's cooling system will be able to circulate in 3 minutes an amount of water equal to the daily municipal pumpage in De Witt County—1,607,000 gallons (Sanderson, 1979).

Waste heat must be disposed of carefully because heat is a pollutant if it enters an environment in quantities that the environment cannot contain without changing. Many life processes in water ecosystems, for example, are governed by very narrow temperature ranges. We in the United States use enormous and increasing quantities of cooling water, and about 85 percent of it is used in electric power generation. One estimate projects that cooling water demand by 1990 will be 350 billion gallons per day (Fowler, 1975).

<u>The visitors center</u>. This center contains exhibits interpreting the power station and its environment. Ask here about tours, programs, and recreation facilities on the lake. Groups should arrange programs and tours by contacting the Clinton Power Station Visitors Center, P.O. Box 936, Clinton, IL 61727. Phone 217/935-3181.

at	go	
12.0	1.2	Leave Stop 2. Turn left (west) onto Route 54 and go to Birkbeck.
13.2	1.3	Passing the grain elevators at Birkbeck, continue ahead (southwest) to second road to left.

<u>De Witt County's greatest landform</u>. We are now driving over the most remarkable landform in De Witt County—or in East Central Illinois, for that matter. Out of sight underfoot is a great river valley, the Mahomet Bedrock Valley, that was buried by the glaciers. The valley is larger than the present day Mississippi Valley, and the river that cut it into bedrock ran from the Appalachians of West Virginia to central Illinois. The Mahomet Valley's deeper part is about 6 miles wide here—we cross it between Stops 2 and 3—and its floor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is as much as 400 feet below us along the way. It lay unmapped below the glacial plain until 1945 when Leland Horberg, a Survey geologist, reported its presence. The valley is not merely a geologic oddity. The sand and gravel beds that half-way fill it supply an estimated 40 million gallons of water daily to roughly 300 to 400 thousand people in the nine Illinois counties along its course.

14.5	0.9	At the white shed on the left, turn left (south) and go to the stop.
15.4	1.0	At the stop, turn right (west). Go to the second road on the left.

Boulders. From this point on to Stop 5 notice the large boulders used for landscaping house yards. Many of them are foreign rocks that the last glacier carried from the states north of us and from Canada. The W. R. Brink history of the County reports that the millstones of several water-powered grist mills in the county were cut from drift boulders. Millstones were often made of granitic rocks, which are very hard and tough.

16.4	1.0	Turn left (south) at the T-intersection. Go to the stop at the Route 10 intersection.

The moraine. The hill line rising ahead of us is part of of the Heyworth Moraine. We ascend about 25 feet from the corner to its crest.

17.4	1.3	Turn right (west) onto State Route 10. Go to the Weldon Springs Road, which is marked by a brown highway sign.
18.7	0.4	Turn left (south) onto the Weldon Springs Road. Cross the unguarded railroad crossing and stop at the crest of the rise ahead.

STOP 3

The Heyworth Moraine overlooking the Mahomet Valley. SW ¼ SW ¼ NW ¼ Sec. 1, T. 19 N., R. 2 E., De Witt County, Maroa 15-minute Quadrangle.

The Heyworth Moraine

This ridge and the earth materials exposed in the roadcut on the east side give us an opportunity to look at the four evidences of continental glaciation: glacial landforms, foreign rocks, glaciated rocks, and till.

Glacial landforms. Glaciers and their meltwater create several distinctive landforms, but the most common are moraines. A moraine is a long, low ridge or line of hills constructed by a glacier. On the route map find the 750-foot contour at this stop and trace it—it outlines this moraine. Most moraines are built along the edge of flowing ice when the amount of ice flowing to the edge is about equal to the amount of ice melting there. In such cases, rock and earth carried in the melting ice were dropped along roughly the same line and formed a ridge. The Shelbyville Morainic System, which we cross between Stops 5 and 6, was formed this way, and this moraine may have been also. However, stream erosion could have had more to do with shaping this ridge than the glacier did.

The top of this ridge is at the same level as the higher levels of the less eroded till plain north of Stop 2 and between Stops 1 and 2, and the ridge could be a remnant of the till plain preserved as a divide between two drainage ways cut by meltwater from the glacier. The Salt Creek meltwater drainage eroded the valley into the till plain along the south side of the ridge, and the Coon Creek meltwater drainage cut down the till plain on the north.

Foreign rocks. A great many of the pebbles and cobbles in the roadcut are rocks from Canada and the states north of Illinois and do not come from Illinois bedrock. Probably the most easily recognized foreign rocks are the granites and granite gneisses—pink or red rocks that contain black, glittering crystals. In the gneisses the black crystals run through the rock in streaks or lines.

Glaciated rocks. Look for pebbles and cobbles with one or several very flat sides. Rocks frozen in the bottom of a flowing glacier and dragged across bedrock have their sides ground flat. The flat sides of glaciated rocks are called "facets" and are marked by parallel sets of scratches and grooves. Cobbles and pebbles that turned in the ice have several facets. Only glaciers leave these distinctive "footprints."

Till. The sandy gravelly mud deposited by glaciers is till. Glaciers drag and scuff rock and earth off the land they flow across and knead it up into their ice. Till deposits are smeared down on the land as the ice flows or let down when it melts. The key characteristics of till is its mixture of all grain sizes—chiefly clay and silt (flour sand) mixed with a large proportion of sand and gravel and a few cobbles and boulders. Only landslides produce similar mixtures of sizes.

Till is not easy to find in the roadcut because slump and grading have partly covered and smeared the exposure. While you are examining the outcrop, look for the two bodies of outwash showing in the top half of the cut. One, about 30 feet wide, is sand. The other, about 20 feet wide, is sand and gravel. Gravel, cobbles, and boulders thickly scattered along the ridge crest to the east are probably part of the outwash. Streams running off a melting glacier make outwash deposits by washing the rock debris out of the ice, rinsing out the mud, sorting the sand and gravel by size, and laying them down in their channels. Keep in mind that innumerable small outwash deposits like these were buried in the drift where glaciers flowed over them and deposited till. Such sand and gravel deposits in the drift are aquifers that supply water to many home and farm wells.

The Mahomet Bedrock Valley*

The Mahomet Valley is one of the largest of a number of buried valleys that geologists searching for water have found under the glacial drift. In Illinois and the glaciated midwest, these "fossil" landforms are mapped and drilled to

*adapted from Kempton, 1977.

find the thick sand and gravel aquifers that supply large, dependable quantities of high quality water. Records of the Northern Illinois Water Corporation, for example, show that the communities of Champaign and Urbana, Illinois, use about 5 billion gallons of water yearly from the Mahomet Valley aquifers. The State Water Survey calculates that De Witt County's municipal pumpage from the Mahomet Valley equals 1,607,000 gallons daily.

The drift aquifers. Drift sand and gravel aquifers like these in the Mahomet Valley sometimes yield such large quantities of water to dug and drilled wells that people imagine they have penetrated rivers or lakes in underground caverns. This is not the case. The water flowing in a sand and gravel aquifer is not one stream but innumerable millions of streams—tiny, intertwining trickles and seeps of water. The water does not flow in a cave but in the small spaces between the grains of sand and gravel that make up the water-bearing layers. "Rivers" of water are indeed pumped from thick sand and gravel aquifers, but the aquifers are in no way like the streams that can be seen emerging from underground in limestone caves in Illinois, Kentucky, and Missouri.

How water enters the aquifers. The water in the buried Mahomet Valley does not come from any great distance. It is the rain and snow water that soaks into the ground over the valley and near it. The water seeps downward slowly through the overlying, clayey till to the sand and gravel aquifer, which supplies water to wells and discharges some water into the main rivers that cross the Mahomet Valley. The aquifers of the Mahomet Valley are such a large reservoir that water supplies pumped from them are little affected even by periods of drought.

The preglacial Mahomet Valley. The Mahomet Valley evidently existed before the Ice Age, which began several million years ago. The valley was carved into bedrock by a large river that flowed from West Virginia to central Illinois, where it joined the Ancient Mississippi River. (At that time, the Ancient Mississippi flowed southeastward from near Rock Island to Hennepin, then southward in a valley now closely followed by the present Illinois River between Hennepin and Alton.) It drained about the same region as the Ohio River does now. In Illinois the Mahomet Valley is about 120 miles long. The bedrock uplands on each side are 200 feet and more above the valley floor—about the height of the present Mississippi Palisades. The valley in Illinois averages about 12 miles in width, much wider than the Mississippi Valley.

The arrival of the glaciers. When the glaciers from Canada flowed south into the area drained by the Mahomet Valley, their floods of meltwater carried sand and gravel outwash into it. These sand and gravel deposits are now porous, water-saturated aquifers in the Mahomet Valley, as much as 200 feet thick in places.

When the glaciers themselves flowed across the valley, they covered the outwash with layers of gray, pebbly, sandy clay that is called "till" by geologists and "blue boulder clay" by drillers and excavators. The succession of glaciers during the Ice Age filled the Mahomet Valley full of alternating layers of ice-carried till and meltwater-laid sand and gravel, burying it beneath the present landscape of glacial plains and moraines.

Discovery of the valley. After the last glaciation, the Mahomet Valley was almost completely buried by glacial debris. The only parts left visible are south of the glaciated region in south-central Ohio and West Virginia. It was there that the existence of the valley was first recognized. The westward con-

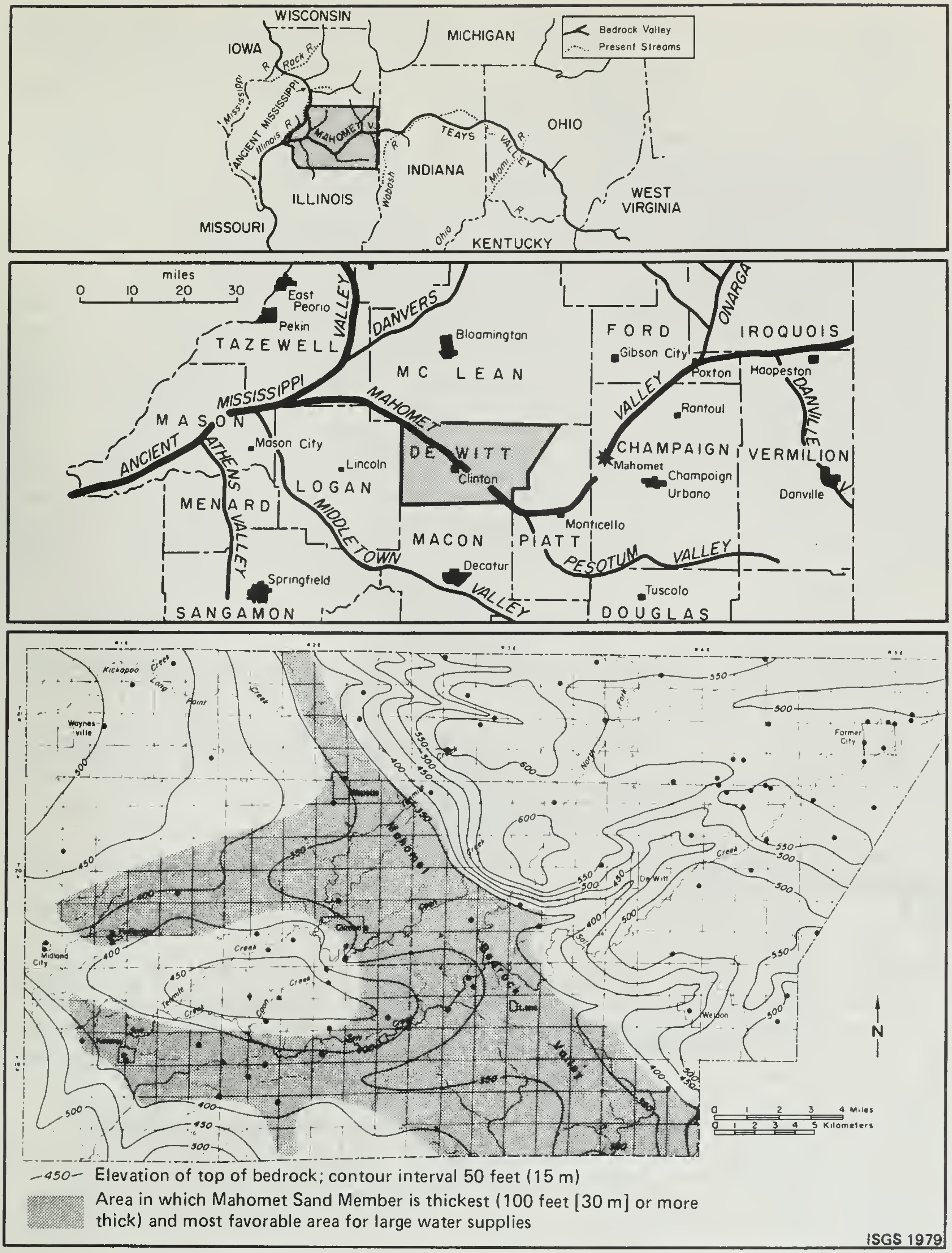


Figure 4. Location of the deepest channels of the buried Mahomet Bedrock and Ancient Mississippi Valleys and their larger tributaries in east-central Illinois.

tinuation of the valley under the drift was discovered by geologists studying the records and samples from wells drilled through the glacial deposits to the old bedrock valley floor. An Illinois geologist, Leland Horberg, named the buried valley after the Village of Mahomet, Champaign County, which is located over the deepest part of the buried channel. East of Illinois, the valley is generally called the Teays Valley. Drilling records furnished by companies making foundation tests and seeking water, oil and gas, and coal have enabled geologists to map in detail the valley, its aquifers, and the ancient landscape under the glacial deposits.

The future. Champaign, Urbana, and the other communities along the Mahomet Bedrock Valley are fortunate. For the most part, their water supplies are assured for a long time, provided that the water resources are developed and managed on the basis of the most up-to-date knowledge. The Illinois Water Survey estimates that as much as 445 million gallons daily might be taken from the Mahomet aquifer without depleting it (Sanderson, 1979). As new data from well drilling become available, geologists can determine more precisely the position of the valley and the distribution and the character of the deposits in it. Similarly, the Illinois Water Survey can continue to update information on the quantity and quality of the water being produced and can predict future trends in use and supply. Such information should help to insure the wise development and use of the ground water in the sand and gravel aquifers of one of our truly great natural resources, the Mahomet Valley.

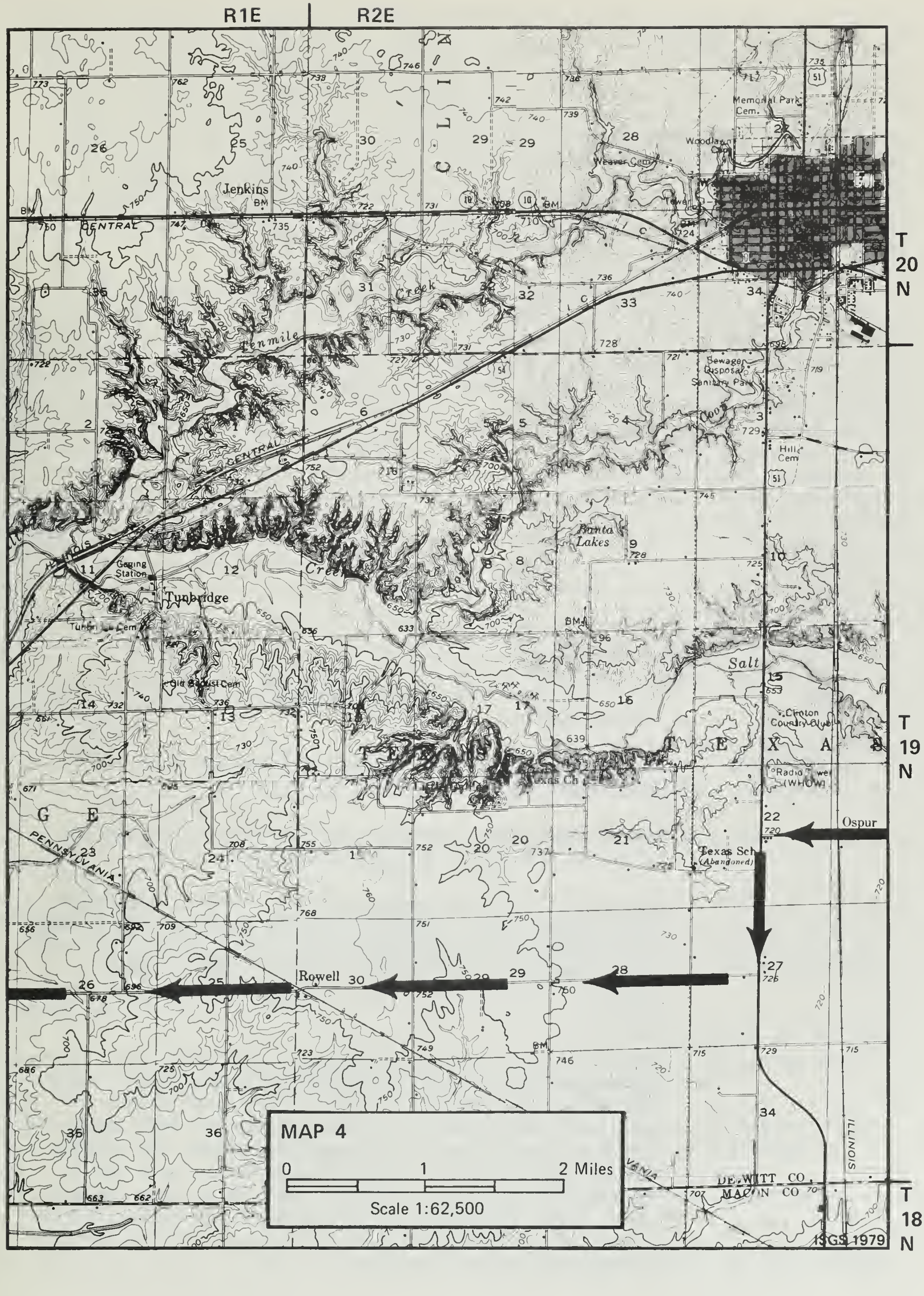
at	go	
19.1	0.6	Leave Stop 3. Continue ahead (south) to the stop.
19.7	0.5	Turn left (east). Follow the signs to Weldon Springs State Park.
20.2		Enter Weldon Springs State Park, Stop 4, for lunch. Take the eastbound road to the Park Office. The springs are south of the road in the hollow.

STOP 4

Weldon Springs. NW ¼ NW ¼ NE ¼ Sec. 12, T. 19 N., R. 2 E., De Witt County, Maroa 15-minute Quadrangle.

The park. Historically, springs have been associated with the locations of settlements, religious traditions, medicine, and magic. As far as we can discover, the Weldon Springs have attracted only local attention as a rustic resort. The iron-salted waters that stain their catch basins with rust seem not to have traditions of a romantic or miraculous sort ascribed to them. However, the locality has been a social center for the region since the turn of the century. It was a Chautauqua site from 1901 through 1920. Chautauquas were summer camp meetings that provided programs of education and entertainment. They were very popular events, held throughout the country in the late 19th and early 20th centuries and featuring nationally prominent statesmen, ministers, authors, and performing artists. A brochure describing the park and its history is available at the Ranger Station or from the Illinois Department of Conservation.

The water cycle at Weldon Springs. The water we see flowing out of the springs fell to earth some months ago as rain and snow. In this area, annual precipitation is about 39 inches of water—almost 678 million gallons per square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Jenkins
Memorial Park Cem.
Woodlawn
Weaver Cem.
Tenmile
Creek
Sewage Disposal
Sanitary Park
Hill Cem
Banta Lakes
Gaging Station
Tunbridge
Tunbridge Cem
Old Baptist Cem
Salt
Clinton Country Club
Radio Tower (WHOW)
Ospur
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mile. Most of the water runs off the surface into streams and lakes and evaporates. Only about 10 percent of the precipitation soaks into the ground and percolates downward. Once underground in the water-saturated earth below the water table, the water continues to be impelled downward by gravity. Some of it flows downslope toward seeps and springs that discharge into the springs, the lake, and Salt Creek. The rest flows deeper into the drift filling the Mahomet Valley and into the bedrock below. Flowing through the ground, the water becomes "hard" by dissolving iron, calcium, and magnesium compounds out of the soil and rock. The Weldon Springs evidently flow out of the edge of a thin, shallow sand and gravel bed buried in the drift. They emerge at points where the stream valley is cut down through the aquifer.

The aquifer feeding the springs was penetrated by a water well drilled at the ranger station, which is about 500 feet north of the springs. Samples from the well (Survey Sample Set No. 57571) show that from the surface to a depth of 15 feet, the drill penetrated a layer of brown silty till that contains gravel in its lower part, probably as thin layers or pockets. The gravelly lower part of the brown till is at about the same level as the springs and is coarse grained enough to allow the relatively rapid discharge of water at the surface. The springs are fed by precipitation that falls on the land up the slope from them to the north. To recharge such low-volume springs as these requires an area that need extend no more than a quarter mile from the springs.

at	go	
20.2	0.3	Leave the park entrance and go west to the stop at the Y-intersection.
20.5	1.3	Turn left (south) and follow the blacktop road to the Salt Creek Bridge.
21.8	1.0	Cross the bridge. Stay on the blacktop road, bearing south at the top of the hill. Go to the stop.

<u>Gravel pits and the valley terrace</u>. There is an abandoned gravel pit on the right, just south of the bridge. Mine symbols mark many other gravel pits along this valley. The pits mined sand and gravel from an older, higher floodplain level above the creek's present floodplain.

Meltwater off the last glacier cut the Salt Creek Valley down into till to a little more than its present depth. The meltwaters then filled the valley with layers of mud, sand, and gravel to a level about 20 feet above the present floodplain. Later meltwater flows and streams occupying the valley since the glaciation have cut a trench into the old, higher floodplain to form the present, lower floodplain. The parts of the higher floodplain left as step-like deposits along the sides of the valley are called "terraces."

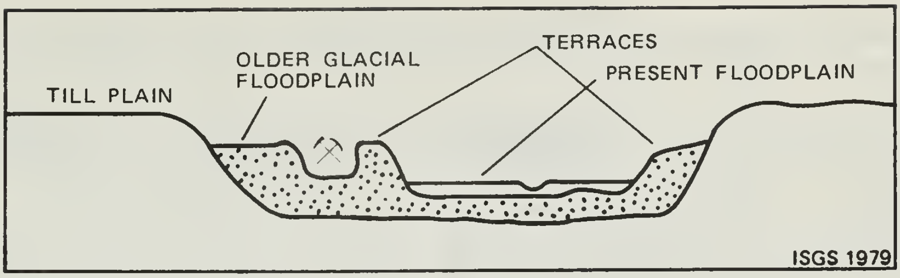


Figure 5. Terraces in the creek valley.

22.8 2.7 Turn right (west) at the stop sign and follow the black-top road west to the stop at U.S. Route 51.

View. Look south (left) across the very flat till plain shaped by the last glacier and its meltwater.

25.5 1.0 At the stop by Texas Township Hall, turn left (south) on U.S. Route 51. Go to the second road on the right.

Texas Township. Township names in the county commemorate settler families (Nixon, Barnett, Harp), statesmen (De Witt Clinton), wars (Santa Anna of the Mexican War), local landmarks (Tunbridge, Creek), and other aspects of history important to the settlers. The name Texas Township preserves a settler's joke. According to the History of De Witt County, "Daniel Newcomb, a citizen of Clinton, sold out with the intention of going to Texas, changed his mind and located within the limits of this township saying it was ...as far into Texas as he wanted to get."

26.5 3.3 Turn right (west) on the Kenny Road. Go to the railroad crossing in the village of Rowell. The road ahead goes up the back slope of the Shelbyville Moraine.

29.8 3.1 Cross the railroad. Go ahead to the stop at the fourth road intersection.

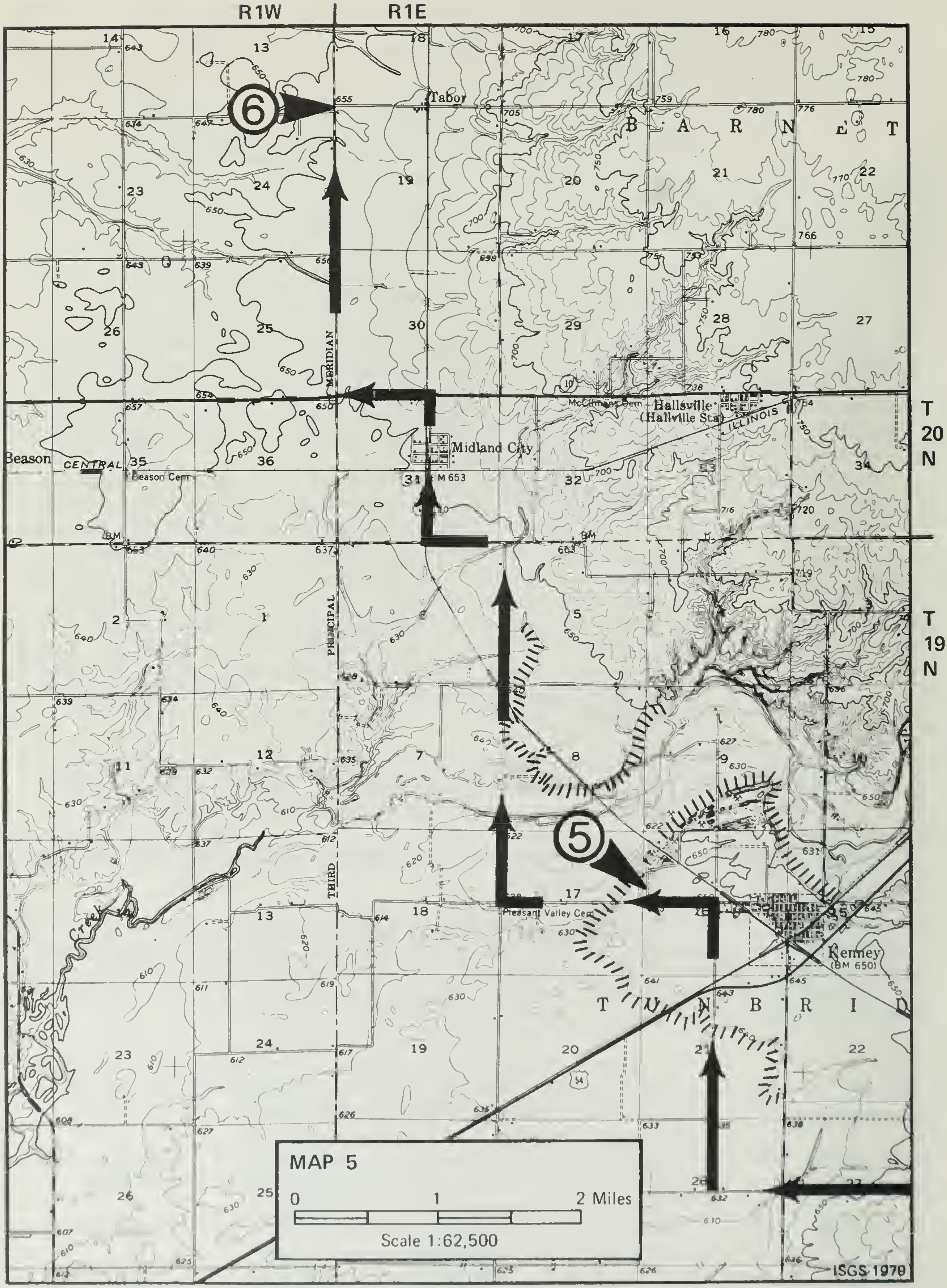
The Shelbyville Moraine. Just ahead is the crest of the moraine that marks the limit of the Wisconsinan glaciation in Illinois. The last glacier to cover the region was building the Shelbyville Moraine about 20,000 years ago.

From the crest of the moraine, we look west across the Illinoian till plain, which was deposited during the glaciation that preceded the Wisconsinan.

32.9 0.5 Stop and cross the road to continue west, jogging right and then left. Go to the first road on the right.

33.4 1.4 Turn right (north) onto the gravel road. Go to the stop at U.S. Route 54.

View. From here to the end of the trip, our route runs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THIRD
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Hallsville
(Hallville Sta)
ILLINOIS
CENTRAL
Midland City
Beason
Beason Cem
Pleasant Valley Cem
Kenney
(BM 650)
T U N B R I D
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ISGS 1979

along the front of the Shelbyville Moraine, which is the continuous ridge about a mile to our right (east).

34.8	0.6	Stop and cross Route 54. Caution, there is a very rough railroad crossing beyond the highway. Go to the stop at the next crossroads.
35.4	0.5	Stop. Turn left (west) onto the blacktop road. Go to the entrance of the Kenney Gravel Pit—its stockpiles are in view ahead.
35.9		Turn right (north) into the lane leading to the working pit and the office.

The Kenney Gravel Pit of Rowe Construction Company. SW ¼ NW ¼ Sec. 16, T. 19 N., R. 1 E., De Witt County, Kenney 15-minute Quadrangle.

STOP 5

NOTE: Please obtain permission to visit the pit by contacting the Company office here or at 1523 North Cottage Street, Bloomington, IL 61701.

The Kenney Gravel Pit supplies road gravel and fill sand to a small market area within about a 20-mile radius of the pit. It is a "surface-mining" or "strip-mining" operation that is typical of the state's largest and smallest producers in almost all respects. Differences in demand create different plant sizes; differences in amounts of fine and coarse materials and the kinds of rock present determine the products sold. In 1976 the industry produced a total of 38,784,000 tons of sand and gravel products with an estimated value of $87,152,000 (Samson and Dingwell, 1979). Evenly divided among our state's 11,229,000 residents (the July 1976 provisional population), this tonnage would provide about 3.5 tons of sand and gravel per person.

Sand and gravel, washed and screened to different product sizes, are used in many ways as surfacing and aggregate materials. Aggregates are the fillers in concrete and "blacktop" mixtures that make up volume so that less of the more expensive binders—cement and asphalt—are used. In an ordinary concrete mix, for example, the gravel (or crushed stone) and sand make up about 85 percent of the mix but amount to only about 45 percent of the cost. In rapidly developing areas, people need great quantities of sand, gravel, and stone for concrete and construction materials, and the closer the source of materials, the lower their cost. Unfortunately, development tends to curtail the operations of neighboring pits and quarries by building over undeveloped gravel and stone reserves and by restricting or excluding the industries by zoning or regulation.

De Witt County is a small producer of sand and gravel. There is not the high demand for it that large populations and developments require in other parts of the state. In addition, the county has only small quantities of near surface reserves, which are almost entirely confined to the terrace deposits along Salt Creek below the North Fork.

The mining operation. According to the mine operators, the gravel deposit is covered by a layer of loess (clayey silt) that averages about 5 feet thick. This layer is stripped off and piled to the side to reach the gravel. A dragline and other earthmoving equipment mine the gravel, carry it to the plant, and load it in. The gravel deposit has an average thickness of about 16 feet.

The processing plant contains screens to size the products and to direct overlarge gravel and rocks to the roll crusher and jaw crusher. The crushers reduce the oversized rocks to product size. All the coarse material cycles through the crushers and screens until it is no larger than one inch in diameter, the maximum size for road mix. The outwash is relatively fine-grained: about half of it will pass through a screen with 3/16-inch openings.

The outwash. As the Wisconsinan glacier melted in this region, it sent floods of sediment-laden water down the Salt Creek Valley and filled it with outwash to a level 20 to 25 feet higher than the creek's present floodplain. Parts of this older and higher floodplain level are preserved on the tops of the terraces in the valley east of the Shelbyville Moraines and on the tops of the gravel deposits mined near Kenney. (Just after we leave this pit, we step down off the terrace from the higher floodplain level to the lower.)

The Kenney gravel deposits were laid down where the glacial stream came through the Shelbyville Moraine. East of the moraine, meltwater was confined to the narrow valley. West of the moraine, the meltwater stream flowed onto the lowland in front of the moraine where it spread, slowed, and shifted from side to side. As a result, most of the sand and gravel the stream carried was laid down in a roughly fan-shaped deposit that extends about 2 miles from the gap in the moraine to the northwest, west, and southwest.

Rock collecting here. As the glaciers flowed southward into Illinois from central Canada, they picked up rocks from every region they crossed. Consequently, the drift gravels in the northeastern quarter of Illinois—the youngest and least weathered—are excellent materials to search for rocks, fossils, and minerals. One can collect dozens of different specimens in an hour, many of them from Canada and the states north of us. Only the soft and easily split rocks from distant regions are hard to find; the weak sedimentary and metamorphic rocks—shales, slates, mica schists, etc.—were usually pulverized by the flowing ice.

at	go	
35.9	1.0	WARNING: There is a 7-ton-limit bridge on the route ahead. To bypass it, return to Kenney and take the Hallsville Road north to Route 10. Leave Stop 5. Turn right (west) at the entrance and go to the first crossroad at the cemetery. Terrace. 0.2 mile west of the gravel pit entrance, the road steps down abruptly from the outwash plain surface (elevation 640 feet) to a lower floodplain (about 620 feet).
36.9	1.4	Turn right (north) at the cemetery. Go to the unguarded railroad crossing. On the way cross the one-lane, 7-ton limit bridge over Salt Creek. Terrace. About 0.2 mile north of the bridge, we go up onto another terrace—from the floodplain of Salt Creek (610 feet) to the surface of the outwash plain (635 feet).

38.3	1.1	At the railroad crossing, continue north to the second road intersection.
39.4	0.5	At the T-intersection, turn left (west) and go to the next corner.
39.9	1.0	Turn right (north) and go through Midland City to the stop on Illinois Route 10.
40.9	0.6	Stop. Turn left (west) on Route 10. Go to the first road to the right, County Road 2400 East.
41.5	2.0	Turn right (north) onto County Road 2400 East. Go to the second road intersection, County Road 1800 North.
43.5		Stop at the intersection of County Roads 2400 East and 1800 North.

The Third Principal Meridian. 250 feet south of the NW corner of Sec. 19, T. 20 N., R. 1 E., De Witt County, Kenney 15-minute Quadrangle. **STOP ⑥**

The survey meridian. County Road 2400 East follows a line that divides Illinois down its entire length. Sighting north along the road, we look down the Third Principal Meridian to its intersection with the Illinois-Wisconsin border about 6 miles west of Beloit. Sighting south, we look to the mouth of the Ohio River at Cairo. A federal land survey established the Third Principal Meridian and the base line crossing it in 1805. These two lines, intersecting at right angles, were divided many times to form part of the rectangular township and range grid that divides almost 80 percent of post-Colonial United States into one-mile squares.

The township and range survey was established soon after the American Revolution as a provision of the comprehensive law devised by the new Congress to distribute and govern the lands won from England and ceded to the government by the federating states. This law, The Great Land Ordinance of 1785, dealt with the first public domain, the Old Northwest Territory, which included Illinois, Indiana, Ohio, Wisconsin, and part of Minnesota. The law provided that the public lands be surveyed and divided into 6-mile-square townships, with the townships to be subdivided into 36 one-mile-square sections.

To appreciate the significance of the Great Land Ordinance, we must realize that, before 1785, rectangular patterns of land division were seldom used. The ordinary European and American land divisions were irregularly shaped parcels surveyed by "metes and bounds." Metes and Bounds lines follow natural features such as hill crests and streams and are also measured between natural landmarks and markers chosen by the surveyor. On a map, parcels surveyed by metes and bounds produce crazyquilt patterns of the sort preserved by land boundaries in the original 13 states.

The survey in Illinois. The federal survey entered Illinois west of Vincennes, Indiana, in 1804. It was carried from the Second Principal Meridian. The pioneer surveyors were a mixed lot, of varied training, skill, and conscientiousness. Some, like Abraham Lincoln, were self-taught. All, as their records attest, were plagued by hostile elements: weather, Indians, squatters,

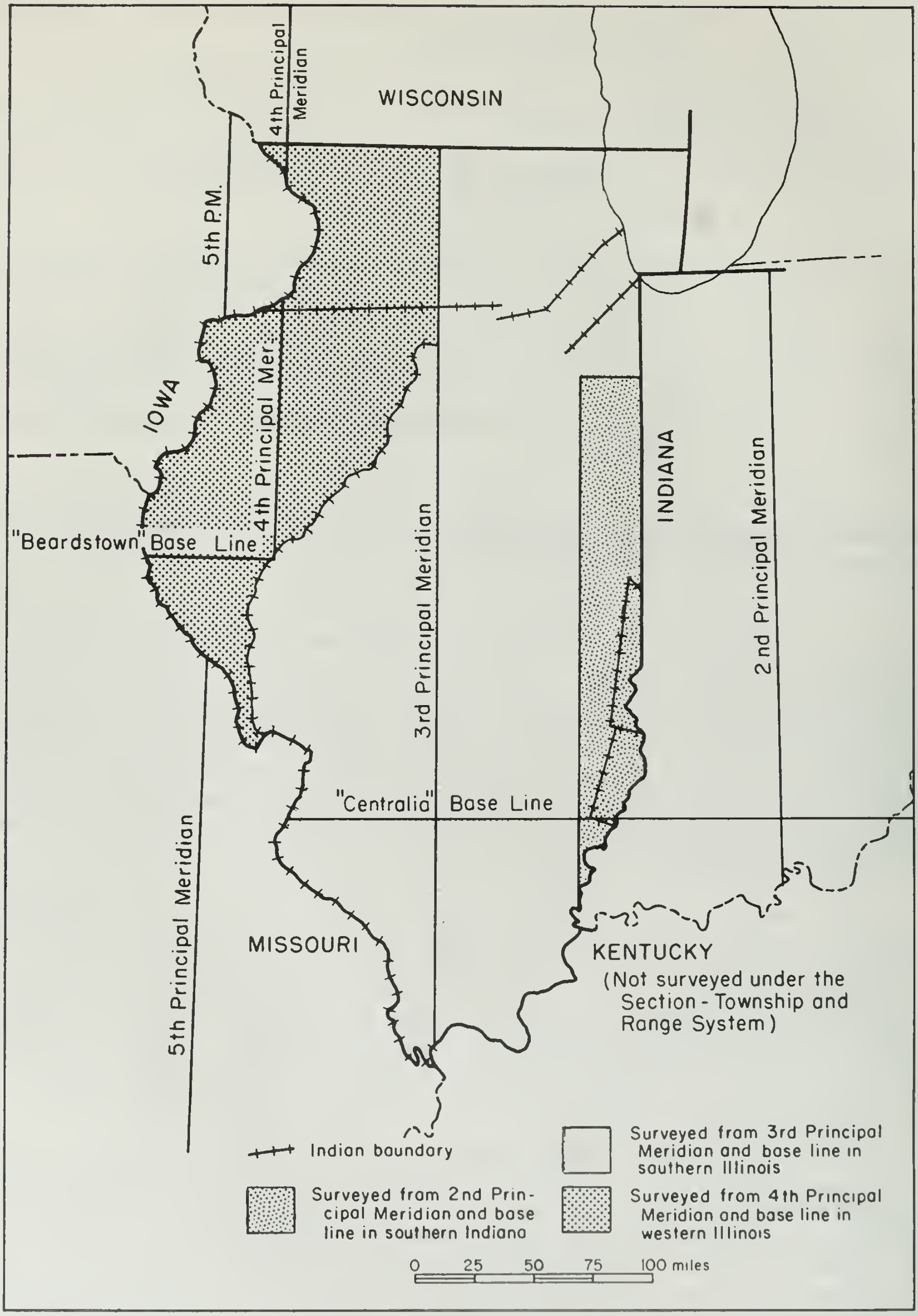

Figure 6. Principal meridians and base lines of Illinois and surrounding states.

insects. Their work was complicated by impassable terrain, bad food, crude instruments, and other hazards. No wonder that the perfect rectangular grid system was not realized; our route maps show that some lines are offset and skewed, and that some sections and townships are too large or too small.

The net that caught the prairies. The American rectangular survey had many effects, both immediate and belated. Townships formed important units of local government for country people. Elected township officers organized road work and other improvements. In functions intermediate to county, state, and federal governments, they administered some elections, censuses, and tax assessments and collections. The rectangular survey determined political boundaries; county lines, city limits, and streets parallel section and township lines. Public education and our belief in it as a right of citizens were encouraged by provisions of the Great Land Ordinance that set aside sections 16 and 36 in each township to finance schools. The Ordinance made certain words commonplace in our language. Country people speak of property "lines" rather than boundaries, of "townships," "quarter-sections," and "forties." The law perpetuated the old English units of land measurement: feet and miles and the unfathomable "rod" and "acre." (A rod is 16½ feet long. An acre is 160 square rods. A quarter mile equals 80 rods. A section is 640 acres.)

"Keeping the lines" has not worked solely to our advantage, however. Look at the two dominant patterns shown on our route maps: the kinked and winding contours outlining landforms are overlain by the grid of right-angled, ruler-straight survey lines. Lakes, floodplains, hills, and plains outlined on the map by contours are figuratively cut to pieces by the regular survey lines. The landforms are really cut to pieces by the developments that follow the lines. One exceedingly important ill effect of following survey lines and ignoring the terrain is soil erosion on farms. For more than a century, straight-line plowing parallel to property lines was the hallmark of a good farmer. What was ignored was that furrows running up and down hill are channels that greatly speed up and increase runoff and hasten soil wash off the slopes.

The unbending, straight line survey has also reinforced the builder's impulse to build straight, regardlessof what is divided or overrun. It encouraged the piecemeal destruction of original ecosystems—prairies, groves, forests—and has added to the difficulties of developing, managing, or preserving large natural divisions of land. Where, for example, a floodplain is crossed by a number of political boundaries and property lines, there are many different and uncoordinated views about the use of the land, about whether to raise levees, clear and cultivate, channelize the stream, or conserve wetlands.

The Great Land Ordinance of 1785 was a mixed blessing. But the law and its revisions set people to work systematically at settling and developing the public lands of the west. Moreover, the government regulation of land surveys and sales provided a generally even-handed and orderly occupation of the land that was, for most European-Americans at least, typically free of violence, fraud, and litigation. In our time, the realities expressed by the juxtaposed contour lines and survey lines have become lively issues. In every community, some variation of this question is being asked. In what ways can our occupation of this land be reconciled to its capacities and nature, and to its geology?

END OF TRIP—HAVE A SAFE JOURNEY HOME!

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