Standing mileage

FIELD TRIP
INTERGOVERNMENTAL SOLID WASTE DISPOSAL ASSOCIATION
HOSTED BY ILLINOIS STATE GEOLOGICAL SURVEY
OCTOBER 14, 1989

INTERVAL MILEAGE	CUMULATIVE MILEAGE	ROADLOG
0.0	0.0	Leave parking lot at ISGS Annex Building. Proceed north on Griffith Drive.
0.2	0.2	T-intersection with St. Mary's Road. Turn right.
0.3	0.5	Four-way stop at 1st Street. Turn right (south). Descend front side of Champaign Moraine.
0.6	1.1	Low-lying area is underlain by outwash sand and gravel beneath a thin loess cover. The outwash was deposited when meltwater flowed from the glacier behind the Champaign Moraine through this low point between the Champaign and West Ridge Moraines. Note large excavation in sand associated with construction of Windsor Road.
0.3	1.4	Ascend back side of West Ridge Moraine.
0.8	2.2	Intersection at stop sign with Curtis Road. Turn left (east) and descend back side of West Ridge Moraine; this long, gentle slope is typical of the ice margin of a moraine. Water that deposited sand and gravel at Windsor Road flowed through this low area.
1.1	3.3	Pull into corn field at side of road. **STOP #1: VIEW OF CHAMPAIGN MORAINE.**

STOP 1. VIEW OF CHAMPAIGN MORAINE FROM WEST ON CURTIS ROAD (NE¼ NE¼, Section 31, T.19N., R.9E., Urbana 7½-minute quadrangle).

The "flat" landscape of central Illinois, considered uninteresting by many and generally taken for granted by most of its citizens, actually records a complex history of advances and retreats by continental glaciers during the Great Ice Age. This history can be at least partially unraveled by studying both the sediments in the subsurface, which we will look at later this morning, and the landforms, or topography, that exist at the ground surface today. The purpose of this stop is to point out a view of a major landform feature--an end moraine--which is typical of the glaciated landscape across much of northern and central Illinois. Here, looking about a mile ahead toward the east, we see Curtis Road rising up onto a long, low ridge built by a vast continental glacier when the rate of advance of the glacier was approximately balanced by the rate of melting along the ice front. When this happened, the ice front itself remained at about the same position, but the ice flowing within the glacier continued to carry forward earth and rock debris incorporated into the ice during its advance from the north and east. As this debris melted out at the stationary ice front, it formed an accumulation of sediment that built up into elongate ridges, or moraines, such as this one. This moraine, others like it in Champaign County, and still others that arc across the northeastern quadrant of the state, record various "stillstands," or times when the ice front was stationary, during the Great Ice Age. As the continental ice sheets advanced and retreated across the Midwest, the ice fronts occasionally reoriented themselves, as one can see by the pattern of moraines in Champaign County. These arc-shaped moraines reflect the shape of the ice front at different stages of glacial retreat.

The sediment in this and other moraines is composed of glacial drift, mostly till. Because till is generally fine-grained and was deposited directly beneath the ice sheet, it has been consolidated (packed tightly) by the weight of the overlying ice, and it can be fairly easily engineered to meet current specifications for landfill waste containment. We will examine two tills at the next stop.

INTERVAL MILEAGE	CUMULATIVE MILEAGE	ROADLOG
0.0	3.3	Continue east on Curtis Road.
0.5	3.8	Intersection at stop sign with Race Street. Continue east and ascend front side of Champaign Moraine. Note steeper topography compared to back side of West Ridge Moraine.
0.9	4.7	Cross from Champaign Moraine to Urbana Moraine.
0.1	4.8	Intersection at stop sign with Ridge Road. Turn right (south) and drive in low area between Champaign Moraine (to right) and crest of Urbana Moraine (to left).
1.0	5.8	T-intersection with county road 1200N. Turn right (west).
0.4	6.2	Cross from Urbana Moraine to Hildreth Moraine.
0.6	6.8	Intersection at yield sign with county road 1350E (Race Street). Turn left (south).
1.0	7.8	Intersection with county road 1100N. Turn right (west) and descend front side of Hildreth Moraine into low-lying area where meltwater flowed from glacier behind Urbana Moraine.
0.3	8.1	Cross Embarras River and ascend back side of West Ridge Moraine. Again, note gentle slope typical of the side of the moraine near the ice.
1.2	9.3	Intersection at stop sign with county road

INTERVAL MILEAGE	CUMULATIVE MILEAGE	ROADLOG
		1200E (1st Street). Continue west.
0.8	10.1	Intersection at stop sign with US45. Turn right (north).
0.7	10.8	Enter town of Savoy.
0.4	11.2	Turn left (west) on Church Street (Champaign County Route 25).
1.1	12.3	Cross from West Ridge Moraine to Pesotum Moraine.
0.6	12.9	Crest of Pesotum Moraine. Willard Airport to the south is built on the high ground of the combined Pesotum and West Ridge Moraines. Continue west and descend steep front side of Pesotum Moraine.
0.6	13.5	Intersection at Prairieview Cemetery with (Duncan Road).
0.4	13.9	Cross Interstate Highway 57.
0.6	14.5	Intersection at stop sign with county road 800E (Staley Road). Note community of older houses to left. Turn right (north). High ground to right (east of I57) is Pesotum Moraine.
1.8	16.3	Ascend front side of Pesotum Moraine.
0.3	16.6	Cross Phinney Branch. Lincolnshire Fields on right. This lake and Maynard Lake are old gravel pits where outwash sand and gravel were removed for construction purposes.
1.9	18.5	Intersection with Springfield Avenue (Illinois Route 10). Marathon tank farm on left. Continue north on Champaign County Route 25.
0.5	19.0	Cross Interstate Highway 72.
1.4	20.4	Descend front edge of Pesotum Moraine. Gravel pit on left is removing sand and gravel from local pocket of outwash. Cluster of NIWC wells is producing water from Mahomet Sand, an outwash sand and

INTERVAL MILEAGE	CUMULATIVE MILEAGE	ROADLOG
		gravel at depth near bedrock.
0.4	20.8	Ascend front side of Champaign Moraine. This moraine reaches elevations of over 850 feet directly in front of us. Relief in this area is 150 feet.
1.0	21.8	Intersection with U.S. Highway 150; Colwell Systems and The Andersons on left. Turn left (west) on US150. Drive west over rolling topography created where streams have eroded headward into the Champaign Moraine.
3.0	24.8	Intersection with Lake of the Woods Road. Turn right (north).
0.4	25.2	Intersection with west-bound ramp of Interstate Highway 74. Turn left (west). The Sangamon River crosses through a gap in the Champaign Moraine created by drainage from the glacier. Southwest of the gap is a large area of outwash sand and gravel; to the northeast is till of the ground moraine.
1.6	26.8	Exit I72 to Illinois Route 47. Turn right. At stop sign, turn right again and proceed north on 47.
0.6	27.4	Turn left and park in grass covered parking area. **STOP #2: Tills underlying the Champaign Moraine.**

STOP 2. EXPOSURE OF TILLS, OUTWASH, AND LOESS NORTHEAST OF MAHOMET, CHAMPAIGN COUNTY FOREST PRESERVE (SW¼ SE¼, Section 10, T.20N., R.7E., Mahomet 7½-minute quadrangle).

As the glacier that deposited the Champaign Moraine retreated to the north, vast amounts of meltwater eroded a major gap into the moraine. Today this channel through the Champaign Moraine is occupied by the Sangamon River. A look at the topographic map shows that the Champaign Moraine gradually descends in elevation from its crest of more than 800 feet above mean sea level, a little over a mile to the northwest, to the point where we are standing, which is at about 700 feet. From this point to the southeast, the land surface descends to the Sangamon River Valley, at less than 675 feet elevation. This means that, during the course of numerous meltwater floods flowing through this gap in the moraine, erosion removed more than 100 feet of sediment from the valley. It also means that we are standing at an elevation below the Batestown Till, which occurs at the surface throughout this part of the county.

At this locality, a creek has eroded a deep cut as it descends to meet the Sangamon River about a half-mile to the southeast. In so doing, it has exposed about 20 feet of glacial drift.

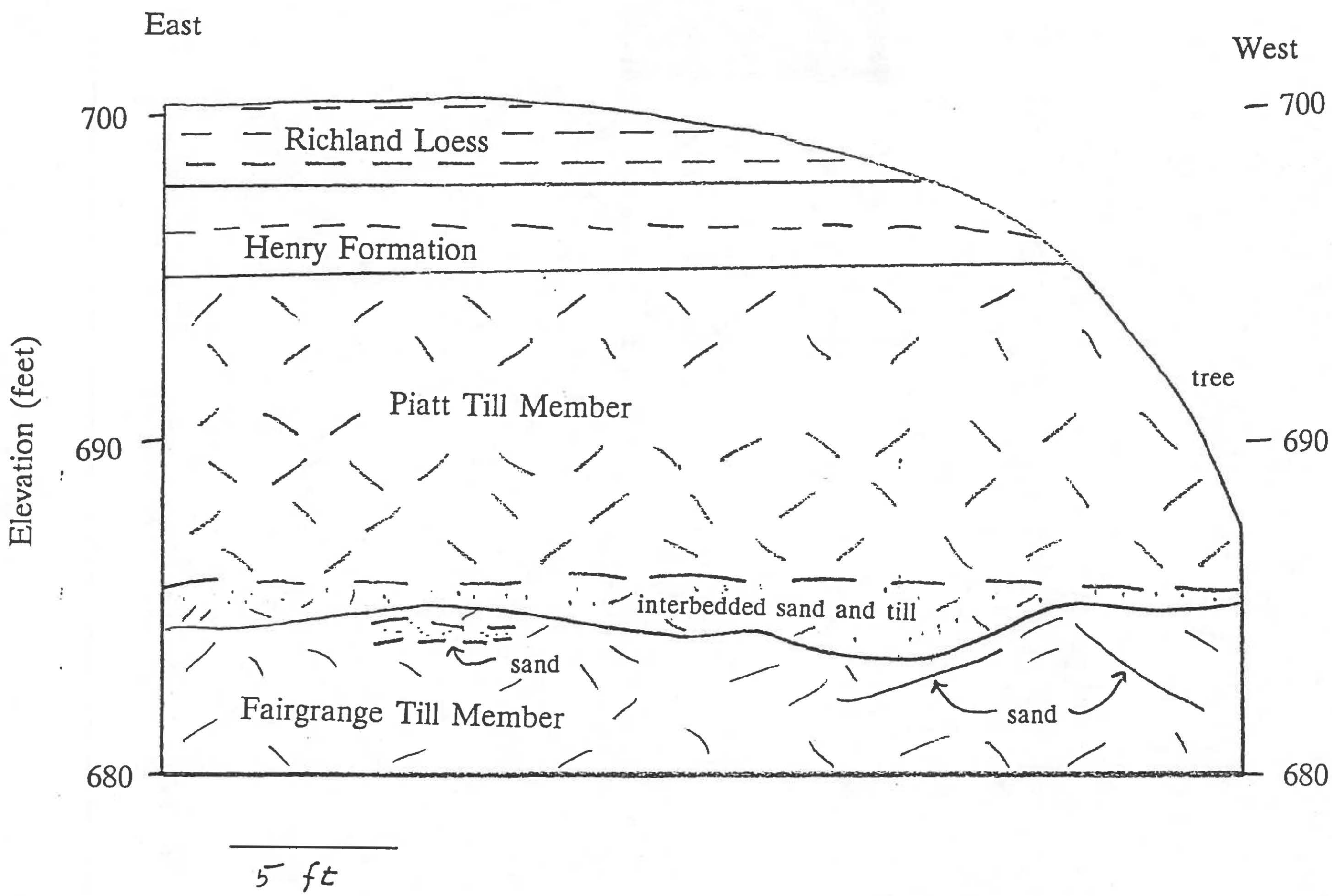
SECTION DESCRIPTION

Richland Loess. At the top of the exposure is about 3 feet of loess, or windblown silt; it looks, and is, uniformly fine-grained in texture. The modern soil--the dark brown to black organic zone--is developed in it.

Henry Formation. Below the loess is about 2 feet of outwash consisting of unsorted, dirty sand and gravel. ("Unsorted" means that many different grain sizes are present; "dirty" means that silt and clay are present in minor amounts, usually adhering to the sand grains.) Prominent iron staining can be seen here.

Wedron Formation. Beneath the Henry are two tills of the Wedron Formation, and the contact between them is obvious because of the distinct color change. Also, in places these tills are separated by interbedded sand and till.

The upper till is the Piatt Till Member of the Wedron Formation; it is about 8 feet thick here. The Piatt lies directly beneath the Batestown Till Member, which has been eroded away at this locality. The lower till, about 3 feet of which is exposed, is the Fairgrange Till Member. The Piatt is generally gray and weathers to a light brown hue, as seen here,


East
West
700
690
680
Elevation (feet)
Richland Loess
Henry Formation
Piatt Till Member
tree
interbedded sand and till
sand
Fairgrange Till Member
sand
5 ft

whereas the Fairgrange is pinkish gray and weathers to dark reddish brown. This color distinction is important: the pinkish cast of the Fairgrange is distinctive and persistent, and allows it to be identified even in some of the poorer-quality sample sets we have studied for this project.

The Piatt is sandier than the Fairgrange, with an average matrix grain size of about 40% sand, 30% silt, and 30% clay. The Fairgrange has an average matrix grain size of about 30% sand, 40% silt, and 30% clay. If you examine moist specimens of these tills, you can feel with your fingertips the grittiness of the sand, the slipperiness or "greasiness" of the silt, and the "clumpiness" of the clay. You can also feel the greater sandiness, or grittiness, of the Piatt compared to the Fairgrange if you examine a sample of Piatt in one hand and a sample of Fairgrange in the other hand at the same time.

Other features. At the time we examined this exposure in early August, two other features of interest could be seen. One is the occurrence of cobbles and pebbles in the till, which emphasizes the heterogeneity of grain size in this type of deposit. A large cobble or boulder such as that near the contact zone between the tills may be encountered in drilling. Depending on how the drill stem strikes the boulder, the persistence of the driller and his understanding of the earth materials he is drilling through, and the depth of the boulder encountered, drilling at a particular location may be abandoned, it may be decided that bedrock has been reached, or the log description may read "boulders," indicating a possible water-yielding deposit, when in fact only one or two may have been encountered.

The other feature of interest is jointing. A joint is a break (fracture) in geologic materials along which no movement has taken place (as opposed to a fault, along which movement has taken place). Joints can have almost any orientation. This one is oblique, and has been exploited by plant or tree root growth. Joints are present in virtually all geologic materials and generally decrease in frequency with increased depth below ground surface. In addition to prosity in the matrix of the till, joint porosity provides the pathway for movement of groundwater through the till unit. Iron staining (rust color) along the joint is evidence of flow of water along this feature.

INTERVAL MILEAGE	CUMULATIVE MILEAGE	ROADLOG
0.0	27.4	Leave parking area and turn right (south) on route 47. Proceed under I74 and into town of Mahomet.
0.8	28.2	Intersection with US150 at stop sign. To the left is the Sangamon River Valley, where meltwater flowed from the glacier, depositing sand and gravel to the south. Turn right (west) and continue through Mahomet.
0.3	28.5	Leave Sangamon outwash channel and ascend Champaign Moraine.
1.0	29.5	Descend Champaign Moraine.
0.9	30.4	Intersection with Spring Lake Road. Turn left (south).
0.6	31.0	Cross Spring Lake.
1.6	32.6	T-intersection with county road 2000N. Turn left (east).
0.2	32.8	Cross Sangamon River. Behind us are the till uplands of the Wisconsinan ground moraine. Before us are the lowlands of the Sangamon River valley and the glacial outwash (sand and gravel) of the Henry Formation. Numerous gravel pits in this area are removing, or have removed in the

INTERVAL MILEAGE	CUMULATIVE MILEAGE	ROADLOG
		recent past, sand and gravel for the Champaign/Urbana building industry.
0.4	33.2	T-intersection with road 150E. On the eastern horizon is the Cerro Gordo Moraine, which served as the eastern boundary of the drainage channel that carried meltwater south from the glacier that formed the Champaign Moraine. Turn left (north).
0.6	33.8	Sharp curve to right (east).
1.0	34.8	Turn left into Mid-America Sand and Gravel Company. **STOP #3: OUTWASH OF THE HENRY FORMATION.**

STOP 3. GRAVEL PIT OPERATING IN HENRY FORMATION OUTWASH (SE¼ NW¼, Section 21, T.20N., R.7E., Mahomet 7½-quadrangle).

The purpose of this stop is to illustrate the nature of sand and gravel outwash and why it should be avoided in landfill siting. Vast deposits of sand and gravel such as you see here also occur in the subsurface within the Banner and Glasford Formations, and were deposited under similar conditions.

Examination of the topographic map allows us to determine why several gravel pits are clustered in this area, because we can note our position (1) immediately south of the Champaign Moraine and (2) in the broad floodplain (here nearly 1½ miles wide) of the Sangamon River. This sand and gravel was deposited by meltwater pouring from the ice front through the gap eroded in the Champaign Moraine as the ice stood at or a short distance behind the moraine. The meltwater--and the future valley of the Sangamon River--was channeled to the southwest because of the high ground of the southwestward-trending Cerro Gordo Moraine, which we can see to the east and southeast. Meltwater did not make "one clean sweep" through the gap in the moraine; instead the velocity and volume of flow changed repeatedly, due both to seasonal changes and to fluctuations in the position of the ice front.

Here you can see the changes in grain size and bedding direction, each indicating a different set of conditions governing flow and deposition. Stratification here probably is a result of deposition in braided streams, typical of glacial meltwater streams. Numerous lens-shaped layers of varying grain size are typical of such sediments. The important point to note is that water can move easily among the individual grains of this deposit. If this deposit occurred in the subsurface, it would be an excellent aquifer and provide an abundant water supply. This is the same type of deposit that we have mapped in the subsurface, according to the best information available from water well records and other sources, as Banner, Glasford, or Wedron aquifers, based on their depth and lithologic characteristics.

INTERVAL MILEAGE	CUMULATIVE MILEAGE	ROADLOG
0.0	34.8	Leave gravel pit and turn left (east) on gravel road.
0.4	35.2	Intersection with Illinois Route 47. Turn right (south) and ascend back side of Cerro Gordo Moraine.
1.7	36.9	Descend front side of Cerro Gordo Moraine.
0.5	37.4	Cross Camp Creek.
0.8	38.2	Cross South Fork of Camp Creek.

INTERVAL MILEAGE	CUMULATIVE MILEAGE	ROADLOG
0.6	38.8	Intersection with gravel road by red barn. Turn left (east).
3.2	42.0	Cross Kaskaskia Ditch. newest well
1.5	43.5	Ascend front of Pesotum Moraine.
0.1	43.6	Intersection at stop sign with 800E (Staley Road). Continue east on Champaign County Route 56.
0.6	44.2	Cross I-57. Excavations to left expose Batestown Till in the Pesotum Moraine.
0.3	44.5	Cross onto Champaign Moraine.
0.1	44.6	Intersection with Duncan Road. Continue east.
0.2	44.8	Turn right into Fox Ridge Apartments. **STOP #4: NORTHERN ILLINOIS WATER CORPORATION WELL NO. 1-68.**

STOP 4. DISCUSSION OF WEST WELL FIELD AND NORTHERN ILLINOIS WATER COMPANY WATER WELL 1-68 (SW¼ SW¼, Section 3, T.19N. R.8E., Rising 7½-minute quadrangle).

Attached is a log of the well drilled at the site just across the street. The well is located on the front slope of the Champaign Moraine and was drilled to bedrock at 330 feet below ground surface elevation, which here is about 768 feet above mean sea level.

The log shows 137 feet of Wedron Formation, in which four tills have been identified. Five feet of gravelly sand occurs at the base of the Batestown, and a silty interval is indicated within the Piatt. A 5-foot thickness of sand is the cut-off point for mapping sands in our stack-unit map; therefore, this sand should show up on the stack-unit map of this area. Of a 78-foot thickness of Glasford Formation sediments, the lower 56 feet

NORTHERN ILLINOIS WATER CORP.
WATER WELL 1-68
SW¼ SW¼, Section 3, T. 19N., R. 8E.
Elevation 767.9 feet MSL

DEPTH (ft)	GRAPHIC LOG	LITHOLOGY	MEMBER	FORMATION
		yellowish brown till	Batestown Till	WEDRON
		gray till with sand streaks		
50		brownish gray till with sand streaks	Piatt Till	
		light gray silt		
100		pinkish gray till		
		pinkish brown till	Fairgrange Till	
		dark brown till	Oakland	
		fine silty sand	Vandalia Till	GLASFORD
150		gray silty sand till		
200		sand and gravel		
		gray till	Tilton Till	BANNER
250		sand and gravel	Mahomet Sand	
300				
		ice contact		
		shale		CARBONDALE
350				

are sand and gravel, mapped as the Glasford aquifer on our aquifer maps. Beneath the Glasford aquifer is 115 feet of Banner Formation sediments, of which the lower 89 feet comprise a sand belonging to the Banner aquifer (the Mahomet Sand Member).

0.0	44.8	Proceed through Fox Ridge Apartments and return to Duncan Road.
0.3	45.1	Intersection with Duncan Road. Turn right (north) to Bradley Avenue and proceed east on Bradley to State Street.
0.6	45.7	Intersection at stop sign with Clayton Road. Parkland College on left. Continue east on Bradley Avenue.
0.5	46.2	Intersection at stop light with Mattis Avenue. Continue east. Kraft complex on right.
0.7	46.9	Intersection at stop sign with McKinley Avenue. Continue east on Bradley Avenue.
0.3	47.2	Intersection at stop light with Prospect Avenue. Continue east on Bradley Avenue.
0.6	47.8	Intersection at stop sign with State Street. Turn right (south) and proceed to Kirby Avenue.
0.6	48.4	Intersection at stop light with Church Street. Continue south on State Street.
0.1	48.5	Intersection at stop light with University Avenue. Continue south on State Street.
0.3	48.8	Intersection at stop light with Springfield Avenue. Continue south on State Street.
0.1	48.9	Intersection at stop light with Green Street. Continue south on State Street.
0.6	49.5	Intersection at stop sign with Hessel Boulevard. Continue south on State Street.
0.3	49.8	Intersection at stop light with Kirby Avenue. Turn left (east).

INTERVAL MILEAGE	CUMULATIVE MILEAGE	ROADLOG
0.1	49.9	Intersection at stop light with Neil Street. Turn right (south).
0.2	50.1	Intersection at stop light with St. Mary's Road. Turn left (east).
0.1	50.2	Intersection with Griffith Drive at east edge of St. Mary's Cemetery. Turn right (south).
0.3	50.5	Turn left into Annex parking lot. **STOP #5: SAMPLES FROM BOREHOLES.**

STOP 5. GEOLOGICAL SAMPLES LIBRARY AT THE ILLINOIS STATE GEOLOGICAL SURVEY ANNEX (SE¼ NE¼, Section 24, T.19N., R.8E., Urbana 7½-minute quadrangle).

The Illinois State Geological Survey manages one of the largest physical collections of geological samples in the United States. As of the end of July, 1989, these collections contained 66,643 sets of drill cuttings from water, engineering, coal, and oil test wells, representing 741,702,387 feet of drilling. The collection also includes 13,424 sets of rock and drift cores representing 937,891 feet of drilling (Charles J. Zelinsky, Head, Geological Samples Library, personal communication, 1989).

For exhibit here we have selected water-well samples that typify the range of quality available to us as we constructed six east-west cross-sections across the county. These cross-sections, in turn, are being used as a basis for stack-unit mapping of the county via water-well descriptions on file in the ISGS Geologic Records Unit.

APPENDIX 1

GLOSSARY

End moraine (or terminal moraine) - An arc-shaped ridge of till, and some outwash, that piles up along the front of a glacier when the rate of ice advance is balanced by the rate of melting.

Glacial drift - The collective name for deposits of earth and rock materials transported and deposited by a glacier. Two major types of glacial drift are "till" and "outwash."

Ground moraine (or till plain) - The gently undulating sheets of till deposited when the ice front melted back. The presence of till identifies an area as having once been covered by glaciers. The northeastern quadrant of Illinois has many alternating end moraines and ground moraines, all deposited by the last of the great continental glaciers--called the Wisconsinan--to enter Illinois.

Loess - Fine-grained sediment, mostly silt, with some clay and very fine sand, that was picked up from floodplains of meltwater streams during times of low flow by prevailing westerly winds and deposited across much of the state. Loess is thickest on the east side of valleys that carried major meltwater streams, such as the Illinois and Mississippi River Valleys. Because Champaign County is not near such a major source of meltwater, its loess cover is nowhere more than about 5 feet thick; it thins to the east and north across the county.

Outwash - Sorted and stratified (layered) sediment deposited by water melting from the glacier. It is bedded, or layered, because the flow of water that deposited it varied in velocity, volume, gradient, and direction. As a stream of meltwater carries rock materials along, it sorts them by size--it drops the heavier load of boulders, cobbles, and pebbles sooner than it does the finer grains of rock material such as sand, silt, and clay.

Till - Glacial drift that is deposited directly by the ice and is not moved or sorted much by water. It is unlayered and may contain rock materials ranging in size from microscopic clay particles to large boulders. Most tills in Illinois contain greater amounts of clay and silt (silt has about the same consistency as kitchen flour) and lesser amounts of sand. Comparatively, they contain few pebbles, cobbles, or boulders, although occasionally concentrations of these larger particles may be found in a till due to depositional conditions.

APPENDIX 2

STRATIGRAPHIC CLASSIFICATION

Geologic materials are separated from or grouped with each other according to a set of rules developed by geologists through the years. A "formation" is the basic unit of classification and is the smallest unit mappable in the field. It can be subdivided, where practical, into members. A member is the smallest formally named stratigraphic unit. In the glacial deposits of this part of Illinois, we recognize three formations: the oldest (and deepest) is the Banner Formation, the middle one is the Glasford Formation, and the youngest (the one nearest the land surface) is the Wedron Formation. Each contains tills and outwash, and each has been subdivided into members; however, for practical application in this project, we have mapped only the members of the Wedron Formation. In Champaign County, the members of the Wedron Formation are, from oldest (deepest) to youngest (shallowest) the Oakland Till Member, the Fairgrange Till Member, the Piatt Till Member, the Batestown Till Member, and the Yorkville Till Member. The Yorkville occurs only in the northeastern corner of the county. The Batestown is the surficial till over much of the central part of the county, but the Piatt is the surficial till in the southwest. The Fairgrange and Oakland do not occur at the surface at all in Champaign County, except where exposed along creeks or in quarries. These members of the Wedron Formation are overlain only by Richland Loess (a formation), the Henry Formation (outwash sand and gravel), the Equality Formation (fine-grained lake deposits), or Cahokia Alluvium (a formation defined as modern stream deposits).

The following discussion of Pleistocene glaciations in Illinois is taken from:

Reinertsen, D. L., D. Berggren, J. P. Kempton, and P. B. DuMontelle, 1977, Geological Science Field Trip Guide Leaflet 1977-B and 1977-D - Urbana Area: Illinois State Geological Survey, Champaign, IL.

PLEISTOCENE GLACIATIONS IN ILLINOIS

Origin of the Glaciers

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

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

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

Effects of Glaciation

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

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

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

Glacial Deposits

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

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

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

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

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

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

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

Loess and Soils

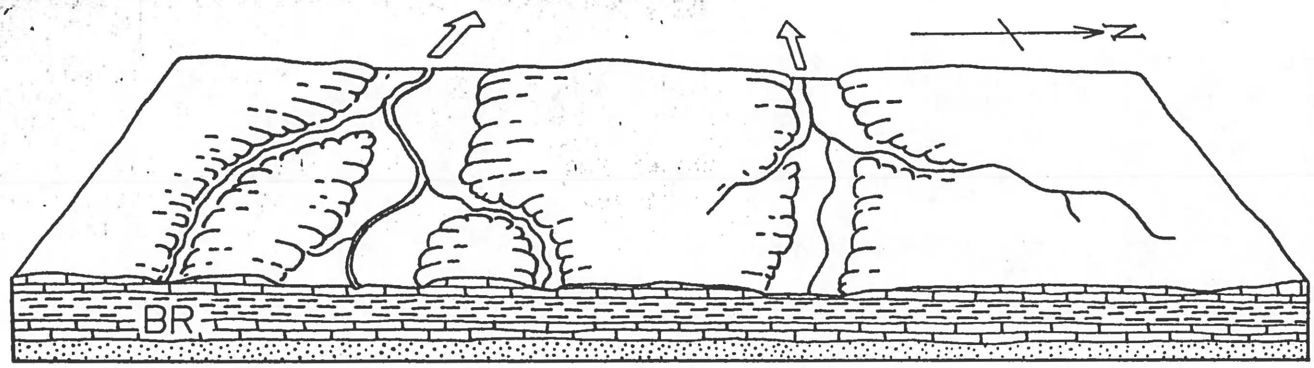
One of the most widespread sediments resulting from glaciation was carried not by ice or water but by wind. Loess is the name given to such deposits of windblown silt and clay. The silt was blown from the valley trains on the floodplains. Most loess deposition occurred in the fall and winter seasons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

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

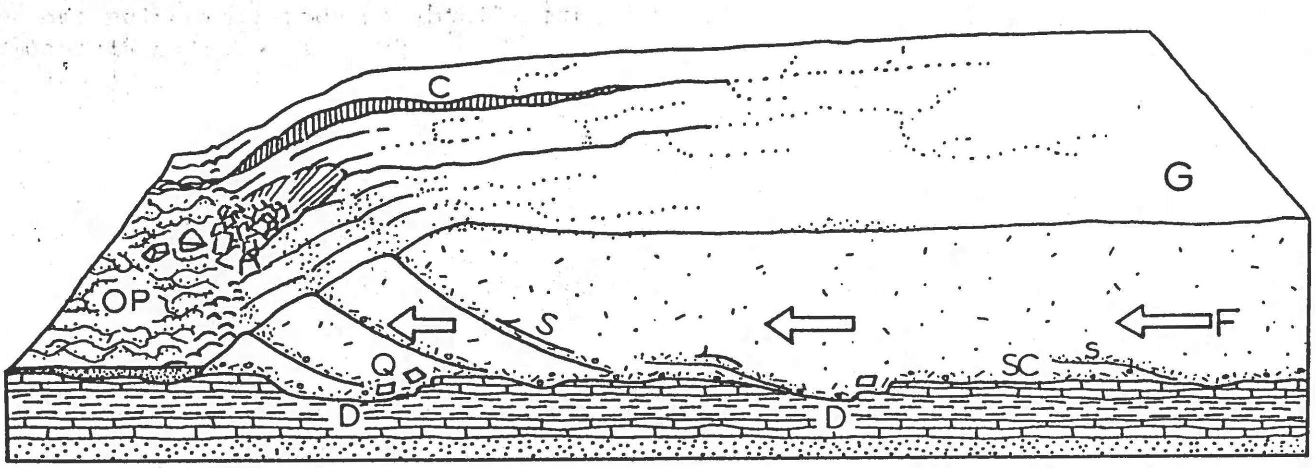
Glaciation in a Small Illinois Region

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

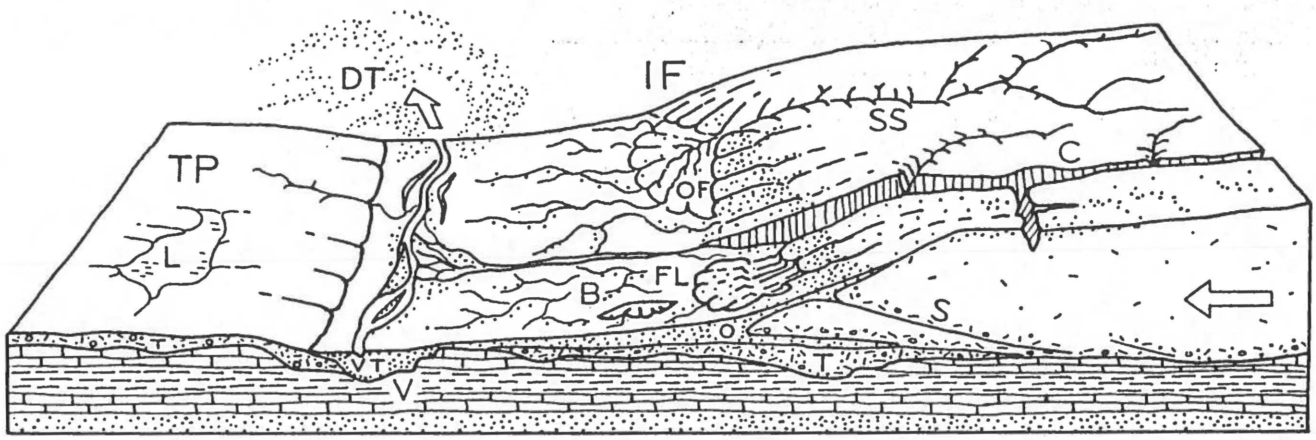
The block of land in the diagrams is several miles wide and about 10 miles long. The vertical scale is exaggerated--layers of material are drawn thicker and landforms higher than they ought to be so that they can be easily seen.



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



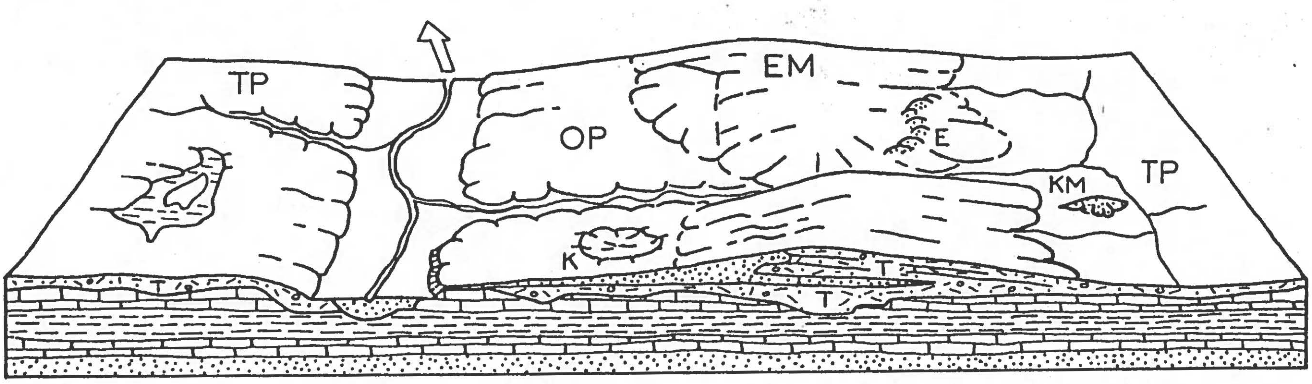
2. <u>The Glacier Advances Southward</u> - As the glacier (G) spreads out from its snowfield, it scours (SC) the soil and rock surface and quarries (Q)--pushes and plucks up--chunks of bedrock. These materials are mixed into the ice and make up the glacier's "load." Where roughnesses in the terrain slow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



3. <u>The Glacier Deposits an End Moraine</u> - 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.

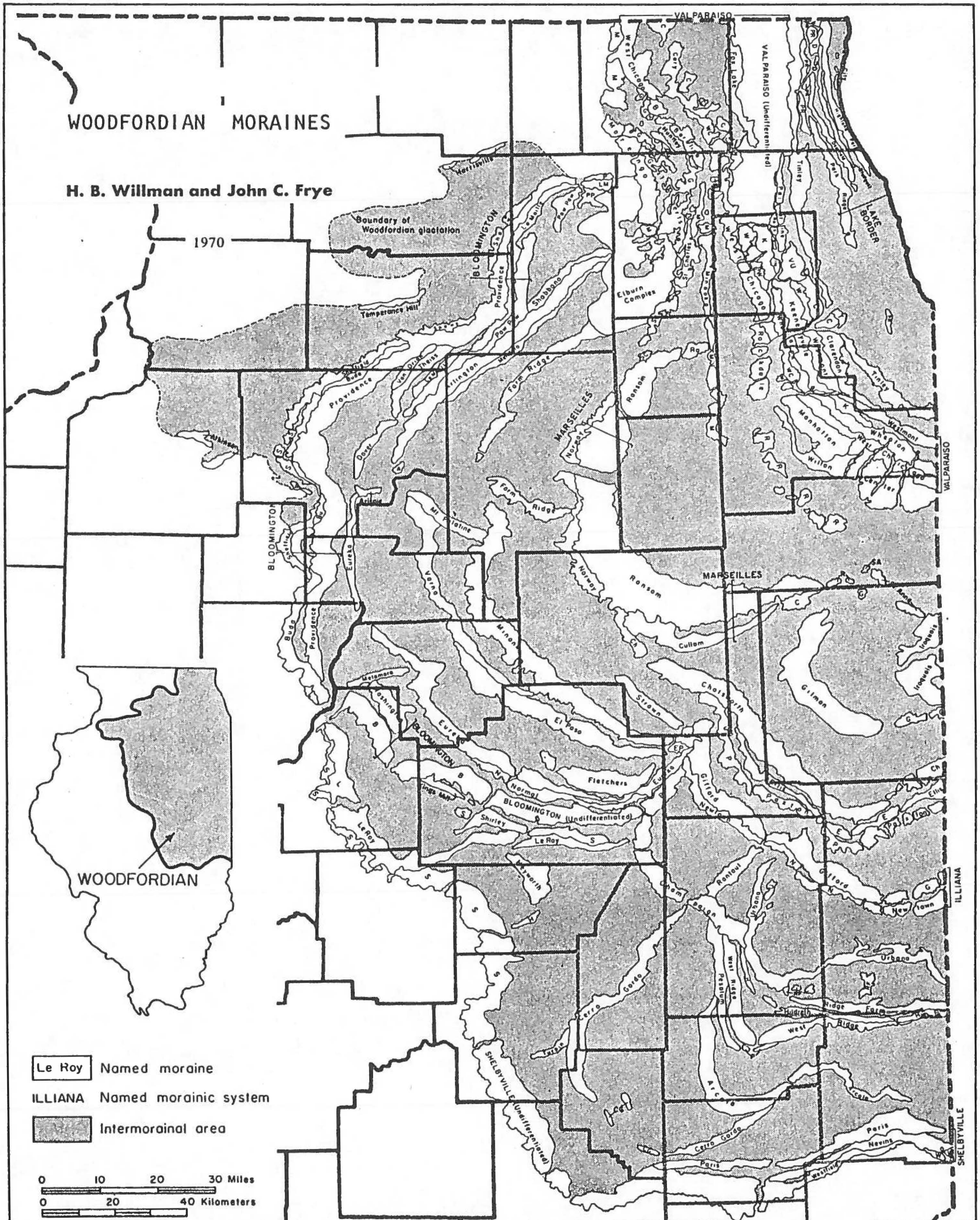
As the top of the glacier melts, some of the sediment that was mixed in the ice accumulates on top of the glacier. Some is carried by meltwater onto the sloping ice front (IF) and out onto the plain beyond. Some of the debris slips down the ice front in a mudflow (FL). Meltwater runs through the ice 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. <u>The Region after Glaciation</u> - 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.



ILLINOIS STATE GEOLOGICAL SURVEY