State of Illinois
Department of Registration and Education
STATE GEOLOGICAL SURVEY DIVISION
M. M. Leighton, Chief

EARTH SCIENCE FIELD TRIP
GUIDE LEAFLET
JACKSONVILLE AREA

MORGAN, SCOTT, AND GREENE COUNTIES
WINCHESTER AND GRIGGSVILLE QUADRANGLES

Leader
Gilbert O. Raasch

Urbana, Illinois
October 22, 1949

GUIDE LEAFLET 49-B

HOST: NEWTON-BATEMAN HIGH SCHOOL

Part I

ITINERARY

0.0	0.0	Caravan assembles facing west on State Street in front of Newton-Bateman High School.
0.0	0.0	Turn left (S).
0.2	0.2	Stop sign. Turn right (W) on Highway 36-54.
1.9	2.1	Leave Jacksonville going west.
2.0	4.1	Road descends west end of "The Mound." This long, narrow rounded ridge along which we have been traveling since Jacksonville, is part of the Jacksonville Moraine of the Illinois Glacier. This ice sheet, which came down from the northeast, originally extended as far west as the Mississippi. Later it melted back until the Jacksonville region was ice-free. Then, as the climate became cooler once more, a lobe of the ice pushed its way down the Illinois valley, but only got as far as a line Jacksonville-Merritt-Exeter before a softening of the climate stopped its advance. The Jacksonville Moraine marks the limit of this advance.
3.6	7.7	Junction with Lynnville Road. Continue ahead (W). Allison Mound can be seen ½ mile to the north. Allison Mound is also a part of the Jacksonville Moraine. Terminal moraines are formed at the margins of glaciers when the ice front is stationary because there is an equilibrium between the forward movement of the ice and the rate of melting. As a consequence large quantities of clay, sand, and boulders collect to form a ridge. The ridge-like moraines of the Illinoian glacier have experienced much erosion during the long period since the glacier disappeared, and therefore, are generally discontinuous.
2.5	10.2	Turn left (S) on gravel road ½ mile east of Riggstown.
4.0	14.2	Turn right (W) at road junction south of Big Branch.
1.8	16.0	STOP NO. 1. St. Louis (Mississippian) limestone ledges in creek north of bridge. Some layers are crowded with the corals, Zaphrentis? and Syringopora.
-	16.0	Continue ahead (W).
0.3	16.3	Stop sign. Junction with Route 106 just west of Sandy Creek Bridge. Turn left (SE) on Route 106.
2.6	18.9	Turn left (E) on secondary gravel road.
2.1	21.0	Turn right (S) on minor road.
1.1	22.1	STOP NO. 2. South of Little Sandy Creek. Between the time when the Mississippian Sea withdrew from this region and the time when the first Pennsylvanian sediments were deposited, the Earth's crust in Illinois was warped and broadly folded. This folding of the strata was followed by a period of erosion which wore away a considerable portion of the Mississippian rock. At this locality the St. Louis limestone seen at Stop No. 1 has been removed as has also the Salem limestone, and most of the Warsaw formation that lie below it (see Geologic Column).

In places along the creek and its tributary, a few feet of Warsaw shale remain beneath the Pennsylvanian strata; in others, the Pennsylvanian rests directly on the older and lower-lying Keokuk limestone. Such an irregular contact between rocks of different age is called an unconformity. (see Appendix).

All of the various formations on which the Pennsylvanian rests in the Jacksonville area are Mississippian in age. In other parts of Illinois the Pennsylvanian lies on still older rocks of Devonian, Silurian, or Ordovician age (see Geologic Column).

The Keokuk limestone can be seen some hundreds of yards west along Little Sandy Creek. The rock is slabby and crowded with fossils, especially brachiopods, bryozoa, and the stems of crinoids.

The Warsaw shaly limestone (not well exposed) has no fossils at this locality, but crystal-lined geodes weather out of the rock. The origin of these hollow rocks is still a matter of controversy. According to Dr. Percival Robertson's theory, they were originally masses of silica gel in soft limy mud. As the rock hardened, the water in the gel separated from the silica which hardened, first as an outer crust of chalcedony and later as quartz crystals lining the interior.

Besides quartz and chalcedony, the geodes here have been found to contain calcite, aragonite, limonite, kaolin, chalcopyrite (altered to limonite), malachite (alteration of chalcopyrite) and a mineral, probably manganite. This latter has not previously been reported from geodes, although the closely related mineral goethite is rather common.

The next continuous layer above is a massive chert conglomerate of Pennsylvanian Age. The chert is clearly of local origin with Keokuk fossils and pieces of Warsaw geodes. The rock was presumably formed by the advancing waters of Pennsylvanian time. Large masses of this rock undermined by Little Sandy Creek, have slid down the bank at the bend below the mouth of the tributary stream.

Filling the irregularities between the Mississippian's uneven surface and the chert conglomerate are patches of shale and sandstone of Pennsylvanian age.

Besides the considerable variety of local rocks of Pennsylvanian and Mississippian age in the creek gravels, are rocks of many kinds that have washed out of the glacial drift that lies above the bedrock in this area. Many of these such as granite, gabbro, and basalt have been transported by the glaciers from the Canadian Shield, hundreds of miles to the north.

0.6 22.7 STOP NO. 3, at road forks. Local coal diggings on east bank of creek. CAUTION: beware of undermined ledges.

The strata in the bank here lie slightly higher than the beds seen downstream at Stop No. 2. At Stop 3, the lowest rock in the creek bed is a knobby limestone (Seahorne) containing brachiopods and other fossils. Between the limestone and the coal, about two feet of underclay is present. The coal, two feet eight inches thick, is No. 2 seam (Springfield coal). Over the coal is three feet ten inches of roof shale and upon this a sandstone (Pleasant View).

At the time when the Pennsylvanian strata which contain Illinois' coal beds were formed, the environment fluctuated between conditions of an inland sea, of coastal swamps and lagoons, and of a coastal plain.

In each of these environmental stages different types of strata originated. Limestones with fossils of sea life formed during the marine stages; the coal was generated in vast fresh water swamps, and much of the sand and shale was the product of river floodplains and deltas (see chart of a "typical cyclothem" in Appendix).

-	22.7	Continue ahead up right fork of road.
1.8	24.5	Stop sign. Turn right (W) on secondary road to Alsey.
2.5	27.0	Stop sign. Junction with Route 106 in Alsey. Note brick plant on left. A fire clay (Cheltenham Clay) that lies below the knobby Seahorne limestone of Stop No. 3 is mined under the plant. An excellent fire brick results.
-	27.0	Turn right (N) on Route 106.
5.9	32.9	Enter Winchester.
0.5	33.4	Stop sign. Turn right (N) on Main Street.
0.5	33.9	Turn right into Monument Park. LUNCH STOP.
0.2	24.1	Leave Park and turn left (S) on Main Street.
0.5	34.6	Junction with Route 106 in Winchester. Turn right (W), on 106.
0.3	34.9	CAUTION; junction with Route 36-54. Continue ahead (W) on Route 36-54.
3.3	38.2	Illinois River Valley. Turn sharp left (E) to Krueger's Quarry.
0.2	38.4	STOP NO. 4. Agricultural Limestone Quarry, mainly buff Mississippian, Salem limestone, with 8 feet of blue-gray Warsaw shale and limestone showing in bottom of pit.

The contact between the Salem and Warsaw formations is undulating, and a green mineral, glauconite, is present in the Salem near the contact. Both these features suggest an unconformity is present here between the two formations. This may be the result of very slow sedimentation or of a shifting in the level of the sea bottom, not necessarily the withdrawal of the sea and erosion of the resultant land surface. In any event, this unconformity is very minor compared to that seen between the Pennsylvanian and Mississippian strata at Stop No. 2.

No fossils are present in the Warsaw strata but are numerous in the lower part of the Salem. Here in some zones the fossils have been dissolved out, leaving their casts and molds in the rock. Some of these are stained green by glauconite. Much of the Salem rock is made up of ground-up shells. Lacey bryozoa are especially abundant. Some of the layers are cross-bedded (foreset), showing the existence of waves or currents in shallow water.

Much calcite is present in vugs in the Salem limestone; other openings are lined with crystals of ankerite, a mineral intermediate between dolomite and siderite.

Above the bedrock of the quarry, is a considerable thickness of glacial till of Illinoian age and of sandy loess and dune sand blown up from the river flats since the melting away of the Illinoian Ice Sheet.

-	38.4	Reverse route.

0.3 38.7 Highway junction. Turn left (S) on blacktop road.

4.5 43.1 STOP NO. 5. Remain in cars. Here we may look across the Illinois Valley to the west bluffs three miles away. The east bluffs on our left are made up largely of loess, a fine silt blown from the river flats onto the uplands by the prevailing westerly winds. The rise on which we are parked, between the bluffs and the floodplain, is covered with dune sand, likewise blown by the wind, but dropped short of the uplands.

Most of this transportation of sand and silt took place after the melting of the Illinoian ice and later when the Wisconsin Ice Sheet lay melting in the valley of the Upper Illinois. Then great quantities of water and sediment came down the valley, winds were strong, and vegetation scant. The blanket of loess is thickest on the uplands immediately east of the valley and thins gradually eastward away from the river.

Before the coming of the Illinoian Glacier, the valley was much deeper than it is today. Through it flowed the Mississippi River. Then, when the Illinoian ice came down from the northeast and drove to the west edge of what is now Illinois, the Mississippi was banished from the valley it had so laboriously cut and forced to excavate a new one around the west edge of the ice sheet.

It never returned, but when the Illinoian Glacier melted away, the old valley, now pretty well-filled by glacial drift left by the ice, was discovered by another southward flowing stream which we have called the Illinois. It partly re-excavated the old channel.

But when the Wisconsin Glacier lay less than 100 miles to the northeast, the sediment washed out from the melting ice was more than the waters could carry away. Thus the floodplain built up to increasing heights, until today it lies about 430 feet above the sea. In this sector of the valley, the stream has made little progress since in cutting its way down through this valley fill.

- 43.1 Continue ahead (S).

1.5 44.3 Turn left (E) at junction south of Little Sandy Creek.

0.2 44.5 STOP NO. 6. Go south along old road to quarry.

The southend of this exposure is a quarry in the Mississippian, Burlington limestone. A better exposure of this rock will be seen at Stop No. 7.

The surface of the bedrock slopes downward to the north. Here we see the effect of glacial action on the rock. Huge rock masses have been twisted and up-turned and striated by the over-riding ice in the process. The bedrock surface has also been striated and polished by the great weight of the moving ice aided by the detritus frozen into its base. The striae here are oriented mainly in a general E-W direction.

Which glacier made these striae? For it is probable that at least three separate glaciations passed over this area. The first of these came from northwest Canada and is called the Nebraskan glaciation. There followed a long, mild interval during which the glacier melted away, fields and forests returned, and soils formed.

Then a second continental ice sheet, the Kansan, advanced from the same Canadian region. But it too faded away before the return of mild climatic conditions.

Several hundred thousand years later, the ice again came down, this time from the northeast, as the Illinoian glaciation. After this third ice sheet melted away, glaciers did not return to Scott County but got only as far as Peoria and Decatur. This last ice advance, which fell short of our region, nevertheless influenced it profoundly through the waters and sediments which poured down the Illinois Valley from the melting ice and the loess which was borne from the valley to the uplands by the winds.

In the exposure north of the quarry we may have evidence of all of these events. The loess blanket can be seen descending from the bluffs as a cover of soft brown silt that originally blanketed all of the glacial till, now exposed in the cut.

In the upper half of the cut typical Illinoian till can be seen. Note the completely heterogenous mixture of boulders, pebbles, sand, and clay, dropped together by the melting of the ice.

The surface of the Illinoian till, below the loess is not level but conforms to the contour of the base of the bluff. The uppermost part of the till is dark, almost waxy, and nearly free of pebbles. Below this is a reddish band, underlain by a zone full of gray, limey bodies (concretions). Finally, going downward, we find light gray till. Note the many faceted and striated pebbles in this till.

The interpretation of these different types of material is as follows. The gray is unaltered till. The uppermost part of the till, on the other hand, has been profoundly altered by weathering and leaching. Such material is called gumbotil. All lime and much iron has been removed. Then in the red zone, the iron still remains but has been oxidized to the red oxide. Below this the lime which was removed above by descending rain water has been redeposited as lime concretions. These successive relationships constitute a typical "profile of weathering."

Going downward, we come to a line at the base of the gray till, underlain in places by stratified clay or sand, in others by an ochre gumbotil. Here obviously we have a record of events which went on before the coming of the Illinoian Ice. The clay and sand were evidently laid down during the "Yarmouth" interval, the mild period that preceded the Illinoian glaciation and followed the Kansan. The till, from its position and degree of weathering, can be presumed to be of Kansan age.

Toward the base of the ochre or buffy Kansan till, a band of pinkish till may represent the Nebraskan gumbotil; or it may be the result of oxidation by waters traveling along the bedrock contact.

(This is a newly discovered outcrop, of a very complex nature, that has not yet received detailed study. Conclusions therefore should be considered as tentative.)

-	44.5	Reverse route to highway.
0.2	44.7	Turn left (S) on valley highway.
0.5	45.2	Steep loess bank above Burlington limestone outcrop. Such steep faces are characteristic of loess outcrops.
1.0	46.2	Quarry in Burlington limestone.

0.4 46.8 STOP NO. 7.

This fine example of quarry operations is being conducted along about a 90 foot face of Burlington limestone. The rock varies in character at different levels, being in some places a coarse, white, crinoidal, nearly pure limestone, in others a brown, rough magnesian limestone (dolomite), in others high in silica due to the abundance of chert nodules. There different types of limestone vary in suitability depending upon whether the use is to be roadstone, agricultural limestone, or for the lime, cement, or chemical industry.

The Burlington formation is famous for the abundance and variety of the crinoids it contains. In addition, brachiopods, bryozoa, corals, and gastropods (snails) are common. Many layers are made up almost wholly of fossil remains.

At the top of the quarry, above the limestone, over 50 feet of over burden is in the process of removal. This consists almost wholly of loess, except for a small wedge of gumbotil near the north end of the exposure. The upper half of the loess bank is light brown in color and the shells of land snails are quite common here. Below this is a zone of violet brown loess stained by humus, and this is underlain by dark brownish gray loess.

This variation in the character of the loess bank is a reflection of climatic changes since the disappearance of the Illinoian Ice. The humic zone represents the height of the mild climate (Sangamon interval) between the cold climates of Illinoian and Wisconsin stages, when the lower and upper loess zones, respectively, were deposited.

BON VOYAGE

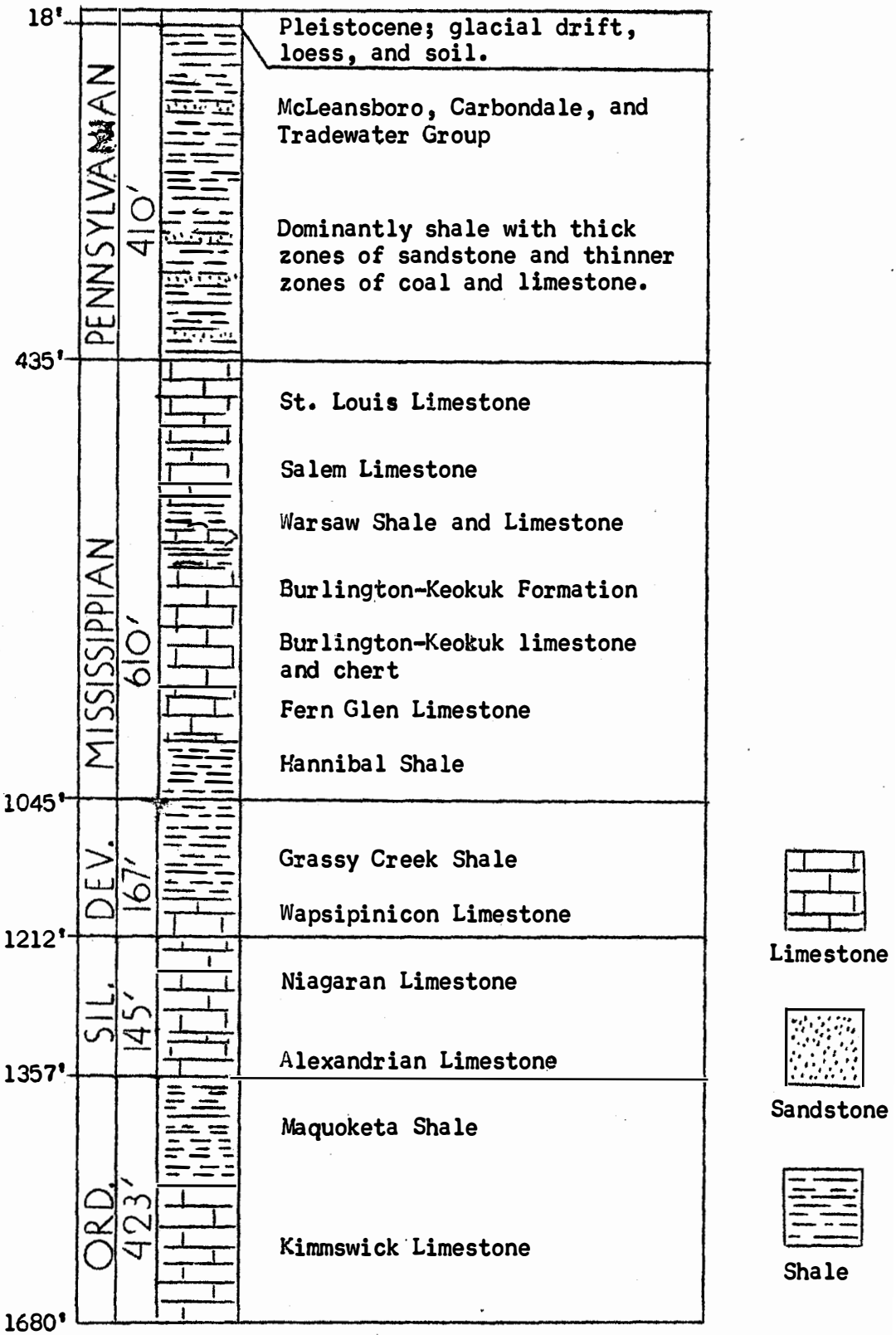
North 8 miles to Route 36-54.

GEOLOGIC COLUMN FOR THE TAYLORVILLE AREA
Prepared by the Illinois State Geological Survey

ERAS		PERIODS	EPOCHS	REMARKS
Cenozoic "Recent Life"	Age of Mammals	Quaternary	Pleistocene	Recent post-glacial stage Wisconsin glacial stage Sangamon interglacial stage Illinoian glacial stage Yarmouth interglacial stage Kansan glacial stage Aftonian interglacial stage Nebraskan glacial stage
		Tertiary		Not present in the Jacksonville area
Mesozoic "Middle Life"	Age of Reptiles	Cretaceous		Not present in the Jacksonville area
		Jurassic		Not present in Illinois
		Triassic		Not present in Illinois
Paleozoic "Ancient Life"	Age of Amphibians and Early Plants	Permian		Not present in Illinois
		Pennsylvanian	McLeansboro	Brereton limestone
			Carbondale	Coal No. 6 Coal No. 4 Pleasant View sandstone Coal No. 2
			Tradewater	Seahorne limestone Cheltenham clay
			Casey	Not present in Jacksonville area
		Mississippian	Chester	Not present in Jacksonville area
			Iowa	St. Louis limestone Salem limestone Warsaw shale-limestone Keokuk limestone Burlington limestone Kinderhook formations
	Age of Fishes	Devonian		Dark shales and limestones in deep wells
	Age of Invertebrates	Silurian		Magnesian limestone in deep wells
		Ordovician		Limestone and shale in deep wells
		Cambrian		No data available
Proterozoic Archeozoic		Pre-Cambrian		No data available

Oil Test Boring 3 miles east of
Franklin, Morgan Co., Illinois

Waverly Oil Co. 1, D. Hubbs — NE ¼ of SE ¼, Sec. 33, T14N, R8W.



1680' Total Depth (985 feet below sea level)

Part 2

GEOLOGIC HISTORY

DEEPLY BURIED FORMATIONS

The oldest bedrock seen in the field trip area is the Burlington limestone of Mississippian age. Below this are older Mississippian limestone and shales which come above the surface across Illinois River at Pilot Knob. Under these Kinderhook shales are black shales of Devonian age. In the eastern part of the area a thin Devonian limestone is present, but is absent westward.

Below the Devonian strata in all wells, Silurian limestone and dolomite is present, but in varying thickness, due evidently to the erosion of its top. Ordovician shale (Maquoketa), limestone (Kimmswick-Decorah-Plattin-Joachim), and sandstone (St. Peter) underlie the Silurian strata.

Deeper than this, wells have not penetrated in Morgan or Scott counties, but deep tests farther west in Pike County have gone down through hundreds of feet of Lower Ordovician limestones below the St. Peter sandstone.

Below these Ordovician limestones are rather similar ones of Cambrian age. Gradually these pass downward to shales and sandstones. These sandstones in turn rest on granite which lies in the bottom of two of the Pike County wells (the deepest is 3207').

The granite in the bottoms of the wells is the top of the Pre-Cambrian "basement," so old, with so involved a history, that we have not time to present it here. In any case, this "basement" in Illinois has been reached in only a few deep wells; but rocks of similar age and character have been brought by the glaciers from the far north and scattered widely through the glacial drift.

Except for the basement granite, nearly all of the formations found in the deep wells contain fossils of marine animals. These show clearly that ancient seas covered this part of Illinois when these old rocks were being formed. Since the different formations lie nearly parallel, like the layers of a cake, it is clear that the Earth's crust in this region remained nearly stable through these hundreds of millions of years. Occasionally the sea withdrew, leaving a land surface of low relief to be cut up into ridges and valleys by the erosion of streams. Then the sea would return with a whole new retinue of ancient species and genera, and additional strata would be laid down as sediment on the sea floor.

EXPOSED MISSISSIPPIAN FORMATIONS

The Mississippian limestones which form the bold bluffs along the Illinois and continue to be exposed eastward in the beds and banks of the creeks were largely laid down in clear and open seas. Many of the layers teem with fossils, especially crinoids, brachiopods, corals, and snails. Trilobites have become sparse by now, and limited in variety. The new bosses of the undersea world were the fish, which first became common in Devonian Time. Their bones are rather numerous in some layers, especially in the Keokuk Formation.

Later in Mississippian Time conditions became less stable, so that the limestones of the sea came to alternate with layers of mud and sand washed from the land. At last, this unstable movement of the crust culminated in a rise of the whole region above the sea. In this section of Illinois a broad up-bowing of the strata resulted. This "Pittsfield Anticline" comes into our area from the west and runs approximately along the south edge of Scott and Morgan counties. It is responsible for the strong northerly dip of the beds noted in the course of the itinerary.

This uplift and erosion resulted in the removal of all of the late Mississippian (Chester) strata and in places cut deep into the earlier Mississippian beds as well.

PENNSYLVANIAN STRATA

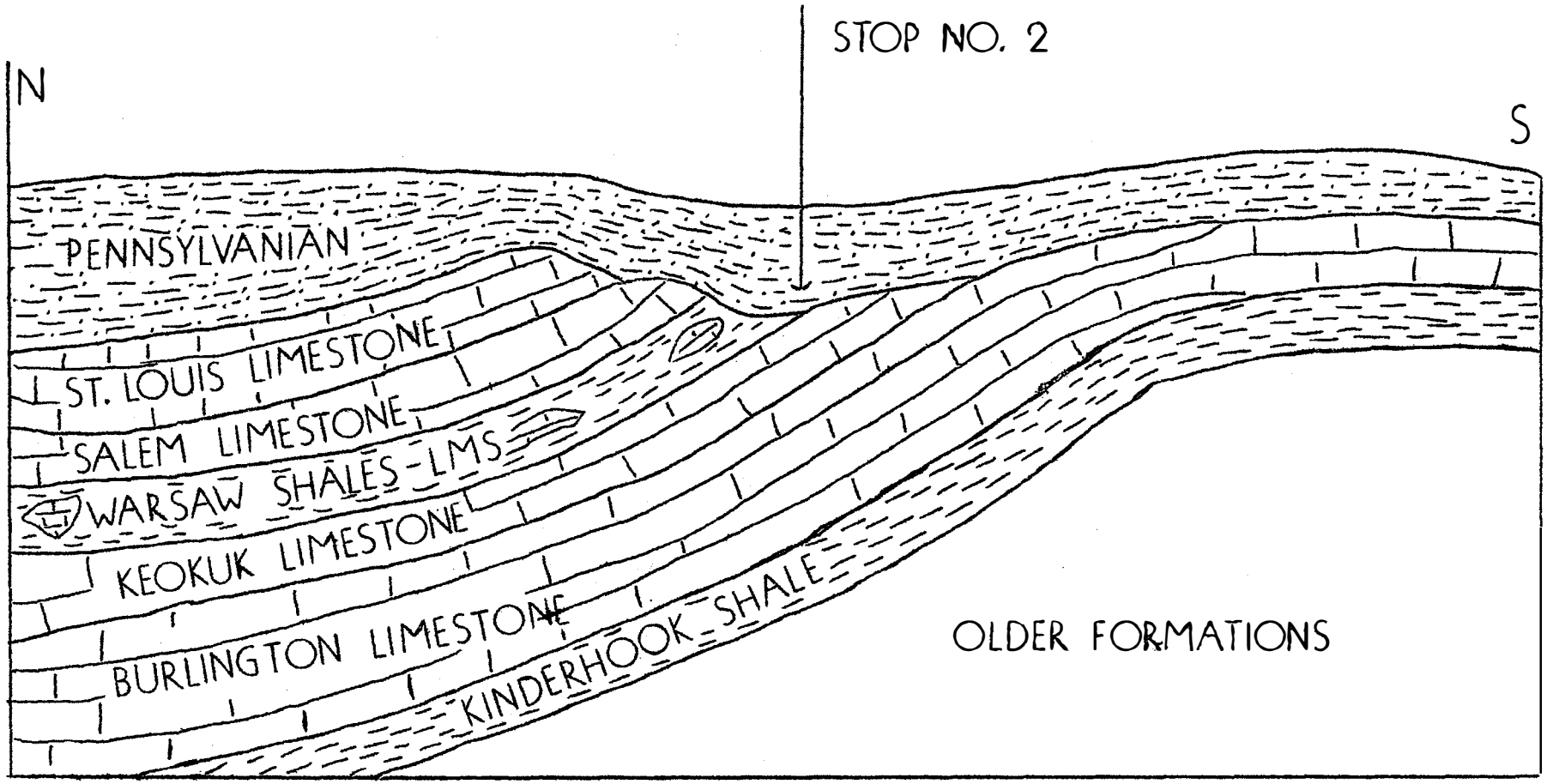
When sediments again came to be laid down in this region in Pennsylvanian Time, they therefore found an uneven surface and came to lie on strata of different age in different places. In time, these irregularities were levelled by the fill of mud, sand, and gravel. Through the rest of the Pennsylvanian Time, there was deposited in seas, coastal swamps, delta flats, and river floodplains, layer after layer of mud and sand. More rarely when the seas swept across the region for a limited time, fossiliferous limestones were laid down; or when clear but stagnant coastal swamps prevailed, the rank jungle vegetation accumulated in the waters to generate the State's valuable coal seams.

The Pennsylvanian seas that withdrew from Illinois hundreds of millions of years ago were the last to cover this region. There followed an immensely long period of time when most of Illinois lay as a moderately lowland area, undergoing erosion by streams and the weather.

ICE AGE HISTORY

This long prevailing condition was terminated at the beginning of the Pleistocene Period, a scant million years ago, when the first, or Nebraskan, ice sheet moved into Illinois from the Canadian Northwest. The alternation of glacial stages and mild climate intervals that prevailed during the Ice Age has been described in the itinerary (stop 6), as have the profound drainage changes these ice mass movements brought about (stop 5, etc.).

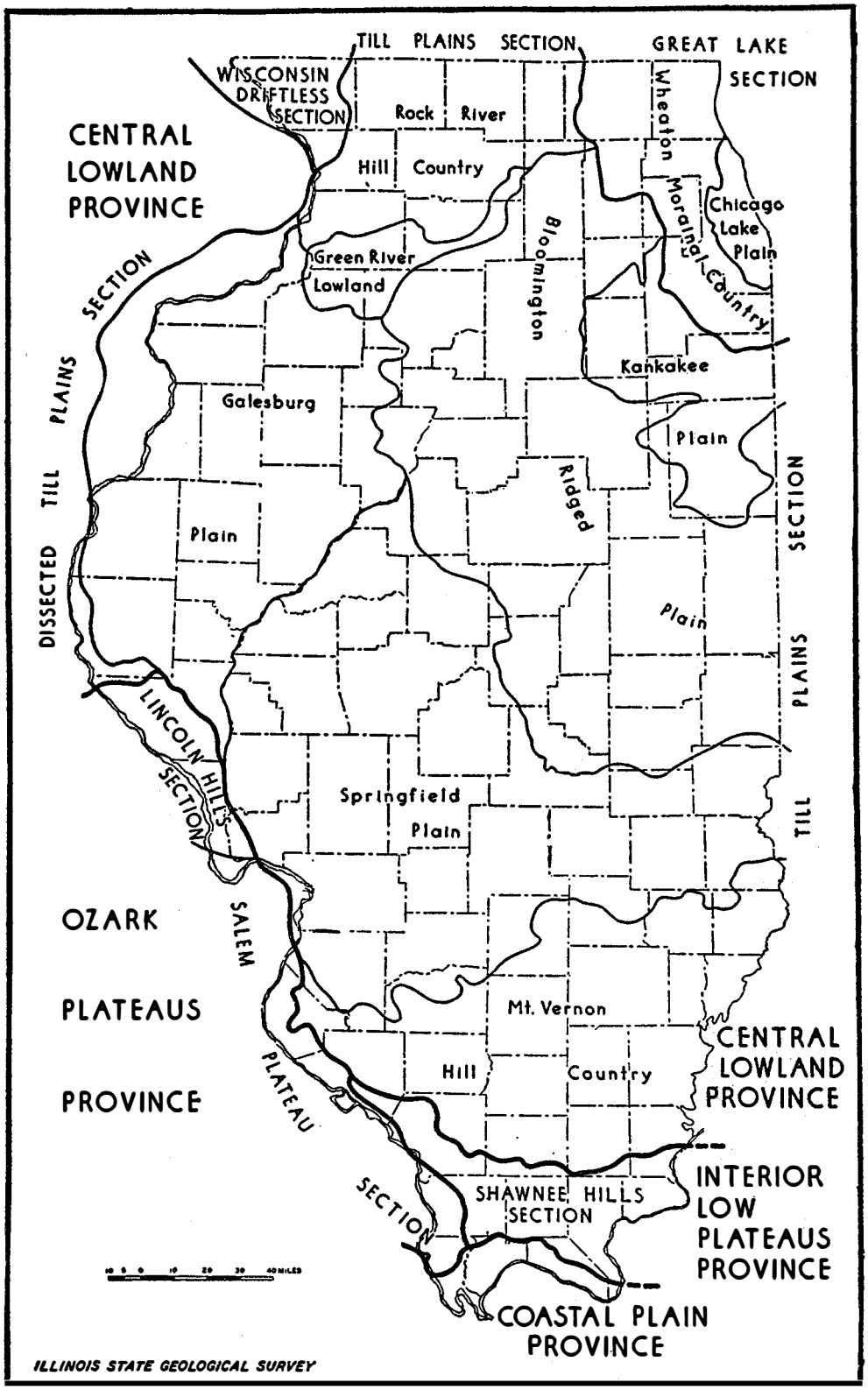
What has been Earth's History since the Ice Age? The last glacier moved out of the Lake Michigan Basin a scant 25,000 years ago. Previous interglacial intervals have lasted from 150,000 to 350,000 years. Therefore, there is no way of knowing that the Ice Age is over. It is the custom for geologists to refer to our own time as the "Recent Stage" of the Pleistocene Period.



PENNSYLVANIAN - MISSISSIPPIAN
UNCONFORMITY IN SCOTT COUNTY

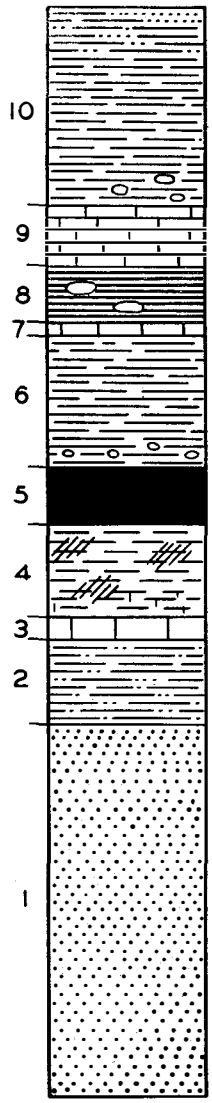
Time Table of Pleistocene Glaciation
(after M. M. Leighton and H. B. Willman, 1950)

Stages	Sub-stages	Nature of Deposits	Special Features
Recent		Soil, infant to youthful profile of weathering, lake and river deposits, dunes, peat.	
Wisconsin (4th glacial)	Late Mankato	Fluvial deposition - Mississippi, Illinois, and Ohio river valleys; dune sand, some loess deposits along the Mississippi River Valley; and deposits in Lake Chicago.	Lake Agassiz Torrent eroded Late Mankato deposits
	Early Mankato		Lake Duluth Torrent eroded Early Mankato deposits
			Forest bed, Two Creeks, Wisconsin
	Cary	Drift, loess, dunes, beginning of deposits in Lake Chicago	Kankakee and Lake Maumee Torrents
	Tazewell	Drift, loess, dunes, lake deposits.	Fox River Torrent Westward diversion of Mississippi River into Iowa by Tazewell ice lobe.
	Iowan	Drift, loess, dunes	
	Farmdale (Pro-Wis.)	Loess (in advance of glaciation)	
Sangamon (3rd interglacial)		Soil, mature profile of weathering, alluvium, peat	
Illinoian (3rd glacial)	Buffalo Hart	Drift	
	Jacksonville	Drift	
	Payson (terminal)	Drift	
	Loveland (Pro-Ill.)	Loess (in advance of glaciation)	
Yarmouth (2nd interglacial)		Soil, mature profile of weathering, alluvium, peat.	
Kansan (2nd glacial)		Drift Loess	
Aftonian (1st interglacial)		Soil, mature profile of weathering, alluvium, peat.	
Nebraskan (1st glacial)		Drift	



PHYSIOGRAPHIC DIVISIONS OF ILLINOIS

(Reprinted from Report of Investigations No. 129, Physiographic Divisions of Illinois, by M. M. Leighton, George E. Ekblaw, and Leland Horberg)



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

9 Limestone; contains marine fossils.

8 Shale, black, hard, laminated; contains large spheroidal concretions ("Niggerheads") and marine fossils.

7 Limestone; contains marine fossils.

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

5 Coal; locally contains clay or shale partings.

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

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

2 Shale, gray, sandy.

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

AN IDEALLY COMPLETE CYCLOTHEM

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

(26459—11-55)