STATE GEOLOGICAL SURVEY DIVISION
John C. Frye, Chief

GUIDE LEAFLET
GEOLOGICAL SCIENCE FIELD TRIP

Sponsored by
ILLINOIS STATE GEOLOGICAL SURVEY, URBANA

BARRY AREA

Pike and Adams Counties
Pittsfield, Liberty, Mt. Sterling, and Barry Quadrangles

Leaders
William Cote, David Reinersen, and Myrna Killey
Urbana, Illinois
May 11, 1968

GUIDE LEAFLET 1968B
HOST: Barry High School
To the Participants:

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

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

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

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

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

Glacial History of Illinois

A knowledge of Illinois glacial history and the glacial deposits is necessary for full appreciation of several points of geologic interest in the Barry area. The following summary is a brief introduction to these subjects and should be read before the field trip begins.

Thousands of years ago much of northern North America was covered by huge glaciers. These glaciers, which advanced from centers in eastern and central Canada, developed when the mean annual temperatures were a few degrees lower than they are now, and the winter snows did not completely melt during the summers. After many years a sheet of ice accumulated that was so thick that its weight caused it to flow outward, eroding and carrying with it the soil and rocks on which it rested and over which it moved.

The Pleistocene Epoch or "Great Ice Age" began about one million years ago and ended about five thousand years ago. During this epoch, there were four major stages of glaciation, each followed by a long interglacial stage characterized by climatic conditions much as they are today (see fig. 1 and attached Pleistocene Time Table).

The oldest glacial stage is the Nebraskan, named after the state of Nebraska where extensive Nebraskan deposits are buried beneath the younger glacial deposits. In Illinois the Nebraskan deposits are also buried, and there are only rare exposures of Nebraskan glacial deposits in extreme western Illinois. A warm climatic interval, called the Aftonian (interglacial) Stage, followed the melting of the Nebraskan glacier.

The next glacial climate produced the Kansan glacier, which left thick deposits of fine rock materials and outwash sand and gravel in Illinois when it melted away. The Kansan Stage was followed by the Yarmouthian (interglacial) Stage. During this stage, erosion carved valleys and hills, and soils were formed in the Kansan deposits.

The third glacial stage, the Illinoian, is particularly important to the residents of Illinois. The Illinoian glacier, in three separate advances (Liman, Jacksonville, and Buffalo Hart), covered 80 percent of the state, reaching southward to Carbondale and Harrisburg. After many thousand years, a warm stage caused the Illinoian ice sheet to melt. During this warm stage, the Sangamonian, the upper part of the deposits left by the glacier was weathered and a soil was developed, as in the preceding Yarmouthian interval. This ancient Sangamon Soil resembles present-day soils in color, texture, and depth, suggesting that the climate during interglacial times was similar to our present climate.

The last and most recent glacial stage in Illinois was the Wisconsinan, which began about 70,000 years ago. The Wisconsinan comprised three major glacial advances—the Altonian, the Woodfordian, and the Valderan. Little is known about the extent of the Altonian glacier, as its deposits were overridden by later glaciers, except in northern Illinois. The Woodfordian glacier advanced southward from the Lake Michigan basin to the present sites of Shelbyville, Decatur, Charleston, and Peoria. The Valderan glacier reached its maximum extent near Milwaukee, Wisconsin, and did not enter Illinois.
Fig. 1 - Sketch maps showing the extent of the major glacial advances into Illinois during the Pleistocene Epoch. Approximate times of invasion are given. Two substages—the Altonian and the Woodfordian—of the Wisconsinan Stage are shown. Arrows indicate the directions of ice movement and flow in major drainage channels which drained the ice front.
When the glaciers melted, they released the rock materials they had picked up as they advanced. These materials are called glacial drift. Glacial drift deposited directly by the ice is called 

When the glaciers melted, they released the rock materials they had picked up as they advanced. These materials are called glacial drift. Glacial drift deposited directly by the ice is called till. It is unsorted and unstratified and consists of a mixture of all kinds and sizes of rock fragments. As the Wisconsinan glacier wasted away, the ice front melted back and readvanced many times, creating a complex sequence of till deposits in northeastern Illinois, the most outstanding of which are end moraines. More than 50 successive end moraines were formed by the Wisconsinan glacier in Illinois alone. The major ones are shown on the accompanying Glacial Map of Northeastern Illinois.

Some of the glacial drift was washed out with the meltwaters and is called outwash. Outwash is layered or stratified. The coarsest material (gravel, sand) carried by the meltwater was deposited nearest the ice front, and the finer material (silt, clay) was carried farther away, with some possibly carried all the way to the sea. Where the outwash was spread widely along the front of the glacier, it formed an outwash plain. Where the outwash was restricted to the stream valleys, such as the Mississippi and Illinois Valleys, it formed valley train deposits. Many valley trains in Illinois are buried beneath younger glacial drift.

An end moraine is an accumulation of drift at the ice margin when the rate of advance and the rate of melting of a glacier are essentially in balance. As more and more rock debris is brought to the edge of the glacier, it piles up and forms a ridge. The surface relief of end moraines is generally greater than that of the surrounding area and is referred to as swell-and-swale or knob-and-kettle topography. At some places there are large gaps in the moraines where subglacial streams presumably carried away most of the drift. The flatter areas behind end moraines are called ground moraines or till plains.

At times, especially in the fall and winter, the meltwaters subsided, exposing the valley trains. The wind picked up silt and fine sand from the floodplains and deposited these materials on the bluffs and uplands to form deposits of loess. Loess mantles most of Illinois. Near the large river valleys, such as the Mississippi, it may be as much as 60 to 80 feet thick, but it thins rapidly away from the valleys.

The importance of the Pleistocene Epoch to Illinois is emphasized by the rich soils formed from the glacial deposits and by the abundant deposits of sand and gravel. The glacial outwash, especially buried valley trains, is an important source of ground water. The state would not have these valuable resources if the glaciers had not invaded Illinois.

Geology of the Barry Area

Physiographically the Barry area lies within the northern part of the Lincoln Hills Section of the Ozark Plateaus Province (see attached Physiographic Divisions of Illinois). The Lincoln Hills Section occupies a broad divide between the Mississippi and Illinois Rivers and narrows southward toward the junction of these great rivers near Grafton in southern Jersey County. The region is one of scenically rolling, rugged terrain that has been deeply dissected by streams that drain westward and eastward from the central ridge of the divide.

During the Pleistocene Epoch or "Great Ice Age" the region was covered by glacial ice at least once, and perhaps twice. Beginning about one million years ago the Nebraskan glacier advanced into the region from the west, covering
the extreme western edge of Illinois (see fig. 1). Later about 700 thousand years ago the Kansan glacier advanced into the region from the west. Both of these glaciers advanced into Illinois from a center of accumulation west of Hudson Bay, Canada. No till of Nebraskan age has been found in the region, but outwash that was deposited by meltwaters from the Nebraskan glacier has been found in a few places. Kansan till and outwash are widespread within the region, but these Kansan deposits are thin and patchily distributed. The absence of Nebraskan till and the patchy distribution of Kansan deposits are the result of erosion following these glaciations. To the south in Calhoun County these glacial deposits are absent, and that part of the Lincoln Hills Section may not have been covered by the glaciers.

The eastern edge of the field trip area, also the eastern boundary of the Lincoln Hills Section, follows the margin of the Illinoian glaciation which began about 250 thousand years ago (see fig. 1 and itinerary map). The Illinoian glacier advanced from a center to the east of Hudson Bay in Labrador. In the field trip area valleys which drain westward to the Mississippi River contain thick deposits of outwash deposited by meltwater from the Illinoian glacier. These glacial gravels are one of the area's important mineral resources. The last of the glaciations which began during Wisconsinan time about 70 thousand years ago did not reach the field trip area. Loess deposits of both Illinoian and Wisconsinan ages thinly blanket the upland areas.

Beneath the glacial deposits the field trip area is underlain by about three thousand feet of bedrock formations consisting of limestones, shales, and sandstones that were deposited layer by layer in the ancient, shallow seas that covered Illinois and the Midwest during the Paleozoic Era from about 550 to 280 million years ago. These ancient rocks form the western margin of a great bedrock depression, known as the Illinois Basin, that is filled with the Paleozoic strata (see fig. 2). The base of the Paleozoic strata rests upon an even more ancient basement of Precambrian granites more than one billion years old. The Illinois Basin covers most of Illinois and adjacent parts of Indiana and Kentucky. Regionally the Paleozoic strata of the Barry area are tilted gently eastward and southeastward and thicken into the basin. In the deepest part of the Illinois Basin in extreme southeastern Illinois the Paleozoic rocks are about 13,000 feet thick.

The upper part of the Paleozoic strata is exposed in the field trip area, and this includes strata of Middle Mississippian age (about 330 million years old) and strata of Early Pennsylvanian age (about 300 million years old). The Mississippian rocks are predominantly limestones of the Valmeyeran Series, but some dolomite, siltstone, and shale are also exposed. The limestones are extensively exposed along the bluffs of the Mississippi River and are the basis of an active and valuable quarrying industry for the region. The Pennsylvanian strata include sandstones, shales, limestones, and coal beds of the Spoon and Carbondale Formations. In the field trip area the coal beds are very thin and not presently of economic value, although small amounts of coal were mined in the past.

Of particular interest in the Barry area are extensive deposits of unconsolidated sands and gravels up to 100 feet thick that form a rather prominent ridge, known as the Beverly-Baylis Ridge. These deposits, known as the Baylis Formation, occur along the divide between the Mississippi and Illinois Rivers from just northwest of Pittsfield northwestward for about 10 miles into Adams County (see fig. 3 and itinerary map). These sands and gravels are Late Cretaceous in age (about 100 million years old), much younger than the Paleozoic
Fig. 2 - North-south cross-section through Illinois showing the Paleozoic strata in the Illinois Basin.
Fig. 3 - Map showing the distribution of the Baylis Formation of Cretaceous age in western Illinois and the boundary of Illinoian glaciation.
strata on which they rest, and much older than the glacial deposits. Formerly these deposits were thought to be of Pleistocene age, but recent studies by Survey geologists have demonstrated their relationship to known Cretaceous deposits that occur in extreme southern Illinois (see attached Geologic Map of Illinois) and 200 miles to the west in Iowa and in central Kansas.

ITINERARY

0.0 0.0 Assemble in front of Barry High School. Proceed east.
0.1 0.1 Intersection. Yield right-of-way. Turn left.
0.2 0.3 STOP. Intersection with U.S. Route 36. Turn right. Continue ahead toward Pittsfield.
2.8 3.1 Road cut in Mississippian Burlington Limestone.
0.8 3.9 Note the relatively even upland surface along the horizon to the east and southeast.

The Calhoun Peneplain

This even surface is believed to represent the northward extension of an ancient plain or surface of erosion known as the Calhoun Peneplain, named after Calhoun County to the south where the peneplain is well developed. As seen now from this vantage point, the peneplain is not a perfectly flat surface, having been glaciated and deeply dissected by streams since its formation. However, it probably was a slightly undulating surface even at the time of its maximum development.

The rolling hilly topography of the Barry area has had a long, complex history of development related to long intervals of erosion during post-Paleozoic and post-Cretaceous times, crustal uplifts, dissection by streams, and glaciation. In general, the present topography is described as being in the mature stage of the erosion cycle. Major streams tributary to the Mississippi and Illinois Rivers have sharp valleys with narrow floodplains, and smaller tributary streams have V-shaped valleys. Interstream divides are for the most part narrow and rounded, but some are fairly broad and rather flat. Glacial deposits on the uplands are thin, so that the present shape of the land surface strongly reflects the form of the bedrock surface. Summit elevations of divides most commonly occur at elevations of about 700 to 750 feet, and when viewed from a distance, their general accordance reveals the Calhoun Peneplain on the skyline.

The exact time of development of the peneplain is not known, since there is little record of the events that took place during the 180 million years or so that followed the last withdrawal of the Pennsylvanian sea and preceded the deposition of the Cretaceous sands and gravels about 100 million years ago. After withdrawal of the Pennsylvanian sea the region was uplifted several hundred feet by movements of the earth's crust, and the region stood much higher than now. Several hundred feet of the Mississippian and Pennsylvanian strata were stripped away by erosion, and the region was reduced to a plain of low relief prior to deposition of the Cretaceous sands and gravels. These Cretaceous
deposits will be discussed more fully later, but it seems certain that they were much more extensive than now, and that the present deposits represent only erosional remnants. At the end of Cretaceous deposition, erosion was resumed, stripping away most of the Cretaceous sediments and again reducing the region to a plain of low relief.

Some geologists believe that the peneplain owes its origin to this post-Cretaceous erosion that took place principally during the latter part of the Tertiary Period between about one to 25 million years ago and preceding the advance of the first Pleistocene glacier of the Nebraskan Stage. However, the fact that the Cretaceous age of the Baylis Formation has been tentatively established, the fact that the Beverly-Baylis Ridge stands prominently above the general upland surface, and the fact that the base of the Baylis Formation rests upon a flat erosion surface developed upon Mississippian and Pennsylvanian strata, make it seem reasonable to assume that peneplanation must have occurred before Cretaceous time. Post-Cretaceous erosion probably exhumed this ancient peneplain. During Late Tertiary time before the advance of the glaciers, the peneplain was uplifted and became deeply dissected by streams. The present Mississippi and Illinois Valleys originated at this time as did many of the larger tributaries, such as Hadley Creek and Kiser Creek in the Barry area.

1.3 Cross Kiser Creek.
1.5 Cross East Branch Kiser Creek.
5.9 Intersection with Route 54. Bear left.
0.1 STOP. Turn left on Routes 54 and 36. Continue ahead (east) to Pittsfield.
1.2 SPEED ZONE AHEAD.
0.8 City limits of Pittsfield. SLOW.
1.7 Entering business district. SLOW.
0.1 STOP. Continue ahead.
0.2 Junction with Illinois Route 107. Turn right (south).
0.1 STOP. Intersection of South Jackson and East Fayette Streets. Turn left (east) on East Fayette.
0.1 Turn right (south) on South Piper Lane.
3.2 Cross Honey Creek.
2.0 Glacial drift in road cut. This will be Stop 1.
0.4 Crossroads with Ramble Road. Independence Christian Church on southeast corner. Turn around and return (north) to Stop 1.
STOP 1. INDEPENDENCE SCHOOL SECTION. Pleistocene drift exposed on both sides of road. (SW¼, NW¼, SE¼, sec. 18, T. 6 S., R. 3 W.)

The unconsolidated deposits exposed along both sides of the road afford a unique opportunity to examine features related to several events that occurred in the Barry area during the Pleistocene Epoch. The deposits are described on the next page in the detailed geologic section and are diagrammatically illustrated in figure 4. The deposits can be seen best on the west side of the road.

The oldest deposit is Kansan till that was laid down by the ice of the Kansan glacier, which advanced into this region from the west beginning about 700,000 years ago. At this locality we are near the eastern margin of the Kansan glacier (see itinerary map). The Kansan glacial margin is not defined by an end moraine, probably because it was obliterated by erosion after withdrawal of the glacier. The extent of the Kansan ice has been determined by the scattered occurrences of Kansan till as observed in exposures and in borings. The Kansan till is deeply weathered, heavy clayey material with pebbles scattered throughout (see description on next page). Because of this extreme weathering, the till does not exhibit the characteristics typical of unweathered tills. The top of the till is marked by a thin zone of angular chert pebbles, indicating that it was eroded during its exposure after the Kansan ice melted away. This chert is rubble that was eroded from the cherty Mississippian limestones over which the Kansan glacier moved. The upper part of the till contains an ancient soil zone, known as the Yarmouth Soil, that was formed during the long, warm interval of weathering, known as the Yarmouthian Stage, that followed the Kansan glaciation and lasted from about 600,000 to 250,000 years ago.

Immediately above the Yarmouth Soil is a thin deposit of clayey silt called the Loveland Silt. This silt deposit is loess that was blown from the floodplain of the Mississippi valley train, which was formed by outwash deposited in the Mississippi Valley by meltwater during the advance and retreat of the Illinoian glacier between about 250,000 to 200,000 years ago. The Illinoian glacier advanced to within about seven miles of this locality just to the east (see fig. 3). Developed within the Loveland Silt is another ancient soil, known as the Sangamon Soil. This buried soil zone is distinctive by its conspicuous reddish brown color. It was formed during the Sangamonian Stage, another long, warm interglacial interval of weathering that followed the melting of the Illinoian glacier and lasted from about 200,000 to 70,000 years ago. Both the Yarmouth and Sangamon Soils occur widely throughout the glaciated areas of Illinois and the Midwest. Wherever they are exposed, these ancient soils are used as important key horizons to indicate the contacts between the Wisconsinan, Illinoian, and Kansan deposits.

Although the Wisconsinan glacier never reached the Barry area, loess deposits of Wisconsinan age reflect the influence of the Wisconsinan glacier beyond the limits of its extent (see fig. 1). The Sangamon Soil is overlain by the Roxana Silt, a loess that was deposited during the advance and retreat of the Altonian glacier of Early Wisconsinan time between about 70,000 to 28,000 years ago. The Roxana generally has a distinctive pink cast that distinguishes it from the typically light brown Peoria Loess that occurs above it. The Peoria Loess was deposited during the advance and retreat of the Woodfordian glacier during Late Wisconsinan time between about 22,000 to 12,000 years ago. Between the deposition of the Roxana and Peoria Loesses there was a short time interval of 6,000 years, known as the Farmdalian, which marked a brief but major withdrawal of the Wisconsinan glacier from Illinois (see attached Pleistocene Time Table).
Fig. 4 - Glacial deposits exposed at Stop 1.

**Description of Glacial Deposits**

**PLEISTOCENE SERIES**

**WISCONSINIAN STAGE**

**WOODFORDIAN SUBSTAGE**

**Peoria Loess**

1. Loess, tan to tan-brown, massive, leached; surface soil in top.

2. Loess, pink-tan, gray-tan, and tan-brown, massive, leached; sandy in lower part with some clay and dispersed streaks of black iron and manganese oxides.

**ALTONIAN SUBSTAGE**

**Roxana Silt**

2. Loess, pink-tan, gray-tan, and tan-brown, massive, leached; sandy in lower part with some clay and dispersed streaks of black iron and manganese oxides.

**ILLINOIAN STAGE**

**Loveland Silt**

3. Sangamon Soil; silt, sand, and clay, leached, massive with soil structure in upper part, red-brown in upper part grading downward to pinkish tan-brown at base; upper part (B-zone) contains strongly developed streaks and splotches of black iron and manganese oxides.

**KANSAN STAGE**

**Yarmouth Soil**

4. Yarmouth Soil; developed on till, brown, tan, and gray, massive, leached; upper part has strongly developed black iron and manganese oxide streaks and splotches; at the top is a 3-inch zone of pebbles, partly coated with iron and manganese oxides; the pebbles may be a lag concentrate on the soil.
Geologists generally agree that the loess deposits are eolian in origin and are genetically related to the major meltwater channels that drained the glacial fronts during the times of advance and retreat of the Pleistocene glaciers in Illinois (see fig. 1). During Pleistocene time, as now, the winds prevailed westerly and blew fine sand, silt, and clay from the surfaces of the valley trains, which were largely unvegetated outwash flats, and deposited these materials on the adjacent bluffs and uplands. Very fine sand and coarse silt occur in the thick loess deposits near the source valleys, while the finest silt and clay were blown eastward to form a gradually thinning blanket across most of the state. Because of the westerly winds, the loess deposits are thicker on the east sides of the valleys. In extreme eastern Illinois the loess is only a thin film barely recognizable in the modern soil. Most of the loess was deposited during the fall and early winter when, because of colder conditions, the glacial meltwaters receded, exposing the surfaces of the valley trains and permitting them to dry out. The recently deposited outwash sediments were then more susceptible to wind erosion. In the Barry area the broad bottomlands of the Ancient Mississippi Valley to the west were the principal source of the loess.

The history of the Pleistocene deposits of Illinois is extremely complex and is further complicated by the fact that post-Pleistocene erosion and their unconsolidated nature makes good exposures rare. In attempting to unravel this history the geologist must be thoroughly familiar with the characteristics of the glacial deposits and learn to recognize all possible variations in their texture, mineral composition, and color. Indeed, sometimes the same stratigraphic units in different localities are entirely different in appearance and physical properties. The presence of ancient buried soil zones within the glacial deposits, such as the Yarmouth and Sangamon Soils here at Independence School, is extremely useful and is the most valuable means of establishing the relative ages of glacial deposits. Fossils, including terrestrial molluscs (usually snails) and woody materials, are rare in the glacial deposits. These have been used to some extent, and although useful when found, these materials cannot be reliably dated by radiocarbon methods much beyond about 50,000 years before the present.

0.0 22.9 Leave Stop 1. Continue north to Pittsfield.
2.2 25.1 Cross Honey Creek.
2.6 27.7 Pittsfield city limits. SLOW.
0.5 28.2 Turn left onto East Fayette Street.
0.1 28.3 Turn right on South Jackson Street. Proceed north.
0.1 28.4 STOP. Intersection with East Washington Street. Continue ahead (north) on Route 107.
1.4 29.8 Cross Bay Creek.
1.9 31.7 SLOW. Prepare to turn left.
0.1 31.8 Turn left (west) on white gravel road.
0.7 32.5 Unguarded railroad crossing. CAUTION. Wabash Railroad.
0.2 32.7 T-road intersection. Turn right (north).
1.0  33.7 Crossroads. Turn left (west).

0.1  33.8 Stop 2. Discussion of Illinoian glacial margin.

At this point we are standing near the margin of the Illinoian glacial deposits, a line which represents the maximum southwestward advance of the Illinoian glacier into this part of the state beginning some 250,000 years ago (see itinerary map). The front of the glacial margin slopes downward toward the shallow valley of Bay Creek in the foreground. In the distance on the horizon to the west and northwest the low Beverly-Baylis Ridge can be seen rising gently to the north. Because of the generally poor exposures of Illinoian drift in the immediate field trip area and the thinness of the drift, we will not be able to see Illinoian till along the present itinerary. Loess associated with the Illinoian glacial advance was seen at Stop 1. Excellent exposures of Illinoian till can be seen along the banks of Bay Creek farther to the south, but these exposures are inaccessible to a field trip party.

For more than 20 miles the upper course of Bay Creek follows the Illinoian glacial margin. The lower part of Bay Creek was established during Late Tertiary time or perhaps Early Pleistocene time, long before the advance of the Illinoian glacier. The glacier covered the upper course of the early creek valley and forced the stream westward. Meltwater from the Illinoian glacier probably formed a series of ponds along the ice front that gradually coalesced and spilled over divides toward the southeast and cut the present upper portion of the creek. During final melting of the ice, a great deal of meltwater flowed down Bay Creek, and the valley is partially filled by Illinoian sand and gravel outwash.

Unlike the Wisconsinan glacier which built prominent ridges of till, known as end moraines, in northeastern Illinois (see Glacial Map of Northeastern Illinois), the Illinoian glacier did not form a prominent end moraine in the field trip area. Generally the Illinoian till is thin, only a few feet and usually less than 20 feet thick. A slight end moraine was formed, however, but it has been largely obliterated by erosion since the withdrawal of the Illinoian glacier. The slight rise in topography just to the north of here probably represents an erosional remnant of the Illinoian end moraine. Toward the southeast in the vicinity of Detroit and Milton, rather distinct ridge remnants stand 60 to 80 feet above the general upland surface, and these also represent portions of the Illinoian end moraine. Another reason for the absence of a prominent Illinoian end moraine may be that the ice was relatively thin and did not stand along the glacial margin long enough to form one. Farther to the northeast in Illinois there is also evidence that the Illinoian glacier became stagnant (stopped moving) soon after it reached its maximum extent, another reason for the absence of a well-developed end moraine. As with the Kansan Stage, the Illinoian glacial margin has been established by careful studies of the occurrences of Illinoian till in limited exposures and in borings.

Prior to the discovery by Survey geologists that the Beverly-Baylis Ridge was composed of Cretaceous deposits, the Illinoian glacial margin was thought to occur about 12 miles to the west of this locality (see fig. 3). At a point north of Payson in Adams County the glacier was believed to have reached 20 miles to the west of the present boundary, almost to the city of Quincy. The Cretaceous deposits were believed to be Illinoian in age, and the Beverly-Baylis Ridge was assumed to be part of the Illinoian end moraine. At that time, because of its apparent greater westward extent, the Illinoian glaciation was named the Payson Substage after the town of Payson. Two later advances of the Illinoian
glacier did not reach the Barry area (Jacksonville and Buffalo Hart Substages) so they will not be discussed at this time (see attached Pleistocene Time Table). Because of this new information about the extent of the earliest Illinoian glacial advance, the Illinoian drift in this region is now called the Mendon Drift after the town of Mendon. The name of this earliest Illinoian advance has been also renamed the Liman Substage after Lima Township in Adams County where the Illinoian till is well represented.

Another outgrowth of this new information about the extent of the Illinoian glacier is that a narrow area, extending from Kingston in Adams County southeast along the Baylis Ridge past Pittsfield, occurs between the Illinoian and Kansan glacial margins and was probably not glaciated. This area did not move. Just to the west of Pittsfield there is also a narrow, elongate, east-west ridge with elevations of up to about 850 feet at its summit which seems to have affected the flow of the Kansan ice. The Kansan glacial margin bends sharply westward around the end of this ridge in the vicinity of Pleasant View School (see itinerary map). This ridge, which was crossed along the itinerary earlier this morning, is formed by a gentle arching of the bedrock strata to form a structure called an anticline. The crustal movements which formed this anticline must have occurred after formation of the Calhoun Peneplain, probably during the Late Tertiary uplift of this region, in order to account for its topographic expression above the general upland level. The anticline, known as the Pittsfield Anticline, was drilled for oil, but only a small amount of gas was found in strata of Silurian age (see Geologic Map of Illinois).

0.0 33.8 Leave Stop 2. Continue west.
1.0 34.8 Crossroads. Continue ahead (west).
1.0 35.8 Crossroads. Jog in road. Continue west.
0.3 36.1 Cross Bay Creek.
1.9 38.0 Crossroads. Turn right (north).
1.0 39.0 Crossroads. Turn left (west).
1.7 40.7 Crossroads. Turn left (south).
0.8 41.5 **Stop 3. ABERDEEN SCHOOL SECTION.** Cretaceous Baylis Formation exposed along creek and hillside in pasture on left. (NW¼, SW¼, SE¼, sec. 31, T. 4 S., R. 4 W.) Enter pasture over gate. DO NOT OPEN GATE. Property of Jack Taylor, Route 1, New Salem, who lives in the house immediately to the south. This stop affords the opportunity to examine the physical characteristics of the Cretaceous Baylis Formation. The Baylis Formation, consisting of unconsolidated gravels and sands, formerly thought to be of Pleistocene age (Illinoian) as mentioned earlier, covers an area of about 100 square miles in portions of Adams and Pike Counties (see fig. 3 and itinerary map). The formation attains a maximum thickness of about 100 feet. The formation rests on a pre-Cretaceous erosion surface of low relief that is developed upon Paleozoic strata of Mississippian and Pennsylvanian age. Here at Aberdeen School the formation rests upon shale of the Pennsylvanian Abbott Formation. The extent of the Baylis Formation in this region was probably at one time more
widespread, and its present distribution is the result of post-Cretaceous erosion that spanned an interval of many millions of years. The strata exposed here are described in the geologic section given below.

### Strata Exposed at Stop 3

<table>
<thead>
<tr>
<th>CRETACEOUS SYSTEM</th>
<th>BAYLIS FORMATION</th>
<th>Thickness (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>Kiser Creek Member</strong>: sand and clay, tan, massive; contains lenses and zones of dark gray sandy clay and of gray clayey sand.</td>
<td></td>
<td>20.0</td>
</tr>
<tr>
<td>2. <strong>Hadley Gravel Member</strong>: sand and gravel, loose, massive; contains cobbles to 4 inches in diameter of chert and quartzite but no igneous rocks.</td>
<td></td>
<td>5.0</td>
</tr>
<tr>
<td>3. Pebbles of chert and some quartzite densely iron cemented at bottom; contains quartz sand in the cement matrix.</td>
<td></td>
<td>0.3</td>
</tr>
</tbody>
</table>

### PENNSYLVANIAN SYSTEM

<table>
<thead>
<tr>
<th>CARBONDALE FORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Shale, gray, platy; weathered to yellow-gray and tan in the uppermost 0.3 feet.</td>
</tr>
</tbody>
</table>

The Aberdeen School Section is the type section of the Baylis Formation in Illinois. The formation has been named for the town of Baylis four miles north of this locality. A type section is the exposure of strata that most typically exhibits the characteristics of a geologic formation. The Baylis Formation has been divided into two parts or members—the Hadley Gravel Member in the lower part, and the Kiser Creek Member, which consists predominantly of sand and clay, in the upper part. The Hadley Gravel has been named for the town of Hadley about four miles to the northwest, and the Kiser Creek Member for East Branch of Kiser Creek just to the southwest.

The Hadley Gravel Member, in places up to 15 feet thick, consists of rounded, polished pebbles and cobbles of chert and minor amounts of quartz and quartzite. The rock fragments have a variety of colors. Much of the chert in the gravel was derived locally from cherty Paleozoic limestones of this region. However, many of the chert fragments, the quartz, and the quartzite, in particular a purplish variety of quartzite, are foreign to this region and were transported from great distances away. The very base of the Hadley Gravel, as here at Stop 3, is commonly marked by a firmly iron oxide-cemented layer that may be up to several inches thick.

The Kiser Creek Member consists predominantly of loose, fine to medium grained quartz sand and clayey sand with occasional lenses of silty clay and scattered, rounded pebbles of chert, quartz, and quartzite similar to those of the underlying Hadley Gravel. The sands are generally massive and indistinctly bedded, but some zones show distinct bedding (layering) and even crossbedding (inclined laminations) indicating deposition by moving water.

The Cretaceous age of the Baylis Formation was established by careful study of the mineralogical composition of the formation by Survey geologists. These analyses included the sand and clay fractions predominantly and are too detailed to be reviewed at this time. However, the findings showed that the
mineralogy of the Baylis Formation is distinctly different from the younger glacial deposits, and that the mineral composition is strikingly similar to that of known Cretaceous formations that occur 200 miles to the west in central Iowa and in central Kansas. The Baylis Formation also contains no igneous rock fragments, a fact which also strongly suggests that it is not of Pleistocene age. No fossils, either plant or animal, have been found in the Baylis Formation, so its Cretaceous age has been established solely on the basis of its mineralogical composition and its stratigraphic relationships with the Paleozoic and Pleistocene formations.

The origin of the Baylis Formation and the environment in which it was deposited have not been definitely established. This problem is still being investigated by Survey geologists. The absence of marine fossils suggests deposition in a nonmarine environment. The present theory is that the Baylis sediments were laid down as sheet-like deposits over a flat surface, probably by an ancient Cretaceous river system flowing swiftly from the north. The northern source is strongly suggested by the presence of a mineral suite in the sands that seems to have been derived from Precambrian igneous and metamorphic rocks that are exposed in south-central Canada. The purple quartzite fragments in the Hadley Gravel are also identical in physical properties to quartzite of a formation in central Wisconsin called the Baraboo Quartzite. If these quartzite pebbles were in fact eroded from the Baraboo Quartzite, this idea of a northern source would be further strengthened. However, in view of the general coarseness of the Hadley Gravel and the large sizes of some of the quartzite cobbles, which would have been transported many hundreds of miles, it is problematical to envision a stream of sufficient velocity to have deposited the gravel. This notion is further complicated by the fact that the gravel rests upon the relatively flat, featureless pre-Cretaceous erosion surface (the Calhoun Peneplain) because streams flowing through a region of such low relief could hardly have current velocities sufficient to transport such coarse gravels.

Because of the coarseness and high degree of roundness and polish of most of the pebbles in the Hadley Gravel, and the purity of the quartz sands, some zones showing crossbedding, and the alternations of the clean quartz sands with clayey sands in the Kiser Creek Member, it has been suggested that the Baylis Formation represents littoral (shoreline) sediments that were deposited along the shore of a shallow Cretaceous sea. The Cretaceous sedimentary strata farther south in extreme southern Illinois consist of both nonmarine and marine clays, sands, and gravels. These sediments were deposited at the upper end of an arm of a sea that extended northward into the Mississippi Valley from the Gulf of Mexico during Late Cretaceous time, covering the tip of the state several times beginning about 100 million years ago. If the Baylis Formation was deposited along the shore of a Cretaceous sea, this would imply that the sea extended some 200 miles farther north than presently believed. This would mean that post-Cretaceous erosion has removed all traces of this northward extension of the sea except for the present limited exposures of the Baylis Formation in this locality. A fact which contradicts the possibility that the Cretaceous sea extended so far north into the Mississippi Valley is that the mineral composition of the Cretaceous sediments of extreme southern Illinois indicates a source of sediments from the southeast in the Appalachian Mountains.

0.0 41.5 Leave Stop 3. Continue south.
0.2 41.7 Crossroads. Turn right (west).
1.2 42.9 T-road intersection. Turn right (north).
1.3 44.2 Tributary to Kiser Creek.

Stop 4. KISER CREEK SECTION. Pennsylvanian strata of the Spoon and Carbondale Formations are exposed along creek banks for several hundred feet. Enter gate just south of bridge. (NWW\(\frac{1}{4}\), SSW\(\frac{1}{4}\), SE\(\frac{1}{4}\), sec. 25, T. 4 S., R. 5 W.) Property of Ervin Campbell, Route 1, New Salem, who lives in the white house just to the south.

This exposure affords an excellent opportunity to collect Early Pennsylvanian fossils. Although not perfectly preserved and frequently flattened, many good specimens may be found.

The Colchester (No. 2) Coal Member may be examined here. Although rarely over 30 inches in thickness, the No. 2 Coal is one of the most widespread coals of the Lower Pennsylvanian System, not only in Illinois, but also in adjacent parts of Missouri, Iowa, Oklahoma, Western Kentucky, Indiana, and Ohio. In the past it was mined extensively throughout Illinois for local markets. At the present it is being mined commercially at Vermont in Fulton County to the north, and near Coal City in Grundy County in the northeastern part of the state.

In the early days of geological field investigations in Illinois, the coal beds were readily recognized as excellent marker beds in the Pennsylvanian strata and could be easily traced laterally from one area to another. Thus the coals were numbered from the oldest, near the base of the Pennsylvanian strata, to the youngest toward the top. Later, more advanced methods of correlation showed that there were many other coals occurring between those that had been numbered. Several coal beds occur between the older No. 1 Coal and the younger Colchester (No. 2) Coal Member that is present here. Further discrepancies and miscorrelations were noted in other areas. Where practical, the numbers are still used, but usually only in connection with a geographic name applied to the coal where it was first described and studied. The majority of Illinois' more than 40 coal beds are not numbered. The Pennsylvanian strata exposed here at Stop 4 are described below.

### Strata Exposed at Stop 4

<table>
<thead>
<tr>
<th>PENNSYLVANIAN SYSTEM</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARBONDALE FORMATION</td>
<td></td>
</tr>
<tr>
<td>(Liverpool Cyclothem)</td>
<td></td>
</tr>
<tr>
<td>Purinton Shale Member, medium gray shale with a slight greenish cast, slightly fossiliferous; this unit represents the upper shale (Unit #10) of the ideal cyclothem (see discussion of Sedimentary History of the Pennsylvanian Rocks on page 17).</td>
<td>5'±</td>
</tr>
<tr>
<td>Oak Grove Limestone Member, composed of a series of thin, gray, fossiliferous limestone beds and thin gray and black shales; cumulatively these beds represent Unit #9 of the ideal cyclothem; the beds show a pronounced dip (tilt) of about 7 degrees to the north; pyrite in the limestones and shales has weathered to melanterite, a white powdery material.</td>
<td>2' 2&quot;</td>
</tr>
<tr>
<td>Shale, medium gray, well bedded, tends to be blocky, becomes darker colored upwards, contains scattered pyrite nodules up to 4 inches long; base concealed; this unit may represent Unit #6 of the ideal cyclothem.</td>
<td>3'±</td>
</tr>
</tbody>
</table>
Covered Interval

Colchester (No. 2) Coal Member, blocky, weathered, top eroded, (Unit #5 of the ideal cyclothem) 4"+

SPOON FORMATION
(Liverpool Cyclothem)
Underclay, medium gray, fairly firm, with Stigmarian roots (plant roots); thickness uncertain because of length of exposure (Unit #4 of the ideal cyclothem). 1'10"+

(Seahorne Cyclothem)
Seahorne Limestone Member, nodular limestone with a light to medium gray matrix containing nodules of dark gray to black limestone; conglomeratic or brecciated in appearance; base concealed below water level. 2'10"+

The Oak Grove beds are especially fossiliferous, including mainly brachiopods, pelecypods, gastropods, and bryozoans. Many of these are shown on the attached fossil chart at the back of the guide book. The following genera of pelecypods and brachiopods are present: Linoproductus, Crurithyris, Cardio-morpha, Mesolobus, Astartella, Composita, and Marginifera.

The large gray limestone nodule with the peculiar network of brown veins that is in the creek bed is known as a septarian concretion. It is not in place, but is probably part of the Oak Grove beds. A light gray, sandy clay can be seen a short distance downstream. This clay may be associated with the Seahorne Limestone, but this relationship is not clear.

Sedimentary History of the Pennsylvanian Rocks

Pennsylvanian sedimentary rocks form the bedrock surface over approximately four-fifths of Illinois and have a maximum cumulative thickness of about 3000 feet. They were deposited between about 280 and 310 million years ago, and contain all of Illinois' minable coal beds, whose recoverable reserves are estimated at 137 billion tons. Coal is one of the state's most important mineral resources, accounting for about one-third of the total production value, which in 1966 amounted to approximately $644,000,000. In 1966, over 63 million tons of coal valued at over $243 million were mined in Illinois, ranking the state fourth among the coal-producing states in the nation.

Unlike the older sedimentary rocks in Illinois, which consist of fairly thick units of limestone, dolomite, sandstone, and shale, the Pennsylvanian strata are made up of comparatively thin rock units, often only a few inches thick and rarely exceeding 30 feet. They are characterized by frequent and abrupt vertical changes in rock type. Several hundred individual units—sandstone, shale, siltstone, clay, limestone, and coal—are present in the Pennsylvanian System. Many of these individual units are quite variable in thickness and grade laterally from one rock type to another. However, some units, especially the limestones, are very persistent laterally and can be traced over large areas of the state.

About 30 years ago, geologists at the Illinois Geological Survey noted from their field studies of the Pennsylvanian strata that the various individual rock units occur in regular sequences which are repeated many times. Each
Shale, gray, sandy at top; contains marine fossils and ironstone concretions, especially in lower part.

Limestone; contains marine fossils.

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

Limestone; contains marine fossils.

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

Coal; locally contains clay or shale partings.

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

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

Shale, gray, sandy.

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)
regular sequence represents a cycle of sedimentation during which the individual units were deposited under environmental conditions that changed with time. Each cycle of sedimentation, called a cyclothem, consists of several lithologic units, part of which were deposited under marine conditions and part under nonmarine conditions. Based on extensive studies of the entire Pennsylvanian System in Illinois and the Midwest, the geologists determined that an ideally complete cyclothem consists of ten distinct sedimentary units. The chart on the next page shows the arrangement of units in the ideal cyclothem. Only a few of the approximately 50 cyclothems that have been described in Illinois contain all ten units. Usually one or more units are missing, but the order of arrangement is almost always the same. The units which are most commonly present are a basal sandstone overlain by an underclay, coal, black slaty shale, limestone, and gray shale.

The variety of sedimentary rock types in the Pennsylvanian System, the thinness of individual units, the abrupt and frequent vertical changes in rock types, and the lateral variations in thickness and lithology of most units indicate a wide range of depositional conditions which changed fairly rapidly with time. The cyclical character of the sedimentary sequences also indicates that the depositional conditions during Pennsylvanian time changed in a regular manner. The geologic framework which produced these conditions is not exactly known, but it was unique to the Pennsylvanian Period, because no other system of sedimentary rocks in the geologic column exhibits a comparable development of cyclic sediments.

Geologists have offered several explanations for the Pennsylvanian cyclothems, too numerous and detailed to discuss at the present time. However, the presence of both marine and nonmarine deposits in each cyclothem indicates that invasion and withdrawal of the sea occurred during the formation of each cycle. The repeated alternations of marine and nonmarine sedimentary rocks also indicate that there were many intervals of invasion and withdrawal. In general, the sandstone-underclay-coal portion (the lower five units) of each cyclothem is nonmarine and was deposited on coastal lowlands from which the sea had withdrawn. However, some of the sandstones are entirely or partially marine. The units above the coal are marine sediments which were deposited during the invasion part of the cycle. The exact mechanism which caused these repeated relative changes in sea level is not known, but the occurrences of cyclic Pennsylvanian sediments on many of the continents suggests that the sea level fluctuations were world-wide. The following discussion briefly explains the geologic conditions that probably existed in the Illinois-Indiana region during the Pennsylvanian Period.

At the end of Late Mississippian time about 310 million years ago, the Mississippian sea withdrew from the Midcontinent region, and a long interval of erosion followed during early Pennsylvanian time. During this erosion interval, several hundred feet of Upper Mississippian strata were eroded away, and an ancient Pennsylvanian river system cut deep channels into the Mississippian sedimentary rocks. This erosion was interrupted by the invasion of the early Pennsylvanian sea.

Throughout Pennsylvanian time the region northeast of the Illinois Basin was a broad swampy lowland bordering the shallow sea which lay to the southwest (fig. 5). This lowland stood only a few feet above sea level, so that only slight changes in relative sea level caused great shifts in the position of the shoreline. A slight rise in sea level would have caused submergence of the low borderland, followed by marine deposition; and conversely, a slight
Fig. 5 - Paleogeography of Illinois-Indiana region during Pennsylvanian time. The diagram shows the Michigan River Delta and the positions of the shoreline and the sea at an instant of time during the Pennsylvanian Period.
lowering would have caused emergence of the lowland and much of the shelf of the Illinois Basin, followed by nonmarine deposition and erosion.

The Pennsylvanian river system, which flowed across the low borderland from the northeast, carried mud and sand from northern highlands and built a great delta out into the sea, much like the present-day Mississippi River delta in Louisiana. Throughout Pennsylvanian time the Illinois Basin continued to subside, and along with the worldwide sea level changes, this caused the position of the shoreline to change continually. The delta front oscillated northward and southward for hundreds of miles due to changes in sea level, intermittent subsidence of the basin, and variations in the amounts of sediment carried seaward from the land.

At various times conditions at any place on the shallow sea floor favored the deposition of sandstone, limestone, or shale. Sandstone was deposited near the mouths of distributary channels. These sands were reworked by waves and spread as thin sheets near the shore. The shales were deposited in quiet water areas—in delta bays between distributaries, and in deeper water beyond the nearshore zone of sand deposition. Limestone, which formed by chemical precipitation from the sea and the accumulation of limy shells of marine plants and animals, was usually deposited farther from shore than the sandstone and shale, but some limestone was formed in nearshore areas where little sand and mud were being deposited. The areas of sandstone, shale, and limestone deposition continually changed as the position of the shoreline changed and as the delta distributaries extended seaward or shifted their positions laterally along the shore.

The nonmarine sandstones, shales, and limestones were deposited on the deltaic lowland bordering the sea. The nonmarine sandstones were deposited in distributary channels, in river channels, and on the broad floodplains of the rivers. Many of the channel sands are preserved as elongate channel deposits in the cyclothems. Some of these sand bodies, 100 or more feet thick, cut through many of the underlying rock units. The shales were deposited mainly on floodplains. Fresh-water limestones and some shales were deposited locally in freshwater lakes and swamps. The coals were formed by the accumulation of plant material, usually where it grew, beneath the quiet waters of extensive swamps. Luxuriant forest vegetation, which thrived in the warm, moist Pennsylvanian climate, covered the region. The origin of the underclays beneath the coals is not exactly known, but they were probably deposited in the swamps as slackwater muds before and during the formation of the coals. The formation of coal marked the end of the nonmarine portion of the depositional cycle. Resubmergence of the borderland by the sea interrupted nonmarine deposition, and the marine portion of the cyclothem was then laid down over the coal.

**Origin of Coal**

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

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

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

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

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

The exact origin of the carbonaceous black shales, which occur above many coals, is uncertain. The black shale may represent a deposit which formed under restricted marine (lagoonal) conditions during the initial part of the invasion cycle, when the region was still closed off from the open sea. The lagoons were quiet water areas where very fine, iron-rich muds and finely-divided plant debris were washed in from the land. The high organic content of the black shales is also in part due to the carbonaceous remains of plants and animals that lived in the lagoons. The fossil remains of animals in the black shales are typically, although not always, depauperate (dwarf), because they were stunted by toxic conditions in the sulfide-rich waters of the lagoons. Many black shales are virtually barren of fossils because swimming and bottom dwelling animals could not live in the stagnant waters. The phosphatic siderite nodules, which occur in the Pennsylvanian shales, were formed by chemical precipitation of calcium carbonate, iron carbonate (siderite), and phosphate from the brackish lagoonal waters. The shales must have accumulated very slowly in order to permit the nodules to form.

0.0 44.2 Leave Stop 4. Continue north.
0.9 45.1 T-road intersection. STOP. Turn right (east) on blacktop. CAUTION.

Continue on blacktop to Baylis.

1.6 46.7 Railroad crossing. CAUTION.

0.7 47.4 Turn left on T-road into Baylis.

0.2 47.6 Turn right on gravel road.

0.2 47.8 **Stop 5.** Baylis Grade School. Lunch.

The town of Baylis is located on the highest part of the Beverly-Baylis Ridge which reaches a maximum elevation of about 885 feet near the edge of town about a quarter of a mile to the southeast. Here at the school the elevation is about 865 feet, the highest elevation along the itinerary. The ridge trends northwest-southeast through the towns of Beverly and Baylis from which it receives its name. At this locality the ridge stands about 150 feet or so above the general upland surface and affords an excellent view of the adjacent terrain, especially towards the west and northwest. The Calhoun Peneplain is nicely revealed by the even western skyline.

0.0 47.8 Leave Lunch Stop. Proceed east.

0.2 48.0 Intersection of three streets. Bear left and proceed straight east.

Turn left (north) at next street intersection. Continue north on blacktop.

0.9 48.9 T-road intersection. Turn left (west).

0.7 49.6 T-road intersection. Continue ahead (west).

2.3 51.9 **Stop 6.** HADLEY CREEK SECTION. Enter gate on east side of bridge.

Walk southwest to high bank along creek about 1500 feet from bridge. (SE₄, NE₄, NW₂, sec. 10, T. 4 S., R. 5 W.) Property of Mrs. Walter Hutter, Quincy. For permission contact Robert Hastings, New Salem, who lives in the first white house east of the old Hayes School about 1.5 miles south of here.

For several hundred feet along the creek banks some of the same Pennsylvanian strata seen earlier at Stop 4 on Kiser Creek can be seen. The No. 2 Coal and underclay are exposed in a small gully in the west bank just north of the high cut bank where the creek turns sharply eastward. The creek bottom is littered with rock fragments eroded from the Pennsylvanian strata, the Kansan glacial deposits, and numerous chert fragments from the Baylis Formation that occurs just to the northeast.

This locality is near the Kansan glacial margin, and the high cut bank at the sharp bend in the creek reveals a thick section of Kansan outwash. The outwash consists of about 14 feet of clayey and sandy silt overlying lenses of coarse gravel two to eight feet in thickness (see fig. 6). These sediments were deposited by meltwater from the Kansan glacier. A glacial origin for these deposits is established by the presence of igneous rock fragments in the gravel, but their Kansan age is only tentatively established by their occurrence near the Kansan ice margin (see itinerary map). The lower part of the silt includes...
a lens of fine gravel with a sandy, silty matrix. The basal gravels are very coarse and fill small channels cut into the underlying bedrock. This bedrock belongs to the Mississippian Warsaw Formation. The gravel contains cobbles up to six inches in diameter and also includes lenses of crossbedded coarse sand, which indicate that the meltwater currents were very swift initially. As the glacial margin melted back, the meltwaters probably became ponded against the ice front, and the finer silts were then deposited in the quieter waters. The gravel consists predominantly of rounded, polished chert fragments of many colors. These were probably eroded by the glacier from the Hadley Gravel Member of the Baylis Formation or from similar younger gravels to the west (page 26).

The Warsaw Formation consists of gray-green, calcareous siltstone. About five feet of the siltstone is exposed. Of particular interest are the numerous, large quartz geodes, up to three inches in diameter, in the siltstone. Most of the geodes are solid, but a few are partially hollow and exhibit nicely formed quartz crystals. The Warsaw Formation is famous for the beautiful geodes that it contains in the Hamilton-Keokuk area farther to the north in Hancock County.

Note that although the Pennsylvanian strata are present only a few yards away, the glacial gravels rest upon the older Mississippian Warsaw Formation. The Pennsylvanian-Mississippian contact unfortunately is not exposed. The contact between the Mississippian and Pennsylvanian strata is a major erosion surface or unconformity throughout the Midwest. At the end of Mississippian time the sea withdrew, and many hundreds of feet of Mississippian strata were stripped away before the Pennsylvanian sea advanced into the region. The Pennsylvanian strata once completely covered this region, but they were also eroded away following withdrawal of the Pennsylvanian sea. The Pennsylvanian strata exposed in the Barry area represent only erosional remnants of these once extensive deposits. The erosional edge of these Pennsylvanian rocks can be seen here at this locality.

Less than a quarter of a mile to the south and southwest a nearly circular area 200 to 250 yards in diameter was mined for coal about 35 years ago. Underground mining methods were first utilized, but later the coal was recovered by strip mining. The coal mined at that locality was a Pennsylvanian coal which occurred stratigraphically beneath the Colchester No. 2 Coal exposed here and seen earlier at Stop 4. The coal at the abandoned mine occurred in a pocket surrounded by Mississippian limestone and ranged in thickness from about two feet near the margin to almost 14 feet near the center. About 10 years ago exploratory drilling adjacent to the mined-out area indicated coal of about 10 feet in thickness. Apparently not much of this more recently discovered thick coal was found because it has not been mined. These thick pockets of coal were deposited in sinkholes or depressions formed in the upper surface of the Mississippian limestone during the long interval of erosion that preceded the advance of the Early Pennsylvanian sea.
0.0 51.9 Leave Stop 6. Continue west.

0.1 52.0 Cross tributary of Hadley Creek.

0.4 52.4 Crossroads. Turn right (north).

0.4 52.8 Narrow bridge. Notice the black shale and the large ironstone concretions in the creek bottom on the left. These form part of the Oak Grove Limestone beds that occur above the No. 2 Coal. The coal is exposed farther downstream.

1.6 54.4 Narrow bridge over tributary to Hadley Creek.

1.8 56.2 STOP. Crossroads. Turn left (west) on blacktop to Beverly.

0.5 56.7 Enter village of Beverly. SLOW. Continue ahead on blacktop.

3.4 60.1 STOP. Intersection with spur to Route 104. Kingston on right. Continue west toward Payson.

3.6 63.7 Cross McCraney Creek.

0.9 64.6 Enter village of Richfield.

Crossroads. Turn left (south) on gravel road.

1.6 66.2 Cross McCraney Creek.

0.4 66.6 T-road intersection. Continue straight ahead.

0.1 66.7 Entrance to quarry on left.

Stop 7. Missouri Gravel Company Quarry. (S 1/2, SW 1/4, NW 1/4, sec. 21, T. 3 S., R. 6 W.) Enter through opening in fence near old house east of gate. DO NOT DRIVE INTO QUARRY. For permission to enter quarry contact either Wilbert Clary, Kinderhook, Illinois, manager of the Missouri Gravel Company's gravel pit located 4.5 miles west of Barry; or Jack Perkey, Hannibal, Missouri, Superintendent of Missouri Gravel Company (telephone 314-221-4436).

This quarry is being operated in the Mississippian Salem and St. Louis Limestones. These formations are younger than the Warsaw Formation seen earlier at Stop 3 and occur just above it. About 30 feet of these formations are being quarried. The upper 15 feet is the St. Louis Limestone. It consists predominantly of light gray-brown, sublithographic, algal limestone with some beds of fine- to medium-grained, crystalline limestone and a few thin beds of light gray-green, silty dolomite. The formation is irregularly and lenticularly bedded, and generally has a highly fractured appearance. It is especially distinguished by splotches and partings of brilliant green clay. The upper surface of the St. Louis Limestone is solution pitted and somewhat channeled with gray-green dolomite filling the channel-like depressions. This dolomite weathers gray-brown. A persistent thin bed of sublithographic, silty limestone near the top of the quarry contains numerous, small pink chert nodules up to about 1 inch in diameter.
About 15 feet of Salem Limestone occurs below the St. Louis Limestone. The Salem consists predominantly of medium gray, coarse-grained, fragmental limestone. The limestone is quite homogeneous and occurs as even to lenticular beds. The contact between the St. Louis and the Salem Limestones is gradational, indicating that deposition was continuous. The contact occurs within a 4-foot zone of thin-bedded, silty dolomite at the top of the coarse-grained fragmental limestone. Near the floor of the quarry the formation contains a persistent bed of dark brown, porous, fossiliferous dolomite, which varies in thickness from about one to three feet. Below the brown dolomite is about one to three feet of light gray-green, silty dolomite, the base of which is concealed and which forms the floor of the quarry. Of particular interest in the upper one foot or so of this silty dolomite are abundant, excellently preserved, lacy fronds of several species of *Fenestrella* bryozoans (see page 28). The fronds, which originally consisted of calcium carbonate, have been replaced by brilliant green clay. These unusually well-preserved bryozoan fronds will make a unique addition to your fossil collections. Bryozoans are colonial marine animals, and *Fenestrella* built a delicate, fan-like structure. The preservation of these delicate fronds indicates that the sea was extremely quiet during deposition of the rock in which they occur. The sea then became shallower, and the sea bottom was swept by waves and currents during deposition of the overlying fragmental limestone.

Above the St. Louis Limestone at the top of the quarry is a section consisting of about 15 feet of unconsolidated clay, gravel, and loess. The age of the clay and gravel is not definitely known as they have not yet been studied by Survey geologists. The gravel is very coarse and consists of rounded and polished chert, quartz, and quartzite fragments that strongly resemble the Hadley Gravel Member of the Baylis Formation. The gravel contains geodes eroded from the Warsaw Formation. The gravel, which is one to four feet thick in shallow channels, rests upon two to five feet of multicolored light gray, green, red, and pink clay containing scattered chert pebbles. It has been suggested that the gravel is Tertiary in age, younger than the Baylis Formation, and was deposited by a Tertiary river system during the Pliocene Epoch, sometime between about 11 and 1 million years ago. Much of the gravel was probably derived from erosion of the Hadley Gravel. However, it is possible that the gravel is actually the Hadley Gravel, which would extend the Cretaceous boundary farther to the west (see itinerary map).

The clay beneath the gravel may represent an ancient residual clay soil developed on the Mississippian limestone. Similar clay residuum overlain by gravel occurs to the south in Calhoun County on the Calhoun Peneplain. It has also been proposed that the clay and gravel are glacial deposits, perhaps of Nebraskan age. If this is true, the clay is a deeply weathered Nebraskan till, and the gravel is Nebraskan outwash. However, no igneous rock fragments are present. Above the gravel are about eight feet of silt. The lower three feet are weathered a deep red color. The red silt may be the Illinoian Loveland Silt containing the Sangamon Soil seen earlier at Stop 1. The brown silt above is probably the Wisconsinan Peoria Loess.

0.0  66.7  Leave Stop 7. Turn around and return west.
0.1  66.8  T-road intersection. Turn left (south).
0.5  67.3  STOP. Turn left (east).
2.7  70.0  Cross Beebe Creek.
0.5 70.5 STOP. 4-WAY STOP. Turn right (south) toward Barry on blacktop.

4.3 74.8 Cross Hadley Creek.

0.3 75.1 Railroad underpass.

1.8 76.9 STOP. Junction with U.S. Route 36 at north limits of Barry. Turn right (west) on Route 36.

1.7 78.6 Exposure of Mississippian Burlington Limestone on right.

0.1 78.7 Cross Hadley Creek.

0.1 78.8 Railroad underpass.

2.5 81.3 Missouri Gravel Company sand and gravel pit on the left.

The gravel is produced from alluvium in the bottom of Hadley Creek. It consists predominantly of chert with some igneous rock fragments. The gravel is crushed and screened to appropriate sizes for use locally as roadstone. The gravel consists in part of Kansan glacial outwash, but is mainly modern alluvium formed by reworking of gravels that were derived from the glacial drift, Cretaceous gravel, and residual Mississippian chert as the stream cut its valley downward to its present level. Common sand and gravel are among Illinois' most important mineral resources, and are widely used in the construction industry. Production of these materials contributes about 30 million dollars to the state's economy.

1.1 82.4 Turn right (north) onto gravel road.

0.3 82.7 Y-intersection. Bear left on quarry road.

0.2 82.9 Stop 8. Quarry in Mississippian Burlington Limestone. (NW¼, NW¼, NE¼, sec. 19, T. 4 S., R. 6 W.) Property of Missouri Gravel Company.

This quarry is in the Mississippian Burlington Limestone, a formation which is older than and which occurs stratigraphically below the Warsaw Formation. The Burlington Limestone is the oldest formation that will be seen along the present field trip. The Burlington consists of coarse, crinoidal limestone and is the most prominent formation in the Mississippi River bluffs from Quincy southward to Alton, a distance of some 80 miles. It caps the bluffs at most places and underlies the divide between the Mississippi and Illinois Rivers. Its prominence is largely attributable to the cherty character of the limestone, a fact which leads to the accumulation of a residual cap of chert as weathering proceeds. The residual chert cap inhibits further weathering.

The exposure here at Stop 8 consists of two lithologically distinct units—an upper very cherty, thin-bedded unit and a lower, less cherty, more massive unit. The lower unit is the upper part of a high purity limestone member commonly referred to as the "Quincy Beds." This pure unit is the basis for the limestone industry in this region, principally in the vicinity of Quincy to the north. The limestone is used for roadstone, agricultural lime, and the manufacture of cement. In Illinois the limestone industry contributes about 73 million dollars annually to the state's economy.

The Burlington Limestone here is very coarse-grained, crinoidal limestone. The upper surface is strongly weathered and very irregular with small
solution channels and cavities. A red, clayey chert residuum of several feet in thickness overlies the limestone. The limestone is crossbedded and very fossiliferous, some beds consisting entirely of broken fossil fragments indicating that the water in which the limestone was deposited was very shallow and that the sea bottom was swept by waves. The upper unit is thin bedded, very cherty, pinkish gray limestone with thin discontinuous, light gray to white chert bands. The chert is also fossiliferous. Weathering has emphasized the bedded nature of the limestone.

The lower unit is more massive and contains very little chert. Thick gray beds of coarse-grained limestone, some almost white, are interbedded with thinner beds of brown to gray-brown beds of fine- to medium-grained dolomite.

Fossil collecting in the Burlington Limestone is very good. Some beds consist entirely of crinoid remains, which are largely pieces of crinoid columnals, but some calyx plates and occasionally a complete calyx can be collected. The crinoids belong to the phylum Echinodermata and are plant-like animals with a calyx and tentacles supported by a long stem that usually attaches the animal to the sea floor. Modern crinoids are often referred to as "sea lilies" because of their plant-like appearance. The segmented stems, consisting of numerous small discs, easily break apart after the animal dies, and these small discs are the most common parts of fossil crinoids found in Illinois limestones. The diagram above shows two species of crinoids that are commonly found in the Burlington Limestone. Other fossils include brachiopods, bryozoans, and corals. Especially interesting is the large brachiopod Spirifer grimesi (see diagram). Attractive chert specimens can also be collected. Travertine, also referred to as cave onyx, coats some surfaces of the solution cavities, and excellent calcite crystals can be collected.

Depositional History of the Mississippian Limestones

The Mississippian strata in the upper Mississippi Valley are predominantly marine limestones, and most of them are rich in fossil remains. During Mississippian time between about 350 to 310 million years ago, the Midcontinent region of North America was a low-lying, stable platform. Clear, warm shallow seas invaded the region, and the Midwest remained almost continually submerged throughout the Mississippian Period. During the middle part of the period the sea reached far to the north, and the relatively pure limestones, such as the Burlington Limestone, were formed over enormous areas on the continental platform.
The sea in which these limestones were deposited was fairly shallow, probably only a few hundred feet deep generally, and in many areas only a few tens of feet. The crinoids found these shallow areas ideal for their development, and because of their abundance in these limestones, the Mississippian Period is often called the "Age of the Crinoids." Some of the limestones consist almost entirely of cemented fossil fragments, reflecting the shallow, wave-swept conditions of deposition.

Some of the limestones are very cherty, a fact which renders them less desirable for quarrying purposes. Because of its great hardness, the chert is also destructive to mining and crushing equipment. The origin of the chert is not completely understood by geologists. The chert apparently was not deposited in its present form at the same time that the limestones were precipitated from the sea. Evidence for this is the fact that most of the chert is fossiliferous and thus appears to have replaced the limestone. Other sedimentary structures are also preserved in the chert. Colloidal and finely-divided silica were probably deposited in small amounts with the limestone, and some was also deposited as the siliceous hard parts of sponges, and microscopic plants and animals. Later, after solidification of the limestones, this disseminated silica was dissolved, concentrated by solution, and redeposited as the irregular bands and nodules that are now present.

End of Field Trip

Thanks for Coming.

Drive Carefully on Your Way Home.
PHYSIOGRAPHIC DIVISIONS OF ILLINOIS

GEOLOGIC MAP OF ILLINOIS
showing
BEDROCK BELOW
THE GLACIAL DRIFT
1961

KEY

Tertiary
(Pliocene omitted)

Cretaceous

Pennsylvanian
(Above No. 6 Coal)

Pennsylvanian
(Below No. 6 Coal)

Mississippian
(Upper)

Mississippian
(Middle and Lower)

Devonian

Silurian and Devonian

Fault

Ordovician

Cambrian

Silurian

Complex faulted area

MILES
<table>
<thead>
<tr>
<th>STAGE</th>
<th>SUBSTAGE</th>
<th>NATURE OF DEPOSITS</th>
<th>SPECIAL FEATURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECENT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil, youthful profile of weathering, lake and river deposits, dunes, peat</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outwash</td>
<td>Outwash along Mississippi Valley</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Peat and alluvium</td>
<td>Ice withdrawal, erosion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drift, loess, dunes, lake deposits</td>
<td>Glaciation, building of many moraines as far south as Shelbyville, extensive valley trains, outwash plains, and lakes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil, silt and peat</td>
<td>Ice withdrawal, weathering, and erosion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drift, loess</td>
<td>Glaciation in northern Illinois, valley trains along major rivers, Winnebago drift</td>
</tr>
<tr>
<td>WISCONSINAN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil, mature profile of weathering, alluvium, peat</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drift</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drift</td>
<td>Glaciers from northeast at maximum reached Mississippi River and nearly to southern tip of Illinois</td>
</tr>
<tr>
<td>SANGAMONIAN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil, mature profile of weathering, alluvium, peat</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drift</td>
<td></td>
</tr>
<tr>
<td>ILLINOIAN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil, mature profile of weathering, alluvium, peat</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drift</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drift, loess</td>
<td></td>
</tr>
<tr>
<td>YARMOUTHIAN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil, mature profile of weathering, alluvium, peat</td>
<td></td>
</tr>
<tr>
<td>KANSAN</td>
<td></td>
<td>Drift</td>
<td>Glaciers from northeast and northwest covered much of state</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loess</td>
<td></td>
</tr>
<tr>
<td>AFTONIAN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil, mature profile of weathering, alluvium, peat</td>
<td>Glaciers from northwest invaded western Illinois</td>
</tr>
<tr>
<td>NEBRASKAN</td>
<td></td>
<td>Drift</td>
<td></td>
</tr>
</tbody>
</table>
**PENNSYLVANIAN SECTION**

**Explanation of Figure 26**

<table>
<thead>
<tr>
<th>Section</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a-1c</td>
<td>Juresania nebrascensis (Owen)</td>
</tr>
<tr>
<td>2a-2c</td>
<td>Crurithyris planoconvexa (Shumard)</td>
</tr>
<tr>
<td>3a-3c</td>
<td>Composita argentea (Shepard)</td>
</tr>
<tr>
<td>4a-4b</td>
<td>Cardiomorpha missouriensis Shumard</td>
</tr>
<tr>
<td>5</td>
<td>Lophophyllidium profundum (Edwards and Haime)</td>
</tr>
<tr>
<td>6a-6c</td>
<td>Mesolobus mesolobus var. euampygus (Girty)</td>
</tr>
<tr>
<td>7a-7c</td>
<td>Mesolobus mesolobus var. decipiens (Girty)</td>
</tr>
<tr>
<td>8a-8b</td>
<td>Euphemites carbonarius (Cox)</td>
</tr>
<tr>
<td>9a-9c</td>
<td>Linoproductus &quot;cora&quot;</td>
</tr>
<tr>
<td>10a-10b</td>
<td>Astartella concentrica (Conrad)</td>
</tr>
<tr>
<td>11a-11b</td>
<td>Glabrocingulum grayvillense (Norwood &amp; Pratten)</td>
</tr>
<tr>
<td>12</td>
<td>Trachydomia wheeleri (Swallow)</td>
</tr>
<tr>
<td>13</td>
<td>Dunbarella knighti Newell</td>
</tr>
<tr>
<td>14a-14c</td>
<td>Marginifera splendens Norwood &amp; Pratten</td>
</tr>
<tr>
<td>15a-15b</td>
<td>Naticopsis altonensis McChesney</td>
</tr>
<tr>
<td>16a-16b</td>
<td>Cymatospora montfortianus (Norwood &amp; Pratten)</td>
</tr>
<tr>
<td>17a-17b</td>
<td>Desmoinesia muricatina (Dunbar &amp; Condra)</td>
</tr>
</tbody>
</table>
Geological Science Field Trip Registration

Barry Area

May 11, 1968

Property owners and others have demanded that they be released from liability for accidents that might occur on their property during the conduct of this field excursion. The release must be signed by each participant.

RELEASE

KNOW ALL MEN BY THESE PRESENTS, That I, ____________________________,

of ______________________, ______ (Street) (City) (State)

____________________, do hereby remise, release and forever discharge THE STATE OF ____________________________, and OTHER PERSONS WHO SERVE AS TRIP LEADERS: THE VILLAGE OF BARRY, ITS EMPLOYEES AND REPRESENTATIVES; THE BARRY HIGH SCHOOL, ITS EMPLOYEES AND REPRESENTATIVES; THE BAYLIS GRADE SCHOOL, ITS EMPLOYEES AND REPRESENTATIVES; THE TOWN OF FITTSFIELD, ITS EMPLOYEES AND REPRESENTATIVES; JACK TAYLOR, NEW SALEM, ILLINOIS; ERVIN CAMPBELL, NEW SALEM, ILLINOIS; MRS. WALTER HUTTER, QUINCY, ILLINOIS; ROBERT HASTINGS, NEW SALEM, ILLINOIS; MISSOURI GRAVEL COMPANY, KINDERHOOK, ILLINOIS; all owners of private property, entered by me in connection with the above named field trip from all manner of actions, causes of actions, suits, proceedings, debts, dues, contracts, judgments, damages, claims, and demands whatsoever in law or equity resulting from my attendance on or participation in said field trip.

IN WITNESS WHEREOF, I have hereunto set my hand and seal the 11th day of May, A. D., 1968.

______________________________ (Signature)

(Signature)

Occupation ________________________________

School ________________________________ (Grade, if student)

Address ________________________________ (Teachers please give school address)

YOUR ZIP CODE MUST BE INCLUDED AS PART OF YOUR ADDRESS IF YOU WISH TO RECEIVE NEXT YEAR’S FIELD TRIP ANNOUNCEMENT.