GUIDE LEAFLET

GEOLOGICAL SCIENCE FIELD TRIP

Sponsored by
ILLINOIS STATE GEOLOGICAL SURVEY

ST. ELMO AREA

Fayette, Effingham, and Clay Counties
St. Elmo, K immundy, and Edgewood Quadrangles

Leaders
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Urbana, Illinois
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GUIDE LEAFLET 1968 D

HOST: St. Elmo Senior High School
TO THE PARTICIPANTS:

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

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

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

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

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

THE STAFF
EDUCATIONAL EXTENSION SECTION
ILLINOIS STATE GEOLOGICAL SURVEY
INTRODUCTION

Glacial History of Illinois

Some knowledge of Illinois glacial history and the glacial deposits is necessary for full appreciation of many geologic features in the St. Elmo 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 its weight caused it to flow outward, 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 diagram on next page and attached Pleistocene Time Table in back of guide leaflet).

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 till 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, Buffalo Hart), covered 80 percent of the state, reaching southward to Carbondale and Harrisburg. After several 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 soil developed, as in the preceding Yarmouthian interval. These ancient Sangamonian soils resemble 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 - Pleistocene glacial and interglacial intervals in Illinois. Arrows indicate major drainage and directions of ice movement.
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, 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 dropped these materials on the bluffs and uplands to form deposits of loess. Loess mantles most of Illinois. Near the large river valleys 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.

Glacial History of the St. Elmo Area

During the Ice Age the St. Elmo area was glaciated during two separate intervals of glaciation—during the Kansan Stage from about 700 to 600 thousand years ago and during the Illinoian Stage from about 250 to 200 thousand years ago. Both the Kansan and Illinoian glaciers advanced across the area from the northeast (fig. 1 and Pleistocene Time Table). The Illinoian till plain comprises the upland surface in the field trip area, and Illinoian till and outwash are exposed at many places (fig. 2). The Kansan till is buried by the younger Illinoian till sheet and is exposed only in a few places where stream erosion has cut through the overlying Illinoian deposits. No Kansan till will be seen during this field trip. The Nebraskan and Wisconsinan glaciers did not extend into this part of the state (fig. 1).
Fig. 2 - Areas underlain by tills of the Kansan, Illinoian, and Wisconsinan Stages. Older tills can be traced beneath younger tills in the subsurface.
The Illinoian Stage was defined in the late nineteenth century for the glacial deposits lying above the Yarmouth Soil and below the Sangamon Soil in western, central, and south-central Illinois. A great part of the glaciated portion of northern North America where Illinoian deposits form the surficial glacial drift lies in the state of Illinois. The position of the Illinoian deposits above the older Kansan tills and below the younger Wisconsinan tills is also best demonstrated in Illinois.

The Illinoian glaciation of North America was the most extensive glaciation of the Pleistocene Epoch. Whereas glaciers from a center west of Hudson Bay had invaded western Illinois during both the Nebraskan and Kansan Stages (fig. 1), the Illinoian glacier did not reach Illinois from the west. The flow of Illinoian ice into Illinois and Indiana originated from a dispersal center in the Labrador region of eastern Canada. Two distinct Illinoian ice lobes invaded Illinois from the northeast, one from the Lake Michigan Basin and another from the basin of Lake Erie (fig. 1, #5). The Erie lobe entered southeastern Illinois, deflecting the Lake Michigan lobe to the west and attaining the southernmost extent of any of the Pleistocene continental glaciers in the northern hemisphere. The junction of these two lobes is marked by a distinctive belt of ridged drift called the "interlobate complex" (fig. 1, #5 and fig. 2).

The interlobate complex consists of a 20- to 30-mile wide belt of sharp ridges and hillocks extending from the margin of the Wisconsinan drift near Shelbyville southwestward to the vicinity of Belleville. The comparatively greater relief and uneven topography of the ridged drift contrasts with the essentially featureless topography of the flat Illinoian till plain. The glacial drift in the St. Elmo area was deposited by the Erie lobe and includes a portion of the ridged drift. Features of the ridged drift will be seen and discussed more fully later at Stop 5.

Differences in the mineral compositions of the Illinoian tills on opposite sides of the interlobate complex are evidence that two distinct lobes of the Illinoian glacier entered Illinois. There are no continuous end moraines like those of the Wisconsinan drift farther to the north to distinguish the deposits of these lobes (see Glacial Map of Northeastern Illinois). Careful study by Survey geologists has revealed that two Illinoian tills are present southeast of the interlobate complex, indicating that there were two advances of the Erie lobe in this region. Northwest of the interlobate complex, three till sheets can be recognized. These have been named in order of relative age--the Mendon, the Jacksonville, and the Buffalo Hart. The Jacksonville and Buffalo Hart tills indicate that following the initial advance and retreat of the Lake Michigan lobe there were at least two readvances (fig. 1, #6 and #7). Thus the Lake Michigan and the Erie lobes appear to have responded somewhat differently to variations in the climatic conditions of Illinoian time, the Lake Michigan lobe being the more active. The two tills southeast of the interlobate complex have not been formally named, but the lower till may be equivalent in age to the Mendon till, and an upper till may be equivalent to the Jacksonville till.

The invasions of ice from the Erie lobe were particularly strong, pushing southwestern across Illinois to the bluffs of the Mississippi Valley and southward to the edge of the Shawnee Hills in Hardin County. It is estimated that these great expanses of ice were probably no more than 1000 feet thick or perhaps thinner, because Illinoian drift deposits on the uplands are thin, usually 30 feet or less. The upper part of the drift (the upper till) contains much sand and gravel, and locally the till plain is characterized by numerous kames. These facts suggest that the ice of the Erie lobe stagnated (stopped moving) after the culmination of its second advance.
Bedrock Geology of the St. Elmo Area

Beneath the glacial drift the St. Elmo area is underlain by approximately 9000 feet of sedimentary strata consisting of limestone, dolomite, sandstone, and shale (fig. 3). These rocks are predominantly marine in origin and were laid down layer by layer in the ancient, shallow seas that periodically covered Illinois and the Midwest during the Paleozoic Era from about 550 to 270 million years ago. The rocks immediately beneath the glacial drift belong to the Pennsylvanian System (see attached Geologic Map of Illinois). Only portions of the upper 300 feet of these are exposed, and some of these rocks, including the Millersville and Omega limestones, will be examined during the field trip. Older Pennsylvanian strata and strata belonging to the Mississippian, Devonian, Silurian, Ordovician, and Cambrian Systems are not exposed and are known only from deep drill holes. The base of the Cambrian strata rests upon a basement of Precambrian igneous and metamorphic rocks more than one billion years old.

Geologically the field trip area is situated over the deeper part of the Illinois Basin, a large, spoon-shaped bedrock depression which underlies most of Illinois and adjacent parts of Indiana and Kentucky (fig. 4). The basin, now filled with the Paleozoic strata, formed by slow subsidence while the sediments accumulated until the end of the Pennsylvanian Period. In the field trip area the strata are tilted gently southeastward toward the deepest part of the basin in extreme southeastern Illinois where they are more than 13,000 feet thick. Immediately north of St. Elmo this regional tilt is interrupted by the Louden Anticline, a gentle, elongate arch of the strata which extends southwestward across the northern part of the field trip area. This bedrock structure acted as an important site for the accumulation of oil, the most valuable mineral resource in the St. Elmo area. Other important mineral resources presently being produced from the bedrock in this part of the state include limestone, sand and gravel, and clay.

Sedimentary History of the Pennsylvanian Rocks

Because the bedrock formations that are exposed in the field trip area are exclusively of Pennsylvanian age, the origin and character of these rocks is discussed below in considerable detail. Although coal is not presently being mined in this part of the state, the origin of coal is also discussed briefly.

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.
### Generalized Geologic Column of Strata in South-Central Illinois

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>SERIES OR GROUP</th>
<th>FORMATION OR MEMBER</th>
<th>COLUMN</th>
<th>THICKNESS (feet)</th>
<th>ROCK TYPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLEISTOCENE</td>
<td>McLEANS-BORO</td>
<td>Mattoon</td>
<td>Omega</td>
<td>0-200</td>
<td>Till, loess, outwash, sand &amp; gravel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bond</td>
<td>Millersville</td>
<td>0-1000</td>
<td>Shale, sandstone, limestone, coal</td>
</tr>
<tr>
<td></td>
<td>Kewanee</td>
<td>Modesto</td>
<td>Shoal Creek</td>
<td>0-300</td>
<td>Shale, sandstone, limestone, coal</td>
</tr>
<tr>
<td></td>
<td>McCormick</td>
<td>Abbott</td>
<td>Caseyville</td>
<td>0-1100</td>
<td>Shale, sandstone, coal</td>
</tr>
<tr>
<td></td>
<td>Chesterian</td>
<td>Kinkaid</td>
<td>Degonia</td>
<td>0-1300</td>
<td>Limestone, sandstone, shale</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Palestine</td>
<td>Menard</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vienna</td>
<td>Tar Springs</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>Glen Dean</td>
<td>Cypress</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Paint Creek</td>
<td>Bethel</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aux Vases</td>
<td>Ste. Genevieve</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mississippian</td>
<td>St. Louis</td>
<td>Salem</td>
<td>500-1500</td>
<td>Limestone, dolomite, shale</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Warsaw</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Burlington-Keokuk</td>
<td>0-250</td>
<td>Limestone, shale</td>
</tr>
<tr>
<td></td>
<td>Kinderhook</td>
<td>New Albany</td>
<td>Grand Tower</td>
<td>0-200</td>
<td>Limestone, dolomite, sandstone, shale</td>
</tr>
<tr>
<td></td>
<td>Devonian</td>
<td></td>
<td></td>
<td>0-1000</td>
<td>Limestone, dolomite, shale</td>
</tr>
<tr>
<td></td>
<td>Silurian</td>
<td></td>
<td></td>
<td>500-1300</td>
<td>Limestone, dolomite, sandstone, shale</td>
</tr>
<tr>
<td></td>
<td>Ordovician</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3500 FEET OF LOWER ORDOVICIAN AND CAMBRIAN STRATA  
(Extending down to PRECAMBRIAN crystalline rocks)
Fig. 4 - North-south cross-section through Illinois showing the Paleozoic strata in the Illinois Basin.
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 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 with a few exceptions 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 the Mississippian Period 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.

For the remainder of Pennsylvanian time the northeast part 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
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)
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.
shoreline. A slight rise in sea level would have caused submergence of the low borderland, followed by marine deposition; and conversely, a slight 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, in lagoons behind barrier bars, 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 cycloths. 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 fresh-water lakes and swamps. The coals were formed by the accumulation of plant material, usually where it grew, beneath the quiet waters of extensive swamps. Lush 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 cycloths. 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) semi-bituminous, (5) semi-anthracite, 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, which formed behind offshore sand bars, 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.
ITINERARY

0.0 0.0 Assemble in parking lot on west side of St. Elmo Senior High School. Proceed through north exit of parking lot and turn left on driveway. STOP. Turn right on blacktop road and proceed north.

1.0 1.0 Enter valley of Sugar Creek. On the right note the earthen dam of Lake Nellie, St. Elmo's municipal water supply.

At this point the itinerary is entering the Louden Oil Field. Note the oil well on the right.

The Louden Field

The Louden oil field has been developed on the Louden Anticline, one of the most important oil-producing structures in Illinois. In 1966 the field ranked first in oil production among Illinois oil fields producing about 8.4 million barrels valued at about 25.3 million dollars. In 1966 there were 1,479 producing wells.

From 1937, the year of its discovery, through 1966 the Louden Field yielded a total of 322.5 million barrels of oil, which ranks it third in overall production among Illinois oil fields. In 1966, also as a result of Louden production, Fayette County led all oil-producing counties in Illinois with 8.9 million barrels or 14.4 per cent of the state's total valued at 26.8 million dollars. During the same year Illinois ranked eighth among the oil-producing states in the nation with a total production of 62 million barrels of oil valued at 186 million dollars.

The Louden Anticline is an arch of bedrock that was formed by warping (bending) of the Paleozoic strata. The crustal forces which caused this warping probably began near the end of the Mississippian Period or at the beginning of the Pennsylvanian Period about 310 million years ago. These movements continued throughout the Pennsylvanian Period while the Pennsylvanian strata were being deposited and probably continued for some time after the end of the Pennsylvanian Period. The anticline, a bedrock high, was an ideal reservoir for the oil that was forming within the Paleozoic rocks. The layers of porous, permeable limestone and sandstone overlain by layers of impermeable limestone or shale served as traps for the oil which migrated upward into the anticline.

Figure 6 illustrates the types of oil traps in Illinois. Structural traps include domes or anticlines formed by arching of the strata. Stratigraphic traps, including channel sandstones and pinchouts, are formed where the permeable sandstones are bounded by or grade laterally into shaly beds which seal them off. Some oil is also produced in Illinois from large coral reefs which consist of porous limestone or dolomite. Oil is also produced from beds that are arched over the tops of coral reefs.

Oil traps in the Louden Field include anticlinal traps, stratigraphic traps, and combination anticlinal-stratigraphic traps. Stratigraphic traps are important oil reservoirs in the Upper Mississippian Chesterian Series. There are no reef-type traps.

The Louden Anticline is about eight miles wide and extends northeast-southwest for about 20 miles across eastern Fayette County into Shelby County.
Fig. 6 - Types of oil traps in Illinois: (A) Anticlines; (B) Stratigraphic traps: (1) pinchouts, (2) channel sandstones; (C) Coral reefs.
The anticline is part of a larger trend of anticlinal structures known as the Salem-Louden anticlinal belt, which extends from northern Jefferson County to south-central Shelby County. In addition to the Louden Field several smaller oil fields have also been discovered along this trend.

The Louden Field was discovered in October, 1937, when the Carter Oil Company's Mary Miller No. 1 well was completed in section 12, T. 8 N., R. 3 E., about 7 1/2 miles north and 1 1/2 miles east of this locality (fig. 7). This well was drilled to a total depth of 3,170 feet into the Devonian Grand Tower Limestone (fig. 3). However, only a small amount of oil was recovered from the Devonian limestone, and the hole was plugged back to the 1,500 foot level in March, 1938. At this level production in the well was increased to 93 barrels per day from the Upper Mississippian Cypress Sandstone.

A total of 1,835 wells had been drilled in the Louden Field by the end of 1940, and during that year production peaked at 74,500 barrels per day. Not until 1941 did further exploration and development of the Devonian limestone take place. In that year 59 producing wells were completed in the Devonian, and by 1966 this number had increased to 86. In addition to Devonian and Mississippian production, small amounts of oil have also been produced from the Ordovician and Pennsylvanian rocks in Louden Field. However, the four major producing zones have been the Devonian Grand Tower Limestone and the Upper Mississippian Cypress, Bethel, and Yankeetown Sandstones. The deepest oil test was drilled into the Precambrian granite at a depth of 8,616 feet.

Note the even surface of the Illinoian till plain in this locality.

Continue ahead and bear left on poorly maintained gravel road.

Stop 1. Natural Gas Pipeline Company of America, Compressor Station No. 206 on the left. (SW 1/4, SW 1/4, sec. 27, T. 8 N., R. 3 E.; St. Elmo Quadrangle.)

Underground Gas Storage

The underground storage of natural gas in Illinois is becoming increasingly important to our present-day society. As the population grows, greater amounts of gas are needed for home heating, cooking, and industrial use. Consumer demand for gas varies considerably from summer to winter months because of fluctuating seasonal requirements, mainly for heating purposes. It would not be economically feasible or efficient to construct greater numbers of expensive pipelines large enough to meet peak demands during the winter heating season. By operating presently existing pipelines at full capacity on a year round basis, the excess gas transmitted from major southern gas fields can be pumped into large underground storage facilities during the off-heating months and stored until it is needed in large market areas such as St. Louis and Chicago (fig. 9). This is exactly what is being done in Illinois and other parts of the United States.

At the present time there are 24 underground reservoirs in Illinois being used to store more than 200 billion cubic feet of natural gas (fig. 7). The Louden gas storage facility is one of these. These reservoirs are estimated to have a potential storage capacity of more than 600 billion cubic feet of natural gas. The Illinois State Geological Survey has recently published a detailed report of underground natural gas storage as Illinois Petroleum 86,
Fig. 7 - Structure map showing arching of the Devonian limestone on the Louden Anticline. Contours are drawn on the top of the Lingle Limestone, which occurs immediately below the New Albany Shale. Contour values indicate depths below sea level, so that about 600 feet must be added to obtain depths below surface topography. The shaded area shows the extent of Devonian production.
Fig. 8 - Mississippian structure map with contours drawn at the base of the Beech Creek Limestone. The shaded area shows the extent of Mississippian production in the Louden Field. The small circles are the locations of 14 Humble Oil Company water treatment plants.
Fig. 9 - Block diagram showing the concept of gas storage at Louden. The diagram shows gas from southern gas fields being injected into the Devonian limestone during the summer months. This gas is stored and later withdrawn during winter months of peak demand. (Reproduced courtesy of Natural Gas Pipeline Company of America.)
"Underground Storage of Natural Gas in Illinois--1967." This publication is available free by writing to the Survey, Natural Resources Building, Urbana, Illinois 61801.

The first successful underground storage of gas occurred in Welland County, Ontario, Canada in 1915. The first successful underground storage of gas in the United States was accomplished south of Buffalo, New York, in 1916. Although experiments with gas storage in Illinois were made at New Harmony by Superior Oil Company as early as 1941, the first practical attempt was made by Mississippi River Fuel Corporation at Waterloo in 1950. Illinois now ranks fifth in the nation behind Pennsylvania, Michigan, Ohio, and West Virginia in total reservoir capacity among the states that utilize underground gas storage.

The first requirement for a successful gas storage facility is a suitable geologic structure in which there are porous and permeable strata overlain by impermeable caprock to trap the gas. The gas is pumped under high pressure into the voids in the rock, which may be the spaces between the sand grains in a sandstone, the openings between mineral particles in limestone or dolomite, fractures in the rock, and solution cavities. The pore or void space in a typical reservoir rock makes up 15 to 25 percent of its total volume. The permeability of the rock is extremely important because the voids must be interconnecting so that the gas can easily pass into and out of the reservoir. As the gas is forced into the reservoir rock, it displaces some of the fluids that already occupy the voids and eventually forms a bubble. During withdrawal of the gas, the pressure within the storage bubble is reduced, and the water reoccupies the voids.

In Illinois nine underground gas storage facilities utilize former oil or gas producing reservoirs, but the remainder utilize bedrock traps in structures that originally contained no commercial quantities of oil and gas. In Illinois gas is stored underground in Paleozoic strata ranging in age from Cambrian to Pennsylvanian. Ninety percent of the present storage volume is in Cambrian and Ordovician sandstones.

Natural Gas Pipeline of America

Natural Gas Pipeline Company of America, an affiliate of Peoples Gas Company, with offices in Chicago, was the first large diameter pipe, long distance gas transmission company in the United States. Their first transmission line was completed in 1931 from Amarillo, Texas, to Joliet, Illinois, a distance of 900 miles. In 1951 a second transmission line was completed from the Texas Gulf Coast region to Joliet, Illinois, a distance of 1200 miles. This pipeline serves the Louden gas storage facility. At the present time the company operates approximately 10,000 miles of pipeline, the largest of which has a diameter of three feet.

Compressor stations, situated at about 100 mile intervals along the pipeline system, compress the gas and push it along at about 850 pounds per square inch. Although a small amount of gas is produced by another affiliate of Peoples Gas Company, 98 percent of the gas transmitted by Natural Gas Pipeline Company of America is purchased from companies producing natural gas from gas fields in New Mexico, west central and north central Texas, the Texas Gulf Coast, the Texas Panhandle, Louisiana, and Oklahoma. The company's present delivery capacity totals about 4.3 billion cubic feet of gas daily, making it one of the largest gas transmission companies in the United States.
Natural Gas Pipeline Company will soon be operating five gas storage facilities in Illinois. The company's first storage field was completed in 1951 at Herscher, Illinois, southwest of Kankakee. In Illinois the company also has operational storage facilities at Cooks Mills, northwest of Mattoon, and a second facility at Herscher (Herscher Northwest). The Louden Field will be operational later this year, and a third facility is under development at Herscher.

Gas Storage at Louden

At Louden the gas is being pumped into the Devonian Grand Tower Limestone, a porous, dolomitic rock, at a depth of about 3,050 feet below the surface (figs. 3 and 7). The Grand Tower is about 90 feet thick and is immediately overlain by 65 feet of the Devonian Lingle Limestone. The impermeable caprock for the reservoir is formed by about 150 feet of Devonian (New Albany) and Lower Mississippian (Kinderhookian) Shale. Oil production in the formations above the Devonian is not affected by the gas storage.

Gas storage at Louden was proposed when extended studies showed that Devonian oil production was approaching its economic limit. In July, 1966, the 109 wells that had been drilled into the Grand Tower Limestone were cleaned out. Seven new wells were also drilled. Plant construction was begun in the fall of 1966, and the present plant with its compressor and cleaning equipment was completed in the summer of 1967. In addition to compressing the gas and pumping it underground, the plant must also clean the gas of certain impurities before injection to prevent contamination and fouling of the reservoir. Hydrogen sulfide, carbon dioxide, and water are removed before it is injected into the limestone. A new phase of construction is now under way that will double the plant's cleaning and injection capacities.

The first gas was injected into the Grand Tower Limestone on September 4, 1967, at the rate of 50 million cubic feet per day. During the late fall of 1967, a two-week test withdrawal of gas from the field was made to test the equipment and the reservoir. This fall the injection rate will be increased to 100 million cubic feet per day, and by September 14 nearly 10.7 billion cubic feet of gas will be in storage. Withdrawal of gas from storage, at a maximum rate of 100 million cubic feet per day, will begin in November, and this field will then become operational as an active supplier to the Natural Gas Pipeline Company's distribution system. The withdrawal season commonly occurs from December 15 to March 15. For about a month before and after this withdrawal period, the field is usually shut in because all of the trunkline gas is being used on the market. By 1977 or 1978 approximately 100 billion cubic feet of gas will be in underground storage with a wellhead pressure of 1,675 pounds per square inch.
Continue ahead up the hill.

0.2 6.2 Cross cattle guard and turn right.

Stop 2. J. B. Tucker Water Treatment Plant of Humble Oil Company. (NE NW , sec. 27, T. 8 N., R. 3 E.; St. Elmo Quadrangle.) Park near pump shed. East of the pump shed are two wells. The well with the pump jack farthest to the east is a producing oil well in the Mississippian Bethel Sandstone. The well with the pump and meter near the pump shed is a salt water well in the Mississippian Tar Springs Sandstone. Water and chemical tanks for treating the salt water before injection are located south of the pump shed, which houses four water pumps and three water filters. A salt water injection well at this site is located about 1,000 feet south of the pump shed. To reach this well walk along the oiled road that passes west of the shed.

Secondary Recovery

Not all of the oil trapped in an oil reservoir is recoverable. Under ideal conditions probably no more than one-fourth to one-third of the oil can be produced by primary recovery methods (initial flowing and pumping) before it becomes uneconomical to continue production. The well or field must either be

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Fig. 10 - Simplified diagram showing the concept of waterflooding. Formation A and Formation B hypothetically represent the Mississippian Bethel and Yankeetown Sandstones respectively. Water injection wells are indicated by I; producing oil wells are indicated by P.
abandoned or else stimulated to further production by employing secondary recovery methods. If secondary recovery methods are successful, another one-fourth to one-third of the oil may be recovered. At the present time methods for removing all of the remaining oil have not proved to be economically feasible. During 1966 approximately 70 percent of the oil produced in Illinois was from secondary recovery.

Energy is required to move oil through the void spaces in a rock toward a producing well. Dissolved gas in oil is one source of energy, water pressure is another. If all of the gas is allowed to escape during the production of oil, initial production will be short-lived. Production will rapidly drop to a low level because the oil remaining in the reservoir has lost its source of energy. Pressure maintenance of the reservoir by reinjecting the gas produced with the oil is one method that is used to conserve energy and keep oil production up. Air may also be injected for pressure maintenance. During the first year of production at Louden the gas was simply burned off and wasted. About one year later producers realized that conservation measures had to be taken, and a cooperative program of gas pressure maintenance was initiated to try to stabilize the production decline rate.

Waterflooding is another method used to maintain reservoir pressure, and is the most widely used method of secondary recovery in Illinois. Water injected under pressure replaces the gas and fluids that were lost during primary production and re-establishes the reservoir's energy system. One method, referred to as peripheral injection, is to use the wells around the periphery or outer boundary of the oil reservoir as the water injection wells. The water then drives the oil toward the producing wells on the higher parts of the reservoir, such as on an anticlinal structure. This method was used to waterflood the Devonian field at Louden before installation of the gas storage facility. A second method of waterflooding is to inject water into wells that are spaced over the entire field in regular patterns designed for most efficient recovery. This method is being used to waterflood the Mississippian field at Louden. Water injected into the input wells flushes the oil in all directions toward the producing wells.

The basic principle of waterflooding is that the oil moves away from the water injection wells, zones of higher pressure, toward the producing wells, zones of lower pressure (fig. 10). After secondary recovery begins, the amount of oil recovered may be fairly high in proportion to the amount of water injected, but as time passes the water to oil ratio increases. The water used for waterflooding may be salt water or fresh water, but it must be chemically compatible with the oil-producing formation. Otherwise, the producing formation may become plugged, and the oil field could be ruined. Chemical additives are sometimes used to help free the oil from the void spaces of the reservoir rock. Water treatment plants are used to filter and treat the water before injection.

Waterflooding at Louden

Waterflooding of the Louden Field began on an experimental basis in 1952. Because of the success of this pilot study, further testing was carried out before the field was flooded on a cooperative basis. In some cases alternate producing wells were converted to water injection wells. In other cases some of the older gas injection wells were converted to water injection. As of 1966, there are about 800 injection wells and 1,479 producing wells. Water flooding has been successful in the Louden Field with production reaching a peak of some 40,000 barrels per day in 1962. Production has been on the decline since that time, but water requirements for flooding the field are still high.
The J. B. Tucker water treatment plant is one of 14 such plants operated by Humble Oil Company throughout the field (fig. 8). Salt water produced with the oil is collected by a pumping and pipeline system, passed through a rapid sand filtering system, treated chemically if necessary, and then distributed to the water input wells. This plant distributes water to three input wells, including the one just to the south. At this well site water at the rate of about 418 barrels per day is being injected into the Mississippian Bethel Sandstone at a depth of approximately 1,550 feet. Immediately to the east of the building is a salt water source well that draws water from the Mississippian Tar Springs Sandstone at a depth of about 1,300 feet. Although this well is not now being used, it can provide water at the rate of 1,000 to 2,000 barrels per day when needed. The well further to the east of this well is a producing oil well that yields about 16 barrels of oil and 66 barrels of salt water per day.

0.0 6.2 Leave Stop 2. Return to main road.
0.3 6.5 Bottom of hill. Turn left.
0.1 6.6 STOP. Intersection with main gravel road. Turn right (north) towards Big Creek.
0.2 6.8 Cross Big Creek. SLOW. Prepare to turn left after crossing bridge.
0.2 7.0 Turn left on gravel road to Winter Stone Company Quarry.
0.3 7.3 Office and scales of Winter Stone Quarry. Stop at office for permission before entering quarry.

Stop 3. Quarry in Pennsylvanian Millersville Limestone. (SW\(\frac{1}{4}\), SE\(\frac{1}{4}\), sec. 21, T. 8 N., R. 3 E.; St. Elmo Quadrangle.)

The limestone being quarried here is the Millersville Limestone of the Pennsylvanian Bond Formation. This locality is near the crest or highest part of the Louden Anticline which raises the Millersville near the bedrock surface. The shales above the limestone belong to the lower part of the Mattoon Formation (fig. 3). The Millersville is unit #9 of the ideal cyclothem and the sideritic shales above represent unit #10. (Refer to page 9 for an explanation of the Pennsylvanian cyclothems.) The rock units exposed in the quarry are illustrated and described in figure 11.

After quarrying, the limestone is crushed and sized for local use as roadstone and agricultural lime. Limestone ranks second behind petroleum in commercial value among the mineral commodities produced in Fayette County. In Illinois limestone for use as crushed stone, agricultural lime, and cement is one of the state's most valuable mineral resources, ranking third in value behind the two leaders--coal and petroleum. In 1966, about 42.6 million tons of crushed stone valued at some 57.4 million dollars were produced in Illinois.

The Millersville Limestone Member is the uppermost unit of the Bond Formation and is one of the thicker Pennsylvanian Limestones in Illinois. The Millersville is very persistent laterally over a large area in the central part of the Illinois Basin, making it an important stratigraphic marker bed in the Pennsylvanian System. (See page 6 for a discussion of the Illinois Basin and its role in the geologic history of Illinois.)

The Millersville Limestone attains a maximum thickness of nearly 50 feet in Christian County, but it is more typically 20 to 30 feet thick. In some areas,
as here in the St. Elmo area, the Millersville occurs as two distinct benches or units of relatively pure limestone separated by a variable thickness of greenish shale and shaly limestone. Here in Winters Quarry a lower 9-foot unit of massive, gray, fine-grained limestone is separated from an upper 3- to 4-foot unit of similar massive limestone by two thin beds of greenish gray shale between which is a unit of about 2 feet of gray, fragmental limestone. This 2-foot bed is especially interesting because it consists largely of small, ovoidal to ellipsoidal, wheat grain size particles. These particles consist of small masses of calcareous algae and small fragments of crinoid stems, brachiopod shells, and pelecypod shells that are coated with layers of calcareous algae and microscopic size, calcareous Foraminifera of the genus *Osagia*.

The Millersville Limestone has the characteristics of a normal marine limestone. It was deposited in the ancient Pennsylvanian sea that covered this region some 280 million years ago. The limestone formed principally by the chemical precipitation of carbonate mud (calcite) from the sea water. The secretions of calcareous plants (algae) and the accumulation of calcareous shells and skeletons of marine animals also contributed to its deposition. The 2-foot bed of fragmental limestone indicates that for a time the sea was very shallow and that the bottom was swept by waves. At other times sand and mud eroded from
the land was mixed with the carbonate material, and as a result some beds of the limestone are impure and shaly. Sometimes the amount of mud was so great that only shale was deposited. The deposition of the Millersville Limestone ended when a great amount of mud was carried into the sea to form the overlying shale beds in the lower part of the Mattoon Formation.

The Millersville contains abundant fossils, many of them complete and excellently preserved. Fossils include crinoid stem fragments, brachiopods, corals, bryozoans, pelecypods, gastropods, trilobites, ostracodes, and Foraminifera (including fusulinids, a family of larger, wheat grain-shaped forams that were abundant during the Pennsylvanian Period). The shale beds between the upper and lower benches and the thin-bedded, shaly limestone at the top of the upper bench afford the best collecting. The fragmental limestone mentioned above is an excellent rock for cutting and polishing because of its unusual texture and composition.

BE CAREFUL WHEN WORKING NEAR THE HIGH WALL. LOOK UP!! THE LIFE YOU SAVE MAY BE YOUR OWN. WHEN WORKING ON TOP OF THE HIGH WALL, WATCH OUT FOR PEOPLE BELOW.

0.0 7.3 Leave Stop 3. Return to main road.
0.3 7.6 STOP. T-road intersection with main road. Turn left (north). On the right note the separator tanks and jack pump.
0.6 8.2 Spring Hill Cumberland Presbyterian Church on the right.
Stop 4. Lunch on grounds of Spring Hill Church.
0.0 8.2 Leave Stop 4. Continue ahead (north).
0.3 8.5 STOP. Crossroads at Wrights Corners. Turn left (west) on gravel road.
0.3 8.8 School on right.
0.5 9.3 Note how flat the Illinoian till plain is in this area.

As noted above, and as will be pointed out at several places along the itinerary, the Illinoian till plain in south-central Illinois, excluding the area of ridged drift, is strikingly flat and essentially featureless. Although locally dissected by streams, in most places the till plain lacks the typical rolling, swell-and-swale characteristics of glacial deposition. Survey geologists have attributed this unusual evenness to smoothing of the original glaciated surface by local erosion and deposition during the long, warm Sangamonian Stage which followed the Illinoian glaciation and lasted from about 200 thousand to 70 thousand years ago. Materials were eroded from the higher parts of the till plain by rain wash and deposited in the adjacent shallow swales.

1.6 10.9 Kaskaskia Church of the Brethren on the right.
0.5 11.4 Crossroads. Continue ahead (west).
0.5 11.9 Descend from the upland into Kaskaskia Valley.
0.7 12.6 Kaskaskia Valley floodplain.
0.4 13.0 Crossroads. Continue ahead (west).
0.5 13.5 T-road from left. Turn left (south). Note how broad and flat the floodplain is here.

1.1 14.6 Cross bridge over Big Creek.

0.5 15.1 Cross bridge over drainage ditch. CAUTION. Dangerous wooden plank bridge.

0.5 15.6 Bridge over South Fork.

0.2 15.8 Ascend valley wall of Kaskaskia River.

0.3 16.1 Crossroads. Turn right (west).

0.4 16.5 Descend again into Kaskaskia Valley.

0.1 16.6 T-road from left. Continue ahead.

This part of the valley lowland is an abandoned channel segment of South Fork of Big Creek (see itinerary map). The south wall of the valley is a long, arcuate meander scar that was cut by South Fork when the creek flowed around the south side of Island Hill, the high area on the right. Island Hill is a kame deposit of Illinoian sand and gravel.

0.5 17.1 T-road intersection. Turn right (north) on gravel road.

0.1 17.2 Ascending south slope of kame (Island Hill). Note the hummocky topography.

0.2 17.4 Farmyard of Jasper Smith. Continue ahead through farmyard and descend north side of kame.

0.4 17.8 Gravel pit on right in Island Hill. Turn right into pit.

0.1 17.9 Stop 5. Kame deposit of Illinoian sand and gravel. (SW₁, SW₂, sec. 27, T. 8 N., R. 2 E.; St. Elmo Quadrangle.)

This gravel pit occupies the northern end of Island Hill, an Illinoian kame deposit of sand and gravel that forms part of the "ridged drift" of the interlobate complex. Small amounts of gravel are still taken out by the county for use on local county roads. Sand and gravel, obtained largely from glacial outwash, are important mineral commodities in Fayette County and the state of Illinois. Common sand and gravel are used extensively in Illinois for various building and construction purposes. Commercial sand and gravel producers reported a total production of about 33.4 million tons in 1966 valued at about 29.4 million dollars.

Kames are mounds of ice-contact, stratified drift, consisting largely of sand and gravel, that was deposited by glacial meltwater. Debris-laden meltwater flowed from the surface of the Illinoian glacier into ponds in crevasses and other cavities in the ice. The abrupt changes in gradient and rapid decrease in current velocity caused deposition of the sand and gravel. When the ice melted away, the accumulated sediments were left standing as isolated mounds on the till plain. The preservation of the kames on the Illinoian till plain is evidence that they were formed during the late melting stages of the Illinoian glacier when the
ice had thinned and become stationary (stagnant). Actively moving ice would have destroyed them.

Much of the gravel exposed in this gravel pit is quite coarse and includes little sand, indicating that the meltwater currents that transported this material were swift-flowing. Many of the rock fragments are angular because they were not transported very far by the meltwaters. The gravel is well stratified, and the beds are steeply inclined, excellently revealing the internal structure of the kame. Beds on the north and south sides of the kame dip (tilt) at about 10 to 15 degrees away from its crest. Some beds of the gravel are somewhat cemented by calcium carbonate and are actually rock known as conglomerate. The calcium carbonate was leached by percolating waters from the thick loess which covers the top of the kame. The gravel consists of many kinds of rocks, including a large variety of igneous and metamorphic types. In a short time one can make an excellent rock collection.

The coarse gravel is overlain by finer, sandy gravel and laminated, medium to coarse sand. The sediments are leached and strongly oxidized to a reddish brown color. Some leached and oxidized, reddish brown till also overlies the gravel on the sides of the kame. This reddish, oxidized zone represents the Sangamon Soil which formed by weathering after the Illinoian glacier melted away. The buff to brown loess above the soil is the Peoria Loess that was deposited during the Wisconsinan glaciation.

In this immediate vicinity, in addition to Island Hill, there are several other similar mounds that rise abruptly above the Mendon till plain. The largest of these is Dean Hills, three miles directly to the north, which stands about 100 feet above the till plain (see Itinerary Map). This feature is also probably a kame deposit of sand and gravel.

Origin of Ridged Drift

The ridged drift, also referred to as the "interlobate complex," includes in addition to kames many elongate and discontinuous ridges composed of sand, gravel, and till, some of them several miles long and up to a mile wide. Some stand as high as 100 feet above the Illinoian till plain, but most are lower, many having only a few feet of relief. The ridges generally have a northeast-southwest orientation which gives the topography a pronounced northeast-southwest linearity. This linearity is excellently displayed in the St. Elmo field trip area, especially southeast of the Kaskaskia Valley from Beecher City southward to Farina and Kimmundy (see Itinerary Map). Most of the ridges in this area have very slight relief, but a few have good topographic expression, standing several tens of feet above the till plain. Note the long, low ridge just northwest of Beecher City and the well-defined ridges near Kimmundy. The ridge at Beecher City extends southwestward for nine miles past the village of Wrights Corner. Note also that the linearity of the ridged topography in the field trip area has influenced the drainage pattern. Many of the streams and their tributaries have developed a parallel drainage pattern which coincides with the northeast-southwest trend of the ridges.

The origin of the Illinoian ridged drift has been investigated for many years by geologists. Several theories have been proposed but none can adequately explain all aspects of the problem. One idea is that the ridges are crevasse fillings. This theory suggests that crevasses or large cracks were developed in the ice within a zone of shearing at the junction of the Michigan and Erie lobes.
during the advance of the Illinoian glacier. When the ice stagnated and began to melt, the crevasses acted as channels for the meltwater and became filled by outwash. When the ice melted away, the crevasse fillings were left standing as ridges on the till plain. Evidence that has been offered to support the crevasse theory includes the subparallel alignment, elongation, and relative straightness of the ridges, the general uniformity of many of their summit elevations, the abruptness with which many rise from the surface of the Illinoian till plain, and their high content of stratified drift. The formation of the ridges within a narrow zone of shearing between two ice lobes would explain the localization of the ridged drift within a narrow, northeast-southwest-trending belt. However, some geologists feel that many of the ridges are too large to be crevasse fillings. The presence of till in some of the ridges is also difficult to explain by the crevasse theory.

Another idea is that the ridges constitute an interlobate morainic system formed within a reentrant or narrow zone between the eastern and western lobes. This theory is based on the fact that some of the ridges in the inter-lobate complex consist of till, an ice-laid deposit, or mixtures of outwash and till. By this theory, the ridges were formed at the margins of active ice in the manner that end moraines are formed. However, this theory does not adequately explain the distinctive linearity or discontinuous character of the ridges, nor can it explain why many of the ridges are composed exclusively of outwash.

Survey geologists presently studying this problem are considering a third possible origin for the ridged drift. The area of the ridged drift is underlain by an elongate, broad depression or valley in the bedrock surface that was eroded by an early Pleistocene river ancestral to the present-day Kaskaskia River. According to the proposed theory, this broad bedrock depression was reflected as a similar depression in the surface of the Illinoian glacier. When the glacier stagnated and began to melt, a great deal of meltwater was channeled into this depression on the ice surface, forming a narrow system of meltwater streams which flowed southwestward toward the Mississippi Valley. These streams cut their channels into the ice, and outwash accumulated in these ice-walled valleys. After the glacier melted away, these channel deposits were left standing as ridges on the till plain. However, like the crevasse theory, the presence of till in some of the ridges is not explained.

As studies of the ridged drift continue and more is learned about it, improved explanations for its origin will be given. Rather than a single process, some combination of processes probably acted to form the ridges.

0.0 17.9 Leave Stop 5. Return to main gravel road.
0.1 18.0 T-road intersection with main road. Turn left (south).
0.7 18.7 T-road from left. Turn left (east).
0.5 19.2 T-road from right. Continue ahead (east).
0.5 19.7 Crossroads. Turn right (south) on blacktop.
1.6 21.3 Crossroads. Continue ahead through village of Sefton.
0.9 22.2 Enter valley of Suck Creek.
0.2 22.4 Cross bridge over Suck Creek.
This exposure affords an excellent opportunity to study some of the glacial deposits that form the surficial materials in the St. Elmo area. These deposits are illustrated and described in figure 12.

About 21 feet of stony, sandy, and silty Illinoian till that was deposited by the second invasion of the Erie lobe forms the lower part of the exposure. The till is overlain by about 6 feet of Wisconsinan loess, a very fine, powdery silt deposit that was laid down by the wind during the Wisconsinan glaciation. Of particular interest is the Sangamon Soil that is developed in the upper 8 feet of the Illinoian till. Till deposited by the first advance of the Erie lobe is buried by the upper till and is not exposed. Only a few exposures of the lower Illinoian till exist in the field trip area, and it will not be seen during this field trip.

Till is drift that was deposited by a glacier. It consists of an unsorted (random) mixture of boulders, pebbles, sand, silt, and clay, and it is typically unstratified (unlayered). Many of the larger and harder rock fragments are faceted (flattened on one or more sides) and striated (scratched) from wear during transport by the ice. Till is composed of rock debris that was eroded from the terrain over which the glacier moved. In addition to fragments of shale, sandstone, limestone, dolomite, and chert that were eroded from the local bedrock, the till sheets in the Midwest also contain rock debris that was carried into the
A large variety of igneous and metamorphic rocks, including granites, gneisses, and schists, were transported by the glaciers from far to the north in central and eastern Canada.

There are two types of till that are the result of differences in the manner of deposition—lodgement till and ablation till. Figure 13 illustrates their origin.

Lodgement till is till that was deposited directly by the ice beneath a moving glacier. Rock debris that was released by melting at the base of the moving ice was literally plastered to the accumulating till sheet. During this process intense crushing, abrasion, and compaction took place because of the great weight of the glacier. As a result, lodgement till is very firm and compact.

Ablation till is till that accumulated by the release of rock debris from the ice during the wasting away of a stagnant glacier. A layer of drift (also referred to as superglacial drift) accumulated on the surface of the glacier, and as melting continued the drift was gradually let down onto the ground. As a result, ablation till is loose and noncompact because it was not subjected to the weight of the glacier. Ablation till is also coarser and looser than lodgement till because it experienced considerable washing by meltwater which carried away most of the fine materials. Because of this washing, ablation till usually contains some outwash and may be somewhat stratified.

Here at Stop 6 the lower 12 feet of massive, firm, gray, stony till is lodgement till. The upper 9 feet of loose gray-brown to brown, sandy till, some of which contains sandy layers, is ablation till. The lodgement till was deposited during the advance of the Illinoian glacier; the ablation till was deposited after the glacier had stagnated.

The Sangamon Soil is an ancient, buried soil that was formed by weathering of the Illinoian till during the long, warm Sangamonian Stage which followed the melting of the Illinoian glacier. This interval of weathering lasted from about 200,000 to 70,000 years ago. In this exposure the soil is distinguished by
a brown to reddish brown, limonite- and manganese-stained, leached and oxidized zone in the upper part of the Illinoian till. The soil is entirely developed in the ablation till. The till below the soil is unleached and contains carbonate which reacts freely with dilute hydrochloric acid. The Sangamon Soil is extensively developed in the top of the Illinoian drift sheet throughout Illinois and the Midwest. This ancient soil is an important stratigraphic marker that helps geologists to distinguish the Illinoian drift from the younger Wisconsinan drift wherever deposits of both of these glaciations are present.

Although the Wisconsinan glacier never reached the St. Elmo area, the loess above the Sangamon Soil in this exposure records the glacier’s influence beyond the limits of its extent (figs. 1 and 9). The loess present here is probably the Peoria Loess that was deposited during the advance and retreat of the Late Wisconsinan Woodfordian glacier between about 22,000 and 12,000 years ago (fig. 1, §10 and §11). However, the lower part of the loess may be the Roxana, an older Wisconsinan loess that was deposited during the Altonian glaciation between about 70,000 to 28,000 years ago. However, because of the thinness of the loess, it has weathered uniformly to a light brown or tan color and is leached. Thus, physical criteria, including color, normally used to distinguish between the Peoria and the Roxana are absent.

Geologists generally agree that the loess deposits are eolian in origin and are genetically related to the major meltwater channels which drained the ice fronts during the advance and retreat of the Pleistocene glaciers in Illinois (fig. 1). During Pleistocene time, as now, the winds prevailed westerly, and fine sand, silt, and clay were blown from the surfaces of the valley trains, which were largely unvegetated outwash flats. These materials were deposited on the adjacent bluffs and uplands. The finest dust (silt and clay) was blown eastward for great distances to form a gradually thinning blanket of loess over a vast area of the Midwest. Most of the loess was deposited during the fall and early winter when, because of colder weather, the meltwaters had receded, exposing the surfaces of the valley trains and permitting them to dry out. The recently deposited outwash sediments were then more easily eroded by the winds. In Illinois the Mississippi and Illinois Valleys were the major sources of the loess.

0.0 22.5 Leave Stop 6. Continue ahead (south).

2.0 24.5 Crossroads. Turn left (east) on oiled road to St. Elmo.

4.8 29.3 T-road. Turn right (south).

0.1 29.4 T-road from left. Turn left (east) toward St. Elmo.

0.2 29.6 Descend into valley of Brickyard Branch.

0.2 29.8 Cross bridge over Brickyard Branch. SLOW. Prepare to turn right.

0.2 30.0 Turn right into yard of Diller Shale Products Company. Stop at company office for permission before entering the shale pit.

Stop 7. Operating pit in Pennsylvanian shale. (NE ½, NE ½, sec. 28, T. 7 N., R. 3 E.; St. Elmo Quadrangle.)

Shale used in the manufacture of tile at this plant is mined from an open pit located about 200 yards west of the plant across Brickyard Branch. The shale is an unnamed member of the Upper Pennsylvanian Mattoon Formation, and it
occurs stratigraphically above the Millersville Limestone Member seen at Stop 3. Continuing southward from the crest of the Louden Anticline, progressively higher and younger bedrock strata are exposed. The shale is about 25 feet thick, but the thickness and character of the strata between this shale and the underlying Millersville are not known.

The shale is medium to dark gray, smooth, and generally well laminated with some zones tending to be somewhat blocky. It contains abundant brown, discoidal siderite (ironstone) nodules up to one foot in diameter, and it is very fossiliferous in some zones. Numerous flattened brachiopods and pelecypods that were squeezed during compaction of the shale occur on some bedding surfaces. These include small phosphatic, inarticulate brachiopods of the genus Orbiculoidea. Some scattered plant fragments and pyrite "trails" are found. The shale represents unit 10 of the ideal cyclothem. The presence of marine fossils indicates that it was deposited in the sea, but not too far from shore at times because the shale contains plant remains. The shale was probably deposited in a large marine bay between distributaries of the Pennsylvanian river. Several feet of Illinoian drift overlies the shale on the western side of the pit.

After mining, the shale from this pit is run through a hammer mill which pulverizes it to pass through a number eight screen (openings of 0.0937 inches). The larger masses of siderite are removed before crushing, but the smaller nodules are crushed with the shale. The shale is then mixed with water to make it plastic enough to pass through the extruding machine die.

After being extruded and cut to length, the tiles are air dried for 36 hours and then stacked in the kilns. The smaller beehive kilns hold an average of 36 tons of tile, while the large rectangular kiln holds 126 tons.

Gas heat is used to fire the kilns. After a kiln has been loaded and sealed, the gas jets around the periphery of the kiln are fired, and the temperature in the kiln is gradually raised over a three-day period to a maximum of 1800°F at the top of the kiln and 1600°F at the bottom. Pyrometric cones, which collapse at predetermined temperatures, are placed within the kiln before it is fired. By observing these cones, it is possible to ascertain the temperature inside the kiln. Depending on the characteristics of the particular kiln, the maximum firing temperature used is maintained for a period of three to ten hours, after which the kiln is allowed to gradually cool for three days before the doors are unsealed and the kiln is unloaded.

Over 10,000 tons of tile are produced at this plant annually, 75 percent of which is field drainage tile. The market area for the company extends over a radius of 150 miles and includes Terre Haute and Evansville, Indiana, St. Louis, Missouri, Decatur, Mt. Vernon, and other communities in Illinois.

0.0 30.0 Leave Stop 7. Return to main road.

Turn right and enter village of St. Elmo.

0.6 30.6 Intersection of Elm and 6th Streets. STOP.

Turn right on Elm Street. CAUTION. Cross railroad (2 tracks) and continue ahead on Elm Street.

0.3 30.9 STOP. Intersection of Elm and 2nd Streets. Continue ahead on Elm.
0.2 31.1 STOP. Intersection with U. S. Route 40. Turn left (east) on Route 40.

0.3 31.4 Railroad crossing. CAUTION.

0.3 31.7 St. Elmo City limits.

1.2 32.9 Junction with Illinois Route 128 from left. Continue ahead on Route 40.

1.3 34.2 Crossroads. Continue ahead.

0.6 34.8 SLOW. Prepare to stop.

0.1 34.9 Turn right onto shoulder and stop just west of driveway from right (near Hanna Paint sign).

Stop 8. Kame on Illinoian till plain. (Sec. 8, T. 7 N., R. 4 E.; St. Elmo Quadrangle.)

Toward the north is a large, low, sub-circular mound, named the Mound (see Itinerary Map), just to the west of the radio tower in the distance. This mound of about one mile in diameter and about 30 feet in height is a kame on the Illinoian till plain. Unlike many of the larger kames on the till plain, the Mound has relatively little relief, but is nevertheless a rather impressive feature. Its rounded profile is well defined from a distance, but in driving over it, one barely notices its presence.

The low relief of the kame probably means that it formed very late during the melting stages of the Illinoian glacier. Since its internal composition is not known, its low relief may also indicate that the kame is composed largely of fine sediments, sand and silt, rather than gravel. These fine materials would form a lower kame because of their low angle of repose.

0.0 34.9 Leave Stop 8. Continue ahead on Route 40. SLOW. Prepare to turn right at next crossroads.

0.4 35.3 Crossroads. Turn right (south) on oiled road.

0.8 36.1 Cross Interstate 70 overpass.

0.4 36.5 Cross Big Creek.

2.0 38.5 Bethlehem Lutheran School on right.

0.4 38.9 Crossroads with sharp jog to right and then left.

0.6 39.5 Cross Fulfer Creek. Note the Pennsylvanian limestone cropping out in the stream bank on the left.

2.6 42.1 Crossroads. Turn right (west).

1.1 43.2 Crossroads. Continue ahead.

0.4 43.6 Note how flat the Illinoian till plain is in this vicinity.

0.7 44.3 T-road intersection. Turn left (south) on oiled road.
Drift

Sandstone, light gray, weathers reddish brown, very fine grained, argillaceous, thin-bedded, micaceous.

Sandstone, as above but massive, thin-bedded at bottom with abundant leaves and twigs, friable in some zones, calcareous in some zones.

Shale, greenish brown to olive, splintery in upper part, laminated in lower one foot, silty, noncalcareous, abundant carbonized twigs and fern leaves.

Shale, dark brown, coal streaks, soft, papery, plant remains.

Limestone, gray, fine grained, lenticular (0-2"), coaly plant fragments, ostracodes, pelecypods, Spirorbis.

Siltstone, brown, shaly, calcareous, thin-bedded.

Shale, light gray-green, laminated, calcareous, with scattered calcareous siltstone nodules.

Fig. 14 - Strata exposed at Stop 9.

6.4 50.7 STOP. Intersection with Illinois Route 185. Turn left on Route 185 to Farina.

4.0 54.7 Enter village of Farina. SLOW.

0.3 55.0 STOP. Intersection with Illinois Route 37. Continue ahead across Route 37.

Cross the Illinois Central Railroad. CAUTION. Three tracks.

Continue ahead (east) on gravel road.

3.2 58.2 SLOW. Prepare to stop before crossing bridge over Crooked Creek.

Stop 9. Exposure of Pennsylvanian sedimentary strata in bank of Crooked Creek. Park on right shoulder. Cross wooden gate and walk across pasture on right to exposure. (Northwest corner, SW\text{\textfrac{1}{4}}, sec. 36, T. 5 N., R. 4 E.; Edgewood Quadrangle.)

This exposure affords an opportunity to examine portions of two Pennsylvanian cyclothemcs, both unnamed. The strata are illustrated and described in Figure 14. These rocks are part of the Mattoon Formation and occur stratigraphically above the shale seen at Stop 7 and below the Omega Limestone which will be seen at Stop 11.
The lower part of the section, from the sandstone in the creek bed to the base of the upper sandstone, forms one cyclothem; the upper sandstone forms the base of the second. The lower cyclothem illustrates the characteristics of a Pennsylvanian cyclothem, although it is incomplete and lacks a well-developed coal. The coal is represented by vitrain bands in the dark brown shale.

The following units of the ideal cyclothem are present—(1) sandstone, (2) sandy shale, (3) freshwater or underclay limestone, (5 and 8) coal and black shale combined, and (9 and 10) shale. The lower sandstone, lower shale, freshwater limestone, and coaly shale form the nonmarine portion of the cyclothem; the upper shale above the coaly shale represents the marine portion. The thinness of these units typically illustrates the rapidity with which the depositional environment changed during their deposition. No underclay (4) is present, and the marine limestone (9), which may be represented by part of the upper shale, did not form. It probably did not form because the shoreline of the sea was too close to this area. The coal is represented only by shiny black streaks (vitrain bands) in the dark brown shale. Apparently the conditions for coal formation in this locality were not exactly right and lasted for only a short time.

Abundant carbonaceous plant remains, including stems and leaves, are present in the freshwater limestone, the upper shale, and the upper sandstone. Fern leaves are beautifully preserved in the shale immediately below the sandstone, but they are very fragile because the shale is soft. The thin freshwater limestone contains a few small pelecypods (clams), ostracodes, and spiral worm borings of the worm genus, Spiorobis.

0.0 58.2 Leave Stop 9. Continue ahead (east). Cross Crooked Creek.
2.1 60.3 Illinois Central Railroad underpass.
0.1 60.4 T-road from right. Turn right (south) on gravel road.
0.5 60.9 Cross tributary to Crooked Creek.
0.8 61.7 Ascending an Illinoian crevasse ridge.
0.1 61.8 Note the ridge rising off towards the east.
0.2 62.0 T-road intersection. Turn left (east). Prepare to stop at top of ridge.
0.2 62.2 Stop 10. Top of Illinoian ridge.
Park on shoulder just west of the house. Stand on elevated right shoulder for views toward the north and the east. (NW¼, NW¼, sec. 8, T. 4 N., R. 5 E.; Edgewood Quadrangle.)

This small hill is part of a discontinuous ridge within the interlobate complex of ridged drift that was discussed earlier at Stop 5. The ridge stands 60 to 80 feet above the Illinoian till plain at places along its crest, and it extends southwestward from this locality for about four miles. The composition of the ridge is not known because there are no exposures. An excellent view of the even, almost flat Illinoian till plain can be seen toward the west.

0.0 62.2 Leave Stop 10. Continue ahead (east).
0.4 62.6 Note the view back towards the ridge.
1.8 64.4 STOP. T-road intersection. Turn left on blacktop.

Cross bridge over Crooked Creek and then turn right on gravel road at Iola Stone Quarry sign.

1.0 65.4 Oil wells on the left are located in the Iola South Field. Producing horizons are the Mississippian Yankeetown Sandstone and Ste. Genevieve Limestone. These formations occur almost 1,000 feet deeper here than on the Louden Anticline. In 1966, this small field produced 13,000 barrels giving a total overall production since discovery of slightly under 300,000 barrels.

0.8 66.2 T-road from right. Turn right (south) on gravel road to Iola Stone Quarry.

0.2 66.4 Office of Iola Stone and Materials Company Quarry.

Stop II. Quarry in Pennsylvanian Omega Limestone. Stop at office for permission before entering quarry. (SWk, NEk, T. 4 N., R. 5 E.; Edgewood Quadrangle.) The active pit is located about one-fourth mile south and slightly east of the office.

The Omega Limestone Member of the Upper Pennsylvanian Mattoon Formation is exposed in this quarry (fig. 3). In a well drilled approximately one mile to the southwest of here, the stratigraphic interval between the Omega Limestone and the Millersville Limestone is about 300 feet. The Omega is a marine limestone usually three to four feet in thickness, but here the thickness is 20 to 22 feet. This unusual thickness appears to be a local development and may be explained by deposition in a slight depression on the sea floor, perhaps a tidal channel.

Most of the limestone is a medium to dark gray, fine-grained, argillaceous, silty, carbonaceous limestone, sandy at the base with fucoids. The base of the limestone is also very carbonaceous and sulfurous with coaly material and marcasite. The limestone is very fossiliferous and contains numerous well-preserved Productid brachiopods, including the genera Echinoconchus, Juresania, and Dictyoclostus. Other fossils include the spiriferid brachiopod Neospirifer, the brachiopod Chonetes, pelecypods, horn corals, crinoid fragments, and bryozoans of the genus Fenestrella. The shells of Echinoconchus are especially conspicuous because of their large size. The preservation of these large, thin-shelled brachiopods, as well as the delicate fronds of Fenestrella, indicates that the limestone was deposited in quiet water. However, conditions changed near the end of limestone deposition, probably becoming shallower as the channel filled up. The upper few feet of the limestone consists of extremely fossiliferous, thin-bedded, fragmental limestone in which most of the fossils are broken. The thick-shelled brachiopod Neospirifer is abundant in these beds.

The limestone is quarried for use locally as roadstone and agricultural lime.

End of Field Trip

Drive carefully on your way home.
## Time Table of Pleistocene Glaciation

(after J. C. Frye and H. B. Willman, 1960)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Substage</th>
<th>Nature of Deposits</th>
<th>Special Features</th>
</tr>
</thead>
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<tr>
<td>Recent</td>
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<tr>
<td></td>
<td></td>
<td>Soil, youthful profile of weathering, lake and river deposits, dunes, peat</td>
<td>Outwash along Mississippi Valley</td>
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<tr>
<td>Wisconsinan</td>
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<td>Outwash</td>
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<td></td>
<td>Valderan</td>
<td>11,000</td>
<td>Peat and alluvium</td>
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<td>Two creekan</td>
<td>12,500</td>
<td>Drift, loess, dunes, lake deposits</td>
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<tr>
<td></td>
<td>Woodfordian</td>
<td>22,000</td>
<td>Soil, silt and peat</td>
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<td>28,000</td>
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<td>50,000 to 70,000</td>
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<tr>
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<td>Drift</td>
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<td>Jacksonville</td>
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<td>Drift</td>
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<td>Liman</td>
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<td>Soil, mature profile of weathering, alluvium, peat</td>
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<td>Nebraskan</td>
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GLACIAL MAP OF NORTHEASTERN ILLINOIS

GEORGE E. EKBLAW
Revised 1960
TRILOBITES

Ameura sangamonensis 1\frac{1}{3}x

Ditomopyge parvulus 1\frac{1}{2}x

Laphaphidium proliferum 1x

CORALS

Fusulina acme 5x

Fusulina girtyi 5x

BRYOZOANS

CEPHALOPODS

Pseudarthoceros knoxense 1x

Gaphrites welleri \frac{2}{3}x

Glophrites welleri 1x

Fenestrella mimica 9x

Fenestrella modesta 10x

Rhombopora lepidodendroides 6x

Fistulipora carbonaria 3\frac{1}{3}x

Prismopora triangulata 12x
PELECYPODS

Nucula (Nuculopsis) girtyi 1x
Edmonia ovata 2x
Astartella concentrica 1x
Dunbarella knighti 1½x
Cardiomorpha missouriensis "Type A" 1x
Cardiomorpha missouriensis "Type B" 1½x

GASTROPODS

Euphemites carbonarius 1½x
Trepospira illinoisensis 1½x
Donaldina robusta Bx
Naticopsis (Jedria) ventricosa 1½x
Trepospira sphaerulata 1x
Knightites montfortianus 2x
Glabrocingulum (Glabrocingulum) grayvillense 3x
BRACHIOPODS

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

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

Derbya crassa 1x

Composita argentina 1x

Neospirifer cameratus 1x

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

Mesolobus mesolobus var. evampygus 2x

Marginifera splendens 1x

Crurithris planoconvexa 2x

Linapuctus "cora" 1x
GEOLOGIC MAP OF ILLINOIS showing BEDROCK BELOW THE GLACIAL DRIFT 1961
LIST OF PROPERTY OWNERS

Stop 1:
Natural Gas Pipeline Company of America
Compressor Station 206
Box 187, St. Elmo, Illinois
Telephone - 618-829-3224

Earnest E. Lindsey
Storage Superintendent

Ron Yonkers
Geologist

Stop 2:
Humble Oil Company
2010 West Ohio Street
Evansville, Indiana
Telephone - 812-425-4351

Bruce Bradley
District Superintendent
Evansville Office

Production Services Department
Taylor Office
Humble Oil Company
Box 235
St. Elmo, Illinois
Telephone - 618-829-6211

W. L. "Pete" Loftin
Production Superintendent
Taylor Office

Charles Schwope
Production Engineer
Taylor Office

Stop 3:
Winter Stone Company
R. R. 1
Altamont, Illinois

Dan Winter
Owner
Ramsey, Illinois

Stop 4:
Spring Hill Cumberland Presbyterian Church
St. Elmo, Illinois

Roy Shelton
Pastor
Fairlane Circle Drive
Altamont, Illinois

James B. Wright
Deacon
R. R. 1
Beecher City, Illinois
Telephone - 618-487-2936

Stop 5:
Mabel Mills
R. R. 2
St. Elmo, Illinois

Stop 7:
Diller Shale Products Company
St. Elmo, Illinois
Telephone - 618-829-3272

Charles Diller
Owner

Stop 9:
Ted Ernst
Farina, Illinois
Telephone - 618-245-3453

Stop 11:
Iola Stone & Materials Company
Box 16
Iola, Illinois

William Livezey
Superintendent

Keith Walker
Owner
Box 187
Salem, Illinois
Telephone - 548-1585
ST. ELMO
GEOLOGICAL SCIENCE FIELD TRIP
SEPTEMBER 14, 1968

[Map of a geological survey area with marked start and end points, showing topographic features and grid lines.]