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GLACIAL TILLS OF NORTHWESTERN ILLINOIS

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ABSTRACT

In northwestern Illinois, outside of the prominent Bloomington-Marengo Moraine, the surface tills have been differentiated into eight mappable till units: four of Illinoian age, two of Altonian age, and two of Woodfordian age. The differentiation is based on clay-mineral composition, grain size, gross lithology, radiocarbon dates, stratigraphy of overlying loess, and soil profiles. These studies confirm the presence of Altonian drift in the eastern part of the region, indicate the Illinoian age of tills in the northwestern part of the region, and have led to extensive remapping. Intensive erosion during the early Woodfordian accounts for the presence, at many places, of youthful soil profiles on Illinoian drift. The extent of the Green River Lobe has been considerably restricted, and it does not extend westward into Iowa as previously mapped. The earliest Altonian tills, below the Argyle till and above the youngest Illinoian (Sterling), are found only in the subsurface in the eastern part of the region and are overlapped by the Argyle and younger tills. The Sterling till is correlated into the subsurface of northeastern Illinois.

INTRODUCTION

With the increasing demand for precise information on the near-surface materials within which man's activities are principally confined, a knowledge of the sequence, distribution, and character of the glacial deposits that mantle most of the state is needed. Such information is of importance particularly for foundation investigations, highway construction, and most other engineering projects, for determination of effective recharge to ground-water reservoirs, for evaluation of the pollution potential of septic systems and sanitary landfills, as basic data on soil parent materials, and for use in resource-based planning studies. An essential element in the understanding of the glacial succession is a detailed knowledge of the tills that compose more than half of these deposits.

The glacial deposits of northwestern Illinois have been studied for many years. However, little information has been available on the mineralogy, texture, and subsurface occurrence of the tills and other glacial materials of the region. The interpretations of the age and distribution of the several tills of this region have been more diverse and contradictory than in any other part of Illinois. It is the purpose of this report to present the results of field and laboratory studies during the last few years, a new interpretation of the glacial history of the area, and a summary of new analytical data.

The data utilized in this study were obtained from field observations, and from samples from exposures, hand auger holes, and cores. Laboratory studies, in addition to examination of cores, consisted mainly of X-ray diffraction analyses of the less than 2-micron fraction of the till samples (more than 1600 analyses) and determination of the sand-silt-clay content of the less than 2-mm fraction of the samples (about 800 determinations). Details of the stratigraphic sequence and position of samples are given at the end of this report for 25 exposures and auger borings and 10 cores. Locations and sample numbers are also given for 31 additional stratigraphic sections referred to in the text. Individual analyses, although not tabulated in the report, are available in the Illinois State Geological Survey' s files and are summarized on four triangular diagrams. Typical analyses for each till unit are given in the table of stratigraphic units.

Particular thanks are expressed to the Illinois Division of Highways, District No. 2, Dixon, for their cooperation by furnishing cores in critical parts of the region, and to Dr. Robert F. Black and Mr. Ned Bleuer, of the University of Wisconsin, for information from adjacent southern Wisconsin.

History of Glacial Studies

The difficulty of mapping the glacial deposits of northwestern Illinois is well shown by the many positions where boundary lines have been drawn (fig. 1). Repeated changes in classification add to the complexity of the problem. The literature on the region is abundant and only the major reports introducing new concepts directly related to northwestern Illinois are discussed.

The absence of drift deposits in extreme northwestern Illinois was recognized by David Dale Owen in the early 1800' s. The boundary of the Driftless Area had been mapped by Worthen and others of the Geological Survey of Illinois by 1866, and later mapped in more detail by Trowbridge and Shaw in 1916.

Chamberlin (1878) recognized that the drift bordering the Great Lakes had a well preserved morainic topography and was less weathered than the drift elsewhere. Therefore, he differentiated two glacial epochs, mapping (1883) the front of the Second or younger drift in northeastern Illinois at the position of the Marengo Moraine and from it southeasterly along the front of the Valparaiso Moraine. By 1888, however, he had extended the front of the younger drift from the southern end of the Marengo Moraine southwestward along the front of the Bloomington Moraine. In 1894, Chamberlin named the Second glacial epoch East Wisconsin and differentiated the older drift into two units (fig. 1). The outer boundary of the younger of the two, named East Iowan, was placed essentially along the Rock River extending southwesterly to and including the present Green River Lobe. The older drift, extending

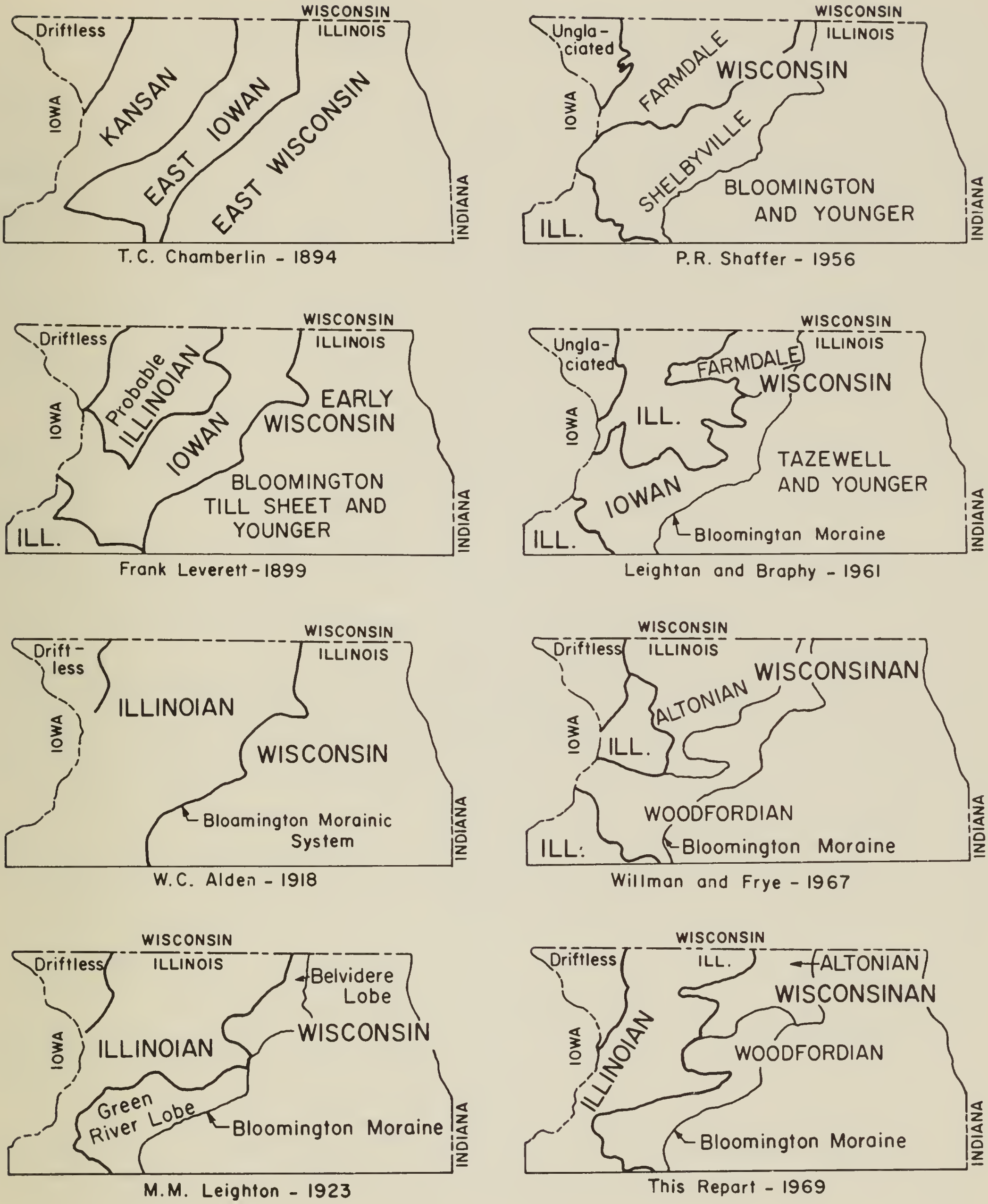


Figure 1 - Generalized maps showing major changes in previous mapping and classification of the glacial drifts of northwestern Illinois.

westward to the Driftless Area was called Kansan, based on correlations with Iowa and Kansas. The following year he dropped the word "East" from before Wisconsin and Iowan.

Hershey (1895) noted that terraces along the northern side of the Pecatonica Valley indicated the presence in the valley of drift younger than the Kansan drift in the adjacent area. Hershey (1893, 1896, 1897a, 1897b) described many glacial features in northwestern Illinois, including eskers, rock gorges, ice-shove features, and lake sediments. He estimated from varved sediments in the Pecatonica Valley that the ice advanced about 25 miles in 750 years.

In 1895, Chamberlin announced Leverett's differentiation of the Illinoian drift—younger than Kansan and older than Iowan. Leverett (1899) interpreted the area previously called Kansan drift in northwestern Illinois as probably Illinoian (fig. 1). He expanded the area of Iowan drift to include the Pecatonica Lobe and also the areas with loess and sand ridges, called "pahas," along the Mississippi Valley in northern Rock Island and western Whiteside Counties.

Alden (1909, 1918) concluded that all of the drift outside the Bloomington Moraine in northwestern Illinois was Illinoian in age (fig. 1). Leighton (1923) also eliminated the Iowan from Illinois and interpreted most of the drift as Illinoian (fig. 1). However, he expanded the Wisconsinan drift westward from the Bloomington front to include the Capron Ridge, west of the Marengo Moraine, and thence southwestward nearly to the Rock River, forming the Belvidere Lobe. Farther southwest, he interpreted most of the Iowan drift of Leverett as Wisconsin in age and named it the Green River Lobe. He restricted the lobe to the Green River Lowland, leaving the "paha" areas in the Illinoian.

Leighton, in 1931, concluded that the Iowan drift in Iowa was not weathered deeply enough to justify its classification as a separate glacial stage, and thus, he interpreted it as the initial substage of Wisconsin glaciation. In 1933, he introduced the names Tazewell, Cary, and Mankato for Leverett's early, middle, and late Wisconsin, giving the Wisconsin four substages.

Flint (1931) described many glacial features in the area of Illinoian drift and interpreted them as evidence for the stagnation of the glacier.

By outlining an area in which he found scattered exposures of calcareous loess on unweathered glacial deposits, Shaffer (1954) extended the Green River Lobe westward across the Mississippi Valley to the Goose Lake Channel in Iowa. In 1956, Shaffer expanded the Green River Lobe (Shelbyville) northward about 10 miles and connected it directly eastward to the maximum westward extent of the Belvidere Lobe, thus eliminating the latter as a separate lobe (fig. 1).

Shaffer's study (1956) of the drift previously called Illinoian in northwestern Illinois convinced him that it was not weathered as deeply as the typical Illinoian drift of central and western Illinois. As he found no definitive evidence for more than one drift, he assigned it all to the earliest Wisconsinan glaciation, then called Farmdale (Leighton and Willman, 1950). Until then, Farmdale glaciation had been indicated only by the pinkish brown Farmdale Loess that overlies the Sangamon Soil, underlies the typical yellow-tan Peoria Loess, and is well developed in the Illinois and Mississippi Valleys. It had been called Late Sangamon Loess in earlier reports. Subsequent to Shaffer's studies, Black (1958, 1959) presented data indicating that the drift bordering the Wisconsin Driftless Areas was Wisconsinan in age, thus supporting Shaffer's conclusion.

Frye and Willman (1960) showed that the Farmdale Loess along the lower Illinois Valley and Mississippi Valley consists of several widely traceable units, that the loess, and therefore the beginning of Wisconsinan glaciation, is much older than previously believed, and that previous radiocarbon dates were entirely from peat and organic-rich silts at the top of the loess. The name Farmdale was restricted to the peat and organic-rich deposits, and the name Roxana was introduced for the underlying silt and loess. The Roxana Silt served as the basis for the Altonian Substage, the earliest Wisconsinan glaciation, and the restricted Farmdale was the basis for the Farmdalian Substage, an interval of peat accumulation and weathering. The name Farmdale, therefore, was not appropriate for the drift in northwestern Illinois, and it was given a local name, Winnebago drift, and assigned to the Altonian Substage. The name Woodfordian was introduced for the interval of deposition of the post-Farmdalian drift, including deposits previously called Iowan, Tazewell, and Cary in Illinois.

Leighton (1960) rejected these changes, preferring to introduce Farm Creek for the upper interval of weathering and peat accumulation and restricting Farmdale to the underlying loess and interval of glaciation.

Leighton (1958) and Leighton and Brophy (1961, 1963, 1966) concluded that only the northeastern part of the area, including the Pecatonica Lobe, was of Farmdale age (fig. 1) and that the drift farther west was Illinoian, as Leighton had called it before the studies by Shaffer. They further restricted the Wisconsinan drift to the area southeast of Rock River, except near Sterling and northwest of Morrison. They accepted Shaffer's extension of the Green River Lobe into Iowa, but, except for the Farmdale drift, interpreted all of the Wisconsinan drift outside the Bloomington Moraine as equivalent to the Iowan drift of Iowa.

From a study of subsurface data, largely in Winnebago, Boone, Kane, and McHenry Counties, Hackett (1960), Kempton (1963, 1966), and Kempton and Hackett (1968a, 1968b) differentiated distinctive lithologic units within the Winnebago drift and by radiocarbon dating determined the Altonian age of the drift. Doyle (1965) described many features of the drift in the Freeport region and assigned it all to the Winnebago drift of Altonian age.

After an extensive study, Ruhe and others (Ruhe, Rubin, and Scholtes, 1957; Ruhe, Dietz, Fenton, and Hall, 1968) concluded that the drift mapped as Iowan in Iowa was Kansan drift from which the Yarmouth and Sangamon Soils had been eroded, a conclusion reached by Leverett in 1909, which supports the decision to drop Iowan as a Wisconsinan Substage in Illinois (Frye and Willman, 1960).

The present study was in progress when the State Geologic Map of Illinois was revised in 1967, and by that time (fig. 1), it was realized that at least the southwestern part of the area, previously interpreted as Altonian, was, in fact, Illinoian in age (Willman and Frye, 1967). In revising the map, the northern side of the Green River Lobe was restricted, which produced a new lobe, the Dixon Lobe; but otherwise, the mapping of Shaffer was followed.

Anderson (1968) restudied the drift relations in the Rock Island area and concluded that the evidence did not require advance of the Green River Lobe to the Mississippi River. He restricted the lobe to essentially the area originally indicated by Leighton.

In 1968, Leighton reviewed the Iowan problem in Iowa and Illinois and restated the evidence for an Iowan glaciation. He did not change his previous mapping and nomenclature.

The classification and nomenclature of the Wisconsinan drift of Illinois and Wisconsin as presently used in Illinois was discussed by Frye, Willman, and Black (1965) and Frye, Willman, Rubin, and Black (1968).

Summary

In the present study it was possible to differentiate eight mappable till units within the region beyond the position of the Bloomington-Marengo Moraine (fig. 2). Each of these till units is characterized by distinctive physical properties, texture, and mineral composition. The stratigraphic sequence of the tills and the typical grain-size and clay-mineral compositions for each unit and several phases are shown in figure 3. Figure 3 also shows the stratigraphic positions of the 15 radiocarbon dates from the region. The results of grain-size analyses of the Wisconsinan age tills are summarized graphically in figure 4, and those of the Illinoian age tills are summarized in figure 5. The clay-mineral analyses of the Wisconsinan age tills are summarized graphically in figure 6, and those of the Illinoian tills are summarized in figure 7.

On the basis of composition, all of the tills described in this region were deposited by glaciers advancing from the northeast or east and associated with the Green Bay and Lake Michigan Lobes. The high content of Devonian black shale and the very high illite content of Esmond and Sterling tills indicate that the depositing glaciers deeply eroded the floor of the central part of the Lake Michigan basin. In contrast, the scarcity of black shale and the lower illite and higher vermiculite contents of the Ogle, Winslow, and Argyle tills suggest an axial glacial flow pattern by way of Green Bay; the more intermediate compositions of the Bloomington-Marengo, Lee Center, and Capron tills suggest primary glacial scour along the western side of the Lake Michigan basin.

Although each of the till units are characterized by their compositions, the ages of the several tills are based on stratigraphic succession, radiocarbon dates, stratigraphy of the overlying loesses, and the soil profiles in the top of each unit. In this region it is particularly difficult to use soils for stratigraphic identification because the wide range in permeability of the tills, the range in compositions (including the dolomite content), and the dissected topography and thinness of the tills all tend to produce a wide variation in degree of development and mineral alteration.

Of even greater significance are the unusually intense episodes of erosion to which the region has been subjected. This region was virtually surrounded by glacial ice during early Woodfordian time when the Green River Lobe was at its maximum extent. This glacial configuration contributed to a climate that accentuated solifluction, sheet wash, and eolian scour and deposition. Similar, but probably less intense, conditions existed during late Altonian time, and perhaps during the building of the massive Bloomington Moraine.

At many localities, the Illinoian tills were deeply truncated and now contain young profiles overlain by Woodfordian loess. As a result, stratigraphic conclusions deduced from soils are based on those relatively scarce localities, generally on uplands, where the surface was not eroded and the primary, maximum profile is present.

The stratigraphy of the loesses above the tills has been of prime importance in establishing age relations. In the area mapped as Illinoian, the Roxana Silt of Altonian age has been found at many places resting on Sangamon Soil. In some places the Roxana is overlain by organic-rich Farmdale Silt as well as Peoria Loess. The Roxana Silt, as well as the Sangamon Soil, has been removed by erosion at many places within the area of Illinoian till. Although very patchy, the Roxana and Farmdale have the same stratigraphic relationship to the Sangamon Soil as in the type Illinoian area of central Illinois. The absence of Roxana and Farmdale

Silts from above the weathered surfaces of Capron and Argyle tills (which are overlain only by Peoria Loess) is consistent with the Altonian age of these tills, and the Richland Loess occurs on the Woodfordian age tills with no evidence of an intervening episode of soil formation.

Radiocarbon dates from organic silt below the Esmond till near Esmond show that the Dixon Lobe is an early Woodfordian drift, whereas other radiocarbon dates from the deposits overlying the Sterling till show that this till, of similar composition, is at least pre-late Altonian in age. The Capron till, bracketed by radiocarbon dates from the Farmdale Silt above and the Plano Silt below, is the youngest Altonian till in the region. Radiocarbon dates from above the Argyle till show that the till is older than 40,000 radiocarbon years B.P.; however, it overlies the Sterling till of youngest Illinoian age.

Within this region the tills are generally thin, and exposures showing a succession of superposed tills are few and widely separated. Nevertheless, the sequence of Woodfordian tills over Altonian tills over Illinoian tills is well demonstrated by core borings in the eastern part of this area and farther east. Surface exposures in the Dixon Lobe illustrate the sequence of Esmond till over Farmdale silts over Argyle till, and in Ogle and Winnebago Counties, exposures show Argyle till over Ogle till. Multiple tills were encountered in a few auger borings and in cuttings from several water wells drilled in the area of Illinoian tills. Because of the scarcity of multiple till exposures it was necessary to correlate the several tills by their compositions, soils, and loess stratigraphy into areas where superposition had been established. However, it was not possible to establish the relative ages of the three phases of Ogle till and the Winslow till.

The present mapping (fig. 2) indicates that the Altonian drifts are not as extensive as mapped by Shaffer (1956). Shaffer's mapping, until recently, was accepted in Geological Survey publications. The present map (fig. 2) shows that the tills west of the newly defined Wisconsinan boundary are Illinoian in age and that the Green River Lobe did not extend as far north or west as previously mapped. The present map (fig. 2) agrees with Leighton (1958) and Leighton and Brophy (1961, 1966) by showing that an Altonian lobe existed along the Pecatonica Valley and to the south, as originally concluded by Hershey (1895). It differs from Leighton and Brophy by including the Capron Ridge in the Winnebago (Altonian) rather than in the Shelbyville (Woodfordian). Southward from the Pecatonica Lobe, the present mapping differs with Leighton and Brophy (1961) in the placement of the Wisconsinan-Illinoian boundary, including the recognition of a Dixon Lobe, and in greatly reducing the western extent of the Green River Lobe. The Lee Center till of the Green River Lobe is correlated with the Shelbyville drift of central Illinois, whereas Leighton and Brophy (1961) classed the till of their Green River Lobe as Iowan.

DIFFERENTIATION OF TILLS

Lithology and Grain Size

The physical properties of tills, and particularly grain-size analyses of the less than 2-mm fraction, have been extensively used for indentifying and correlating till units during recent years (Kempton, 1963; Kempton and Hackett, 1968a, 1968b; Johnson, 1964) and have demonstrated the relative homogeneity of bodies of glacial

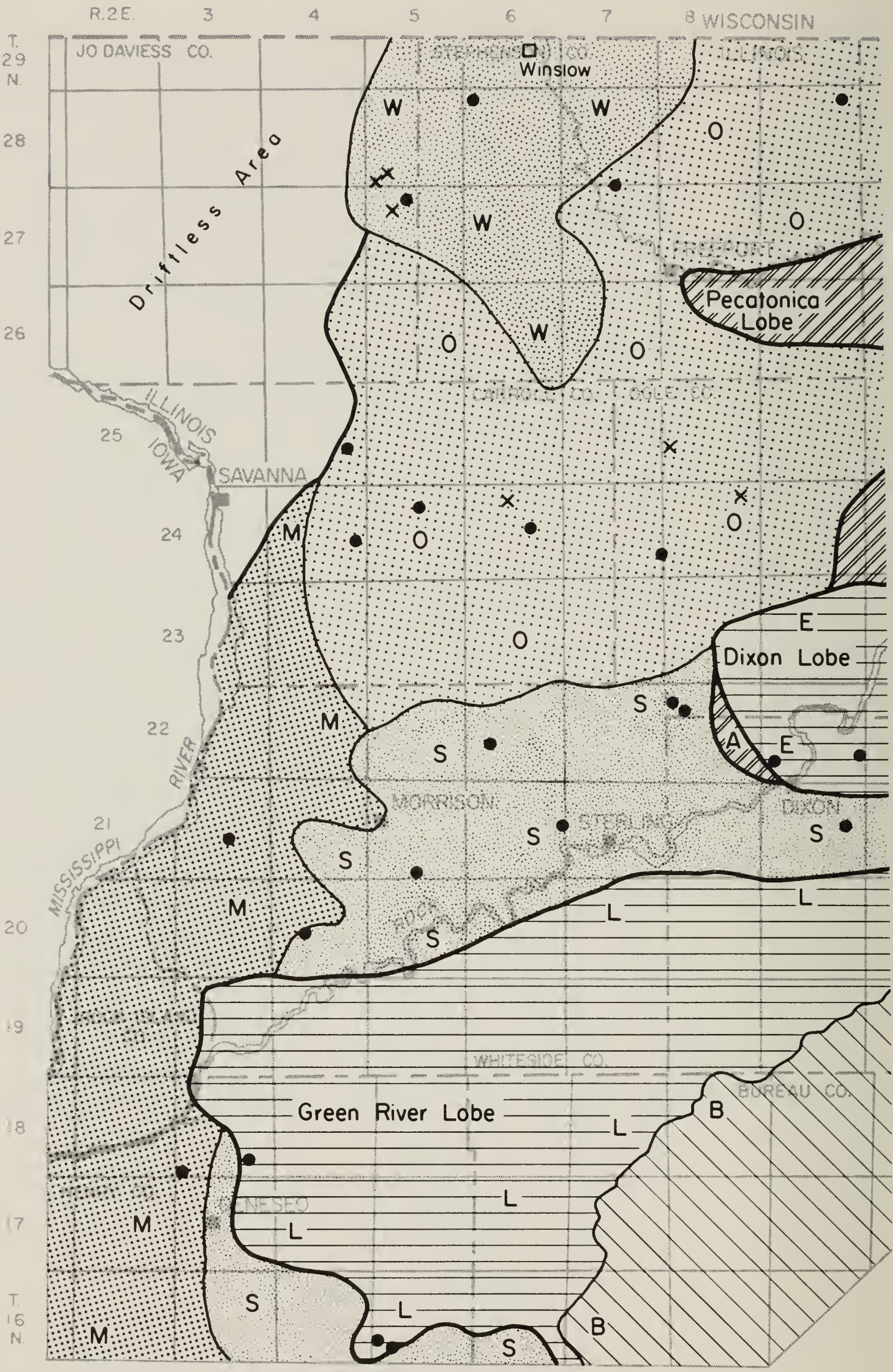
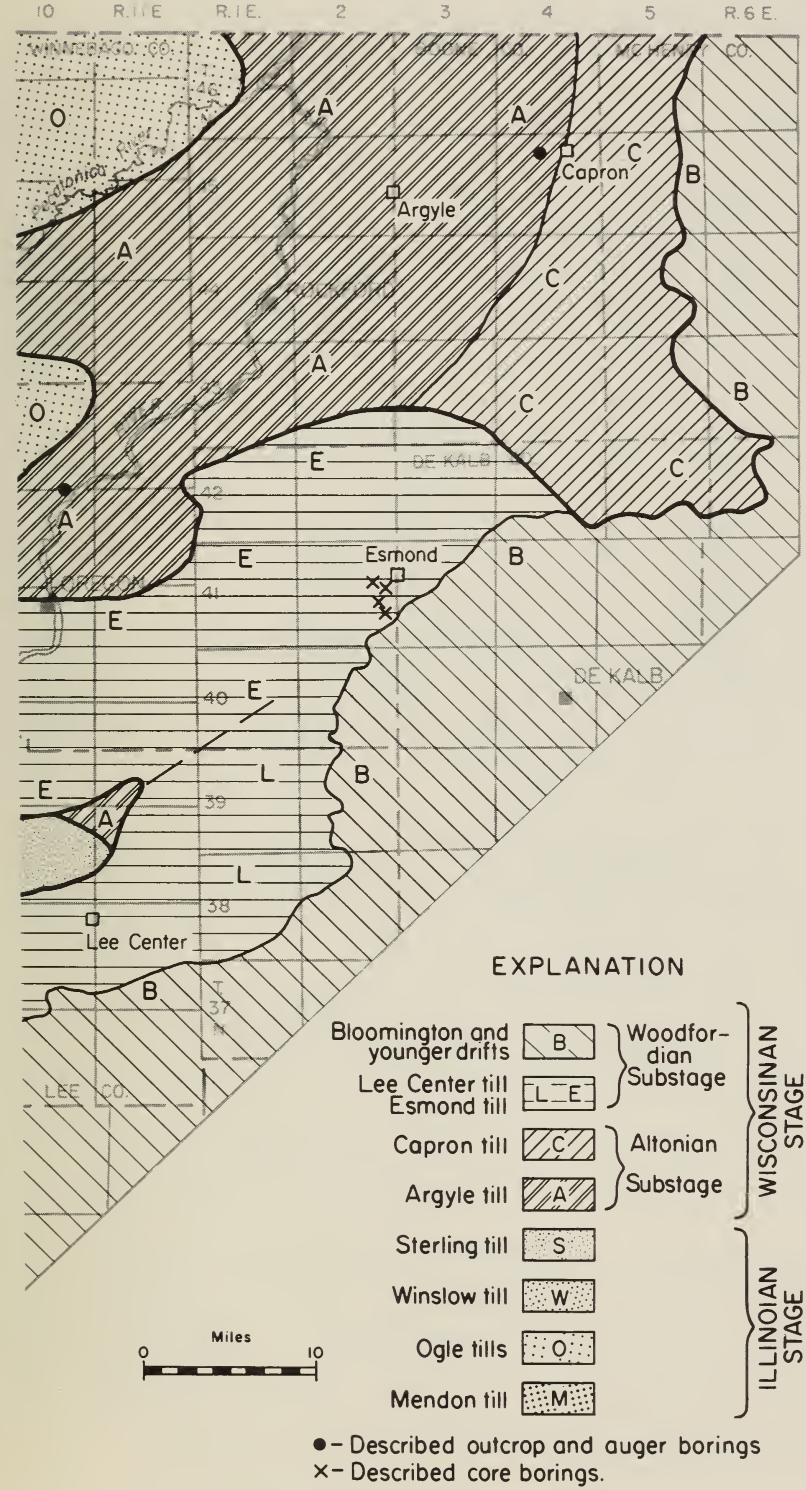


Figure 2 - Map of northwestern Illinois showing distribution of till units described
covered by thick loess,



in this report. At many places these tills have been removed by erosion, or are dune sand, or outwash.

STAGE	Radiocarbon years before present	Radiocarbon dates*	SUB-STAGE	NAMED UNITS		TYPICAL COMPOSITION†	
RECENT	5,000						
WISCONSINAN	10,000		VALDERAN				
WISCONSINAN		▲	TWO-CREEKAN			Alluvial silt, organic silt	
WISCONSINAN	15,000		WOODFORDIAN	(Peoria Loess); Wedron Fm: Bloomington and younger drifts (Richland Loess)		Glacial tills, outwash, loess	
WISCONSINAN	20,000		WOODFORDIAN	Esmond till	Lee Center till	Esmond[a]	Lee Center[b]
WISCONSINAN			WOODFORDIAN	Morton Loess		Silt, thin clay beds, sparse molluscan fauna	
WISCONSINAN	25,000	▲▲▲▲▲▲△	FARMDALIAN	Farmdale Silt		Silt, organic silt, peat	
WISCONSINAN	30,000	△▲	ALTONIAN	Winnebago Formation (Roxana Silt): Capron tills		Sandy phase, pinkish brown; Silty clay phase, pinkish brown	CM 37-50-13, G 43-33-24; CM 29-58-13, G 25-43-32
WISCONSINAN	35,000–40,000	▲△△▲▲	ALTONIAN	Winnebago Formation (Roxana Silt): Plano Silt		Organic silt, silt, peat	
WISCONSINAN	45,000		ALTONIAN	Winnebago Formation: Argyle till		Pinkish brown "salmon" to reddish gray	CM 23-62-15, G 54-31-15
WISCONSINAN	50,000 – ? 75,000		ALTONIAN	Drifts in subsurface east of map area		Glacial tills, outwash, silts	
SANGAMONIAN				Sangamon Soil and Accretion-gley		Clay, silt, organic silt, pebbles; *in-situ* soil developed in till	
ILLINOIAN			BUFFALO HART	Sterling till		Yellowish brown to gray	CM 7-81-12, G 25-45-30
ILLINOIAN			JACKSONVILLE	Winslow till	Ogle tills	Winslow;[c] Subsurface CM 12-65-23	Ogle;[d]
ILLINOIAN			LIMAN	Mendon till		CM 42-34-24, G 38-40-22	

* Radiocarbon dates from Northern Illinois
▲ Finite date
△ "Greater than" date

† CM 6-81-13 = Clay minerals, percent montmorillonite - illite - chlorite plus kaolinite
G 37-38-25 = Grain size, percent sand - silt - clay

a Esmond CM 6-81-13
Yellowish brn silty phase G 24-43-33
to gray silty clay phase G 13-40-47

b Lee Center CM 13-67-20
Pinkish brn to pinkish gray G 37-38-25

c Winslow CM 37-52-11
Brown to brownish gray G 17-43-40

d Ogle CM 60-29-11
Yellow-tan to CM 37-48-15
tan-gray CM 22-68-10
G 32-45-23

Figure 3 - Classification of Pleistocene stratigraphic units in northwestern Illinois showing radiocarbon dates and typical compositions.

till over rather large areas. Such data are particularly valuable when the number of analyses is great enough to define the range of grain size as well as establish the medians. In this region more than 800 laboratory determinations have been made of sand-silt-clay percentages by hydrometer and sieving methods, and a larger number of observations have been made of till color and of the content of pebbles and coarser materials.

Some of the units of till are quite homogeneous throughout their extent (e.g., the Bloomington-Marengo ranges no more than ± 5 percent from 37 percent sand, 38 percent silt, and 25 percent clay within the region), but in others the composition differs from one geographic area to another (e.g., Ogle tills) or includes several distinctly different grain-size compositions in stratigraphic superposition (Esmond and Capron tills). As the subdivisions of the Esmond and Capron tills are not gradational with one another but rather appear to have consistent relationships, they are considered phases of the till unit. The grain size of each of the several tills of the region is shown graphically by triangular diagrams in figures 4 and 5, and the typical composition of each of the tills and their several phases are given on the chart in figure 3.

Because the grain size of a till is the result of both the regimen of the glacier and the source rocks over which the glacier moved, the sand-silt-clay percentages are not an infallible identification of any individual till. Rather, this is only one of the many properties that can be used to categorize the deposits. Grain-size analysis of the till matrix permits grouping the tills of northwestern Illinois into three general categories. First, the very sandy tills include the Argyle and the sandy Ogle. Second, the sandy, silty tills include the Bloomington-Marengo, Lee Center, Mendon, silty Ogle, and coarser phase of the Capron. Third, the clayey, silty tills include the Esmond, Winslow, and clayey phases of the Capron and Sterling.

A lithologic characteristic of till, readily usable both in the field and in subsurface studies, is color. Although no two tills have exactly the same color, they can be roughly placed in three color categories: the gray tills, which include the Esmond, Sterling, and Mendon; the tan, gray-tan, and brownish gray tills, which include the Lee Center, Ogle, and Winslow; and the pink, red, and pinkish gray tills, which include the Argyle, Bloomington-Marengo, and Capron.

Another lithologic characteristic that permits differentiation of the tills is the percentage of pebbles and cobbles in the total till mass. Here, again, we can arrange the tills of northwestern Illinois into three categories. In the first, the Argyle till, the sandiest of all the tills of the region, contains a significantly higher percentage of pebbles and cobbles than the other tills. In the second, tills that are only moderately pebbly and cobbly include the Bloomington-Marengo, Capron, Lee Center, Mendon, and Ogle. In the third are the tills with the lowest percentage of pebbles and cobbles, including the clayey tills—the Esmond, Sterling, and Winslow.

Other characteristics that are helpful in differentiating the many units include the prominent jointing and the oxidized joint surfaces in the older tills, the greater compaction and density of the older Illinoian tills, the exceptionally loose, friable, unstructured character of the Argyle till, and the red color of the Marengo till. Also, some of the till units grouped together in the preceding categories have other differences that permit a more detailed subdivision in many places.

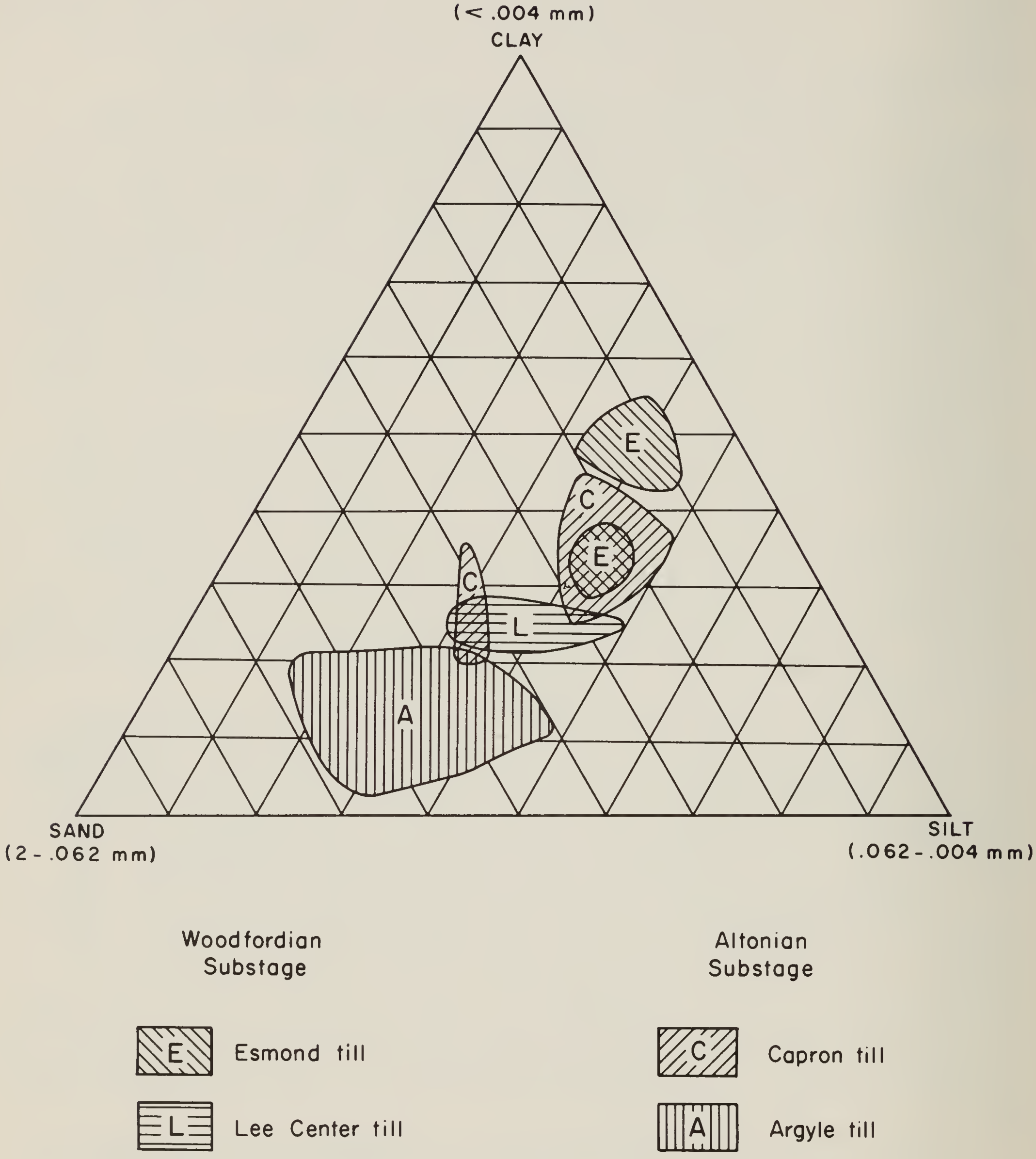


Figure 4 - Triangular diagram showing grain sizes of the less than 2-mm fraction of Wisconsinan tills in northwestern Illinois.

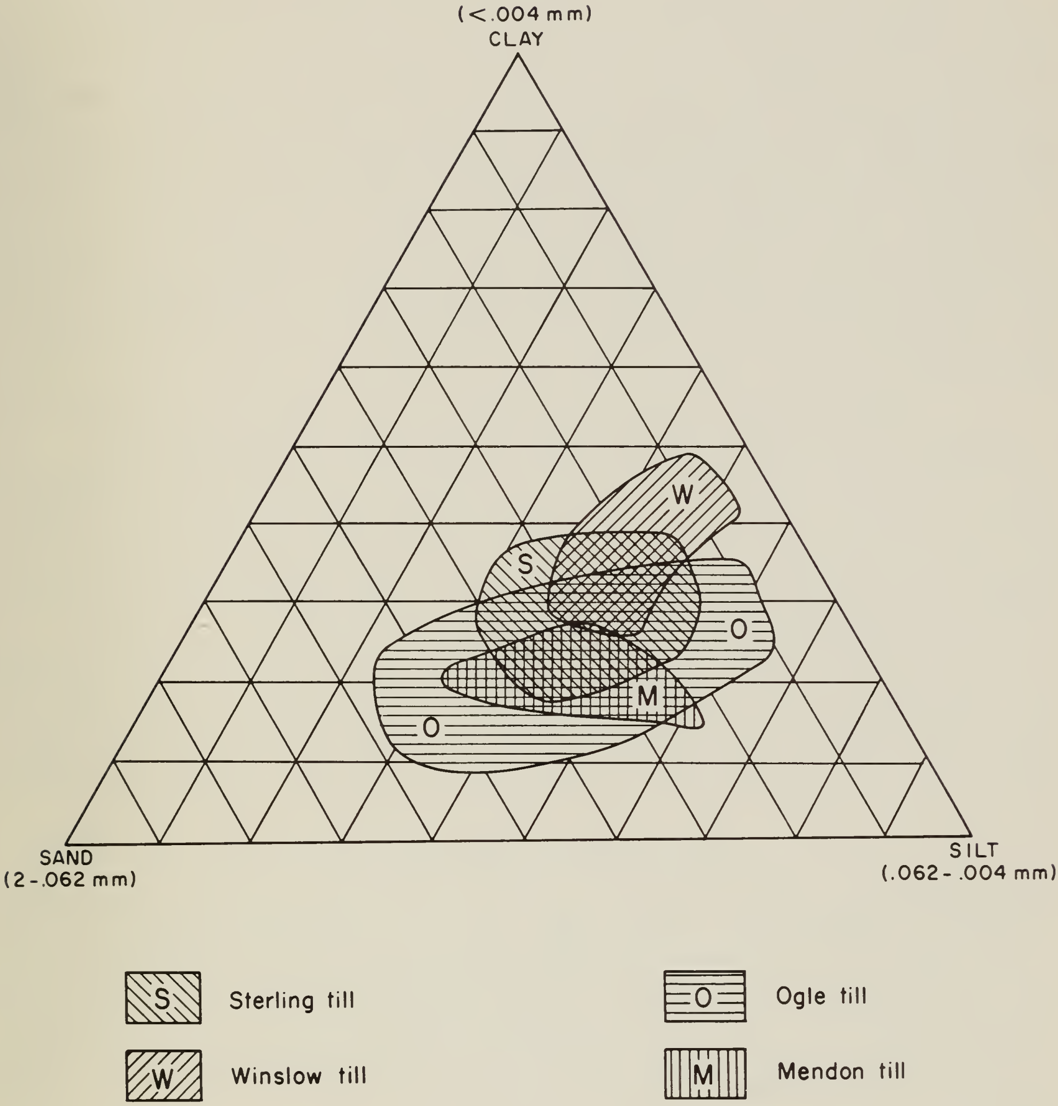


Figure 5 - Triangular diagram showing grain sizes of the less than 2-mm fraction of Illinoian tills in northwestern Illinois.

Mineral Compositions

For more than a decade the Illinois State Geological Survey has been using mineral compositions as a means of identifying and correlating units of till and loess and for evaluating the degree of development of soil profiles (Frye, Glass, and Willman, 1962, 1968; Glass, Frye, and Willman, 1964, 1968; Frye, Willman, and Glass, 1960, 1964; Willman, Glass, and Frye, 1963, 1966). The clay minerals in the tills of northwestern Illinois are complex assemblages of four primary clay minerals—montmorillonite, illite, chlorite, and kaolinite—and the secondary clay mineral, vermiculite, formed as an alteration product of both illite and chlorite. The vermiculite is most difficult to evaluate or quantify because it occurs in all stages of alteration through complex mixed-lattice clay minerals to material that expands with ethylene glycol treatment and is not distinquished from montmorillonite. In this report, the terms montmorillonite and vermiculite refer to specific clay minerals, whereas the term expandable clay minerals refers to mixtures of montmorillonite and vermiculite.

In order to use clay-mineral compositions in a meaningful way for the correlation of till units and the evaluation of soil profiles, it is necessary to consider the type, rate, and depth of mineral alteration caused by weathering. The most sensitive of the clay minerals is chlorite; its alteration starts with the oxidation of the deposit. Appreciable alteration may occur, particularly of the iron-rich varieties, before the leaching of calcite begins. Iron-rich chlorites readily alter to vermiculite products, whereas the more magnesium-rich chlorites alter to heterogeneous swelling materials. Alteration of chlorite in the highly permeable sandy till (Argyle till) has been detected to depths of as much as 25 feet below the till surface. Illite is much more resistant to alteration by weathering. The illite alters to vermiculite and expandable clay minerals, and thus its loss is accompanied by increase in expandable types. Within uneroded primary soil profiles on Woodfordian age tills (less than 18,000 radiocarbon years B.P.), little if any illite alteration is detected. In the Altonian age tills, illite alteration is limited to the B_2-zone in Capron tills, whereas it occurs throughout the entire B-zone in the Argyle till. Below the accretion-gleys on the Illinoian age Sterling and Mendon tills, illite alteration has proceeded downward to as much as $2\frac{1}{2}$ feet into the CL-zone (leached C-zone) of the till. Illite alteration is not as deep below the B-zones of in-situ soils on the Illinoian tills as it is below the accretion-gley.

Pedogenesis of clay minerals occurs in accretion-gleys and the A- and B_1-zones of some in-situ profiles. In the accretion-gleys, well ordered montmorillonite may make up as much as 90 percent of the clay minerals present, and pedogenic vermiculite is also commonly present. In the A-zones of some in-situ profiles, pedogenic aluminum interlayers serve to increase the apparent percentage of vermiculite.

Clay-mineral analyses for the differentiation and correlation of tills were made on calcareous samples. Oxidized material was used where it was impossible to secure unoxidized material. Nearly 400 clay-mineral analyses were made from calcareous till samples collected from outcrops and auger borings, and more than 500 analyses were made of calcareous till samples from core borings. The results of these analyses are summarized on the triangular diagrams in figures 6 and 7. These diagrams show the ranges in clay-mineral composition, and the median value for each till is listed in figure 3. In addition, about 200 clay-mineral analyses were made on samples of the soil profiles above the tills, and more than 500 analyses were made to assist in the identification of the stratigraphy of the overlying loesses and sands.

In interpreting the significance of the plots in the triangular diagrams, several features become immediately apparent. The Esmond and Sterling tills, both typified by high percentages of illite and resembling the composition of the pre-Pennsylvanian shales of the region, are clearly distinguished from all of the other tills but cannot be distinguished from one another on the basis of clay-mineral composition. A second grouping of compositions includes Bloomington-Marengo, Lee Center, Capron, Argyle, Winslow, and one of the Ogle tills. Although the ranges of the composition of each of these tills are somewhat different, they significantly overlap and all are characterized by moderately high percentages of illite. Alteration of the iron-rich chlorite gives them progressively higher percentages of expandable clay minerals as weathering proceeds. A third grouping of compositions includes Mendon and one of the Ogle tills. The Mendon generally is distinguished from all other tills by its much higher percentage of montmorillonite combined with the highest percentages of kaolinite. In local areas where the kaolinite content is lower, the Mendon composition resembles one of the Ogle tills. Some samples of Ogle till, erratic in geographic occurrence, have an unusual till composition characterized by very high percentages of montmorillonite.

The carbonate minerals in the matrix of these tills were also evaluated semi-quantitatively by X-ray diffraction analyses. Most of these tills show significantly more dolomite than calcite. However, in both the Capron and Argyle tills, the calcite is higher than in any of the other tills studied and in some samples is equal to or exceeds the amount of dolomite. This is true in the less than 2-micron fraction in spite of the dominance of dolomite in the pebble and cobble fractions.

Below the Illinoian tills, Kansan till (Willman, Glass, and Frye, 1963) occurs widely in the southwestern part of this region. The composition of the Kansan till, derived from a western source, makes it readily separable from the Illinoian tills. The Kansan is characterized by high montmorillonite content (typically more than 60 percent), low illite content (about 15 percent), more kaolinite plus chlorite than illite, and more calcite than dolomite.

Soil Profiles and Their Significance

Soils of various types have been used for the subdivision and correlation of glacial deposits for nearly a century. They include in-situ profiles (produced by the alteration of previously deposited rock and mineral materials by the action of weather and organisms), accretion-gley soils (produced by the slow accumulation of sediments in an undrained or poorly drained situation), and depositional organic soils and peats (surficial deposits formed by the accumulation of organic debris with varying admixtures of silt and clay). Where they are buried in a succession of sediments, each of these soil types furnishes critical information for stratigraphic interpretations. The in-situ profiles reflect the parent material, climate, flora, and time during which the surface was at or near erosional equilibrium; the accretion-gleys give an indication of time span of deposition by their thickness, extent, and degree of pedogenic mineral formation; and the organic soils and peats in the Wisconsinan give evidence of surface conditions and can be radiocarbon dated.

In order to fully utilize the evidence from soil stratigraphy, soil profiles were studied and sampled for clay-mineral analysis from the Marengo (Bloomington) westward across all of the units described and into the Driftless Area of Jo Daviess County. It was anticipated that the several ages of soils might be distinguished from one another by comparisons of morphology and by the degree and depth of mineral alteration, but this approach was only partly successful. Typical profiles

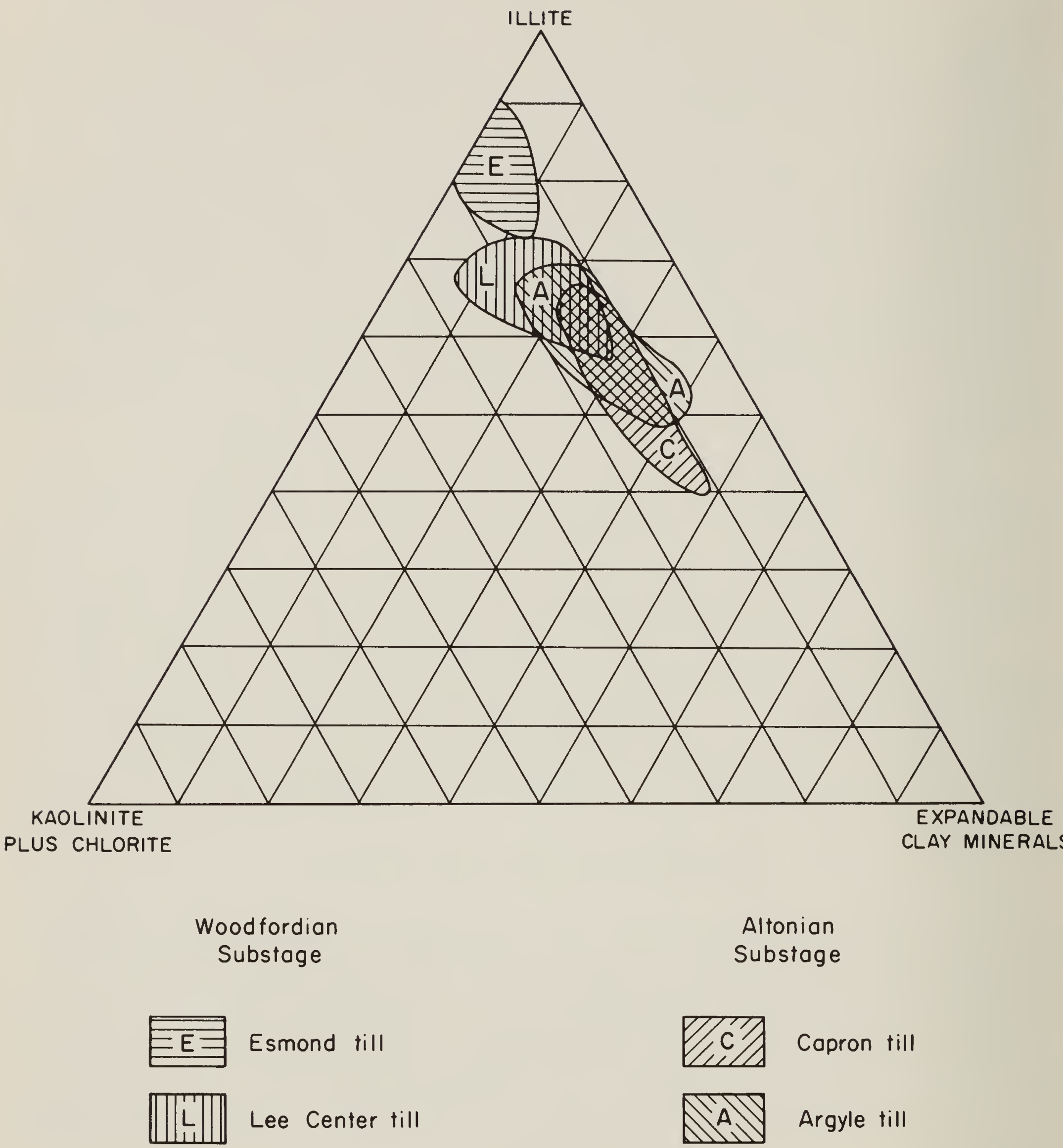


Figure 6 - Triangular diagram showing the clay-mineral composition of the less than 2-micron fraction of Wisconsinan tills in northwestern Illinois.

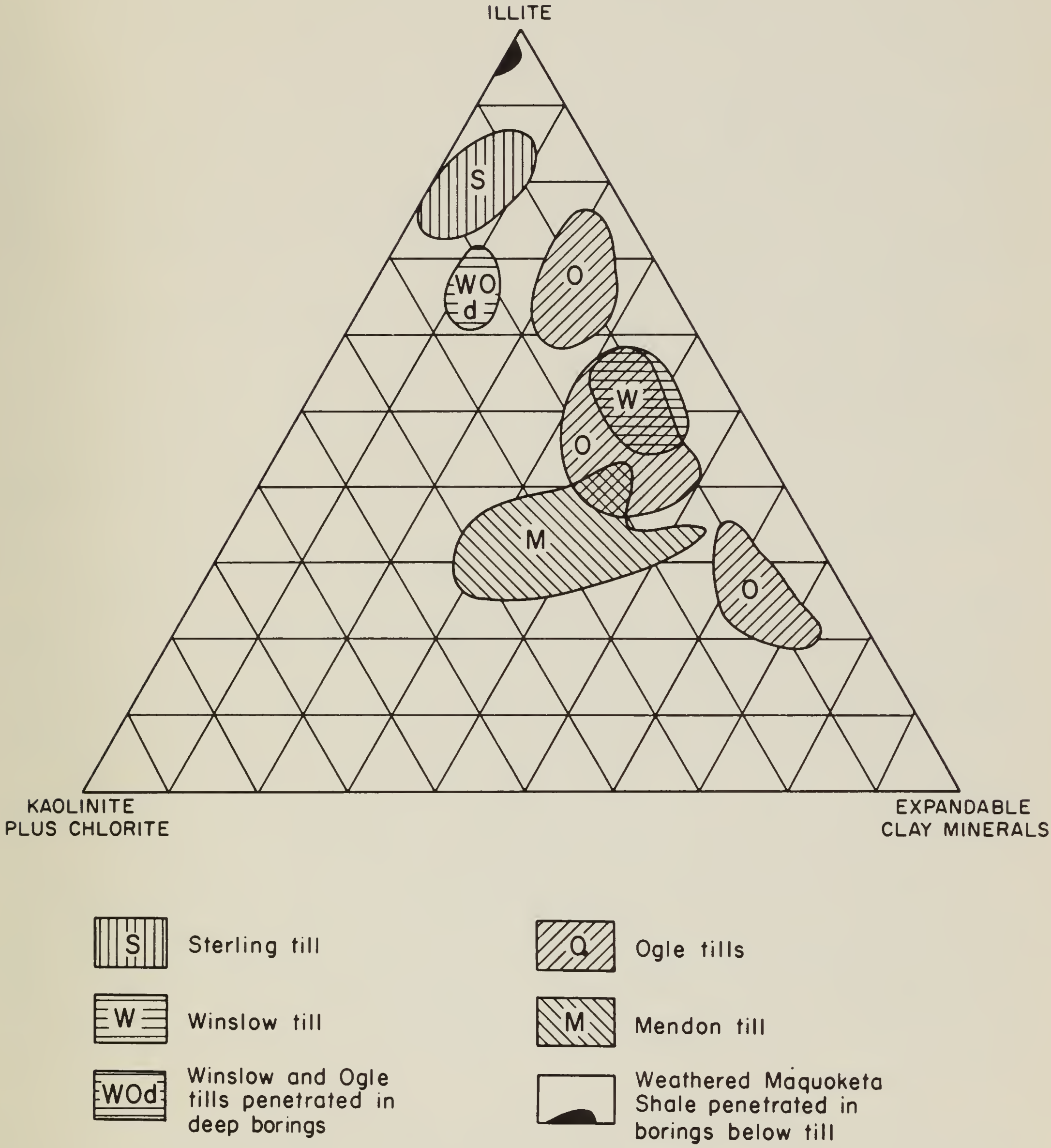


Figure 7 - Triangular diagram showing the clay-mineral composition of the less than 2-micron fraction of Illinoian tills in northwestern Illinois.

on each of the nine tills involved will be described. However, problems are caused by (1) the episode of extreme early Woodfordian erosional stripping that destroyed the indigenous profiles over large areas, and (2) the extreme contrast in parent materials, both in permeability and rock and mineral composition, that have given rise to profiles that cannot easily be contrasted with one another.

A profile on Marengo (Bloomington) till at the Marengo South Section will be considered first. Here, there is a sharply zoned thin profile, developed in pink, dolomitic till. Clay-mineral analyses show no illite loss, but chlorite progressively decreases upward with compensating formation of expandable clay minerals. The B-zone is only 11 inches thick with rotten dolomite pebbles at the base, and therefore no CL-zone is present. Any loess present in the top of the profile is included in the A-zone of the solum.

Soil profiles developed in the earliest of the Woodfordian tills (Esmond and Lee Center) were difficult to find. At the Carthage Section a soil is developed into the Esmond till through 2 feet of overlying loess. There is no indication that soil development occurred in the till prior to the deposition of the 2 feet of loess and, therefore, it is treated as a single profile. Here, there is less than $1\frac{1}{2}$ feet of leached till below the loess, classed as B_3 of the profile, and, although the chlorite loss is quite distinct upward, the loss of illite is minor. The Acme School Section shows a profile in the outwash and loess overlying the Lee Center till, but there is no illite loss or other evidence of soil development in the till.

The soil developed in the next older Capron till (the youngest of the Altonian tills) is well illustrated by the Capron North Section. Here, the loess above the till contains the surface soil profile, distinct from an underlying profile in the till, and the loess immediately above the till contains a trace of dolomite. The second soil developed in the till (Farmdale Soil) shows a 50 percent loss of illite in the uppermost one-half foot and is a well zoned, but thin, profile below the thin loess cover. A profile of particular interest is developed on slack water terrace deposits north of Pecatonica River (North Ridott School Section). The Farmdale Soil in late Altonian deposits occurs below Peoria Loess; the depth of leaching is only $1\frac{3}{4}$ feet, and the B-zone is less than 1-foot thick. Chlorite loss progressively increases upward through the profile, but there is no detectable illite loss.

The next older till unit is the mid-Altonian Argyle till. The Beaverton Section illustrates the Farmdale Soil profile in this till below Peoria Loess. This soil started its development during late Altonian time and continued through Farmdalian time, being terminated by the deposition of the overlying Peoria Loess. The surface soil profile in the overlying Peoria Loess is independent of the soil in the till. The Farmdale Soil in the till shows illite loss ranging from 12 to 65 percent upward through the B-zone with almost complete destruction of chlorite in the upper part of the B-zone.

Most of the other profiles developed in Argyle till that were studied in detail (Meridian Road No. 1 and No. 3, Rock Valley College, KSA-Tower, and Coolidge Creek East Sections) lacked a Peoria Loess cover of sufficient thickness to permit the differentiation of two independent profiles. In these profiles the illite loss in the B-zone ranged up to 50 to 60 percent. The B-zone in these profiles averaged 2 feet thick or less, and a CL-zone was either lacking or quite thin.

Within the area mapped as Argyle till, three profiles studied mineralogically (Harrison Southeast, Sheldon School, and Tunnison Creek Sections) contrast quite strongly with the above. In these profiles, a red B- or pseudo B-zone exceeds 6 feet thick, and illite loss of 35 to 50 percent occurs in the basal 1 foot. Above the basal 1 foot the clay minerals are so altered that a percentage calculation is not meaningful. These abnormally thick B-zones lack typical soil structure, clay skins, Mn–Fe pellets, and a CL-zone of appreciable thickness between the red zone and calcareous sandy till, or sand and gravel, below. However, they are leached of all carbonate rock types and have some clay accumulation, red color, and deeply weathered and disaggregated igneous rock cobbles. When we add to these factors the observation that at some places (Sheldon School and White Pigeon Sections) there is strong evidence that these soils have been overridden and truncated by a younger glacier, it seems reasonable to class these profiles with similar Sangamon Soil profiles developed in sandy Ogle till and outwash.

The youngest Illinoian till, the Sterling till, has both in-situ developed profiles and accretion-gley profiles. The accretion-gley profiles (Red Birch School and Coleta Sections) are similar to accretion-gleys on Illinoian tills in central Illinois (Willman, Glass, and Frye, 1966). The accretion-gley is 3 to 4 feet thick and occurs above $2\frac{1}{2}$ to 3 feet of leached till and below Roxana Silt, Farmdale Silt, and Peoria Loess. The percentage of expandable clay minerals sharply increases from about 12 percent in calcareous till to as much as 90 percent in the accretion-gley. Illite loss in the leached till below the accretion-gley is as much as 60 percent. The in-situ Sangamon Soils on Sterling till (Kewanee North and Woosung West Sections) are strongly developed, with 50 to 60 percent illite loss in the 2 to $3\frac{1}{4}$-foot thick B-zones. These profiles were developed before the deposition of the overlying Roxana Silt and Peoria Loess.

Indigenous profiles were not found on the Winslow till. The Christian Hollow Church Section was examined in detail, and here the surface of the till appears to have been truncated with the existing profile representing only development during Woodfordian time. The B-zone is quite thin and illite loss occurs only in the top two-thirds-foot of the profile. Within the Winslow till area, however, outwash that occurs unconformably above the till contains a Sangamon Soil with a B-zone showing a maximum thickness of 7 feet (Salem School Gravel Pit Section).

The Ogle till, in contrast to the Winslow, afforded a wide range of profiles for study. The normal in-situ Sangamon Soils display red-brown, well structured B-zones, 2 to 4 feet thick, with some Mn-Fe pellets and clay skins (Springdale School, Haldane West, Sylvan School, Damascus East, and Lanark Southeast and West Sections). Illite loss in the B-zone ranges from 40 to 60 percent; distinct CL-zones occur below the B-zones, and the soil is overlain by Roxana Silt and Peoria Loess. At a few localities (State Line and Ridott Sections) a thick, unstructured, brick-red "pseudo" B-zone is similar to those described farther east in the area of Argyle till (e.g., Harrison Southeast and Sheldon School Sections). These unusual profiles occur on sandy tills; they lack a thick or distinct CL-zone, and illite loss of as much as 70 percent occurs in the basal 1 foot of the B-zone.

An accretion-gley profile on Ogle till was penetrated in one boring (Lanark East core) below 5 feet of organic-rich Farmdale-Roxana Silt. Strongly developed Sangamon Soil on sand and gravel outwash and eskerine deposits related to Ogle till occurs at several places (Mt. Carroll South, Gravel Hill School, Hazelhurst Hills, and Freeport West Sections). Clay-mineral analyses of these profiles on sand and gravel show as much as 50 percent illite loss from the B_3-zone upward through the B_2-zone. The solum was from $3\frac{1}{2}$ to 5 feet thick, and a distinct zone of disaggregated and rotten dolomite cobbles was present below the B-zone. In some places (e.g., Mt. Carroll South Section) Roxana, Farmdale, and Peoria Loesses occur above the Sangamon Soil developed in sand and gravel. Within the area of Ogle till, at some places on the upland (e.g., Henze School Section), the Sangamon Soil is at least partly developed in bedrock with only a few igneous pebbles in a matrix of silt, clay, and red geest above disaggregated dolomite sand. The fact that the profile is Sangamon is shown by the overlying stratigraphy of Roxana Silt and Peoria Loess.

Sangamon Soil on Mendon till was studied mineralogically at only two localities in this area. At the Rapid City B Section the soil consists of $3\frac{1}{2}$ feet of accretion-gley resting on 3 feet of leached till, with significant illite loss in the leached till. The expandable clay-mineral content of the accretion-gley ranges up to 80 percent. In the secondarily oxidized accretion-gley, chlorite is absent and goethite and lepidocrocite are present. This soil is unusual because it has a strongly developed iron-pan, and an additional iron-pan occurs in the overlying Farmdale Silt. An in-situ profile in Mendon till and thin Loveland Silt was studied at the Morrison Section, and a profile in Loveland Loess was studied at the Mt. Carroll North Section.

The soil profiles that have been used to characterize the "typical" soil development on each of the several tills occur in situations where there has been no more than slight erosional truncation of the till since its deposition. Uneroded situations are commonly found on Woodfordian tills, but on the older tills of this region, soils dating back to the period immediately following till deposition are quite rare. Their scarcity in north-central and northwestern Illinois is in sharp contrast to their common occurrence in central and south-central Illinois. In central Illinois, Sangamon Soil (both in-situ profiles and accretion-gleys) commonly occurs in the top of Illinoian till overlain by a succession of Roxana and Peoria Loesses, or by younger tills and loesses. The extreme scarcity of well developed Sangamon Soil in northwestern Illinois has been a major factor in the historic difficulty of determining the age and correlation of the tills in this region, and, therefore, the genetic reasons for their relative absence must be briefly considered.

At least three contributing factors have caused the widespread erosional truncation of Sangamon Soil in the area of northwestern Illinois north of the Green River Lowland: first, the relatively greater local relief and degree of topographic dissection prior to glaciation; second, the relative thinness of the till sheets, which left them as surface mantles on a pre-existing topography; and third, the unusual climatic regimen of the region during early Woodfordian time.

Of these three factors, the third needs explanation. The geographic distribution of glaciers during early Woodfordian time (20,000-18,000 radiocarbon years B.P.) shows that a glacial lobe extended westward, south of this area, to Rock Island County, Illinois (fig. 2). Continental glaciers also extended westward across southern Wisconsin and northward across Wisconsin and Minnesota. West of the region, a glacial lobe extended southward through north-central Iowa. In other words, this region was surrounded, nearly on four sides, by glaciers, with an unglaciated corridor extending across eastern Iowa. The climatic environment of northwestern Illinois must have contrasted strongly with the climatic regimen south of the Green River Lobe in central Illinois and caused a period of intensive destruction of vegetation, solifluction, and slope erosion in the part of the terrain that already consisted largely of slopes.

The evidence is also clear that this rather brief episode of intensive erosion by solifluction and sheet wash was accompanied and immediately followed by an episode of intense and exceptional eolian scour and deposition. The effects of the eolian activity are clearly shown in the areas of WNW-ESE aligned topography, locally called "paha" areas, prominently developed in Whiteside and Carroll Counties. In the paha areas, Peoria Loess of early Woodfordian age, or eolian sand interzoned with Peoria Loess, or eolian sand, rests directly on thin lag gravel on the truncated surface of Illinoian till (e.g., Pink Prairie Section). Augering in the paha areas revealed no preserved Sangamon Soil but demonstrated that the linear ridges were composed of as much as 40 feet or more of wind-deposited silt and sand. The troughs between the ridges contain only thin eolian deposits above till or bedrock. These data indicate eolian scour of the Illinoian tills before the extensive deposition of Peoria Loess, and the absence not only of the Sangamon Soil but also of Roxana and Farmdale Silts gives rise to a deceptive stratigraphy.

The area of thin loess in northwestern Whiteside and southwestern Carroll Counties was interpreted by Ray and Watters (1961) and by Leighton (1968) as evidence for a tongue of a Wisconsinan glacier in this area. However, the thin loess rests on eolian sand interbedded with loess, and the underlying till has been correlated with the Illinoian on the basis of its composition.

Outside of the paha areas the presence of Farmdale Silt (e.g., Fenton Southwest and Haldane West Sections) directly on the truncated surface of Illinoian till suggests an earlier episode of erosional stripping during late Altonian time. A less intensive episode probably occurred during the building of the Bloomington and immediately succeeding moraines. Such an episode is suggested by the erratic distribution of thickness of the Peoria Loess.

The unusual erosional history of northwestern Illinois causes great difficulty in the use of soil stratigraphy as a means of identifying the several till sheets. At many places a profile occurs on the Illinoian tills that displays the characteristics of a mid-Woodfordian soil—and indeed it is, because it is the soil profile that developed after the episode of intensive early Woodfordian erosional stripping. This history has also locally produced colluvial wedges on slopes, with a moderate to strongly developed soil in the colluvium, which in turn rests on relatively unweathered till.

Stratigraphic Succession

Interpretation of the succession of glacial deposits in the region (fig. 3) has been developed by use of lithologic and mineralogic character of the tills, soil profiles, stratigraphy of the loess deposits overlying the tills, stratigraphic superposition of the several units (primarily derived from subsurface data), and radiocarbon dates. This region singularly lacks exposures showing a sequence of superposed tills, like those widely exposed in central Illinois. This lack, together with the limited usefulness of soil profiles and the very thin loess in parts of the region, has contributed to the difficulties of establishing a meaningful stratigraphic sequence. Furthermore, beyond the limit of the Bloomington-Marengo Moraine, physiographic criteria for glacial till separation and correlation by identifying and tracing moraines are of very minor use in this region.

Generally, a combination of grain-size and clay-mineral analyses serves to identify a particular till unit, but a few "pairs" of tills cannot be differentiated by these data. Of most importance is the differentiation of the Esmond till, of earliest Woodfordian age, from the Sterling till, of latest Illinoian age. As shown by the map (fig. 2), these tills are locally in adjacent areas, and, although the Argyle till of distinctly different composition underlies the Esmond till in much of the Dixon Lobe (e.g., Dixon Northwest and Grand Detour Sections), the Argyle till does not extend far beyond the limit of the Esmond. The age of the Esmond till is indicated by a radiocarbon date of 23,750 + 1050-950(I-2784) B.P. from organic silt from a core below the till (Greenway School Core 3). The Esmond till has a relatively weak soil profile and lacks overlying Roxana or Farmdale Silt. In contrast, dates above the Sterling till of 27,500 ± 500(ISGS-6) (McAllister School Section) and greater than 27,850 (ISGS-8) (Union School Section) show its pre-Farmdalian age. The Sterling till has a Sangamon Soil in its top overlain by Roxana Silt, Farmdale Silt, and Peoria Loess (Coleta, Emerson Quarry, Fenton Southwest, Red Birch School, and Woosung West Sections). These data serve to clearly differentiate these two tills even though their compositions are similar.

The geographic and stratigraphic relations of the Lee Center and Esmond tills suggest their approximate contemporaneity. Both tills have the same relationship to the Bloomington Moraine. The composition of the Lee Center till (Acme School and Moon School Sections) is similar to that of the Bloomington till, but is distinctly different from that of the Esmond. The two till types meet in a belt characterized by abundant outwash and thin till on bedrock along a northeast-southwest line in the vicinity of Rochelle. The Lee Center and Esmond are similar in physiographic development, relation to overlying loess stratigraphy, and soil profiles. The Lee Center till commonly overlies Sterling till.

Differentiation of the Capron tills from the Bloomington-Marengo above and the Argyle below is also critical because the Capron drift until recently has been included within the Woodfordian. This distinction is made by radiocarbon dates (Kempton, 1966; Kempton and Hackett, 1964, 1968b) from below Marengo till and above Capron tills of 23,000 + 2100-1950(I-2783), 25,300 ± 1100(I-1624), 25,600 ± 800(I-849), and 26,900 + 1600-1300(I-1625), and by other radiocarbon dates from the Plano Silt below Capron till and above Argyle till of 35,000 ± 2500(W-1450), 38,000 ± 3000(I-847), and 41,000 ± 1500(GrN.-4468). Also, below Marengo and Capron tills and above Sterling till is a date of 32,600 ± 520(GrN.-4408). These dates serve to establish that the Capron tills are pre-Farmdalian in age and are the youngest of the Altonian tills in north-central Illinois. They also establish that the Argyle till, below the Plano Silt, is a significantly older Altonian till that overlies the Sterling till, the youngest identifiable Illinoian till, as well as Ogle till (Byron West Section).

Even though these data serve to establish the sequence of the Argyle, Capron, Esmond-Lee Center, and Bloomington-Marengo tills within the Wisconsinan and above the Sangamon Soil, the relative position of the several Illinoian tills is not as clearly established. The Sterling till is the youngest of the Illinoian tills, as shown by its position above both Ogle and Mendon tills and its lithologic correlation southward with the type Buffalo Hart till of central Illinois. However, the relation of the several types of Ogle till to one another, and to the Winslow till, is still an unsettled question. The Winslow till is included within the mid-Illinoian because of the presence of a well developed Sangamon Soil in overlying outwash and of Roxana and Farmdale Silts below calcareous Peoria Loess above the till (Tiger Whip and Cross Road School Sections and Stockton cores). The Ogle and Winslow tills are grouped together as mid-Illinoian without an attempt to indicate relative stratigraphic positions.

The oldest Illinoian till of the region is the Mendon. This is indicated by its geographic position, its lithologic tracing southward to the type Mendon in Adams County, Illinois, and the sparse data suggesting its position below Ogle till. The presence of Kansan till below Mendon till is indicated by subsurface data in the western part of the region and by meager exposures (Otter Creek Section).

The general stratigraphic succession of the region has been described, but the changes from former mapping (fig. 2) should be briefly discussed. A striking modification, in part introduced on the geologic map of Illinois in 1967 (Willman and Frye, 1967), involves the western limit of the Woodfordian tills. The existence of the Dixon Lobe is required by the presence of Roxana and Farmdale Silts below Peoria Loess and above Sangamon accretion-gley in a belt between Dixon and Eldena (Red Birch School Section). The elimination of the Green River Lobe from its former mapped extension across northwestern Whiteside County is based on loess stratigraphy, the presence of Sangamon Soil, and radiocarbon dates (e.g., McAllister School, Emerson Quarry, Fenton Southwest, Union School, Woosung West, Coleta, and Morrison Sections). The western projection of the Green River Lobe to the Mississippi has been eliminated on the basis of a strongly developed Sangamon Soil in the "Garden Plain Esker" deposits, by the determination of typical Mendon till composition (Garden Plain West Section), and by the presence of Roxana and Farmdale Silts above the till and below thick, calcareous Peoria Loess (Bernard School Section).

The limit of Altonian till (earliest Wisconsinan) is sharply defined along the northern side of the Pecatonica Lobe at the Pecatonica River Valley. The Illinoian age of the till north of the valley is demonstrated by its composition, the Sangamon Soil, the overlying Roxana Silt below Peoria Loess (e. g., Henze School and Berlin School Sections), and the presence above Ogle till of Altonian age terrace deposits containing a Farmdale Soil below Peoria Loess (North Ridott School Section) along the northern side of the valley. The southern limit of the Pecatonica Lobe is not as sharply defined, but the presence of Argyle till over Sangamon Soil on Ogle till is demonstrated within the lobe (e.g., Sheldon School Section), and farther south the absence of Argyle till above Ogle till is shown by a group of localities (e.g., Collman School and Beuth School Sections, and Forreston cores). The position of this line may be changed as more detailed data become available. The western limit of the lobe is drawn between the area of Altonian kame topography with moderate to weakly developed soils east of Freeport (Doyle, 1965) and the area of strongly developed Sangamon Soil on outwash west of Freeport (Freeport West Section). The evidence of the strongly developed soils in outwash is supported by the composition of the tills and the presence of thick accretion-gley that yielded a radiocarbon date of more than 39,900(I-1962) (Follmer, 1967). South of the Pecatonica Lobe, the surface till is shown to be Illinoian in age by its composition, the presence of strongly developed Sangamon Soil, and the overlying Roxana Silt below Peoria Loess (Hazelhurst Hills, Gravel Hill School, Haldane West, and Lanark West Sections, and Forreston and Lanark cores).

DESCRIPTION OF TILLS

In northwestern Illinois, west of the prominent Bloomington-Marengo Moraine, several tills have been recognized, differentiated, and correlated on the basis of their physical properties and mineral composition. Each of these tills will be described as an informal lithologic unit, and, therefore, the word till is not capitalized. These tills generally lack distinctive physiographic expression and, thus, cannot be classed as morphostratigraphic units, nor are they formally defined rock-stratigraphic units. However, the age of each of the tills has been determined in relation to the standard time-stratigraphic sequence.

Illinoian Stage

Liman Substage

Mendon till.—The oldest Illinoian till of this region is correlated with the Mendon till of central western Illinois (Frye, Willman, and Glass, 1964) on the basis of physical tracing and similar mineral composition. The Mendon till consistently has a high montmorillonite content and is distinguished by the highest content of kaolinite and lowest content of illite (figs. 3, 7). At some localities (e.g., Albany South Section), a high kaolinite phase overlies a phase containing less kaolinite. The lower phase is similar to the high montmorillonite type of the Ogle till, but the latter occurs only in local areas. Although the Mendon till generally contains more dolomite than calcite, some samples contain about equal amounts.

The Mendon is a sandy, silty till (figs. 3, 5), generally neutral gray in color, and contains an intermediate amount of cobbles and pebbles. In outcrops it generally displays prominent joints and is tough and compact.

Jacksonville Substage

Ogle tills.—The Ogle tills are named for their occurrences in western Ogle County, and the Haldane West Section is the type locality. The stratigraphic position of Ogle till below Sterling till is suggested by water-well samples in the vicinity of Sterling, and its relation to the older Mendon till is indicated by geographic position and meager subsurface data. The composition data plotted on figure 7 show that four clay-mineral types are included within the Ogle and that clay-mineral compositions encountered in cores from the Ogle in western Ogle County and the Winslow in Jo Daviess County are similar, but differ from the other three types of clay-mineral compositions. The Winslow till, which is distinguished from the Ogle tills by its much higher clay content, has clay-mineral compositions similar to two of the Ogle tills.

For purposes of description, the four clay-mineral types within the Ogle tills are considered separately. One type of Ogle till is exposed in the Haldane West Section and is characterized by the highest percentage of illite (about 65 percent). This till is predominantly silty, gray-tan to tan in color, and contains an intermediate percentage of pebbles and cobbles. It is noticeably less compact and jointed than the Mendon till. The Haldane type occurs predominantly in northwestern Ogle County.

A second compositional type of Ogle till is illustrated by the Lanark East core boring. Here, the montmorillonite content (37 percent) is distinctly higher, and illite constitutes about 48 percent. This type is somewhat sandier than the till at Haldane and is brownish gray in color; in other regards it is similar to the till at Haldane. This type is generally present in northern Carroll County, northeastern Stephenson, and northwestern Winnebago Counties.

A third compositional type of Ogle till occurs on the northern side of the Pecatonica Valley in Stephenson and Winnebago Counties, in central and northern

Carroll County, and in south-central Stephenson County. This type is illustrated by the till at the Collman School Section and contains an exceptionally high percentage of montmorillonite (60 percent). In grain size and color this type resembles the till at Haldane.

A fourth compositional type was encountered in the core borings near Forreston. This till is characterized by low percentages of expandable clay minerals and high percentages of chlorite, but in grain size and physical properties it resembles the Haldane type till.

The compositional complexities of the Ogle tills, and the associated Winslow till, are not as yet explainable. Heavy mineral studies and much more closely spaced core drilling might show the genetic and stratigraphic relations of the several types. On the basis of present data, however, they are all placed within the Jacksonville Substage of the Illinoian.

Winslow till.—The Winslow till is named for its occurrence in roadcut exposures (SW$\frac{1}{4}$ SE$\frac{1}{4}$ SW$\frac{1}{4}$ Sec. 21, T. 29 N., R. 6 E.) west of Winslow, Stephenson County, and is well shown by the cores from three borings near Stockton. The mineral composition of the Winslow till from outcrop samples is similar to that of the Lanark type of the Ogle till (figs. 3, 7). The Winslow till, however, is the most clayey of the Illinoian tills (figs. 3, 5), is quite low in cobbles and pebbles, and is gray-tan in color. In the Stockton cores, the clay-mineral composition of the Winslow till is similar to that in the three cores from near Forreston.

Buffalo Hart Substage

Sterling till.—The Sterling till is named for its occurrence in the region of Sterling, Whiteside County, and is typically exposed in roadcuts along U. S. Highway 30, 3 miles east of Sterling, and in the Emerson Quarry Section. The extremely high illite content of the Sterling till (more than 80 percent) clearly sets it apart from all of the other Illinoian tills of the region (figs. 3, 7). The Sterling till occurs mainly in Whiteside and Lee Counties; it overlaps the Mendon and Ogle tills, and is overlapped (Greenway School cores) by the Argyle, Esmond, and Lee Center tills. It is a silty, clayey till (fig. 5) with an intermediate content of cobbles and pebbles, gray to dark gray in color, and well compacted and jointed. On the basis of composition, the Sterling is indistinguishable from the Esmond till and has been included within the Wisconsinan Stage in many earlier reports.

Wisconsinan Stage

Altonian Substage

Winnebago Formation

The name Winnebago drift was proposed (Frye and Willman, 1960) for the drift previously called Farmdale (Shaffer, 1956). The name is derived from Winnebago County in which Altonian age till is extensively exposed. The Winnebago is here defined as a formation including the tills and associated deposits occurring below the Farmdale Silt and above the Sangamon Soil in northern Illinois. The type locality is designated as the Rock Valley College Section and adjacent exposures and Northwest Tollway borings No. 2 and No. 5 (Kempton, 1963, p. 38). The formation and its subdivisions are described from deep core borings in Kane and McHenry Counties (Kempton, 1965, p. C-S-3).

Argyle till.—The Argyle till is named from exposures in the vicinity of Argyle, on the eastern line of Winnebago County. It is typically exposed in the Rock Valley College, Meridian Road, and Beaverton Sections. The mineral composition (fig. 6) is characterized by moderately high percentages of illite (62 percent), and the till is distinguished by its high sand content (54 percent) (fig. 4), cobbly and pebbly character, and salmon pink or pinkish gray to reddish brown color. It is quite loosely compacted and almost completely lacks structure. Although calcite is quite abundant in the clay fraction, dolomite is predominant within the cobbles and pebbles. It has a distinctly ridged topography with drumlinoid forms trending in a northeast to southwest direction.

Capron till.—The Capron till is named from its occurrences in the prominent ridge trending north-south through Capron, Boone County. The till is typically exposed at the Capron North Section and in roadcuts in the NW$\frac{1}{4}$ NW$\frac{1}{4}$ NW$\frac{1}{4}$ Sec. 19, T. 45 N., R. 5 E., McHenry County. There are two compositional phases included within the Capron, an upper sandy phase and a lower silty phase (figs. 3, 4). The clay-mineral compositions of the two phases (figs. 3, 6) are also somewhat different as the sandy unit contains more expandable clay minerals and less illite than the silty phase, whereas the silty phase contains somewhat more calcite in the clay fraction. The sandy phase is generally limited to the eastern edge of Boone County and adjacent McHenry County. The Capron till has an intermediate content of cobbles and pebbles, is pinkish gray to reddish brown in color, and (particularly the sandy phase) is moderately compact and blocky.

Woodfordian Substage

Wedron Formation

The Wedron Formation was defined (Frye, Willman, Rubin, and Black, 1968) as including all of the Woodfordian tills and associated deposits above the Morton Loess and below the Richland Loess.

Esmond till.—The Esmond till is named for the village of Esmond in DeKalb County. In the vicinity of Esmond it has been studied in detail in the Greenway School cores and is typically exposed in roadcuts in the NW$\frac{1}{4}$ SW$\frac{1}{4}$ NW$\frac{1}{4}$ Sec. 27, T. 43 N., R. 2 E., Winnebago County, and the Dixon North and Grand Detour Sections. The Esmond till in the Dixon Lobe and in eastern Ogle County has been called Shelbyville because of its stratigraphic position as the earliest Woodfordian, but it seems undesirable to extend the name Shelbyville north of the Green River Lobe. The Esmond till has two phases (fig. 4), an upper silty phase and a lower silty clay phase, both of which are characterized by very high illite content (fig. 6). The clay-mineral composition of the Esmond serves to distinguish it from the other tills of the region, except for the Sterling. The Esmond till is gray in color and contains a relatively low content of cobbles and pebbles. The till is relatively compact and indistinctly blocky; it generally lacks a distinctive end moraine, but at many places displays well defined hummocky glacial topography.

Lee Center till.—The Lee Center till is named for the village of Lee Center in central Lee County, located on the back slope of the subdued morainic ridge that marks the northern limit of the till. The Lee Center is the till of the Green River Lobe (fig. 2), but throughout most of the lobe, this till has been eroded or is covered by surficial deposits of outwash sand and gravel and eolian dune sands of Woodfordian age. The Lee Center till was studied along the morainic ridge in Lee County, in the Lee No. 3 core boring, at several localities near the front of the Bloomington Moraine in southern Lee and northwestern Bureau Counties, and in the area of subdued hummocky topography in eastern Henry County (Acme School and Moon School Sections). The boundary of the northwestern extent of the Green River Lobe is drawn through an area of outwash that is limited to the north and west by the presence of Illinoian tills. The Lee Center is a sandy, silty (fig. 4), tan-gray to pinkish gray till, with intermediate content of cobbles and pebbles. Unweathered Lee Center till is moderately high in illite and low in expandable clay minerals (fig. 6).

Bloomington-Marengo and younger drifts.—The prominent Bloomington and Marengo Moraines, which rise as much as 250 feet above the adjacent surface, serve as a sharp boundary between the generally subdued glacial and erosional topography described here and the strongly developed morainic topography to the east and south. The Bloomington-Marengo tills are characterized by their pink to red color, but in mineral and textural composition they are indistinguishable from the Lee Center till.

CORRELATION WITH SUBSURFACE UNITS IN NORTHEASTERN ILLINOIS

Recognition of multiple tills within the Winnebago Formation came from the study of cores obtained from borings for the Northwest Tollway (Kempton, 1963) across southwestern McHenry, southern Boone, and eastern Winnebago Counties. Cores from a drilling program sponsored by the Northeastern Illinois Planning Commission (Hackett and Hughes, 1965) provided regional stratigraphic information that suggested three distinct glacial episodes separated by beds of silt and peat within the Winnebago. Radiocarbon dates from two peat beds established the presence of a late Altonian glaciation older than 27,000 and younger than 35,000 radiocarbon years B. P. (Kempton and Hackett, 1968a), and subsurface studies related this upper Winnebago unit to the surface drift (Capron till) of eastern and southeastern Boone County (fig. 2). Kempton and Hackett (1968b) established the subsurface relations and surface boundaries of the middle Winnebago till unit (Argyle till) in western Boone and Winnebago Counties. Thus, the subsurface units of northeastern Illinois may be correlated with the till units described from surface exposures and auger borings.

In the subsurface, early Woodfordian till overlies Farmdale deposits (organic silt and peat) that have yielded radiocarbon dates ranging between 23,000 and 26,900 B.P. Physical evidence indicates that the till of the Dixon Lobe (Esmond) is only slightly older than the till of the prominent Bloomington-Marengo Moraine, but, thus far, little evidence has been found for the occurrence of Esmond till in the subsurface below Bloomington till. The Lee Center till is lithologically and mineralogically similar to the Bloomington till and cannot be differentiated from the Bloomington in the subsurface.

In the subsurface, the Capron till is present below the Farmdale Silt and above the Plano Silt throughout most of McHenry, Kane, and DeKalb Counties. Two compositional phases of this till are locally present. The lower phase of the Capron till (fig. 3) extends southwestward under Esmond till at least to Greenway School (cores 4 and 5) in east-central Ogle County and as far southeast as northern Kendall County.

The distinctive sandy texture and mineral composition of Argyle till is easily recognized in the subsurface, and this till is present in several of the deep borings in northeastern Illinois. The southern limit of subsurface occurrence of the Argyle till is in southern Kane County.

Several tills below the Argyle till in the subsurface of northeastern Illinois have been differentiated. Because of the absence of weathering profiles these tills have been considered Altonian in age (Kempton and Hackett, 1968b). One of these tills, on the basis of its clay-mineral composition and lithologic character, is correlated now with the Sterling till and is considered latest Illinoian in age. Between the Argyle and the Sterling tills are two and possibly three distinguishable clayey silt and silty clay tills, which have been identified throughout much of Kane and McHenry Counties but have not been observed in exposures and presumably were overlapped completely by the Argyle till. Their stratigraphic position and similar color, clay-mineral composition, and relatively high calcite content, all place these tills within the Altonian.

One of the tills within the lower Winnebago unit described by Kempton and Hackett (1968a) from the subsurface (a sandy, silty till) occurs below the Sterling and may correlate with one of the phases of the Ogle till. Within the more than 450-foot deep fill of the Troy Bedrock Valley, a thick sequence of reddish brown till (Kempton and Hackett, 1968b) occurs below the till now correlated with the Sterling. There is no known surface till with which it can be correlated, and its age is early Illinoian or older.

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SELECTED GEOLOGIC SECTIONS

The following are selected geologic sections from outcrop exposures, hand auger holes, and core borings, from which samples were collected for this study. Samples were also used from many additional outcrops and borings. The sample numbers in the P-series are the numbers used in the Illinois State Geological Survey collections. Core samples are identified by a core number followed by a sample number. The cores consist largely of segments representing intervals of 1½ feet, separated by 1-foot intervals not sampled. The segments are numbered from the top down. Subdivisions of each segment are identified by T for top, M for middle, and B for base. The absence of a letter indicates that the sample is from the middle part or represents all of the core segment. Analytical data for individual samples are available at the Geological Survey. The sections are arranged alphabetically by name.

ACME SCHOOL SECTION

Roadcut and auger hole in NE¼ NE¼ SW¼ Sec. 25, T. 16 N., R. 4 E., Henry County, Illinois (1968)

Thickness (feet)

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Richland Loess

5. Loess, leached, tan-brown, massive, surface soil in top. 4.0

Wedron Formation

4. Gravel and sand, leached, brown and tan with black splotches and gray streaks; some clay in upper part and some pellets and staining of Mn-Fe; appears to be downward continuation of soil developed in the loess above (P-6345 to P-6343 downward through lower half). 3.2
3. Clay, leached, olive-gray to gray-tan, laminated, some carbonate in lower half (P-6342). 0.4
2. Silt, uniform, calcareous, tan with streaks of gray and rusty bands; gradational at top with clay unit above (P-6341 to P-6337). 2.4

Lee Center till

1. Till, calcareous, gray, sandy, sharp contact at top but without pebble concentrate or other evidence of truncation (P-6336). 0.4

Total. . 10.4

BEAVERTON SECTION

Roadcut in SW¼ NE¼ SW¼ Sec. 4, T. 45 N., R. 4 E., Boone County, Illinois (1967)

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Peoria Loess

8. A-zone of surface soil developed in loess, gray, leached, platy structure in lower part, granular streaks in upper part (P-2755) 1.0

Thickness (feet)

7. B_1- zone of surface soil developed in loess, tan-brown, leached, structure indistinct (P-2754). 0.8
6. B_2-zone of surface soil developed in loess, brown, leached, clayey, micro-blocky structure, some clay skins on peds (P-2753 top, P-2752 bottom). 0.5
5. B_3-zone of surface soil developed in loess, tan-brown, leached, indistinct micro-blocky structure; some sand and a few small pebbles in lower part (P-2751 middle, P-2750 lower). 1.0

Altonian Substage
Argyle till

4. A-zone of Farmdale Soil developed in till, tan-brown with dark gray streaks, leached, massive; some mottling with red-brown (P-2749) 0.7
3. B_2-zone of Farmdale Soil developed in till, reddish brown with some mottling with dark gray, leached, clayey, massive (P-2748) 0.7
2. B_3-zone of Farmdale Soil developed in till, tan-brown, leached, massive (P-2747) 0.7
1. Till, sandy, calcareous, pink, massive; upper few inches partly leached with rotten dolomite pebbles; darker tan-pink at top (P-2746 top, P-2745 1' down). 2.0

Total. . 7.4

BERNARD SCHOOL SECTION

Roadcut and auger hole in SW¼ SW¼ NW¼ Sec. 31, T. 18 N., R. 3 E., Henry County, Illinois (1967)

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Peoria Loess

4. Loess, calcareous below the surface soil in the top, tan to light yellow-tan, coarse, massive; contains $CaCO_3$ concretions in lower part; lowermost few feet partly leached with mottling and streaks of rusty brown (P-3017 to P-3012 downward to base at 5' intervals) 30.0

Thickness (feet)

Farmdalian Substage
Farmdale Silt
3. Silt, leached, black, dark gray and gray, organic streaks throughout; locally contains streaks of secondary $CaCO_3$ (P-3011, P-3010) 2.0

Altonian Substage
Roxana Silt
2. Silt, leached, dark gray, tough (P-3009, P-3008) 1.5
1. Silt and clay, leached, gray to light gray; contains some streaks of rusty brown and secondary $CaCO_3$ (P-3007 to P-3005) 2.0

Total. . 35.5

BYRON WEST SECTION

Roadcut in SW¼ SE¼ SE¼ Sec. 34, T. 25 N., R. 10 E., Ogle County, Illinois (1965)

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Peoria Loess
4. Silt, light brown, leached. 1.5

Altonian Substage
Winnebago Formation
Argyle till
3. Till—sand, silty, gravelly, pinkish brown, upper 2.5' leached, lower 3' calcareous (P-8059 from 1' above base) . 5.5
2. Silt, tan, mottled with brown and reddish brown, slowly calcareous (P-8061) . . 1.0

Illinoian Stage?
Ogle till?
1. Till?—silt, clayey to silty, tan-brown to dark brown, slowly calcareous, sparse pebbles include some of brown chert (P-8060). 2.0

About 10' east and west of this section, Argyle till lies directly on bedrock.

Total. . 10.0

COLETA SECTION

Roadcut and auger hole in NE¼ SE¼ NW¼ Sec. 20, T. 22 N., R. 6 E., Whiteside County, Illinois (1966)

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Peoria Loess
7. Loess, leached, tan-brown, massive, surface soil in top (P-2382 in lower part) 7.0
6. Loess, calcareous, tan, massive, in lower part weakly calcareous and mottled gray and brown (P-2381, P-2380 downward) . 2.0

Thickness (feet)

Altonian Substage
Roxana Silt
5. Silt, leached, brown, compact (P-2379, P-2378). 2.0
4. Silt and sand with a few pebbles, leached, brown (P-2377). 0.5

Sangamonian Stage
3. Accretion-gley; Sangamon Soil; clay and silt with some sand and a few small pebbles throughout; somewhat oxidized at top; leached, dark gray (P-2376 to P-2372). 4.5

Illinoian Stage
Sterling till
2. Till, leached, gleyed at top, gray to tan-brown (P-2371, P-2370) 2.0
1. Till, silty, clayey, calcareous, tan-brown to gray, massive, compact (P-2369) 1.0

Total . . 19.0

CROSS ROAD SCHOOL SECTION

Roadcut and auger hole in SE¼ SE¼ SW¼ Sec. 6, T. 28 N., R. 6 E., Stephenson County, Illinois (1967)

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Peoria Loess
8. Loess, leached, tan to light brown, massive, surface soil in top (P-2864, P-2863 downward in lower part). 5.5
7. Loess, calcareous, yellow-tan in upper part becoming gray downward with rusty brown streaks in lower part (P-2862 to P-2856). 4.0

Farmdalian Substage
Farmdale Silt
6. Silt, leached, medium gray streaked with black organic material (P-2855). . . 1.0
5. Clay, silty, leached, light gray with rusty brown streaks (P-2854) 0.5

Altonian Substage
Roxana Silt
4. Silt, coarse, with some clay, leached, massive (P-2853 to P-2851) 2.5
3. Silt and sand, leached, dark gray streaked with rusty brown, massive; in lower part a few small pebbles including igneous rocks (P-2850 to P-2848) . . 2.5
2. Sand and silt, leached, brown (P-2847) 0.5
1. Silt, brown, leached grading downward to Maquoketa Shale (P-2846 silt, P-2845 shale) 0.5

Total . . 17.0

DAMASCUS EAST SECTION

Roadcut and auger hole in SE¼ SE¼ SW¼ Sec. 34, T. 28 N., R. 7 E., Stephenson County, Illinois (1968)

Thickness (feet)

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Peoria Loess

5. Loess, leached, light brown to yellow-tan, massive, surface soil in top (P-6065 base) 8.5
4. Loess, calcareous, gray-tan to yellow-tan mottled with rusty brown; massive sand zone in middle part and very coarse silt in basal part (P-6064 to P-6056 downward) 5.2
3. Loess, calcareous, tan, contains chert fragments throughout (P-6055 upper, P-6054 lower) 1.0

Altonian Substage
Roxana Silt

2. Silt, leached, brown, chert fragments throughout, massive (P-6053). 0.5

Illinoian Stage
Ogle till

1. Sangamon Soil developed in till, leached, red-brown grading downward to reddish tan-brown, very clayey, compact, tough in upper part; the B_2-zone of the soil is seemingly truncated with a pebble concentrate at top (P-6052 to P-6046) . . . 3.3

Total. . 18.5

DIXON NORTHWEST SECTION

Roadcut in NE¼ SE¼ SE¼ Sec. 30, T. 22 N., R. 9 E., Lee County, Illinois (1965)

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Wedron Formation
Esmond till

4. Till—silt, sandy, and silt, clayey, calcareous, yellowish brown, mostly covered (P-8078, P-8077 downward) 10.0
3. Till—clay, silty, calcareous, brownish gray (P-8076) 2.0

Morton Loess

2. Silt, calcareous, yellow-tan, with a sparse snail fauna (P-8075) 1.5

Altonian Substage
Winnebago Formation
Argyle till

1. Till—sand, silty, gravelly, calcareous, pinkish brown (P-8074). 3.0

Total. . 16.5

EMERSON QUARRY SECTION

Overburden of dolomite quarry in SE¼ NW¼ SE¼ Sec. 13, T. 21 N., R. 6 E., Whiteside County, Illinois (1968)

Thickness (feet)

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Peoria Silt

5. Silt, loess-like, leached, tan and gray; appears to be water-deposited loess. 6.0

Altonian Substage
Roxana Silt

4. Silt and very fine sand, leached, tan-brown. 1.0

Illinoian Stage

3. Sangamon Soil developed in sand and gravel, red-brown, clayey, tough. . . . 2.0

Sterling till

2. Till, leached in top, calcareous in lower part, silty, clayey with some sand, gray-tan (P-6489 in lower part) 3.0
1. Sand, bedded, calcareous, tan-brown; thickness varies on irregular top of Silurian Kankakee Dolomite. Maximum. 3.0

Total. . 15.0

FENTON SOUTHWEST SECTION

Roadcut and auger hole in SE¼ SE¼ SE¼ Sec. 17, T. 20 N., R. 4 E., Whiteside County, Illinois (1967)

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Peoria Loess

4. Loess, coarse, calcareous except in thin surface soil at top, light tan to yellow-tan (P-3073 to P-3069 downward). . . 7.5

Farmdalian Substage
Farmdale Silt

3. Silt, weakly calcareous to leached, gray streaked with tan, indistinct bedding; at top a 3" zone is dark gray and organic rich (P-3068 to P-3065). 3.0
2. Silt and peat; silt interzoned with sand, silty, clayey, leached, dark gray to gray; peaty zones throughout, some of which contain carbonized wood fragments (P-3064 to P-3057) 7.5

Illinoian Stage
Sterling till

1. Till, calcareous, tan and gray, clayey, pebbly (P-3056, P-3055). 0.5

Total. . 18.5

FORRESTON NORTHWEST CORE (B-50G)

Along road in SW¼ SW¼ SW¼ Sec. 19, T. 25 N., R. 8 E., Ogle County, Illinois. Boring by Illinois Division of Highways, Dixon (1968). Summary of core study.

Thickness (feet)

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Peoria Loess
11. Silt, leached, yellowish brown, mottled with gray; upper 3½' not sampled (1, 2) 8.0
10. Silt, leached, light gray mottled with yellowish brown, slightly organic (3T) 1.5

Sangamonian Stage
9. Accretion-gley?—silt, clayey, little gravel, dark grayish brown to black, organic, leached (3B, 4) 3.5

Illinoian Stage
Jacksonville Substage
8. Silt, slightly sandy and clayey, light yellowish brown, slowly calcareous (5). 2.5
7. Sand and gravel, very silty, brown, slowly calcareous (6, 7, lost 8 to 10) 12.5

Ogle till
6. Till—silt, sandy, gravelly, calcareous, brown to yellowish brown (11, 12). . 5.0
5. Till—silt, clayey, calcareous, tan-brown to grayish brown, with some sand (13) 2.5

Jacksonville Substage or older
4. Clay, silty, dark brown streaked with black, calcareous, organic (14, 15). 5.0
3. Silt and clay, calcareous, brown to grayish brown, faintly bedded; contains a few thin organic streaks (16 to 25T) 22.5

Illinoian Stage or older
2. Silt and clay, slowly calcareous, dark brown to brown mottled with yellowish brown; bottom 6" is organic silt (25B, 26). 2.0
1. Weathered dolomite and dolomite sand (27) 2.5

Total. . 67.5

FORRESTON SOUTHEAST CORE (B-60G)

Along road in NW¼ NW¼ NE¼ Sec. 2, T. 24 N., R. 8 E., Ogle County, Illinois. Boring by Illinois Division of Highways, Dixon (1968). Summary of core study.

Thickness (feet)

Pleistocene Series
Illinoian Stage
Jacksonville Substage
Ogle till
5. Till—sand, silty, leached, very slowly calcareous at base, light yellowish brown, thin sand lenses; upper 3½' not cored (1, 2) 8.0
4. Till—silt with clay and sand, little gravel, calcareous, tan-brown (3 to 10) 20.0
3. Till—silt with sand and clay, calcareous, tan-brown (11 to 18) 20.0

Pre-Illinoian Stage
2. Clay, dark yellowish brown, little sand and dolomite gravel (19T). 1.0
1. Weathered dolomite sand (19B, 20). . 2.5

Total. . 51.5

GARDEN PLAIN WEST SECTION

Auger hole in road ditch in SE¼ NW¼ NW¼ Sec. 22, T. 21 N., R. 3 E., Whiteside County, Illinois; 200 yards south of and 30' lower than the crest of the "Garden Plain Esker" (1968).

Pleistocene Series
Illinoian Stage
6. Sand, leached, uniform, tan, friable, some silt and clay upper part (P-6419 to P-6416 downward in lower half) . . . 8.5
5. Silt with some sand, weakly calcareous, light tan-brown, massive, compact (P-6415) 1.0

Mendon till
4. Till, calcareous, tan to light brown, sandy, compact, more silt and clay in lower part (P-6414, P-6413) . . . 2.0
3. Gravel and sand, calcareous, tan, contains igneous rocks and some large pebbles (P-6412) 1.0
2. Sand, calcareous, tan, well sorted (P-6411) 0.5
1. Till, or lag material, calcareous, pebbly; hole was stopped by either a large boulder or by bedrock (P-6410, P-6409). 0.4

Total . . 13.4

GRAND DETOUR SECTION

Roadcut in NW¼ SW¼ NE¼ Sec. 25, T. 22 N., R. 9 E., Lee County, Illinois (1966).

	Thickness (feet)
Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Wedron Formation	
6. Sand grading downward to sand and gravel at the base, brown, surface soil in top	5.0
Esmond till	
5. Till, gray, clayey, calcareous, massive (P-8159, P-8158 downward).	3.0
Morton Silt	
4. Silt, gray, calcareous, indistinct bedding; upper part is contorted by overriding glacier and contains thin lenticular streaks of gray till similar to the overlying till (P-8157).	1.5
3. Clay and silt, calcareous, tough (P-8156).	0.3
2. Silt, gray and tan, calcareous, massive; contains fossil snails (P-8155, P-8154)	2.0
Altonian Substage	
Argyle till	
1. Till, salmon-pink, calcareous, sandy, massive (P-8153, P-8152).	3.0
Total	14.8

GREENWAY SCHOOL CORE 2 (OGLE 2)

Along road in NW¼ SW¼ NW¼ Sec. 1, T. 41 N., R. 2 E., Ogle County, Illinois. Boring by Illinois Division of Highways, Dixon (1966). Summary of core study.

	Thickness (feet)
Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Wedron Formation	
Esmond till	
10. Till—silt, sandy, slowly calcareous, yellowish brown; upper 3½' not cored (1)	5.5
9. Till—silt, sandy, calcareous, yellowish brown to brownish gray (2 to 4T).	6.0
8. Till—silt, clayey, calcareous, brownish gray (4B to 7T)	7.5
7. Clay, silty, calcareous, faintly bedded, gray to brownish gray (7B to 9)	6.5
Altonian Substage	
Winnebago Formation	
6. Sand, silty, gravelly, calcareous, yellowish to pinkish brown (10)	2.5
Plano Silt	
5. Silt and clayey silt, slowly calcareous, grayish brown, contains abundant wood fibers (11T).	1.0
4. Silt, sandy, pebbly, calcareous, yellowish brown (11B).	1.0±
3. "Fluid sand and fine gravel," samples lost	8.0±
Illinoian Stage	
Buffalo Hart Substage	
Sterling till	
2. Till—silt, sandy, clayey, calcareous, brownish gray to gray (13, 14)	4.5
1. "Alternating hard and soft material, probably till with large chunks of limestone and boulders," rejected auger, lost samples	10.0
Total	52.5

GREENWAY SCHOOL CORE 3 (OGLE 3)

Along road in SW¼ NW¼ SW¼ Sec. 1, T. 41 N., R. 2 E., Ogle County, Illinois. Boring by Illinois Division of Highways, Dixon (1966). Composited with Core 6 which is 400 feet north. Summary of core study.

	Thickness (feet)
Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Wedron Formation	
Esmond till	
13. Till—silt, clayey, sandy, calcareous, yellowish brown; upper 3½' not cored (1).	4.5
12. Till—silt, clayey, calcareous, yellowish brown to grayish brown (2, 3, 4T).	7.0
11. Till—clay, silty, calcareous, gray to brownish gray (4B, 5)	4.0
10. Clay, silty, calcareous, gray with brownish tinge (6T).	1.0
Farmdalian Substage	
Farmdale Silt	
9. Silt, dark gray, organic, with wood fibers, slowly calcareous, radiocarbon date sample I-2784 is 23,750, plus 1050 or minus 950 radiocarbon years B. P. (Ogle 3-6M and Ogle 6-7M combined)	0.5
Altonian Substage	
Winnebago Formation	
8. Silt, slowly calcareous, brown to yellowish brown (6B)	1.0
7. "Fluid sand and silt" (7 lost)	2.5
Illinoian Stage	
Buffalo Hart Substage	
Sterling till	
6. Till—sand, silty, gravelly, calcareous, brownish gray, dry (8 to 17)	24.5

Thickness (feet)

5. "Large boulders in till, unable to sample" (18 to 20 lost) 8.5
4. Till—silt, sandy, clayey, calcareous, brownish gray, hard, dry (21 to 23) 7.5
3. Till—silt, sandy, calcareous, grayish brown, hard, dry (24, 25) 5.0
2. Sand, gravelly, slightly silty, calcareous, brown (26T). 1.0
1. Till—silt, sandy, calcareous, brownish gray, hard, dry 1.0
   (26B, lost 27). 2.5

Total . . 70.5

GREENWAY SCHOOL CORE 4 (OGLE 4)

Along road in NW¼ NE¼ NW¼ Sec. 12, T. 41 N., R. 2 E., Ogle County, Illinois. Boring by Illinois Division of Highways, Dixon (1966). Summary of core study.

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Wedron Formation

10. Sand, silty, slowly calcareous, dark yellowish brown; upper 3½' not cored (1) 5.5

Esmond till

9. Till—clay, silty, calcareous, light brown (2) 2.5

Altonian Substage
Winnebago Formation

8. Sand, silty, gravelly, slowly calcareous, yellowish brown (3) 2.5
7. Silt, brown mottled with yellowish brown, calcareous (4 lost, described from sample remaining on core tube) 2.5

Capron till

6. Till—silt, clayey, calcareous, pinkish brown to grayish brown, sand streak in middle (5, 6T). 3.5
5. Silt, calcareous, light pinkish brown (6B, 7T). 2.6

Plano Silt

4. Silt, calcareous, gray, some gravel, abundant wood fibers. 1.4

Argyle till

3. Till—sand, silty, calcareous, brown (8) 2.5

Illinoian Stage
Buffalo Hart Substage

2. Silt, calcareous, brownish gray to gray (9T) 1.0

Sterling till

1. Till—silt, sandy, calcareous, gray (9B, 10). 3.5

Total . . 27.5

GREENWAY SCHOOL CORE 5 (OGLE 5)

Along road in SE¼ SE¼ SW¼ Sec. 35, T. 42 N., R. 2 E., Ogle County, Illinois. Boring by Illinois Division of Highways, Dixon (1966). Summary of core study.

Thickness (feet)

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Wedron Formation
Esmond till

8. Till—silt, clayey, slowly calcareous, yellowish brown; upper 3½' not cored (1, 2T) 6.5
7. Clay, silty, calcareous, brown to grayish brown (2B, 3) 4.0

Altonian Substage
Winnebago Formation
Capron till

6. Till—silt, sandy, calcareous, yellowish brown to brown (4 to 7T). . . . 8.7
5. Sand, silty, little gravel, calcareous, dark yellowish brown (7B) 1.3
4. Till—silt, sandy, calcareous, brownish gray (8). 4.0

Argyle till

3. Till—sand, silty, calcareous, yellowish brown to pinkish brown (10) . . 3.5

Illinoian Stage?
Buffalo Hart Substage?

2. Sand, silty, little gravel, calcareous (12, lost 11, 13) 7.5

Sterling till

1. Till—silt, sandy, calcareous, brownish gray, bottomed on bedrock (14) 2.0

Total . . 37.5

HALDANE WEST SECTION

Roadcut in NE¼ NE¼ NE¼ Sec. 25, T. 24 N., R. 7 E., Ogle County, Illinois (1968).

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Peoria Loess

6. Loess, leached, tan-brown, surface soil in top; locally rests directly on Sangamon Soil, Unit 4; ranges in thickness up to. 8.0

Altonian Substage
Roxana Silt

5. Silt with some sand, leached, maroon-brown, pebbles in lower part; lenticular deposit on surface truncating Units 4 to 1 below. 5.0

	Thickness (feet)
Illinoian Stage	
Ogle till	
4. Sangamon Soil developed in till, leached, red-brown, indistinct prismatic structure, some Mn-Fe staining; at top a thin zone of colluvium rests on surface of soil truncated to the B_2-zone	4.0
3. Silt and sand with a few small pebbles, leached, tan-brown to reddish tan-brown	1.5
2. Till, leached, red-brown to dark brown, clayey, some mottling with gray-brown; has some characters of a soil B-zone	2.5
1. Till, silty, calcareous, light gray-tan (P-6273) interzoned with calcareous gravel and sand. (P-6462 from west side, P-6466 to P-6463 downward from east side of road)	10.0
Total	31.0

HENZE SCHOOL SECTION

Roadcut and auger hole in SE¼ SW¼ SE¼ Sec. 2, T. 28 N., R. 9 E., Stephenson County, Illinois (1967).

	Thickness (feet)
Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Peoria Loess	
5. Loess, leached, tan to light brown, massive, surface soil in top (P-2924 to P-2922 downward in lower part).	5.3
Altonian Substage	
Roxana Silt	
4. Silt, leached, gray-tan, tough, some clay and sand and a few small pebbles in lower part (P-2921 to P-2918)	2.0
3. Silt, clay, and pebbles, leached, gray-tan-brown, compact (P-2917)	0.5
Sangamonian Stage	
2. Sangamon Soil; clay, silt, and pebbles, leached, red-brown with some black mottling, becoming brown and tan mottled in lower part (P-2916 to P-2914)	1.8
1. Dolomite sand and red-brown clay (P-2913)	0.2
Total	9.8

LANARK SOUTHEAST SECTION

Roadcut and 16' auger hole in SE¼ SE¼ SE¼ Sec. 15, T. 24 N., R. 6 E., Carroll County, Illinois (1968).

	Thickness (feet)
Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Peoria Loess	
7. Loess, leached, tan-brown, some gray mottling in lower part, massive; surface soil in top (P-6252 to P-6250 downward)	4.5
Altonian Substage	
Roxana Silt	
6. Silt, leached, lavender-tan-brown, platy structure, few small pebbles in lower part (P-6249 to P-6247)	3.3
Illinoian Stage	
Ogle till	
5. Sangamon Soil developed in till, leached, tan-brown to pinkish brown, pebbly and silty; B-zone in upper part has minor Mn-Fe pellets and clay skins (P-6246 to P-6236, P-2498, P-2497)	5.0
4. Soil developed in sand, leached, pinkish tan-brown to reddish brown, clayey, massive (P-6235 to P-6232, P-2496)	2.0
3. Sand, coarse with some pebbles, leached, tan-brown (P-6231 to P-6329)	1.5
2. Sand, leached, tan-brown, uniform texture and moderately loose (P-6228 to P-6224)	2.5
1. Soil developed in sand and gravel, clayey, leached, dark brown to tan in lower part, pebbles up to 2" in diameter in upper part but rather uniform sand in lower part (P-6223 to P-6216)	3.7
Total	22.5

LANARK EAST CORE (B-4CA)

Along road in NW¼ NW¼ SE¼ Sec. 4, T. 24 N., R. 6 E., Carroll County, Illinois. Boring by Illinois Division of Highways, Dixon (1968). Summary of core study.

	Thickness (feet)
Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Peoria Loess	
10. Silt, dark yellowish brown mottled with brown, leached; upper 3½' not cored (1, 2T)	7.0
9. Silt, yellowish brown, slowly calcareous (2B, 3T)	2.5
8. Silt, brown, mottled with yellowish brown, slowly calcareous (3B)	1.0

Thickness (feet)

Farmdalian Substage
Farmdale Silt
7. Silt, leached, dark brown, organic? (4) 2.5

Sangamonian Substage
6. Accretion-gley—silt, sandy, clayey pebbly, leached, black to very dark gray, upper 2' organic (5, 6) . . . 5.0

Illinoian Stage
Jacksonville Substage
Ogle till
5. Till—sand, silty, pebbly, calcareous, light grayish brown (7 to 12) . . . 15.0
4. Silt, calcareous to slowly calcareous, bedded, light brown to gray-brown, few sand lenses (13 to 26T) 34.0

Jacksonville Substage or older
3. Silt, clayey silt, and silty clay, calcareous, massive to bedded, brown to light grayish brown (26B to 34T). 20.0

Illinoian Stage or older
2. Silt, leached to very slowly calcareous, gray, mottled with little dark yellowish brown (34B, 35) 3.0
1. Sand, silty, very gravelly, slowly calcareous, dark yellowish brown, a few chert pebbles (36). 3.5

Total . . 93.5

LANARK WEST SECTION

Gravel pit in NE¼ NW¼ NW¼ Sec. 10, T. 24 N., R. 5 E., Carroll County, Illinois (1966).

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Peoria Loess
7. Loess, leached, tan-brown, massive; the upper part of the Peoria Loess had previously been removed to an unknown depth by gravel pit operations. 3.0

Farmdalian Substage
Farmdale Silt
6. Silt, leached, tan-brown grading downward to gray-brown; in lower part contains abundant organic flecks and streaks (P-2495 to P-2493 downward) 2.5

Altonian Substage
Roxana Silt
5. Silt, leached, maroon-brown to purplish brown, some clay and sand; micro-blocky with blocks ranging from ½ to 1 cm. across; clay skins on blocks; some granular coarse silt concentrated on upper surfaces of individual peds; micro-blocky structure becomes indistinct in upper part (P-2492 to P-2489). 3.5

Illinoian Stage
Ogle till
4. Sangamon Soil developed in till; B_2-zone, leached, yellow-brown, indistinctly platy, some clay skins and Mn-Fe pellets (P-2488, P-2487) . . . 2.0
3. Sangamon Soil developed in till; B_3-zone, leached, yellow-brown, massive (P-2486) 2.0
2. Sangamon Soil developed in till; CL-zone, leached, tan-brown, massive (P-2485, P-2484) 3.5
1. Gravel and sand, top 1' leached except for rotten dolomite cobbles, top 6' partly leached, highly calcareous below with dolomite cobbles and pebbles dominant (P-2483 1' below top; P-2482 4' below top) . . . . 20.0+

Total . . 36.5+

McALLISTER SCHOOL SECTION

Auger hole along road in SE¼ NE¼ NE¼ Sec. 33, T. 21 N., R. 5 E., Whiteside County, Illinois (1968).

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Peoria silt and sand
5. Silt, leached, surface soil, mottled dark-gray, rusty brown and gray-tan, compact (P-6529, P-6528 downward). . 2.5
4. Sand, leached, with some silt and clay, neutral gray with tan-brown mottling (P-6527, P-6526) 2.0
3. Sand, calcareous, loose, gray, gradational at top with leached sand (P-6525, P-6524). 2.0

Farmdalian Substage
Farmdale silt and peat
2. Organic silt, leached, black, sharp contacts at top and bottom (P-6523, P-6522). 1.0
1. Peat, leached, dark brown, tough, fragments of plant material throughout (P-6521 to P-6519). Radiocarbon date of basal sample, 27,500 ± 500 radiocarbon years B.P. (ISGS-6). 1.0

Total . . 8.5

MOON SCHOOL SECTION

Roadcut and auger hole in SW¼ SE¼ NE¼ Sec. 30, T. 16 N., R. 5 E., Henry County, Illinois (1968).

	Thickness (feet)
Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Richland Loess	
3. Loess, leached, tan-brown mottled with black, surface soil in top (P-6354 at base)	5.5
Wedron Formation	
2. Sand and gravel outwash, leached, clayey with some Mn-Fe splotches upper part; tan sand with some pebbles in lower part (P-6353 to P-6350 downward) .	2.9
Lee Center till	
1. Till, calcareous except for upper few inches, tan-brown with some mottling of gray, clayey, massive (P-6349 to P-6346).	1.6
Total . .	10.0

MT. CARROLL NORTH SECTION

Roadcut down slope in SE¼ SE¼ SE¼ Sec. 23, T. 25 N., R. 4 E., Carroll County, Illinois (1965).

Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Peoria Loess	
6. Loess, leached, gray, lenticular body of loess above an A-C soil profile in loess below, weak surface soil in top.	3.0
5. Loess, leached, light yellow-brown, massive (P-2052 at base, P-2467 5' above base).	12.0
Altonian Substage	
Roxana Silt	
4. Loess, leached, tan-brown, some small Mn-Fe pellets, massive (P-2051). .	1.0
3. Silt, leached, brown, clayey, massive, Mn-Fe pellets throughout, compact (P-2050)	4.0
Illinoian Stage	
Loveland Silt	
2. Sangamon Soil developed in silt, leached, dark red-brown in upper part becoming orange-tan in lower part, clayey and tough in the B-zone of the soil in upper part; Mn-Fe pellets and coating on surfaces, clay skins on micro-blocky surfaces (P-2049) . .	6.0
Yarmouthian Stage	
Yarmouth Soil	
1. Geest, clay residuum on Silurian dolomite, leached, dark red, micro-blocky structure with clay skins on micropeds, Mn-Fe pellets, coatings, and black mottling (P-2048).	1.5
Total . .	27.5

MT. CARROLL SOUTH SECTION

Gravel pit in SE¼ NE¼ NW¼ Sec. 24, T. 24 N., R. 4 E., Carroll County, Illinois (1966).

	Thickness (feet)
Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Peoria Loess	
8. Loess, leached, coarse, brown, massive; surface soil in top (P-2480 and P-2479 downward in lower part). . .	6.5
7. Loess, leached, coarse, mottled brown and gray (P-2478)	0.5
Farmdalian Substage	
Farmdale Silt	
6. Silt, leached, dark gray with organic flecks and streaks (P-2477)	0.5
Altonian Substage	
Roxana Silt	
5. Silt with some sand and clay and a few small pebbles dispersed throughout, leached, maroon-brown, strongly developed micro-blocky structure (P-2476 to P-2474).	2.5
Illinoian Stage	
4. A-zone of Sangamon Soil developed in sand and gravel, leached, gray-brown, granular (P-2473)	0.5
3. B_2-zone of Sangamon Soil developed in sand and gravel, leached, red-brown, clayey, massive; contains large krotovinas filled with overlying Roxana Silt (P-2472, P-2471). . . .	2.0
2. B_3-zone of Sangamon Soil developed in sand and gravel, leached except for some rotten dolomite cobbles, more common in lower part, brown to tan-brown downward (P-2470, P-2469) . .	2.5
1. Sand and gravel, calcareous with dolomite pebbles and cobbles dominant, tan (P-2468).	20.0+
Total . .	35.0

PINK PRAIRIE SECTION

Auger hole along road in NW¼ NW¼ SW¼ Sec. 26, T. 18 N., R. 3 E., Henry County, Illinois (1968).

Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Peoria Loess	
3. Loess, leached, gray with black Prairie surface soil in top (P-6366 lower part)	2.8

	Thickness (feet)
2. Loess, calcareous, gray, fine textured, massive, compact; appears to be gleyed in upper part but becomes streaked with rusty tan-brown in lower part (P-6365 to P-6359 downward) .	3.7
Illinoian Stage	
Sterling till	
1. Till, calcareous, tan-gray, with brown oxidized zone at top, clayey, massive; concentrate of pebbles at top on truncated surface (P-6358 to P-6355).	1.5
Total . .	8.0

RED BIRCH SCHOOL SECTION

Roadcut and auger hole in SW¼ NW¼ SW¼ Sec. 13, T. 21 N., R. 9 E., Lee County, Illinois (1966).

Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Peoria Loess	
6. Loess, leached, tan, surface soil in top.	6.5
5. Loess, calcareous, yellow-tan in upper part to gray in lower part (P-2422, P-2421 downward)	2.0
Farmdalian Substage	
Farmdale Silt	
4. Silt, leached, dark gray (P-2420, P-2419).	2.5
Sangamonian Stage	
3. Accretion-gley; Sangamon Soil; clay and silt with a very small amount of sand and pebbles, leached, gray, tough, compact (P-2418 to P-2415).	3.0
Illinoian Stage	
Sterling till	
2. Till, leached, gray and tan-brown, gleyed at top, compact (P-2414, P-2413).	3.0
1. Till, calcareous, gray (P-2412 to P-2410).	3.0
Total . .	20.0

STOCKTON EAST CORE (B-3JD)

Along road in SE¼ SE¼ SE¼ Sec. 8, T. 27 N., R. 5 E., Jo Daviess County, Illinois. Boring by Illinois Division of Highways, Dixon (1968). Summary of core study.

	Thickness (feet)
Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Peoria Loess	
12. Silt, leached, yellowish brown mottled with gray; upper 3½' not cored (1, 2T)	7.0
11. Silt, slowly calcareous, yellowish brown mottled with gray (2B). . . .	1.0
10. Silt, leached, light gray-brown (3)	2.5
9. Silt, leached, dark brown mottled with gray, slightly organic (4) . .	2.5
Farmdalian Substage?	
Farmdale Silt?	
8. Silt, clayey, slightly sandy, few pebbles, leached, dark brownish gray, colluvium? (5, 6T).	4.0
Sangamonian Stage	
7. Clay, sandy, pebbly, leached, dark brown, alluvium? (6B, 7)	3.5
Illinoian Stage	
6. Silt and sandy silt, slowly calcareous, yellowish gray (8 to 17T, lost 9) .	26.5
5. Till—clay, silty, sandy, pebbly, calcareous, brownish gray (17B to 19T, lost 18 on "boulder").	5.0
4. Silt, sandy, pebbly, brownish gray, calcareous (19B).	1.0
3. Till—clay, silty, sandy, few pebbles, numerous thin silt and sand streaks, calcareous, brownish gray (20 to 24T).	11.5
Illinoian Stage or older	
2. Silt, clayey, leached?, brownish gray, organic? (24B, lost 25)	3.5
1. Dolomite sand	4.5
Total . .	72.5

STOCKTON NORTHEAST CORE 1 (3-1JD)

Along road in SE¼ NE¼ SE¼ Sec. 31, T. 28 N., R. 5 E., Jo Daviess County, Illinois. Boring by Illinois Division of Highways, Dixon (1968). Summary of core study.

Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Peoria Loess	
12. Silt, calcareous, yellowish brown to tan-gray; upper 3½' not sampled (1 to 3).	11.0
Illinoian Stage	
Jacksonville Substage	
11. Sand, silty, fine to coarse, gray, calcareous (4).	6.0
Winslow till	
10. Till—clayey silt to silty clay, calcareous, brownish gray, few pebbles (5 to 12T).	20.0

	Thickness (feet)
9. Silt, sandy at base, calcareous, brownish gray (12B to 15)	8.5
8. Till—clayey silt to silty clay, calcareous, brownish gray, few pebbles (16 to 18T)	6.5
7. Silt, sandy, calcareous, brownish gray (18B)	1.0
6. Clay, silty, brownish gray (19, 20)	5.0
5. Till—clayey silt to silty clay, calcareous, brownish gray, few pebbles (21 to 26)	15.0
4. Clay, calcareous, brownish gray, bedded (varved?), little silt (27 to 29)	7.5
Illinoian Stage or older	
3. Silt, organic, black to dark gray, with rootlets at top, very slowly calcareous (30)	2.5
2. Silt, gray, organic?, very slowly calcareous (31, 32)	5.0
1. Silt, clayey, greenish gray, few pebbles, very slowly calcareous, organic? near base; bottom 2" is weathered dolomite and chert (33 to 35)	7.0
Total	95.0

STOCKTON NORTHEAST CORE 2 (B-2JD)

Along road in NE¼ NW¼ NE¼ Sec. 32, T. 28 N., R. 5 E., Jo Daviess County, Illinois. Boring by Illinois Division of Highways, Dixon (1968). Summary of core study.

	Thickness (feet)
Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Peoria Loess	
11. Silt, leached, yellowish brown mottled with gray; upper 3½' not cored (1)	5.5
10. Silt, slowly calcareous, gray mottled with brown (2, 3)	5.0
9. Silt, slowly calcareous, dark brownish gray, slightly organic (4)	2.5
Farmdalian Substage	
Farmdale Silt	
8. Silt, leached, dark brown to black, organic with wood fibers (5, 6)	5.0
Sangamonian Stage?	
7. Accretion-gley—silt, clayey, light greenish gray, leached (7)	2.5
Illinoian Stage	
Jacksonville Substage	
6. Silt, clayey, leached, light gray, bedded (8T)	1.5
5. Silt, clayey, slowly calcareous, light yellowish brown, bedded (8B to 10T)	5.0
4. Silt, clayey, light brownish gray, bedded (10B to 12T)	5.0
Winslow till	
3. Till—clayey silt to silty clay with silt streaks, calcareous, brownish gray (12B to 16T)	10.0
2. Clay, silty, calcareous, brownish gray, bedded, varved? in upper 3' (16B to 21)	13.5
Illinoian Stage or older	
1. Silt, clayey, sandy, few pebbles, calcareous, bedded, organic streaks, bottom 6" is weathered dolomite sand	2.0
Total	57.5

TIGER WHIP SCHOOL SECTION

Roadcut and auger hole in SE¼ SE¼ NW¼ Sec. 4, T. 27 N., R. 5 E., Jo Daviess County, Illinois (1967).

	Thickness (feet)
Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Peoria Loess	
4. Loess, leached, light tan to brown, massive; surface soil in top (P-2894 to P-2890 downward in lower half)	8.5
3. Loess, calcareous, yellow-tan mottled with gray; gray mottled with rusty-tan lower part (P-2889 to P-2883 top to bottom)	6.5
Farmdalian Substage	
Farmdale Silt	
2. Silt, coarse with some very fine sand, leached, dark gray to black with organic streaks (P-2882 to P-2880 top to bottom)	2.0
Altonian Substage	
Roxana Silt	
1. Silt, leached, mottled rusty brown, dark gray-tan and light gray, massive, compact, tough (P-2879 to P-2876)	2.0
Total	19.0

UNION SCHOOL SECTION

Roadcut and auger hole in NE¼ NE¼ NW¼ Sec. 8, T. 22 N., R. 8 E., Ogle County, Illinois (1968).

	Thickness (feet)
Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Peoria Loess	
6. Loess, leached, tan-brown, clayey in upper part, tough, some mottling with rusty brown (P-6457 to P-6454 downward)	6.5

	Thickness (feet)
5. Loess, calcareous, gray-tan streaked with yellow-tan, massive, compact, clayey (P-6453 to P-6448)	6.0
4. Loess, calcareous, gray (P-6447). .	1.0
3. Loess, leached, dark rusty brown, mottled with gray and some splotches of black; contains a few flakes of charcoal, compact, clayey (P-6446).	0.5
Farmdalian Substage	
Farmdale Silt	
2. Organic silt and peaty silt, leached, black to dark gray with indistinct banding, massive (P-6445 to P-6440); radiocarbon date from lower part >27,800 radiocarbon years (ISGS-8)	3.5
Altonian Substage	
Roxana Silt	
1. Silt, very coarse, and very fine sand, leached, dove gray to light gray, compact (P-6439, P-6438)	1.0
Total . .	18.5

WOOSUNG WEST SECTION

Roadcut and auger hole in NW¼ SW¼ SW¼ Sec. 6, T. 22 N., R. 8 E., Ogle County, Illinois (1966).

	Thickness (feet)
Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Peoria Loess	
6. Loess, leached, tan to brown, massive, surface soil in top	7.0
5. Loess, calcareous, tan to yellow-tan with gray mottling in lower part (P-2402 to P-2397 downward)	7.0
Altonian Substage	
Roxana Silt	
4. Silt, leached, gray-brown, compact (P-2396 to P-2394).	2.0
3. Silt with some sand and small pebbles, leached, brown, compact (P-2393). .	0.5
Illinoian Stage	
Sterling till	
2. Sangamon Soil developed in till, leached, red-brown with black pellets of Mn-Fe; friable in top but clayey in the B_2-zone (P-2392 to P-2389) .	2.5
1. Till, calcareous, gray-tan, compact; upper part leached of all but some dolomite (P-2388 to P-2386)	1.0
Total . .	20.0

Additional stratigraphic sections studied in outcrops and auger borings, and cited in the text, are listed below. The name of the geologic section is followed by the location and, in parenthesis, the numbers of the samples analyzed from the locality. The described sections and analytical data are on file at the Illinois State Geological Survey. The many single samples from exposures in the region are not listed, but these analytical data also are on file at the Geological Survey.

Albany South Section, SW$\frac{1}{4}$ SW$\frac{1}{4}$ NW$\frac{1}{4}$ Sec. 12, T. 20 N., R. 2 E., Whiteside County (P-2527 to P-2530; P-3041 to P-3049).

Berlin School Auger Section, SE cor. SW$\frac{1}{4}$ SE$\frac{1}{4}$ SE$\frac{1}{4}$ Sec. 7, T. 27 N., R. 9 E., Stephenson County (P-2895 to P-2911).

Beuth School Auger Section, SW$\frac{1}{4}$ SW$\frac{1}{4}$ SE$\frac{1}{4}$ Sec. 30, T. 26 N., R. 10 E., Winnebago County (P-6204 to P-6214).

Capron North Section, NE$\frac{1}{4}$ SE$\frac{1}{4}$ SE$\frac{1}{4}$ Sec. 23, T. 46 N., R. 4 E., Boone County (P-2734 to P-2744).

Carthage Section, NE cor. Sec. 10, T. 22 N., R. 10 E., Ogle County (P-726 to P-730).

Christian Hollow Church Section, SE$\frac{1}{4}$ SE$\frac{1}{4}$ SE$\frac{1}{4}$ Sec. 19, T. 29 N., R. 6 E., Stephenson County (P-2868 to P-2875; P-6079, P-6080).

Collman School Auger Section, SE$\frac{1}{4}$ SE$\frac{1}{4}$ SW$\frac{1}{4}$ Sec. 36, T. 26 N., R. 8 E., Stephenson County (P-6082 to P-6095).

Coolidge Creek East Section, NW$\frac{1}{4}$ NE$\frac{1}{4}$ NE$\frac{1}{4}$ Sec. 30, T. 27 N., R. 11 E., Winnebago County (P-2999 to P-3003).

Freeport West Section, NW$\frac{1}{4}$ NE$\frac{1}{4}$ SE$\frac{1}{4}$ Sec. 34, T. 27 N., R. 7 E., Stephenson County.

Gravel Hill School Section, NW$\frac{1}{4}$ SW$\frac{1}{4}$ NW$\frac{1}{4}$ Sec. 19, T. 25 N., R. 8 E., Ogle County.

Harrison Southeast Section, NW$\frac{1}{4}$ NW$\frac{1}{4}$ SW$\frac{1}{4}$ Sec. 9, T. 45 N., R. 1 E., Winnebago County (P-2770 to P-2778; P-2933).

Hazelhurst Hills Section, SW$\frac{1}{4}$ SE$\frac{1}{4}$ NE$\frac{1}{4}$ Sec. 21, T. 23 N., R. 7 E., Carroll County.

Kewanee North Section, SW$\frac{1}{4}$ NW$\frac{1}{4}$ NW$\frac{1}{4}$ Sec. 15, T. 15 N., R. 5 E., Henry County (P-312 to P-319).

KSA – Tower Section, SE$\frac{1}{4}$ SE$\frac{1}{4}$ SW$\frac{1}{4}$ Sec. 30, T. 45 N., R. 1 E., Winnebago County (P-2963 to P-2968).

Lee County No. 3 core, SW$\frac{1}{4}$ SW$\frac{1}{4}$ NW$\frac{1}{4}$ Sec. 22, T. 38 N., R. 1 E., Lee County.

Marengo South Section, SE$\frac{1}{4}$ SE$\frac{1}{4}$ NE$\frac{1}{4}$ Sec. 12, T. 43 N., R. 5 E., McHenry County (P-2726 to P-2733).

Meridian Road No. 1 Section, NW$\frac{1}{4}$ NW$\frac{1}{4}$ NW$\frac{1}{4}$ Sec. 7, T. 43 N., R. 1 E., Winnebago County (P-698 to P-704).

Meridian Road No. 3 Section, SW$\frac{1}{4}$ NW$\frac{1}{4}$ SW$\frac{1}{4}$ Sec. 6, T. 43 N., R. 1 E., Winnebago County (P-2756 to P-2763).

Morrison Section, SW$\frac{1}{4}$ SE$\frac{1}{4}$ Sec. 7, T. 21 N., R. 5 E., Whiteside County (P-8161 to P-8188).

North Ridott School Section, SW cor. NW$\frac{1}{4}$ Sec. 21, T. 27 N., R. 9 E., Stephenson County (P-6103 to P-6106).

Otter Creek Section, SE$\frac{1}{4}$ NE$\frac{1}{4}$ NE$\frac{1}{4}$ Sec. 3, T. 22 N., R. 4 E., Whiteside County (P-2458 to P-2460; P-2791, P-2792).

Rapid City B Section, interstate approach in SE$\frac{1}{4}$ Sec. 3, T. 18 N., R. 1 E., Rock Island County (P-2431 to P-2453).

Ridott Section, NE cor. Sec. 29, T. 27 N., R. 9 E., Stephenson County (P-8189 to P-8198).

Rock Valley College Section, SW$\frac{1}{4}$ NW$\frac{1}{4}$ SW$\frac{1}{4}$ Sec. 10, T. 44 N., R. 2 E., Winnebago County (P-2936 to P-2947).

Salem School Gravel Pit Section, NE$\frac{1}{4}$ SE$\frac{1}{4}$ NW$\frac{1}{4}$ Sec. 9, T. 28 N., R. 7 E., Stephenson County.

Sheldon School Section, SE$\frac{1}{4}$ SW$\frac{1}{4}$ SE$\frac{1}{4}$ Sec. 11, T. 26 N., R. 10 E., Winnebago County (P-2779 to P-2785; P-6192 to P-6202).

Springdale School Section, NW$\frac{1}{4}$ NE$\frac{1}{4}$ NE$\frac{1}{4}$ Sec. 19, T. 24 N., R. 8 E., Ogle County (P-2817 to P-2822).

State Line Section, SW$\frac{1}{4}$ SW$\frac{1}{4}$ NW$\frac{1}{4}$ Sec. 20, T. 29 N., R. 10 E., Winnebago County (P-2789; P-2925 to P-2930).

Sylvan School Auger Section, NW$\frac{1}{4}$ NW$\frac{1}{4}$ NW$\frac{1}{4}$ Sec. 26, T. 29 N., R. 9 E., Stephenson County (P-6029 to P-6040).

Tunnison Creek Section, NE$\frac{1}{4}$ SE$\frac{1}{4}$ SE$\frac{1}{4}$ Sec. 1, T. 27 N., R. 11 E., Winnebago County (P-2970 to P-2980).

White Pigeon Section, SE$\frac{1}{4}$ SE$\frac{1}{4}$ SE$\frac{1}{4}$ Sec. 18, T. 44 N., R. 3 E., Boone County (P-8132).

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