490

STATE OF ILLINOIS
DEPARTMENT OF REGISTRATION AND EDUCATION

# GLACIAL DRIFT IN ILLINOIS: THICKNESS AND CHARACTER

Kemal Piskin
Robert E. Bergstrom

Revision of Circular 416

ILLINOIS STATE GEOLOGICAL SURVEY
Jack A. Simon, Chief
Urbana, IL 61801

CIRCULAR 490
1975

# GLACIAL DRIFT IN ILLINOIS: THICKNESS AND CHARACTER*

**Kemal Piskin and Robert E. Bergstrom**

ABSTRACT

Unconsolidated deposits—mainly glacial drift—overlie bedrock and form the land surface in most of Illinois. These unconsolidated deposits, which consist of various sediments transported by ice, wind, and water, are parent materials for most Illinois soils, are important sources of building products and ground water, and affect land use, mining, construction, and drilling operations.

As shown by the drift thickness map of the state included in the report, glacial drift ranges from less than a few feet to about 600 feet in thickness. Throughout the state, the thickest drift occurs in major valleys cut into bedrock, and, regionally, it occurs in the northeastern quarter of the state, the part that was covered by the last (Wisconsinan) glacier. The thinnest drift—less than 25 feet thick and intersected by numerous bedrock outcrops—occurs widely in southern and western Illinois.

## INTRODUCTION

Most of the landscape of Illinois is developed on earth materials deposited by great continental glaciers of the geologically recent Ice Age, by wind, and by streams. These materials, generally unconsolidated, mantle the much older, layered bedrock—mainly shale, limestone, and sandstone—that extends downward to the ancient crystalline basement rocks.

Most of the unconsolidated deposits are the result of glaciation and commonly are called glacial drift or simply drift. The unconsolidated deposits

*This report, including drift thickness map and cross-sections, revises and updates Circular 416 (1967), which was prepared by the same authors and is now out of print.

include unsorted, ice-laid rock debris, called till; sorted meltwater-laid sand and gravel, called outwash; fine-grained sediments laid down in glacial lakes; wind-blown silt, called loess; and fine- to coarse-grained sediments of modern streams. They range from 1 or 2 feet to about 600 feet in thickness.

The thickness and character of the glacial deposits are of interest for several reasons. The most fertile soils of Illinois are developed on the unconsolidated deposits, and most buildings and roads are constructed on them. They are important sources of building materials and ground water, and they must be penetrated or removed in any mining operations that go into the bedrock.

## Purpose of Study

The purpose of this study is to describe the thickness, distribution, and character of the unconsolidated deposits—essentially the drift—of Illinois. Emphasis is on the physical characteristics of the drift materials rather than on their age or stratigraphic relations. The basic data for the study of drift thickness are primarily well records from the files of the Illinois State Geological Survey that have been systematically examined in studies of drift aquifers during the past 11 years. These records have been provided by drillers, consultants, oil operators, industrial and municipal officials, and cooperating state and federal agencies. Piskin and Bergstrom (1967) reported on the thickness and character of the glacial drift in Illinois in Circular 416, which is now out of print. This report revises and updates Circular 416.

Presentations of the stratigraphy, areal distribution, and character of the drift are summarized from the work of other investigators, as cited in the text. Additional details on the drift may be obtained from the published reports referred to here. The most important of these is Leland Horberg's report (1950) on the bedrock topography of Illinois, in which the bedrock surface map of the state is included. This map, reprinted by the Illinois State Geological Survey on a scale of 1:500,000 in 1957, complements the drift thickness map (pl. 1) of the present report. Another major source of information on the history, classification, distribution, and physical characteristics of the glacial deposits is a report on the Pleistocene stratigraphy of Illinois by Willman and Frye (1970), in which geographic names are assigned to formations and members of the Pleistocene Series, to buried soils, and to deposits associated with certain landforms such as glacial end moraines. Willman and Frye's report gives a classification for the various Pleistocene units similar to that in use for the bedrock formations. Such a classification will eventually provide a basis for delineating the distribution and specific characteristics of the various materials described in general terms in the present report. The nature of the bedrock formations below the drift and the general features of the drift are shown on the state geologic map published by the Illinois Geological Survey (Willman and others, 1967).

It is anticipated that the information presented in this report has potential application to the study of both regions and sites. This information bears on ground-water exploration and development, drilling procedures, mining operations, construction, and waste disposal, in which the following aspects are pertinent: (1) thickness of drift (areas of thick drift or overburden, of thin drift, and of rock outcrop; depth to bedrock); (2) distribution of drift (location of outwash-filled bedrock valleys, moraines, lake plains, thick loess, and drift borders); and (3) nature of drift (texture of beds, vertical and lateral variability; presence of aquifers, impermeable beds, weathered zones, and loess).

## ORIGIN OF DRIFT

For convenience, the terms "drift" and "unconsolidated deposits" are used synonymously in this report to refer to the glacial, interglacial, and Holocene ("Recent") deposits of the Pleistocene Series (table 1), representing the latest division of geologic time. (Technically, the term "drift" is restricted to the glacial till and interbedded silt, sand, and gravel in the glaciated region and does not include the loess that mantles these deposits nor the recent alluvium along the stream valleys. Similarly, the term "unconsolidated deposits" includes consolidated, or cemented, sand and gravel in local areas but does not include unconsolidated older formations, such as the Cretaceous and Tertiary deposits of southern and western Illinois.)

As suggested by table 1, the Pleistocene history of Illinois, though geologically brief, is complex. Willman and Frye (1970) detail this history. From the time of the Nebraskan glacier, which advanced into midwestern United States from an ice center in northern Canada about a million years ago, Illinois has been repeatedly overridden by glaciers. The glaciers, carrying great quantities of rock debris, flowed southward during periods of cold and increased precipitation and then melted as the climate warmed. Drift sheets left by the glaciers were weathered during long, warm interglacial stages. For example, the Illinoian glacier advanced southward to Carbondale (fig. 1), and during the Sangamonian Stage (interglacial) that followed, drift from the glacier was weathered as deeply as 15 feet (Horberg, 1953, p. 28).

Wisconsinan drift was deposited on the weathered Illinoian drift in much of Illinois. Later, Holocene deposits of diverse origins were distributed over the glacial and interglacial sequences. Logs of representative wells passing through the drift are given in the appendix.

### Types of Deposits

The relations of the various earth materials of the drift to the land surface, glacial features, and bedrock surface are diagrammatically illustrated in figure 2. Glacial deposits can be differentiated into those deposited directly from the ice (till) and those modified by the associated meltwater into glaciofluvial (glacial river) and glaciolacustrine (glacial lake) deposits. Thornburn (1963, p. 16-25) presents a pertinent discussion of the character and origin of the glacial and related deposits of Illinois. Willman and Frye (1970) list and systematically describe these deposits.

#### Till

Till is ice-laid debris—a mixture of fragments of all sizes—rarely with any stratification. Commonly, it has a matrix of silt, clay, and sand in which pebbles, cobbles, and sometimes large boulders are imbedded. It occurs in the form of ridges called end moraines and intervening undulatory plains called ground moraines or till plains. The names of moraines, such as "Cerro Gordo Moraine," refer to the end moraines. Ground moraines, if named, bear the same name as the end moraine with which they are associated, for example, "Cerro Gordo ground moraine." "Cerro Gordo Drift" refers to deposits of both end and

TABLE 1 — CLASSIFICATION AND CHARACTER OF PLEISTOCENE DEPOSITS (DRIFT) IN ILLINOIS
(For more complete classification, see Willman and Frye, 1970, and Johnson et al., 1972)

| SYSTEM | SERIES | STAGE | SUBSTAGE | YEARS BEFORE PRESENT[1] | KINDS OF DEPOSITS | PRINCIPAL NAMED DEPOSITS | MORAINES AND MORAINIC SYSTEMS |
|---|---|---|---|---|---|---|---|
| QUATERNARY SYSTEM | PLEISTOCENE SERIES | HOLOCENE | | 7,000* | Clays, silts, sands, and gravels of present streams; slopewash sediments; lake and beach sediments; dune sands; swamp peat and muck. | Cahokia Alluvium | |
| | | WISCONSINAN | VALDERAN | 11,000* | Outwash. | Henry Formation; Equality Formation | |
| | | | TWOCREEKAN | 12,500* | Weathering products; not prominent in Illinois. | Peoria Loess | |
| | | | WOODFORDIAN | 22,000* | Tills, in many well developed moraines; loess, outwash; lake sediments. | Peoria Loess; Wedron Fm. | Lake Border M. S.<br>Many named moraines<br>Shelbyville M. S. |
| | | | FARMDALIAN | 28,000* | Silt, muck, and peat. | Robein Silt | |
| | | | ALTONIAN | 75,000 | Thick, extensive loesses; tills; outwash. | Roxana Silt; Winnebago Fm. | |
| | | SANGAMONIAN | | | Soil and weathering products; accretion-gley (slopewash) deposits. | | |
| | | ILLINOIAN | JUBILEEAN | | Tills, some in morainic forms; fossiliferous silts; outwash; mixed ice-contact deposits. | Loveland Silt; Pearl Formation; Glasford Formation | Buffalo Hart |
| | | | MONICAN | | | | Jacksonville<br>Oak Hill<br>Williamsfield<br>Oneida<br>Table Grove |
| | | | LIMAN | | | | Mendon |
| | | YARMOUTHIAN | | | Soil and weathering products; accretion-gley (slopewash) deposits. | | |
| | | KANSAN | | | Till, outwash, and slackwater silts. | Banner Fm.; Mahomet and Sankoty Sand Members | |
| | | AFTONIAN | | | Soil and weathering products; accretion-gley (slopewash) deposits. | | |
| | | NEBRASKAN | | 1,000,000 | Till and outwash of uncertain extent. | Enion Fm. | |

[1]From radiocarbon dating* or estimation.

ground moraines and all deposits of the glacier that deposited the Cerro Gordo Moraine. The named drifts associated with landforms such as moraines are units within a morphostratigraphic (morphē = form) classification of Pleistocene deposits (Willman and Frye, 1970).

The end moraines record times when the ice front temporarily maintained a fixed position. The moraine was built as rock debris was carried to the melting ice front. The intervening plains between end moraines record times when the front of the glacier melted back.

In composition, the tills of Illinois range from dense clayey silt with few pebbles to gravelly sand containing abundant stratified, water-sorted material. The finer grained tills are much more abundant than the coarser grained.

### Glaciofluvial Deposits

Glaciofluvial deposits were laid down by meltwater that was discharged along the front of the ice and through crevasses, tunnels, and channels extending back into the ice. The meltwater contained rock debris ranging from clay and rock flour to gravel. In response to changing volume and velocity of flow, the meltwater sorted the particles as it deposited them downstream. Sand and gravel generally were deposited as outwash plains close to the ice front, as along the moraine shown in figure 2, or as valley trains in channels that led meltwater away from the ice. The finer particles were carried farther, often not settling until they reached the quiet water of a lake. Other glaciofluvial deposits were formed as eskers, fillings of meltwater channels that flowed on or below the ice, or as kames, mounds of sediment where meltwater cascaded into holes in the ice.

The glaciofluvial deposits, especially the valley trains that are extensive along major valleys such as those of the Mississippi, Illinois, Rock, Kaskaskia, and Green Rivers (fig. 1), are important sources of sand and gravel and constitute the most widely used aquifer system in Illinois.

### Glaciolacustrine Deposits

Glaciolacustrine deposits consist of well-sorted sand and gravel accumulated along beaches of glacial lakes by wave action; inclined sand and gravel beds laid down in deltas; and fine sediment that settled in quiet waters offshore. Many glacial lakes formed behind end moraines in the northern half of Illinois and in sediment-dammed river valleys in the southern half of Illinois (fig. 1). In these places lake sediments form a veneer over glacial till. Fraser and Steinmetz (1971), Willman, Leonard, and Frye (1971), and Frye et al. (1972) have reported on the conditions of deposition, nature of deposits, and the faunas in some of the Pleistocene lakes. Gross et al. (1970), Lineback, Ayer, and Gross (1970), Lineback et al. (1971), Lineback, Gross, and Meyer (1972), and Lineback and Gross (1972) have reported on the Pleistocene deposits on the floor of Lake Michigan.

### Wind-Blown Deposits

Wind-blown sediment, chiefly silt, was widely distributed in Illinois during the glacial stages. The source of much of the silt was the river valleys that were partly filled with coarse- to fine-grained glacial outwash (Leighton and Willman, 1950, p. 606). The river flats, kept free of vegetation by frequent

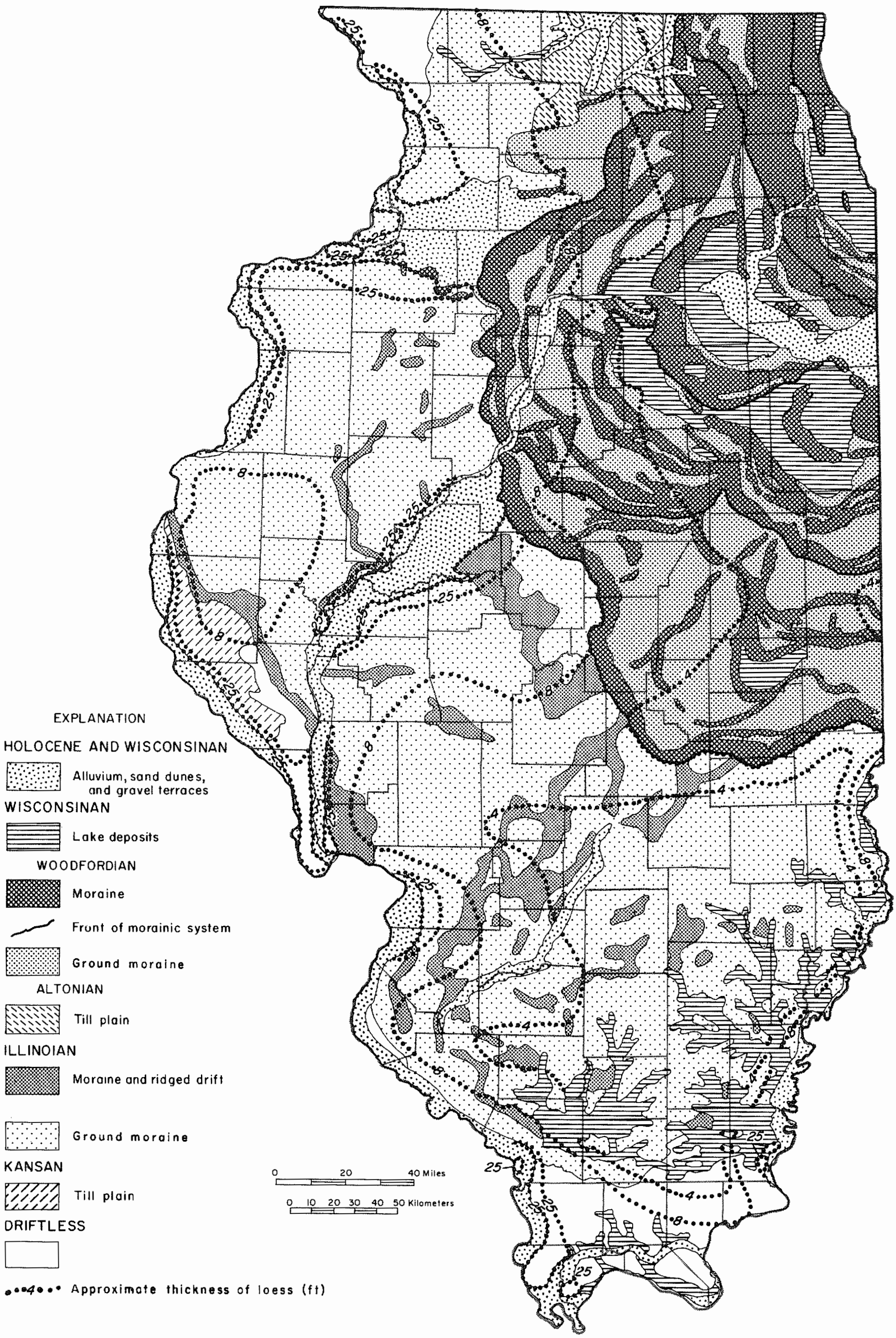


Fig. 1 - Glacial geology of Illinois (modified from maps by Willman and Frye, 1970).

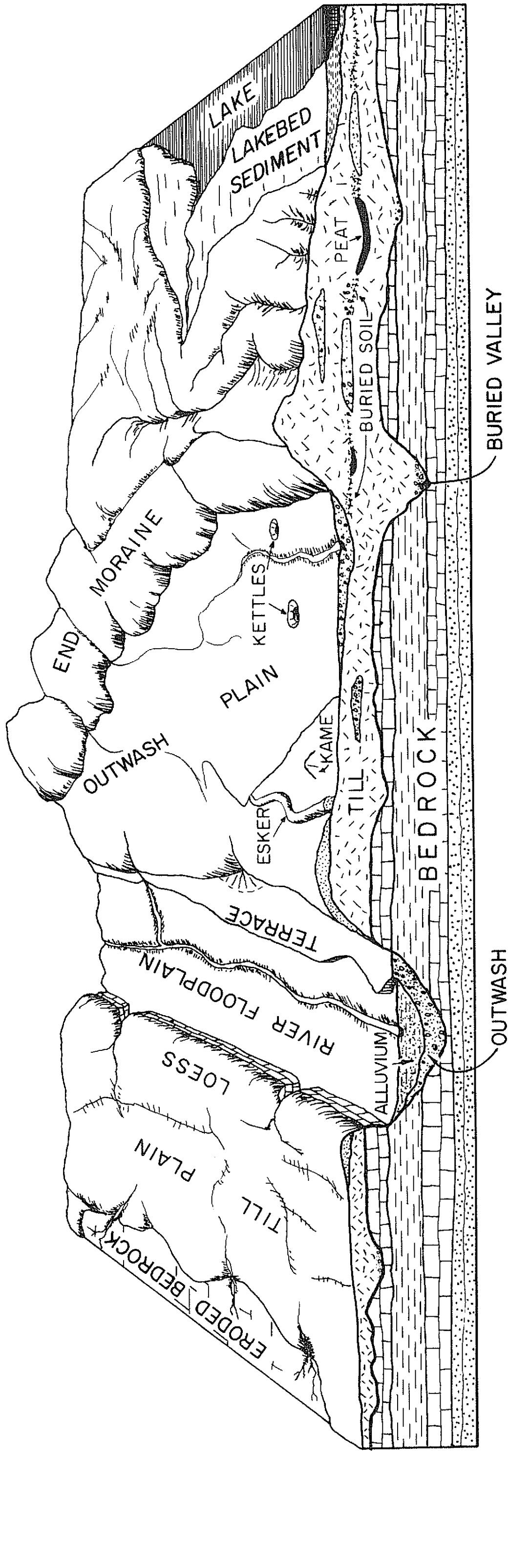


Fig. 2 - Block diagram showing relation of glacial and alluvial deposits to landforms and bedrock surface.

glacial flooding, were subject to wind erosion, and great volumes of silt were blown onto the uplands bordering the valleys and formed loess deposits. Because the winds were generally from the northwest, the loess deposits are thicker on uplands east of the main river valleys than on uplands west of the valleys (figs. 1 and 2). In some places on the east side of wide flats of the Mississippi and Illinois River Valleys, from 50 to almost 100 feet of loess caps the river bluffs (Smith, 1942). The loess becomes finer grained and thins rapidly away from the river valleys, but is widespread in the state. Loess deposits occur interbedded with glacial tills and as a mantle over some of the uppermost tills.

### Products of Weathering

The effects and products of the interglacial stages are observable in the drift in various degrees. In some places, humus, peat, wood, or other organic matter occurs between drift sheets. In other places, parts or all of a soil, or weathering, profile are found on a drift sheet; the profile consists from top downward of the following elements: (1) soil with humus and resistant residual pebbles, (2) clay-enriched subsoil, (3) leached and oxidized drift, (4) oxidized drift, and (5) unaltered drift (Horberg, 1953, p. 9). The profile indicates progressive weathering and alteration of the drift, with oxidation of iron compounds and leaching of carbonates advancing more rapidly than the decomposition of minerals to clays. A widely noted result of weathering of the drift sheets is the occurrence of oxidized brown till over more compact unoxidized blue and gray till. The buried soils indicated by the effects described above have been named (table 1) (Willman and Frye, 1970) and commonly have been used as marker horizons.

Another type of material that characterizes the weathered upper part of drift sheets is fine-textured sediment, largely clay, that was washed into shallow initial depressions in the till plain. This type of deposit, called accretion-gley, resembles the clay-enriched zone of a weathering profile but was formed by a different process and does not have great significance as a time indicator (Frye, Willman, and Glass, 1960, p. 19-20; Willman, Glass, and Frye, 1966).

### Holocene (Recent) Deposits

Many of the Holocene deposits (table 1) of Illinois are a result of the reworking or redistribution of glacial deposits. Silts, sands, and gravels are shifted about by scour and fill in floodplains (fig. 2). Coarse- to fine-grained sediments are deposited as alluvial fans where tributary streams of relatively high gradients enter the floodplain of a larger stream. Silts are carried by slopewash to lower ground and eventually into ponds, lakes, swamps, and streams. Along Illinois lakes, waves and shore currents are forming beach deposits. The wind has formed dunes in Holocene time, most of them south of Lake Michigan.

Organic matter is another component of Holocene deposition. Peat, marl, and driftwood are common in present-day floodplains. Many swamps in the poorly drained morainal areas and on the lake plain of Lake Michigan fill with water-bearing vegetation and other sediments, forming peat and muck.

The Holocene deposits, compared to the glacial deposits, constitute a minor part of the unconsolidated overburden of Illinois.

## Rocks Confused with Drift

The classification of shale in the geologic sequence in Illinois is sometimes misunderstood. Shale, which crops out or occurs at various depths in wide areas of Illinois, is part of the bedrock rather than part of the drift. However, some drillers have considered it drift and this has resulted in a misunderstanding about the securing of permits and payment of fees to the Department of Mines and Minerals when water wells are to penetrate the subsurface below the drift. In much of Illinois, where shales of the Pennsylvanian System form the uppermost bedrock, the drift is less than 50 feet thick. The Geologic Map of Illinois (Willman and others, 1967), which shows the distribution of bedrock formations below the drift, should be examined in conjunction with the drift thickness map (pl. 1) to determine depth to bedrock and kind of bedrock. Where shales are shown to constitute a large part of the uppermost bedrock, special care is required to distinguish drift from bedrock.

## THICKNESS OF DRIFT

### Method of Study and Extent of Data

The drift thickness map (pl. 1) is based on four sources of information—well records, refraction seismic determinations, drift thickness maps from previous areal investigations, and differences in elevation between land surface and mapped bedrock surface in selected areas where well data are sparse or poorly distributed. Altogether, about 18,600 drift thickness points were used in preparing the present map. A 25-foot thickness line was added to the map in revising the 1967 map (Piskin and Bergstrom, 1967). The distribution of control points and the areas for which drift thickness maps had previously been prepared are shown in figure 3.

The thickness of drift at about 16,000 points was plotted from key well records in the files of the Geological Survey. The records considered most reliable for determination of drift thickness were the logs of water wells, engineering borings, and coal borings; many of these have drill cuttings that have been interpreted by Survey personnel. Such records were used as a key in interpreting other kinds of records. Some data on drift thickness were obtained from records of oil wells in many localities in the southern part of the state. In some cases, subsurface samples were reexamined to verify the depth of bedrock.

Drift thickness maps for parts of the state have been made previously by Geological Survey personnel, chiefly in connection with ground-water investigations. These maps were incorporated, with modifications as necessary, in plate 1. Some of these maps are at present unpublished.

In area A (fig. 3), drift thickness maps were presented by Suter et al. (1959) for most of an eight-county area and by Zeizel et al. (1962) for Du Page County.

Drift thickness maps of Boone and De Kalb Counties (area B) were prepared by John P. Kempton (1968a, b) as part of a ground-water investigation. The adjacent area (C) was studied by James E. Hackett (1960); in this study 600 well records were used, of which about 200 are based on drill samples. Ogle County (D) was studied by Richard R. Parizek (1962).

Area E was studied by D. A. Stephenson (1967) relative to ground-water geology of part of the Mahomet Bedrock Valley. His drift thickness map, based largely on water well records, shows contours at a 50-foot interval. The southern part of McLean County of Stephenson's map was modified in preparing the drift thickness map for this report.

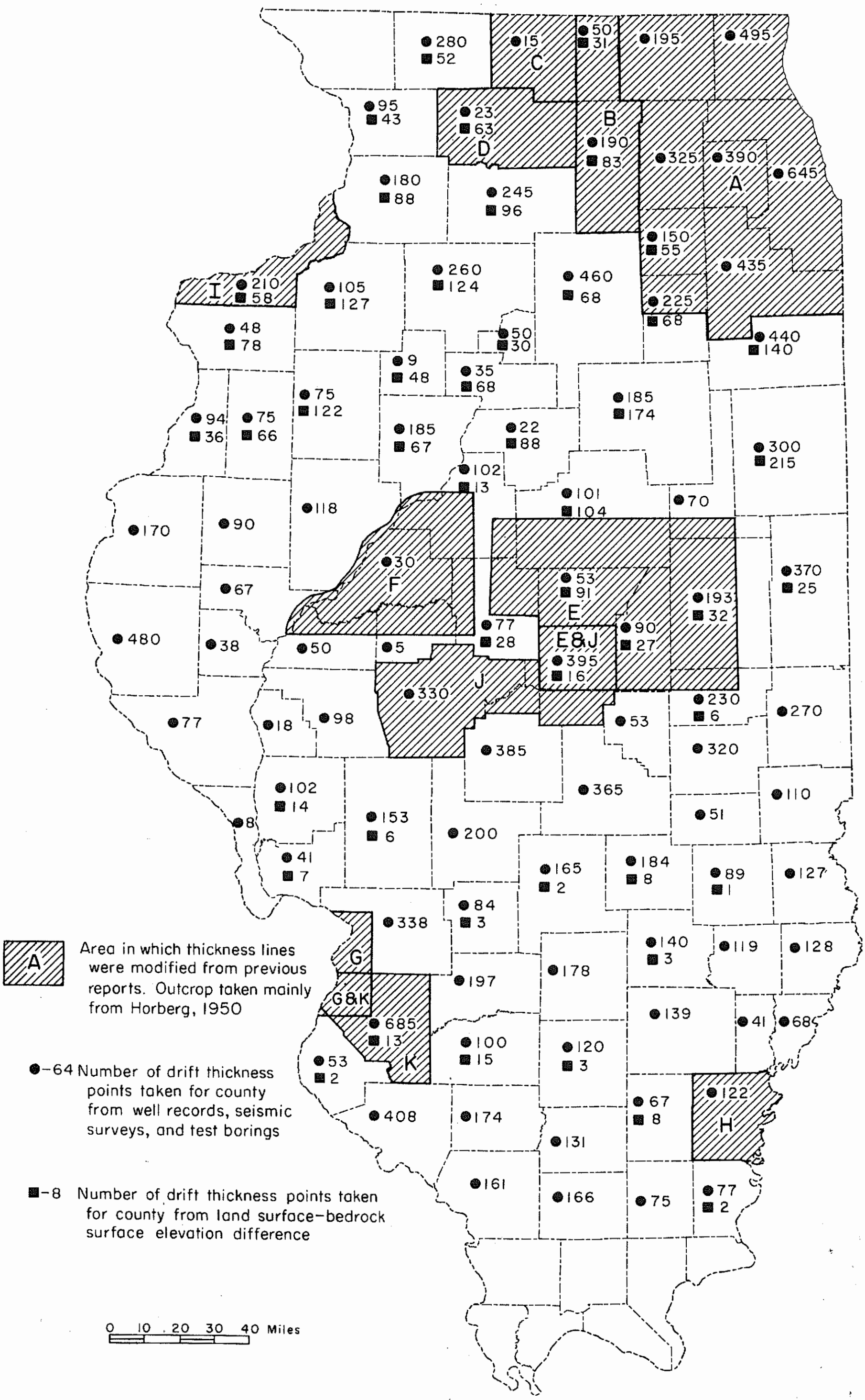


Fig. 3 - Sources of data for drift thickness map (pl. 1). (See page 35 for map of Illinois showing county names; previous reports on areas indicated by diagonal pattern are cited on pages 9 and 11.)

A drift thickness map on a 50-foot interval was prepared for area F by Walker, Bergstrom, and Walton (1965). This map was adapted for the present state map by using only the 50-, 100-, 200-, and 300-foot thickness lines.

For area G, Bergstrom and Walker (1956) presented a drift thickness map at a 20-foot contour interval. Some modifications of this map were made in preparing the present state map. Similarly, some revisions of a map of White County (H) by Pryor (1956b) were made for the state map. The contouring of Rock Island County (I) was revised from a map prepared by Richard C. Anderson in 1973. Drift thickness in Sangamon, Macon, and extreme northern Christian Counties (J) was adapted from a map for a regional geologic study for planning by Bergstrom, Piskin, and Follmer (in preparation). The thickness of drift in St. Clair County (K) also was adapted from a map for a planning study (Jacobs, 1971).

The other data on drift thickness came from calculated differences in elevation between land surface and mapped bedrock surface. Approximately 2,500 thicknesses were calculated in selected areas where well control is sparse. Land surface elevations were taken from U.S. Geological Survey quadrangle topographic maps, and bedrock surface elevations in most of the state were estimated from Horberg's bedrock topography map (1950, 1957). Most of the bedrock outcrop points were also taken from Horberg's map.

In addition to Horberg's bedrock surface map, for which data were compiled from all Survey reports published before 1950, the following bedrock surface maps were used: an unpublished map of Iroquois, northern Vermilion, and Ford Counties by Keros Cartwright (1970); a map of area E (fig. 3) by Stephenson (1967); and a map of the De Witt-McLean County area by Heigold, McGinnis, and Howard (1964).

## Factors Controlling Drift Thickness

Differences in the thickness of drift are a result of the depositional patterns of the ice, water, and wind that laid down the drift and of the subsequent erosion of the drift by ice and running water. In areas that were glaciated several times, including those that were covered by the latest glaciation, the Wisconsinan, thicker drift accumulated. In areas outside the Wisconsinan drift plain (fig. 1), the drift is thinner, for there were fewer and older glaciations and there has been time since the last (Illinoian) ice melted for extensive weathering and erosion to occur. The thickening of the drift from south to north and from west to east is illustrated by the cross-sections on plate 2 and by the drift thickness map (pl. 1). For example, cross-section F-F' in plate 2 shows the drift across the Illinoian till plain in the southern part of the state to be thin in contrast to the thick drift of the Wisconsinan ridged plain in the northern part (cross-section B-B'). In cross-section E-E', the thin Illinoian drift is on the left, the Shelbyville Moraines marking the Wisconsinan front are near the middle, and the thicker drift below the Wisconsinan drift plain is on the right.

The patterns of drift thickness shown in plate 1 reflect irregularities at the base of the drift (the bedrock surface) or at the top of the drift (present land surface), or both. An intricate erosion surface with valleys and uplands was developed on the uppermost bedrock before and during glacial times, with the result that the drift was deposited on a very uneven floor. The glaciers themselves fashioned many landforms, such as end moraines, kames, and eskers, that make the upper surface of the drift uneven; and in some areas erosion has produced further irregularities. The cross-sections (pl. 2) show that of the two surfaces involved—bedrock surface and present land surface—the bedrock surface has greater gross relief; the drift mantle has somewhat subdued the older topography. In general, then, drift thickness and the pattern of thickness lines reflect mainly the bedrock topography.

## Drift in Bedrock Valleys

Horberg's report (1950) on the bedrock topography of Illinois delineated the main valleys and upland surfaces and described the character of the drift fill in the valleys. The bedrock valley systems shown in figure 4 are taken basically from Horberg's report.

Comparison of plate 1 (generalized in fig. 5) with figure 4 and the cross-sections (pl. 2) shows that the areas of thickest drift correspond to the Princeton, Pawpaw, Troy, Middle Illinois, Mackinaw, Danvers, and Mahomet Bedrock Valleys and their tributaries. With the exception of the Middle Illinois, these valleys are almost completely buried by glacial drift and do not conform with present drainage lines. Where moraines (fig. 1) cross buried valleys or are aligned with them, the drift is further thickened. Drift thickness in the major buried bedrock valleys and in related present valleys and lowlands is summarized below.

### Princeton Bedrock Valley

The Princeton Bedrock Valley carried the Ancient Mississippi River eastward to the valley of the present Illinois River before being closed by drift deposited in Wisconsinan time, when the Mississippi assumed its present more westerly course. The valley underlies the Green River Lowland on the west and the Wisconsinan drift plain on the east (C-C', pl. 2). The valley is about 65 miles long and 3 to 7 miles wide.

In the Green River Lowland, the drift averages 160 feet in thickness, but over a deep bedrock channel in the middle of the Lowland, it probably attains a thickness of 225 feet. At Erie, a mile south of the deep channel, bedrock was reached at 167 feet. Where the bedrock valley passes under the Bloomington Morainic System and the Eureka-Dover Moraines, in central Bureau County, the drift averages 300 feet in thickness and attains a maximum thickness of more than 400 feet. A well at Princeton reached bedrock at 372 feet.

### Upper Rock River, Troy, and Pawpaw Bedrock Valleys

The Upper Rock River Bedrock Valley includes the bedrock valley system still followed by present drainage north of the Harrisville Moraine. From the point in southeastern Ogle County at which the bedrock valley passes southward under the Bloomington Moraines, it is known as Pawpaw Bedrock Valley. Troy Bedrock Valley, in Boone and De Kalb Counties (A-A', pl. 2), parallels the Upper Rock and Pawpaw Valleys, then joins Pawpaw Valley in southeastern Lee County. Pawpaw Valley joins Princeton Valley in Bureau County, in the vicinity of Princeton.

The Upper Rock River Bedrock Valley in Illinois is nearly 45 miles long and from $1\frac{1}{2}$ to $3\frac{1}{2}$ miles wide. The thickness of the drift ranges from 150 to 400 feet and averages 200 feet. At Rockford, wells commonly reach bedrock at depths of more than 200 feet. In Pecatonica River Valley, the drift averages 125 feet in thickness and attains a maximum of more than 250 feet.

Pawpaw Bedrock Valley is about 45 miles long and up to 8 miles wide. The drift is mainly 350 to 550 feet thick (B-B', pl. 2) and in a few places is probably 600 feet thick. The thickest drift in the state is found in southeastern Lee County, where the Bloomington Moraines cross Pawpaw Bedrock Valley. At Pawpaw, bedrock is reached at a depth of about 450 feet. The nature of the drift in the lower Pawpaw Valley is illustrated by the log of well 6 (appendix).

Troy Bedrock Valley is completely filled by drift, except for a few miles in southwestern Boone and southeastern Winnebago Counties where it is occupied by the Kishwaukee River. The valley is 60 miles long and $1\frac{1}{2}$ to 3 miles wide (McGinnis, Kempton, and Heigold, 1963). In southern De Kalb County, the drift exceeds 400 feet in thickness, and in northeastern Boone and northwestern McHenry Counties, it may be 500 feet thick. A core boring drilled for the Northeastern Illinois Metropolitan Area Planning Commission in sec. 7, T. 46 N., R. 5 E., in northwestern McHenry County (Lund, 1965, p. 43-52) passed through a typical Wisconsinan till and gravel sequence (well 7, appendix) and reached bedrock at about 474 feet.

### Ticona Bedrock Valley

Ticona Bedrock Valley joins Princeton Bedrock Valley just east of Hennepin, Putnam County, and is entirely buried eastward to the western boundary of Grundy County. The drift attains a thickness of more than 200 feet (B-B', pl. 2).

### Newark Bedrock Valley

Newark Bedrock Valley, of Kane, Kendall, and Grundy Counties, may have carried the headwaters of Kempton Bedrock Valley of Livingston and Grundy Counties. Newark Valley is about 1 mile wide and is entirely buried by drift ranging from 50 to approximately 200 feet in thickness (C-C', pl. 2).

### Illinois Valley

From Hennepin southward, the Illinois River flows in an alluviated bedrock valley that is composed of segments of different ages and has various thicknesses of fill. The Middle Illinois Bedrock Valley, between Hennepin and Peoria, is about 35 miles long and about 7 miles wide, whereas the present Illinois River Valley is about 4 miles wide (C-C', pl. 2). The western bluff of the river coincides with the western edge of the bedrock valley. Drift beneath the river floodplain attains a maximum thickness of 200 feet, whereas beneath the upland, over the bedrock channel east of the river, the drift is up to 350 feet thick.

Just north of Peoria, the wide, deep bedrock valley angles southeast beneath the upland, where it is called Mackinaw Bedrock Valley. The Illinois River continues south, first passing through a narrow, shallow bedrock gorge between Peoria and East Peoria and then following a slightly wider bedrock channel (Pekin-Sankoty) that diverges from the main bedrock valley just north of Peoria and passes under western Peoria and past Pekin to the Havana Lowland. The channel is 2 to 3 miles wide, in places underlies the upland, and in places underlies the present floodplain.

Within the narrow gorge between Peoria and East Peoria, the drift—outwash and Holocene alluvium—attains a thickness of 100 feet. Over the Pekin-

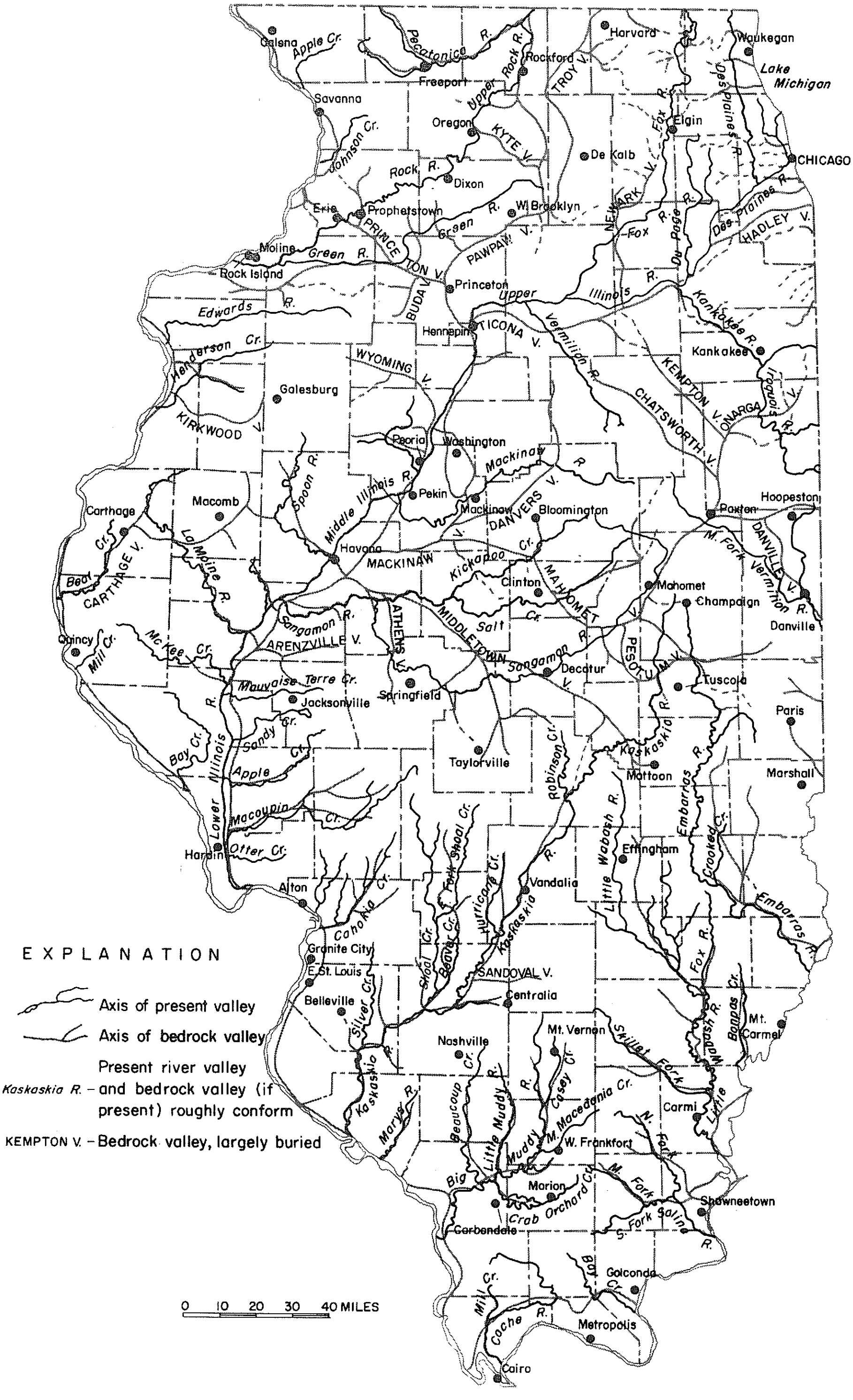


Fig. 4 - Axes of present valleys and bedrock valleys.

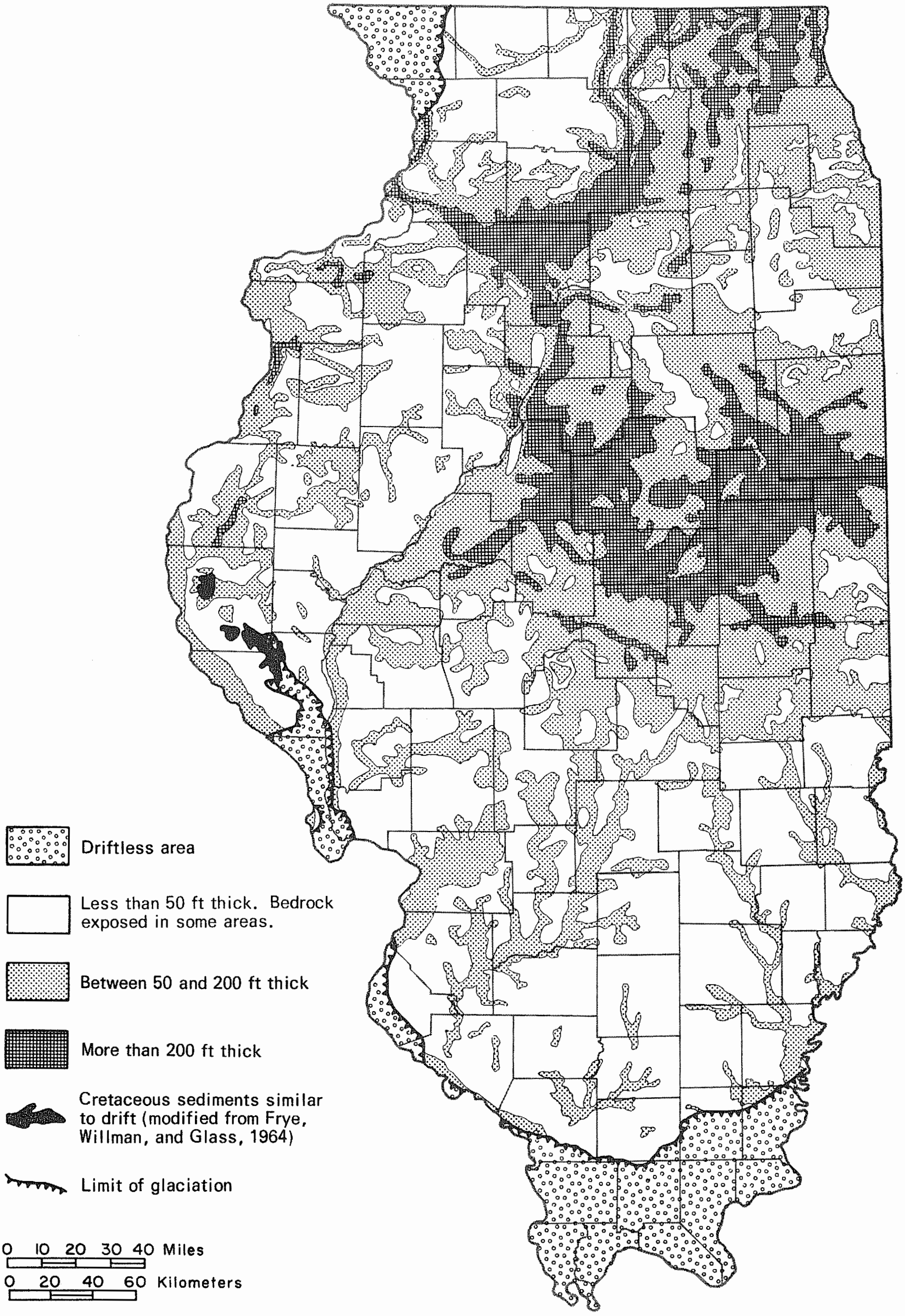


Fig. 5 - Generalized drift thickness in Illinois.

Sankoty Bedrock Channel, glacial deposits may reach a thickness of 400 feet under the present upland and are about 120 feet thick below the present floodplain.

South of Pekin, the Illinois River crosses the western part of a wide lowland. Here the drift ranges from less than 50 feet in thickness beneath the floodplain, west of the river, to more than 200 feet east of the river, where river terraces with sand dunes overlie the deepest part of the bedrock valley (D-D', pl. 2). Where the Illinoian and Wisconsinan drift uplands, which contain loess deposits, overlie the deep part of the bedrock valley, the drift reaches 400 feet in thickness.

The Illinois River Bedrock Valley becomes progressively narrower south of the Havana Lowland, decreasing from 6 miles in width at Beardstown to slightly more than 2 miles in width at the mouth of the river. The average thickness of the fill in the valley is 125 feet, and the maximum is about 175 feet.

### Mackinaw Bedrock Valley

The Mackinaw Bedrock Valley is 5 to 10 miles wide and extends from western Woodford County to southern Tazewell County, where it joins the Mahomet Bedrock Valley. Between 300 and 500 feet of drift overlies the valley. At Washington, Tazewell County, a well over the valley reached bedrock at 370 feet. At Mackinaw, Tazewell County, a well reached bedrock at 380 feet.

### Danvers Bedrock Valley

The Danvers Bedrock Valley, an east-side tributary of Mackinaw Valley, is from 3 to 9 miles wide in Livingston, Woodford, and Tazewell Counties and is overlain by 100 to more than 400 feet of drift.

### Mahomet Bedrock Valley

The Mahomet Bedrock Valley and its tributaries are well defined by belts of thick drift in east-central Illinois. Originally described by Horberg (1945, 1950), the Mahomet Valley enters Illinois at the northeastern corner of Vermilion County and joins the Mackinaw Bedrock Valley in southern Tazewell County. The axes of the valley and its tributaries, shown in figure 4, are essentially from Horberg (1950, pl. 2), with modifications by Cartwright (1970); Heigold, McGinnis, and Howard (1964); and Stephenson (1967). The chief modification is the movement of the valley axis eastward 5 or 6 miles in De Witt County. The modifications are based on additional subsurface data and on seismic investigations.

The Mahomet Valley is about 135 miles long in Illinois, and the belt of thick drift (300 feet or more) over the valley is at least 3 miles wide and locally up to 10 miles wide (B-B', E-E', pl. 2). The maximum thickness of drift penetrated in a well to date is 447 feet at Paxton, Ford County. Thick drift (more than 400 feet) is found in the vicinities of Hoopeston and Rankin in Vermilion County, Kenney in De Witt County, and Mahomet in Champaign County, where moraines cross the bedrock valley. In the eastern part of the valley, the drift may attain a thickness of 500 feet. Typical deposits of the Mahomet Valley are illustrated by the log of well 4 (appendix).

### Kempton-Chatsworth-Onarga Bedrock Valleys

The Kempton-Chatsworth-Onarga Bedrock Valleys, a tributary system of the Mahomet, localize belts of thicker drift in Iroquois, northern Ford, and eastern Livingston Counties. At the junction of the Kempton and Mahomet Valleys, the drift is more than 400 feet thick, whereas up valley in the three tributaries, the drift is more than 200 feet thick.

Middletown Bedrock Valley

The position of the lower course of the Middletown Bedrock Valley (fig. 4) is modified from Walker, Bergstrom, and Walton (1965) rather than Horberg. The Middletown Valley and a tributary, Athens Bedrock Valley, are sites of thicker drift in Menard, Logan, Sangamon, Christian, Macon, and Moultrie Counties (D-D', pl. 2). Wells at Middletown, in western Logan County, are about 150 feet deep and are finished in sand and gravel on the western flank of the Middletown Valley. Farther east, over the axis of the valley, the drift attains a thickness of more than 200 feet.

Present Drainages

The Mississippi, Kaskaskia, Big Muddy, Wabash, Embarras, Little Wabash, Ohio, and Cache River Valleys generally contain thicker unconsolidated deposits than the regions they cross.

Deposits in the bedrock channel of the Mississippi Valley north of Princeton Valley range in thickness from about 140 feet to possibly more than 300 feet, the average being more than 150 feet. A thickness of 340 feet is reported by Horberg (1950, p. 46) for a well at Dubuque, Iowa, across the river from the northwestern corner of Illinois. In the Mississippi Valley, between Princeton Valley and the mouth of the Illinois River, the deposits have an average thickness of 150 feet and locally are more than 200 feet thick. In several places (fig. 1), the river is directly against the bluff and at these places there is essentially no floodplain in Illinois. The fill in the Mississippi Valley south of the Illinois River ranges in thickness from 125 feet to more than 170 feet. In the American Bottoms, in Madison County, the valley fill exceeds 170 feet in thickness below a terrace at Wood River (F-F', pl. 2) (Bergstrom and Walker, 1956).

Deposits in the Kaskaskia and Big Muddy Valleys reach thicknesses of 125 feet (F-F', pl. 2). The bedrock valleys do not conform to the present valleys in all courses of the streams.

Deposits in the Wabash Valley are 100 to 150 feet thick. In a long stretch of the Embarras Valley and in portions of the Little Wabash River Valley, they are more than 100 feet thick.

Approximately 25 miles south of the Illinoian drift border, the Cache Bedrock Valley, a former course of the Ohio River, contains as much as 160 feet of pebbly sand. The valley fill of the Ohio and Mississippi Rivers at the very southern tip of the state is as much as 250 feet thick (Pryor and Ross, 1962). The alluvial deposits in the Black Bottom area of the Ohio River floodplain in the southeastern part of the state are up to 100 feet thick (Ross, 1964).

## Drift on Bedrock Uplands

The drift on the bedrock uplands in wide stretches of northwestern, western, and southern Illinois is less than 50 feet thick. In many places—on hillsides, in river bluffs, or in tributary creek beds or ravines—the drift has been removed by erosion, exposing bedrock. The areas of thin, eroded drift of western and southern Illinois (fig. 5) approximately coincide with the Illinoian drift plain (fig. 1).

Within the Wisconsinan drift plain, thin eroded drift overlies the bedrock uplands in northwestern Illinois and in La Salle, Livingston, Kendall, Grundy, Will, and Kankakee Counties. Fairly thick drift, commonly 100 feet thick or more, overlies the bedrock uplands in east-central and northeastern Illinois. As shown by the cross-sections (pl. 2), drift more than 100 feet thick over bedrock uplands usually occurs only where moraines are present.

### Surficial Features

In addition to reflecting features of the bedrock surface, the drift thickness map shows some of the moraines, terraces, and dunes and many of the drainage lines of the present landscape. The thickening of the drift to more than 50 feet in east-central Illinois marks the Shelbyville Moraines. The Valparaiso and Lake Border Moraines in northeastern Illinois are marked by belts of drift from 100 to more than 200 feet thick. Small, closed, irregular thickness lines, showing 200 and 300 feet of drift in Mason County, reflect dunes on terraces and on the drift plain of the Havana Lowland. If data were available, additional closed contours showing local thickening of drift would probably be shown adjacent to the Illinois and Mississippi Valleys where thick deposits of loess occur.

The present major drainages—such as the Mississippi and lower Illinois Rivers—are accentuated by bands of rock outcrops along linear belts of thicker drift. Many of the smaller tributary streams are marked by dendritic belts of rock outcrop, showing that they are flowing on rock with essentially no fill. The course of the lower Des Plaines River is marked in this fashion.

## CHARACTER OF DRIFT

### Wisconsinan Deposits

Deposits of the Wisconsinan Stage (table 1) are the uppermost earth materials in much of Illinois. The most prominent area of Wisconsinan deposits is the ridged plain north of Shelbyville and east of Peoria (fig. 1) that includes almost 100 named end moraines (Willman and Frye, 1970). These deposits average 75 to 100 feet in thickness and attain a maximum thickness of about 250 feet (Horberg, 1953, pl. 1). They consist essentially of tills, with some loess, lake sediments, and outwash, and are divided into formations and members on the basis of physical characteristics. The log of well 1 (appendix) in Lake County illustrates a fairly typical Wisconsinan sequence in northeastern Illinois.

The Wisconsinan tills are generally less compact, lighter in color, and have a shallower profile of weathering than the older glacial deposits; the average depth of leaching is about 3 feet (Horberg, 1953, p. 38). In subsurface, there is less outwash associated with till sheets than in the Illinoian deposits. Pebbles constitute 1 or 2 percent to more than 80 percent of the tills and commonly constitute 5 to 10 percent (Krumbein, 1933; Anderson, 1955, 1957). The tills range in texture from clayey to sandy and gravelly (Krumbein, 1933; Willman, Payne, and Voskuil, 1942; Bretz, 1955; Horberg and Potter, 1955; Shaffer, 1956; Kempton, 1963; Frye, Glass, and Willman, 1969; Johnson et al., 1971). Extensive data reported by Willman and Frye (1970) show that the matrix of the Wisconsinan tills tends to be clayey to silty rather than sandy. Data on the physical, chemical, and engineering properties of the surficial deposits of the region are given by Wascher et al. (1960) and Thornburn (1963).

Outwash, ranging from gravel to silt, occurs in valleys that pass through and beyond the Wisconsinan drift border and in outwash plains that border moraines. Two of the largest outwash areas, the Green River-lower Rock River basin (Leighton, Ekblaw, and Horberg, 1948, p. 25) and the Havana region of the Illinois River (Walker, Bergstrom, and Walton, 1965), contain sand and gravel deposits that are essentially continuous to bedrock (fig. 1; pl. 2); but in these areas there is also fine-grained Holocene alluvium along present streams. The log of well 2 (appendix) illustrates the sand and gravel sequence near Havana. The Kaskaskia, Little Wabash, and Embarras Rivers (figs. 1 and 4) all contain valley-train deposits that head within the Wisconsinan drift plain and become finer downstream. Horberg (1950) describes the outwash of the valley systems.

Much glaciofluvial sand and gravel is present in the form of outwash plains, valley trains, and kames in McHenry and Kane Counties in northeastern Illinois (Ekblaw and Lamar, 1964). The deposits here overlie fairly thick till. The occurrence and nature of other surficial and shallow sand and gravel deposits of Wisconsinan age are described in county sand and gravel resource reports and in quadrangle and other regional geologic reports. Anderson described the sand and gravel resources in Champaign (1960) and De Kalb (1964) Counties and along the Rock River (1967). Anderson and Block reported on McHenry County (1962); Anderson and Hunter, on Peoria County (1965); Block, on Kane County (1960); Hunter, on Tazewell County (1966); Hunter and Kempton, on Boone County (1967); Hester, on Sangamon County (1970); and Hester and Anderson, on Macon County (1969). Willman and Frye (1969) reported on high-level outwash in northwestern Illinois. In 1923, Bretz reported on the geology and mineral resources of the Kings Quadrangle, and in 1939, he described the geology of the Chicago region. Willman, Payne, and Voskuil (1942) described the geology and mineral resources of the Marseilles, Ottawa, and Streator Quadrangles. The Beardstown, Glasford, Havana, and Vermont Quadrangles were covered by Wanless (1957). The geology of the Buda Quadrangle was described by MacClintock and Willman (1959). Willman (1971) summarized the geology of northeastern Illinois.

The occurrence of deeper outwash of Wisconsinan age and older is described in reports that deal primarily with ground water. Horberg (1950) described the bedrock topography of Illinois and later (1953) the Pleistocene deposits below the Wisconsinan drift in northeastern Illinois. Bergstrom et al. (1955) described ground-water possibilities in northeastern Illinois, and Suter et al. (1959) described ground-water resources of the Chicago region. Hackett and Bergstrom (1956) reported on ground water in northwestern Illinois; Selkregg and Kempton (1958), on ground water in east-central Illinois; Bergstrom (1956) and Bergstrom and Zeizel (1957), on ground water in western Illinois; Selkregg, Pryor, and Kempton (1957), on ground water in south-central Illinois; and Pryor (1956a), on ground water in southern Illinois. Ground-water resources of Du Page County were described by Zeizel et al. (1962). Foster (1956) described the ground-water geology of Lee and Whiteside Counties. Hackett (1960) reported on Winnebago County, and the ground-water geology of White County was described by Pryor (1956b). Walker, Bergstrom, and Walton (1965) described ground-water resources of the Havana region. The East St. Louis area was described by Bergstrom and Walker (1956). Horberg, Suter, and Larson (1950) described ground water in the Peoria region, and Foster and Buhle (1951) investigated aquifers in glacial drift near Champaign-Urbana.

Wisconsinan loess is widespread in Illinois and constitutes the parent materials of the modern soils in much of the state. Where viewed in road cuts or river bluffs, it usually appears as massive yellowish to reddish brown silt that stands in steep vertical faces. It is thickest and coarsest on the lee sides of the Mississippi, Illinois, Green, and Ohio Rivers (fig. 1; Smith, 1942 [fig. 3]), especially adjacent to the wider stretches of valley flat. For example, east of the wide American Bottoms at East St. Louis the loess is about 70 feet thick, and in Cass County, adjacent to the broad valley at Havana, the loess in a few places is more than 90 feet thick. The loess decreases rapidly in thickness and coarseness within 2 or 3 miles of the river bluffs, then thins and gradually becomes finer grained. In much of Illinois, the loess is only a few feet thick. Along the river bluffs, where the loess is thick, it is commonly calcareous and contains small fossil snail shells. Away from the valley, where the loess thins, it is usually leached and unfossiliferous.

The loess consists of a distinct succession of deposits that have been intensively studied (Smith, 1942; Leighton and Willman, 1950; Frye and Willman, 1960; Leonard and Frye, 1960; and Frye, Glass, and Willman, 1962, 1968).

## Illinoian Deposits

Illinoian deposits with a cover of Wisconsinan loess vary in thickness and extend into southern Illinois to about 8 or 10 miles south of Carbondale and into western Illinois approximately to the Mississippi River (fig. 1). Illinoian drift has been traced beneath the Wisconsinan drift of northeastern Illinois for many miles (Horberg, 1953, p. 26).

Several Illinoian moraines occur in the western part of the state (fig. 1), but no continuous end moraine developed at the border of the Illinoian drift. The Illinoian is characterized by a relatively high proportion of outwash and by hard, silty, brownish gray or dark gray tills. The log of well 3 (appendix) in Montgomery County illustrates the nature of the Illinoian drift.

At the top of the Illinoian till the intensely weathered zone is as much as 6 feet thick and averages about 2 feet. The till is leached to a depth of 5 to 12 feet, with an average of about 8 feet, and the oxidized zone extends down to 12 to 15 feet below the surface (Horberg, 1953, p. 28). A very clayey deposit, called accretion-gley, that accumulated in low places on the till plain is common in many areas. Where Wisconsinan and Illinoian tills can be compared in one exposure, the Illinoian till is much more compact and jointed. Beds of sand and gravel are common at the base, in the middle, and at the top of the Illinoian deposits.

Data on the texture and mineralogy of the Illinoian tills are given by Horberg (1956); Frye, Willman, and Glass (1960); Willman, Glass, and Frye (1963, 1966); and Willman and Frye (1970). Descriptions of the Illinoian deposits in various areas of Illinois are given by Horberg, Suter, and Larson (1950); Foster and Buhle (1951); Pryor (1956a); Wanless (1957); Johnson (1964); Jacobs and Lineback (1969); Frye, Glass, and Willman (1969); Johnson (1971); and Johnson et al. (1971).

## Pre-Illinoian Deposits

Pre-Illinoian deposits are irregularly distributed in Illinois. Their extent is not well known, and, where present, they are usually overlain by younger drift. Only in western Hancock, Adams, and Pike Counties does the older drift—the Kansan—emerge from beneath the outer edge of the Illinoian (fig. 1).

The older drifts are usually identified by weathered zones at their tops and by their occurrence below the Illinoian drift. They are commonly dark colored, oxidized, and dense and frequently contain wood fragments and peaty material. The mineralogy of the pre-Illinoian drift has been studied by Willman, Glass, and Frye (1963), and areal descriptions of the Kansan deposits are given by Horberg (1956), Wanless (1957), Johnson (1964, 1971), and Willman and Frye (1969, 1970).

In the Champaign-Urbana area, and extensively along the Mahomet Bedrock Valley, the Kansan deposits consist of yellow-brown to gray, pebbly, silty till underlain by thick beds of sand and gravel that extend to bedrock. The thickness of the sand and gravel ranges up to about 150 feet (Foster and Buhle, 1951, p. 381-383). Horberg (1953, p. 18) applied the name "Mahomet Sand" to the thick sand and gravel beds overlying bedrock in the Mahomet Bedrock Valley (pl. 2) and considered them similar in age and origin to the Sankoty Sand of the Ancient Mississippi Valley. The log of well 4 (appendix) illustrates the nature of the Mahomet Sand and overlying Illinoian and Wisconsinan deposits in the Mahomet Valley in Champaign County.

The Sankoty Sand (Horberg, 1950, p. 34-36) is a continuous fill along the Ancient Mississippi Valley (pl. 2) and has been recognized in cuttings from wells as far south as Havana in Mason County and as far north as Prophetstown in southern Whiteside County (Horberg, 1953, p. 13-18). The sand is commonly medium grained, but the deposits range from fine-grained silty sand to coarse-grained gravelly beds. The thickness of the sand varies greatly; the maximum thickness may be almost 300 feet, but the average is closer to 100 feet. The position and nature of the Sankoty Sand in Mason and Bureau Counties are illustrated in logs 4 and 5 (appendix).

The Sankoty and Mahomet Sands are economically the most important Kansan deposits, for they constitute one of the most prolific aquifer systems in Illinois, providing water for many towns and industries in a part of the state where no other highly permeable aquifers are present.

The Nebraskan glacier invaded western Illinois, but its deposits have been so extensively eroded that the extent of the area it covered is highly indefinite. Nebraskan deposits probably constitute an insignificant part of the drift mantle of Illinois.

Some sand, gravel, and clay deposits up to 100 feet thick in Adams and Pike Counties, east of Quincy (fig. 5), have been interpreted as Cretaceous in age (Frye, Willman, and Glass, 1964). They differ markedly in mineralogy from the glacial deposits.

## CONCLUSIONS

The thickness and character of drift in Illinois have practical implications for individual, industrial, and administrative interests in the state. In this report we have summarized the main features of the drift. We have shown that the drift includes many kinds of earth materials and varies in character and thickness from place to place. Geologically speaking, these materials are relatively young and were formed on land, as opposed to the layered (and usually cemented or consolidated) bedrock that underlies the drift, that is many millions of years older than the drift, and that was formed from sediments deposited in or close to the sea. Shale is part of the bedrock, not of the drift.

The drift is thin and the bedrock is widely exposed in southern and western Illinois and the part of northeastern Illinois adjacent to the Illinois, Des Plaines, and Kankakee Rivers. These areas may be of special interest to industries that quarry limestone, sandstone, or shale, or that mine coal. The Geologic Map of Illinois shows the nature of the bedrock.

Public health officials have different interests in the thickness and nature of the drift and the kind of bedrock directly below. For example, where limestone or dolomite is the uppermost bedrock, crops out extensively, and is only partly covered by thin drift, there are opportunities for pollutants to enter the ground-water reservoir and travel for considerable distances through joints and channels. Furthermore, burial of wastes in these areas introduces the danger of pollution.

Thin drift and extensive rock outcrop, as opposed to thick drift, create some problems in highway and building location and construction. Drift thickness is also of interest to the drilling industry, particularly with regard to setting surface casing.

In Illinois the drift is thickest in the present major river valleys, in buried bedrock valleys, and regionally in the northeastern quarter, which was covered by the Wisconsinan glacier. The drift is more than 200 feet thick in some of the major valleys and beneath some of the moraines and attains a maximum thickness of some 600 feet in the Pawpaw Bedrock Valley in southeastern Lee County.

The areas of thicker drift, which are commonly situated along valleys where glacial meltwater deposited sand and gravel, are the most favorable areas for developing ground-water supplies. In most of the southern two-thirds of the state, where the bedrock yields only modest supplies of ground water, the drift in bedrock valleys is the only source of large supplies, such as those required for municipalities, industries, and irrigation.

## REFERENCES

Anderson, R. C., 1955, Pebble lithology of the Marseilles till sheet in northeastern Illinois: Journal of Geology, v. 63, no. 3, p. 243.

Anderson, R. C., 1957, Pebble and sand lithology of the major Wisconsin glacial lobes of the central lowland: Bulletin of the Geological Society of America, v. 68, no. 11, p. 1415-1450.

Anderson, R. C., 1960, Sand and gravel resources of Champaign County, Illinois: Illinois Geological Survey Circular 294, 15 p.

Anderson, R. C., 1964, Sand and gravel resources of DeKalb County: Illinois Geological Survey Circular 367, 16 p.

Anderson, R. C., 1967, Sand and gravel resources along the Rock River in Illinois: Illinois Geological Survey Circular 414, 17 p.

Anderson, R. C., 1973, Drift thickness map of Rock Island County, Illinois: Unpubl. map, Illinois Geological Survey.

Anderson, R. C., and D. A. Block, 1962, Sand and gravel resources of McHenry County, Illinois: Illinois Geological Survey Circular 336, 15 p.

Anderson, R. C., and R. E. Hunter, 1965, Sand and gravel resources of Peoria County: Illinois Geological Survey Circular 381, 16 p.

Bergstrom, R. E., 1956, Ground-water geology in western Illinois, north part: Illinois Geological Survey Circular 222, 24 p.

Bergstrom, R. E., J. W. Foster, L. F. Selkregg, and W. A. Pryor, 1955, Ground-water possibilities in northeastern Illinois: Illinois Geological Survey Circular 198, 24 p.

Bergstrom, R. E., Kemal Piskin, and L. R. Follmer, in preparation, Geology for planning in the Springfield-Decatur region, Illinois: Illinois Geological Survey Circular.

Bergstrom, R. E., and T. R. Walker, 1956, Ground-water geology of the East St. Louis area, Illinois: Illinois Geological Survey Report of Investigations 191, 44 p.

Bergstrom, R. E., and A. J. Zeizel, 1957, Ground-water geology in western Illinois, south part: Illinois Geological Survey Circular 232, 28 p.

Block, D. A., 1960, Sand and gravel resources of Kane County, Illinois: Illinois Geological Survey Circular 299, 11 p.

Bretz, J H., 1923, Geology and mineral resources of the Kings Quadrangle: Illinois Geological Survey Bulletin 43C, 100 p.

Bretz, J H., 1939, Geology of the Chicago region. Part I. General: Illinois Geological Survey Bulletin 65, pt. I, 118 p.

Bretz, J H., 1955, Geology of the Chicago region. Part II. The Pleistocene: Illinois Geological Survey Bulletin 65, pt. II, 132 p.

Cartwright, Keros, 1970, Drift thickness map of Iroquois, northern Vermilion, and Ford Counties, Illinois: Unpubl. map, Illinois Geological Survey.

Ekblaw, G. E., and J. E. Lamar, 1964, Sand and gravel resources of northeastern Illinois: Illinois Geological Survey Circular 359, 8 p.

Foster, J. W., 1956, Ground-water geology of Lee and Whiteside Counties, Illinois: Illinois Geological Survey Report of Investigations 194, 67 p.

Foster, J. W., and M. B. Buhle, 1951, An integrated geophysical and geological investigation of aquifers in glacial drift near Champaign-Urbana, Illinois: Illinois Geological Survey Report of Investigations 155, 31 p.

Fraser, G. S., and J. C. Steinmetz, 1971, Deltaic sedimentation in glacial Lake Douglas: Illinois Geological Survey Circular 466, 12 p.

Frye, J. C., H. D. Glass, and H. B. Willman, 1962, Stratigraphy and mineralogy of the Wisconsinan loesses of Illinois: Illinois Geological Survey Circular 334, 55 p.

Frye, J. C., H. D. Glass, and H. B. Willman, 1968, Mineral zonation of Woodfordian loesses of Illinois: Illinois Geological Survey Circular 427, 44 p.

Frye, J. C., H. D. Glass, and H. B. Willman, 1969, Glacial tills of northwestern Illinois: Illinois Geological Survey Circular 437, 47 p.

Frye, J. C., A. B. Leonard, H. B. Willman, and H. D. Glass, 1972, Geology and paleontology of late Pleistocene Lake Saline, southeastern Illinois: Illinois Geological Survey Circular 471, 44 p.

Frye, J. C., and H. B. Willman, 1960, Classification of the Wisconsinan Stage in the Lake Michigan glacial lobe: Illinois Geological Survey Circular 285, 16 p.

Frye, J. C., H. B. Willman, and H. D. Glass, 1960, Gumbotil, accretion-gley, and the weathering profile: Illinois Geological Survey Circular 295, 39 p.

Frye, J. C., H. B. Willman, and H. D. Glass, 1964, Cretaceous deposits and the Illinoian glacial boundary in western Illinois: Illinois Geological Survey Circular 364, 28 p.

Gross, D. L., J. A. Lineback, W. A. White, N. J. Ayer, Charles Collinson, and H. V. Leland, 1970, Preliminary stratigraphy of unconsolidated sediments from the southwestern part of Lake Michigan: Illinois Geological Survey Environmental Geology Note 30, 20 p.

Hackett, J. E., 1960, Ground-water geology of Winnebago County: Illinois Geological Survey Report of Investigations 213, 63 p.

Hackett, J. E., and R. E. Bergstrom, 1956, Ground water in northwestern Illinois: Illinois Geological Survey Circular 207, 25 p.

Heigold, P. C., L. D. McGinnis, and R. H. Howard, 1964, Geologic significance of the gravity field in the DeWitt-McLean County area, Illinois: Illinois Geological Survey Circular 369, 16 p.

Hester, N. C., 1970, Sand and gravel resources of Sangamon County, Illinois: Illinois Geological Survey Circular 452, 20 p.

Hester, N. C., and R. C. Anderson, 1969, Sand and gravel resources of Macon County, Illinois: Illinois Geological Survey Circular 446, 16 p.

Horberg, Leland, 1945, A major buried valley in east-central Illinois and its regional relationships: Illinois Geological Survey Report of Investigations 106, 11 p.

Horberg, Leland, 1950, Bedrock topography of Illinois: Illinois Geological Survey Bulletin 73, 111 p.

Horberg, Leland, 1953, Pleistocene deposits below the Wisconsin drift in northeastern Illinois: Illinois Geological Survey Report of Investigations 165, 61 p.

Horberg, Leland, 1956, Pleistocene deposits along the Mississippi Valley in central-western Illinois: Illinois Geological Survey Report of Investigations 192, 39 p.

Horberg, Leland, 1957, Bedrock surface of Illinois: Illinois Geological Survey map, reprinted from plate 1, Illinois Geological Survey Bulletin 73 (scale 1:500,000).

Horberg, Leland, and P. E. Potter, 1955, Stratigraphic and sedimentologic aspects of the Lemont drift of northeastern Illinois: Illinois Geological Survey Report of Investigations 185, 23 p.

Horberg, Leland, Max Suter, and T. E. Larson, 1950, Ground water in the Peoria region: Illinois Water Survey Bulletin 39, 128 p.

Hunter, R. E., 1966, Sand and gravel resources of Tazewell County: Illinois Geological Survey Circular 399, 22 p.

Hunter, R. E., and J. P. Kempton, 1967, Sand and gravel resources of Boone County, Illinois: Illinois Geological Survey Circular 417, 14 p.

Jacobs, A. M. [compiler], 1971, Geology for planning in St. Clair County, Illinois: Illinois Geological Survey Circular 465, 35 p.

Jacobs, A. M., and J. A. Lineback, 1969, Glacial geology of the Vandalia, Illinois, region: Illinois Geological Survey Circular 442, 24 p.

Johnson, W. H., 1964, Stratigraphy of Illinoian and Kansan drift in central Illinois: Illinois Geological Survey Circular 378, 38 p.

Johnson, W. H., 1971, Old glacial drift near Danville, Illinois: Illinois Geological Survey Circular 457, 16 p.

Johnson, W. H., L. R. Follmer, D. L. Gross, and A. M. Jacobs, 1972, Pleistocene stratigraphy of east-central Illinois: Illinois Geological Survey Guidebook 9, 97 p.

Johnson, W. H., H. D. Glass, D. L. Gross, and S. R. Moran, 1971, Glacial drift of the Shelbyville Moraine at Shelbyville, Illinois: Illinois Geological Survey Circular 459, 22 p.

Kempton, J. P., 1963, Subsurface stratigraphy of the Pleistocene deposits of central northern Illinois: Illinois Geological Survey Circular 356, 43 p.

Kempton, J. P., 1968a, Drift thickness map of Boone County, Illinois: Unpubl. map, Illinois Geological Survey.

Kempton, J. P., 1968b, Drift thickness map of De Kalb County, Illinois: Unpubl. map, Illinois Geological Survey.

Krumbein, W. C., 1933, Textural and lithologic variations in glacial till: Journal of Geology, v. 41, p. 382-408.

Labotka, T. C., and N. C. Hester, 1971, Sand and gravel resources of Mason County, Illinois: Illinois Geological Survey Circular 464, 20 p.

Leighton, M. M., G. E. Ekblaw, and Leland Horberg, 1948, Physiographic divisions of Illinois: Illinois Geological Survey Report of Investigations 129, 19 p.

Leighton, M. M., and H. B. Willman, 1950, Loess formations of the Mississippi Valley: Illinois Geological Survey Report of Investigations 149, 27 p.

Leonard, A. B., and J. C. Frye, 1960, Wisconsinan molluscan faunas of the Illinois Valley region: Illinois Geological Survey Circular 304, 32 p.

Lineback, J. A., N. J. Ayer, and D. L. Gross, 1970, Stratigraphy of unconsolidated sediments in the southern part of Lake Michigan: Illinois Geological Survey Environmental Geology Note 35, 35 p.

Lineback, J. A., and D. L. Gross, 1972, Depositional patterns, facies, and trace element accumulation in the Waukegan Member of the late Pleistocene Lake Michigan: Illinois Geological Survey Environmental Geology Note 58, 25 p.

Lineback, J. A., D. L. Gross, and R. P. Meyer, 1972, Geologic cross sections derived from seismic profiles and sediment cores from southern Lake Michigan: Illinois Geological Survey Environmental Geology Note 54, 43 p.

Lineback, J. A., D. L. Gross, R. P. Meyer, and W. L. Unger, 1971, High-resolution seismic profile and gravity cores of sediments in southern Lake Michigan: Illinois Geological Survey Environmental Geology Note 47, 41 p.

Lund, C. R., 1965, Data from controlled drilling program in McHenry County, Illinois: Illinois Geological Survey Environmental Geology Note 7, 64 p.

MacClintock, Paul, and H. B. Willman, 1959, Geology of Buda Quadrangle, Illinois: Illinois Geological Survey Circular 275, 29 p.

McGinnis, L. D., J. P. Kempton, and P. C. Heigold, 1963, Relationship of gravity anomalies to a drift-filled bedrock valley system in northern Illinois: Illinois Geological Survey Circular 354, 23 p.

Parizek, R. R., 1962, Drift thickness map of Ogle County, Illinois: Unpubl. map, Illinois Geological Survey.

Piskin, Kemal, and R. E. Bergstrom, 1967, Glacial drift in Illinois: Thickness and character: Illinois Geological Survey Circular 416, 33 p.

Pryor, W. A., 1956a, Groundwater geology in southern Illinois—A preliminary geologic report: Illinois Geological Survey Circular 212, 25 p.

Pryor, W. A., 1956b, Groundwater geology of White County, Illinois: Illinois Geological Survey Report of Investigations 196, 50 p.

Pryor, W. A., and C. A. Ross, 1962, Geology of the Illinois parts of the Cairo, LaCenter, and Thebes Quadrangles: Illinois Geological Survey Circular 332, 39 p.

Ross, C. A., 1964, Geology of the Paducah and Smithland Quadrangles in Illinois: Illinois Geological Survey Circular 360, 32 p.

Selkregg, L. F., and J. P. Kempton, 1958, Groundwater geology in east-central Illinois—A preliminary geologic report: Illinois Geological Survey Circular 248, 36 p.

Selkregg, L. F., W. A. Pryor, and J. P. Kempton, 1957, Groundwater geology in south-central Illinois: Illinois Geological Survey Circular 225, 30 p.

Shaffer, P. R., 1956, Farmdale drift in northwestern Illinois: Illinois Geological Survey Report of Investigations 198, 25 p.

Smith, G. D., 1942, Illinois loess: University of Illinois Agricultural Experiment Station Bulletin 490, p. 139-184.

Stephenson, D. A., 1967, Hydrogeology of glacial deposits of the Mahomet Bedrock Valley in east-central Illinois: Illinois Geological Survey Circular 409, 51 p.

Suter, Max, R. E. Bergstrom, H. F. Smith, G. H. Emrich, W. C. Walton, and T. E. Larson, 1959, Preliminary report on ground-water resources of the Chicago region, Illinois: Illinois Geological Survey and Illinois Water Survey Cooperative Ground-Water Report 1, 89 p.

Thornburn, T. H., 1963, Surface deposits of Illinois—A guide for soil engineers: University of Illinois Engineering Experiment Station Circular 80, p. 135.

Walker, W. H., R. E. Bergstrom, and W. C. Walton, 1965, Preliminary report on the ground-water resources of the Havana region in west-central Illinois: Illinois Geological Survey and Illinois Water Survey Cooperative Ground-Water Report 3, 61 p.

Wanless, H. R., 1957, Geology and mineral resources of the Beardstown, Glasford, Havana, and Vermont Quadrangles: Illinois Geological Survey Bulletin 82, 233 p.

Wascher, H. L., J. D. Alexander, B. W. Ray, A. H. Beavers, and R. T. Odell, 1960, Characteristics of soils associated with glacial tills in northeastern Illinois: University of Illinois Agriculture Experiment Station Bulletin 665, 156 p.

Willman, H. B., 1971, Summary of the geology of the Chicago area: Illinois Geological Survey Circular 460, 77 p.

Willman, H. B., and J. C. Frye, 1969, High level glacial outwash in the Driftless Area of northwestern Illinois: Illinois Geological Survey Circular 440, 23 p.

Willman, H. B., and J. C. Frye, 1970, Pleistocene stratigraphy of Illinois: Illinois Geological Survey Bulletin 94, 204 p.

Willman, H. B., and others, 1967, Geologic map of Illinois: Illinois Geological Survey map (scale 1:500,000).

Willman, H. B., H. D. Glass, and J. C. Frye, 1963, Mineralogy of glacial tills and their weathering profiles in Illinois—Part I. Glacial tills: Illinois Geological Survey Circular 347, 55 p.

Willman, H. B., H. D. Glass, and J. C. Frye, 1966, Mineralogy of glacial tills and their weathering profiles in Illinois—Part II. Weathering profiles: Illinois Geological Survey Circular 400, 76 p.

Willman, H. B., A. B. Leonard, and J. C. Frye, 1971, Farmdalian lake deposits in northern Illinois: Illinois Geological Survey Circular 467, 12 p.

Willman, H. B., J. N. Payne, and W. H. Voskuil, 1942, Geology and mineral resources of the Marseilles, Ottawa, and Streator Quadrangles: Illinois Geological Survey Bulletin 66, 388 p.

Zeizel, A. J., W. C. Walton, R. T. Sasman, and T. A. Prickett, 1962, Ground-water resources of Du Page County, Illinois: Illinois Geological Survey and Illinois Water Survey Cooperative Ground-Water Report 2, 103 p.

## APPENDIX

### Logs of Representative Wells

1. Austin (Deep Freeze) No. 1, 1951, SE¼SW¼SE¼ sec. 18, T. 44 N., R. 12 E., Lake County. Elevation E.T.M.* 678 feet. Sample set 21463. Studied by P. M. Busch.

| | Thickness (ft) | Depth to base (ft) |
|---|---|---|
| Pleistocene Series | | |
| Wisconsinan Stage | | |
| Wedron Formation | | |
| Soil, sandy, black, with organic fragments | 5.0 | 5.0 |
| Till, clayey, yellowish orange | 5.0 | 10.0 |
| Till, calcareous, dark grayish pink | 30.0 | 40.0 |
| Till, calcareous, sandy, dark yellowish gray | 25.0 | 65.0 |
| Sand; fine-grained gravel, dolomitic, gray | 35.0 | 100.0 |
| Sand and gravel, clayey, silty, dolomitic, yellowish gray | 5.0 | 105.0 |
| Sand and gravel, dolomitic, yellowish gray | 30.0 | 135.0 |
| Gravel to ½" and a little sand; dolomitic, gray | 10.0 | 145.0 |
| Till, calcareous, dark grayish pink | 5.0 | 150.0 |
| Till, calcareous, silty, yellowish gray | 15.0 | 165.0 |
| Till, calcareous, gravelly, silty, yellowish gray | 5.0 | 170.0 |
| Gravel and sand, clayey, silty, gray | 5.0 | 175.0 |
| Bedrock, dolomite | | |

Driller's log of Austin well.

| | Thickness (ft) | Depth to base (ft) |
|---|---|---|
| Sand, gravel, clay | 185.0 | 185.0 |
| Limestone | | |

2. Stelter, Julius, farm, 1959, cen. line NE¼NE¼ sec. 28, T. 21 N., R. 8 W., Mason County. Elevation E.T.M. 495 feet. Sample set 35414. Studied by R. E. Bergstrom.

* Estimated from topographic map.

| | Thickness (ft) | Depth to base (ft) |
|---|---|---|
| Pleistocene Series | | |
| No samples | 18.0 | 18.0 |
| Wisconsinan Stage | | |
| Henry Formation | | |
| Sand, fine- to medium-grained; yellowish brown subangular grains; ferruginous staining; abundant yellowish quartz grains; some brown silt | 8.0 | 26.0 |
| Sand, medium-grained, as above; some granular gravel | 10.0 | 36.0 |
| Silt, brown, calcareous | 2.0 | 38.0 |
| Sand, medium-grained; yellowish brown subangular grains | 4.0 | 42.0 |
| Sand, medium- to coarse-grained with granular gravel, yellowish brown; granules of dolomite, quartz, and granite | 12.0 | 54.0 |
| Sand, fine- to coarse-grained, some very coarse grained, yellowish brown; abundant grains of yellowish quartz and feldspar | 12.0 | 66.0 |
| Kansan Stage | | |
| Banner Formation | | |
| Sankoty Sand Member | | |
| Sand, medium- to coarse-grained, pinkish gray; subangular to rounded grains; abundant pink and pink-stained quartz grains; some granular gravel and fine-grained sand beds | 22.0 | 88.0 |
| Sand, fine- to very coarse grained, pinkish gray; abundant pink grains; some granules of dolomite, quartz, feldspar, and igneous rocks | 10.0 | 98.0 |
| Sand, fine- to medium-grained, reddish brown, subangular; abundant pink grains; many grains with pink clay skins | 8.0 | 106.0 |
| Sand, medium- to very coarse grained, pinkish gray; pink grains; granules of chert, dolomite, and dark igneous rock | 12.0 | 118.0 |
| Gravel, granular, with very coarse grained sand; granules of dolomite, granite, sandstone, felsite, and dark igneous rock | 4.0 | 122.0 (Total depth)* |

* "Total depth" indicates that drilling either stopped in unconsolidated rocks or barely penetrated bedrock.

Driller's log of Stelter well.

| | Thickness (ft) | Depth to base (ft) |
|---|---|---|
| Top stratum | 22.0 | 22.0 |
| Fine-grained sand | 8.0 | 30.0 |
| Medium-grained sand | 4.0 | 34.0 |
| Mud | 2.0 | 36.0 |
| Medium-grained sand | 4.0 | 40.0 |
| Mud | 2.0 | 42.0 |
| Sand and gravel | 24.0 | 66.0 |
| Medium-grained sand | 6.0 | 72.0 |
| Medium-grained sand | 6.0 | 78.0 |
| Good sand and some gravel | 2.0 | 80.0 |
| Fine-grained sand | 6.0 | 86.0 |
| Medium-grained sand | 6.0 | 92.0 |
| Coarse-grained gravel and some cobbles | 6.0 | 98.0 |
| Sand | 4.0 | 102.0 |
| Sand | 2.0 | 104.0 |
| Medium-grained sand and some stones | 4.0 | 108.0 |
| Good gravel | 5.0 | 113.0 |
| Mostly sand, some gravel | 3.0 | 116.0 |
| Good sand and gravel | 6.0 | 122.0 (Total depth) |

3. Held, Joe, No. 1, 1954, SW$\frac{1}{4}$SE$\frac{1}{4}$SW$\frac{1}{4}$ sec. 8, T. 10 N., R. 4 W., Montgomery County. Elevation E.T.M. 636 feet. Sample set 24625. Studied by Elwood Atherton.

| | | |
|---|---|---|
| Pleistocene Series | | |
| Illinoian Stage | | |
| Glasford Formation | | |
| Till, noncalcareous, very silty, light brown | 15.0 | 15.0 |
| Gravel, fine- to medium-grained; till, calcareous, orange | 5.0 | 20.0 |
| Till, calcareous, brownish gray | 10.0 | 30.0 |
| Bedrock, shale | | |

Driller's log of Held well.

| | | |
|---|---|---|
| Surface soil | 5.0 | 5.0 |
| Clay | 25.0 | 30.0 |
| Shale and gravel | | |

4. Illinois Water Service Co. No. 38, 1950, 20 feet N. of cen. of S. line sec. 36, T. 20 N., R. 7 E., Champaign County. Elevation E.T.M. 715 feet. Sample set 20601. Studied by J. W. Foster.

| | Thickness (ft) | Depth to base (ft) |
|---|---|---|
| Pleistocene Series | | |
| Wisconsinan Stage | | |
| Wedron Formation | | |
| Soil, dark brown, and yellow, clayey, noncalcareous till | 10.0 | 10.0 |
| Till, yellow-buff, clayey, calcareous | 10.0 | 20.0 |
| Till, gray-buff, silty, calcareous; some sand | 20.0 | 40.0 |
| Soil, black over yellow, non-calcareous till | 10.0 | 50.0 |
| Till, gray-buff, and scattered soil (possibly caved), calcareous | 5.0 | 55.0 |
| Till, pinkish, silty, calcareous, and soil, as above | 5.0 | 60.0 |
| Till, pinkish, silty, with sand and gravel | 15.0 | 75.0 |
| Till, pinkish, silty, sandy, with scattered soil | 5.0 | 80.0 |
| Illinoian Stage | | |
| Glasford Formation | | |
| Till, buff and weathered, non-calcareous, and black soil | 5.0 | 85.0 |
| Till, buff and yellow, partly calcareous; calcareous in lower part | 15.0 | 100.0 |
| Till, as above, very sandy | 20.0 | 120.0 |
| Till, as above, with light brown soil fragments | 5.0 | 125.0 |
| Till, yellow-buff, sandy, calcareous; scattered black soil | 10.0 | 135.0 |
| Till, gray-buff, sandy and gravelly, pinkish in lower part, calcareous | 55.0 | 190.0 |
| Till, as above, with strong soil show | 15.0 | 205.0 |
| Kansan Stage | | |
| Banner Formation | | |
| Till, yellow, oxidized, non-calcareous, and black soil | 5.0 | 210.0 |
| Till, buff, sandy, gravelly, calcareous | 10.0 | 220.0 |
| Mahomet Sand Member | | |
| Sand, yellow, very coarse grained, very dirty, with fine-grained gravel in lower part | 35.0 | 255.0 |

| | Thickness (ft) | Depth to base (ft) |
|---|---|---|
| Gravel, fine- to medium-grained, very dirty, calcareous | 10.0 | 265.0 |
| Gravel, fine-grained, very dirty, with silt interbedding | 5.0 | 270.0 |
| Gravel, fine- to medium-grained, dirty; scattered soil in lower part | 15.0 | 285.0 |
| Gravel, fine-grained, very dirty; soil fragments | 5.0 | 290.0 |
| Gravel, medium-grained, dirty, with till interbedding; calcareous | 15.0 | 305.0 |
| Gravel, fine- to medium-grained, poorly sorted, dirty with till fragments and probable Pennsylvanian sandstone chips; bedrock not detected | 2.0 | 307.0 (Total depth) |

5. Doty, S. L., 1935-1938, SE$\frac{1}{4}$SE$\frac{1}{4}$NW$\frac{1}{4}$ sec. 8, T. 17 N., R. 6 E., Bureau County. Elevation E.T.M. 620 feet. Sample set 1619. Studied by L. Horberg.

| | Thickness (ft) | Depth to base (ft) |
|---|---|---|
| Pleistocene Series | | |
| Wisconsinan Stage | | |
| Henry Formation | | |
| Sand, medium-grained, slightly calcareous, clean, buff, largely angular quartz | 48.0 | 48.0 |
| Kansan Stage | | |
| Banner Formation | | |
| Sankoty Sand Member | | |
| Sand, fine- to coarse-grained, slightly silty; humus trace | 4.0 | 52.0 |
| Granular gravel; with some sand, fine- to medium-grained, polished | 6.0 | 58.0 |
| Sand, coarse-grained, gravelly, calcareous; humus abundant | 8.0 | 66.0 |
| Silt, loesslike, calcareous, yellow-gray; contains spores, wood fragments | 4.0 | 70.0 |
| Sand, coarse- to very coarse grained, calcareous, numerous polished and frosted grains | 2.0 | 72.0 |
| Silt, calcareous, loesslike; contains yellowish gray spores and wood fragments | 14.0 | 86.0 |
| Sand, some gravel, medium- to coarse-grained, humus-stained | 132.0 | 218.0 |
| Bedrock, dolomite | | |

Driller's log of Doty well

| | Thickness (ft) | Depth to base (ft) |
|---|---|---|
| Sand, yellow | 48.0 | 48.0 |
| Sand and gravel | 10.0 | 58.0 |
| Sand, gravel, dirty | 8.0 | 66.0 |
| Silt and clay | 2.0 | 68.0 |
| Sand and gravel | 2.0 | 70.0 |
| Sand, medium-grained | 42.0 | 112.0 |
| Sand, granular, buff, red, black | 41.0 | 153.0 |
| Sand, buff, red, coarse-grained, polished | 20.0 | 173.0 |
| Sand, granular, buff, red, black | 7.0 | 180.0 |
| Gravel, buff, red, black, fine- to medium-grained | 10.0 | 190.0 |
| Sand, scattered, granular | 20.0 | 210.0 |
| Gravel, sand | 8.0 | 218.0 |
| Dolomite | | |

6. West Brooklyn Village No. 3, 1948, SE$\frac{1}{4}$SW$\frac{1}{4}$NW$\frac{1}{4}$ sec. 8, T. 37 N., R. 1 E., Lee County. Elevation E.T.M. 980 feet. Sample set 17800. Studied by M. P. Meyer; modified by J. W. Foster.

| | | |
|---|---|---|
| Pleistocene Series | | |
| Wisconsinan Stage | | |
| Wedron Formation | | |
| Till, brown, grading to sand | 109.0 | 109.0 |
| Sand, coarse-grained, and clayey gravel | 22.0 | 131.0 |
| Sand, fine- to medium-grained, clayey | 9.0 | 140.0 |
| Till, brown, with gray in lower part | 146.0 | 286.0 |
| Illinoian Stage | | |
| Glasford Formation | | |
| Till, greenish, partly noncalcareous | 7.0 | 293.0 |
| Till, gray, calcareous | 28.0 | 321.0 |
| Sand and gravel, silty and clayey, generally cleaner near base | 105.0 | 426.0 |
| Kansan Stage | | |
| Banner Formation | | |
| Humus on noncalcareous clay, with sand and gravel in lower part | 21.0 | 447.0 |
| Till, gray, very sandy, gravelly, calcareous | 19.0 | 466.0 |
| Sand, medium- to very coarse grained, slightly silty | 18.0 | 484.0 |

| | Thickness (ft) | Depth to base (ft) |
|---|---|---|
| Till, yellow and gray, non-calcareous, with thin sand and gravel in lower part | 6.0 | 490.0 |
| Bedrock, sandstone | | |

Driller's log of West Brooklyn No. 3 well

| | Thickness (ft) | Depth to base (ft) |
|---|---|---|
| Top soil | 3.0 | 3.0 |
| Clay, yellow | 2.0 | 5.0 |
| Clay, brown | 7.0 | 12.0 |
| Clay and stones, red | 77.0 | 89.0 |
| Sand and clay | 6.0 | 95.0 |
| Clay, sand, and stones, red | 14.0 | 109.0 |
| Sand and gravel, dirty | 11.0 | 120.0 |
| Sand, clay, and stones, red | 20.0 | 140.0 |
| Clay and stones, red | 14.0 | 154.0 |
| Clay, red | 7.0 | 161.0 |
| Clay, sand, and stones, red | 97.0 | 258.0 |
| Clay, sand, and stones, blue | 21.0 | 279.0 |
| Clay, sand, and stones, blue, hard | 21.0 | 300.0 |
| Clay, sand, and stones, blue | 14.0 | 314.0 |
| Stones, clay, and sand, hard | 14.0 | 328.0 |
| Sand, clay, and stones, water-bearing | 7.0 | 335.0 |
| Sand, clay, and stones | 7.0 | 342.0 |
| Sand, clay, and stones | 7.0 | 349.0 |
| Sand, clay, and gravel | 14.0 | 363.0 |
| Sand, gravel, clay | 28.0 | 391.0 |
| Sand, clay, and stones | 7.0 | 398.0 |
| Clay, sand, and stones | 7.0 | 405.0 |
| Sand, clay, and stones | 12.0 | 417.0 |
| Sand and gravel | 3.0 | 420.0 |
| Sand, clay, and stones | 6.0 | 426.0 |
| Clay, brown, hard | 6.0 | 432.0 |
| Sand, dirty | 3.0 | 435.0 |
| Clay, sand, and stones | 26.0 | 461.0 |
| Sand, clay, and stones | 5.0 | 466.0 |
| Sand, dirty | 18.0 | 484.0 |
| Clay, hard | 3.0 | 487.0 |
| Sand and gravel | 2.5 | 489.5 |
| Sand rock, hard | | |

7. Northeastern Illinois Metropolitan Area Planning Commission Test Hole No. 1, 1962, SE$\frac{1}{4}$SE$\frac{1}{4}$SW$\frac{1}{4}$ sec. 7, T. 46 N., R. 5 E., McHenry County. Elevation E.T.M. 975 feet. Core 4515. Logged by K. Swanson (Layne-Western Co.).

| | Thickness (ft) | Depth to base (ft) |
|---|---|---|
| Pleistocene Series | | |
| Wisconsinan Stage | | |
| Wedron Formation | | |
| Clay, silty, gray, mottled | 5.0 | 5.0 |
| Till, yellowish red-brown to gray silty sand and sandy silt | 83.0 | 88.0 |
| Sand and gravel, gray; a few silty layers | 25.0 | 113.0 |
| Sand, silty, gray-brown; trace of clay | 13.0 | 126.0 |
| Silt, clayey, gray; a few speckled seams of very fine grained sand | 50.0 | 176.0 |
| Till, gray-brown clayey silt; a few sand and silt seams | 24.0 | 210.0 |
| Silt, dark brown; trace of sand and fine-grained gravel | 26.0 | 236.0 |
| Sand, brown-pink; a little gravel; trace of silt and clay | 40.0 | 276.0 |
| Till, pink-brown sandy silt; trace of gravel and clay | 74.0 | 350.0 |
| Sand, silty, dark gray; trace of clay and gravel | 4.0 | 354.0 |
| Gravel, sandy, coarse-grained, poorly sorted | 36.0 | 390.0 |
| Silt, gray-buff; small lenses of sand | 12.0 | 402.0 |
| Gravel, sandy, coarse-grained; trace of silt | 4.0 | 406.0 |
| Silt, brown; trace of clay | 6.0 | 412.0 |
| Gravel, gray-brown, some sand; little clay and silt | 46.0 | 458.0 |
| Silt, hard, gray-brown; trace of very fine grained sand | 12.0 | 470.0 |
| Till; medium-brown hard clay, silt, sand | 3.5 | 473.5 (Total depth) |
| Bedrock, dolomite, gray-brown | | |


Counties in Illinois

Illinois State Geological Survey Circular 490
35 p., 5 figs., 1 table, 1 app., 2 plates, 4000 cop., 1975
Urbana, Illinois 61801

Printed by Authority of State of Illinois, Ch. 127, IRS, Par. 58.25.