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ILLINOIAN DRIFT REGION OF NORTHEAST CENTRAL OHIO

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INTRODUCTION

The purpose of this paper is to discuss the pre-Wisconsin drift region in northeast central Ohio, including northeastern Licking, southwestern Coshocton, eastern Knox, southeastern Richland, and southwestern Ashland counties, (Fig. 1).¹ This area is the northern part of the area of Illinoian drift, which lies east of the Scioto lobe of Wisconsin drift and south of the Killbuck lobe (9, Fig. 1)² of Wisconsin drift. To the north, the Illinoian drift occupies the re-entrant angle between these two Wisconsin lobes. The area lies wholly within the Allegheny Plateau which was here dissected to maturity, and which had a relief of 200 to 400 feet before Illinoian drift masked the pre-Illinoian erosion topography in varying degrees—at most places but slightly, but at some, however, mainly in wide valleys, it effectually covers the bedrock topography and controls the topographic expression.

CORRELATION

The drift of northeastern Licking, southeastern Knox, and southwestern Coshocton counties was described as Illinoian by Leverett who traced the Illinoian drift from Illinois across Indiana and southern Ohio to this area (2, pp. 253-261). His correlation is used here. Although Leverett regarded the drift of much of northeastern and north central Knox County as Wisconsin, the studies of the present writer show that this drift has the same characteristics as, and can be traced directly into, the drift of southeastern Knox County. It must, therefore, be Illinoian, and is so shown on the map, Fig. 1.

¹The topographic maps of the area are Shauk, Perrysville, Loudonville, Gambier, Brinkhaven, Newark, and Frazeyburg.

²References are to bibliography at end of paper.

THE TILL

The unoxidized, unleached, fresh Illinoian till is a strongly calcareous, bluish gray, pebbly clay, of a somewhat silty character. Pebbles and cobbles are common, but boulders are rare. Few boulders larger than two feet in greatest diameter were seen. The percentage composition of one half

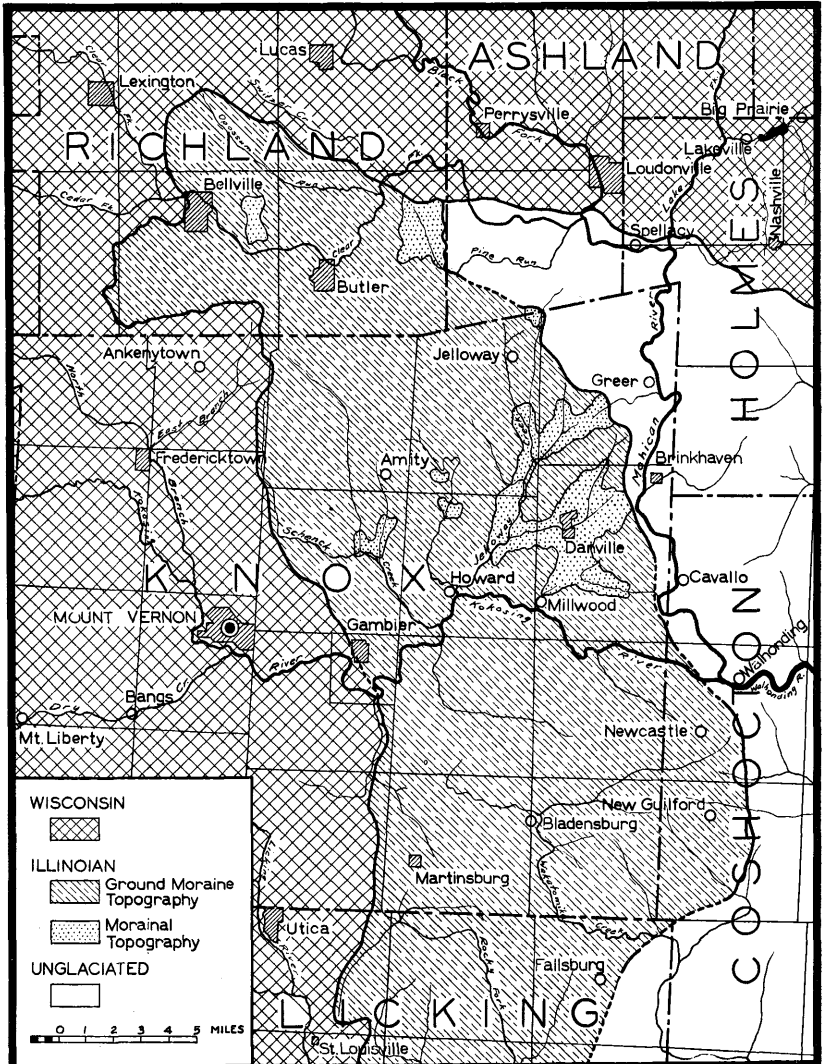


FIG. 1. Map showing glacial geology of a part of north central Ohio.

to two inch pebbles from unaltered till in northeastern Section 7, Perry Township, Coshocton County, was determined as:

Limestone.....	46
Sandstone.....	32
Carbonaceous shale and coal.....	7
Flint.....	6
Granite.....	2
Quartzite.....	7
	100

The limestone, constituting 46 per cent, came from southern Ontario or the Erie basin. The sandstone, carbonaceous material and flint came from the Waverly and Pottsville formations of the Allegheny Plateau and travelled from one to a maximum of 40 miles. The igneous and metamorphic material came from the Canadian Shield.

The upper part of the till is at all places altered by agencies of weathering. A trustworthy average section of the weathered upper part can hardly be given, because comparatively few exposures reveal the unaltered till, but the following section is based on the data at hand:

	Feet
ZONE 3. Till: light brown, porous, oxidized, leached.....	8
Sharp contact with Zone 2.	
ZONE 2. Till: brown, oxidized, unleached.....	7
Irregular gradation into Zone 1.	
ZONE 1. Till: grayish-blue, silty, calcareous, moderately hard, pebbly....	0-25+

Zone 1 is the unaltered unoxidized, unleached till that has been described. Zone 2 is the oxidized, unleached zone and Zone 3 is the oxidized, leached zone which grades into soil near the surface.

The oxidized Illinoian till of Zone 2 is brown, the exact shade varying from medium to light, depending on the amount of moisture present. This oxidized, unleached zone has a thickness of from 6 to 12 feet and grades with an uneven contact into the unoxidized blue till below, the oxidation having advanced more rapidly where the till is more porous. It is similar in texture and mineral content to the blue till of Zone 1. This unleached, oxidized zone in the till of Illinois has been called "Horizon 4" by Leighton and MacClintock (1).

The leached, oxidized Illinoian till of Zone 3 is light brown in color, the shade decreasing in intensity toward the surface. This zone is looser and more porous than Zones 1 and 2, because of the solution of limestone pebbles and finer calcareous material and of the entrainment of finer rock particles by ground water.

This leached zone has a thickness of from 5 to 15 feet, and rests with a sharp contact upon the oxidized, unleached zone below. In Illinois (1, Fig. 1), this zone has been divided into Horizons 1, 2, and 3, but in that part of Ohio here discussed the distinction between "Horizon 2" and "Horizon 3" is not immediately apparent, in part, possibly, because the till is so well drained.

The thicknesses of Zones 2 and 3 vary greatly from place to place because oxidation is faster in more porous till and in those portions having better drainage, and to the removal of the oxidized zone by erosion at the surface. On steep slopes this removal may keep pace with, or exceed, leaching. The following section was observed on the road cut along the state highway in the northeastern part of Section 7, Perry Township, Coshocton County, one-fourth mile northeast of New Guilford:

	Ft.	In.
Soil and silttill (1, p. 41): dark brown, sandy, leached.....	2	10
Clay: brown, pebbleless, leached.....	0	6
Clay: gray, pebbleless, leached.....	1	1
Clay: gray, pebbleless, unleached.....	0	6
Till: brown, only moderately pebbly, silty, oxidized, unleached.....	6	4
Till: dark blue, silty, only moderately pebbly; grades into above fairly sharply.....	4	0

This section is only one-half mile west of the glacial boundary and is unusually thick for a location so close to the glacial border.

Along the Martinsburg-Bladensburg state road in Clay Township, Knox County, one and one-half miles west of the village of Bladensburg, the following section was measured:

	Ft.	In.
Soil and Silttill: buff to ashen, fine-grained, silty; much weathered.....	1	6
Till: brown, silty, thoroughly oxidized, leached, pebbly; grading upward to yellow; with some dark stains along joints in lower part.....	4	0
Till: yellow-brown, sandy, very pebbly, unleached; with white spots and limestone pebbles.....	5	4
Till: gray-blue, sandy, pebbly, unleached.....	2	0

In a new road cut along the Mt. Vernon-Coshocton road in western Howard Township, one-quarter mile east of Monroe Mills, 12½ feet of yellow, leached, porous till, with many sandstone cobbles and pebbles included, resting on Waverly (Blackhand) sandstone, were exposed. This is more than usual depth of leaching and is attributed to the fact that here the till is quite sandy and porous. The variation in depth of leaching over short distances, especially where erosion may

have been active on slopes, is shown by the following section measured along the same road one mile west of the above exposure:

	Ft.	In.
Till: yellow, sandy, leached.....	4	6
Till: yellowish-brown, silty, hard, unleached.....	7	6
Till: blue-gray, hard, pebbly, strongly calcareous.....	5	0

A section measured in a newly excavated road cut one-half mile east of Amity in eastern central Section 21, Pike Township, shows only five and one-half feet of unleached till, and indicates that part of the leached zone has been removed. The section is as follows:

	Ft.	In.
Till: yellow, weathered, leached.....	5	6
Till: yellowish-brown, silty, strongly calcareous.....	6	6
Till: dark blue, silty, pebbly, strongly calcareous.....	1	0

The leached zone is from seven to over twelve feet thick in Pike and Brown townships in northern Knox County. In Jefferson and Union townships, northeastern Knox County, the depth of leaching varies generally from six to eight feet. Probably the till here has suffered more erosion, and the surface is now being eroded away faster than leaching can penetrate downward.

The Illinoian till is thin and discontinuous in much of Worthington and eastern Jefferson townships of Richland County. It is thicker and more generally present in central and central western Jefferson and central southern Washington townships, where deep exposures may disclose unaltered blue till. An excellent section was exposed by the relocation of the Bellville-Mansfield state road, two miles north of Bellville in central Section 4, Washington Township, where the following divisions were measured:

	Ft.	In.
6. Soil: buff to ashen gray, strongly weathered, silty, almost pebbleless.	2	0
5. Till: very dark brown with black stains along joints, with some pebbles, leached, strongly oxidized.....	2	3
4. Till: yellow-brown, leached, oxidized, sandy with pebbles; becomes more buff upward and grades into No. 5.....	6	4
3. Till: brown, hard, oxidized, unleached, very pebbly; with darker stains along joints and an uneven contact with No. 2.....	6	6
2. Till: gray-blue, hard, unevenly oxidized along joints.....	4	0
1. Till: blue, hard, pebbly, with boulders up to 4 feet in diameter; to road level.....	15	0

It may be noted that 1 and 2 correspond to "Horizon 5," and 3, 4, 5, and 6 to "Horizons" 4, 3, 2, and 1, respectively (1).

ILLINOIAN BOUNDARY

The outer limit of Illinoian drift extends in a general northerly direction across Licking County, swings eastward to include the southwestern part of Coshocton County and thence northwestward across northeastern Knox and southwestern Ashland counties to disappear underneath the Wisconsin drift in southeastern Richland County.

The Illinoian boundary varies in distinctness. In some places it is marked by continuous drift which influences the topography; in places by only scattered boulders and pebbles; and in still other places it is only conjectural and must be mapped by extending a line between two known points. Road cuts, ravines, and fields were carefully examined, and, in order to be sure that the most eastern foreign pebbles or cobbles were actually found, a belt of from two to more than five miles beyond the boundary was carefully searched.

The Illinoian boundary shown on the map, Fig. 1, agrees with that of Leverett (2, pl. 13) in Licking and southwestern Coshocton counties, but to the north the present investigation shows the Illinoian boundary to be considerably west of that mapped by Leverett. Extended search failed to bring to light any glacially derived material east of the Mohican River in northwestern Coshocton County or in southwestern Holmes County, (4, p. 437).

Licking County.—The Illinoian boundary in that part of Licking County included in Fig. 1, crosses from the northern part of Perry Township into Fallsburg Township which it crosses in a northeasterly direction to the corner of that township. The boundary from the great glacial dam at Hanover to Fallsburg in northeastern Licking County is exceedingly vague. Erosion has removed almost all of that Illinoian drift not only from the region near the mapped boundary, but from the territory several miles to the west. Indeed, the Illinoian drift found closest to the conjectural boundary mapped south of Fallsburg, was one mile north-northwest of Hickman in northern Mary Ann Township and in central Section 21, Eden Township. It may be possible that south of Fallsburg the Illinoian boundary as drawn is too far east.

One mile northeast of Fallsburg, in northwestern Section 12, Fallsburg Township, a few cobbles and pebbles of resistant foreign rocks, found on the north side of a road cut, are taken as the limit of ice advance; the location of these is shown in

Fig. 1 by a solid line. Northeast from this locality for several miles, the boundary is again indistinct.

Coshocton County.—The boundary enters Coshocton County in the southwestern corner of Perry Township and passes northeastward to Winding Fork. Thence it passes in a general northerly direction across Perry Township into Newcastle Township to the edge of the upland south of the Walhonding River. Across these townships the drift extends almost, or quite to the boundary at numerous places, although it becomes quite thin along the outer margin.

One-half mile east of Newcastle the boundary turns sharply to the northwest and passes into a more rugged area along the Kokosing valley for two and one-half miles northwest to the Coshocton-Knox county line, one-half mile north of the Kokosing River. Erosion has removed all the drift from the steep valley walls of the Kokosing valley, and even from the narrow interstream areas, so that foreign pebbles are absent for some distance back from where the ice margin rested, as mapped by a broken line on Fig. 1.

Knox County.—North of the Kokosing valley the Illinoian boundary lies only one to two miles west of the Mohican River valley for a distance of about ten miles. The Illinoian ice margin was apparently the factor which determined the location of this part of the Mohican River (8). The boundary enters Knox County in the southeast corner of Union Township in Section 21, where igneous pebbles exist along the top of the ridge. North of Section 21, the boundary is indefinite for about three miles to Tager Valley, where areas with constructional topography make a fairly definite boundary. Thick deposits of drift mark the boundary northward into Jefferson Township. In Section 8, Jefferson Township, the border crosses a preglacial valley, and its course is especially clear in central and northwestern Section 8, where gravel knolls are prominent at the border (Fig. 2). Thence the drift limit runs in a general northwesterly direction to the northeastern corner of Brown Township.

In the northeast corner of Brown Township, one and one-half miles northeast of Jelloway, a morainic ridge, about a mile long extends across a preglacial valley and forms a water parting in the old valley. The drainage of the portion to the northeast was diverted during the ice occupancy southward across a former divide to Shadley Valley Creek. The Columbus-

Cleveland highway crosses the south end of this moraine one and one-half miles northeast of Jelloway, and for one-half mile northeast the highway skirts the pre-Illinoian valley which is dammed by the drift ridge.

Ashland County.—From the northeastern corner of Brown Township, Knox County, the boundary runs north-northwest across southwestern Hanover Township, Ashland County, to the west line of Section 19, on the Ashland-Richland county line. The boundary is indefinite and may be mapped only by examining the fields and road cuts for foreign pebbles, there being no till for a mile or even two miles or more inside the boundary.

Richland County.—The Illinoian boundary in Worthington Township is located just west of the county line. A considerable thickness of Illinoian drift extends almost or quite to the boundary which is topographically distinguishable against the hills to the east. The Illinoian boundary passes under the east-west trending Wisconsin drift boundary in western central Section 12, about 300 yards west of the county line. Here the overlapping of the Wisconsin moraine makes separation of the moraines of the two ages very difficult.

THE ILLINOIAN-WISCONSIN BOUNDARY

The inner boundary of the Illinoian drift region is the outer boundary of the Scioto lobe of the Wisconsin drift region. It is 10 to 13 miles west of, and roughly parallel to the outer boundary of the Illinoian drift (Fig. 1). The northern boundary of the Illinoian area is made by the overlapping edge of the Killbuck lobe of the Wisconsin drift sheet. Brief descriptions of these boundaries have been published (6, 7).

AREAS OF GROUND MORaine TOPOGRAPHY

The Illinoian drift region is in large part an area of ground moraine (Fig. 1), but small areas of morainal topography and of kames and kame terraces are present. Most of the area consists of a maturely dissected bedrock topography with a veneer of drift which mantles the surface and forms minor relief features. In some localities the pre-Illinoian bedrock topography is more masked than in others. In many localities drift was either never deposited or has been considerably eroded from hilltops. Most of the Illinoian drift region here described falls generally in MacClintock's type 3 (3, Figs. 2 and 8).



FIG. 2. Kames near Illinoian boundary in central Jefferson Township, Knox County, two miles southwest of Greer. Bed-rock hills in distance with thin veneer of till.

FIG. 3. Illinoian ground moraine one mile southeast of Newcastle, Coshocton County.

FIG. 4. Knolls of Illinoian drift in northwestern Jefferson Township, Richland County, two miles east of Bellville. The most distant hills are only thinly covered with drift.

Licking County.—The eastern part of Washington Township and the western part of Eden Township are quite generally drift covered, although bedrock frequently outcrops in gullies and along the roads, especially near the tops of the hills. In eastern Eden Township and western Fallsbury Township, the drift is very thin and discontinuous, and confined to scattered boulders and small masses of till on the ridges. A little kame gravel is present in the valley of Long Run, central Section 21, Eden Township. Swells of gravelly till are present along the county line in Section 2, Eden Township.

Coshocton County.—The glaciated part of Coshocton County is more generally till covered than is the territory nearest the glacial boundary farther to the southwest. Indeed, the till is so thick in parts of these townships, that the topography has been somewhat subdued by the drift control. The surface is rolling in long smooth sweeps. The relief varies from 50 to 100 feet, the slopes commonly having a grade of 100 feet or less per mile except along the valleys of the eastward flowing streams where the relief is more pronounced. Fig. 3 shows a part of this rolling plain south of Newcastle.

Knox County.—The Illinoian surface of that part of Knox County south of the Kokosing River offers considerable contrast to the Illinoian surface north of the river. The surface is generally till covered, and in many places, especially in the valley of Wakatomika Creek, constructional topography is evident. Bedrock is exposed, however, on many of the slopes, which is in distinct contrast to the Wisconsin drift region to the west where the till is a great deal thicker and where bedrock is much less generally exposed.

The Illinoian region is much more rugged north of the Kokosing River than the rolling areas south of the river. Three factors seem to be responsible: (1) the pre-Illinoian surface was an area of mature dissection having a bedrock relief of 200 to 400 feet and possibly somewhat greater; (2) only enough till was deposited in most places to veneer the bedrock topography; and (3) the greater relief, and steeper slopes of the bedrock topography have allowed erosion to remove much of the thin till sheet that was deposited. In a few small areas sufficient drift to cover the bedrock remains, making rolling areas of small extent.

In Union, Howard, southern Brown, and southwestern Jefferson townships the drift is generally discontinuous, except

in certain valleys where morainal areas exist. The general aspect is one of wide valleys with undulating till surfaces, flanked by valley slopes, commonly of bedrock. The hilltops preserve evidence of glaciation—till where they are broad, but only foreign cobbles and boulders where they are narrow. In Monroe and Pike townships the Illinoian drift is more continuous although bedrock often appears at the surface on the upper slopes and hilltops. In the central part of Pike Township, in the headwaters of Little Schenck Creek, the slopes are more undulating than is common, and the topography is quite constructional. The till here is unusually gravelly. To the north, in the vicinity of North Liberty, the till is thick and somewhat gravelly. Here is an upland area of about one-half a township that has thicker till and more billowy surface than usual, being similar to the area south of the Kokosing River.

Richland County.—In the Illinoian area in Richland County the till is generally thin and discontinuous except in the Davis Basin and in a few of the valleys. An area east of Butler (2, pp. 393–394) has been described as driftless, but the present writer has found scattered boulders and occasional till patches in this area in southern Worthington Township. In Jefferson Township both north and south of Bellville, the Illinoian drift is thicker than it is to the east. Considerable drift, sometimes with an undulating surface, remains in the valleys and even on some of the hilltops.

AREAS OF MORAINAL TOPOGRAPHY

Only a few areas showing definite morainal topography exist in the Illinoian drift region and these areas are almost entirely confined to wide pre-Illinoian lowland areas mostly near the Illinoian border (Fig. 1). It is believed that morainal topography was rarely, if ever, developed on the uplands of this rugged area. This interpretation is supported by the fact that in those parts of the Wisconsin region which are equally rugged, morainal topography is usually found only in the old valley areas (4, 5). The position of these depositional features in the old valley courses, from which the pre-Illinoian streams were in most cases diverted, has protected them from active erosion such as similar features would have suffered on the higher slopes or over the upland, and has permitted constructional features to persist to the present. Their preserva-

tion was still further aided by the gravelly character of the morainal drift which allows greater percolation of the rainfall, thus preventing excessive surface erosion.

These irregular areas of Illinoian morainal topography are explained by the writer as deposits made by melting of stagnant ice, and not as end moraines. They are similar to previously described Wisconsin morainal deposits in similar topographic positions (4, 5).

Danville Area.—The largest area of Illinoian morainal topography is in a plexus of wide pre-Illinoian valleys in northeastern Knox County, in Union, and southwestern Jefferson townships. The topography is indeed unusually morainal for Illinoian, and Leverett (2, p. 383) described it in 1902 as Wisconsin terminal moraine. An Illinoian age is indicated, however, by the fact that the region between this morainal area and the Wisconsin boundary shown on Fig. 1 is discontinuously mantled by typical Illinoian ground moraine.³

West and southwest of Danville, on either side of the valley of East Branch, low swells of gravelly till are plastered against the valley walls to a height of about 100 feet above the wide valley bottom. Above this height bedrock outcrops are common. The unnamed valley from Danville south to Millwood is filled with kames and with swells of sandy till containing pockets of gravel. To the southeast of Danville a prong of the moraine extends over into the headwaters of Flat Run and continues to within less than two miles of the drift border. The sides and bottom of the valley of Flat Run from its head almost to Flat Run School are covered with low swells, made up of silty till with some pockets of gravel.

A group of conspicuous kames, some of them 100 feet high, cover about a square mile of the area one to two miles south of Danville. The gravel is medium-grained at places and coarse at others, with many six- to eight-inch cobbles and a few boulders up to two feet in diameter.

The valley of East Branch northeast of Danville is moderately broad and the slopes have a constructional topography. Many sections of till are exposed along the Danville-Greer road, but most of them are not deep enough to expose unaltered blue till.

³Similar extensive areas of morainal topography of Illinoian age are well developed in the valley of Jonathan Creek in southwestern Muskingum County and northeastern Perry County.

Broad swells with a relief of 20 to 30 feet begin one to two miles east of Danville, south of the railroad, and extend east to the glacial boundary. Here several large kames rise from 50 to 100 feet near the glacial boundary. The gravel composing them is cobbly to medium-grained gravel, with some pockets of fine gravel and sand. The bedding is irregular and slumped, and it dips at high angles in various directions. Large masses of blue, silty till are included in the gravel. Eastward from these kames, for about three-fourths of a mile between the Pleasant Valley School and the southwestern corner of Section 22, Wisconsin outwash has filled the Mohican valley and probably slightly overlaps the Illinoian drift. Though this outwash might appear to be associated with the Illinoian terminal moraine, investigation shows very definitely that it is a part of a Wisconsin valley train deposited in the Mohican valley. Remnants of this valley train can be traced from the Wisconsin boundary, north of the Knox-Holmes county line (4, Fig. 2), southward to the mouth of the Mohican River, and thence down the Walhonding valley.

Morainal topography is well developed in the wide valleys of Jelloway Creek and its tributary, Dowd Creek, in eastern Brown and southwestern Jefferson townships. Knolls partly fill a pre-Illinoian valley carved by a stream which rose east of Greer and flowed southwest. These deposits form the present water parting between the westward flowing east fork of Dowd Creek and a small eastward flowing tributary to the Mohican River which now drain the valley. Morainal topography is especially well developed in Section 14, southern Section 7, and southwestern Section 8, where the knolls rise 40 feet or more. In southwestern Section 7, a few small kame-like knolls 20 feet high are made up in large part of dirty, poorly sorted, subangular gravel in which till masses are included. At the Illinoian boundary in the northwestern central part of Section 8, well developed kames from 30 to 50 feet high cover an area of about one-fourth square mile (Fig. 2), choking a pre-Illinoian valley and causing a minor stream diversion.

Other Areas in Knox County.—Well developed constructional topography, consisting of rounded knolls 20 to 30 feet in height banked against the valley sides, exists in a small area of about one square mile along the northeast side of the valley of Schenck Creek in northeastern Monroe Township. The area extends

northward for a little more than a mile up the valley of Coleman Branch and northwestward to the mouth of Little Schenck Creek. Cobbly gravel is present on either side of Coleman Branch about one-half mile north of its junction with Schenck Creek. The till of the northern part of this area is very bouldery as is the till of the ground moraine farther northward.

An oval shaped area of rounded drift knolls, one-half mile long and one-quarter mile wide, is crossed by Little Jelloway Creek just south of the Brown Township line in northwestern Howard Township. About a mile to the north is a slightly smaller moraine area in central Section 24, Brown Township. It rises about 40 feet above the valley floor. Little Jelloway Creek detours around it through the hills, the stream returning to its old valley one-half mile south of the till dam. The surface is undulating to hummocky and quite constructional in appearance.

The Davis Basin.—This is a rectangular area about three miles northeast of Butler, covering about three square miles in Sections 13, southern 12, eastern 14, and southeastern 11 in eastern Worthington Township, Richland County, just west of the Ashland County line. The name, not on the map, is derived from the tiny hamlet formerly known as "Davis Post Office" at the crossroad on the line between sections 12 and 13. The surface is gently undulating rather than hummocky, except in the northeastern Section 14, where rather smooth, gravelly knolls 10 to 20 feet high are present. The floor of the basin rises from an elevation of 1,220 feet in the central part to about 1,300 feet at the borders. The basin is bounded on the east by unglaciated bedrock hills, on the south and west by bedrock hills on which glacial deposits are very meager, and on the north by Wisconsin moraine. The material is silty till, except for the gravel knolls in Section 14, and for a small area of dirty gravel in central Section 13. Till continues to within 200 yards of the glacial boundary, just west of the county line.

Northeastern Jefferson Township, Richland County.—Drift with fairly definite constructional topography partly fills the valley of a small southward flowing tributary to Clear Fork in central Section 11 and central southern Section 2. Pronounced drift knolls are banked against the hillside just north of the road forks at the line between the two sections (Fig. 4). The till is quite variable in this small area, ranging from silty, through sandy, to gravelly clay. Brown, leached, pebbly till

is exposed in a cut 12 feet deep along a road just northeast of the road forks. The pebbles are so greatly weathered that many of them break with a light blow of the hammer.

AREAS OF KAME TOPOGRAPHY

Small areas of kame-like hills are associated with the larger areas of morainal topography at several places in western Knox County and have already been mentioned. Kame-like knolls, aggregated in the form of kame terraces, are also present at two places in the Kokosing valley. These benches made by kames that rise to a general level are quite similar to the more extensive Wisconsin kame terraces in valleys in the Allegheny Plateau (4, 5), and are believed to be remnants of Illinoian kame terraces.

An area of kames nearly one-half square mile in extent exists about one mile west of Millwood in eastern Howard Township along the north side of the Kokosing valley. Gravel hills are banked against the valley wall, making a rude terrace bench that rises to an elevation of 1,040 feet, although mostly below 1,000 feet. The gravel is variable in texture, ranging from medium-grained to cobbly, and apparently includes some till masses. To the north the gravel grades into gravelly till which conceals the bedrock up to an elevation of 1,100 feet.

Two miles east of Gambier, on the south side of the Kokosing valley just north of Arbutus Glen, is another area of kames about one-quarter square mile in extent. The area is within the valley but rises nearly 80 feet above the flood plain of the river, making a terrace-like feature. The surface is strongly undulating rather than with knobs, suggesting kame and kettle topography that has been modified by erosion, the kames being subdued, the kettle holes reduced and breached. Cobbles of resistant rocks are common on the surface. This undulating and irregular surface is very poorly delineated on the Gambier topographic sheet.

VALLEY TRAIN REMNANTS

Outwash gravels must have been laid down in valleys, beyond and within the Illinoian drift region, but they have been so completely removed by later erosion that only a few remnants remain. Only one fairly extensive group of terrace remnants and two isolated remnants have been noted.

Clear Fork Valley.—Remnants of an Illinoian terrace are preserved over a distance of two and one-half miles on the north side of Clear Fork valley at Bellville, Richland County. These remnants are about 60 feet above the continuous lower Wisconsin valley train at Bellville. One small remnant of the higher terrace remains on the south side of the valley.

The remnant of the Illinoian terrace farthest upstream is immediately north of Bellville at an elevation of 1,200 to 1,220 feet, just east of the Wisconsin boundary. One-half mile east of the village, a larger remnant one-third mile long is preserved. It is flat-topped, has an elevation of 1,190 feet, and partly closes a tributary valley from the north. One-quarter mile southeast of the village another small remnant has an elevation of 1,190 feet, and one-half mile farther east, in southern Section 11, a larger remnant about one-half mile long has an elevation of about 1,180 feet. Farther downstream no evidence of Illinoian terrace remnants was noted.

That these remnants of the higher terrace are Illinoian and not a high Wisconsin terrace is shown by several lines of evidence. First, the elevation of the top of the Wisconsin end-moraine at Bellville is 1,180 feet. The well marked valley train extending down valley from it has an altitude of 1,144 feet in Bellville. The remnants of the higher terrace are therefore above the possible reach of Wisconsin waters. Further, the surface of the higher terrace is much more eroded than the surface of the lower terraces. Finally, the mineral grains separated from the soil on top of the higher remnants show the degree of alteration characteristic of Illinoian drift deposits (6).

The remnants represent a valley train that was at least three miles long, and probably much longer, deposited from the Illinoian ice after it had retreated more than eight miles west of its farthest eastward position. These remnants indicate definitely, however, that in the vicinity of Bellville, the valley of Clear Fork was filled, during the waning of the Illinoian ice, to an elevation from 60 to 80 feet higher than the present stream level. All remnants have been completely removed downstream from a point two and one-half miles east of Bellville and Wisconsin glaciation has obliterated any remnants that may have been preserved west of Bellville. It is impossible, therefore, to determine where the valley train headed or how far downstream it extended.

Mohican Valley.—A small bench area about one-half mile long and 100 feet above the Wisconsin terraces exists on the inside of a great bend on the east side of the Mohican River at the Knox-Coshocton county line, one mile southwest of Cavallo. It extends from central eastern Section 20, Union Township, Knox County, eastward into Tiverton Township, Coshocton County, and is crossed by the road along the east side of the Mohican valley. The elevation of this bench is a little over 1,000 feet and the elevation of the Wisconsin terrace below is a little over 900 feet. There are no good exposures of the material, but cobbles are prominent on the surface. These cobbles are more weathered than those of the Wisconsin terrace below. This bench, one mile east of the mapped Illinoian boundary, may be a remnant of local outwash deposited before the present course of the Mohican River was established by the meltwater from the ice.

A small, ridge-like remnant of Illinoian outwash is present in the Walhonding valley, three-fourths mile east of the Mohican River, just northwest of Walhonding village. This remnant is one-quarter mile long and one-eighth mile wide. Its top is considerably dissected, but small, flat-topped areas remain at an elevation of 940 to 960 feet. It is separated from bedrock hills to the north by a small, open valley, one-quarter mile wide. The Illinoian outwash is overlapped to the east and south by an extensive Wisconsin outwash terrace having an elevation of 880 to 900 feet. The Illinoian gravel ridge apparently continues to the northwest, but actually, the ridge to the northwest, above an elevation of 960 feet, is of Mississippian bedrock. The Illinoian gravel is not exposed in any pits, but from surface indications it seems to be medium to coarse-grained, with a few cobbles up to six inches in diameter.

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