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FARMDALE DRIFT NEAR DANVILLE, ILLINOIS[1]

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When the new Harmattan strip-mine of the Fairview Collieries Corporation northwest of Danville, Illinois, was opened a few years ago, a portion of the stream in Hungry Hollow was diverted to an artificial ditch several hundred yards north of its original course (fig. 1). The ditch exposes an extraordinary succession of Pleistocene deposits, including a till that is believed to be of Farmdale age, with unusual relations between some of these deposits.

The ditch was originally dug about 35 feet deep, in two approximately equal "lifts." The lower "lift" is about 25 feet wide and the upper is 2 to 3 times as wide; the additional width on the north side is clear but that on the south side is largely filled with the material excavated from the lower lift. The original gradient of the ditch was the minimum necessary, starting from the toe of a low concrete dam across the Hollow at the upper point of diversion. Because this minimum gradient is less than that of the natural stream, the bottom of the ditch where it rejoined the Hollow at the lower point of diversion was several feet higher than the bottom of the Hollow, creating a waterfall. This waterfall has retreated headward about 500 feet, deepening and widening the ditch and revealing new and different geological phenomena as it retreated.

A description and interpretation of the glacial deposits as they appeared along the ditch in 1949-50 has been published.[2] Reexaminations by the authors during the last year, since additional phenomena have been exposed, have enabled a revised, more detailed description and a new interpretation of the deposits. The authors profited from discussion with Dr. M. M. Leighton, Illinois State Geological Survey, and Professors George W. White and Paul R. Shaffer, University of Illinois, Department of Geology, who joined in one of these examinations.

For convenience of description, the exposure may be considered in four segments: one is the upper

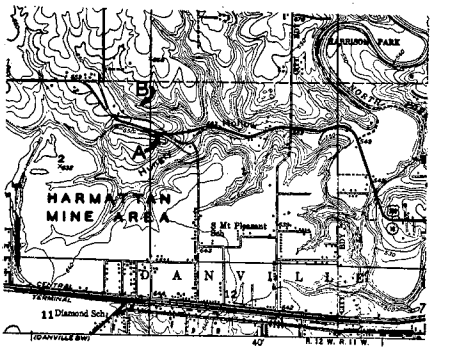

FIG. 1.—Map of area northwest of Danville, showing general area of Harmattan Mine, the diverted course (dash-tridot line) of the stream in Hungry Hollow, the approximate location (A) of the diagrammatic section in fig. 2 and the successions shown in figs. 3-6, and the approximate location (B) of significant outcrops in "School House" Hollow.

[1] Presented and published with permission of the Chief, Illinois State Geological Survey.

[2] Eveland, Harmon E., Pleistocene geology of the Danville region, Ill.: State Geol. Survey Rept. Inv. 159, pp. 19-24, figs. 10-12, geol. sec. 13 (p. 30), 1952.

"lift" of the ditch, in which the deposits occur in essentially horizontal layers, and the other three are in the lower "lift," respectively east and west of the place (W, fig. 2) at which the deposits to the east are more or less inclined, and the point (E, fig. 2) to which the waterfall has retreated. The deposits exposed in the upper "lift" and in the middle segment of the lower "lift" are shown diagrammatically in figure 2. Another convenient point of reference, designated X, is the place about a hundred feet west of W where a small drain from the adjacent highway spills over the north side of the ditch. The deposits will be discussed as units, numbered from the top down.

I. Silt, loessial, leached, oxidized, light brown, 4-5 feet thick; follows down west slope of Hungry Hollow, overlapping successively units II-VII as they terminate against the slope.

II. Sand and gravel, thin or generally absent along ditch but as much as 15 feet thick in area.

III. Till, clayey, light grayish buff, leached in upper part, calcareous below, total 5-6 feet, thins eastward, absent east of W.

IV. Silt and sand, calcareous, light buffish gray, in irregular layer usually only a few inches thick but thicker at some places and absent at others; at X it is about 2 feet thick, comprised of about 8 inches of silt at top, about 8 inches of sand in the middle, and as much as 4 inches of laminated gray clay at bottom.

V. Till, like unit III, but less clayey, more silty, more pebbly, slightly lighter and a little more yellow, with a faint greenish cast, calcareous throughout. Although seemingly not greatly different in tex-

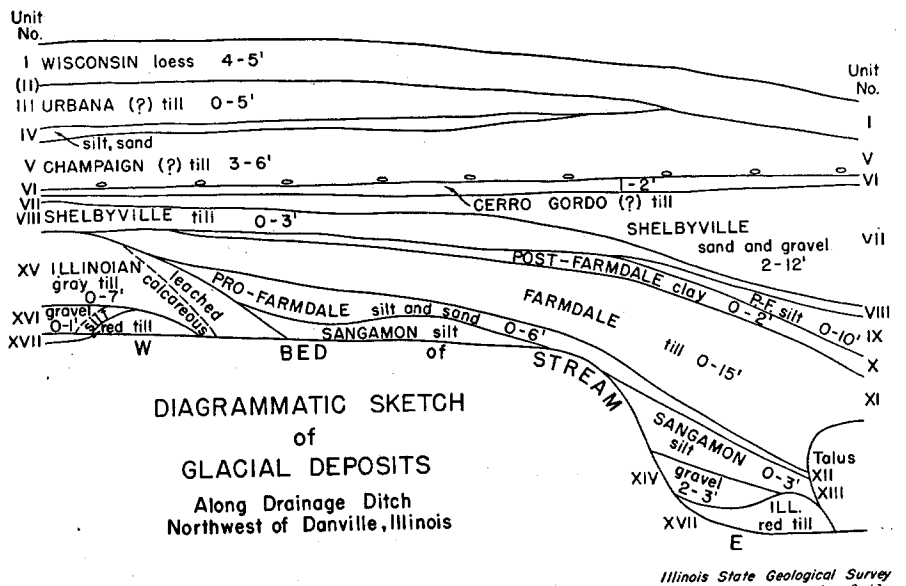

FIG. 2.—Diagrammatic sketch of the glacial deposits exposed along part of the diversion ditch for the Hungry Hollow stream.

ture, the two tills react differently to erosion, so that on the "spurs" between the rivulet channels along the north slope of the ditch the break between them, without regard to unit IV, is marked by distinct shelves or shoulders a few inches wide developed on the lower till. The base of the greenish till, especially east of point X, is marked by a concentrate of cobbles and boulders up to 4 feet in diameter. The top surfaces of most of these rocks appear to be the most faceted and striated.

VI. (East of point X.) Till, calcareous, light pinkish buffish gray, essentially like units III and V in texture but much more bouldery than any other till exposed along the ditch; 1-1½ feet thick. The boulders concentrated in the base of the overlying till are obviously derived from this pinkish till layer.

VII. Sand and gravel with occasional boulders, gray to yellow, usually calcareous but where locally thicker the upper part is leached[3] and oxidized brown to depths of as much as 2½ feet; usually 1-2 feet thick but thickens eastward from W and east of E attains thicknesses of at least 12 feet; cross-bedded, especially where thicker. This unit is at base of upper "lift."

VIII. Till, sandy, calcareous, gray, generally 2-3 feet thick but thins and is absent near and east of E as it follows down under the thickening sand and gravel of unit VII; crudely layered and contains numerous pockets and lenses of sand and gravel between W and X; locally west of X up to 2 feet of silt at base; contact with overlying sand and gravel irregular.

[3] The leaching was first noted by Dr. James Thorp, Earlham University, June 1953.

Under unit VIII and east of W there is a succession of deposits comprising at least 6 units, all inclined eastward and wedging out westward until they become absent west of W (fig. 2).

IX. Principally silt, fossiliferous, generally calcareous, especially to west, but locally noncalcareous, especially to east, laminated, gray, with sand lenses and dark-brown humus-bearing bands. One calcareous sand lens about 12 feet long and 2 feet thick at the maximum occurs at the base of the unit on the south side of the ditch at E. A lens of noncalcareous gravel has also been reported as occurring near the base.[4] At and east of E the unit is 6-10 feet thick but west of E it thins rapidly and wedges out seemingly by truncation by unit VIII.

X. Clay, noncalcareous, pebbly, green, weakly laminated, contains a few fossils; pebbles include unweathered igneous rocks; at and near E is uniformly 1-2 feet thick but thins to the west and is absent at W, apparently truncated by unit VIII, and thickens to the east where it consists of 2 or 3 layers of noncalcareous clay interlaminated with dark silt like unit IX, some calcareous and some noncalcareous, totaling 6-10 feet. Thicknesses of units IX and X seem to be somewhat complementary, at least in part.

Locally east of E units IX and X are deformed into crude diapiric cones injected upward into unit VII (fig. 3).

XI. Till, silty, calcareous, light buffish gray with chocolate-brown cast, irregularly layered with partings or thin laminae of silt and fine

[4] Eveland, op. cit., p. 20.

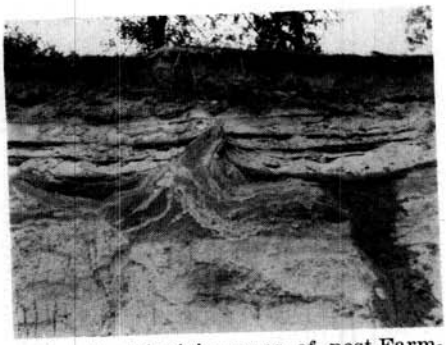

FIG. 3.—Diapiric cones of post-Farmdale, pre-Shelbyville clay and silt injected upward into the overlying Shelbyville outwash.

sand; contains small gastropod and pelecypod shells, whole and undamaged despite their fragility, and abundant wood fragments ranging from tiny pieces of twigs to sections of tree trunks 3 feet long and 1 foot in diameter; at E, near center of unit, lens of dark gray humus-bearing generally non-calcareous silt, maximum 16 inches thick, with streaks of pebbly sand and light gray calcareous silt and with wood fragments up to 10 inches long at base; east of E includes masses of brownish noncalcareous till and brown oxidized gravel; east of E, up to 15 feet thick, at and near E 6-8 feet thick, thinning westward and terminating at W partly by truncation by unit VIII and partly by abutment against steep slope of older deposits (fig. 5).

XII A. At and west of E: sand and silt, generally calcareous, dark gray, variable in thickness and character; upper part laminated silt and sand (fig. 4), up to 3 feet thick, 70 feet west of E gravel lens 6 inches thick at top, 50 feet east of W, lens of dark laminated silt 6 inches thick at base, containing an abundance of wood fragments and humic debris; lower part, intergrading with upper part, weakly or locally laminated humus-bearing fossiliferous silt (fig. 4), also up to 3 feet thick; at W, unit abuts steep slope of older deposits (fig. 5).

XII B. East of E: gravel, sand, and silt, calcareous, light brown, containing wood fragments, humic debris, gastropod fossils, and pebble-armored "balls" of silt and clay, stratified, some strata cross-bedded, grades generally from coarse, relatively well sorted gravel below to silt at top, 8-14 feet thick.

Because of talus along both sides of the ditch immediately east of E, the relations between units XII A and XII B are uncertain, except that both lie immediately under unit XI. They may be completely independent and lie one upon the other, or they may completely intergrade laterally; it is considered most likely that at least the upper part of XII A grades laterally into XII B.

XIII. Silt, sandy, pebbly, noncalcareous, humus-bearing, nonlaminated, dark gray to black, pebbles up

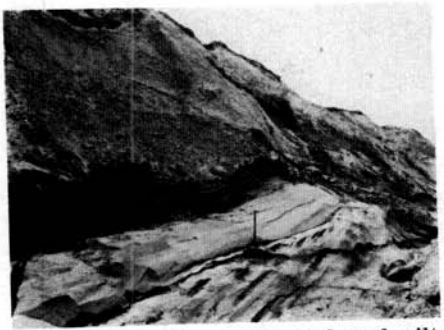

FIG. 4.—Pro-Farmdale sand and silt overlying Sangamon silt at E (contact marked by head of pick) and overlain by Farmdale till. In background Shelbyville till overlies the Farmdale till.

to 3/4 inch in diameter, 1-3 feet exposed, base concealed for 150 feet between E and W as it forms bottom of ditch (fig. 4); absent east of E, and at W abuts against older deposits; superficially like lower part of unit XII A but distinguished from it by being noncalcareous; grades rapidly down into unit XIV; numerous limonite-filled joints up to 1-inch thick, of which only a few continue weakly into unit XII.

XIV. Gravel, clayey, noncalcareous, poorly sorted, nonbedded, nonlaminated, cobbly and bouldery at base, 2-3 feet thick; not exposed elsewhere along ditch.

XV. Till, sandy, gray with slight pinkish cast, generally similar to unit VIII but more compact and jointed; at W it terminates in a slope dipping eastward 20-30 degrees, against which units XI-XIII abut; generally calcareous, but at W upper part is leached and oxidized to increasing thickness downslope (fig. 5). At W three calcareous tills—units VIII, XI, and XV—are in contact one above the other, but all along the ditch farther west unit VIII lies directly on unit XV, the contact identified by a pebble band (fig. 6) and by slight oxidation of the upper part of the lower unit. Unit XV contains numerous lenses and pockets of silt, sand, and gravel (fig. 5), some gray, some more or less oxidized yellow to brown.

XVI. Silt, sand, and fine gravel, calcareous, gray, up to 1 foot thick in very irregular distribution between units XV and XVII, in shallow, irregular channels in Unit XVII; exposed for about 100 feet west of W.

XVII. Till, like Unit XV, but definitely reddish and calcareous throughout, exposed for about 50 feet west of W (figs. 2 and 5) and also at E, under Unit XIV (fig. 2).

Interpretation

As the exposure lies just outside the Bloomington moraine of Wisconsin age, the highest till, unit III, and lower deposits must be older. The only older unit in the exposure that has part of a normally developed soil profile is the unit XV till, which is thereby identified as Illinoian, and units III to XIV are therefore post-Illinoian and pre-Bloomington.

In eastern Illinois five Wisconsin moraines older than Bloomington are recognized in order from oldest to youngest, Shelbyville, Cerro Gordo, West Ridge, Champaign, and Urbana.[5] The five post-Illinoian tills in the exposure—units XI, VIII, VI, V, and III—might be considered as the drifts correlative with these moraines, but for several reasons this conclusion is not held to be correct. According to this interpretation the oldest of these tills, unit XI, should be Shelbyville, but its limited distribution, its character, and the deposits associated above and below it all suggest that the ice-sheet from which it was deposited was not nearly as extensive as the Shelbyville must have been. The limited leaching of the top part of the sand and gravel that constitutes unit VII is comparable to that noted at the top

[5] The Urbana moraine was differentiated by W. C. Krumbein while mapping the road-materials resources of Champaign County in 1930. It trends both northeasterly and southerly from the east part of Urbana, overriding the back slope of the Champaign moraine southeast of Urbana. Near Philo it becomes again separate from the Champaign moraine and trends easterly. This portion was recognized and designated as the Inner Ridge of the Champaign morainic system by Leverett (Illinois Glacial Lobe, U. S. Geol. Survey Mon. 38, pp. 223-231, 1899).

FIG. 5.—Illinoian till overlain by pro-Farmdale silt and Farmdale till at W (contact marked by head of upper pick). Note slope of contact. Upper part of Illinoian till is leached; lower part is calcareous and includes lenses of sand and gravel which have been washed out. Head of lower pick marks contact of gray Illinoian till on red till.

of what has been identified as Shelbyville drift elsewhere in eastern Illinois, and for this reason both unit VII and the associated till, unit VIII, are considered to be Shelbyville in age.

The three higher tills cannot be definitely identified. They could be any combination of three of the four post - Shelbyville, pre - Bloomington drifts. One good possibility, based on the relationships of the moraines, is that units VI and V are respectively the Cerro Gordo and West Ridge drifts and unit III is the Champaign and Urbana drifts combined. Another possibility, which seems more likely, is that unit VI is the Cerro Gordo drift, or less likely the West Ridge drift or both drifts combined, unit V is the Champaign drift, and unit III is the Urbana drift. In support of this correlation are (a) the evident partial erosion of unit VI after deposition and the concentration of boulders which would be ascribed to the Champaign glacier overriding the older drifts as it advanced, and (b) the thin layer of silt and sand (unit IV) between units V and III, which accords with the glaciofluvial deposits associated with both the Champaign and Urbana drifts as known elsewhere.

The uppermost sand and gravel, unit II, is Bloomington outwash, and the top silt, unit I, is post-Urbana Wisconsin. Its overlap on successively older deposits along the west slope of Hungry Hollow shows that it was there deposited after the valley had been developed.

The correlation of units VII and VIII as Shelbyville and unit XV as Illinoian with a Sangamon weathered zone leaves the unit XI till a hitherto unrecognized and unidentified drift in eastern Illinois. In stratigraphic sequence it is at the position of Farmdale drift, which has recently been reported in northern Illinois,[6] and it is herewith so identified. The deposits above and below it are in harmony with this identification.[7]

The layering of this till, the interlayer partings of sand and silt, the lenses of silt, the fossils and wood

[6] Shaffer, Paul R., Farmdale drift: Science, vol. 119, no. 3098, pp. 693-694, May 14, 1954.

[7] Previously (Eveland, op. cit., pp. 20-22, fig. 10, geologic sec. 13, p. 30) this till was identified as Illinoian, in the belief that the noncalcareous clay, unit X, above it was gumbotil, and accordingly the lower till, unit XV, with a leached zone was identified as Kansan instead of Illinoian.

fragments, and the manner of their inclusion are all evidence that it is a water-laid till, that is, a till deposited in intimate association with standing water. The noncalcareous clay, unit X, and the generally calcareous silt, unit IX, above it and the calcareous silt and sand and gravel, units XII A and XII B, and the noncalcareous silt and gravel, units XIII and XIV, below it are also evidently water-laid. All of them were deposited in a valley eroded in Illinoian till, whose west wall is at W. Because the Farmdale till and associated deposits were evidently laid down in standing water, it follows that the valley must have drained northerly; it was blocked and the water in it impounded by the Farmdale glacier advancing from the north.

Units IX and X are considered post-Farmdale, pre-Shelbyville, units XII A and XII B are considered pre-Farmdale, post-Sangamon, and units XIII and XIV are considered Sangamon in age. Units IX to XII inclusive are therefore equivalent in age to the Farmdale loess that is distributed widely over much of Illinois and many adjacent states. The change from the noncalcareous unit XIII to the calcareous unit XII is believed to mark the advance of the Farmdale glacier, when the calcareous loess that was associated with it began to be washed into the Danville valley.

The leached zone on the Illinoian till is also considered Sangamon in age. Its thinning upwards on the valley wall would be normal. The age of the red till, unit XVII, can not be positively determined from the local exposures. The red till is believed to have been deposited by an advance of the Illinoian glacier earlier than the one that deposited the gray,[8] but it could be Kansan, in which case the entire Yarmouth weathering profile was eroded prior to the advance of the Illinoian glacier. The silt, sand, and gravel, unit XVI, between the tills would therefore be either intra-Illinoian in age, deposited at some time between the two advances, or pro-Illinoian.

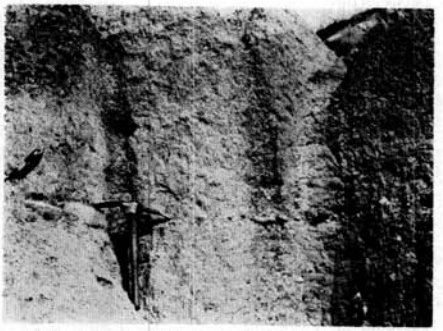

FIG. 6.—Pebble band marking contact of Shelbyville till on Illinoian till west of W.

GEOLOGIC HISTORY

After the deposition of the Illinoian drifts and the ultimate retreat of the Illinoian glacier, there developed in the vicinity of Danville a valley that was apparently the Sangamon-age successor to the northward-draining preglacial Danville valley.[9] The west wall of the valley is exposed in the drainage ditch. A

[8] Three advances of the Illinoian glacier—Payson, Jacksonville, and Buffalo Hart—have been recognized.

Leighton, M. M., and Willman, H. B., Loess formations of the Mississippi Valley: Jour. Geol., vol. 58, no. 6, Nov. 1950, pp. 599-623 (fig. 2), 1950; reprinted as Ill. Geol. Survey Rept. Inv. 149.

[9] Horberg, C. L., A major buried valley in east-central Illinois and its regional relationships: Jour. Geol., vol. 53, no. 5, 1945, fig. 2; reprinted as Ill. Geol. Survey Rept. Inv. 106.

———, Bedrock topography of Illinois: Ill. Geol. Survey Bull. 73, p.71, plates 1 and 2, 1950.

normal weathering or soil profile could not develop on the valley walls, because of constant slope-erosion, but the walls were leached to depths which increased downslope. The normal profile that presumably was developed on the upland drift-plain bordering the valley was removed by the Wisconsin glaciers. Gravel residual from the erosion of the valley and its tributaries accumulated in the bottom of the valley. Noncalcareous silt and pebbles derived from the leached and weathered drift on the uplands and slopes accumulated over the gravel at the sides and up the slopes of the valley.

When the Sangamon interglacial stage was terminated by the advance of the Farmdale glacier, the character of the deposits in the valley changed. A cooler climate with greater precipitation and greater erosion on the uplands may have prevailed. Calcareous silt derived from the loess associated with the Farmdale drift began to be washed into the valley. Later this silt graded to sand and then to gravel on the sides of the valley, presumably as the glacier approached. Coarser material accumulated in the bottom of the valley, although the evident gradation from coarse gravel at the base to silt at the top seems to be contrary to the succession expected with relation to an advancing glacier. This may be accounted for by the fact that the valley was dammed by the glacier. Considerable driftwood and humus material of local derivation was mixed with the proglacial deposits.

In due time the Farmdale glacier advanced to the vicinity of Danville. As noted above, the till must have been deposited in intimate association with water, probably in a lake created by the damming of Danville Valley. The limited distribution of the till, apparently restricted to the valley, suggests that the local glacier was not expansive and was probably only a tongue extending up the valley, probably never far beyond this locality.

The noncalcareous clay layer immediately above the till supports this view. Its character indicates that the clay was leached before deposition, and it is therefore interpreted as composed of pre-Farmdale Sangamon soil washed from adjacent uplands into the valley as it was locally freed from but still impounded by the retreating Farmdale glacier. If the Farmdale glacier had covered all of the upland areas adjacent to the valley, the Sangamon soil would have been covered by calcareous Farmdale drift and any material washed into the valley from the uplands following the deposition of the till would have been calcareous also.

The calcareous silt over the noncalcareous clay is also interpreted as wash into the valley. Its calcareous content is believed to have derived from fresh Farmdale drift and loess, exposed as the Farmdale retreated farther but while the valley was still impounded.

Subsequent to the recession of the Farmdale glacier there was little erosion in the valley before the advance of the Shelbyville glacier. How much the Shelbyville glacier eroded the valley deposits cannot be ascertained, but on the adjacent upland it eroded all the Sangamon soil down into zone 4 of the weathering profile, so that its drift now lies di-

rectly on calcareous, oxidized Illinoian till, and it truncated the post-Sangamon deposits along the side of the valley. The thinness and absence of Shelbyville till in the old Danville valley indicates that the valley either was maintained during the Shelbyville glaciation, possibly as a subglacial channel, or was revived as the glacier retreated and was filled with outwash from the retreating glacier.

As a result either of periglacial congeliturbation at this or a later glacial time or of plastic flow induced by the weight of post-Shelbyville glaciers, the post-Farmdale, pre-Shelbyville clay and silt beds in the valley were forced into diapirs[10] projecting up into the Shelbyville outwash.

Subsequent to Shelbyville glaciation there was a brief period of weathering, during which the upper part of the Shelbyville outwash sand was leached and oxidized. This period was terminated by the advent of the Cerro Gordo glacier. Following the recession of the Cerro Gordo and West Ridge glaciers, the Champaign glacier advanced over the area, eroding most of the Cerro Gordo and West Ridge drifts and faceting, striating, and polishing the boulders concentrated on the surface of the older till. With the retreat of the Champaign glacier and perhaps also with the advance of the Urbana glacier a little silt and sand outwash was deposited. The retreat of the Urbana glacier was followed by the advances of the Bloomington glacier to a point 1/4 to 1/3 of a mile from the exposure. A considerable amount of outwash was discharged from the Bloomington glacier and distributed irregularly over the area in front of it.

The last glacial episode recorded in the exposure was the deposition of loess, following the Urbana and Bloomington glaciations. It probably continued during the Tazewell substage at least, and may have continued into the Cary and Mankato substages.

Since the deposition of the loess, all the loess and the upper part of the Urbana till has been leached. The valley of Middle Fork has been eroded through all the glacial deposits to bedrock. During its development the loess has washed down its slopes to mantle the older deposits.

School House Branch

The succession of glacial deposits exposed in a series of streambank cuts along School House Branch (B in fig. 1), a tributary of Hungry Hollow lying about 500 feet north of and roughly paralleling the highway on the north side of the drainage ditch, corroborates the interpretation given above.

In the northeast valley-wall, at the point where the valley changes from a southeasterly course to an easterly course, there is a normal succession of Wisconsin till in the upper part, over a few inches of sand, over a few inches of chocolate-brown Farmdale loess, over Sangamon soil and gumbotil. In the streambed a few feet lower and some yards to the southeast is calcareous red till. This seems to be the same red Illinoian till noted in the drainage ditch; whether the

[10] Mrazec, L., Les plis diapirs et les diapirisme en general: Comptes-Rendus des seances Inst. Geol. de Roumanie, Tome V (1913-1915), pp. 226-270, 1923.

gumbotil is developed on this red till or on a gray till overlying it could not be ascertained.

Northwest a few hundred feet gumbotil is exposed in the low stream banks at and just above stream level. It is overlain by Farmdale loess and thin calcareous drift. Reddish leached drift underlies the gumbotil.

Downstream about 100 feet from the first exposure a vertical bank 20-25 feet high along the east side of the east limb of a stream meander exposes calcareous Wisconsin till in the upper part, calcareous reddish till at the base, and several feet of noncalcareous clayey gravel with lenses of calcareous silt in between. This clayey gravel has the appearance of colluvium[11] and is interpreted as a deposit equivalent to the Sangamon gravel and silt in whole or in part, and in part to the post-Farmdale clay and silt, in the drainage ditch. It is evident that the west edge of the old valley lies between these two exposures, and for this reason the valley would probably not be very deep at the second. Farther down the branch till and pro-Farmdale silt are preserved in the deeper part of the old Danville valley.

[11] In Eveland, op. cit., fig. 9A (p. 19) and geol. sec. 14 (pp. 30-31), this material was designated as Sangamon over Yarmouth gumbotil.