CORRELATION OF TILLS EXPOSED IN TOLEDO EDISON DAM CUT, OHIO

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INTRODUCTION

Two tills, separated by a cobble pavement and overlain by lacustrine and alluvial deposits, are exposed in the east bank of the Auglaize River three miles south of Defiance, just north of the Toledo Edison Dam. This section is of significance because these tills have mechanical compositions which match those of the two tills described on the north side of Lake Erie by Dreimanis (1957, and Dreimanis and Reavely, 1953) and two of the three tills mapped in northeastern Ohio by White (1952, 1953, and White and Shepps, 1952) and described by Shepps (1953). Because of its proximity to the dam, this exposure is referred to as the Toledo Edison Dam cut.

LOCATION

The Toledo Edison Dam cut is an exposure about a quarter of a mile long in the east bank of the Auglaize River, a quarter of a mile north of the relatively new Toledo Edison Dam and approximately three miles south of the town of Defiance. The site occurs just north of the mouth of Jackson Ditch, in the southwest quarter of section 3, T3N, R4E, Defiance Township, Defiance County (near the north edge of the Continental quadrangle).

STRATIGRAPHY

The stratigraphic sequence exposed in the Toledo Edison Dam cut, which is illustrated in figure 2, consists of the following units:

7. 0–5' Alluvium, leached reddish alluvial silt and gravel, present mainly in the southern part of the cut, with Lucas silt loam soil, sandy substratum phase, developed in it (described by Francis Baker, Ohio Division of Lands and Soil).
6. 3–5' Lake silts, leached, locally poorly laminated, thicker toward the north end of the cut, where some sandy material is present near base of unit.
5. 2–8' Till, clayey (sand-silt-clay ratio: 18–40–42), dark blue-gray, thicker toward the northern end of the cut.
4. 0–1' Sand and sandy gravel, present only in the northern part of the cut.
3. 0–1' Till, very sandy (sand-silt-clay ratio: 59–34–7), present only in the northern part of the cut where it is associated with the overlying sand (unit 4).
2. 6–10' Till, clayey (sand-silt-clay ratios: 20–43–37 at north end of cut; 22–43–35 and 19–45–36 at south end of cut), bluish-gray, somewhat thicker toward northern end of cut.

   Separated from underlying till by incomplete pavement of cobbles four to eight in. in diameter, composed dominantly of crystalline rocks (gneiss, diorite, basalt, also limestone), with striations oriented from S 53° W to S 62° W.
1. 8' Till, sandy (sand-silt-clay ratios: 54–38–8 at north end of cut; 52–41–7 and 51–39–10 at south end of cut several feet below contact and 39–43–18 only 18 in. below contact), unoxidized brownish-gray; containing several discontinuous horizons of cobble pavement, none of which appear to separate different tills, cobbles composed mostly of dolomite, with striations oriented from S 47° W to S 64° W.

SURFACE SOIL PROFILE

The soil developed at the top of this section is the Lucas silt loam, sandy substratum phase, and has been described by Mr. Francis Baker, of the Ohio Division of Lands and Soil (personal communication, 1957). His description, greatly abbreviated, is as follows:

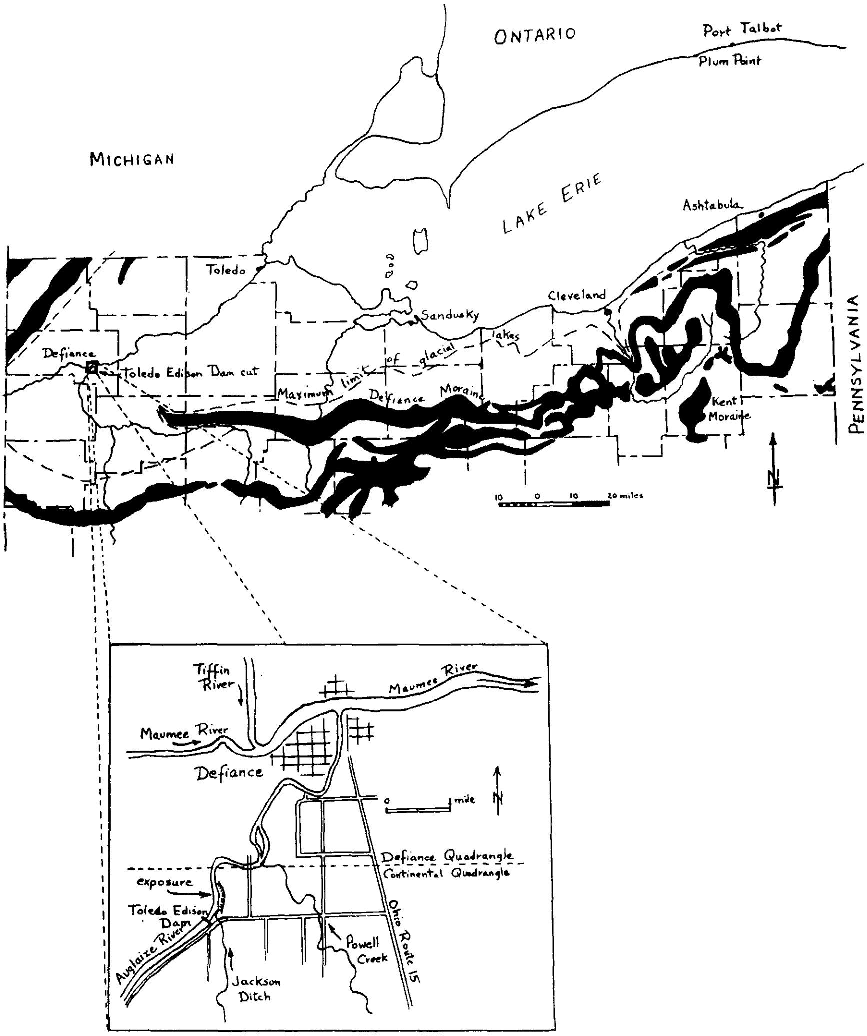

FIGURE 1. General location of Toledo Edison Dam cut.

Ap	0–6"	Dark brown silt loam with light yellowish-brown mottling (probably the result of ancient plowing), fine granular structure.
A_2	6–8½"	Light yellowish-brown silt loam with medium granular structure.
B_1	8½–14"	Brown fine silty clay loam, with medium subangular blocky structure.
B_{21}	14–22"	Brown silty clay peds (structural masses) coated with very thin continuous dark brown clay skins, strong angular blocky structure.
B_{22}	22–33"	Dark yellowish-brown peds, mottled with grayish-brown, of fine silty clay, coated with thin continuous grayish-brown clay skins, blocky structure.
B_3	33–39"	Dark brown peds, mottled with light brownish-gray, of silty clay, coated with thin continuous grayish-brown clay skins and dark brown manganese coatings, angular blocky structure.
D_1	39–44"	Finely mottled yellowish-brown and dark brown clay loam peds, coated with thin discontinuous grayish-brown clay skins, weak subangular blocky structure.
D_2	44–114"	Brown sandy clay loam with yellowish-brown mottling, massive.
D_3	114± "	Yellowish-brown calcareous silty clay till mottled with grayish-brown.

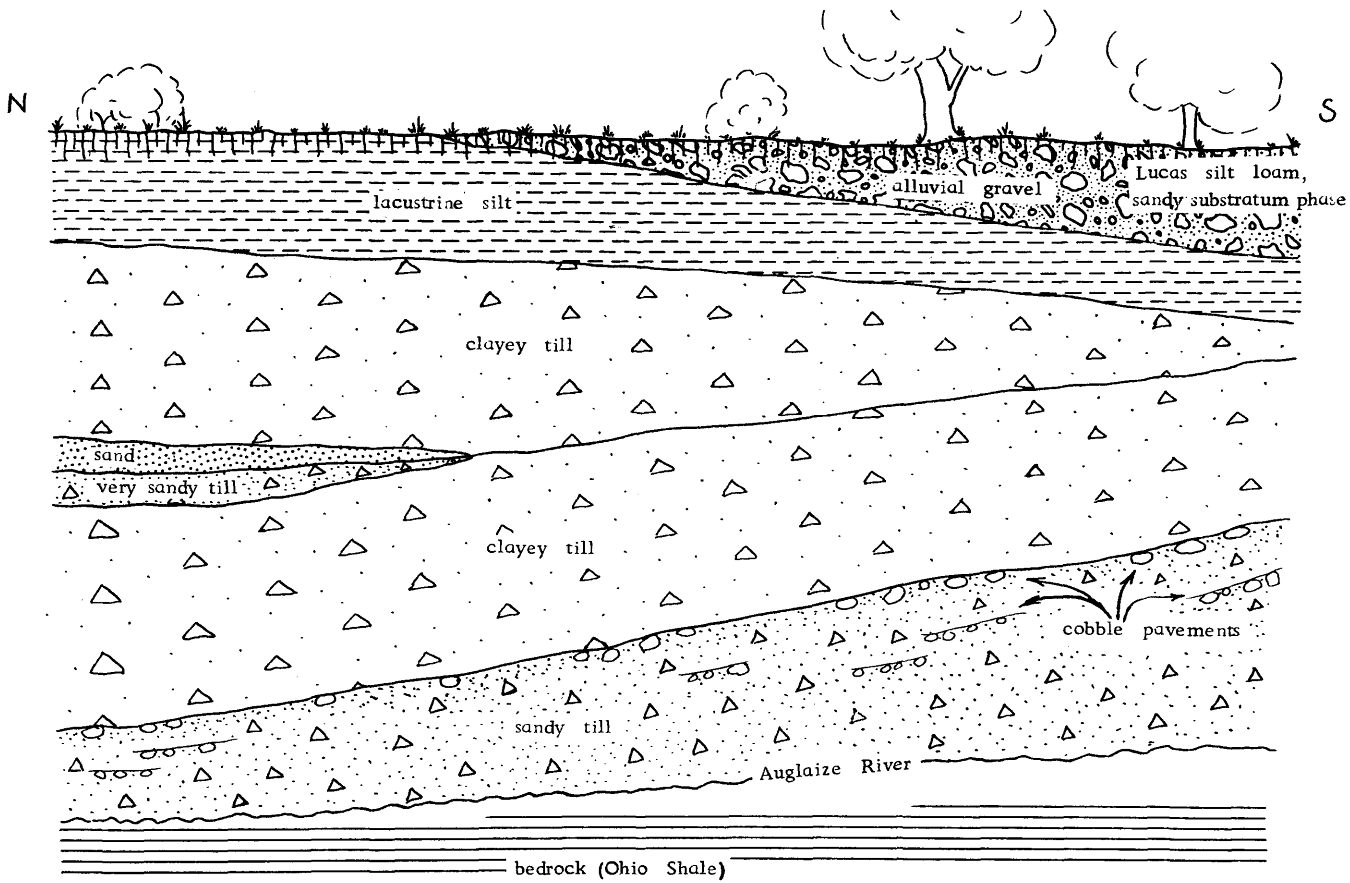

FIGURE 2. Diagrammatic cross section illustrating stratigraphy exposed in Toledo Edison Dam cut.

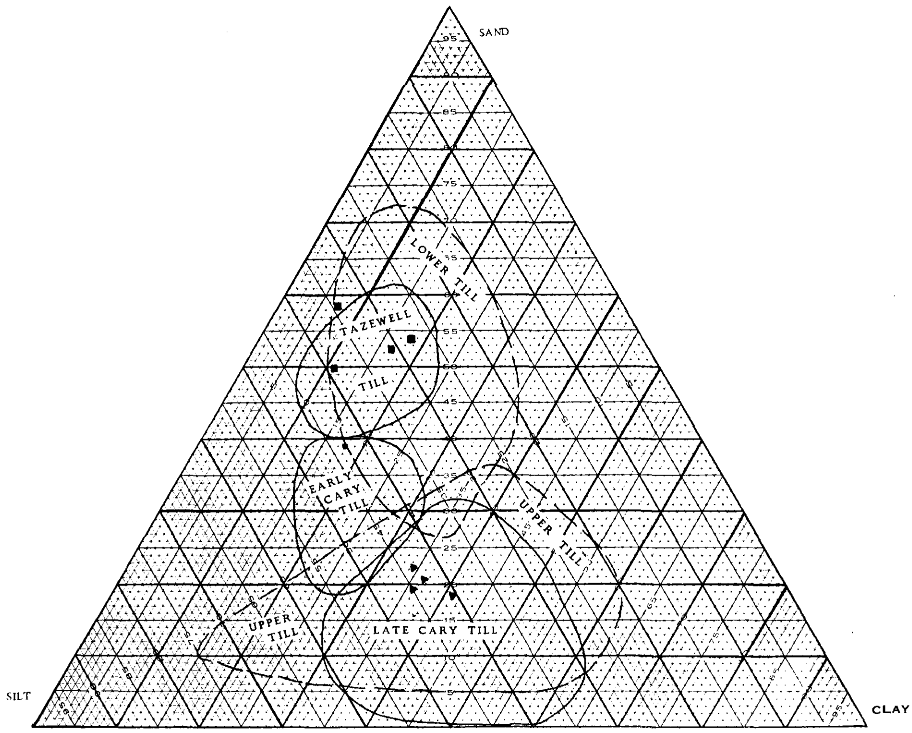

FIGURE 3. Triangular diagram showing results of mechanical analyses from northeastern Ohio (*shown by solid lines*, taken from Shepps, 1953, p. 39, fig. 2), from southern Ontario (*shown by dashed lines*, taken from Dreimanis and Reavely, 1953, p. 246, fig. 3), and individual determinations from the Toledo Edison Dam cut (upper till *shown by triangular spots*; lower till *shown by square spots*).

COMPARISONS OF MECHANICAL ANALYSES AND CONCLUSIONS

In his report on the tills of northeastern Ohio, V. C. Shepps (1953) reported strikingly consistent differences in the mechanical compositions of the three tills shown by G. W. White (1952, 1953, 1957) to have characteristic and persistent stratigraphic and geographic distribution. In order of increasing age, these tills are called (1952, 1953) late Cary, early Cary, and Tazewell. The ranges in mechanical composition of these three tills, as determined by Shepps (1953, p. 43), are:

	% Sand	% Silt	% Clay
late Cary	4–31	29–58	29–63
early Cary	19–39	37–55	16–30
Tazewell	42–60	26–45	10–23

In spite of careful work (Campbell, 1955; Gregory, 1956), it has not previously been possible to trace these drifts west of Ashland County.

Dreimanis and Reavely (1953) reported two distinct tills, an upper clayey till and a lower more sandy till, along the north shore of Lake Erie. The general ranges in mechanical composition of these two tills are:

	% Sand	% Silt	% Clay
upper till	6–35	20–58	23–62
lower till	28–70	17–43	6–36

Dreimanis also noted (p. 243), ". . . several ***boulder pavements*** or sheetlike ***accumulations of cobbles*** were found either at the base of, or within the lower till," just as has been described in the Toledo Edison Dam cut.

On the triangular diagram (fig. 3) are outlined areas enclosing the characteristic compositions of each of the tills described by Shepps and by Dreimanis. The individual analyses of the tills exposed in the Toledo Edison Dam cut are shown by spots, triangular shaped for analyses of the upper till and square for analyses of the lower till.

It will be seen immediately that the mechanical compositions of Shepps' late Cary till and of Dreimanis' upper till are strikingly similar (as pointed out by Dreimanis and Reavely, 1953 p. 246) and that the analyses of the upper till at the Toledo Edison Dam cut fit squarely into the middle of this same area. The nature of Dreimanis' lower till matches, though less precisely, the characteristics of both the Tazewell and the early Cary tills of Shepps. Dreimanis is aware of this since he said (p. 246), "The lower till of the north shore of Lake Erie, however, corresponds to either the early Cary or the Tazewell tills of northeastern Ohio, if correlated on the basis of grain-size analysis." This would suggest that the time represented by White and Shepps' two lower tills might equal that of Dreimanis' lower till; two fluctuations of the ice front in northeastern Ohio may be contemporaneous with a single continuous advance north of Lake Erie. The lack of precise agreement between the plots of Dreimanis' lower till and White and Shepps' two lower tills is probably due to the fact that the upper corner of Dreimanis' triangular diagram is "sand and gravel," rather than just "sand" as is true on Shepps' diagram. (This lack of consistency is true for both the upper and lower tills, but only in the lower till is the coarse fraction great enough to introduce some discrepancy. The gravel fraction was also disregarded in the Toledo Edison Dam cut samples.)

The hypothesis that Dreimanis' lower till is contemporaneous with both the early Cary and Tazewell tills of White and Shepps is supported by the few mechanical analyses of the lower till at the Toledo Edison Dam exposure. Most of the samples of this lower till were taken three to six ft below the contact and plot within Shepps' Tazewell area of figure 3. One sample, however, has somewhat less sand than the others and plots within the margin of Shepps' early Cary area; this sample was taken only 18 in. below the contact and within the area of the discontinuous cobble pavements. This modification in mechanical composition may indicate a change in ice age conditions which, in northeastern Ohio, resulted in the deposition of two distinct tills.

Therefore, I believe that the upper till at the Toledo Edison Dam cut is the same as Dremanis' upper till and Shepps' late Cary till, and that the lower till at the Toledo Edison Dam cut is equivalent to Dremanis' lower till and generally to both the Tazewell and early Cary tills of Shepps. The fact that these tills occur in similar stratigraphic relationships and have such strikingly similar mechanical compositions suggests that the glacial history must have been about the same throughout the entire Lake Erie basin and surroundings during this late Wisconsin time.

AGE OF THE TILLS

Dreimanis has obtained radiocarbon dates which limit the ages of both his upper and lower tills (Dreimanis, 1957, 1958). Wood from near the base of the lower till is dated at 28,200±1500 (L–185B), 27,500±1200 (W–177) and 24,600±1600 yr (L–217B). These dates are not significantly different from the date of 24,600±800 yr (W–71) obtained on wood collected by White from lake deposits associated with the Wisconsin glacial advance in Cleveland, or from other Ohio dates like 23,000±850 (Y–449) in Columbus, 21,400±600 (W–88) in Newark, or 23,000±800 yr (W–188) in Sidney. Other dates from farther south in Ohio show that this ice advance reached its southern boundary near Chillicothe and Oxford about 18,000 yr ago and then began to retreat (Goldthwait 1958).

The next younger dates are for postglacial materials. Driftwood from lake deposits lying directly above the upper till in southern Ontario is dated at 12,660 ± 440 yr (S–25). Similar dates have been obtained from postglacial materials in Ohio: 13,600 ± 500 (W–33) in Cleveland, 12,920 ± 400 (W–430) south of Sandusky, and 12,800 ± 250 yr (Y–240) at Bellevue.

The older dates listed above are obtained from wood embedded in the base of the lower sandy till or, farther south in Ohio, in the base of the surface till; the younger dates come from nonglacial materials lying directly on the youngest till (Dreimanis, 1957; Goldthwait, 1958). Thus, these two age groups mark the beginning and end of a major Wisconsin glacial advance which included, near the end of the interval, a less extensive readvance associated with a more clayey till.

As defined in Illinois, the classic Wisconsin is represented by radiocarbon dates varying from 25,100 ± 800 (W–69) at Farmdale, Illinois, to 12,200 ± 350 yr (W–161) at Dyer, Indiana (Horberg 1955). Thus, based on radiocarbon dates, all the tills discussed in this paper, including the two tills exposed in the Toledo Edison Dam cut, appear to represent the entire interval of classic Wisconsin time.

SUMMARY

An exposure in the east bank of the Auglaize River just downstream from the Toledo Edison Dam, three miles south of Defiance, Ohio, reveals two tills, separated by a cobble pavement and overlain by lacustrine and alluvial deposits. The upper till is clay-rich, with a mechanical analysis that fits within the ranges of both the late Cary till of northeastern Ohio (Shepps, 1953) and the upper till of southern Ontario (Dreimanis and Reavely, 1953). The lower till is much sandier, with a mechanical composition that fits within the ranges of the sandier Tazewell till of northern Ohio and the lower till of southern Ontario.

One sample of this lower till, taken not far beneath the contact with the upper till, has a mechanical composition more like that of the early Cary till of northeastern Ohio suggesting that, in this area, there was a transition, near the end of the time during which the lower till was deposited, to conditions leading to the deposition of a till more like that of the early Cary.

Because the mechanical analyses of the tills and their relative stratigraphic positions are almost the same in northeastern Ohio, southern Ontario, and in the Toledo Edison Dam cut, it is inferred that the glacial history of the three areas must have been almost the same, thus providing a basis of correlation between these areas.

Radiocarbon determinations give a date of 24–27,000 yr ago for the advance of the glacier which deposited the lower sandy till. By about 12,000 yr ago, both the sandy and clayey tills had been deposited and the ice had made its final retreat from the area. On the basis of comparison with radiocarbon dates in Illinois (Horberg, 1955), this ice advance and retreat appear to have occupied the entire classic Wisconsin interval.

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