CHARACTERISTICS AND IMPLICATIONS OF A THIN LOESS AREA IN NORTHWESTERN ILLINOIS

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An unusual area of thin loess, which averages less than 5 feet in thickness irrespective of slope, was observed during the recent detailed soil survey of Carroll County, Illinois. This area was observed in an upland portion of southwestern Carroll County and was subsequently traced into the uplands of northwestern Whiteside County (Fig. 1). The thin loess occurs in a region adjacent to the flood plain of the Mississippi River and only a few miles from the Iowan till border in Iowa, both considered to be good sources of loess. Thick loess deposits surround this thin loess area, and the upland portions of southwestern Carroll County and northwestern Whiteside County have previously been shown on a generalized loess thickness map of Illinois as having more than 25 feet of loess (Smith, 1942, Fig. 3).

A possible explanation of this unusual thin loess area is presented which is based on studies of soils and parent materials in the area and which has implications concerning the glacial history of these portions of the two counties. The detailed soil survey of Carroll County has made available new information on morphology and genesis of soils in the thin loess area. The parent materials in southwestern Carroll County are shown in Figure 2.

Near the close of the 19th century, Leverett (1899, p. 154) mentioned the occurrence of this same thin loess area. He wrote, "Attention has been called to the existence of a tract nearly free from loess in southwestern Carroll and northwestern Whiteside Counties, Illinois, which may find its explanation in ice occupancy of the territory up to a date so late that the loess was barred out." Leverett offered as a possible (but not probable) theory that a tongue of ice invaded this area from Iowa on the west and represented an extension of the Iowan ice into Illinois (Leverett, 1899, p. 151).

Reimer (1957, Fig. 1) constructed a generalized loess depth map of Carroll County based on borings in 5 east-west traverses. He noted that, except for the southwest corner of Carroll County, the loess thins with increasing distance eastward from the Mississippi River valley. He indicated the thin loess area but did not characterize it.

Methods of Study

The soil survey of Carroll County was a cooperative project of the University of Illinois Agricultural Experiment Station and the Soil Conservation Service of the United States Department of Agriculture. Soil types were mapped on aerial photographs having a scale of 4 inches to 1 mile. Thousands of auger borings were made in the southwestern portion of Carroll County, using 60-inch augers equipped with bits 1 inch in diameter. These observations were supplemented by numerous deeper auger borings and by profiles exposed in stream banks, road cuts, and railroad cuts.

At the conclusion of the detailed soil mapping in Carroll County, the thin loess area was traced into northwestern Whiteside County where 55 observations were made utilizing road cuts and auger borings to establish the boundary between thick and thin loess and to observe materials below the thin loess.

Results

Parent materials and soils. Nine significant kinds of parent materials in southwestern Carroll County are shown in Figure 2. Five parent materials occurring in the upland thin loess area are designated as areas A through E. Soils in area A are developed in 0 to 5 feet of loess overlying till. Soil profile descriptions in Tables 1 and 3 indicate the distinct morphological differences between soils developed in the till and it is suggested that two ages of till may occur in a mixed pattern in the till areas.

The morphology of Wacker (tentative) silt loam (Table 1) suggests the following interpretation of its genesis. The A_1, A_3, and B_1 horizons, 0 to 23 inches, were formed in recently deposited loess. Morphol-

Table 1.—Description of Wacker (Tentative) Silt Loam.

Location—Sixty-five paces east of center of Illinois Route 78 in roadbank on the north side of road in SW 2½ of SW 10 of SW 40 of SE 160 of Section 36, T23N, R4E, Carroll County.

Parent Material—Thin loess over till.

Vegetation—Native, prairie grasses; at present, bluegrass.

Drainage Class—Well drained.

Slope—4% to southwest.

Horizon	Depth (in.)	Morphology
A_1	0-9	Very dark brown (10YR 2/2) friable silt loam; moderate medium to fine granular structure; clear smooth boundary to horizon below. (All Munsell notations and corresponding color names are for moist material.)
A_3	9-14	Very dark grayish-brown (10YR 3/2) friable silt loam; weak medium to fine subangular blocky structure; clear smooth boundary to horizon below.
B_1	14-23	Dark yellowish-brown (10YR 3/4) with coatings of light gray (10YR 7/1) friable silt loam; weak medium to fine subangular blocky structure; gradual smooth boundary to horizon below.
B_{21}	23-29	Dark brown (7.5YR 3/4) with coatings of light gray (10YR 7/1) friable gritty silt loam; weak medium to coarse subangular blocky structure; clear smooth boundary to horizon below.
B_{22}	29-33	Dark reddish-brown (5YR 3/4) with coatings of light gray (10YR 7/1) friable loam; weak medium to coarse subangular blocky structure; clear smooth boundary to horizon below.
B_{23}	33-98	Reddish-brown (5YR 4/4) firm clay loam; weak coarse to very coarse angular to subangular blocky structure.
D_1	98-120	Brownish-yellow (10YR 6/6) disintegrated dolomitic limestone which can be penetrated by an auger.
D_2	120+	Brownish-yellow (10YR 6/6) solid dolomitic limestone.

TABLE 2.—Particle Size Distribution[a] and pH[b] of Wacker (Tentative) Silt Loam

Horizon	Depth sampled	pH	Gravel (> 2mm)	Total sand (2-.05mm)	V. F. Sand (.1-.05mm)	Silt (.05-.002mm)	Clay (< .002mm)
	in.		%	%	%	%	%
A_1	0-9	5.7	0.0	6.9	3.6	73.3	18.7
A_3	9-14	5.2	0.0	7.2	3.3	72.1	19.2
B_1	14-23	5.2	0.0	9.8	3.4	69.5	19.8
B_{21}	23-29	5.0	0.0	26.2	4.7	54.7	17.4
B_{23} (upper)	36-46	5.3	5.4	32.3*	5.0*	32.4*	34.0*
B_{23} (lower)	60-70	5.4	3.5	28.6*	5.7*	33.6*	36.2*

[a] Pipette method with sodium hexametaphosphate dispersion.
[b] pH by Beckman glass electrode using a 1-1 soil water ratio.
* Calculated on basis of < 2mm material.

ogy of the loess horizons and data in Table 2 give little evidence of clay formation or movement from prolonged weathering in place. Horizons from 23 to 33 inches are interpreted as having been formed in water-deposited material and the upper 6 inches appear to be mixed with loess. The leached and weathered till, 33 to 98 inches, is the B horizon of a paleosol profile from which the original surface horizons have been removed. This till apparently weathered for a long period of time before the present surface material was deposited. The profile above 33 inches is difficult to explain without assigning its age to late Wisconsinan time.

Thin loess-over-till profiles occur in area A which contrast with the above profile. The till appears to be younger and less weathered, and soil formation in the loess and till portions appears to have occurred simultaneously. A description of this kind of profile is given in Table 3.

The Strawn silt loam profile (Table 3) is indistinguishable from profiles that occur in thin loess over loam till in northeastern Illinois where the till is middle to late Wisconsinan in age.

Soils in area B (Fig. 2) are developed in 0 to 5 feet of loess over sandy deposits. Normally, a thin loess deposit overlies sands. However, the deposits are quite variable and stratification of sands and silts in certain places may indicate mixing of sand and loess by wind. Some areas are void of loess and the sand has been blown into dunes. The sands in areas nearest to the Mississippi River bluff are uniformly textured and appear to be wind-deposited. Away from the bluff, however, the sandy deposits were observed to be stratified in many areas, indicating water deposition. Good examples of stratification in sandy deposits occur in stream banks along Sand Creek in Section 7, T23N, R5E at elevations of 760 feet. These cuts contain numerous chert pieces, some 4 to 5 inches in diameter, mixed with the sand. Soils in area B are weakly developed and the sandy deposits range from sandy loam to sand in texture.

Soils in areas C and D are characterized by loess or drift or a combination of the two over dolomitic limestone and calcareous shale, respectively. A stratified sandy layer several inches thick occurs above the bed-rock and below the loess in most parts of these areas. In other parts thin till layers are readily identified above the dolomite or shale.

Gravelly deposits, designated as area E, are minor in extent. They appear to be ice-contact features and occur on the south side of Johnson Creek valley. They range from well to somewhat poorly stratified deposits of sand and gravel which are frequently calcareous at the surface, but they may be leached of carbonates in a tongued pattern to depths of 4 to 5 feet. These gravelly deposits are interpreted as constructional rather than erosional landscape features.

The portion of the thin loess area occurring in Whiteside County is similar to that in Carroll County. Observations indicated the presence of till, sands, and dolomitic limestone beneath the thin loess with sandy deposits predominating.

Significance of absence of Farmdale loess. The absence of Farmdale loess is very significant in the thin loess area. In the thick deposits of loess north and east of the thin loess area (Fig. 1), Farmdale loess was found to occur regularly in many deep borings. In ridgetop borings, Farmdale loess was found everywhere to overlie a paleosol in till and was in turn overlain by many feet of calcareous and leached Pe-

TABLE 3.—Description of Strawn Silt Loam.

Location—NE 10 of SE 40 of NW 160 of Section 25, T24N, R4E, Carroll County.
Parent Material—Very thin loess over till.
Vegetation—Originally oak and hickory; at present, bluegrass.
Drainage Class—Well drained.
Slope—7% to west.

Horizon	Depth (in.)	Morphology
A_1	0-5	Very dark grayish-brown (10YR 3/2.5) friable silt loam; weak fine to medium crumb structure; abrupt smooth boundary to horizon below. (All Munsell notations and corresponding color names are for moist material.)
A_2	5-9	Dark grayish-brown (10YR 4/2) friable silt loam; weak fine to medium platy structure; clear smooth boundary to horizon below.
A_3-B_1	9-12	Dark yellowish-brown (10YR 4.5/4) friable loam; moderate very fine to fine subangular blocky structure; clear smooth boundary to horizon below.
B_{21}	12-18	Dark yellowish-brown (10YR 4.5/4) firm clay loam; moderate very fine to fine subangular blocky structure; thin clay skins on structure faces; clear smooth boundary to horizon below.
B_{22}	18-23	Dark brown to brown (7.5YR 4/4) with some spots of black (5YR 2/1) firm clay loam; strong fine to medium subangular blocky structure; thin clay skins on structure faces; clear wavy boundary to horizon below.
C	23-60+	Dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/4) firm loam till; massive in place, breaking to coarse subangular blocky structure; calcareous.

TABLE 4.—Description of Typical Section in Deep Loess Area.

Description of Material	Thickness feet	Thickness inches
Soil profile in upper 4½ feet, Peorian loess, silty, leached, brown (10YR 4.5/3).*	10	0
Peorian loess, silty, strongly calcareous, yellowish-brown (10YR 5/4).	10	10
Peorian loess, silty, weakly calcareous, light grayish-brown to pale brown (10 YR 6/2.5).	2	6
Farmdale loess, silty, non-calcareous, dark yellowish-brown (10YR 3.5/4).	3	9
Gritty silt loam; possible surface of paleosol.		10
Clay loam, firm, dark brown to brown (7.5YR 4/4), B horizon of paleosol in till.		15+ (stopped boring at 29 feet 2 in.)

* All Munsell notations and corresponding color names are for moist material.

orian loess. Identification of Farmdale loess in these portions of Whiteside and Carroll Counties agrees with observations of Leighton (1923, p. 272). In Table 4 a typical section is described from a road cut and auger boring in the NE ¼ of SW ¼ of Section 34, T23N, R5E, Carroll County.

The Farmdale loess contrasts with the Peorian loess in both color and carbonate content. The Farmdale loess is darker brown and frequently has the Munsell notation of 7.5YR 4/4. It is usually non-calcareous or occasionally very weakly calcareous. This property is difficult to assess from auger borings because the Farmdale loess is drawn up through a casing of calcareous Peorian loess and contamination may result.

Calcareous Peorian loess, in most borings, could be separated into two contrasting portions, with the lower loess being more gray and effervescing less than the upper yellowish-brown loess.

Absence of Farmdale loess in the thin loess area indicates the drift in this area is either post-Farmdale in age or has been greatly altered during post-Farmdale time.

Discussion

Interpretation of Pleistocene geology of northwestern Illinois has been controversial. Field studies by Shaffer (1954, Fig. 4) have shown that the Tazewell substage (Woodfordian of Frye and Willman, 1960) of the Wisconsinan stage extended into Iowa from Illinois and that the Iowan (Keewatin) drift border occurs in Iowa, but does not extend into Illinois as Leverett (1899, p. 151) suggested. Shaffer's Tazewell substage boundary of 1954 is shown in Figure 1. This is essentially the same boundary shown by Leighton (1958, Fig. 3) for the northern limit of his Iowan (Labradorean) substage of the Wisconsinan stage.

As a result of later field work, Shaffer (1956, Fig. 2a) extended his Tazewell substage boundary further north as shown in Figure 1. This boundary was shown with question marks and the author described the deposits as being discontinuous at the outer margins.

Leighton and Brophy (1961, Fig. 1) have very recently revised their Iowan (Labradorean) boundary in this area. Their publication appeared subsequent to the oral presentation of this paper at the annual meeting of the Illinois Academy of Sciences at Quincy, Illinois, in April, 1960. Their revision is an extension in a northerly direction from immediately west of Morrison in Whiteside County to about the vicinity of Ideal in Carroll County. This is slightly further north than Shaffer's Tazewell extension of 1956, as shown in Figure 1. The basis for the extension is not given in their paper and no observations in this extended area are indicated or described.

We believe that the northerly extensions described above are justified. We suggest, however, that the ice extended further northward into Carroll County following the general direction of the thin loess area and that the eastern border of the thin loess area generally marks the eastern edge of the ice extension. Outlets for the melt-water were furnished by the Johnson Creek valley and the subdued bluff area west of

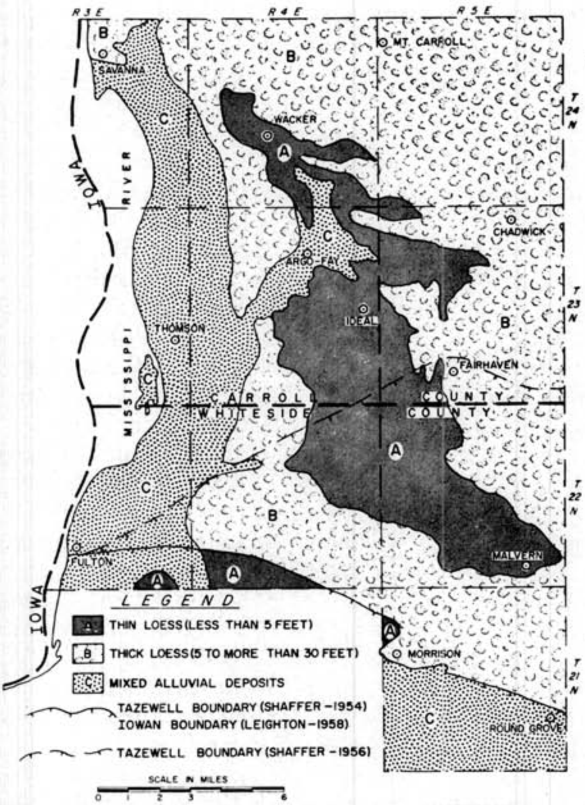

Fig. 1.—Location of thin loess area in Carroll and Whiteside Counties, Illinois.

the village of Wacker and southeast of Savanna. Disagreement prevails as to whether the substage involved is Tazewell (Woodfordian) or Iowan. We will refer to it as the Tazewell substage in the remainder of this paper.

A possible glacial spillway has been indicated in the Wacker area by Horberg (1950, Fig. 10). Horberg stated (1950, p. 48) "As the channel lies close to the Illinoian drift border, it seems probable that it was eroded as a glacial spillway when Illinoian ice filled the valley to the east. This possibility needs to be verified by field studies as the glacial boundary is poorly defined because of the thin and patchy character of the drift and the loess cover." The thin loess cover over mixed till and water-deposited material (Fig. 1) supports the hypothesis that the spillway mentioned by Horberg (1950, Fig. 10) was last used by a tongue of Tazewell-age ice. This northerly extension of Tazewell ice to the vicinity of Wacker, Illinois, could have been very similar to the tongue of ice of this same substage which pushed northward on the west side of the Mississippi River toward the village of Goose Lake in Iowa (Shaffer, 1954, Fig. 4).

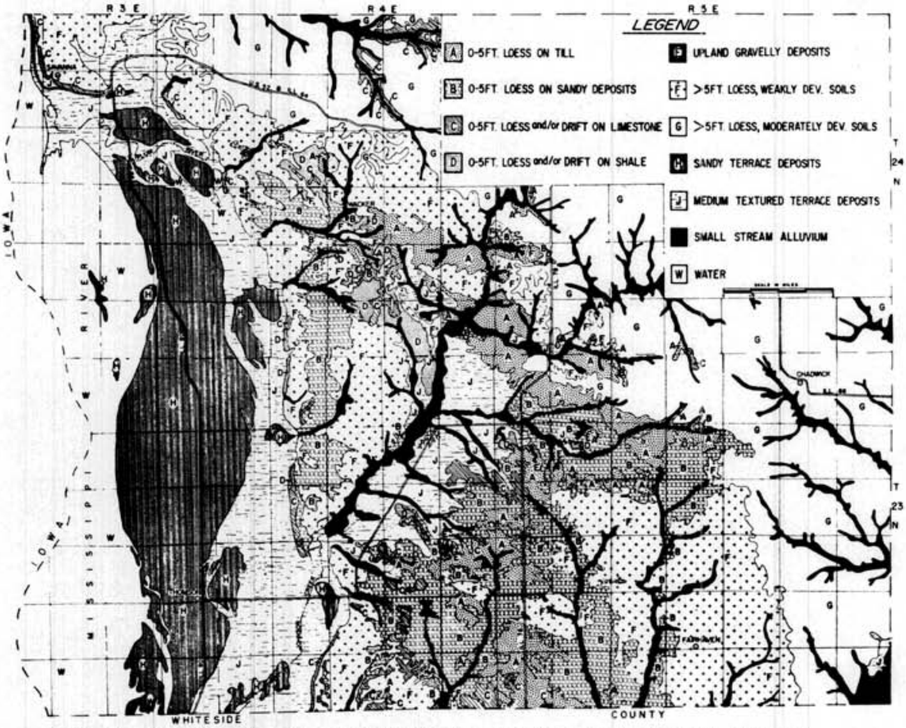

Fig. 2.—Major soil parent materials in southwestern Carroll County.

The main area of Tazewell drift in Carroll and Whiteside Counties is characterized by the patchy deposits of till and sandy material with their thin loess cover. The thin loess area indicates the main drift area but does not show the exact boundaries. The thick loess to the west and south of the thin loess area needs explanation. It is possible that this area was glaciated at the same time, but that the thicker loess here represents subsequent local accumulation very close to the source, namely the Mississippi River flood plain to the west and the Green River lowland to the south. Many deep borings in these areas failed to penetrate through calcareous Peorian loess at depths of 30 feet.

Summary and Conclusions

An unusual area of thin loess in southwestern Carroll and northwestern Whiteside Counties has been delineated. A detailed map of soil parent materials in the Carroll County portion of the thin loess area has been presented.

Soil profile morphology in this area reflects the variability of the drift. Some profiles in till suggest the presence of youthful material while others indicate the presence of a paleosol which has been truncated and recently covered with thin loess deposits. Water deposited sandy material occurs commonly in the area.

Loess thickness in this area suggests ice occupancy at a much later date than the area to the north and east. This occurred as a northwesterly extension of the Tazewell drift described by Shaffer (1954 and 1956) to a point southeast of Savanna. The deposits of this ice occur in a patchy pattern as till and waterlaid material.

The drift directly adjacent to the thin loess area to the north and east, except on the steepest slopes, is covered by Farmdale loess and thick deposits of Peorian loess. The profile developed in till below Farmdale loess suggests an age older than classic Farmdale.

Many questions remain unanswered in this area, but pedologic evidence strongly suggests the thin loess area can best be explained by ice occupancy of the area which prevented loess deposition until post-Tazewell time.

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Literature Cited

FRYE, JOHN C., and H. B. WILLMAN. 1960. Classification of the Wisconsinan stage in the Lake Michigan glacial lobe. Ill. State Geological Survey, Cir. 285, 16 pp.

HORBERG, LELAND. 1950. Bedrock topography of Illinois. Ill. State Geological Survey, Bul. 73, 111 pp.

LEIGHTON, MORRIS M. 1923. The differentiation of the drift sheets in northwestern Illinois. Jour. of Geology, 31 (4): 265-281.

LEIGHTON, MORRIS M. 1958. Important elements in the classification of the Wisconsin glacial stage. Jour. of Geology, 66 (3): 288-309.

LEIGHTON, MORRIS M. and J. A. BROPHY. 1961. Illinoian glaciation in Illinois. Jour. of Geology, 69 (1): 1-31.

LEVERETT, FRANK. 1899. The Illinois glacial lobe. U. S. Geol. Survey Mon. 38, 817 pp.

REIMER, ALLEN. 1957. The characteristics of Tama silt loam in northwestern Illinois with special reference to degree of mottling. Unpublished M.S. thesis, University of Illinois, 65 pp.

SHAFFER, PAUL R. 1954. Extension of Tazewell glacial substage of western Illinois into eastern Iowa. Bul. of the Geological Society of America, 65: 443-456.

SHAFFER, PAUL R. 1956. Farmdale drift in northwestern Illinois. Ill. State Geological Survey, Report of Investigations 198, 25 pp.

SMITH, GUY D. 1942. Illinois loess. Ill. Agr. Exp. Sta. Bul. 490, 48 pp.

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