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George M. Schafer
Iowa State College

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A Disturbed Buried Gumbotil Soil Profile in Jefferson County, Iowa[1]

By George M. Schafer[2]

During the progress of the soil survey of Jefferson County, Iowa observations of the Kansan gumbotil and the overlying loess have revealed a limited number of locations in this county and in adjacent Van Buren County in which there is a very uneven boundary between these two materials. This deformation of the gumbotil and loess contact appears to be attributable to periglacial conditions prevalent during a part of the Pleistocene.

Figure 1 shows the disturbed gumbotil-loess contact which occurs in the northeast quarter of Section 28, Round Prairie Township, T71N, R8W. A diagram, figure 2, gives the detail of the contact at this location. The five locations at which this type of deformation has been observed are as follows:

Jefferson County

1. Round Prairie Township, T71N, R8W; about center of NE¼ of Section 28.
2. Center Township, T72N, R10W; about center of NE¼ of Section 15.
3. Blackhawk Township, T73N, R10W; SE¼ of NE¼ of Section 15.
4. Blackhawk Township, T73N, R10W; NW¼ of SE¼ of Section 34.

Van Buren County

5. Lick Creek Township, T70N, R10W; ¼ mile S of NE corner of Section 3.

On the basis of very limited observations at these sites, the Kansan gumbotil is considered to be a buried Humic-Gley or Wiesenboden soil as defined by Thorp and Smith (9). It is a black (10YR2/1)[3] plastic clay to the depth exposed in the road cuts. No evidence of horizon differentiation in the till is apparent at these sites. It appears that the former soil was a fine-textured Humic-Gley rather than a Planosol which is observed in a greater proportion of the exposures of Kansan till in Jefferson County. The kinds of buried soil profiles occurring on glacial till have been discussed by Scholtes,

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[2]Soil Scientist, Division of Soil Survey and Collaborator, Iowa Agricultural Experiment Station.

[3]Color of moist soil using standard color names and Munsell color designations.

Figure 1. View of disturbed gumbotil-loess contact in northeast quarter of Section 28, Round Prairie Township, Jefferson County, Iowa.

Ruhe, and Riecken (6). The Humic-Gley soil is one which might be expected to occur on the broader poorly-drained upland flats. There are very few exposures of Kansan till in such topographic positions, and it is only occasionally that the present drainage ways have encroached to such areas. A slope reading with a hand level on the average former surface apparent in figure 1 indicated a slope of about one-half percent to the south while the slope of the present land surface at this location is about five percent.

The loess is considered to be of Iowan or possible Tazewell age.[4] No evidence indicating more than one age of deposition has been observed at this location. The loess is a brown (10YR5/3) non-plastic silt loam with slight mottling. The loess above the gumbotil grades upward to a light or medium silty clay loam in the lower part of the modern soil profile. The observed thickness of the loess

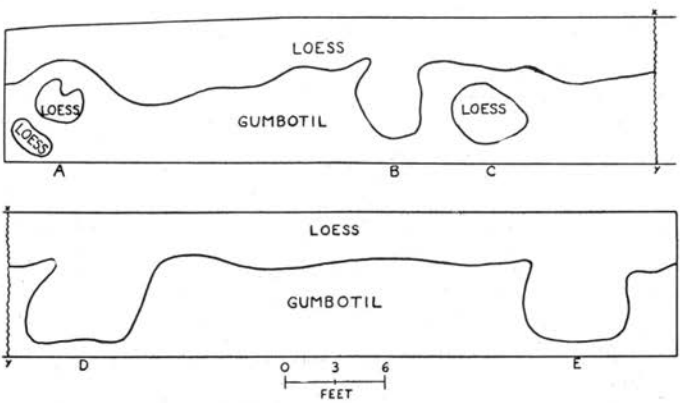

Figure 2. Diagram of the detail of disturbed gumbotil-loess contact.

[4]Information from R. V. Ruhe.

on the nearly level uplands of Jefferson County ranges from 116 inches in the northwestern part of the county to 86 inches at the southern boundary.

Disturbances of all types resulting from frost action have been described as congeliturbation by Bryan (1). Local features which show deformation and interpenetration of unlike materials as a result of frost action have been termed "involutions" by Denny (3), Sharp (8), and Schafer (5). An involution then is a variety of congeliturbate. Bryan (2) gives a diagram that shows the relations of involutions and congeliturbate. It is believed that the deformation of the loess-till contact described in this paper can be considered to be involutions. The type of deformation is indicated in the diagram of figure 2. In figure 3 involutions B and C of the dia-

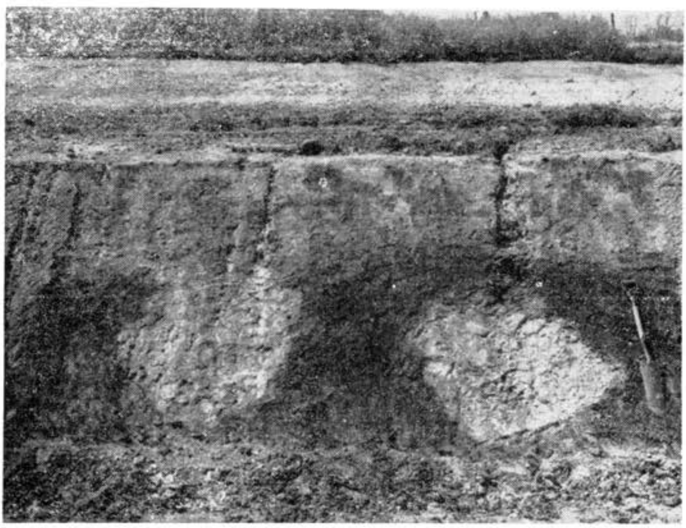

Figure 3. View of loess inclusions B and C of figure 2.

gram are shown. The boundary between the loess and till is very sharp. At no point was intermixing of the two materials observed. The upper surface of the gumbotil is extremely uneven and varies, within the area of the diagram, as much as 32 inches. At variable intervals involutions of loess extend deeply, as much as 65 inches, into the gumbotil. In some cases, on the plane surface of the road cut, the gumbotil completely surrounds the loess inclusion. Horizontal borings in the centers of involutions B and C of the diagram reached gumbotil at horizontal distances of 17 and 18 inches respectively. It is not certain that the loess involutions at A and C are completely surrounded by till. It is possible that they are at the edge of larger involutions. It is apparent from the diagram that a cut perpendicular to the present cut at the left side of either B or D would produce an involution capped by gumbotil similar to the ones in A and C.

Processes which might be capable of the formation of involutions are discussed by Sharp (8) and by Schafer (5). Conclusions are that frost action taking place in a layer overlying perennially frozen ground are competent to produce such features. Conditions favorable for such action would be prevalent during a part of the Pleistocene when the margin of the glacier was not far to the north.

Differential expansion of the gumbotil and the loess in the formation of the involutions is apparent. It appears that portions of the gumbotil were forced upward entrapping portions of the loess, and in some cases partially or perhaps completely coalescing around loess units. It is not certain that it is necessary to have perennially frozen ground underlying the horizon in which the involutions are produced in order to provide sufficient moisture for freezing and thawing to be effective. From the character of the gumbotil, it is inferred that the involutions were produced in an area of poor natural drainage. It is perhaps significant that similar involutions have not been observed in any of the exposures of Kansan till which have development of Planosols with strong horizon differentiation.

A time for the formation of the involutions cannot be assigned with any certainty. The loess deposition of southeastern Iowa is considered to have followed the Iowan and possibly the Tazewell glaciation. The formation of the involutions appears to have been subsequent to the Iowan unless periglacial conditions were suitable early in the period of loess deposition. The Tazewell of eastern Iowa and adjacent Illinois, described by Shaffer (7), and late Wisconsin, Cary or Mankato, all had glacier borders at approximately similar distances from these sites in Jefferson County.

Very few reports have been made of features in Iowa which have resulted from periglacial conditions while they have been reported for nearby states, Sharp (8). Sharp does suggest that Lees (4) illustrates and describes a deformed layer in Crawford County, Iowa that appears to be a typical involution layer although it is attributed by Lees to other causes. This report of a probable periglacial feature in Jefferson County and adjacent areas of southeastern Iowa therefore is deemed significant.

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Agricultural Experiment Station, Agronomy Department
Iowa State College
Ames, Iowa