Proceedings of the Iowa Academy of Science

Volume 62 | Annual Issue Article 37

1955

The Iowan Terrace and Terrace Soils of the Nishnabotna Valley in Western Iowa

J. F. Corliss
Iowa State College

R. V. Ruhe
Iowa State College

The Iowan Terrace and Terrace Soils of the Nishnabotna Valley in Western Iowa[1]

By J. F. Corliss and R. V. Ruhe[2]

Iowan Drift in Carroll County

Smith and Riecken (1947) in their revision of the Iowan-drift border in northwestern Iowan, extended a sublobe of the Iowan-drift southward to near Roselle and Halbur in Carroll County.

During field studies in Carroll County in 1953, the margin of the Iowan-drift sublobe was found to extend as far southward as Manning and Templeton in Carroll County (Figure 1). The Iowan drift is delineated from the loess-mantled Kansan drift on the basis of four lines of evidence: (1) in topographic positions that preclude significant erosion on the Iowan-drift surface, calcareous loess overlies calcareous till. (2) In topographic positions that preclude significant erosion on the Kansan-drift surface, calcareous loess overlies a leached, buried soil in the uppermost part of the Kansan till. (3) An abrupt change in topography occurs at the margin of the Iowan-drift. (4) A discontinuity in loess thickness occurs at the margin of the Iowan-drift.

The occurrence of calcareous loess over calcareous till in topographic positions where significant erosion is precluded, is restricted to the Iowan-drift sublobe (Figure 1). The lack of a buried soil that stratigraphically separates the loess from the till has been considered as evidence that the two sediments are closely related in time (Leighton, 1931; Smith and Riecken, 1947; and Ruhe, 1950), and is characteristic of the Iowan drift of northwestern Iowa.

The occurrence of calcareous loess over buried soils in the uppermost parts of the underlying drift is restricted to the Kansan-drift region (Figure 1). Such buried soils long have been considered as diagnostic of Kansan-drift overlain by Wisconsin loess in western Iowa (Kay and Apfel, 1929; and Simonson, 1941). Recent studies indicate that most of the buried soils in the uppermost part of the Kansan till are comparable morpho-

[1]Joint contribution of the Iowa Agricultural Experiment Station and Soil Survey Investigations, Soil Conservation Service, U. S. Department of Agriculture. Journal Paper No. J-*2760* of the Iowa Agricultural Experiment Station, Ames, Iowa. Projects Nos. 1152, 1250.

[2]Associate in Soils, Iowa Agricultural Experiment Station, and Research Geologist, Soil Survey Inv., SCS, USDA, respectively.

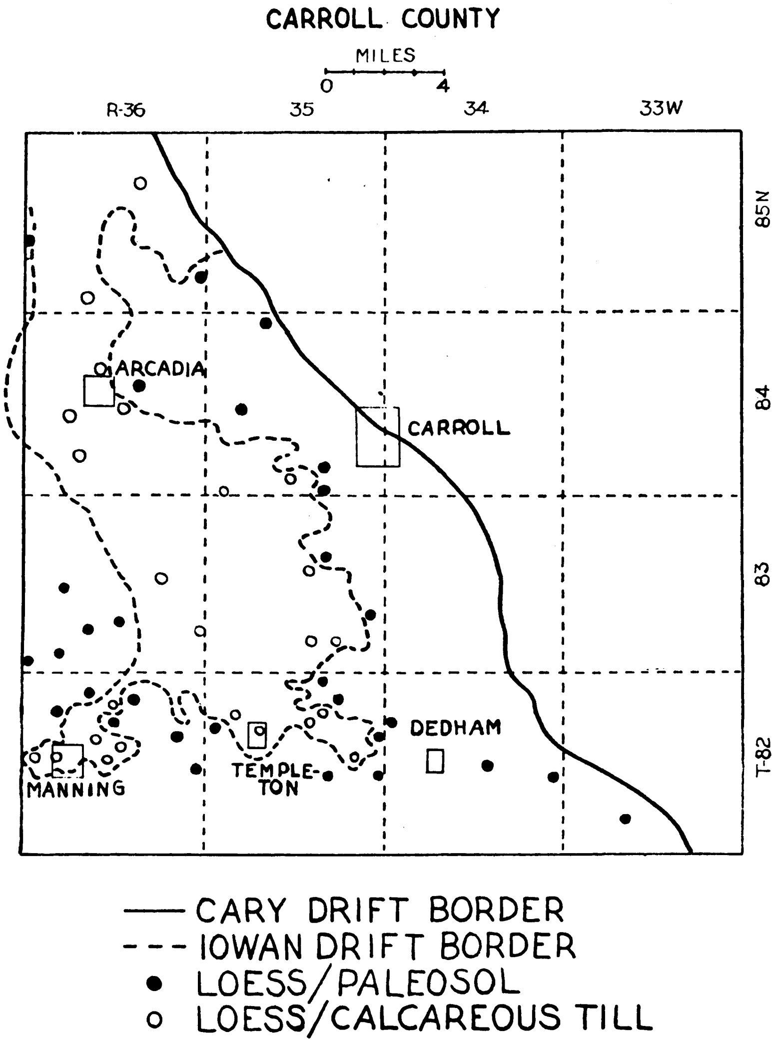

Figure 1. Geographic distributions of the Cary, Iowan and Kansan drifts in Carroll County, Iowa.

logically to soils of the modern Great Soil Groups: Brunizems, Humic Gleys, Planosols, and Gray Brown-Red Yellow Podzolic soils (Scholtes, Ruhe, and Riecken, 1951; Simonson, 1954).

The topographic difference between the loess-mantled Iowan-drift surface and the loess-mantled Kansan-drift surface is distinct. The Iowan surface is generally level to undulating with slopes ranging from 0-3 to 3-6 percent. The Kansan surface is rolling to hilly with slopes ranging from 10-15 to 20-40 percent. Relief on the Iowan surface varies from 10 to 40 feet, whereas on the Kansan surface relief varies from 60 to 120 feet. Altitudes on the Kansan-drift adjacent to the Iowan border are commonly higher than on the Iowan-drift.

The thickness of Wisconsin loess on the Kansan-drift is generally greater than on the Iowan. For example, in the SW ¼ sec. 19, T.85N., R.36W., Carroll County, loess that is 300 inches thick overlies a Gray Brown-Red Yellow Podzolic paleosol in Kansan till. Two miles southeastward in the WC sec. 33, T.85N., R.36W., Carroll County, Wisconsin loess that is 180 inches thick overlies calcareous Iowan till. In both sample sites the topographic expressions are level to slightly rounded, broad ridges. Such a loess-thickness discontinuity is characteristic of the Iowan-drift border in northwestern Iowa (Smith and Riecken, 1947).

Kay (1917) described in detail a traverse from Manilla in Crawford County to Coon Rapids in Carroll County. This traverse, along the Chicago, Milwaukee and St. Paul Railroad, transects the southern part of the revised Iowan-drift sublobe in Carroll County as well as the Kansan-drift in the area. Kay (*op. cit. passim*) described many sections where calcareous (Wisconsin) loess overlies buried soils in Kansan till. However, where calcareous loess overlies calcareous till, Kay (*op. cit.,* pp. 221, 225-226, 228, 230) concluded that weathered profiles in Kansan till had been eroded prior to deposition of loess. Kay's sections, where calcareous loess overlies calcareous till, are located geographically in the areas that the present writers consider to be an extension of the Iowan sublobe in Carroll County. Thus, the stratigraphic relationships of loess-till are not erosional as Kay concluded, but conform to the normal loess-till relationships that are characteristic of the Iowan-drift region.

Iowan Terrace of the Nishnabotna Valley

The West Nishnabotna River heads in sec. 32, T.84N., R.36W., Carroll County, Iowa approximately 9½ miles north of the southern margin of and on the Iowan-drift sublobe. Thus, Iowan glaciation has been effective in the watershed of the West Nishnabotna River.

A well developed loess-mantled terrace debouches from the margin of the Iowan drift at Manning, Carroll County, and occurs along the valley sides of the Nishnabotna River. The terrace has been traced southward from the Iowan sublobe in

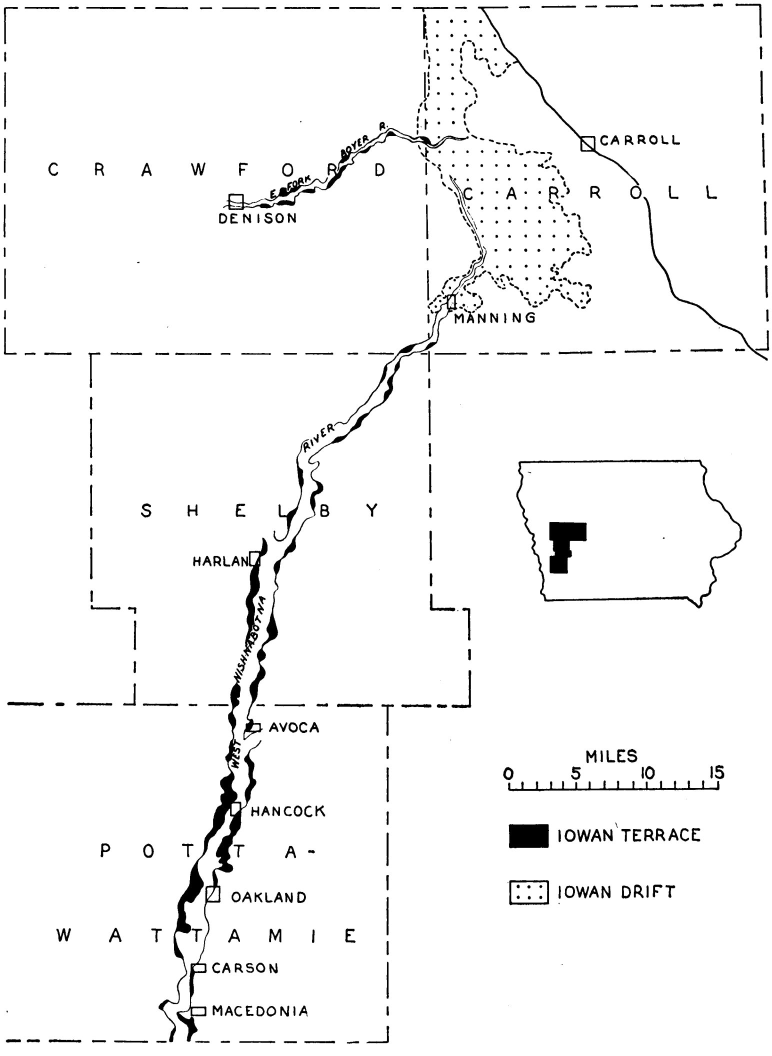

Figure 2. Geographic distribution of the Iowan Terrace in the West Nishnabotna Valley, Western Iowa.

Carroll County through Crawford, Shelby, and Pottawattamie Counties (Figure 2). The surface of the thickly loess-mantled terrace generally stands 10 to 20 feet above the adjacent modern floodplain of the stream. For example, near Hancock, Pottawattamie County, the surface of the terrace is 17 feet above the modern floodplain. Below the level of the floodplain, alluvium of more than 50 feet in thickness fills the valley of the Nishnabotna River.

The terrace at many places in the valley extends for considerable distances along the valley walls. For example, on the west side of the valley in Shelby County the terrace extends almost continuously from Harlan to south of the Harlan municipal airport, a distance of approximately 6 miles. In Pottawattamie County near Hancock and Oakland the terrace occurs along the west side of the valley for distances of 4 and 5 miles. In these areas the terrace varies in width from a quarter to three quarters of a mile.

The terrace in the Nishnabotna Valley is probably a remnant of an outwash-alluvium complex that filled the valley during deglaciation of the Iowan sublobe. The outwash-alluvium probably filled the valley at elevations comparable to or higher than the level of the modern floodplain. Such higher sand and gravel fills are well displayed in a correlative terrace along the east fork of the Boyer River, Crawford County, that heads near Arcadia, Carroll County, on the Iowan-drift sublobe (Figure 2). The Iowan outwash-alluvium of both streams is mantled by loess of Iowan and Tazewell age (Ruhe, 1954). and in this regard is similar to the upland landscapes in the Nishnabotna watershed.

Soils on the Loess-Mantled Iowan Terrace

Terrace soils in Iowa have received little study or recognition by soil scientists. A study was carried out recently (Coultas and McCracken, 1952) in regions of Wisconsin glaciation. Most of the soils developed in terrace sands and gravels in this region had been classified as the O'Neill series, until it was shown by physical and chemical determinations that at least three distinct series were present. The problem is somewhat different, however, in areas where loess mantles the terraces. On the Iowan terraces in the Nishnabotna River Valley, the soils are developed in Iowan-Tazewell loess that mantles the terraces. The present terrace surface is located well above the floodplain level and so has not been subjected to recent overflow.

The common soils found on the loess-mantled terraces are the Marshall silt loam, the Minden silt loam, the Corley silty clay loam and a lightly-forested associate of the Marshall and tentatively called Glenwood here. These soils occur also on upland topogrophic positions. The following profiles have been described in Shelby County, Iowa. The tables which follow the profile descriptions present data on the Marshall and Minden profiles from the upland topographic locations and for the Corley profiles from terrace and upland positions.

Marshall silt loam, upland phase. Location: NE¼ NE¼ sec. 29, Jackson Township, Shelby County, Iowa. Collected by C. E. Hutton, 1948.

Horizon Designation	Depth Inches	Description
A_1	0-12	Black to very dark brown (10YR 2/1 to 2/2) medium silt loam, medium to fine granular structure.
A_3-B_1	12-18	Dark grayish brown to very dark brown (10YR 3/2 to 2/2) heavy silt loam.
B_2	18-27	Brown (10YR 4/3) light to medium silty clay loam with weak to moderate subangular blocky structure.
B_3-C_1	27-33	Dark yellowish brown to yellowish brown (10YR 4/4 to 5/4) heavy silt loam to light silty clay loam; massive.
C_2	33+	Dark yellowish brown (10YR 4/4 medium silt loam; occasional light gray mottlings (10YR 7/1); massive.

Marshall silt loam, terrace phase. Location: SW¼ NW¼ sec. 36, Lincoln Township, Shelby County, Iowa. Collected by J. F. Corliss and C. L. Coultas, March 18, 1955.

Horizon Designation	Depth Inches	Description
A_1	0-14	Very dark gray to very dark gray brown (10YR 3/1.5) silt loam with medium to fine granular structure; friable. Some black ped coatings.
A_3-B_1	14-20	Very dark gray brown (10YR 3/2) heavy silt loam with medium and fine granular to weak subangular blocky structure; friable.
B_2	20-28	Dark brown (10YR 4/3) medium silty clay loam with medium subangular blocky structure; friable to slightly firm when moist.
B_3	28-35	Dark brown (10YR 4/3) light silty clay loam with weak medium subangular blocky to massive structure; friable to very slightly firm when moist.
C_1	35+	Dark yelowish brown to yellowish brown (10YR 4/4 to 5/6) heavy silt loam with massive structure; friable when moist.

Minden silt loam, upland phase. Location: NW¼ NE¼ NW¼ sec. 19, Lincoln Township, Shelby County, Iowa. Collected by R. Ulrich, 1949.

Horizon Designation	Depth Inches	Description
A_1	0- 6	Black (10YR 2/1) heavy silt loam; fine granular structure.

A_{11}	6-11	Very dark brown (10YR 2/2) light silty clay loam, fine to medium granular structure.
A_{12}	11-16	Very dark brown (10YR 2/2) light silty clay loam; very weakly subangular blocky to medium granular structure.
A_3-B_1	16-21	Very dark brown (10YR 2/2) to dark brown (7.5 YR 3/2) light silty clay loam; weakly developed subangular blocky structure; friable.
B_1	21-26	Dark grayish brown (10YR 3/2) light silty clay loam; weakly developed subangular blocky structure.
B_{11}	26-31	Brown (10YR 4/3) light silty clay loam; weakly developed subangular blocky structure.
B_2	31-39	Dark yellowish brown to yellowish brown (10YR 4/4 to 5/6) with some low contrast mottles of yellowish red (5YR 5/8) and pinkish gray (5 YR 6/2 to 7/2); weakly developed subangular blocky structure with a tendency to cleave vertically.
C_1	39-48	Pinkish gray (5YR 6/2) light silty clay loam with numerous mottles and irregular seams of reddish yellow (5YR 6/8) and very dark brown (10YR 2/2) mottlings; massive structure with a tendency to cleave vertically.

Minden silt loam, terrace phase. Location: NE¼ NE¼ sec. 25, Lincoln Township, Shelby County, Iowa. Permanent bluegrass pasture. Collected by J. F. Corliss and C. L. Coultas, March 18, 1955.

Horizon Designation	Depth Inches	Description
A_1	0-16	Black to very dark brown (10YR 2/1.5) heavy silt loam with medium to fine granular structure; friable.
A_3-B_1	16-28	Very dark gray to very dark gray brown (10YR 3/1.5) with very dark brown (10YR 2/2) ped coatings; heavy silt loam with medium granular to weak subangular blocky structure; friable.
B_2	28-36	Very dark gray brown (10YR 3/2) with some very dark gray (10YR 3/1) ped coatings; light silty clay loam with weak subangular blocky structure; friable to slightly firm when moist.
B_3	36-40	Very dark gray brown to dark brown (10YR 3/2 to 4/3) heavy silt loam with weak subangular to massive structure; friable when moist.
C_1	40+	Dark brown (10YR 4/3) silt loam with massive structure; massive friable; few strong brown (7.5 YR 5/6) mottles.

Corley silty clay loam, upland phase, (P-442). Location: SE¼ SW¼ sec. 20, Monroe Township, Shelby County, Iowa. Permanent pasture. Collected by J. F. Corliss, L. A. Nelson, W. M. Jury and F. J. Klopfenstein, August 10, 1954.

Horizon Designation	Depth Inches	Description
A_1	0-16	Black 10YR 2/1) light silty clay loam of medium granular structure; friable.
A_{21}	16-23	Black (10YR 2/1) light silty clay loam of course to medium granular structure; friable. Light gray (10YR 7/2) on dry peds; friable when moist.
A_{22}	23-28	Very dark gray (10YR 3/1) silt loam with some gray brown (10YR 5/2). Fine to course granular with some fine, very weak platiness; friable when moist.
A_{23}	28-34	Very dark gray (10YR 3/1) with very dark gray brown (10YR 3/2) coatings, very light silt loam of very fine granular structure; friable to slightly firm when moist. Gray colors along weakly expressed vertical cleavage.
A_3-B_1	34-38	Dark gray brown (10YR 4/2) with numerous small yellowish brown (10YR 5/4) mottles and many gray brown (10YR 5/2) coatings and pockets. Light silty clay loam of weak subangular blocky to course granular structure; firm to slightly firm when moist.
B_{21}	38-45	Gray brown (10YR 5/2) with numerous dark brown (7.5YR 4/4) mottles and very dark gray (10YR 3/1) ped coatings on vertical and horizontal faces. Heavy silty clay loam of medium angular and subangular blocky structure; slightly firm to firm.
B_{22}	45-52	Gray brown (10YR 5/2) with fewer dark brown (7.5YR 4/4) mottles and very dark gray (10YR 3/1) ped coatings less evident. Heavy silty clay loam of medium subangular blocky structure; slightly firm to firm.
B_{31}	52-66	Gray brown (10YR 5/2) medium silty clay loam with numerous dark brown (7.5YR 4/4) mottles; massive structure with weak vertical cleavage; friable.
B_{32}	66-72	Light brown gray (10YR 5/2) matrix with fewer dark brown (7.5YR 4/4) mottles. Light silty clay loam; massive structure.
C_1	72+	Matrix light brown gray (10YR 6/2) with few dark brown (7.5YR 4/4) mottles and common gray brown (10YR 5/2) silty pockets; heavy silty loam with massive structure; friable.

Corley silty clay loam, terrace phase, (P-441). Location: NE¼ NE¼ NE¼, sec. 25, Lincoln Township, Shelby County, Iowa. Permanent pasture. Collected by J. F. Corliss, R. C. Prill and R. J. McCracken, October 31, 1953.

Horizon Designation	Depth Inches	Description
A_1	0-13	Black to very dark gray (10YR 2/1 to 3/1) light silty clay loam of medium to fine granular structure; friable.
A_{21}	13-18	Very dark gray (10YR 3/1) silt loam of medium granular structure; friable.
A_{22}	18-22	Very dark gray (10YR 3/1) silt loam of fine and medium granular structure with weak platiness; numerous gray brown (10 YR 5/2) coatings and channels; friable.
A_{23}	22-25	Gray brown (10YR 5/2) silt loam of weak medium subangular blocky structure with some weak platiness; friable.
A_3	25-29	Mottled dark gray (10YR 4/1) and gray brown (2.5YR 5/2) with thick gray brown (10YR 5/2) coatings; silt loam of medium moderate and course subangular blocky structure with weak vertical cleavage; friable.
B_1	29-32	Mottled gray brown and dark gray brown (2.5Y 5/2 and 4/2) light silty clay loam with yellowish brown and gray brown (10 YR 5/4 and 5/2) coatings; medium moderate subangular blocky structure with weak vertical cleavage; slightly firm to firm.
B_{21}	32-37	Dark gray brown (2.5Y 4/2) medium silty clay loam with yellowish brown (10YR 5/4 and 5/6) mottles; medium moderate subangular blocky structure with weak vertical cleavage; slightly firm to firm.
B_{22}	37-42	Mottled olive gray (5Y 5/2) to dark gray brown (2.5Y 4/2) and light olive brown (10YR 5/4 and 5/6); heavy silty clay loam of medium moderate subangular blocky structure with weak vertical cleavage; firm
B_{31}	42-47	Mottled olive gray (5Y 5/2) to light brown gray (2.5Y 6/2) and dark gray brown (2.5Y 4/2); medium silty clay loam of weak medium to coarse subangular blocky structure; firm to slightly firm.
B_{32}	47-55	Mottled light brown gray, gray brown and light olive brown (2.5Y 6/2, 5/2, 5/4); medium silty clay loam of massive structure; firm.
C_1	55+	Dominant color light brown gray (2.5Y 6/2) with light olive brown (2.5Y 5/4), dark brown (7.5YR 4/4) and yellowish brown (10YR 5/4) mottles; light silty clay loam of massive structure; firm.

Glenwood silt loam (tentative), upland phase. Location: SW¼ SE¼ SE¼ sec.3, Cass Township, Shelby County, Iowa. Oak and maple forested site, virgin, 6 per cent convex slope. Collected by L. A. Nelson and C. L. Coultas, November 29, 1954.

Horizon Designation	Depth Inches	Description
A_1	0- 5	Very dark brown (10YR 3/2) silt loam of fine granular structure; friable.
A_2	5- 7	Dark gray brown (10YR 4/2) silt loam of very fine granular to fine subangular blocky structure; friable.
A_3	7-13	Dark gray brown (10YR 4/2) light silty clay loam of very fine to fine granular structure; friable.
B_1	13-19	Dark brown (10YR 4/3) silty clay loam of fine granular to weak subangular blocky structure; slightly firm.
B_2	19-26	Dark yellowish brown (10YR 4/4) to yellowish brown (10YR 5/4) silty clay loam of very fine to fine subangular blocky structure; slightly firm.
B_3	26-38	Yellowish brown (10YR 5/4) silty clay loam of very fine to fine subangular blocky structure more weakly developed than in the B_2 horizon; slightly firm.
C_1	38-47	Yellowish brown (10YR 5/4) silt loam of massive structure; friable.
C_2	47+	Yellowish brown (10YR 5/4) silt loam of massive structure; friable.

Glenwood silt loam (tentative), terrace phase. Location: At south edge of correction overlap in sec. 3, Fairview Township, Shelby County, Iowa. Collected by J. F. Corliss and O. D. Friedrich, April, 1954.

Horizon Designation	Depth Inches	Description
A_1	0- 6	Very dark gray (10YR 3/1) silt loam, fine granular very friable with few gray ped coatings.
A_{21}	6-12	Very dark gray to very dark gray brown (10YR 3/1.5) with numerous gray ped coating.
A_{22}	12-21	Very dark gray brown (10YR 3/2) silt loam with weak medium subangular blocky structure breaking to fine granular with many gray ped coatings; friable.
B_{22}	21-36	Dark gray brown to dark brown (10YR 4/2.5) silty clay loam with medium subangular blocky structure; gray ped coatings; slightly firm.
B_{23}	36-59	Dark brown to dark yellowish brown (10 YR 4/3.5) heavy silt loam; massive structure; friable.
C_1	59+	Dark brown (10YR 4/3) silty clay loam with weak medium subangular blocky to massive structure; few glossy ped coatings; slightly firm.

From the profile description of the upland soils, increased A_1 horizon thickness and darker color is in the order of Marshall, Minden and Corley. These soils with relatively thick and dark colored A_1 horizons have all developed under prairie vegetation. The Glenwood, with a thinner A_1, has developed under forest vegetation.

The Marshall and Minden profiles have a relatively thick zone of transition from the A_1 to the B_2 horizons which is intermediate in clay content between these two horizons (Table 1). The Corley profile exhibits a well-developed A_2 horizon which is lower in clay than the horizons immediately above and below. The A_2 horizon of the Glenwood profile had only slightly less clay, as determined in the field, than the A to B transition horizon of the associated Marshall, though the color as observed in a pit or on borings made with a soil auger was visibly grayer.

The Marshall and Minden profiles have similar quantities of clay in the B_2 horizon. The Corley profile has considerably more clay in the B_2. This accumlation is probably the result of downward migration of the fine clay particles (Ulrich, 1949) with subsequent flocculation of particles by electrolytes (Jenny and Smith, 1935) or by a purely physical mechanism of sieving (Bray, 1935). The graphic representation of the porosity distribution with depth (Figure 3) indicates that the areation porosity is greatly decreased in this zone of clay accumulation. Since a correlation between aeration porosity and permeability has been established (Baver, 1938), it is to be expected that the Minden profile, with a greater percent of aeration porosity, would be quite well drained while the Corley profile with a low percent of aeration porosity at a depth of 30 inches would be much more poorly drained. Intermittent ponds over the Corley site areas after periods of medium to heavy precipitation bear out this hypothesis.

From field determinations of texture for the B_2 horizon of the Glenwood profile a clay content of approximately 37 percent is estimated, slightly higher than that found in the corresponding horizon of the Marshall, but about the same as that found in the B_2 horizon of the Corley profile. The C_1 horizons of all the profiles are heavy silt loam to light silty clay loam. The Corley profile shows somewhat more mottling than do the Marshall, Minden and Glenwood profiles. This mottling would indicate that the Corley profile is somewhat more poorly drained than are the other three soils.

The descriptions of terrace phase of Corley (profile P-441) and upland phase of Corley (profile P-442) show a marked similarity. Laboratory data also indicate similarities. The A_1 and B_2 horizons are similar in color, texture and structure. Minor

Table 1.
Particle size analysis for Marshall, Minden and Corley Profiles

Depth Inches	Horizon Designation	Percent 50 u sand	Percent 50-20 u coarse silt	Percent 20-2 u fine silt	Percent <2 u clay
		Marshall silt loam, upland phase			
0-3	A_1	16.7	28.7	25.8	28.8
6-9	A_1	14.6	32.2	21.9	31.3
12-15	A_3-B_1	12.8	32.7	23.0	31.5
18-21	B_2	9.5	34.7	24.3	31.5
24-27	B_2	8.0	34.9	24.1	33.0
30-33	B_3-C_1	13.1	34.3	23.2	29.4
39-42	C_2	11.1	40.8	21.5	26.6
		Minden silt loam, upland phase			
0-6	A_1	7.0	34.3	32.1	26.6
11-16	A_{12}	9.5	31.2	31.2	28.1
21-26	B_1	10.0	30.4	32.3	27.3
31-39	B_2	6.8	33.3	29.7	30.2
39-48	C_1	6.8	36.7	28.6	27.9
		Corley silty clay loam, upland phase			
0-6	A_1	2.3	36.5	32.2	29.0
16-23	A_{21}	0.7	37.4	33.1	28.8
28-34	A_{23}	1.6	42.3	35.7	20.4
38-45	B_{21}	1.3	35.3	26.1	37.3
52-66	B_{31}	2.0	35.5	26.9	35.6
90-102	C	2.2	44.2	25.8	27.7
		Corley silty clay loam, terrace phase			
0-6	A_1	3.4	34.1	33.9	28.6
13-18	A_1	2.6	35.3	37.0	25.1
22-25	A_{23}	5.0	35.4	43.8	15.8
29-32	B_1	3.8	38.7	28.2	29.3
37-42	B_{22}	4.0	35.0	23.2	37.7
47-55	B_{32}	4.2	40.8	22.4	32.5

variations in B_2 thickness occur, but this may be due to differences in site characteristics. The A_2 horizons are not identical in detail, though this is not considered related to terrace or upland position, but rather to minor variations in site characteristics such as size of drainage area and relief. The porosities of the two profiles are similar. Both would be restrictive to downward percolation of water.

If the profile descriptions which reflect the morphology of the Marshall silt loam, Minden silt loam and Glenwood silt loam on the upland topographic position are compared to their terrace position counterparts, similarity is again evident. The Marshall silt loam, terrace phase, has the same sequence of horizons with nearly the same thickness for corresponding horizons as the upland

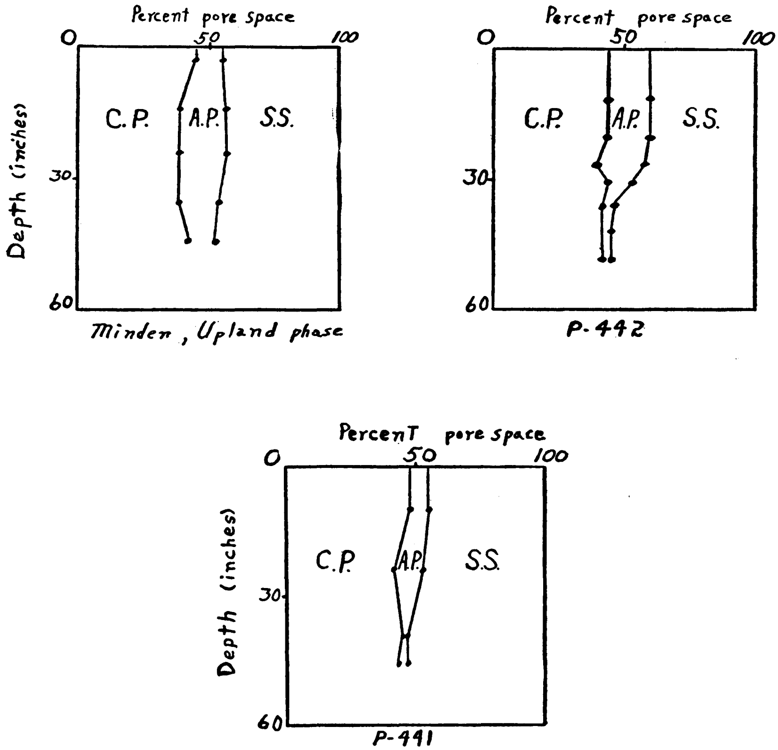

Figure 3. Porosity distribution with depth for Minden and Corley profiles.
C.P.=capillary porosity A.P.=aeration porosity S.S.=soil solids

profiles of this series. The field determinations of texture are the same. There is no indication in the solum of increased sand content. The horizon structure and color are as nearly identical as could be expected from a field determination.

The Minden profiles likewise show similarity in thickness of horizons, color, texture and structure between the upland and terrace positions. The terrace phase Minden silt loam profile was located approximately fifty feet from the terrace phase Corley site.

The Glenwood profiles of the terrace and upland positions show similarity in the amount of clay in the textural profile as determined in the field study. Sand contents are low. The colors of corresponding horizons are also similar, but the profile developed on the terrace has horizons of somewhat greater thickness than the horizons of the profile developed on the uplands. However, the upland site was located on a 6 percent slope while the terrace phase profile was located on a slope of 2 percent. This increased slope would lead to increased surface runoff with less water available to percolate through the profile and could account for the greater thickness of horizons of the terrace phase.

The dissimilarities of profile characteristics of the Marshall, Minden, Corley and Glenwood series on a given topographic position have been shown. A comparison of the profiles of upland and terrace soils of each series show that the range of profile properties within the series was not excessive in traversing from upland to terrace position. Apparently, the soil forming factors (Jenny, 1941) have similar effectiveness on the terraces as on the uplands. However, there are differences in the degree to which each factor influences the direction of soil formation.

The parent materials are similar in that the soils are developed in Iowan-Tazewell loess. The sand content is low and relatively constant for both terrace and upland soil profiles.

Time can be discounted as a major factor in explaining the variations in the physical and chemical characteristics of the soil profiles found on the terraces and uplands. Loess deposition occurred with sufficient uniformity and over so short a geographic distribution that age variation is precluded.

The effects on soil formation by macro-climatic variations have been minimized due to the restricted area extent of the problem location.

These climatic limitations do not apply to variations in micro-climate due to slight variations in local topography. Topography is especially effective in controlling the microclimate. This is illustrated in the relationship of Marshall silt loam to Minden silt loam to Corley silty clay loam. In this order, the A horizons become thicker and the B horizons become finer textured as the result of increased moisture which cannot run off the very flat to slightly depressional areas on the surfaces of the terraces and broad, flat upland ridgetops.

The type of vegetation and its intensity may have been effective on the process of soil formation. By intensity is meant the length of time during which this vegetation, either grass or timber or both, flourished as well as the density of stand. It is likely that a stand which was either sparse or of short duration would not exert as great an effect on the process of soil formation as would a stand of greater intensity. This might be illustrated by the relationships of the Corley and Minden profiles. The Corley A_1 horizon is deep and dark colored and is probably the result of luxurious plant growth and organic accumulation. Because of the depression in which the Corley profile is located, moisture accumulated here and created an environment favorable to plant growth, whereas the Marshall profile was located on a very gentle slope from which water tended to run off rather than accumulate. The Glenwood profile on the other hand has undergone a change in vegetation, from grass to timber. It is probable that there will be no sharp line of delineation of one soil area from another on the basis of discrete profile characteristics such as those which might be listed for the modal member of the series. The series was defined by Baldwin and Thorp (1938) as follows: "A group of soils having genetic horizons similar as to differentiating characteristics and arrangement in the soil profile, except for the texture of the surface soil, and developed from a particular type of parent material." A modification (Riecken and Smith, 1949) of the series definition was made: ". . . the series has come to mean a landscape unit that has a narrow range of soil properties, most of which are significant to agriculture." The problem at hand of terrace and upland soil formation should be considered in light of the latter definition.

In the field, the soils on the terrace should be mapped using the same criteria for separation into series as used on the uplands. Soil unit separations within a series can be made on the basis of topographic position, but are not significant from the standpoint of representing genetically different profiles. Recommendations for mangement should not vary for the two topographic locations of the same series if other conditions such as slope and topsoil depth are identical.

Literature Cited

Baldwin, M., Kellogg, C. E., and Thorp, J. 1938. Soil Classification, U. S. Dept. of Agr. Yearbook 1938: 979-1001.

Baver, L. D. 1940. Soil Physics. John Wiley and Sons., New York, p. 227.

Bray, R. H. 1935. The origin of horizons in claypan soils. Amer. Soil Surv. Assoc. Bull. 15: 70-75.

Coultas, C. L. and McCracken, H. J. 1952. Soils of outwash terraces. Iowa Acad. Sci. Proc. 59: 233-247.

Hutton, C. E. 1948. The morphology and genesis of Prairie soils developed from Peorian loess in southwestern Iowa. Ph.D. Thesis, Iowa State College Library, Ames, Iowa.

Jenny, H. 1941. Factors of Soil Formation. McGraw Hill, New York. 1st ed.

Jenny, H. and Smith, G. D. 1953. Colloid chemical aspects of claypan formation in soil profiles. Soil Sci. 39: 377-399.

Kay, G. F. 1917. Pleistocene deposits between Manilla in Crawford County and Coon Rapids in Carroll County, Iowa. Iowa Geol. Survey, 26: 215-231.

Kay, G. F. and Apfel, E. T. 1929. The pre-Illinoian Pleistocene geology of Iowa. Iowa Geol. Survey, 34: 1-304.

Leighton, M. M. 1931. The Peorian loess and the classification of the glacial drift sheets of the Mississippi Valley. Jour. Geology, 39: 45-53.

Riecken, F. F. and Smith, G. D. 1949. Lower categories of soil classification: Family, series, type, phase. Soil Sci. 67: 107-115.

Ruhe, R. V. 1950. Reclassification and correlation of the glacial drifts of northwestern Iowa and adjacent areas. Geol. Soc. Amer. Bull., 61: 1500-01.

Ruhe, R. V. 1954. Relations of the properties of Wisconsin loess to topography in western Iowa. Amer. Jour. Sci., 252: 663-672.

Scholtes, W. H., Ruhe, R. V., and Riecken, F. F., 1951. Use of the morphology of buried soil profiles in the Pleistocene of Iowa. Iowa Acad. Sci. Proc., 58: 259-306.

Simonson, R. W., 1941. Studies of buried soils formed from till in Iowa. Soil Sci. Soc. America Proc. 6: 373-381.

Simonson, R. W. 1954. Identification and interpretation of buried soils. Am. Jour. Sci., 252: 705-732.

Smith, G. D., and Riecken, F. F., 1947. The Iowan drift border of northwestern Iowa. Am. Jour. Sci., 245: 706-713.

Ulrich, R. 1949. Some physical and chemical properties of Planosol and Wiesenboden soil series as related to loess thickness and distribution. Ph. D. thesis, Iowa State College Library, Ames, Iowa.

Department of Agronomy
Iowa State College
Ames, Iowa