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Depth Studies of the Wisconsin Loess in Southwestern Iowa: I. Particle-Size and In-Place Density

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The Soil Research Laboratory of the Iowa Engineering Experiment Station has been studying areal and stratigraphic variations in properties of the Wisconsin (Peorian) loess in southwestern Iowa since September, 1950. The information on loess properties is being utilized in soil stabilization studies now in progress.

A paper presented before the Geology Section of the Iowa Academy of Science in 1952 (1) discussed the distribution of and some property variations in the Wisconsin loess in the southwestern Iowa area shown by Figure 1. While last year's paper presented some depth data, the main emphasis was on areal property variations. More detailed studies of selected Wisconsin loess sections are now in progress to determine the variations in properties with depth. The present paper, Part I of two parts, presents particle-size, field moisture, and in-place density data. Part II will cover chemical, mineralogical, and additional physical property data.

Wisconsin Loess Sections

As an aid in selecting loess sections for detailed sampling, the southwestern Iowa loess area was divided into three sub-areas on the basis of the Bureau of Public Roads classification system (2). The liquid limit, plasticity index, and particle-size data necessary for this classification were obtained from over 100 samples of Wisconsin loess taken along five traverses (Figure 1). The majority of these samples were from the upper C-horizon. The tentative boundaries of the A-4, A-6, and A-7-6 sub-areas are shown in Figure 1. The A-4 group includes friable, silty soils, and the A-6 group includes more plastic, clayey soils. Soils in the A-7-6 subgroup (A-7 group) are even more plastic and clayey. The A-4 loess area coincides approximately with the area of deep-loess topography bordering the Missouri River floodplain.

Sections for detailed depth sampling, shown in Figure 1, were chosen to be representative of each of the three sub-areas. Because of the great abundance of loess in the A-4 area and the low agricultural value of the land, this is a potentially important source of road-building material, and for this reason four sections (1, 2, 3

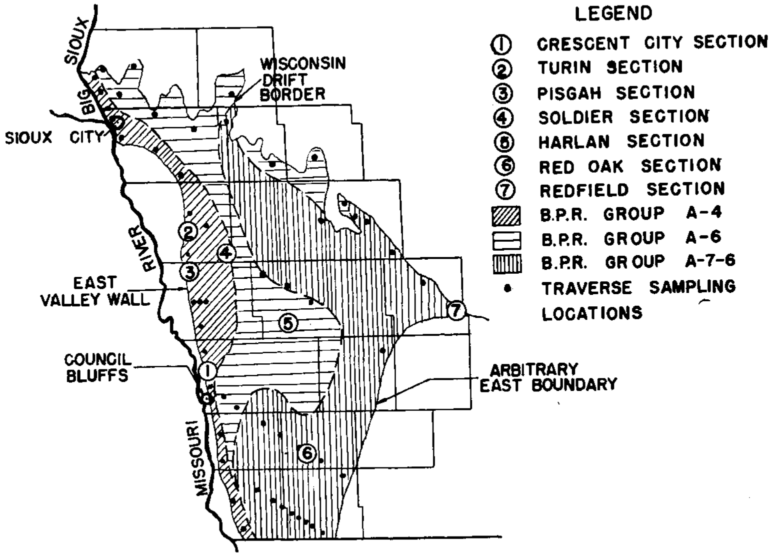

Figure 1. Locations of depth sections in Southwestern Iowa loess area.

and 4 in Figure 1) were studied. Of these, three are in the first bluff line east of the Missouri River flood plain. The Pisgah section (3 in Figure 1) in the A-4 area was selected to compare a recognized* section of Cary-Mankato or Upper Wisconsin loess with the undifferentiated Wisconsin loess in other sections. A section near Soldier (4 in Figure 1) was chosen to represent A-4 loess near the transition to the A-6. The A-6 loess is represented by a section near Harlan (5 in Figure 1), the A-7-6 by a section near Red Oak (6 in Figure 1). An additional A-7-6 loess section adjacent to the Mankato lobe of the Wisconsin glaciation near Redfield (7 in Figure 1) was studied because of the extent of the A-7-6 area and for comparison with data from an eastern Iowa loess study now under way. Detailed locations and descriptions of the above southwestern Iowa loess sections will be found in Appendix A.

Methods of Sampling and Testing

For the most part in the deep loess sections sampling and in-place density measurements were conducted from a rope swing equipped with a 3-to-1 block and tackle arrangement. This was suspended from a collapsible aluminum beam anchored at the back by a cork-screw type soil anchor (Figure 2 and 3). Where necessary, augering was employed in sampling. Shallower loess sections could be studied without the use of ropes (Figure 4). On old

*Identified by Ruhe (3).

cuts the exposed face of the section was cut back a distance of about 2 ft. before samples were taken or density determinations were made.

In-place density tests were conducted with a modified rubber-balloon apparatus designed and constructed by the authors for use on vertical or inclined faces. With this rubber-balloon apparatus (Figures 4 and 5) density measurements were made as follows:

> A hole approximately 4 in. in diameter and 4 in. deep was dug in the soil, and the material removed was weighed and sampled for a field moisture determination (4).
>
> A balloon was forced into the hole by water from a vertical standpipe calibrated so that the volume of the hole could be read directly from the fall of the water level in the standpipe.

Previous types of rubber-balloon apparatus were found to be too bulky, heavy, and awkward to read for convenient use from ropes, especially since their use is restricted to horizontal surfaces cut in the soil. Other in-place density methods used by engineers are more time-consuming, require more calculations, and are frequently less accurate (4) than the rubber-balloon-method.

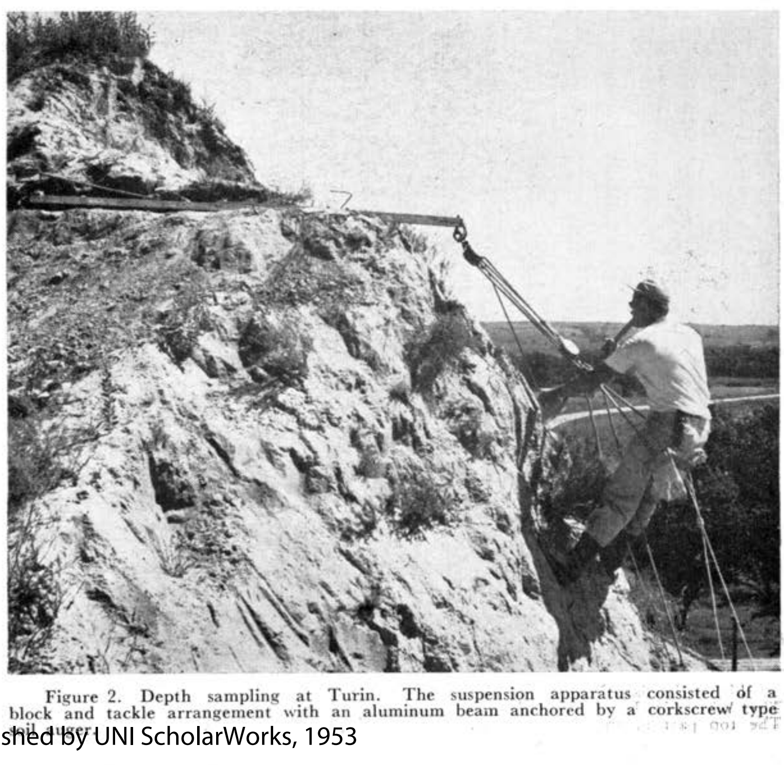

Figure 2. Depth sampling at Turin. The suspension apparatus consisted of a block and tackle arrangement with an aluminum beam anchored by a corkscrew type soil auger.

Mechanical analyses of the silt and clay fractions of the samples were made by the standard American Society for Testing Materials hydrometer method D422-51 as modified by Davidson and Chu (5). Sodium metaphosphate was used as the dispersing agent. The sand fraction was separated by mechanical sieving.

Results and Conclusions

Particle-Size

Particle-size data for the seven loess sections studied are presented in Appendix B; they are shown graphically in Figure 6. In the Crescent City Section the sand content is low, averaging 3.2 percent, but increases with depth from 1 to almost 10 percent sand. The clay content averages 16.5 percent and shows several broad general peaks at various depths. The textural variation of the loess

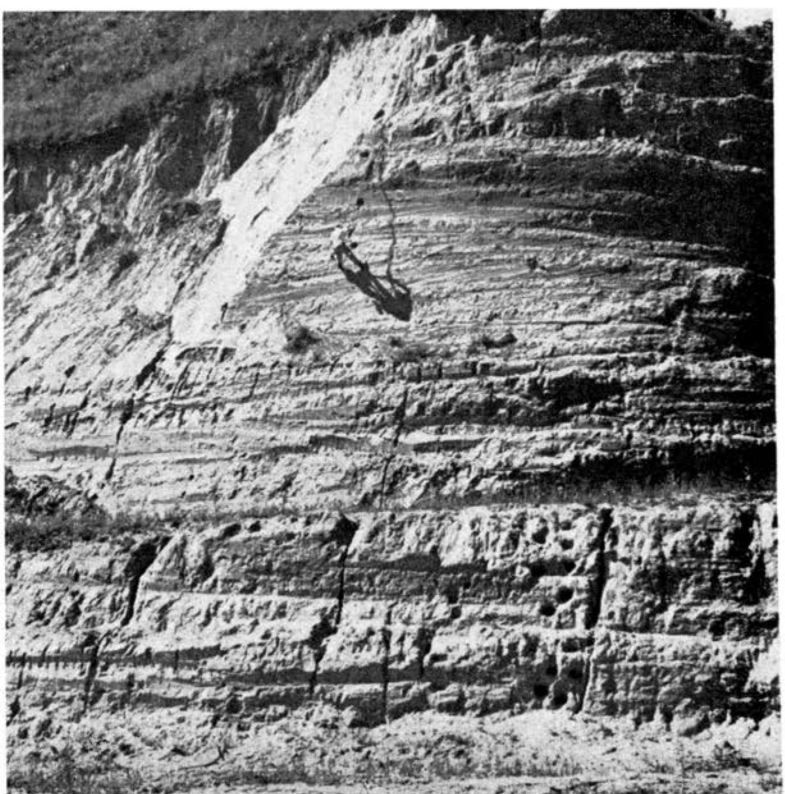

Figure 3. Sampling the vertical face of the Crescent City Section of deep loess. The Wisconsin loess was estimated to extend 10 feet below the bottom of the cut. The top part of the section was sampled by augering horizontally into the hill.

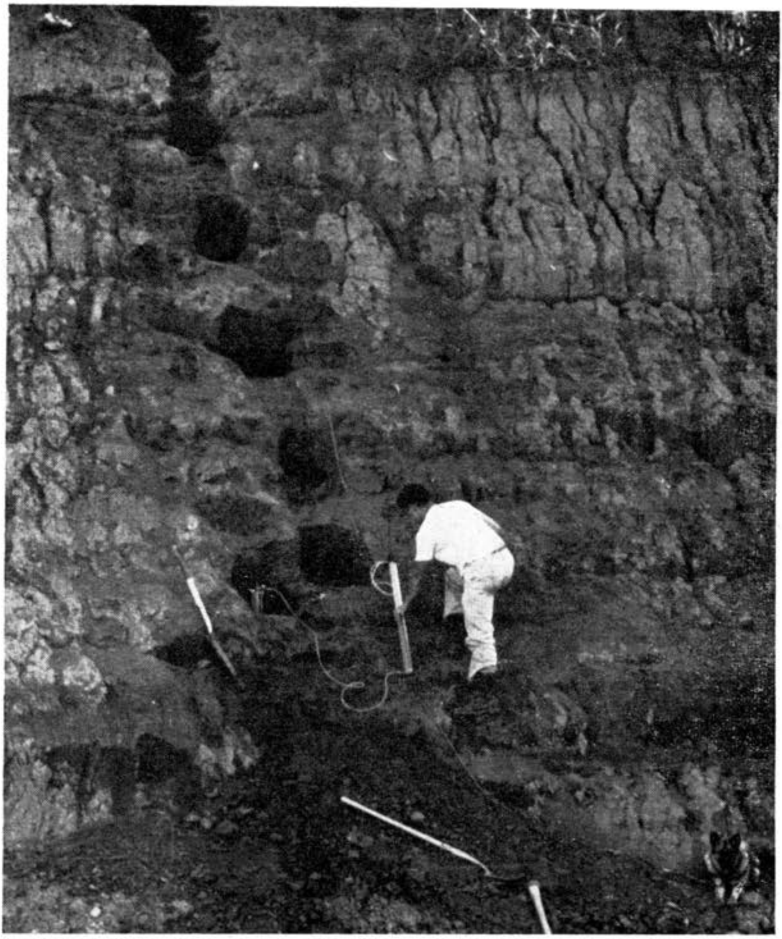

Figure 4. In-place density determination in Red Oak Section with rubber-balloon apparatus. The test being made is at the bottom of the loess.

in the Crescent City Section is probably negligible for engineering uses. No Brady soil (6) was detected in the field.

A histogram showing the distribution of the Crescent City loess samples with regard to their clay contents is given in Figure 7. From the graph it can be seen that the largest number of samples are in the minimum clay content bar, and progressively fewer samples show higher clay contents. Identical trends were noted in histograms for the other A-4 sections at Turin and Soldier. Similar histograms for sand contents show a more nearly normal distribution. The skewed clay content distribution is probably related to the origin of the loess and might conceivably indicate lulls from a sustained maximum rate of deposition. If this is true, carbonate

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data not yet obtained may verify it, or migration of carbonates may have obliterated any trends. In the Crescent City Section four clay content peaks may be noted (Figure 6) at approximate depths of 0, 25, 45 and 75 ft. The peaks divide the section into four units which may be related to the four divisions of the Wisconsin glacia-

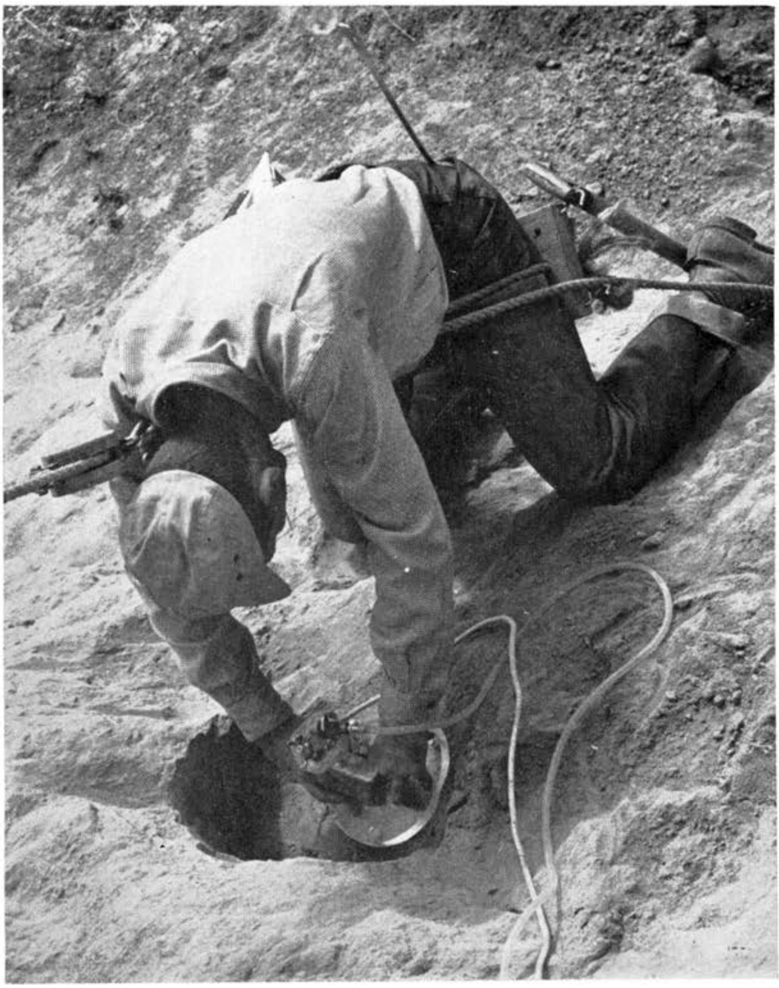

Figure 5. In-place density determination at Turin with rubber-balloon apparatus.

tion. Concretions near the bottom of the loess section prevented augering and sampling completely down to the contact.

In the Turin Section sampling was done at 10 ft. intervals instead of every 5 ft., so clay peaks may have been missed. Peaks occur at 40, 80 and 100 ft.; the latter sample is at the base of the section. The top of the section has been removed by erosion and borrow

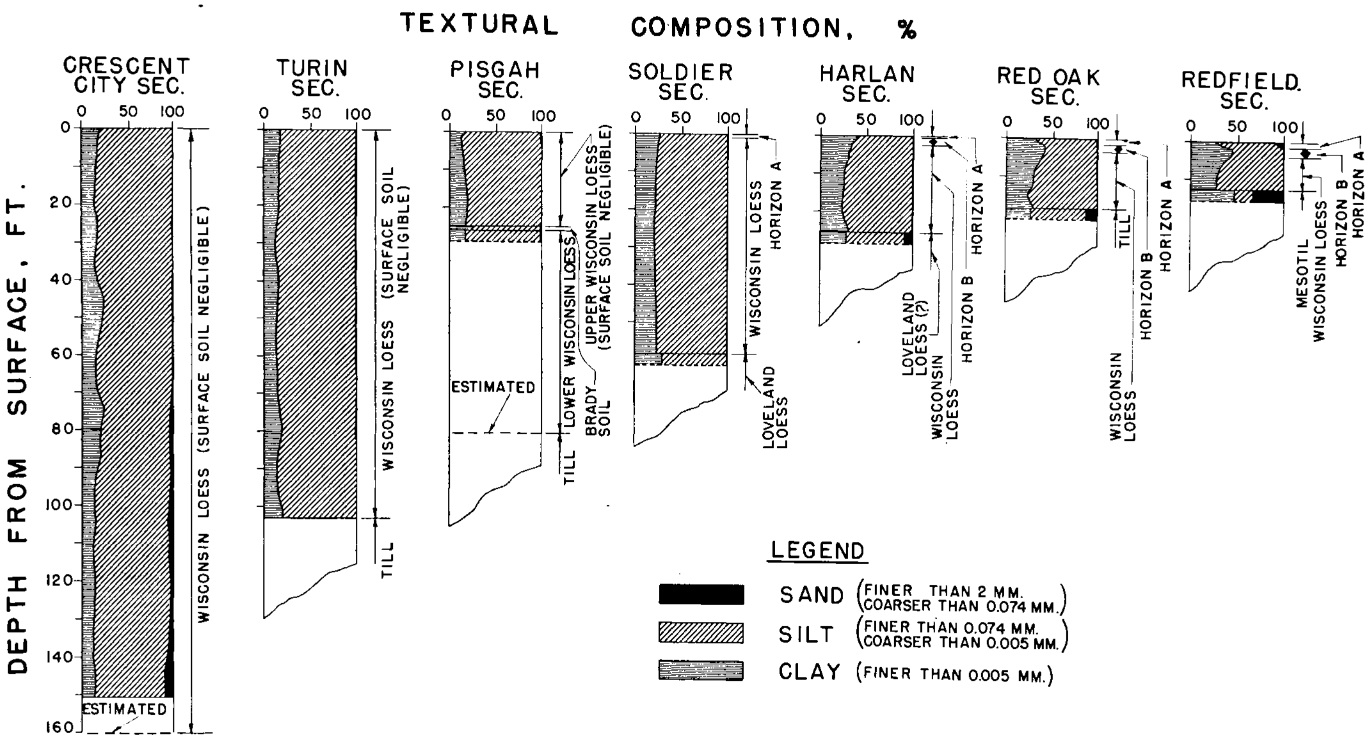

Figure 6. Variation of Textural Composition with Depth in the Wisconsin Loess.

operations. Again the clay and sand contents are fairly uniform from an engineering standpoint, averaging 15.3 and 1.9 percent, respectively.

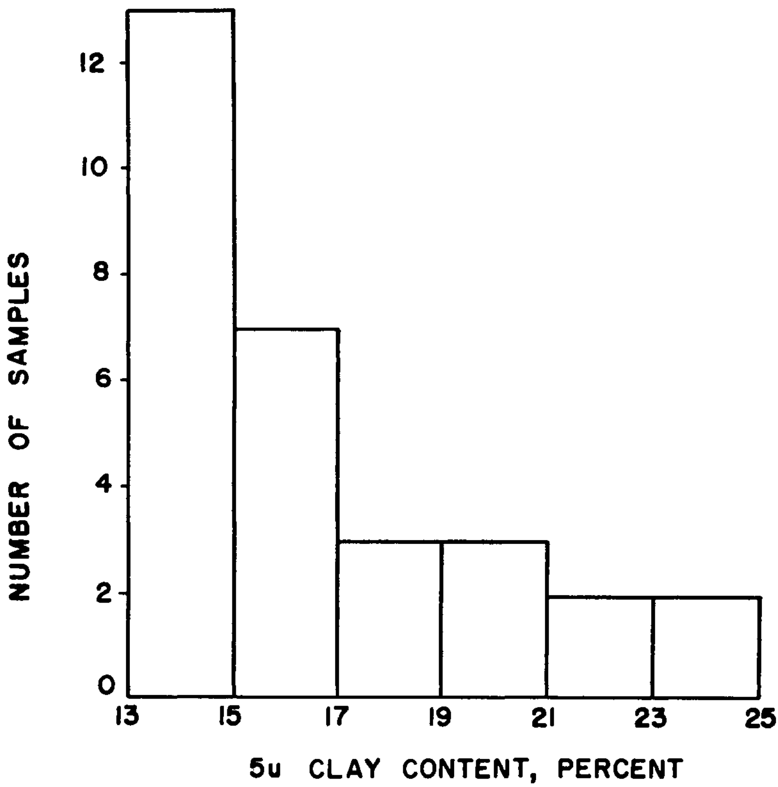

Figure 7. Histogram showing distribution of Crescent City Section loess samples with regard to their clay contents.

In the Pisgah Section clay content peaks occur at the surface and in and above the Brady soil. Sampling was not continued from the Brady down through the lower Wisconsin loess because of slump. The clay content reaches a sharp peak in the Brady soil; the sand content drops abruptly above the Brady. For about 2 ft. above the Brady soil the loess is gray and non-calcareous but contains a few snail shells. Above this it is calcareous. Below the Brady it is leached for about 2 ft.

Due to the steep slopes and the porous nature of the loess in the above bluff-line sections at Crescent City, Turin, and Pisgah, there is little or no soil profile development at the surface. The surface soil is a lithosol of the Hamburg soil series.

In the Soldier Section, which represents inland A-4 loess, the loess is thinner, contains more clay on the average and less sand than in the bluff-line sections. The sand and clay contents of the loess are remarkably uniform with depth, averaging 0.8 and 22.8 percent, respectively. The surface soil is a lithosol of the Ida series with a brown, calcareous A-horizon about one foot thick.

The Harlan Section, representing A-6 loess, is considerably thinner than the A-4 loess sections. The clay content of the loess is higher, averaging 25.8 percent in the loess, and there is considerable soil profile development (Marshall series). Due to erosion the A-horizon is absent. The sand content is uniform and lower than in previously discussed sections, averaging 0.7 percent. The first prominent leaching, to a depth of between 5 and 7 feet, was noted in this section. There is a slight increase in clay in the lower 3 feet of the Wisconsin loess; this basal loess is unoxidized and leached.

The Red Oak Section is quite similar texturally to the Harlan Section but shows further increases in clay content and soil profile development (Marshall series) and a decrease in thickness. The entire section is leached, and all except the lower 2 feet is oxidized.

The Redfield Section is also leached throughout and shows a further increase in clay content and an even greater dominance of the section by the soil profile (Sharpsburg series).

In the Harlan, Red Oak, and Redfield Sections the soil profile is transitional to the loess. Sand contents in these sections are low and uniform but may show slight increases in the foot of loess immediately above the contact with older deposits. The presence of unoxidized layers at the bases of the Soldier, Harlan, Red Oak and Redfield Sections appears to be due to submergence below the water table and may be caused by deoxidation.

In-Place Density

In-place density and field moisture measurements were made in the Turin, Harlan and Red Oak Sections* representative of the A-4, A-6 and A-7-6 loess areas. As seen in Figure 8, there was a trend in all of these sections for density to increase with depth, due to consolidation from the load of the overlying material. Anomalies in the Red Oak and Harlan Sections may be explained by soil profile development and variations in moisture content. In these sections low moisture content was apparently related to high density. In the Red Oak Section there was a decrease in density just above the till, where the loess was saturated with water. In general the field moisture content increased with increasing depth and increasing clay content.

*Made on October 25, 1952, September 19, 1952, and September 27, 1952, respectively.

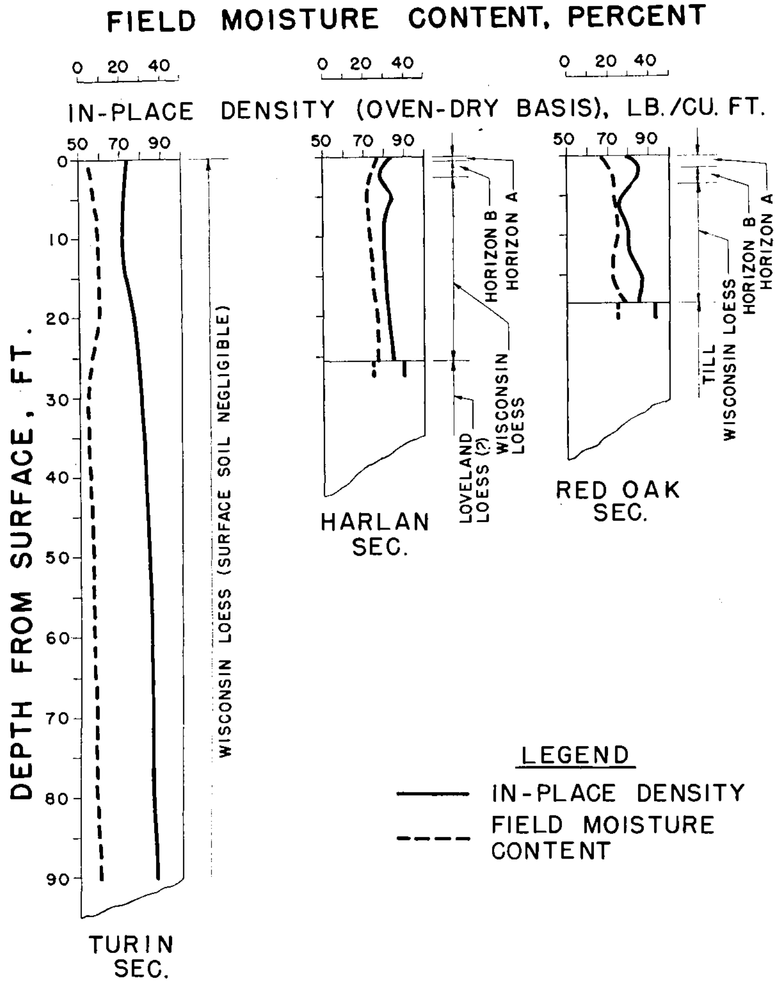

Figure 8. Variation of in-place density and of field moisture content with depth in the Wisconsin loess.

ACKNOWLEDGEMENT

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Appendix A

WISCONSIN LOESS SECTIONS, SOUTHWESTERN IOWA

Crescent City Section†.—North face of quarry 1.5 mi. southwest of Crescent City, Pottawattamie County, Iowa. NW corner, Sec. 35, T. 76 N., R. 44 W.

Sample No.	Depth, ft.	Method of Sampling	Material	Soil Series
1	0 — ½	Augered at crest of hill	Loess. Coarse-textured, friable, calcareous, light buff in color. No Brady soil detected.	Hamburg. Lithosol, little soil profile development, calcareous to surface. No distinct A-horizon.
2	2 — 2½	"	"	
3	5 — 5½	Augered horizontally into hill down 41° south slope.	"	
4	10 — 10½	"	"	
5	15 — 15½	"	"	
6	20 — 20½	"	"	
7	25 — 25½	"	"	
8	30 — 30½	"	"	
9	35 — 35½	"	"	
10	40 — 40½	"	"	
11	45 — 45½	"	"	
12	50 — 50½	"	"	
13	60 — 60½	Sampled down vertical face from ropes	"	
14	65 — 65½	"	"	
15	70 — 70½	"	"	
16	75 — 75½	"	"	
17	80 — 80½	"	"	
18	85 — 85½	"	"	

Appendix A (Continued)

WISCONSIN LOESS SECTIONS, SOUTHWESTERN IOWA

Crescent City Section† (Continued).—North face of quarry 1.5 mi. southwest of Crescent City, Pottawattamie County, Iowa. NW corner, Sec. 35, T. 76 N., R. 44 W.

Sample No.	Depth, ft.	Method of Sampling	Material	Soil Series
19	90 — 90½	Sampled down vertical face from ropes	Loess. Coarse-textured, friable, calcareous, light buff in color. No Brady soil detected.	Hamburg. Lithosol, little soil profile development, calcareous to surface. No distinct A-horizon.
20	95 — 95½	"	"	
21	100 —100½	"	"	
22	105 —105½	"	"	
23	110 —110½	"	"	
24	115 —115½	"	"	
25	120 —120½	"	"	
26	125 —125½	"	"	
27	135 —135½	"	"	
28	140 —140½	"	"	
29	145 —145½	Augured	"	
30	150 —150½	"	Concretion zone, large carbonate concretions. Augering stopped by concretions.	
....	160 (estimated)	No Sample		

†Since sampling (September, 1952) this section has been considerably modified by quarrying operations.

Appendix A (Continued)

Pisgah Section.—Exposed face of bluff about 100 ft. south of County Road D, 4 mi. west of Pisgah, Harrison County, Iowa. SW corner, SW¼, Sec. 8, T. 81 N., R. 44 W.

Sample No.	Depth, ft.	Method of Sampling	Material	Soil Series
1	0 — ½	Sampled down slope.	Loess, Upper Wisconsin. Coarse-textured, friable, calcareous, fossiliferous, light gray-buff in color.	Hamburg. No soil profile.
2	2½— 3	"	"	
3	14½— 15	"	"	
4	21 — 22	"	"	
5	23½— 24	"	Loess, Upper Wisconsin. Coarse-textured, friable, non-calcareous, fossiliferous, very light gray in color with rusty streaks. This zone is 2 ft. thick.	
6	25 — 25½	"	Brady soil. Leached, medium gray "buried soil" layer 12 to 16 in. thick. Organic layer at top contains minor amounts of charcoal.	
7	28 — 28½	"	Loess, Lower Wisconsin. Coarse-textured, friable, leached, light gray colored with rusty mottles.	
....	28½	No Sample.	Loess, Lower Wisconsin. Coarse-textured, friable, calcareous, fossiliferous, light gray-buff in color. Below this, slump.	
....	65	"	Concretion zone in loess.	
....	75	"	Slump.	
....	80 (estimated)	"	Till (exposed to west).	

Appendix A (Continued)

Turin Section†.—Borrow Pit at Turin, Monona County, Iowa. NW corner, Sec. 10, T. 83 N., R. 44 W.

Sample No.	Depth, ft.	Method of sampling	Material	Soil Series
1*	0 — ½	Augered from crest of knob back from face.	Loess. Coarse-textured, friable, calcareous, buff in color.	Hamburg. No soil profile.
2	2 — 2½	"	"	
3*	10 — 10½	Sampled from west side of knob.		
4*	20 — 20½	"	"	
4a*	20 — 20½	Sampled down vertical face from ropes.	"	
5*	30 — 30½	"	"	
6*	40 — 40½	"	"	
7*	50 — 50½	"	"	
8*	60 — 60½	"	"	
9*	70 — 70½	"	"	
10*	80 — 80½	"	"	
11*	90 — 90½	"	"	
12	100 —100½	Augered at base of cut.	"	
....	103	Reached with auger. No sample.	Glacial till.	

†Since last sampling (October, 1952) this section has been modified by a slide.
*In-place density tests made.

Appendix A (Continued)

Soldier Section.—North side of road cut on County Road M, 7 mi. southeast from Soldier, Monona County, Iowa. SW corner, SW¼, SE¼, Sec. 14, T. 82 N., R. 42 W.

Sample No.	Depth, ft.	Method of Sampling	Material	Soil Series
1	0 — 1	Sampled from ropes down vertical face.	Soil, A-horizon. Brown, calcareous, silt loam.	Ida. Lithosol, little profile development, calcareous to surface.
2	1 — 2	”	Loess. Medium coarse-textured, friable, calcareous, buff-colored.	
3	3 — 3½	”	”	
4	10 — 10½	”	”	
5	20 — 20½	”	”	
6	30 — 30½	”	”	
7	40 — 40½	”	”	
8	50 — 50½	Augered.	Loess. Slightly calcareous, buff-colored with gray mottles.	
9	58 — 58½	”	Loess. Leached, buff-colored with red and yellow streaks.	
10	58½— 59	”	Loveland Loess. Fine-textured, plastic, leached, medium gray-colored with red-brown mottles.	

Appendix A (Continued)

Harlan Section.—North side of road cut on U. S. Highway 64, 1 mi. east of Harlan, Shelby County, Iowa.
SE¼, SW¼, Sec. 16, T. 79 N., R. 38 W.

Sample No.	Depth, ft.	Method of Sampling	Material	Soil Series.
1*	0 — ½	Augered at crest of hill.	Soil, A_3-horizon. Dark brown, leached, silty clay loam.	Marshall
2	½— 1	”	Soil, B-horizon. Medium brown, leached, silty clay loam.	
3	1 — 1½	”	”	
4	1½— 2	”	”	
5*	2 — 2½	”	”	
6	2½— 3	”	”	
7	3 — 3½	”	”	
8	3½— 4	”	Loess. Medium-textured, leached, light brown in color.	
9	4 — 4½	”	”	
10	4½— 5	”	”	
11*	5 — 5½	”	”	
12*	7 — 7½	Sampled down slope of road cut.	Loess. Medium-textured, calcareous, buff-colored. Some small lime concretions.	
13*	10 — 10½	”	”	
14*	15 — 15½	”	”	
15*	20 — 20½	”	”	
....	23	No sample.	Loess. Medium textured, leached, unoxidized, gray-colored.	
16*	25 — 25½	Sampled down slope.	”	
17*	26 — 26½	”	Loveland loess (?). Medium-textured, sandy, leached, medium brown in color.	
....	29	Reached with auger. No sample.	Glacial till.	

*In-place density tests made.

Appendix A (Continued)

Red Oak Section.—South face of new gravel pit 4 mi. south of Red Oak, Montgomery County, Iowa. SE¼, SW¼, Sec. 17, T. 71 N., R. 38 W.

Sample No.	Depth, ft.	Method of Sampling	Material	Soil Series
1*	0 — ½	Sampled down slope of face in pit.	Soil, A_1-horizon. Dark brown, leached, silt loam.	Marshall.
2*	1 — 1½	"	Soil, A_3-horizon.	
3*	1½— 2	"	Soil, B_1-horizon. Medium brown.	
4*	2¼— 3¼	"	Soil, B_2-horizon.	
5*	3 — 3⅓	"	Soil, B_3-horizon.	
6*	3½— 4	"	Loess. Fine-textured, plastic, leached, buff in color.	
7	6 — 6½	"	"	
8*	9 — 9½	"	"	
9*	12 — 12½	"	"	
10*	15 — 15½	"	"	
....	16½	No sample.	Loess. Fine-textured, plastic, leached, unoxidized. Gray-colored with red-brown and brown streaks.	
11*	17 — 17½	Sampled down slope.	"	
12	18 — 18½	"	"	
13*	18½— 19	"	Glacial till.	

*In-place density tests made.

Appendix A (Continued)

Redfield Section†.—West side of road cut 3 mi. west of Redfield, Dallas County, Iowa.
NE corner, SW¼, Sec. 32, T. 79 N., R. 29 W.

Sample No.	Depth, ft.	Method of Sampling	Material	Soil Series
1	0 — ½	Sampled down slope.	Soil, A-horizon (1 ft. thick). Dark brown, leached, silt loam.	Sharpsburg.
2	1½— 2	"	Soil, B_2-horizon. Medium brown, leached, silty clay loam. Blocky structure.	
3	2½— 3	"	Soil, B_3-horizon. Blocky structure fading out.	
4	5½— 6	"	Loess. Fine-textured, plastic, leached, medium-brown in color. Vertical jointing.	
5	8½— 9	"	"	
6	11 — 11½	"	Loess. Plastic, leached, unoxidized, gray-colored. Grades down into 1 ft. of sandy material.	
7	12½— 13	"	Mesotil. Heavy, brownish-black, blocky B-horizon developed on till.	

†Since sampling, this section has been considerably modified by a slump-block slide in the spring of 1953.

Appendix B

TEXTURAL COMPOSITION OF DEPTH STUDY SAMPLES

Section	Sample No.	Depth, ft.	Textural Composition*, Percent		
			Sand	Silt	Clay
Crescent City	1	0 — ½	1.2	78.8	20.0
	2	2 — 2½	1.1	80.9	18.0
	3	5 — 5½	0.8	82.0	17.2
	4	10 — 10½	0.8	82.8	16.4
	5	15 — 15½	0.8	84.2	15.0
	6	20 — 20½	0.9	86.1	13.0
	7	25 — 25½	1.7	80.5	17.8
	8	30 — 30½	1.5	82.5	16.0
	9	35 — 35½	1.4	84.3	14.3
	10	40 — 40½	2.0	83.2	14.8
	11	45 — 45½	2.3	73.2	24.5
	12	50 — 50½	2.1	75.3	22.6
	13	60 — 60½	2.0	82.5	15.5
	14	65 — 65½	2.2	82.6	15.2
	15	70 — 70½	2.2	81.2	16.6
	16	75 — 75½	3.1	72.9	24.0
	17	80 — 80½	5.4	74.3	20.3
	18	85 — 85½	4.6	74.5	20.9
	19	90 — 90½	3.2	77.4	19.4
	20	95 — 95½	2.9	82.8	14.3
	21	100 —100½	4.7	81.2	14.1
	22	105 —105½	6.0	78.9	15.1
	23	110 —110½	3.6	83.1	13.3
	24	115 —115½	4.2	82.5	13.3
	25	120 —120½	2.2	83.8	14.0
	26	125 —125½	2.5	83.4	14.1
	27	135 —135½	5.2	81.8	13.0
	28	140 —140½	6.9	79.7	13.4
	29	145 —145½	9.9	76.1	14.0
	30	150 —150½	8.2	77.7	14.1

*Sand—Finer than 2 mm. and coarser than 0.074 mm.
Silt—Finer than 0.074 mm. and coarser than 0.005 mm.
Clay—Finer than 0.005 mm.

Appendix B (Continued)

Section	Sample No.	Depth, ft.	Textural Composition, Percent Sand	Silt	Clay
Turin	1	0 — ½	2.2	80.8	17.0
	2	2 — 2½	2.3	82.0	15.7
	3	10 — 10½	1.8	83.4	14.8
	4	20 — 20½	1.5	83.7	14.8
	4a	20 — 20½	2.9	83.2	13.9
	5	30 — 30½	2.7	83.9	13.4
	6	40 — 40½	1.9	81.1	17.0
	7	50 — 50½	2.1	84.3	13.6
	8	60 — 60½	1.8	84.1	14.1
	9	70 — 70½	1.1	83.5	15.4
	10	80 — 80½	1.8	78.2	20.0
	11	90 — 90½	0.2	85.4	14.4
	12	100 —100½	1.1	79.7	19.2
Pisgah	1	0 — ½	1.6	80.4	18.0
	2	2½— 3	2.4	85.2	12.4
	3	14½— 15	0.6	81.4	18.0
	4	21 — 22	0.6	80.5	18.9
	5	23½— 24	1.3	81.2	17.5
	6	25 — 25½	2.6	72.5	24.9
	7	28 — 28½	2.1	80.9	17.0
Soldier	1	0 — 1	0.8	72.7	26.5
	2	1 — 2	1.5	73.7	24.8
	3	3 — 3½	1.1	74.6	24.3
	4	10 — 10½	0.7	77.2	22.1
	5	20 — 20½	0.8	77.2	22.0
	6	30 — 30½	0.6	79.6	19.8
	7.	40 — 40½	0.3	77.7	22.0
	8	50 — 50½	1.0	76.2	22.8
	9	58 — 58½	0.5	75.2	24.3
	10	58½— 59	1.1	68.4	30.5
Harlan	1	0 — ½	1.3	60.6	38.1
	2	½— 1	0.6	59.7	39.7
	3	1 — 1½	0.8	61.7	37.5
	4	1½— 2	1.1	64.0	34.9
	5	2 — 2½	0.7	66.0	33.3
	6	2½— 3	0.5	66.8	32.7
	7	3 — 3½	0.8	66.4	32.8
	8	3½— 4	0.5	69.0	30.5
	9	4 — 4½	0.3	69.9	29.8
	10	4½— 5	0.5	68.5	31.0
	11	5 — 5½	0.6	70.0	29.4
	12	7 — 7½	0.6	70.1	29.3
	13	10 — 10½	0.9	73.8	25.3
	14	15 — 15½	0.5	74.7	24.8
	15	20 — 20½	0.7	76.3	23.0
	16	25 — 25½	0.6	69.4	30.0
	17	26 — 26½	8.6	63.2	28.2

Appendix B (Continued)

Section	Sample No.	Depth, ft.	Textural Composition, Percent		
			Sand	Silt	Clay
Red Oak	1	0 — ½	0.9	66.6	32.5
	2	1 — 1½	0.4	59.1	40.5
	3	1½— 2	0.4	58.6	41.0
	4	2½— 2¾	0.4	56.6	43.0
	5	3 — 3⅓	0.3	57.5	42.2
	6	3½— 4	0.5	59.7	39.8
	7	6 — 6½	0.4	63.9	35.7
	8	9 — 9½	0.3	68.8	30.9
	9	12 — 12½	0.4	70.3	29.3
	10	15 — 15½	0.9	76.3	22.8
	11	17 — 17½	0.6	72.6	26.8
	12	18 — 18½	2.7	68.3	29.0
	13	18½— 19	12.5	60.3	27.2
Redfield	1	0 — ½	8.0	65.0	27.0
	2	1½— 2	1.1	54.9	44.0
	3	2½— 3	1.0	54.0	45.0
	4	5½— 6	0.9	64.5	34.6
	5	8½— 9	0.7	71.3	28.0
	6	11 — 11½	0.5	71.7	27.8
	7	12½— 13	33.0	19.2	47.8

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