THE PLEISTOCENE LOESSES OF A PART OF THE JUNCTION CITY QUADRANGLE

by

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INTRODUCTION

Purpose of the Investigation

For many years there has been much controversy over the origin of the unconsolidated materials in this area. This investigation was undertaken to try to determine the origin of those materials working on the assumption that they might be loess. The deposits were to be described and mapped as individual units if such mapping proved feasible. The laboratory analyses were made to add any information possible to the field observations. It is hoped that this investigation will contribute a constructive basis for more detailed work on the origin, occurrence, classification, correlation and description of the unconsolidated materials in this area.

Area of the Investigation

The area of this investigation lies between 39 15 and 39 30 north latitude and 96 45 and 97 00 west longitude. Although the area includes only the northeastern part of Clay and the northwestern part of Riley county reconnaissance trips were taken into Washington, Dickinson, Saline, and Jewell counties to study the loesses there. After the investigation was completed a field trip was taken through northern Kansas, central Nebraska, and southwestern Kansas to check some of the interpretations made during the course of the field phase of the investigation.

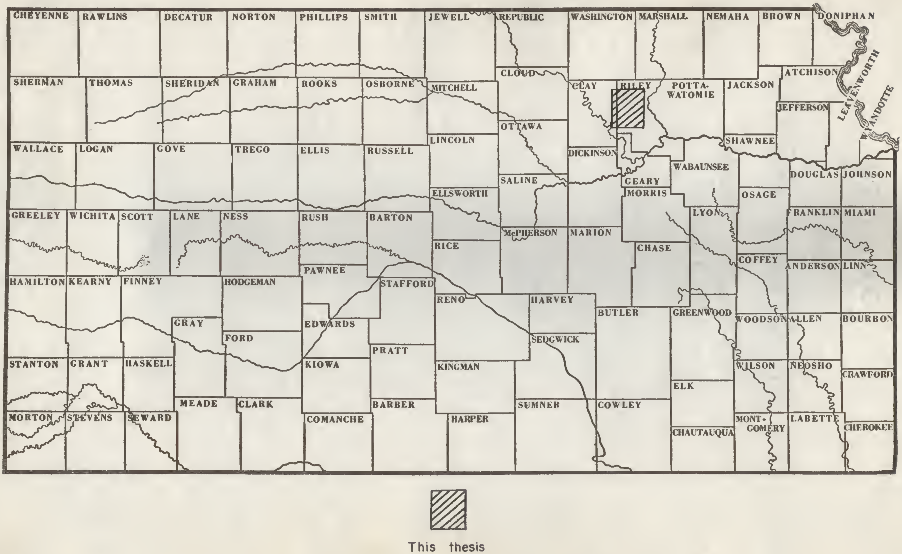


Fig. I. Index map of Kansas showing area covered by this thesis.

REVIEW OF LITERATURE

Origin of Loess

Strongly conflicting ideas have been advanced concerning the origin of deposits classed as loess. The term has been used by some workers in a genetic sense and by others in a lithologic sense. Richthofen (1882) interpreted the loess of China as being an eolian formation. In the arid regions of central Asia the products of rock disintegration are sorted by the winds, and the finest blown dust finally comes to rest where it is entangled and protected by the grasses of the steppes. Temporary streams, formed by torrential rains, assist in its concentration and bring about accumulation of loess in valleys and other depressions of the land. According to Russell (1889) the adobe of the Great Basin is formed essentially in this way, and the sediments deposited in the so-called "playa" lakes, whose beds are dry during a great portion of the year, consist of this material. The adobe contains the finer products formed by subaerial erosion of the mountains slopes, and may be commingled sometimes with dust of volcanic origin.

The loess of Iowa is regarded by McGee (1891) as a glacial silt deposited along the margins of glaciers during the glacial period. Hume (1892) studying the Russian loess, described that also as glacial silt, distributed partly by winds and partly by floods. Davidson (1894) considers loess to be a product of glacial erosion, accumulated first in banks of snow and concentrated later in the valleys by the rush of water following a thaw.

Origin and Deposition of Mississippi Valley Loess

While loess may vary from one area to another with respect to source and method of deposition, there seems now to be fairly general agreement that the Mississippi Valley loess is a wind deposit and that its source was the flood plains of the Pleistocene rivers.

Chamberlain (1897) presented this hypothesis, assuming among other things, the development of extensive flats over which glacial silts were spread during great periodic extensions of glacial waters caused by periods of warm weather in the melting season or by warm rains or both. Chamberlain reasoned that after the waters had retreated the extensive silt-covered flats would become exposed to the sweeping influence of the wind, and when they had dried the silt would be borne in great quantities over the adjoining uplands. His hypothesis appears to be borne out by the presence of the major loess deposits adjacent to the courses of the major streams which carried the glacial waters. There must be a relationship between the breadth of the fluvial deposits and the extent and massiveness of the eolian deposits on the adjacent uplands.

Keyes (1898) arguing that the wind was the agent of loess deposition, pointed out that mud flats along rivers furnish a source of loess and presented evidence of recent deposition of loess along the Missouri River. He further reasoned that the loess deposit should be thicker on the leeward side of the mud flats than on the windward.

A modern example of the deposition of loess in the manner suggested by Chamberlain and Keyes has been described by Tuck (1938) in Matanuska Valley, Alaska. With the glaciers standing 20 to 45 miles up the valleys, the glacial rock flour is deposited down the valley in the many and constantly changing channels or on the broad flood plains. Tuck describes a pall of dust as being visible over Palmer and the surrounding country in dry weather and even in winter. Section corners staked in 1913 were found to be covered to a depth of several inches in 1935.

Time of Deposition

Loess deposition along the river flood plains could conceivably have taken place during the advance, the climax, or the retreat of the ice. Very little accumulation would be expected during the interglacial periods unless during such periods extensive erosion of the till deposits took place. Visher (1922) citing the fossils of the loess and the pebble bands of the till, concluded that the loess was deposited principally during the retreat of the ice rather than at the climax or during the interglacial periods.

Climatic Conditions During Loess Accumulation

Shimek (1908, 1913, 1930) concluded from his studies of the loess fossils that "the conditions under which the loess was deposited were not essentially different from those which prevail in the Mississippi Valley today". His conclusions were based on the observation that the loess fossil fauna of a certain area, composed largely of terrestrial, herbivorous air-breathing mollusks, does not differ materially from the fauna of the same area today. He says, "Such differences as do exist (between the modern and fossil faunas) point to a drier climate in the northern part of the loess covered area than that of today."

Baker (1931) in reconstructing conditions during the period of loess deposition, says, "The fauna of the loess probably lived under conditions practically the same as those obtaining today. The river bluffs were forrested much as at present... and here the larger species lived. Many of the smaller species probably inhabited open woods or thickets, or even the open prairies, as they do today." Baker concluded that differences in the fossil fauna of the loess and the modern fauna are best explained by the assumption that the isotherms were displaced southward during at least part of the periods of loess deposition. He says, "This does not necessitate the assumption that the climate was arctic but simply that an isotherm that now occurs in southern Michigan and Wisconsin moved southward temporarily to central Iowa or Illinois."

It would seem that Baker and Shimek are in essential agreement that the climate in certain regions during the period of loess deposition was very similar to that in the same regions today. Neither has found evidence of great drouth or extreme cold. Nor would there seem to be serious conflict between the concept of a mild climate during the period of loess deposition and the concept of deposition during the retreat of the ice, for it has always been assumed that the glaciers retreated as a result of an increase in temperature.

Loesses of Nebraska

Much work has been done on the Pleistocene deposits of Nebraska. Lugn (1935) described the loess sheets that capped the uplands of the state and found that they correlated with the Loveland and Peorian deposits of Iowa. Later Schultz and Stout (1945) gave the name Bignell to loess deposits found above the Brady soil at the top of the Peorian loess. More recently these earlier works have been substantiated by other workers (Condra, Reed, and Gordon, 1947).

Kansas Loess

Extensive study has been made of the silts occurring in Kansas. Much of which has been found to be loess. In a reconnaissance report on Pleistocene deposits of north-central Kansas, Hibbard, Frye, and Leonard (1944) reported that loess occurs in much of Jewell, Smith, Phillips, Norton, Decatur, Rawlins, Rooks, Trego, and Sheridan counties. In central Kansas the loesses were found by Frye and Fent (1947) to be Loveland, Peoria, and Bignell in age. They reported that the texture and chemical composition was much the same as that of loess found elsewhere.

In Riley county the loess was mapped (Beck, 1947) as a unit in the Sanborn formation and no concentrated effort was made to make a distinction between the individual members.

METHODS OF INVESTIGATION

Field Methods

Measurement of Loess Depths. The measurements in thickness were made by use of the hand auger in places where the topographic situations seemed to preclude any possibility of significant changes in thickness through erosion or the deposition of wash from adjacent higher land. All significant measurements were taken on the crest of the interstream areas.

Differentiation of Loess Sheets. The Loveland and Peoria loess sheets were separated on the basis of color and of effervescence with acid. The Loveland loess was leached free of carbonates before the Peoria deposition began. When the basal part of the Peoria loess was calcareous, the line of separation was fairly sharp; the transitional zone between the two loess sheets usually being only a few inches.

Collection of Samples. Samples were taken in a 4 inch bucket type auger, about 5000 grams being collected for each sample. All samples were taken from the lower "B" horizon in order to insure getting the most unaltered materials possible. Each sample was given a number and this number along with the location was placed in a canvas bag with the sample and the sample number written on the bag. Every sample number and location was recorded in a field notebook at the time of sampling so that a second record was to be had in case the first was lost.

Location of Samples

<u>Samples of Loveland Loess</u>

1L	SE¼NW¼SW¼	sec.26, T.6S., R.4E., Riley County, Kansas
2L	NE¼NE¼NE¼	sec.13, T.7S., R.4E., Riley County, Kansas
3L	NE¼NE¼NW¼	sec.17, T.7S., R.5E., Riley County, Kansas
4L	SE¼SE¼SW¼	sec.4, T.7S., R.5E., Riley County, Kansas
5L	SE¼SW¼SW¼	sec.25, T.6S., R.5E., Riley County, Kansas
6L	NW¼SW¼SE¼	sec.27, T.6S., R.5E., Riley County, Kansas
7L	SW¼SW¼NW¼	sec.2, T.7S., R.5E., Riley County, Kansas
8L	SW¼SW¼NW¼	sec.3, T.8S., R.6E., Riley County, Kansas
9L	SE¼SE¼SE¼	sec.5, T.8S., R.6E., Riley County, Kansas
10L	SE¼SW¼SW¼	sec.14, T.8S., R.5E., Riley County, Kansas
11L	NE¼NW¼NW¼	sec.23, T.8S., R.4E., Riley County, Kansas
12L	NW¼NW¼NE¼	sec.7, T.9S., R.5E., Riley County, Kansas

<u>Samples of Peoria Loess</u>

1P	SE¼SW¼SW¼	sec.4, T.9S., R.4E., Clay County, Kansas
2P	NW¼SW¼SW¼	sec.16, T.8S., R.4E., Clay County, Kansas
3P	NW¼NW¼SW¼	sec.2, T.8S., R.4E., Riley County, Kansas
4P	NW¼NW¼NW¼	sec.7, T.8S., R.5E., Riley County, Kansas
5P	SE¼SW¼SW¼	sec.14, T.8S., R.5E., Riley County, Kansas
6P	SW¼NE¼NE¼	sec.20, T.8S., R.5E., Riley County, Kansas
7P	SE¼SE¼SW¼	sec.13, T.8S., R.4E., Riley County, Kansas
8P	NE¼NW¼NW¼	sec.23, T.8S., R.4E., Riley County, Kansas
9P	SE¼SW¼SW¼	sec.20, T.7S., R.5E., Riley County, Kansas
10P	NW¼NW¼NW¼	sec.12, T.9S., R.4E., Riley County, Kansas
11P	NE¼NW¼NE¼	sec.7, T.9S., R.5E., Riley County, Kansas
12P	SE¼SW¼SW¼	sec.4, T.9S., R.5E., Riley County, Kansas
13P	NW¼NW¼NE¼	sec.10, T.9S., R.5E., Riley County, Kansas
14P	NE¼NW¼NE¼	sec.7, T.9S., R.6E., Riley County, Kansas
15P	SW¼SE¼SE¼	sec.4, T.9S., R.6E., Riley County, Kansas
16P	SE¼SW¼SE¼	sec.23, T.9S., R.4E., Riley County, Kansas
17P	SW¼SE¼SE¼	sec.21, T.9S., R.5E., Riley County, Kansas
18P	NE¼SW¼SW¼	sec.22, T.9S., R.6E., Riley County, Kansas

Laboratory Methods

The loess samples were first air dried in the canvas bags in which they were collected. After being completely dried they were pulverized with a rubber hammer then screened to eliminate any hard lime concretions. Next the samples were thoroughly mixed and halved. Half was placed in the original sample bag and stored for possible use in future studies. The other half was prepared for various analyses which will be discussed in a later section.

OCCURRENCE OF LOESS IN THE AREA OF INVESTIGATION

At least two ages of loess were observed to mantle most of the uplands in this area. These deposits are relatively thin varying in thickness from a few inches to about 20 feet.

Classification

Loveland Silt Member. The Loveland loess was named by Shimek in 1909 with the type locality in the Missouri River bluffs just northeast of Loveland, Pottawatomie County, Iowa. He considered it to be fluvial in origin. In the area of the type locality, this loess consists of massive leached reddish silt that unconformably overlies glacial till and stratified sand and silt which locally contains volcanic ash.

Later, Kaye re-described this and other Loveland deposition and gave the name Loveland formation to include two phases of deposition--alluvial and eolian. His idea was that the alluvial phase found in valleys grades into the eolian phase of the uplands.

Kaye and Graham (1944) say that "The Loveland loess of the Illinoian drift area in Iowa has now been established by stratigraphic methods as being younger than the Illionian glacial drift and older than the Iowan glacial drift, that is, it is late Sangamon in age."

The Loveland has been traced westward across Nebraska (Lugn, 1933; Condra, Reed, and Gordan, 1947) and Southward from Nebraska as far as Central Kansas (Frye and Fent, 1947).

The Loveland within the area of this investigation consists of clayey silts with some fine sand. It is generally thin and mantles the pre-Loveland surface. It is moderate brown to reddish through its whole thickness and it varies in thickness from a few inches to 15 or more feet. The Loveland is for the most part deeply leached and contains a zone of large calcareous concretions in the "B" horizon. It is capped by a somewhat persistent old soil which has been called the Sangamon soil.

At most places in this area the Loveland rests unconformably on Permian limestones and shales. In the SE¼NW¼SW¼ sec.26, T.6S., R.4E., and the NW¼NW¼NW¼ sec.25, T.6S., R.4E., however, it was observed to grade downward into a quartz gravel which may correlate with the Crete sand and gravel member.

There is insufficient data at the present time to state the source of the Loveland loess found in this area. No fossils were found in this deposit.

<u>Peoria Silt Member</u>. The Peoria loess has been described in

Western Illinois and Iowa and is exposed unconformably above Loveland loess in the Missouri Valley area of Iowa and Nebraska. This unit has been traced westward from the Missouri Valley across Nebraska (Lugn, 1935; Condra, Reed, and Gordon, 1947), and southward as far as central Kansas (Frye and Fent, 1947).

The Peoria loess found in this area consists of clayey silts and some fine sands. It ranges in thickness from a few inches to about 15 feet at its maximum development. The Peoria is a moderate yellowish brown in color and weathers to a light tan. It is shallowly leached of its soluble carbonates and contains many small rounded calcareous nodules in the clay pan. It contains many limonitic stains and tubules in its lower part that have been leached from the surface zone. The basal part is sometimes leached free of its soluble carbonates by water which, after percolating downward strikes the impervious Sangamon soil and is forced to move laterally. In some areas where the Sangamon soil is in a depressional position the water stands above it and the basal part of the Peoria loess becomes highly limonitic and takes on a darker brown color. This zone is easily confused with the Sangamon soil and distinction must be made by effervescense with acid.

The Peoria of this area is capped by a present day soil and is underlain unconformably by Permian limestones and shales and by the dark Sangamon soil. It caps most of the uplands within the area of investigation but in sections 1 to 18 inclusive of T.6S., R.5E., no Peoria was found in an upland position. Some thin deposits were found on the valley slopes on the east sides of the interstream areas.

It is possible that the area could have been devoid of vegetation at the time of deposition of the Peoria. Had the loess been deposited on a surface lacking a vegetative cover, it could subsequently have been picked up by the wind and redeposited at some other point. Hobbs (1931) has pointed out the influence of vegetation in the lodgement of the loess. In discussing the current deposition of loess in Greenland, he describes the collection of dust in the tundra and the tendency, in areas without vegetation, for the sediments to drift and collect in the lee of objects which break the wind. According to E. C. Reed (personal communication) some topographic situations are such that loess will not remain in place if deposited there. The full extent and significance of these topographic settings is not fully understood at the present time.

The Peoria loess gradually decreased in thickness from 14.4 feet adjacent to the Republican River bluffs to 3.4 feet at a distance of 12.5 miles east of the river. It also becomes slightly more plastic away from the river suggesting an increase in clay content. These two factors seem to indicate that the Republican River was the source of the Peoria loess in this area and that it was deposited by westerly winds.

No fossils were found in the Peoria loess but they easily could have been leached out by percolating waters. According to A. Byron Leonard (personal communication) this is usually the case in deposits as thin as those that occur in this area.

Measured Sections

The following measured sections in the Loveland and Peoria loess were chosen as representative sections in this area.

Auger section in the SE¼SW¼SW¼ sec.26, T.6S., R.4E.,
Riley County, Kansas

Loveland silt member

Soil, clayey, non-calcareous, dusky brown........1.5

Silt, clayey, non-calcareous, gray brown.........3.1

Silt, clayey, non-calcareous, moderate brown.....2.0

Silt, non-calcareous, light brown; contains some very fine sand.............................1.6

Silt, moderately calcareous, light brown; contains fine sand and irregular nodules and tubules of calcium carbonate....................5.0

Gravel, sandy*...................................0.3

Total thickness measured........................13.0

*This gravel was too coarse to auger through.

Stream cut in the SE¼SW¼SW¼ sec.26, T.7S., R.5E.,
Riley County, Kansas

Peoria silt member

Soil, silty, non-calcareous, grayish black.......1.4

Silt, clayey, non-calcareous, dark yellowish brown...1.7

Silt, moderately calcareous, moderate yellowish brown; contains small rounded nodules of calcium carbonate, limonitic stains abundant.............9.0

Silt, slightly calcareous, moderage yellowish brown; limonitic stains common..................2.3

Total thickness exposed.........................14.4

Auger section in the SE¼SW¼SW¼ sec.4, T.9S., R.5E.,
Riley County, Kansas

Peoria silt member

Soil, clayey, non-calcareous, grayish black.......1.2

Silt, clayey, non-calcareous, dark yellowish brown...1.3

Silt, highly calcareous, moderate yellowish brown; contains many small rounded nodules of calcium carbonate; limonitic stains abundant......4.9

Silt, slightly calcareous, moderate yellowish brown; limonitic stains common...................4.6

Loveland silt member

Soil, clayey, non-calcareous, grayish brown.......1.5

Silt, clayey, non-calcareous, moderate brown......1.7

Gage shale

Total thickness measured..........................16.2

Auger section in the SE¼NE¼NW¼ sec.6, T.7S., R.5E., Riley County, Kansas

Peoria silt member

Soil, clayey, non-calcareous, dusky brown.........0.8

Silt, clayey, non-calcareous, dark yellowish brown...1.4

Silt, highly calcareous, moderate yellowish brown; contains small irregular nodules of calcium carbonate, limonitic stains abundant..............3.6

Loveland silt member

Soil, clayey, non-calcareous, grayish brown.......1.2

Silt, clayey, noncalcareous, moderate brown.......2.3

Gage Shale

Total thickness measured...........................9.3

Auger section in the NW¼NE¼NE¼ sec.4, T.9S., R.5E., Riley County, Kansas

Peoria silt member

Soil, clayey, non-calcareous, grayish black.......1.2

Silt, clayey, non-calcareous, dark yellowish brown...2.1

Silt, slightly clayey, moderately calcareous, moderate yellowish brown; contains numerous small rounded nodules of calcium carbonate; limonitic stains abundant..........................3.8

Loveland silt member
Silt, clayey, non-calcareous, moderate brown......4.6

Odell Shale

Total thickness measured...........................11.7

Auger section in the NW¼NW¼NE¼ sec.10, T.9S., R.5E.,
Riley County, Kansas

Peoria silt member
Soil, clayey, non-calcareous, grayish black.......1.3

Silt, clayey, non-calcareous, dark yellowish brown...1.7

Silt, slightly clayey, highly calcareous, moderate yellowish brown; contains small rounded nodules of calcium carbonate; limonitic stains common............................1.5

Loveland silt member
Silt, clayey, non-calcareous, moderate brown......2.5

Odell Shale

Total thickness measured...........................7.0

COMPOSITION AND TEXTURE

Petrographic Analysis

From the samples prepared as described under the heading of laboratory procedure 400 grams of material was selected and sieved under a water bath. Since the optimum grain size for mineral mounts is that size smaller than 1/8 millimeter and larger than 1/16 millimeter, only the fraction passing through the U. S. Series No. 120 sieve and retained on the No. 230 sieve was used in the petrographic analysis.

The material retained on the No. 230 sieve was next subjected to treatment with cold dilute hydrochloric acid to remove any soluble carbonates present. After this treatment it was again thoroughly washed to remove the acid.

The selected material was then divided into light and heavy mineral fractions by placing it in bromoform and drawing off the heavy minerals that descended in the separatory funnel. The bromoform used had a specific gravity of 2.75. The minerals of lower specific gravity, which therefore floated on the bromoform, were designated as the light fraction, and those which settled were termed the heavy fraction. These fractions were washed in alcohol after their separation to remove the bromoform.

It is here desirable to note that the total assemblage of heavy minerals of the Peoria samples became less with increased distance to the east from the Republican River bluffs thus substantiating the earlier concept that the source of the Peoria was the Republican River.

Mineral mounts were made of both the light and heavy fractions of selected samples of both the Loveland and Peoria loesses. Canada balsam, which has a refractive index of 1.537 was used as the mounting medium.

These slides were examined to identify the minerals present in each fraction and to determine the relative abundance of the minerals present. The minerals were identified on the basis of their optical properties by the use of a petrographic microscope.

Table 1 gives the percentage of light and heavy minerals present in the samples of Loveland loess and Table 2 those of Peoria loess.

It may be readily noted that quartz is the predominant constituent of the light fraction of both the Loveland and Peoria loesses. In only one slide, that of sample no.11P, was any chalcedony noted. Its presence in this sample is best explained by the presence of an outcrop of cherty Stovall limestone ¼ mile west of the spot where the sample was taken. The wind evidently picked up some of the fine products of rock disintegration there and deposited them farther along. A similar situation was found in sample 5P where a large abundance of biotite was noted. This sample was taken about 3/4 mile east of the Leonardville igneous intrusion which contains a large amount of biotite. The wind picked up the flakey mica at the intrusion and carried it a short distance before redepositing it.

Table 1. Mineral analysis of samples of the Loveland loess.

Minerals	Sample no. 1L	Sample no. 2L	Sample no. 11L
	Light fraction		
Quartz	60.0	70.0	65.0
Chalcedony	1.0		
Orthoclase	10.0	8.0	7.0
Microcline	14.0	6.0	18.0
Plagioclase	15.0	16.0	10.0
	Heavy fraction		
Zircon	50.0	55.0	55.0
Topaz	15.0	8.0	10.0
Hornblende	3.0		3.0
Muscovite	5.0	3.0	2.0
Biotite	15.0	10.0	10.0
Garnet			2.0
Tourmaline	1.0	2.0	3.0
Corundum		1.0	1.0
Magnetite	2.0	1.0	1.0
Hematite*	9.0	10.0	10.0
Pyrite			
Ilmenite			
Rutile		5.0	2.0
Augite		5.0	1.0

*Occurs as grains and as coatings on other minerals.

Table 2. Mineral analysis of samples of the Peoria loess.

Minerals	Sample no. 2P	Sample no. 7P	Sample no. 5P	Sample no. 1P	Sample no.11P	Sample no.13P
			Light fraction			
Quartz	50.0	55.0	40.0	50.0	50.0	55.0
Chalcedony					5.0	
Orthoclase	15.0	10.0	20.0	10.0	15.0	15.0
Microcline	20.0	15.0	15.0	20.0	15.0	20.0
Plagioclase	15.0	20.0	25.0	20.0	15.0	10.0
			Heavy fraction			
Zircon	40.0	35.0	21.0	40.0	35.0	38.0
Topaz	10.0	8.0	2.0	7.0	12.0	10.0
Hornblende	5.0	7.0	1.0	3.0	4.0	4.0
Muscovite	5.0	10.0	10.0	10.0	7.0	11.0
Biotite	25.0	30.0	60.0	30.0	35.0	30.0
Garnet		1.0	3.0	1.0		1.0
Apatite		1.0		1.0	1.0	
Titanite	1.0				1.0	1.0
Tourmaline	2.0	3.0	2.0	3.0	2.0	3.0
Rutile	2.0	1.0		1.0	1.0	1.0
Lazulite	1.0					
Magnetite	1.0			2.0		
Hematite	3.0	4.0	1.0	2.0	2.0	1.0

Differential Thermal Analysis

Thermal analysis is, in principle, a method of studying the thermal reactions of a sample when heated at a constant heating rate. These reactions are either endothermic or exothermic in nature, and they are due to the loss of either adsorbed water or water of hydration, changes in physical structure, or chemical decomposition.

The sample to be analyzed is placed in a nickel sample-holder which also contains an inert substance which is adjacent to but separate from the sample. Chromel and alumnel couples are inserted into the sample and the inert substance, respectively, to record the e. m. f. generation that occurs when the loaded sample-holder is heated. Purified alundum, manufactured by the Norton Company, was used for the inert material.

The sample-holder was heated in an electric furnace at a rapid (increase of 33 degrees centigrade per minute) rate. The temperature interval recorded for these analyses was from 0 degrees to 1000 degrees centigrade, and this interval was continuously recorded through a platinum-rhodium temperature recording thermocouple.

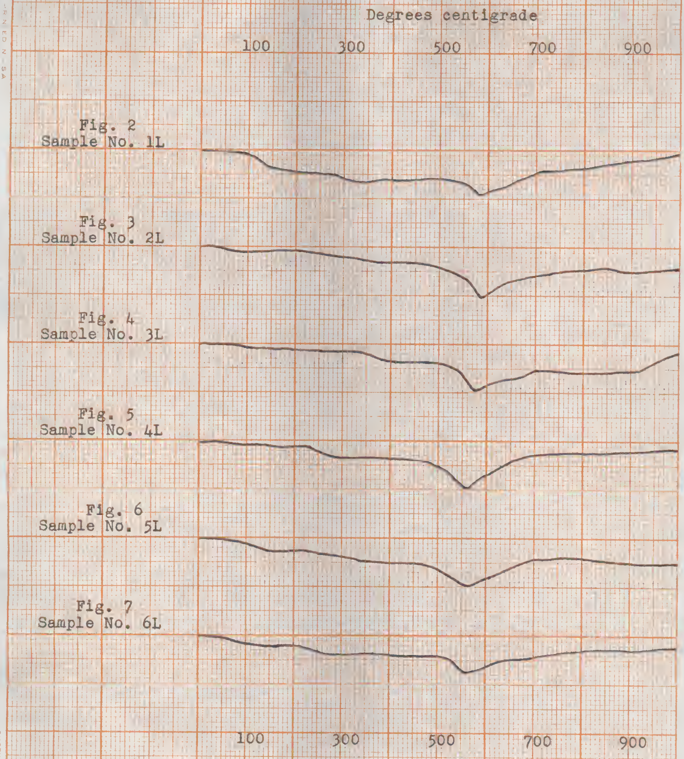
The equipment was frequently calibrated with the alpha-beta quartz change at 575 degrees centigrade, and the reproducibility was checked also by analyzing samples of standard Georgia kaolinite after short periods of operation. This procedure permitted a correction of the "drift" which is inherent in all electronic devices.

All of the samples analyzed with the thermal apparatus were first treated with cold hydrochloric acid to remove the soluble carbonates. The samples were then washed free of the acid by the decantation method and allowed to dry.

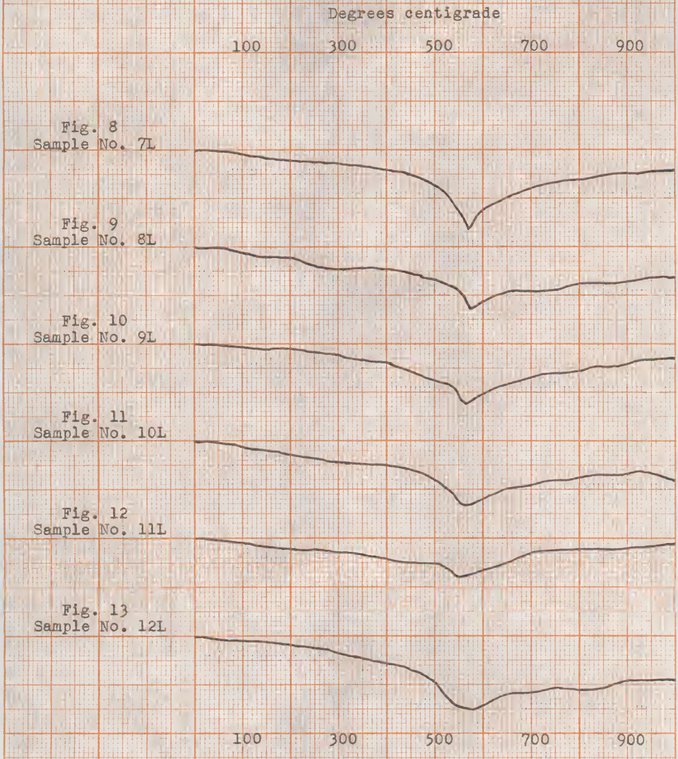
Two series of samples of both the Loveland and Peoria loess were analyzed. The first of these series were pulverized to a size which passed the U. S. Series No. 120 sieve and was retained on the No. 250 sieve. The alundum for both series was also ground to this size. Care was exercised at all times to avoid contamination of the samples, and the procedure of filling the sample-holder, inserting the thermocouples, etc. was duplicated as nearly as possible for each analysis.

The thermal curves of the Loveland samples of the first series are shown in Figs. 2 to 13. These curves show quartz to be the major constituent in this size range. The thermal curves of the samples of Peoria loess are shown in Figs. 14 to 31 and they show one peak (150 degrees centigrade) that indicates water of hydration, a second peak shown at 380 degrees centigrade indicates carbon in the samples.

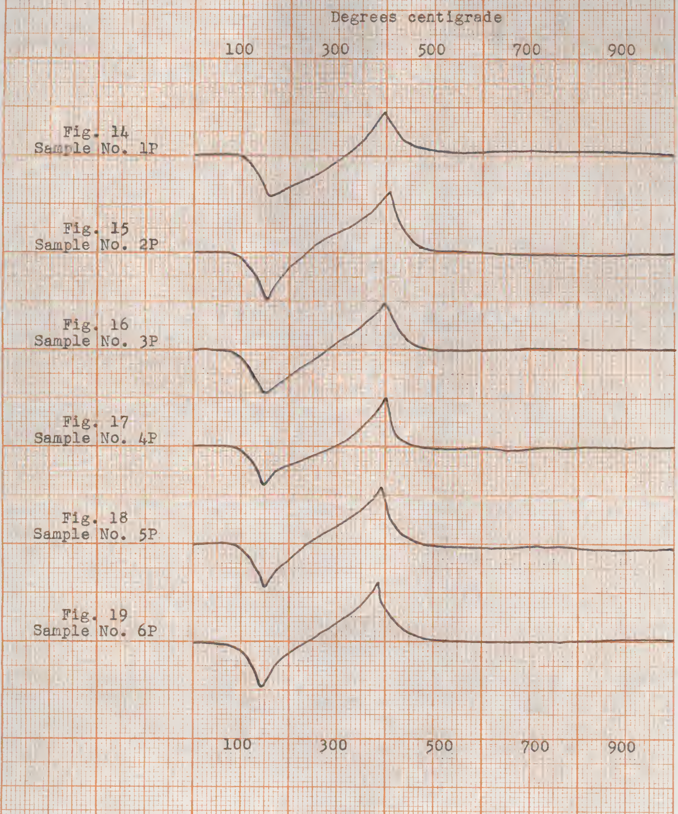
The occurrence of carbon in the Peoria samples was thought by the author to indicate a slow deposition of the Peoria with continuous plant cover. The roots and leaves of the plants contributed to the carbon content as more loess slowly accumulated. According to A. Byron Leonard (personal communication) the fossil fauna of the Peoria, where fossils are found in it, are such that a continuous grass cover is necessary in order to prevent the desication of the eggs of the fauna. Without a



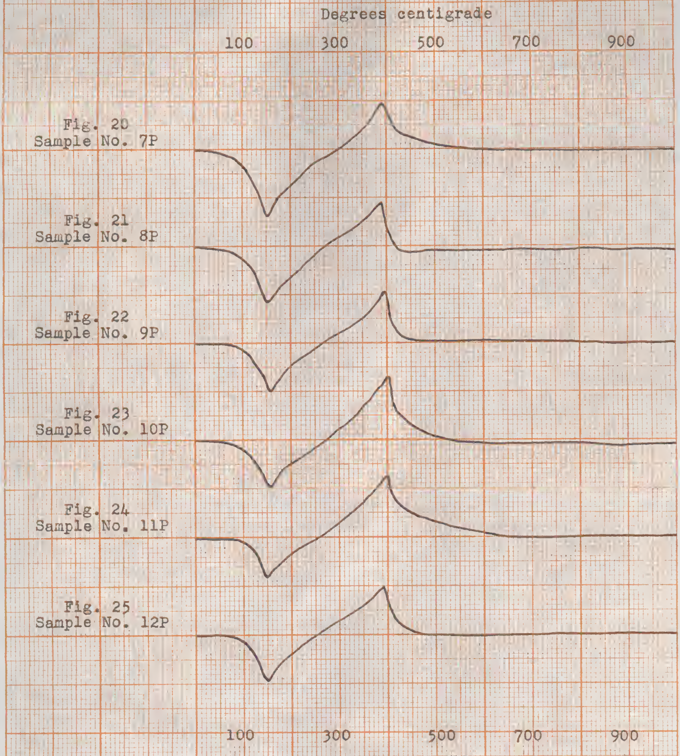
Thermal curves showing quartz



Thermal curves showing quartz



Thermal curves showing carbon



Thermal curves showing carbon

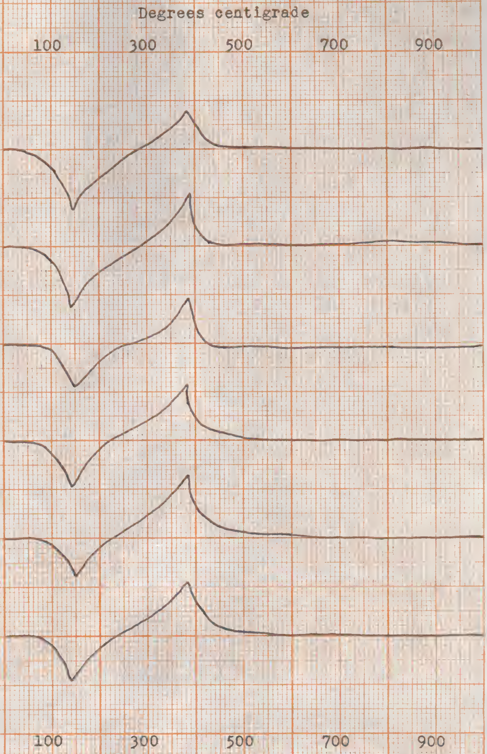


Fig. 26
Sample No. 13P

Fig. 27
Sample No. 14P

Fig. 28
Sample No. 15P

Fig. 29
Sample No. 16P

Fig. 30
Sample No. 17P

Fig. 31
Sample No. 18P

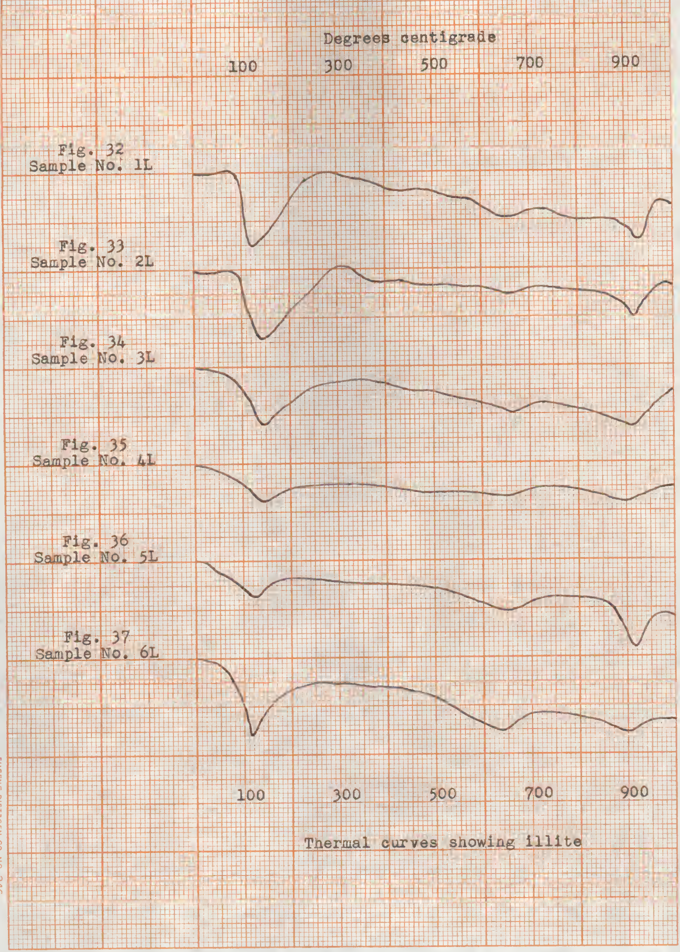
Thermal curves showing carbon

grass cover the reproduction of the molluscs could not have occurred.

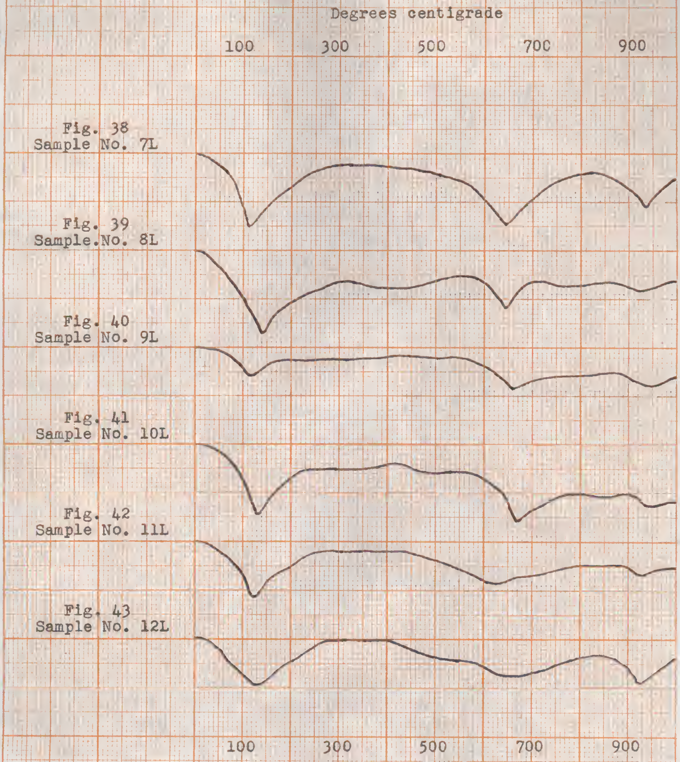
The second series of samples were made from that portion of the loesses that passed through the U. S. Series No. 400 sieve. The thermal curves of the Loveland samples of this series are shown in Figs. 32 to 43. These curves show that illite is the clay mineral found in the Lovel nd loess of this area. The Peoria samples of this series are shown in Figs. 44 to 62. These too show that illite is the clay mineral found in the Peoria of this area.

According to James Thorpe (personal communication) the clay minerals found in the loesses were probably not carried by the wind as individual clay particles. Instead they were carried as silt sized aggregates of the clay particles. These aggregates being considerably lighter than the other materials would be carried farther from the source area in greater abundance than would the heavier silt particles of the same size range.

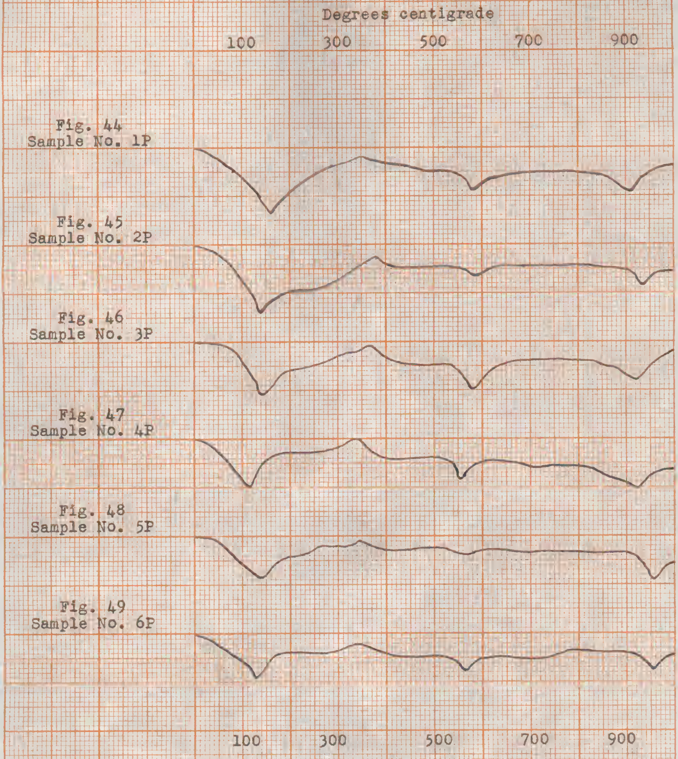
The thermal curves shown in the figures cited above are the deviations from a straight line plot of temperature differences against temperature, and these deviations are dependent upon the nature of the heat change for their direction and amplitude. In plotting the thermal curves, the writer h s followed the standard practice of plotting endothermic reactions below the exothermic reactions above the line of zero deviation.



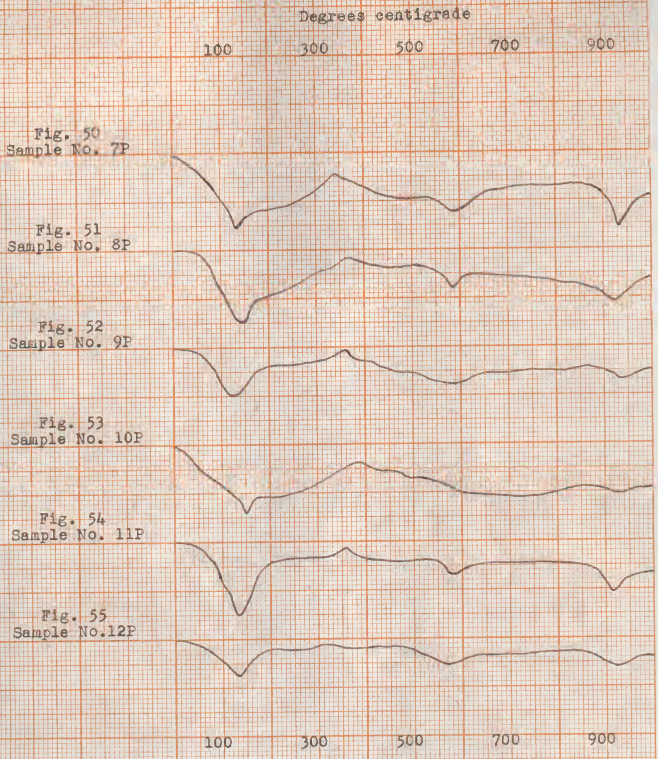
Thermal curves showing illite



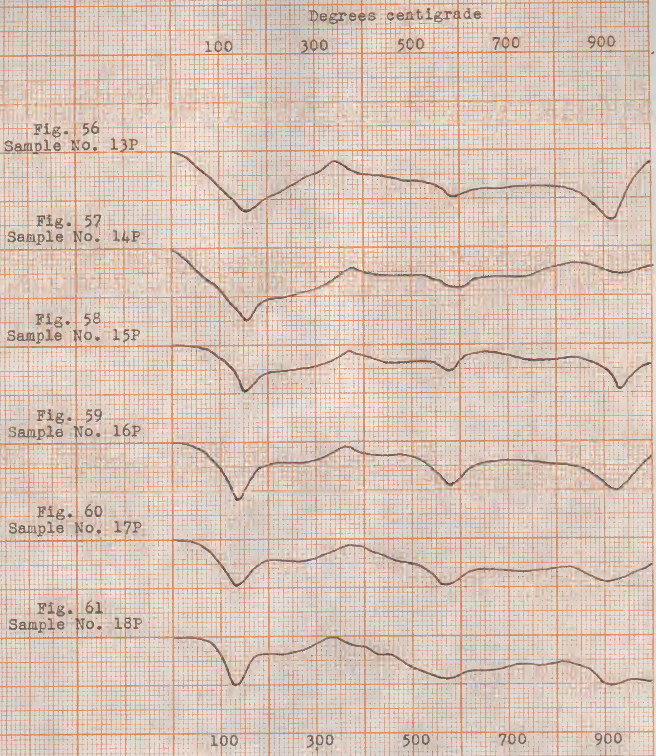
Thermal curves showing illite



Thermal curves showing illite



Thermal curves showing illite



Thermal curves showing illite

Mechanical Analysis

The Loveland and Peoria samples were subjected to mechanical analysis by the hydrometer method following the procedure of Bouyoucos (1928, p. 233). In this method data are collected by reading a hydrometer placed in the suspension at various intervals of time and recording the readings as corrected for temperature. The purpose of this analysis was to try to determine the relation between particle size and distance from the source area.

The samples were first screened through the U. S. Series No. 230 screen to determine the percentage of fine sand present. Next 50 grams of the screened material was dispersed in 400 grams of de-ionized water using sodium silicate as the dispersing agent. Then it was agitated for a period of one and one-half hours in a mechanical shaker to disaggregate the particles. More de-ionized water was then added to the dispersed and disaggregated sample to bring the total volume of fluid to one liter.

The amount of material present in each of the size ranges was determined by taking hydrometer readings at intervals computed from Stoke's formula. The beakers containing the suspension were shaken by hand after each reading to give independent readings for each size class.

The data collected were plotted as histograms for easy visual comparison of the loesses. The histograms of the Loveland samples are shown in Figs. 63 to 68 and those of the Peoria in Figs. 69 to 78.

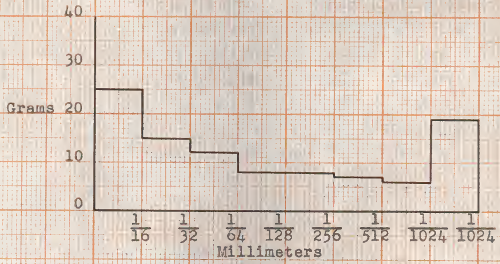


Fig. 62. Histogram showing the distribution of particle size of sample no. 1L

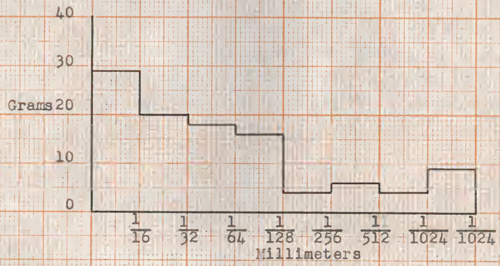


Fig. 63. Histogram showing the distribution of particle size of sample no. 2L.

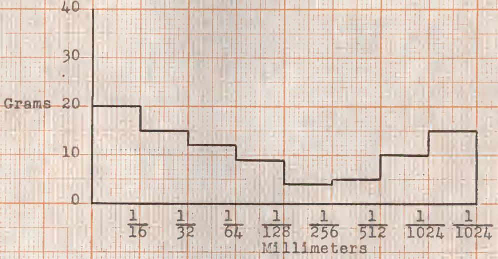


Fig. 64. Histogram showing the distribution of particle size of sample no. 5L.

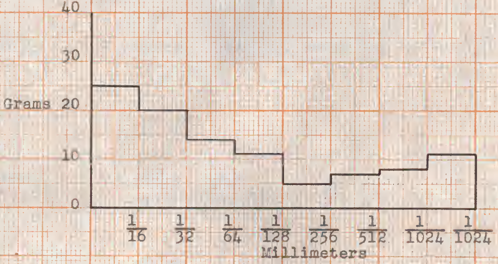


Fig. 65. Histogram showing the distribution of particle size of sample no. 10L.

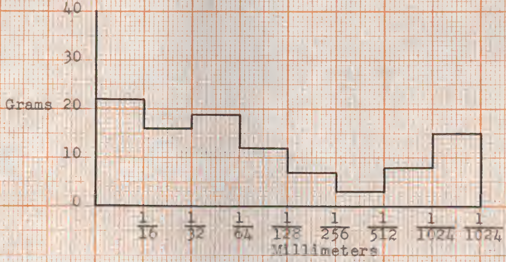


Fig. 66. Histogram showing the distribution of particle size of sample no. 111.

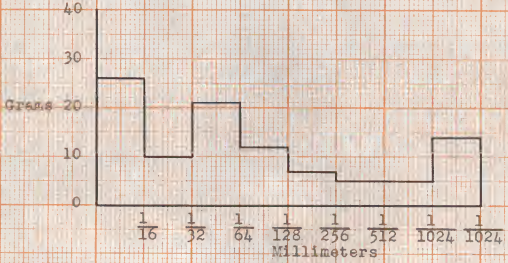


Fig. 67, Histogram showing the distribution of particle size of sample no. 121.

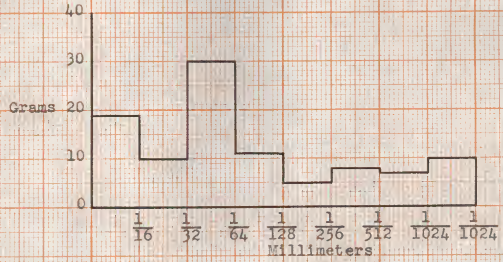


Fig. 68. Histogram showing the distribution of particle size of sample no. 1P.

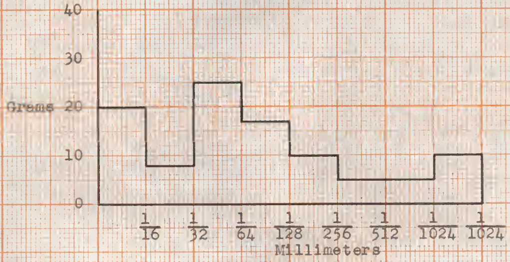


Fig. 69. Histogram showing the distribution of particle size of sample no. 2P.

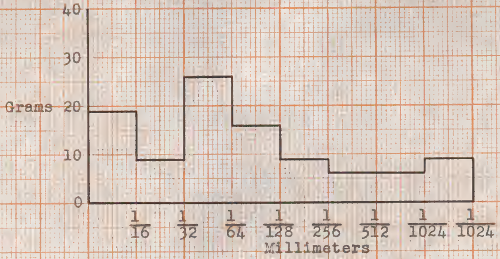


Fig. 70. Histogram showing the distribution of particle size of sample no. 3P.

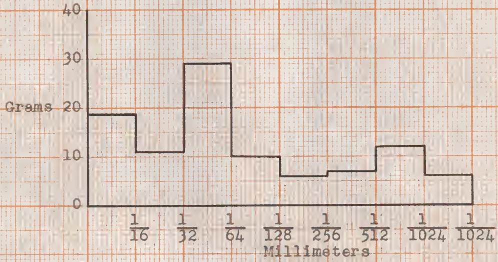


Fig. 71. Histogram showing the distribution of particle size of sample no. 4P.

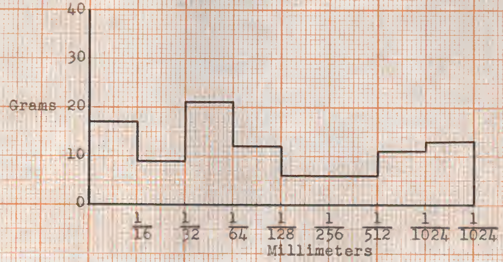


Fig. 72. Histogram showing the distribution of particle size of sample no. 5P.

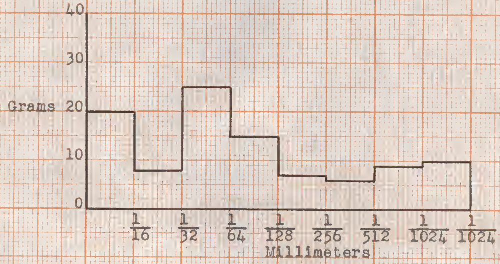


Fig. 73. Histogram showing the distribution of particle size of sample no. 7P.

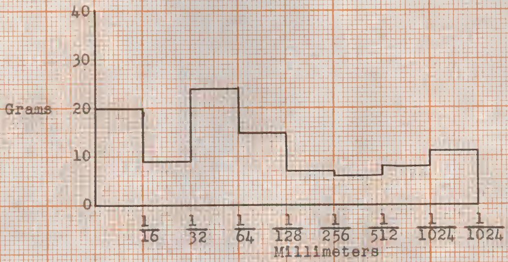


Fig. 74. Histogram showing the distribution of particle size of sample no. 10P.

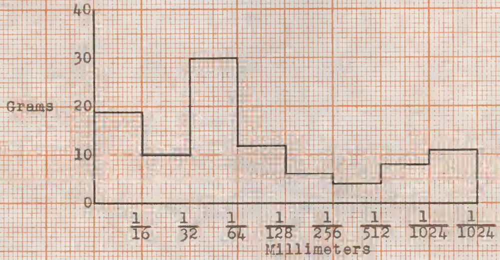


Fig. 75. Histogram showing the distribution of particle size of sample no. 12P.

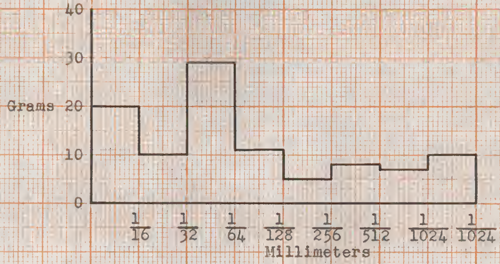


Fig. 76. Histogram showing the distribution of particle size of sample no. 16P.

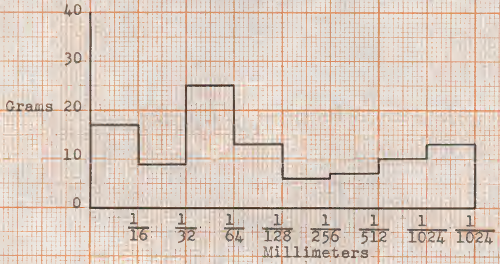


Fig. 77. Histogram showing the distribution of particle size of sample no. 17P.

Most of the histograms of the Loveland samples showed two prominent peaks, one in the fine sand size range and the other in the clay size range. Those of the Peoria showed three peaks, one in the fine sand size range, one in the silt size range, and the other in the clay size range.

The mechanical analyses failed to show any relationship between size of particle and distance from source area. They did show that at least 50 percent of the material fell within the silt size range which is in agreement with the results of pipette analyses made of loess samples collected by Frye in northwestern Kansas (Swineford and Frye, 1945; Frye 1945). The Peoria samples showed an average smaller grain size than did the Loveland.

SUMMARY AND CONCLUSIONS

Field and laboratory observations showed that the Loveland differed from the Peoria in many ways. The Loveland was moderate brown in color whereas the Peoria was yellowish brown. Quartz was more abundant in the Loveland and feldspars more abundant in the Peoria. The Loveland contained more zircon, topaz, and hematite than did the Peoria. Table 3 gives the average mineral analysis of both the Loveland and Peoria loesses. Illite was found to be the clay mineral in both the loess sheets. Carbon was found in the Peoria and not the Loveland. Figure 79 shows an average of all the histograms of the Loveland and Figure 80 an average of those of the Peoria. From these it may be seen that there is more fine sand and clay

Table 3. Average mineral analysis of the Loveland and Peoria loesses.

Minerals	Loveland samples	Peoria samples
	Light fraction	
Quartz	65.0	50.0
Chalcedony	tr*	
Orthoclase	8.3	14.2
Microcline	12.7	17.5
Plagioclase	13.7	17.5
	Heavy fraction	
Zircon	53.3	34.8
Topaz	11.0	8.2
Hornblende	2.0	4.0
Muscovite	3.3	9.0
Biotite	11.7	35.0
Garnet	0.7	1.0
Tourmaline	2.0	2.5
Corundum	0.7	
Magnetite	1.3	0.5
Hematite	9.7	2.1
Pyrite		
Ilmenite		
Rutile	2.3	1.0
Augite	2.0	
Apatite		0.5
Titanite		0.5
Lazulite		tr*

*Less than 0.5 percent found in all the samples.

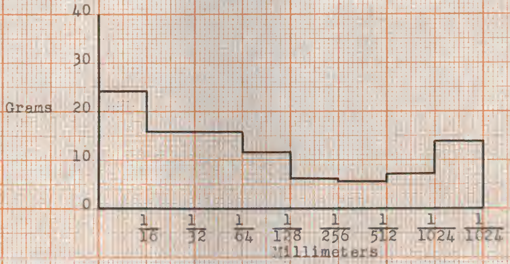


Fig. 78. Histogram showing the distribution of particle size of an average of all the Loveland samples.

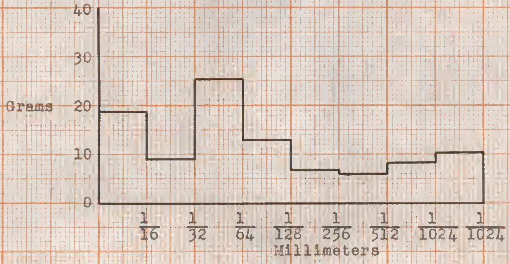


Fig. 79. Histogram showing the distribution of particle size of an average of all the Peoria samples.

size particles in the Loveland than the Peoria. The Loveland is usually leached of its soluble carbonates to a depth of 7 or 8 feet whereas the Peoria is leached to only 2 or 3 feet. The Loveland contains large nodules of calcium carbonate that are somewhat elongate in its "B" horizon while those in the Peoria are smaller and rounded.

It was found from field observations that it is impractical to map the Loveland and Peoria members as separate units.

The loess deposits are eolian in origin and the source of the Peoria was the Republican River. The source of the Loveland was not determined.

The loess deposits are subjected to weathering, leaching, soil formation, some chemical alteration, erosion, re-working, and re-deposition. The calcium carbonate and some iron leached from the surface zone of a deposit are carried downward by water and accumulated as concretions or as coatings on the loess particles, causing a change in color.

ACKNOWLEDGMENTS

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THE PLEISTOCENE LOESSES OF A PART
OF THE JUNCTION CITY QUADRANGLE

by

CARL F. CRUMPTON

B. S., Kansas State College
of Agriculture and Applied Science, 1949

AN ABSTRACT OF
A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Geology and Geography

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1951

ABSTRACT

The Pleistocene loesses in this area were found to be Loveland and Peoria in age with the Sangamon soil separating them in many places. The basis of differentiating these units was color and the effervescence with acid. These units are described separately and typical measured sections for each of the loesses are given. A petrographic analysis was made and quartz was found to be the most abundant mineral in the light fraction of each of the loesses, whereas zircon was the most common mineral in the heavy fraction of each of the loess sheets. A differential thermal analysis was made to determine what clay minerals were present, and illite was found in all the samples. The thermal curves for each of the samples are shown and the interpretations of those curves are given. A mechanical analysis was made to determine the size of particle of the different loess units and the texture as determined by that analysis was found to be similar to the texture of the same loess units found elsewhere. Histograms were made and included for easy visual comparison of the different units. It was found that the Loveland and Peoria could not be mapped separately with any degree of accuracy.