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Pleistocene Geology in a Part of the Kansas City Area

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CONTRIBUTION
STATE GEOLOGICAL SURVEY
OF
KANSAS

Transactions of the Kansas Academy of Science, Vol. 66, No. 4, 1963
This issue was published February 25, 1964

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Pleistocene Geology in a part of the Kansas City Area[1]

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The general concept of the Pleistocene stratigraphy in northeastern Kansas has been developed over a period of many years by a large number of geologists. It is quite well established that only the Nebraskan and Kansan glaciers entered northeastern Kansas. Even though the detailed stratigraphy remains to be determined through mapping and surface and subsurface studies, the regional picture has been well established. For example, the presence of a major filled and buried pre-Kansan valley across northeastern Kansas is known, the presence of two tills along the Missouri River in Doniphan County is well known, and the general areas in which till deposits are found are farily well established.

There are, on the other hand, certain features of the Pleistocene geology of northeastern Kansas that have not been studied in detail and others that have not been recognized or described previously.

In this paper regional aspects of Pleistocene geology are first summarized as they have been established and then new data and descriptions for the Kansas City area are presented, some of which are not in agreement with previously developed concepts.

Figure 1 shows the areas glaciated by the Nebraskan and the Kansan ice sheets. Frye and Leonard (1952, fig. 12) have depicted the Nebraskan glacier as having been more extensive than is shown here and they have indicated the probable presence of Nebraskan glacial deposits in Atchison, Doniphan, Brown, Jackson, and Nemaha Counties. More recently, as a result of an extensive drilling program in Brown County, Charles K. Bayne (1963, personal communication) concluded that Nebraska Till is absent or only doubtfully present over most of Brown County, and, on the basis of this information, the extent of Nebraskan glaciation is restricted to the area shown. The probable extent of Nebraskan glaciation in Missouri has been determined as a result of a recent drilling program in northwestern Missouri by the Missouri Division of Geological Survey and Water Resources (Heim, in Howe and Koenig, 1961).

The limit of Kansan ice has been depicted by several early workers as bounded on the west generally by the Big and Little Blue Rivers and on the south by the Kansas River. Within the past 12 years several publications (Beck, 1959; Dufford, 1958; Mudge, 1955; Mudge and Burton, 1949; O'Connor, 1960, Scott, Foster, and Crumpton, 1959; and

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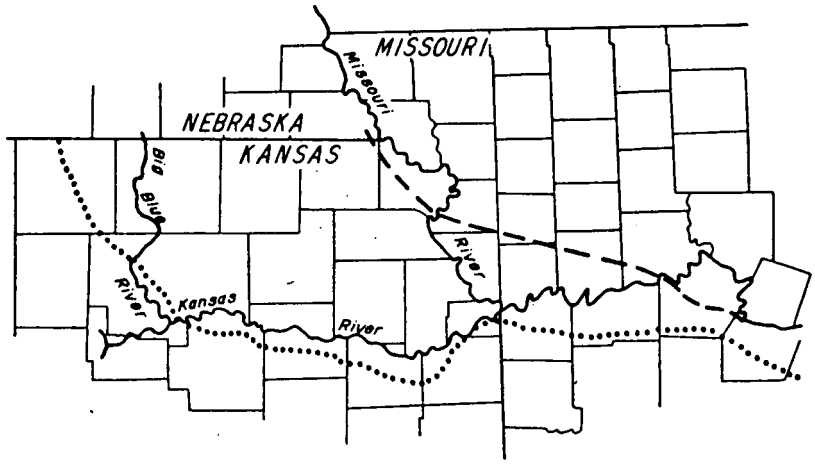
[1] Symposium paper presented before the geology section at the Kansas Academy of Science meeting, Lawrence, on May 3, 1963.

Walters, 1953, 1954) have refined this boundary to the extent here shown. Kansas Till is as much as 300 feet thick in Nemaha and Marshall Counties (Frye and Walters, 1950) but thins toward the margins, and along the Kansas River thicknesses of more than 50 feet are uncommon. The Kansas River was a major stream along the margin of the ice during the climax of Kansan glaciation and the maximum depth of Kansan glacial and fluvial scour (base level) has been stated by several investigators to have been approximately 10 to 30 feet above the present Kansas River flood plain (Davis and Carlson, 1952; Dufford, 1958; Frye and Leonard, 1952; O'Connor, 1960; and Todd, 1918). The position of Kansan base level has been illustrated in a number of cross sections across the Kansas River valley. The Kansas Till and Grand Island Formation (retreatal Kansan outwash) have been reported by Davis and Carlson and by Frye and Leonard to interfinger in Shawnee County along the Kansas River valley about 20 feet above the Kansas River flood plain. The Grand Island and Sappa Formations, in a comparable terrace position, have not been recognized along the Missouri River valley of northeastern Kansas, which supports the interpretation that the Missouri River above Kansas City probably is a post-Kansan stream.

In considering a part of the Kansas City area the thickness of Pleistocene deposits outside the valley areas are seen to consist chiefly of



Limit of Kansan Glaciation .....

Limit of Nebraskan Glaciation — — — —

Fig. 1. Map showing limits of Nebraskan and Kansan glaciation in northeastern Kansas and northwestern Missouri. Glacial boundaries in Missouri adapted from "The Stratigraphic Succession in Missouri" (Heim in Howe and Koenig, 1961).

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loess and glacial deposits (Fig. 2). The loess deposits are as thick as 30 feet locally along the Kansas and Missouri River bluffs, but they decrease rapidly in thickness in a direction away from the bluffs. Most of the Pleistocene deposits shown in the wells is Kansas Till, except along the Kansas and Missouri River where the loess is as thick as 30 feet.

Figure 3 shows the surface elevations of selected wells, and the bedrock elevations of some of the wells in the area shown in Figure 2. This illustrates that there are no unusual surface sags or low areas across

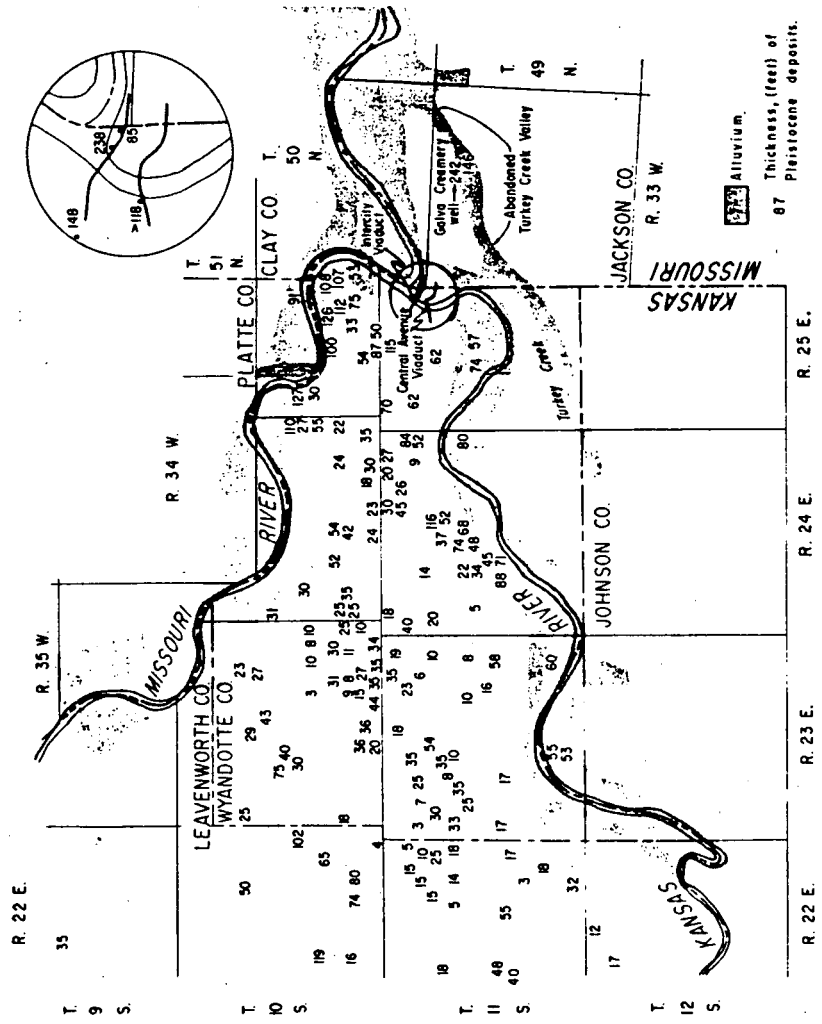

Fig. 2. Thickness of Pleistocene deposits in selected wells in a part of the Kansas City area.

the upland west of the junction of the Kansas and Missouri Rivers, therefore, the concept of thin Kansas Till on the uplands north of the Kansas River and of Kansan outwash deposits (Grand Island and Sappa Formations) approximately 20 feet above the present Kansas River flood plain seems valid.

As far as the authors know, there are no published data citing good evidence for the presence of Kansan deposits, either till or outwash, along

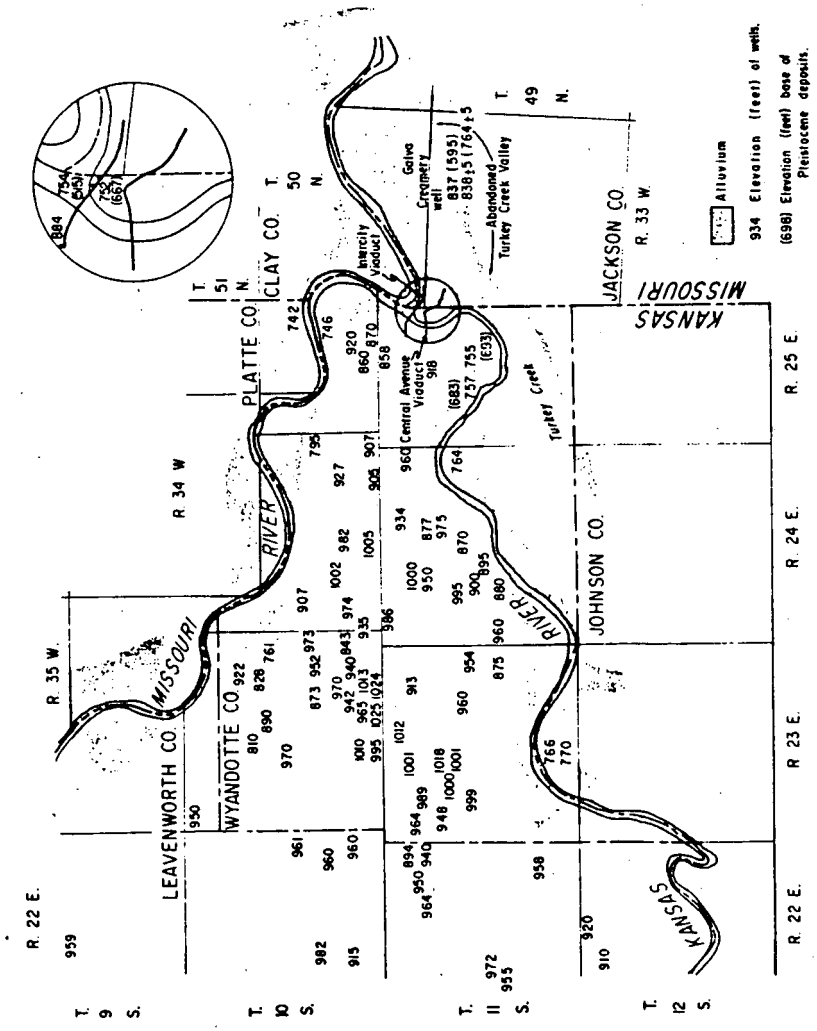

Fig. 3. Surface elevations and elevations of the base of Pleistocene deposits of selected wells in a part of the Kansas City area.

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the Kansas River in a topographic position lower than the approximate position of the present flood plain, and the alluvial deposits occupying the present Kansas River valley have been considered previously to be chiefly Wisconsinan and Recent in age except for local remnants of an Illinoisan terrace that is distinctly intermediate between the Kansan terrace level and the Wisconsinan and Recent surface.

Fishel (1948) in a report on the ground-water resources of the Kansas City, Kansas, area prepared 5 cross sections of the Kansas River valley and 2 cross sections of the Missouri River valley based on test-hole data. Fishel's report is primarily a ground-water report and he does not discuss the age of the Pleistocene deposits in detail, but he does say: "Alluvium of Recent age and probably some of Pleistocene age occurs in the Kansas and Missouri River valleys." He subsequently states: "Much of the alluvium in the Kansas Valley near Kansas City probably is of glacial origin" but he does not clearly identify its age. Thus, it is not evident, from the contrasting statements, exactly to what part of the Pleistocene Fishel assigned the alluvial deposits, and in the cross sections the Pleistocene deposits are identified only as "Alluvium." Fishel's cross section C–C′, (reproduced here as Figure 4) extending eastward along the Central Avenue Viaduct is of particular interest in that a narrow, deep channel is depicted at test-hole 84. The alluvium is uniformly 70 to 80 feet thick across the valley except at test-hole 84, where 106 feet of alluvium is shown in a narrow channel.

Recently investigations of the engineering geology for the new west-

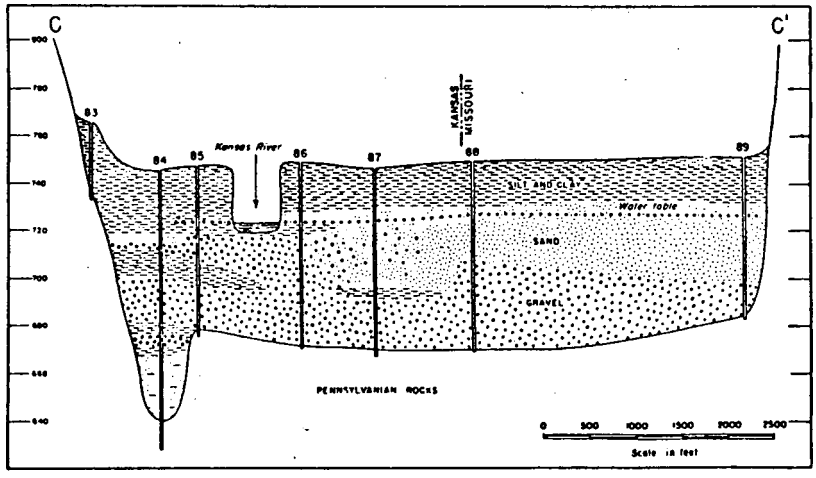

Fig. 4. Geologic cross-section across Kansas River Valley near the Central Avenue Viaduct (from Fishel, 1948).

bound lane of the Intercity Viaduct between 6th Street in Missouri and Minnesota Avenue in Kansas City, Kansas have revealed information on the Pleistocene deposits that was both puzzling and completely unsuspected. Figure 5 illustrates the geology along the viaduct from the state line west to Minnesota Avenue. A narrow, deep valley about 1,200 feet wide and containing 150 feet of glacial till was discovered below the general valley floor. This till was in turn overlain by about 85 to 90 feet of alluvium. Geologic investigations on the Missouri portion of the viaduct showed no similar anomalous situation, and there the thickness of alluvium and depth to bedrock were relatively uniform. Rocks of the lower part of the Kansas City Group form the walls of the Kansas River valley, and the upper part of the Pleasanton Group underlies the Kansas River alluvium. The base of the alluvium is about 660 to 670 feet in elevation and it averages 80 to 90 feet thick.

In core-hole No. 3B (Fig. 5) the maximum thickness of 239 feet of Pleistocene deposits was encountered, including 150.5 feet of glacial till about midway between the Kansas River and the state line. Split-spoon samples were taken at several localities for geologic and engineering evaluation. Upon examination of the samples the material below the alluvium was determined to be glacial till. This till is dominantly unsorted medium-gray to greenish-gray calcareous clay. The sand-sized fraction includes fragments of coal, limestone, chert, quartz, pyrite, granite, quartzite, feldspar, greenstone, fine-grained sandstone, and fragments of several types of shale, including black shale. Samples from test-hole 84 of Fishel's investigation were restudied and compared with the till obtained in the split-spoon samples from the Intercity Viaduct area, and the samples logged as gray shale at the base of test-hole 84 (106–118

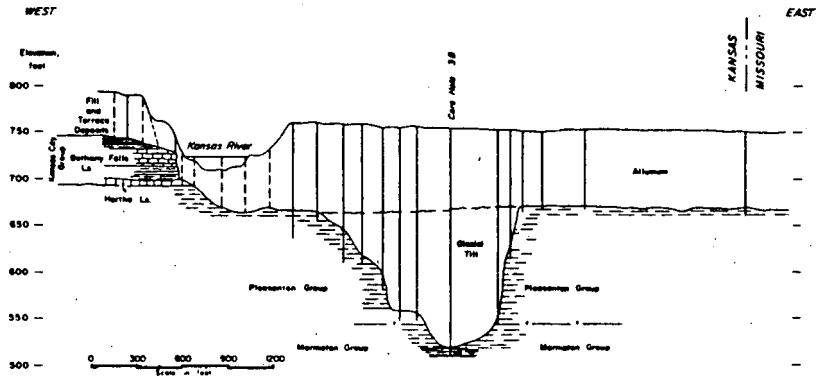

Fig. 5. Geologic cross-section along Intercity Viaduct from state line to Minnesota Avenue.

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feet) appears to us to be identical with the till at the viaduct and can best be described as gray, sandy, calcareous clay rather than shale. It is probable that Fishel's test-hole 84 is located in the same narrow, till-filled valley found in the Intercity Viaduct investigation. Because previous investigators have found no evidence of Nebraska Till as far south as Kansas City, the till is judged to be Kansan in age.

As a result of the foregoing discussion two questions immediately arise . . .

1. How does the discovery of Kansas Till below Kansas River alluvium affect our previously developed concepts of Pleistocene stratigraphy in eastern Kansas?
2. How was 150 feet of Kansas Till emplaced 250 feet lower than the previously recognized Kansas River base level and, similarily, 250 feet lower than Kansas Till recognized elsewhere along Kansas River?

Our answer is not that the previously developed general concept of Pleistocene stratigraphy is invalid, but that statements regarding the base level of Kansas River and the depth of Kansan glacial scour in the Kansas City area must be modified to conform to the new evidence. That the base level of the Kansas River at Kansas City near the climax of Kansan glaciation must have been lower, locally, than the 10 to 30 feet above the modern flood plain suggested by previous investigators is indicated also by the depth of stream erosion and alluviation in the abandoned Turkey Creek valley (Fig. 2 and 3). At the Galva Creamery well (15th and Benton, Kansas City, Mo.) Pleistocene deposits at least 242 feet thick, consisting predominently of sand and gravel, are judged to be chiefly Kansan outwash. The base of the Pleistocene deposits at the Galva Creamery well is at an elevation of 595 feet, or approximately 100 feet lower than the general floor of the alluvium of the Kansas River valley at its junction with the abandoned Turkey Creek valley. The base of the till at the Intercity Viaduct is at an elevation of 515 feet, or 80 feet lower than the base of the alluvium at the Galva Creamery well. In each place, both in Kansas River valley and abandoned Turkey Creek valley, where unusually thick Kansan deposits are recognized, the deposits of till or alluvium appear to occupy a relatively deep, narrow channel cut into the Pennsylvanian bedrock and the width of the deep channel constitutes but a small part of the entire valley.

Although several possible interpretations can be postulated to explain these narrow, deep channels filled with till or alluvium, none seem ade-

quate in all respects. In our opinion the most logical explanation for the deep, narrow, alluvium-filled channel in Turkey Creek valley and the till-filled channel below the alluvium at the Intercity Viaduct locality is as follows: The pre-Kansan and early Kansan course of the lower Kansas River across Wyandotte County was essentially as it is today. From its present junction with the Missouri River, the Kansas River turned east following the course of the present Missouri River valley. Near the climax of Kansan glaciation ice covered much of northeastern Kansas and northwestern Missouri, and large volumes of meltwater were discharged into and carried by the Kansas River in eastern Kansas and its extension eastward from Kansas City along the present Missouri River valley. At several points along the lower Kansas River blockage of the Kansas River valley by glacial ice resulted in temporary diversion channels being cut south of the ice-blocked valley. Glacial ice at one time blocked the Kansas River for a few miles east of the present junction of the Kansas and Missouri Rivers and the Kansas River was temporarily ponded. Soon, however, the narrow divide between the Kansas River and Turkey Creek was breached and the large volume of meltwater carried by Kansas River quickly deepened and enlarged Turkey Creek valley across Kansas City, Missouri. After erosion of the more resistant limestones and shales of the Kansas City Group along Turkey Creek valley, a deep but relatively narrow channel was quickly cut into the soft, underlying Pleasanton Group. Following this initial period of incision the profile along Turkey Creek valley became both more uniform and less steep and the valley was filled with alluvium generally ranging in depth from 30 to 150 feet.

The narrow till-filled channel below the alluvium in the Kansas River valley at the Intercity and Central Avenue Viaducts (Fig. 4 and 5) may have developed nearly contemporaneously with the deep scour and fill in Turkey Creek valley. Glacial striations at several localities along the Kansas and Missouri River bluffs are uniformally 100 to 150 feet above the Kansas River flood plain, and previous to the Intercity Viaduct investigation, there was no evidence to suggest glacial till might be found below the Kansas River alluvium.

The terminal area of glaciers commonly becomes crevassed and fissured and during the summer meltwater from the surface of the ice forms superglacial, englacial, and subglacial streams. Meltwater derived from the surface of the Kansan glacier north of Kansas City probably with an elevation 500 feet or more above the floor of Kansas River valley might have become, as the meltwater progressively neared the margin of the ice, first an englacial stream flowing within the ice and finally a

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subglacial stream near the margin of the ice. The floor of the Kansas River valley at Kansas City consists chiefly of soft shale (Pleasanton Group) below a thick sequence of relatively resistant limestones (Kansas City Group). Under the postulated conditions it seems possible that a subglacial stream as it flowed beneath the ice and discharged into Kansas River valley might have eroded a deep, narrow channel into the Pleasanton Group. With adequate hydraulic head a stream of moderate volume confined beneath the ice could erode a channel in soft rock several thousand feet long in a relatively short period of time.

Blockage of the subglacial stream as a result of ice collapse at a point north of the Intercity Viaduct area and diversion of the water to another discharge point would have resulted in the erosion channel beneath the ice becoming progressively filled with glacial ice and till. A variable thickness of glacial till may have been deposited in this area across the valley floor and subsequently removed by stream erosion after withdrawal of the ice sheet and reestablishment of the Kansas River drainage through the present Kansas and Missouri River valleys.

Summary

The general concept of the Pleistocene stratigraphy in eastern Kansas as developed by past workers is still valid, but glacial till and glacial outwash is known to occur at much lower elevations in and along the Kansas River valley (including its temporary diversion channel through the abandoned Turkey Creek valley) than previously recognized. The coarse gravel deposit (cobbles and boulders) at the base of the alluvium in the lower Kansas River valley, which has not yet been dated on fossil evidence, may be Kansan in age rather than early Wisconsinan as has been suggested by several previous workers. The deeper part of the Kansas River valley between Manhattan and Kansas City as shown in a number of cross sections prepared by previous investigators (Beck, 1959; Davis and Carlson, 1952; Dufford, 1958; Fishel, 1948; Frye and Leonard, 1952; O'Connor, 1960) may have been eroded to its present depth just prior to or during the climax of Kansan glaciation in eastern Kansas.

It seems reasonable to indicate a Kansan age for the till and also for the coarse cobble and boulder gravel at the base of the deepest alluvial fill in the Kansas River valley at Kansas City, and to infer a similar history and similar age for the deepest alluvial fill in parts of the Kansas River valley between Kansas City and Manhattan. The age of the finer-grained middle and upper parts of the alluvium is still considered to be Wisconsinan and Recent.

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