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Preliminary Investigation of the Little Sioux River Valley

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is an important variate, because it is during this time of high discharge that most of a river's erosive work is carried out (Leopold and Miller, 1956). However, to incorporate this data into the study, it was necessary to use the records of other southern Ontario streams. These were not available, so that it necessitated the use of data from the nearest area of similar climate and river regimes, which in this case was the northern Appalachians (Brush, 1961). Plotting basin area against mean annual flood discharge on log-paper a linear relationship results (see figure 5). The fit of the data from the three gaging stations on the Humber gets better as the drainage area at the respective station also increases.

Conclusion

The hydrologic and morphologic variables selected for study show distinctive linear relationships that reflect the regularity of the processes at work in stream flow. The correlations between stream flow and basin area were found to be high and significant, though a full explanation would require the operationalizing of variables that are, as yet, only in the qualitative stage of recognition.

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Purpose

The purpose of this paper is to describe the aerial extent, thickness, and nature of the materials that comprise the modern alluvium and terrace sediments of the Little Sioux River valley. This paper is part of a study conducted in the spring and summer of 1962 which was concerned with the alluvial morphology

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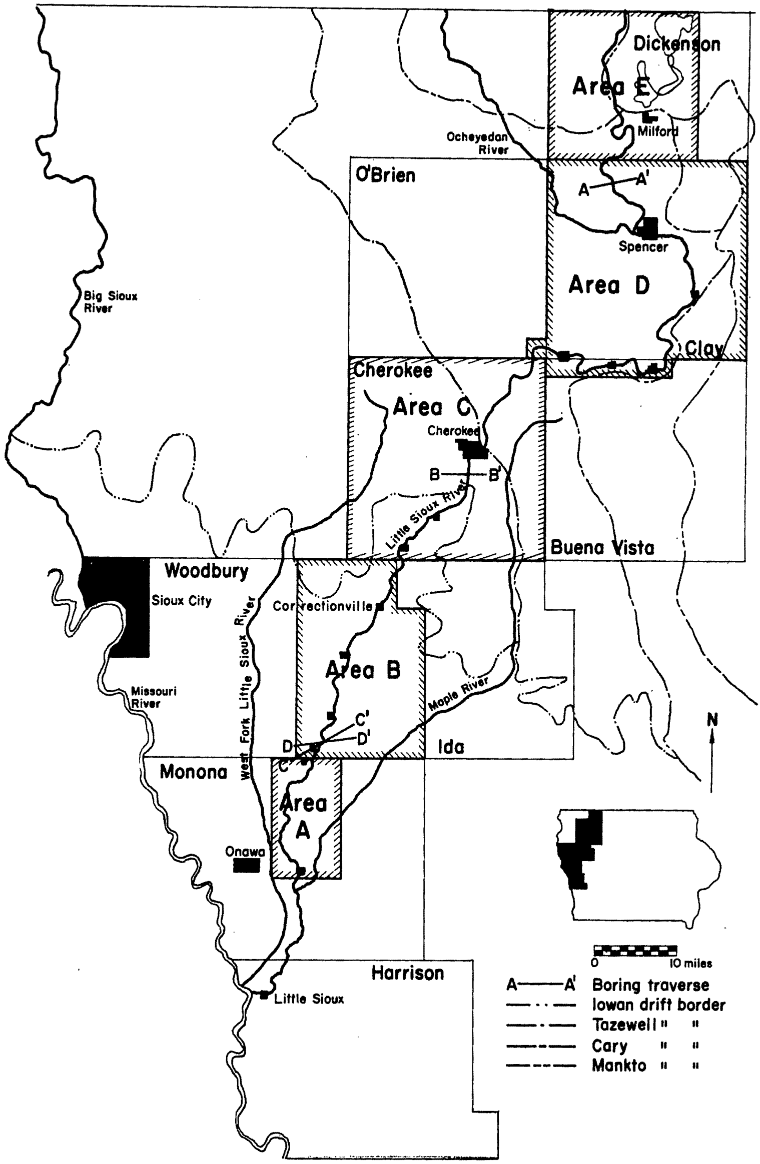

Figure 1. Index map.

and engineering properties of the deposits within the valley. This research was supported by the Iowa Engineering Experiment Station and Department of Geology, Iowa State Universtiy.

Location

The Little Sioux River flows across northwestern Iowa and is the largest tributary to the Missouri River in Iowa. The index map, figure 1, is divided into five areas, A-E in the appendix.

Method of Investigation

The terraces and floodplain were mapped on aerial photographs, and then field checked. Observations of road cuts and gravel pits were supplemented with subsurface information obtained by borings made with a rotary drilling rig, hand auger, and a power auger. These data were supplemented with well logs from the Letsche Well Company of Cherokee, the Thorpe Well Company of Des Moines, and the Vandenburg Well Company of Milford. Elevations of the terraces were determined by altimeter, using the corrected barometric method devised by Lane and Cooper (1953) and U.S. Coast and Geodetic Survey benchmarks.

General Description of Valley

In the lower reaches of the valley, in Areas A and B, the width of the floodplain ranges from about 1 mile to over 2 miles in width. The valley walls are marked by the presence of many alluvial fans. In the middle reaches of the valley, Area C and upstream to Gillett Grove in Area D, the valley ranges from 1 to less than ½-mile in width. Alluvial fans are not as well developed in this area. Where the confluence of a tributary, the Ocheyedan River, and the Little Sioux River occurs, the valley attains a maximum width of about 5 miles, more typically ranging in width from 1 to 3 miles, upstream from Gillett Grove in Area D, and upstream to Milford in Area E. In the upper reaches of the valley, upstream from Milford in Area E, the valley does not exceed ¼-mile in width.

Floodplain and Alluvium

The floodplain has an average gradient of 2.1 feet per mile. The alluvium in the Little Sioux valley consists of a coarse sand and gravel substratum and a finer grained silt and clay topstratum. The substratum ranges in thickness from about 20 feet in Dickinson County to about 35 feet in Monona County, and the topstratum from about 10 feet in Dickinson County to over 20 feet in Monona County, as shown in figure 2.

Terraces

From Correctionville to Gillett Grove, there are three distinct terrace levels present, here designated the low, intermediate, and high levels, as shown in figure 2. Carman (1929) measured elevations of some of the terraces in Cherokee and Woodbury Counties, which suggested 3 levels, but he did not correlate them. In this section of the valley, the height of the low level above the floodplain ranges from 30 to 40 feet. At Washta, however, the low level is within 5 feet of the floodplain, and at Anthon, where another break in floodplain slope occurs,

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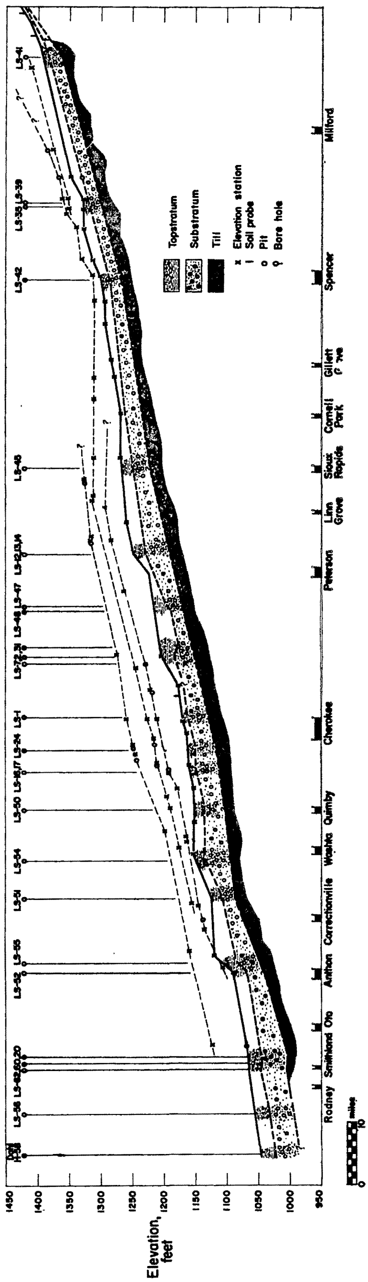

Figure 2. Slope profile of flood plain and terraces and geologic cross-section of flood plain.

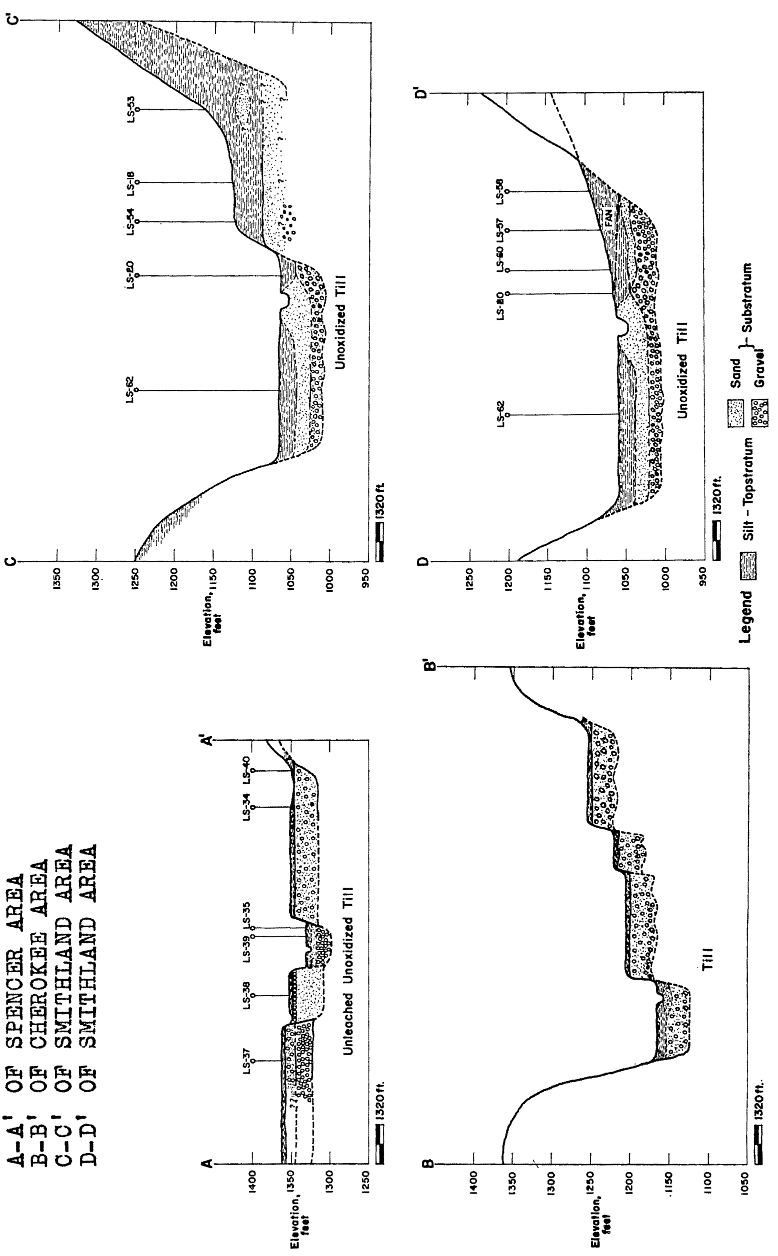

Figure 3. Geologic cross-sections of the Little Sioux River valley.

the low level projects below the floodplain. The height of the intermediate level above the floodplain ranges from 20 to 70 feet. The high level ranges in height from 40 to 90 feet. The terraces

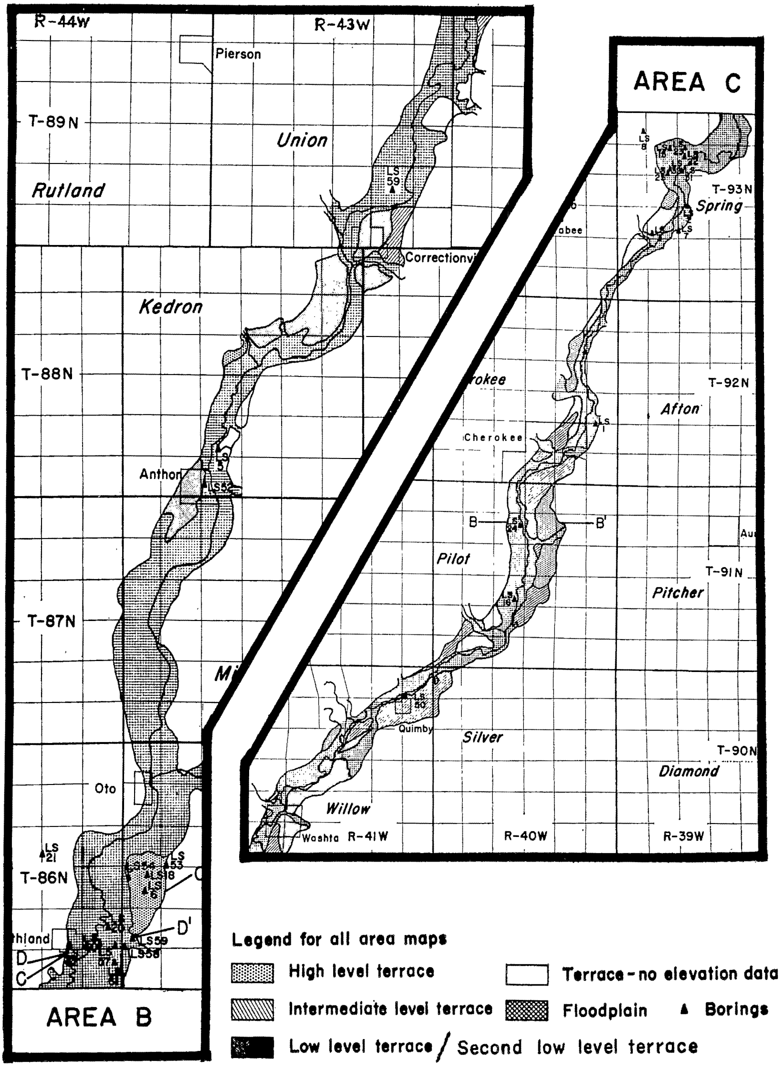

Figure 4. Areas B and C, Woodbury and Cherokee Counties.

often occur as multiple levels in step-like succession which is best seen 1 to 6 miles south of Cherokee. The remnants range in length from ½ to over 3 miles, and attain a maximum width of ½-mile. In O'Brien, the southwest corner of Clay, and in Buena Vista counties, remnants occur on the inside of almost every meander bend of the river.

Upstream from Gillett Grove, only the intermediate level persists, where it ranges from 10 to 30 feet above the floodplain. From Spencer upstream to Milford, this terrace level forms an

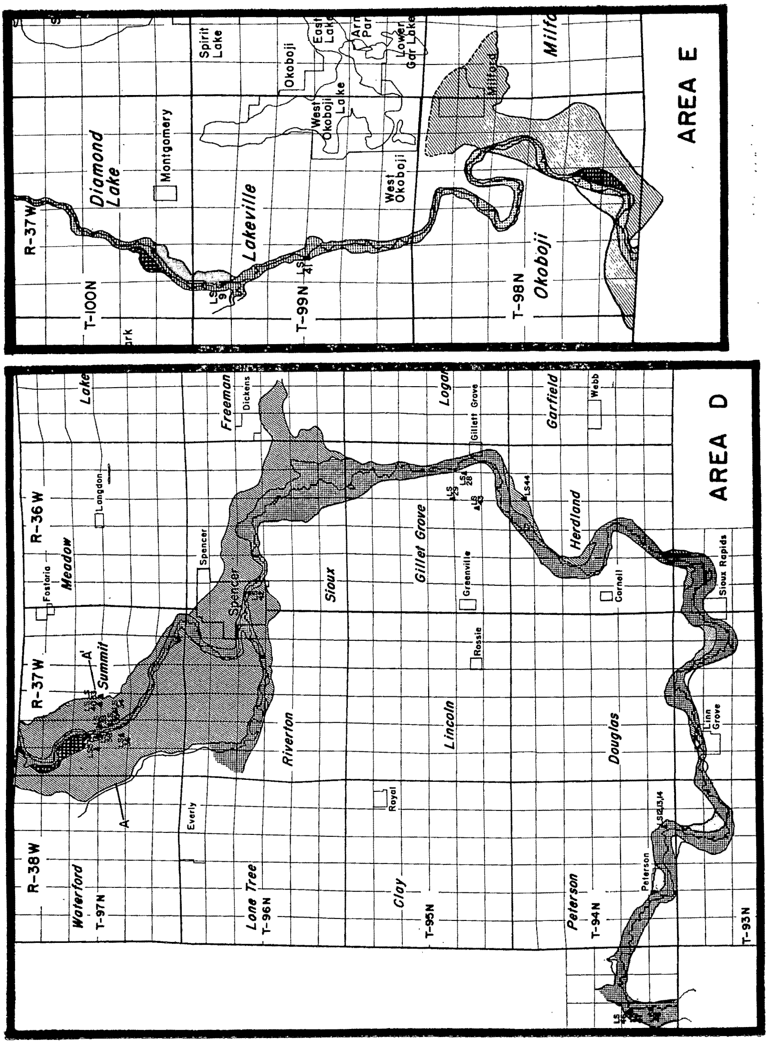

Figure 5. Areas D and E, Clay and Dickinson Counties.

extensive surface, in Areas D and E, as previously noted, and displays a distinct braided pattern on the aerial photographs. Here, the floodplain of the Little Sioux River is confined on both sides by this terrace. North of Milford, the stratified alluvial deposits of the intermediate terrace are no longer confined in a valley and may be considered outwash. This outwash is terminated on the north by Mankato end moraine. One mile south of Milford, the valley of the Little Sioux River leaves the valley which confines the intermediate level terrace, and it makes a horseshoe bend as it tends in a northwesterly course.

A second low level terrace is represented by four remnants, one 10 miles and another 20 miles upstream from Spencer, and two paired terraces about 9 miles upstream from Milford, which lie about 15 feet above the floodplain. This second low level differs from the low level terraces downstream, best represented in Area C, in that it is composed of sandy fill almost lacking in gravel, as shown in Section A of figure 3. Section B-B^1 is of the valley in the Cherokee area, and Section C-C^1 and D-D$_1$ are of the valley in the Smithland area.

The only terrace present downstream from Anthon is a terrace which lies 60 feet above the floodplain at the town of Smithland.

Terrace Deposits

The majority of the terraces in the Little Sioux valley are underlain by coarse sand and gravel from 25 to 50 feet thick, overlain by 3 to 6 feet of silt. This coarse fill generally contains about 60 per cent gravel and 25 per cent coarse sand (AASHO classification). The exceptions to this are the four previously mentioned second low level remnants (which are underlain by sandy fill) upstream from Spencer, and the remnant at Smithland which has at least 15 feet of fine to medium sand overlain by 37 feet of silt.

Depths of gravel pits in Cherokee and Buena Vista counties and an exposure of till under the low level terrace in a cut along Cherokee County road B indicate that the till surface under each terrace level is higher than the till surface under each successively lower terrace. In other words, the terrace fills are deposited on successive step-like benches. This suggests 3 cycles of cut and fill, with each successive cycle trenching its channel to a depth lower than the previously cut channel. The modern alluvium would represent the fill of a fourth cycle.

Further study of upland stratigraphy is necessary to relate the alluvial history of the valley to the Pleistocene history of the area, and further studies upstream from Spencer and in the Smithland area are needed to explain the relationship of these terraces to the normal cut and fill terrace sequence in the middle reaches of the valley.

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