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# Evidence for Quaternary Piracy of Pumpkin Creek, South-Central Morrill County, Nebraska

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# EARTH SCIENCES

## EVIDENCE FOR QUATERNARY PIRACY OF PUMPKIN CREEK, SOUTH-CENTRAL MORRILL COUNTY, NEBRASKA

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The occurrence of Quaternary anorthosite-rich sand and gravel deposits in south-central Morrill County, Nebraska, southeast of the mouth of Pumpkin Creek and south of the North Platte River suggests that the creek formerly flowed farther east than it does today. This eastern extension of the creek was abandoned when a headward-cutting tributary of the North Platte River eroded through the divide between Pumpkin Creek and the North Platte just east of Jail and Courthouse rocks, and captured Pumpkin Creek.

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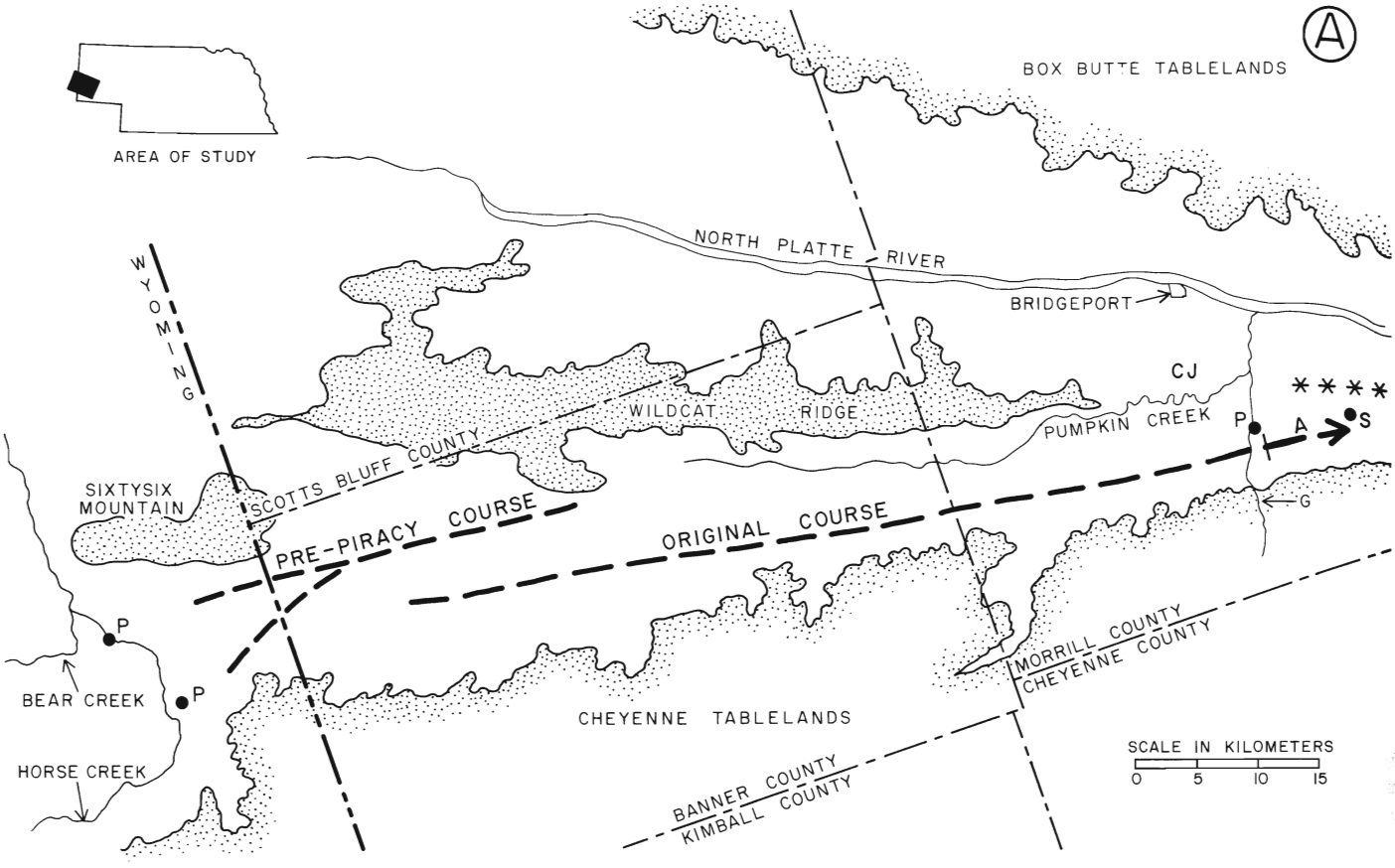
### INTRODUCTION

Changes in positions of rivers and their tributary streams in western Nebraska and southeastern Wyoming during the Quaternary have been commented upon previously in several papers. These views are outlined here and evidence is presented that a major part of Pumpkin Creek, a tributary to the North Platte River, was pirated in Morrill County, Nebraska (Fig. 1), during the Quaternary.

Probably the earliest statement about the former course of a river in the southern panhandle of Nebraska was by Darton (1899:729), who claimed that the Wildcat Ridge ". . . owes its isolation to a former branch channel of Platte River which at one time flowed through Pumpkinseed Valley," and who elaborated on this idea later in the same report (p. 740). Adams (1902:25) pointed out in a footnote that Darton considered the North Platte to have flowed through Pumpkin (= Pumpkinseed) Valley at one time, but did not define a "branch channel." Adams (1902:25 and Plate II), instead, argued that there was a former "Horse Creek-Pumpkin Creek Valley." The drainage from the western part of this valley, Adams said, was diverted to the present course of Horse Creek between Bear Creek and 66 mountains by a headward-cutting tributary of the North Platte River. Darton (1903a:11) seems to have changed his mind, at least in part, about events in the North Platte and Pumpkin Creek valleys by stating that the Wildcat Ridge ". . . owes its isolation to a former channel of Horse Creek, which at one time flowed through the Pumpkinseed Valley," but later in the same report (p. 22) he repeated the idea stated in 1899 that a branch stream of the Platte at one time flowed through the depression now occupied by Pumpkin Creek. Darton (1903b) elaborated on the first of these two ideas by noting that Pumpkin Creek headed ". . . in a wide depression near longitude 104° which extends to the west and northwest through low saddles to the valleys of Horse Creek and North Platte River, and it is apparent that Horse Creek at one time passed over the southernmost of these saddles and down Pumpkin Creek Valley."

Since the work of Adams and Darton, most have viewed ancestral Pumpkin Creek (including the Horse Creek segment) and the younger Horse and Pumpkin creeks as tributaries of the North Platte River and have followed Darton's most recent account of the diversion of the upper reaches of ancestral Pumpkin Creek. Babcock and Visher (1952), and Rapp et al. (1957:13, 17, and 18) accepted these views. Smith and Souders (1975:12 and 31) mentioned the idea of piracy of the western part of ancestral Pumpkin Creek. Diffendal and Corner (1983) and Corner and Diffendal (1983) also offered evidence in support of the concepts of Adams and Darton.

In contrast to the idea that Horse Creek-Pumpkin Creek was tributary to the North Platte throughout its history,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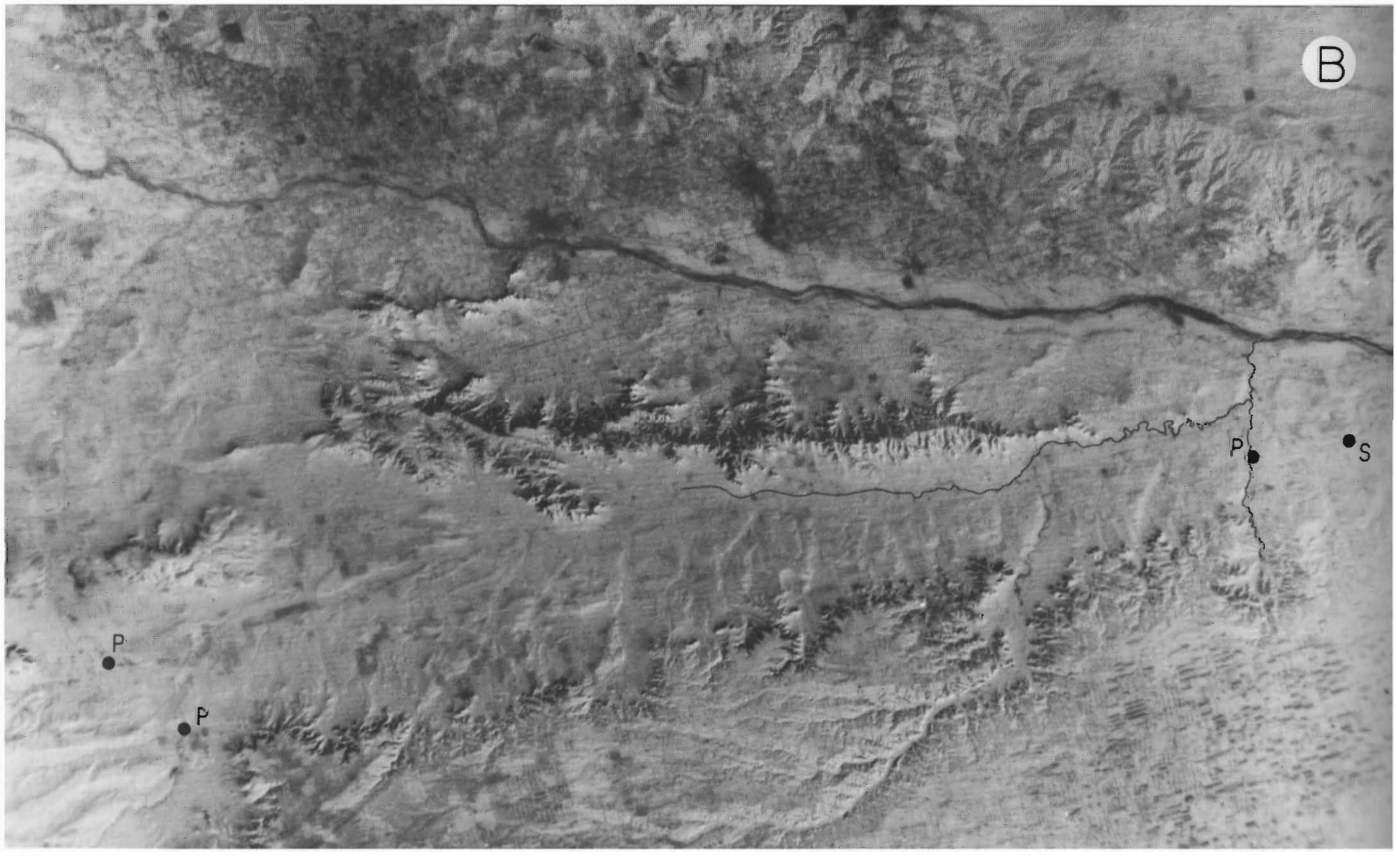
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Stanley and Wayne (1972:3,684) argued that ". . . even though the drainage basin of the Platte River System came into existence in the Tertiary, its present course across Nebraska dates only from mid-Pleistocene time." They went on to suggest that the North Platte River headed in the Laramie Range in Wyoming during the Early Pleistocene and flowed eastward along the ancestral Pumpkin Creek Valley to southeastern Morrill County, Nebraska. Bennett (1979) followed this view. No other author seems to have adopted Stanley and Wayne's idea.

Regardless of whether the ancestral stream that carved out the first valley of Pumpkin Creek is called Horse Creek, Pumpkin Creek, or the headwaters of the North Platte, the path of the stream can be traced out easily because the gravels carried by the stream have a distinctive composition. The idea of separating ancient drainageways by using differences in gravel compositions probably was first suggested for the study area by Adams (1902:21), but it was not until the work of Stanley (1971a and b) and Stanley and Wayne (1972) that this concept was successfully applied in western Nebraska. They demonstrated that Pumpkin Creek gravels have a high proportion of anorthosite, which shows their principal source to be in the Laramie Range in southeastern Wyoming. Diffendal and Corner (1983) expanded on the work of Stanley (1971a and b) and Stanley and Wayne (1972) and added further evidence that the Wyoming segment of the Horse Creek–Pumpkin Creek drainage had been pirated by another tributary of the North Platte River probably during the Middle or Late Pleistocene.

## PRESENT STUDY

### Procedure

Stanley and Wayne (1972) indicated that an Early Pleistocene stream-course followed the Pumpkin Creek Valley through Banner County, Nebraska, and continued eastward to the Morrill–Garden County line. They included data from one site in Banner County and from the type locality of the Broadwater Formation in Morrill County, north of the North Platte River, to demonstrate the existence of this former stream-course. While the oldest Quaternary deposits known along Pumpkin Creek Valley have been proven by Diffendal and Corner (1983) to be younger than the age suggested by Stanley and Wayne (1972), the occurrence of anorthosite-rich gravels on remnants of strath terraces east of Pumpkin Creek and south of the North Platte River would be strong evidence that Pumpkin Creek originally followed a path through Morrill County like that hypothesized by Stanley and Wayne. Such deposits were sought.

### Results

The map of the locations of center-pivot irrigation systems in Nebraska for 1981 (Hoffman, 1983) shows a cluster of systems on a bench south of the North Platte River from east of the valley of Greenwood Creek to south of Broadwater in Morrill County. The bench lies to the east of the point where Pumpkin Creek turns north to join the North Platte River about 7 km southeast of Bridgeport, Nebraska. Logs of test drilling by the Conservation and Survey Division, University of Nebraska, and drillers' logs of irrigation wells drilled in the area indicate that a thin blanket of Quaternary alluvium and aeolian deposits directly underlies the surface of the bench. Beneath this blanket are siltstones belonging to the upper part of the White River Group.

Outcrops on the bench are composed primarily of light brown, very fine to medium sand, but the test hole and irrigation-well logs indicate that coarser sediments occur within the Quaternary sequence at depth. One roadcut just north of Deep Holes Creek in the SW¼ SW¼ SW¼ NW¼ Sec. 10, T. 18 N., R. 49 W., however, contains sand and gravel interbedded with finer grained sands and silts. The composition of the gravel in the 8-to-16 mm size range is shown in Table I. Of great importance are the high proportion of granite and anorthosite in the sample and the presence of jasper, a clast type known from Pumpkin Creek gravels to the west in Morrill and Banner counties, and in Wyoming along Horse and Bear creeks east of the Laramie Range. These two aspects of the gravel composition, taken together, make it extremely likely that the deposits at the Deep Holes Creek site are remnants of a Quaternary Pumpkin Creek alluvial fill and not of some older Ogallala fill. While there are anorthosite-rich gravels in the Ogallala to the west in southwestern Morrill County and in southern Banner County, they are cemented by calcium carbonate, and are interbedded with fluvially deposited sedimentary rocks and not with loose sand and silt. Further, because no anorthosite-rich Ogallala conglomerate occurs along the drainages to the south of the sample locality, it is unlikely that the gravels at the Deep Holes Creek site were reworked from older local sources.

Another piece of evidence supporting the idea that Pumpkin Creek extended farther east in Morrill County than it does today comes from the determination of the slopes of the older Quaternary surfaces overlain by alluvium in Pumpkin Creek Valley. The altitude of the highest and oldest strath terrace

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FIGURE 1. Pumpkin Creek Valley and adjacent areas. A. Map showing former course of Pumpkin Creek and points of capture (P), abandoned segment (A) of ancestral Pumpkin Creek, Greenwood Creek (G), sample site (S) on Deep Holes Creek, Courthouse and Jail (CJ) rocks, and position of former Wildcat Ridge extension (*). B. Landsat image showing points of capture (P) and Deep Holes Creek sample site (S).

TABLE I. Average composition of gravels (8 to 16 mm) at Deep Holes Creek Site.

| Clast Type | Number Counted | Percentage of Sample |
|---|---|---|
| Granite and orthoclase | 1,529 | 82.9 |
| Quartz | 15 | 0.8 |
| Anorthosite | 212 | 11.5 |
| Volcanics | 10 | 0.5 |
| Quartzite | 16 | 0.9 |
| Other metamorphics | 16 | 0.9 |
| Silica varieties (including jasper) | 2 | 0.1 |
| Sandstone and siltstone | 6 | 0.3 |
| Local Ogallala | 26 | 1.4 |
| Local White River | 12 | 0.7 |
| Total | 1,844 | 100.0 |

north of Harrisburg, Banner County, Nebraska, is about 1,385 m, while its altitude in extreme western Morrill County, 32.2 km to the east, is approximately 1,270 m. At both localities the altitude of the next lower alluvium-covered surface is about 40 m below this oldest terrace. The slope of both surfaces is to the east-southeast at about 3.6 m/km. The sample site at Deep Holes Creek is 30.5 km east of the western Morrill County locality cited above. The altitude of the bedrock surface beneath the alluvium should be at least 110 m lower at Deep Holes Creek if the oldest surface to the west is preserved there and 150 m lower if the next younger surface is represented, assuming that more recent deformation has not affected the area. The altitude of the top of the bedrock is at least 140 m lower at Deep Holes Creek than in western Morrill County, and the deposits above the bedrock probably are part of the younger "La Grange fill," an informal name assigned to the fill by Diffendal and Corner (1983).

These pieces of evidence permit further reconstruction of the earlier Quaternary path of Pumpkin Creek across the study area. During the Early Quaternary, Pumpkin Creek followed a course like that shown by Stanley and Wayne (1972) for their Platte River, at least as far east as the area southwest of Broadwater, Nebraska. The segment of the creek east of the valley of Greenwood Creek was abandoned during the later Quaternary when Pumpkin Creek was captured by a north-flowing headward-cutting tributary of the North Platte River just east of Jail and Courthouse rocks (Fig. 1).

Another hypothesis, which could be advanced to explain this stream capture, is that the capture may have been facilitated by actions of tributary streams south of Pumpkin Creek. The drainage basins of these tributaries are larger than those of the intermittent streams draining the south side of Wildcat Ridge, so discharges are greater along the southern water courses. Greater discharge of water and sediment at the points of juncture of these tributaries with Pumpkin Creek during flood events could provide the added force necessary to shift Pumpkin Creek north and to give it the power to erode the south side of the Wildcat Ridge. Once the creek breached the ridge, its waters would be diverted down the nearest high gradient stream north of the ridge flowing to the North Platte River. Rapid downcutting from the breach point up stream could leave an abandoned segment of Pumpkin Creek from this point eastward and could result in the formation of new terraces along the entrenched drainage system. Perhaps ancestral Greenwood Creek acted on Pumpkin Creek in this way.

## CONCLUSIONS

Regardless of which deposit of Quaternary alluvium to the west is equivalent in age to the Quaternary deposits sampled at the Deep Holes Creek site, it is clear that Pumpkin Creek once flowed past the site and continued on eastward into an ancestral North Platte River, possibly east of Broadwater. The segment of Pumpkin Creek east of the present deflection of the creek to the north probably was abandoned in Middle or Late Quaternary time.

## ACKNOWLEDGMENTS

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