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RADIOCARBON DATING OF TERRACES ALONG BEAR CREEK, PENNINGTON COUNTY, SOUTH DAKOTA

by

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ABSTRACT

Two charcoal samples from Recent alluvial terrace deposits along Bear Creek in Pennington County, South Dakota, were dated at 780 and 2350 years B.P. These dates, when coupled with the stratigraphic relationships observed at the collecting site, indicate that the base level of Bear Creek is fluctuating quite rapidly. The dates also show that the lower alluvial terraces are younger than previously suspected.

INTRODUCTION

Bear Creek (fig. 1) has figured prominently in many of the early studies of the Cenozoic geology of southwestern South Dakota. The Fort Pierre-Fort Laramie Road, one of the earliest trails in the region, crossed Bear Creek near the springs in sec. 28, T. 2 S., R. 13 E. The land close to the springs became a favorite camping site for early travelers. The existence of this trail and camp site brought early explorers and scientists into the area from the steamboat landing at Fort Pierre. John Evans camped along Bear Creek while amassing the first collection of White River (Oligocene) fossils from South Dakota (Owen, 1852). General Harney and the team of Meek and Hayden also camped along Bear Creek while exploring the region.

Geological work in the area has continued from the middle 19th century up to the present. For example, the Bear Creek basin is the site for the type section of the Chadron Formation (Osborn, 1929) as well as the type section for the Scenic Member of the Brule Formation (Bump, 1956). Harksen and Macdonald (1969b) give additional information on the type sections for the Chadron and Brule Formations and the geology of the Bear Creek area.

In October 1970, three men, in their search for agates, discovered two apparent Indian hearth sites in an undercut terrace along Bear Creek (fig. 1). A subsequent trip to the site with representatives of the South Dakota School of Mines and Technology and the South Dakota Geological Survey resulted in the collection of charcoal samples that serve as the basis for this report.

Between October 1970 and May 1971, the spring runoff of Bear Creek had been sufficient to undercut the bank causing it to slump into Bear Creek. Thus, all traces of the two hearth sites had been removed and swept on downstream.

REGIONAL GEOLOGY

Deposits of Cretaceous, Oligocene, and Quaternary sediments are present in the Bear Creek basin. The marine Cretaceous Pierre Shale is the oldest exposed unit in the immediate area. The Pierre is exposed in all of the deeper cuts of Bear Creek.

The Oligocene White River Group lies unconformably upon the Pierre Shale. Along Bear Creek the Interior Paleosol (Ward, 1922; Pettyjohn, 1966) is developed on the Pierre Shale below the unconformable contact with the White River Group. The Cretaceous Fox Hills and Hell Creek Formations, the Paleocene Fort Union Group, and the Eocene Golden Valley and Slim Buttes Formations, all known from other areas in western South Dakota, are not exposed along Bear Creek.

In southwestern South Dakota the deposition of the White River Group initiated the long continuum of Tertiary deposition which apparently was continuous from early Oligocene through early Miocene. Many minor periods of erosion alternated with periods of deposition in the Miocene and Pliocene. The Rosebud and Batesland Formations and the Ogallala Group were deposited during this time (Harksen and Macdonald, 1969a). By late Pliocene most of western South Dakota was buried under a flat-lying blanket of Tertiary sediments which sloped very gradually away from the Black Hills. The only part of western South Dakota not buried under these sediments was that part of the Black Hills that is currently above 4400 feet above sea level.

While Oligocene, Miocene, and early to middle Pliocene time were characterized by more or less continuing deposition, late Pliocene and Quaternary time were characterized by erosion. In late Pliocene time the regional streams were rejuvenated and began to cut down through the soft Tertiary sediments. For example, the White River has cut down through over 1200 feet of sedimentary rock since late Pliocene time (Harksen, 1968).

Glacial events in the eastern Dakotas and/or orogenic pulsations in the Black Hills may be related to periods of rapid downcutting alternating with periods of broad terrace development. The tops of Kube and 71 tables (fig. 1) are remnants of extensive Quaternary alluvial terraces developed along the Cheyenne River. The lower terraces along Bear Creek are the results of Recent fluctuations in the base level of the Cheyenne River-Bear Creek complex. Figure 2 shows several stages of low level terrace development along Bear Creek at the hearth site of figure 1.

SITE DESCRIPTION

Along Bear Creek in sec. 34, T. 2 S., R. 13 E., Pennington County, South Dakota, at the point marked "hearth site" in figure 1, two samples of charcoal were collected from a Recent alluvial terrace. The two charcoal accumulations were both possibly the work of Indians; charcoal sample No. 2 (fig. 3) was definitely from an Indian hearth. This hearth was originally a bowl-shaped hole 21 inches deep and 19 inches across. The bottom half of the hearth was filled with charcoal and fist-sized igneous

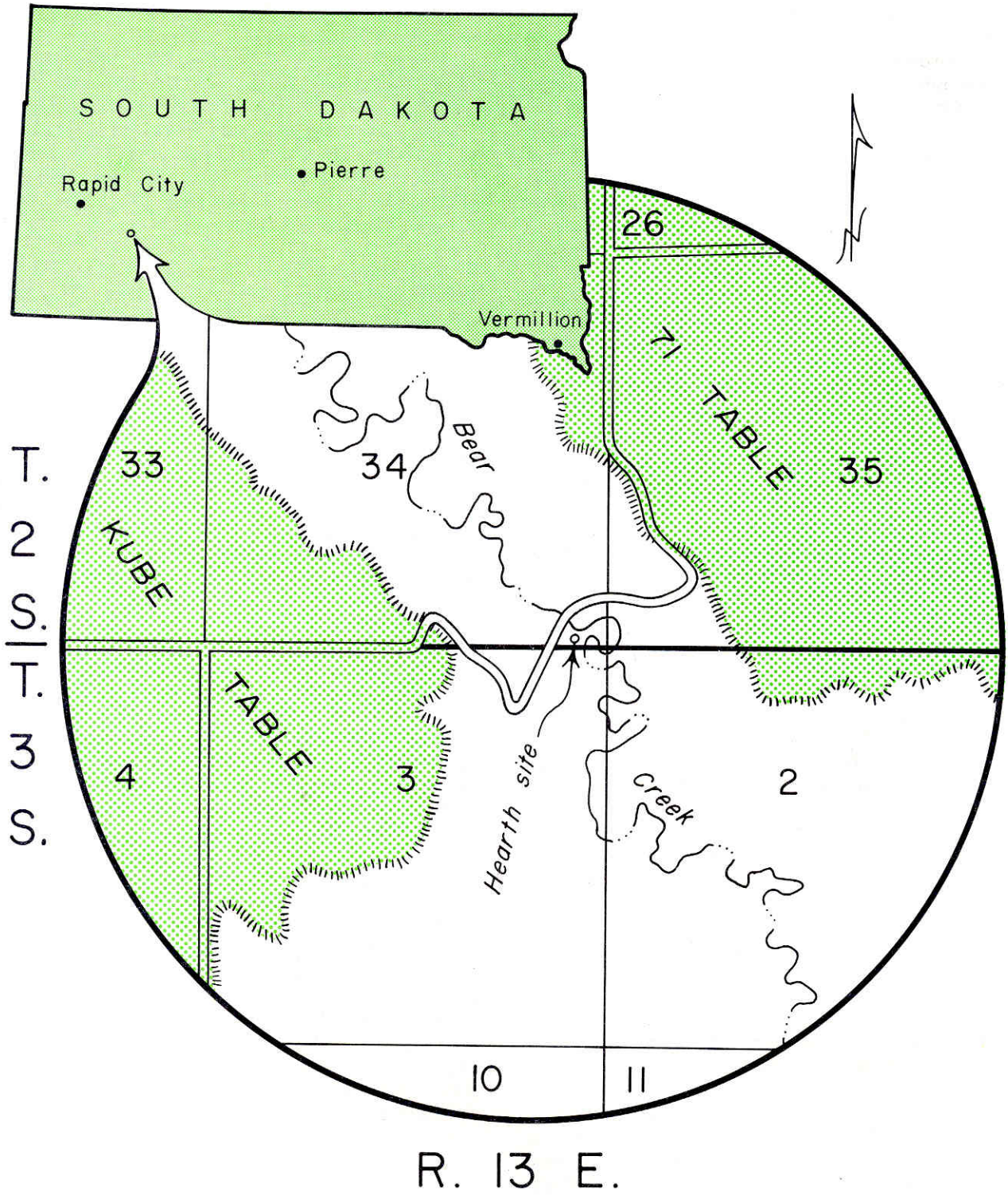

Figure 1. Index map of South Dakota showing the location of the hearth site which furnished the two charcoal samples which form the basis for this report.

Figure 2. Terrace deposits along Bear Creek. The undercut bank below the parked cars is the bank portrayed in figure 3.

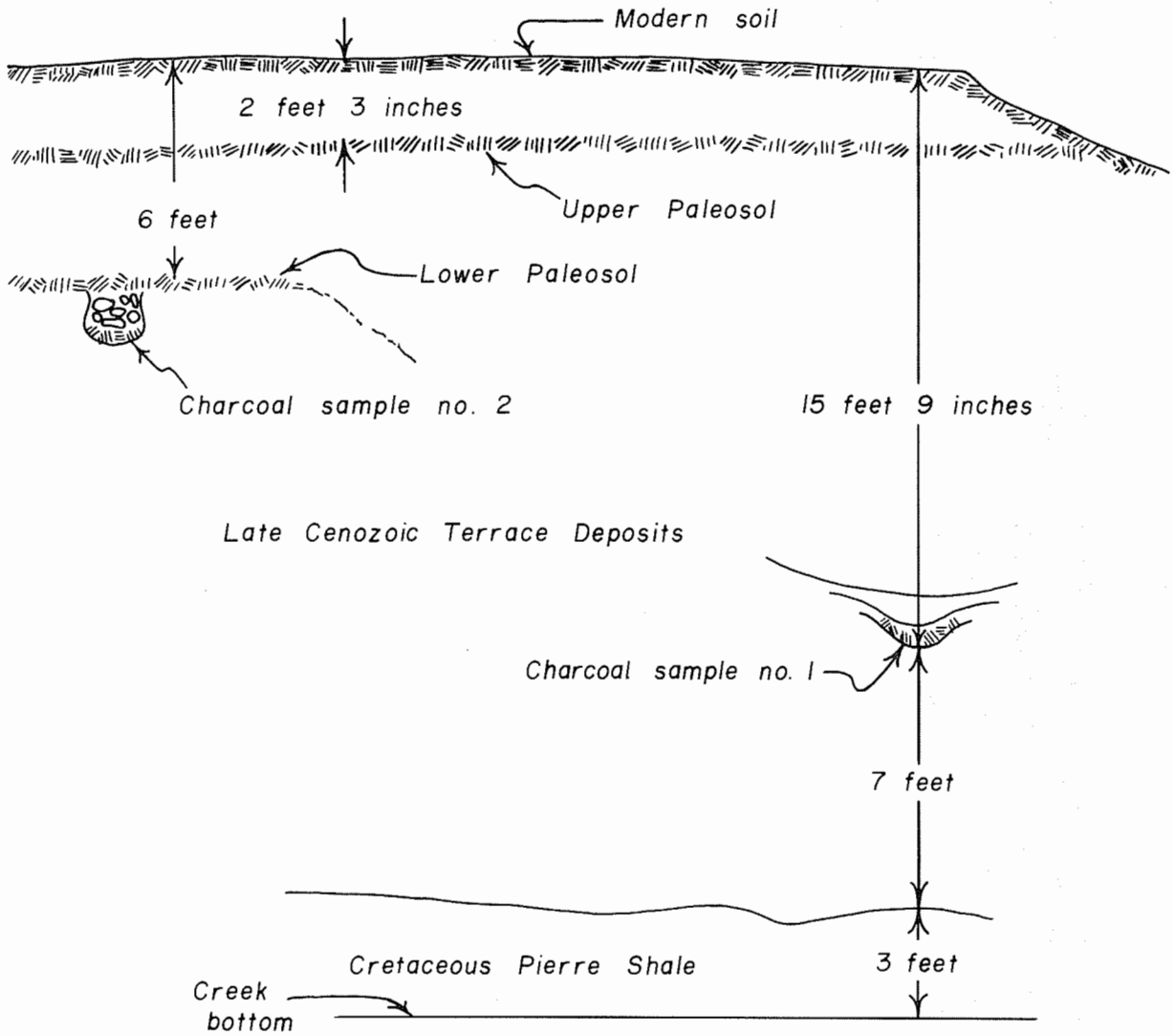

Figure 3. Graphic reproduction of the undercut bank along Bear Creek marked "Hearth site" on figure 1.

rocks while the top half was filled with fine charcoal and soil. In light of the paper by Hughes (1949) this hearth was probably of the Red Canyon Focus. A photograph of the Indian hearth that furnished charcoal sample No. 2 is here presented as figure 4. Figure 4 is a bit out of focus; however, as the bank face has been removed by erosion, there is no way of obtaining a better photograph.

Charcoal sample No. 1 (fig. 3) was deposited in a depression similar to the hearth described above but no stones were present in this "hearth." A photograph of the "hearth," the source of charcoal sample No. 1, is presented as figure 5.

The mode of deposition or the archaeological significance of the two charcoal deposits is only of casual interest as far as this paper is concerned. What is of concern is to establish a sequence of events and to attach finite dates to local geological events based on dates derived from the two charcoal samples.

RADIOCARBON DATING

Using clean steel tools, charcoal sample No. 1 (figs. 3 and 5) was collected and placed in a new polyethylene bag. The sample was sent to Geochron Laboratories in November 1970 for radiocarbon age determination. Geochron dated the sample (GX-2087) at 780 ± 130 C-14 years B.P. Geochron Laboratories commented on the pretreatment as follows:

> *The finely divided charcoal was concentrated and impurities were picked out. The entire sample was then digested in hot dilute HC1 to remove carbonates prior to combustion and analysis. The size and nature of the sample did not permit us to use a NaOH digestion without great risk of making the sample too small to date reliably.*

Charcoal sample No. 2 (figs. 3 and 4) was collected in the same manner as was sample No. 1. The sample was sent to Geochron Laboratories in August of 1971 for radiocarbon age determination. Geochron dated the sample (GX-2340) at 2350 ± 180 C-14 years B.P. Geochron commented on the pretreatment as follows:

> *Selected charcoal fragments were cleaned of foreign material, including rootlets or other contaminating material that could be observed. They were then digested in hot dilute HC1 and in hot dilute NaOH to remove chemical contaminants prior to combustion and analysis.*

On both samples No. 1 and No. 2 Geochron noted:

> *This date is based upon the Libby half life (5570 years) for C-14. The error stated is ±1 Σ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.*
>
> *The age is referenced to the year A.D. 1950.*

REGIONAL IMPLICATIONS

Assuming the two C-14 dates to be valid, or nearly so, can lead to some very interesting conclusions. At the time of collecting, the stratigraphic relationships between the two charcoal samples were obscured. However, the C-14 dates show sample No. 2 to be about three times older than sample No. 1.

Apparently the bulk of the low lying terrace deposits along Bear Creek were deposited sometime previous to 2350 years B.P. At this time Indians camping on the Bear Creek floodplain dug and used the hearth which was the source of charcoal sample No. 2. As the lowest paleosol is well developed and extended unbroken across the top of the hearth the lower paleosol represents an equilibrium surface that remained unchanged for a great length of time.

Sometime between 2350 and 780 years B.P. Bear Creek was rejuvenated and began downcutting. During this period of rejuvenation the stream was entrenched more than 10 feet into its floodplain. After this short period of rejuvenation Bear Creek again became an aggrading stream. Shortly after this period of deposition began, the charcoal of sample No. 1 was emplaced. This terrace building continued until sample No. 1 was buried under some 13 feet of sediment. A period of equilibrium then allowed the upper paleosol to form.

Following the formation of the upper paleosol a period of eolian deposition resulted in an additional 2 feet of sediment being deposited. The development of the modern soil on top of these eolian deposits continues to this day.

At some point in time, perhaps as early as the time of formation of the upper paleosol or as late as the formation of the modern soil, Bear Creek was rejuvenated and began the modern phase of downcutting. Some indication of the volume of sediments that have been removed can be seen in figure 2.

SUMMARY

The two radiocarbon dates reported in this paper (780 and 2350 years B.P.) are significant if for no other reason than they are the only finite dates reported from the lower terraces of this region. These two dates seem to indicate that the lower terraces are much younger than had previously been thought and also that local base level is fluctuating quite rapidly.

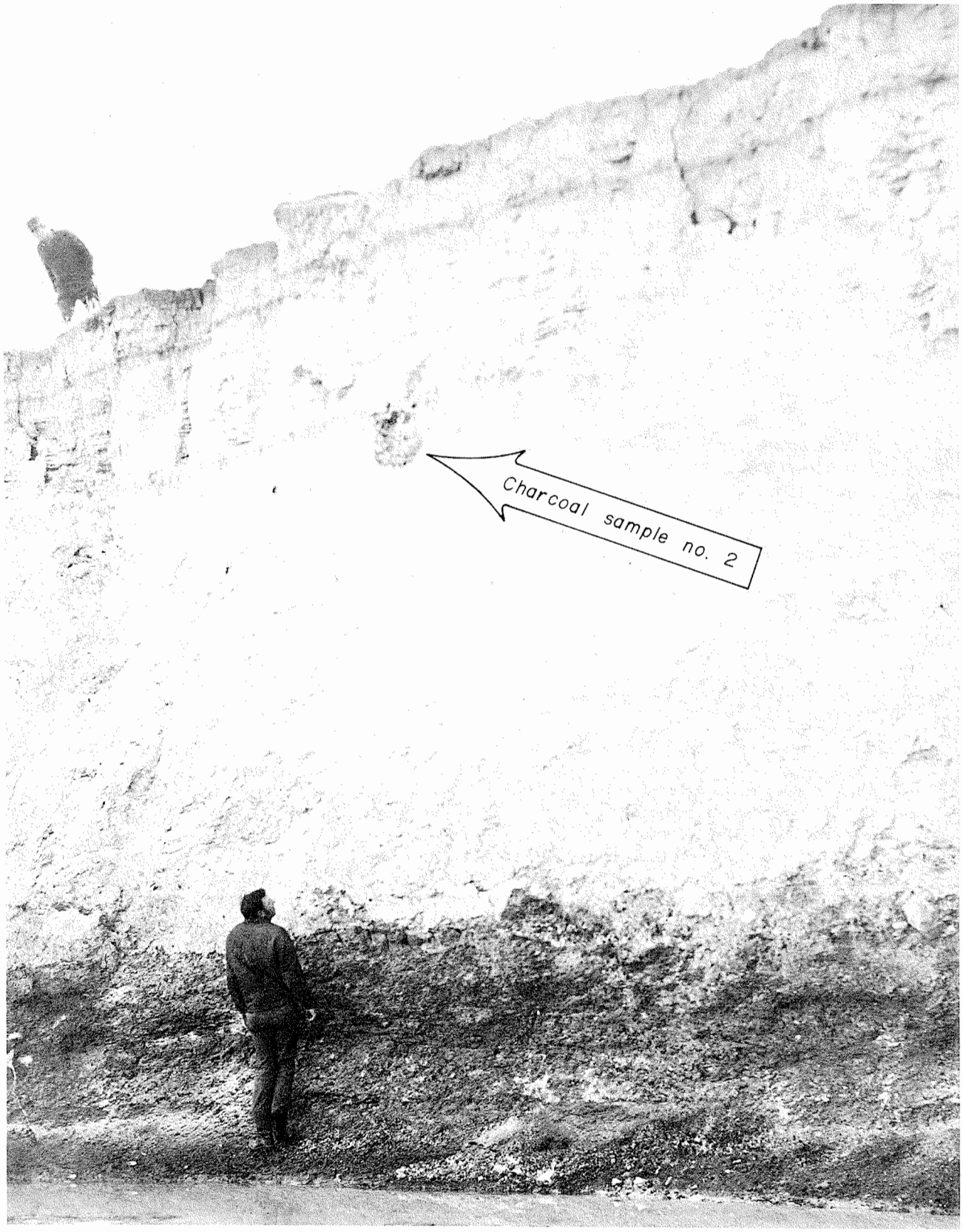

Figure 4. Undercut bank along Bear Creek showing the Indian hearth which contained charcoal dated at 2350 ± 180 C-14 years B. P.

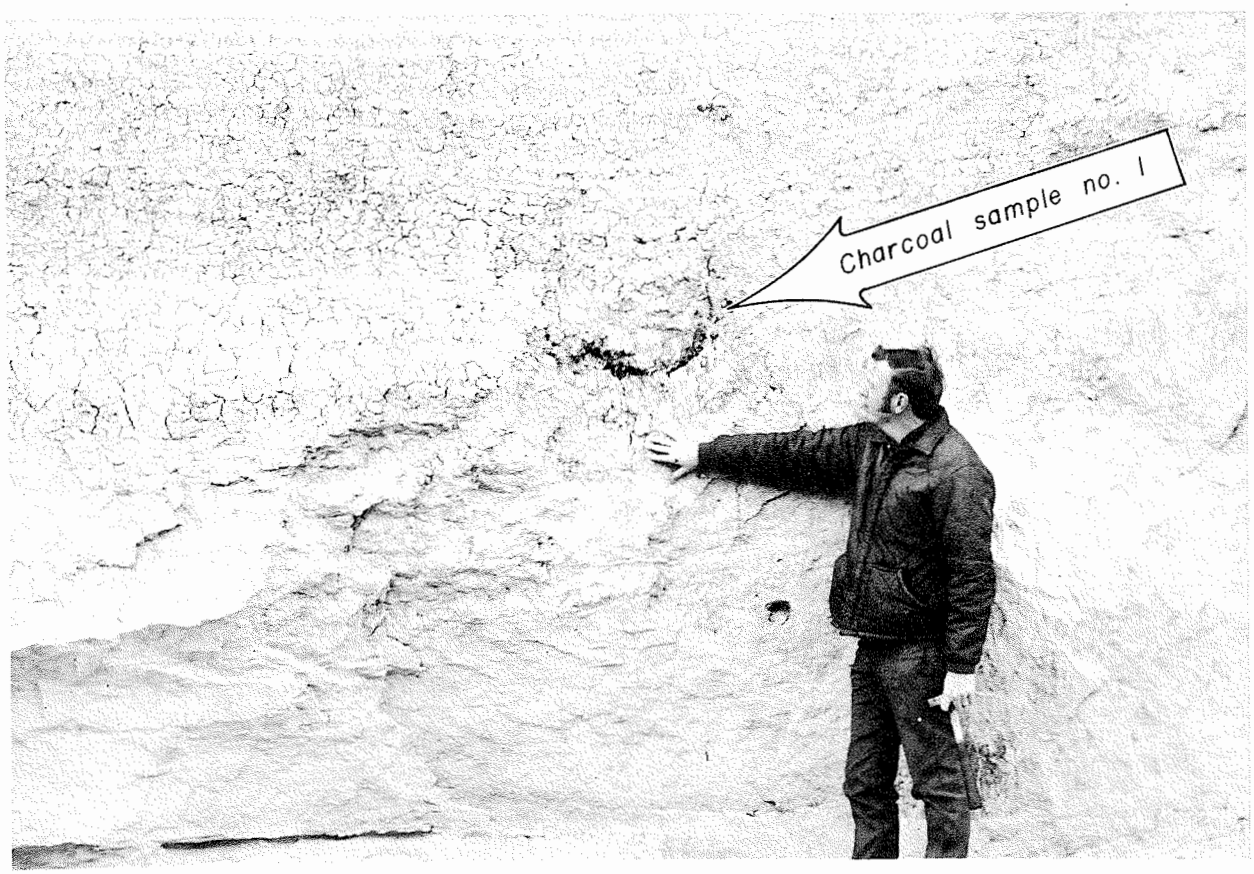

Figure 5. Undercut bank along Bear Creek showing the concentration of charcoal which was dated at 780± 130 C-14 years B. P.

More dates are needed along Bear Creek and adjacent drainages to both substantiate the data presented here and to establish their regional implications.

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