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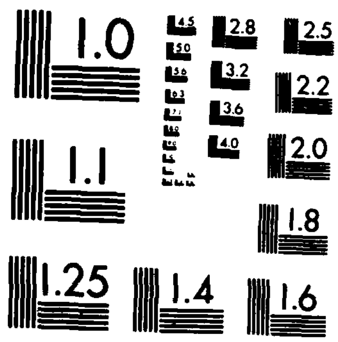

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Prepared by
Historical Research Associates
Missoula, Montana

Sun River (24CA74): A Stratified Pelican Lake and Oxbow Occupation Site near Great Falls, Montana.

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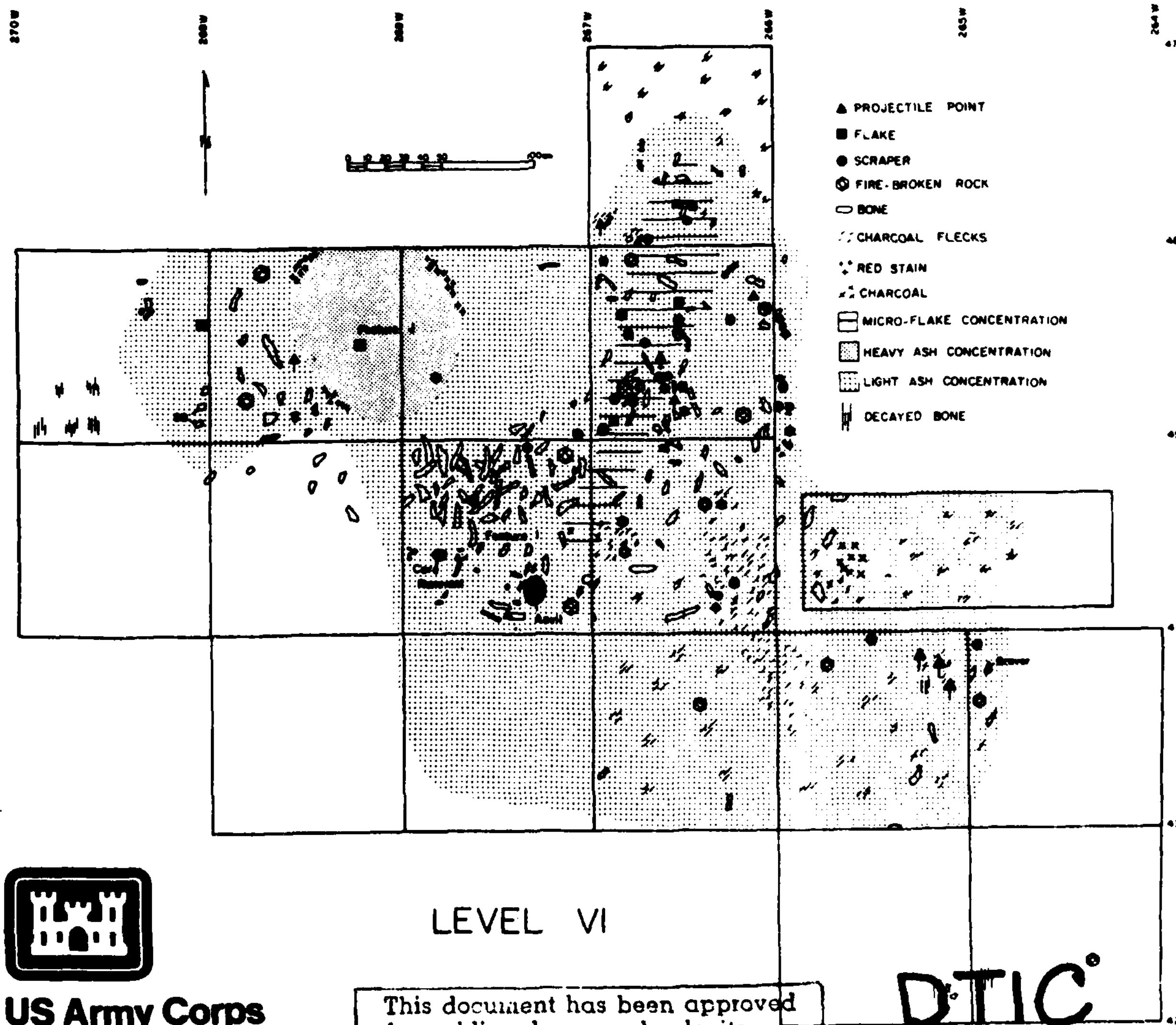

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Montana	Sun River	Pollen	
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
The Sun River site (24CA74), a stratified occupation located just west of Great Falls, Montana, was excavated by Historical Research Associates in 1982 under contract with the Omaha District of the Corps of Engineers. Six occupation layers were defined, characterized by butchered faunal remains in association with lithic artifacts, fire-broken rocks, and various features. The upper layers (I-II) were occupied at various intervals between ca. 2800 to 3600 BP by Pelican Lake and probably Hanna peoples.

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20. Abstract (continued):

The lower layers (IV-VI), each representing a single Oxbow component, dated between ca. 3600 and 5200 BP. Most of the prehistoric occupants focused on the exploitation of bison although a variety of fauna are represented in each layer and the earliest component is predominated by pronghorn.

The site is especially significant because it is the first dated occurrence of Oxbow components in Montana. Furthermore, the occupations span the millenia of notable climatic change from late Altithermal to Medithermal conditions. Informative paleoenvironmental data enhance the archeological results. Sun River provides an important key toward the understanding of prehistoric adaptations on the Northwestern Plains during a poorly understood period.

FINAL REPORT

SUN RIVER (24CA74): A STRATIFIED PELICAN LAKE AND OXBOW OCCUPATION SITE NEAR GREAT FALLS, MONTANA

Prepared for

Department of the Army
Omaha District, Corps of Engineers
Omaha, Nebraska

Contract No. DACW45-82-C-0152

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Federal Antiquities Permit No. 82-MT/WY/SD/ND/ID/WA-004

August 31, 1983

ABSTRACT

The Sun River site (24CA74), a stratified occupation located just west of Great Falls, Montana, was excavated by Historical Research Associates in 1982 under contract with the Omaha District of the Corps of Engineers. (Contract No. DACW45-82-C-0152). Six occupation levels were defined, characterized by butchered faunal remains in association with lithic artifacts, fire-broken rocks, and various features. The upper levels (I-III) were occupied at various intervals between ca. 2800 to 3600 BP. The lower levels (IV-VI), each representing a single Oxbow component, dated between ca. 3600 and 5200 BP. Most of the prehistoric occupants focused on the exploitation of bison, although a variety of fauna are represented in each level and the earliest component is predominated by pronghorn, and the proportions of represented species changed through time.

The site is especially significant because it is the first dated occurrence of Oxbow components in Montana. Furthermore, the occupations span the millenia of notable climatic change from late Altithermal to Medithermal conditions. Informative paleoenvironmental data enhance the archeological results. Sun River provides an important key toward the understanding of prehistoric adaptations on the Northwestern Plains during a poorly understood period.

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CHAPTER 1

INTRODUCTION

In 1982, archeological investigations were conducted by Historical Research Associates (HRA) at the Sun River site (24CA74), a few miles west of Great Falls, in Cascade County, Montana (Fig. 1-1). These and earlier cultural resource investigations (McLean et al. 1978; McLean 1979; Deaver and Morter 1982) were conducted because the location had been selected as a possible "borrow area" for levee construction by the U.S. Army Corps of Engineers, Omaha District (COE).

SETTING

The Sun River site lies within the Middle Rocky Mountain physiographic area adjacent to the Northwestern Plains (Mulloy 1958) (Fig. 1-2). More specifically, the site is situated on a level flood plain approximately 300 m north of the present channel of the Sun River and 5 km west of the Missouri River. The undissected surface grades gently from the north at less than 1 percent to about 983 m (3,225 feet) elevation in the south. Only 130 km to the west is the Continental Divide. From the mountains, the Sun River meanders eastward through rolling, short grass prairie foothills, to its confluence with the Missouri River.

North of the site, the flood plain is bordered by rolling hills and benchlands of typical short grass prairie vegetation (Fig. 1-3). Deciduous trees and bushes cluster along tributary drainages and springs. High bluffs, paralleled by lower benches and terraces, characterize the terrain to the south of the Sun River (Fig. 1-4).

As local collectors well know, the high bluffs were used during Late Prehistoric times as buffalo jumps. Earlier bison procurement methods for this particular area are unknown due to a lack of professional research. What is known is that the Missouri River and its major tributaries, such as the Sun, provided a wide range of resources which attracted people to the area for at least 11,000 years. According to Shumate (1950:24):

> The area around Great Falls, Montana, had an unusually dense population. Abundant game, coupled with the fact it was the edge of the Great Plains, where the Sun River, the Missouri River, and the Smith River emerged from the mountains insured that

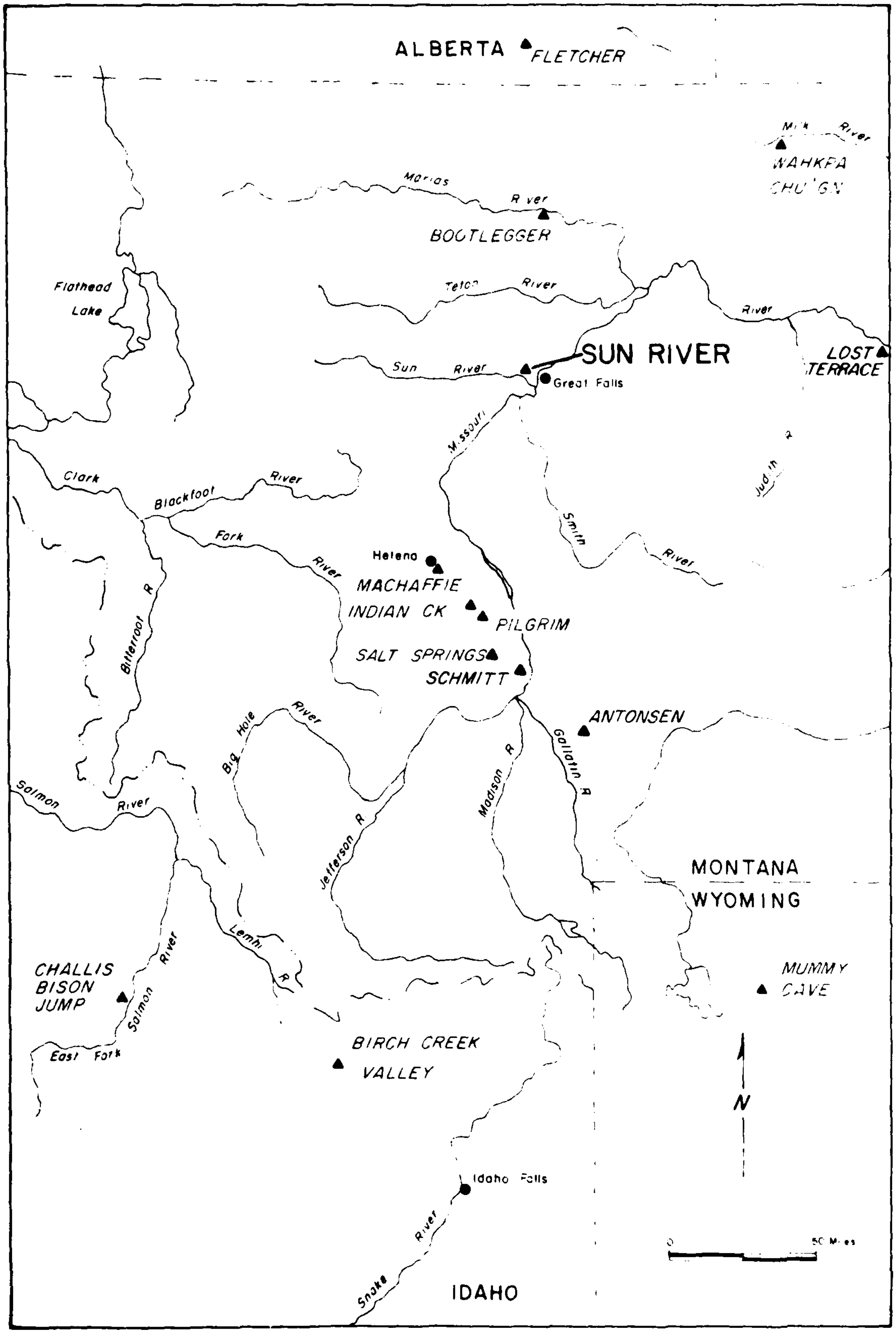


Figure 1-1. Location map of the Sun River site (24CA74).

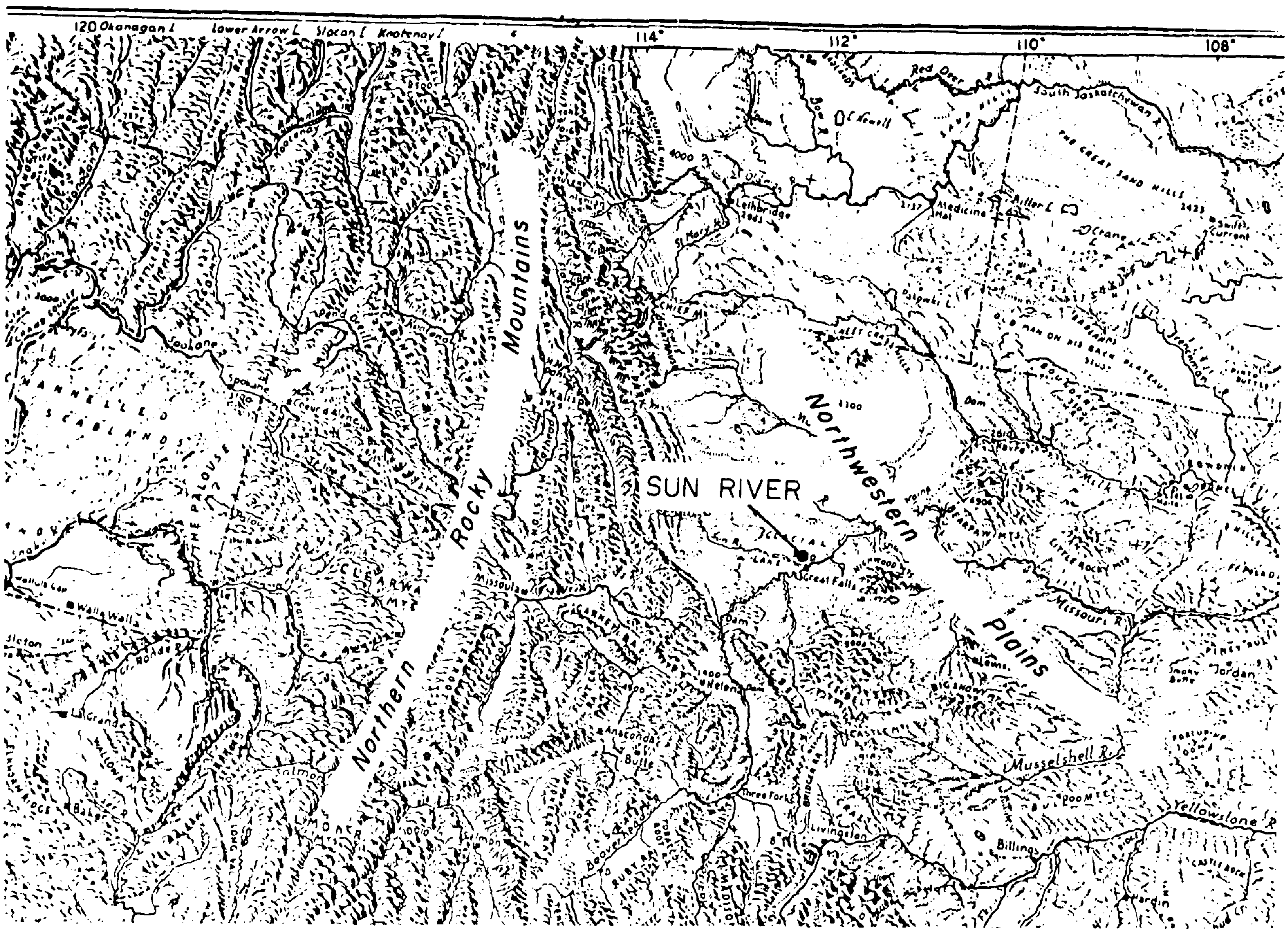


Figure 1-2. Physiographic setting of the Sun River site (24CA74).

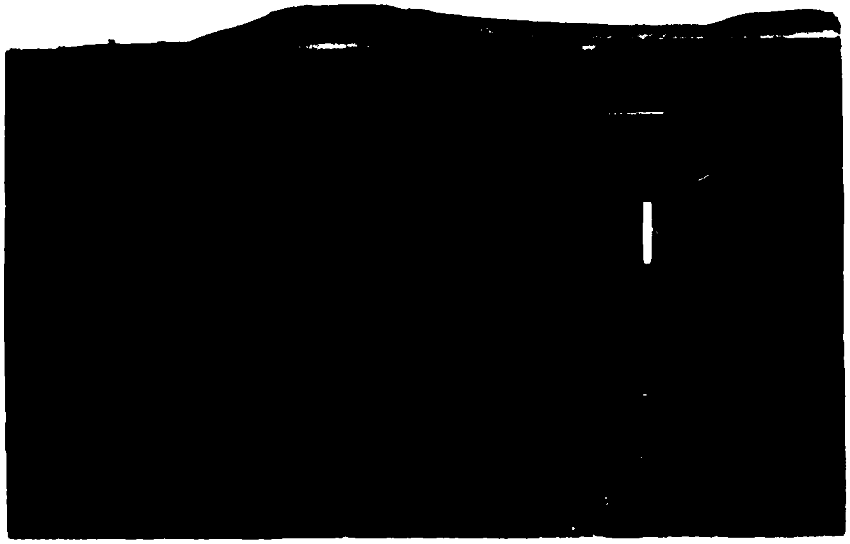


Figure 1-3. Site 24CA74 looking north.

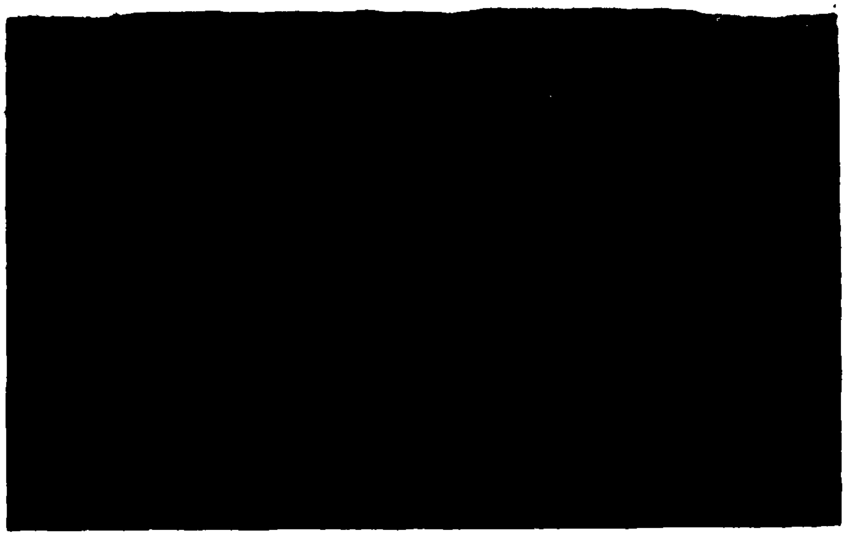


Figure 1-4. Site 24CA74 looking south.

> it would be a locality of great importance to the aborigines. All three of these rivers gave entranceways to the Rocky Mountains where game besides antelope and bison could be obtained.

The contemporary climate of Cascade County is classified as continental, with wide seasonal temperature ranges and year-round precipitation which falls principally during the warm parts of the year (Dregne 1976:117). Summers are hot and winters are cold, with temperatures dropping well below 0° F several times each year. Mean annual air temperature is 45° F (USDC 1971) with about 130 days of freeze free temperatures (Caprio 1965). Average annual precipitation is 14 inches with 62 percent coming between May and August (USDC 1971). Conditions are characteristically arid and windy.

Kuchler (1964) recognized this area as a relatively dry Grama-needlegrass-wheatgrass grassland. Local conditions are indicated by the following species: green needlegrass, western and thickspike wheatgrass, bluebunch wheatgrass, needleandthread, prairie junegrass, plains reedgrass, milkvetches, scarlet globemallow, winterfat, and prairie sandreed, which are in the clayey and shallow clay range sites of the Soil Conservation Service site classification (Ross and Hunter 1976). In 1806, when travelling down the Sun River from what is now Fort Shaw to Great Falls, Lewis recorded interesting observations about the vegetation (Thwaites 1969 v. 5:197-199).

> Much the greater part of the bottom is untimbered. . . . great quantities of prickly pear of two kinds on the plains. . . . from our encampment [near Big Muddy Creek] down we know the river. . . . gooseberries are very abundant of the common red kind and are beginning to ripen, no currants on this river. . . .

Regarding timber, in 1805, Clark (Thwaites 1969 v. 2:223), in the Great Falls area, recorded:

> We ar much at a loss for wood. . . . no other wood but Cotton Box elder Choke Cherry and red arrow wood.

While no riparian species are directly on the site, cottonwoods and various willows line the Sun River channel (USAED 1978). Species observed at the site are listed in Table 1-1.

TABLE 1-1

PLANT SPECIES OBSERVED AT THE SUN RIVER SITE

GRASSES
Green needlegrass--Stipa viridula
Western and thickspike wheatgrass--Agropyron smithii and dasystachyum
Needleandthread--Stipa comata
Indian ricegrass--Oryzopsis hymenoides
Sandberg bluegrass--Poa secunda
Plains reedgrass--Calamagrostis montanensis
Blue grama--Bouteloua gracilis
Fringed sagewart--Artemisia frigida
Curlycup gumweed--Grindelia squarrosa
SHRUBS AND FORBS
Silver sagebrush--Artemisia cana
Wormwood, false-tarrgon sagewort--Artemisia dracunculus
Saltbush--Atriplex--probably nuttalii
Wild rose--Rosa--probably woodsii
Common snowberry--Symphoricarpos albus
Wild licorice--Glycyrrhiza lepidota
Rocky Mountain bee plant--Cleome serrulata
Yellow sweetclover--Melilotus officinalis
Milkvetch--Astragalus spp.
Scarlet globemallow--Sphaeralcea coccinea
Winterfat--Eurotia lanata
Prairie sandreed (on fractured shale outcrops)--Calamovilfa longifolia

A wide variety of fauna abounded in the study area when first observed by Euro-Americans in the early nineteenth century. Native ungulate species included bison, pronghorn, mule deer, white-tailed deer, and wapiti. On July 8, 1805, Lewis wrote:

> The hunters also returned having killed 3 buffaloe 2 Antelopes and a deer. he informed me that the immence herds of buffaloe which we had seen for some time past in this neighborhood have almost entirely disappeared and he believes are gone down the river (Thwaites 1969 v. 2:215).

Again in the area on July 11, 1806, Lewis wrote:

> I sent the hunters down Medicine [Sun] River to hunt Elk and proceeded with the party across the plain to the white bear Islands . . . through a level beautifull and extensive high plain covered with immense hirds of buffaloe. . . . when I arrived in sight of the white-bear Islands the missouri bottoms on both sides of the river were crouded with buffaloe I sincerely belief that there were not less than 10 thousand buffaloe within a circle of 2 mules around that place (Thwaites 1969 v. 5:199).

On July 16, still in the area, Lewis noted seeing goats and antelopes "thinly scattered over the plains but seem universally distributed in every part" (Thwaites 1969 v. 5:205).

Smaller mammals included beaver, muskrat, raccoon, skunk, mink, weasel, rabbit, hare, ground squirrel, otter, and marmot. Predators and scavengers were abundant, including grizzly and black bear, bobcat, mountain lion, wolf, coyote, fox, and badger.

Lewis and Clark also reported a wide variety of waterfowl and other birds. In 1806, Lewis (Thwaites 1969 v. 5:205) noted that:

> there are a great number of geese which usually raise their young above these falls about the entrance of the Medicine [Sun] river we saw them in large flocks of several hundred as we passed today.

In addition to waterfowl, sharp-tailed grouse, as well as a variety of song birds, herons, hawks, eagles, and owls occupy the area.

Native fish species include mountain whitefish, cutthroat trout, flathead chub, longnose dace, mountain sucker, stonecat, burbot, and mottled sculpin.

HISTORY OF PROJECT

The site was first recorded in 1978 (McLean *et al.* 1978), when HRA personnel conducted a survey of the area. A 140-acre area was described as containing abundant flaked stone tools and debris, including Late Plains side-notched, Pelican Lake, and Hanna projectile points. Fire-broken rock clusters also were noted. Local informants told of finding spear points and arrowheads in the site area. They also noted that stone circles, or "tipi rings," were visible in the past.

This survey was followed by limited test excavations (McLean 1979), which produced data indicating that the site was eligible for nomination to the National Register of Historic Places. Specifically, in 11-m-sq. excavation units, hearth features and a wide range of artifacts, including a fragmentary Pelican Lake projectile point, were found within 30 cm of the site's surface. Tests deeper than 60 cm were not conducted because of the incredibly dense clay which comprises the site matrix. HRA recommended that the site was eligible for nomination, and suggested that a two-phase mitigation plan be implemented. The first phase was to allow for determination of site boundaries, and the second phase was for actual impact mitigation. This plan was agreed upon by all involved parties, and the site was determined eligible.

In 1981, Professional Analysts (Prolyst) was hired to re-evaluate the site, especially to conduct deep tests so that more could be known about the depth of cultural deposits. The Prolyst results (Deaver and Morter 1982) confirmed the presence of cultural remains within the upper 30 cm. Additionally, they reported "burned" features between 1 and 2 m below the surface. These fire-reddened features, some of which had associated carbon-enriched soils, lacked associated cultural remains, but were attributed to prehistoric activity because these features were "far more easily explained by cultural rather than natural factors" (Deaver and Morter 1982:5-17).

The results of these two phases of testing indicated that at least one episode of prehistoric occupation was present and datable, and that, based on the presence of the burned features, earlier occupations also were possible.

In July and August, 1982, HRA archeologists conducted excavations at the site. Alan Stanfill served as Field Director, assisted by Susan Vetter. Crew members included Dave Adkisson, Jim Atkinson, Audrey Glick, John Barsness, Andy Bailey, Jim Sutton, Mary Ann Sutton, Sandy Stevens, Lisa Stewart, Jean Nelson, Heidi Plochman, Rich Bailey, Larry Kingsbury, and Irene Santoli. Bob Ottersberg was subcontracted to conduct soils investigations and Dr. Leslie B. Davis, of Montana State University, served as a consultant. Overall direction of the project was the responsibility of Dr. Sally T. Greiser, as Principal Investigator, and T. Weber Greiser, Project Manager/Co-Investigator.

METHODS OF INVESTIGATION

On the basis of previous testing results, and in keeping with the scope-of-work defined by COE, HRA designed a mitigation plan that would accomplish the following goals:

(1) Define the horizontal and vertical limits of the site; and

(2) Excavate a large enough sample to recover sufficient data for definition of prehistoric site occupation.

In order to accomplish these goals, a series of tasks were specified. Defining the horizontal limits of the site included surface reconnaissance of the entire borrow and levee areas, surface collections of cultural materials along a north/south and an east/west transect, and power auger tests to a depth of at least 30 cm at 50-m intervals over the entire area.

Defining the vertical limits of the site included an interplay between manual and mechanical excavation as a phased process with the results of one type of excavation influencing the determination of subsequent excavation (Fig. 1-5). The results of these investigations are detailed in Chapter 3.

After defining the spatial extent of the site, the selection of manual excavation units was to be influenced by the need to maximize cultural and environmental data retrieval and open horizontal areas of sufficient extent to define large activity areas. Our selection would attempt to maximize diversity of features in addition to emphasizing selection of units with definable occupation surfaces, hearth features with sufficient charcoal for radiometric dating, and features associated with diagnostic artifacts. From information derived from aerial photographs, we knew that a complex depositional environment formed the flood plain and that our testing had to take these factors into account.

To summarize, we expected to encounter relatively shallow cultural remains attributable to people of the Pelican Lake Complex, who occupied the Northwestern Plains between approximately 1300 BC - AD 200. Additionally, we recognized the possibility of encountering deeper cultural remains, although evidence of such was limited and inconclusive. After several days of testing, we believed that our preconceived notions were confirmed. Shallow test excavations revealed that several episodes of occupation were present in the upper 40 cm, and results of deep trenching (i.e., 2-3 m) were negative. However, in the thirteenth and final trench to be excavated, we encountered bone, lithic debris, and charcoal at depths greater than 1.8 m.

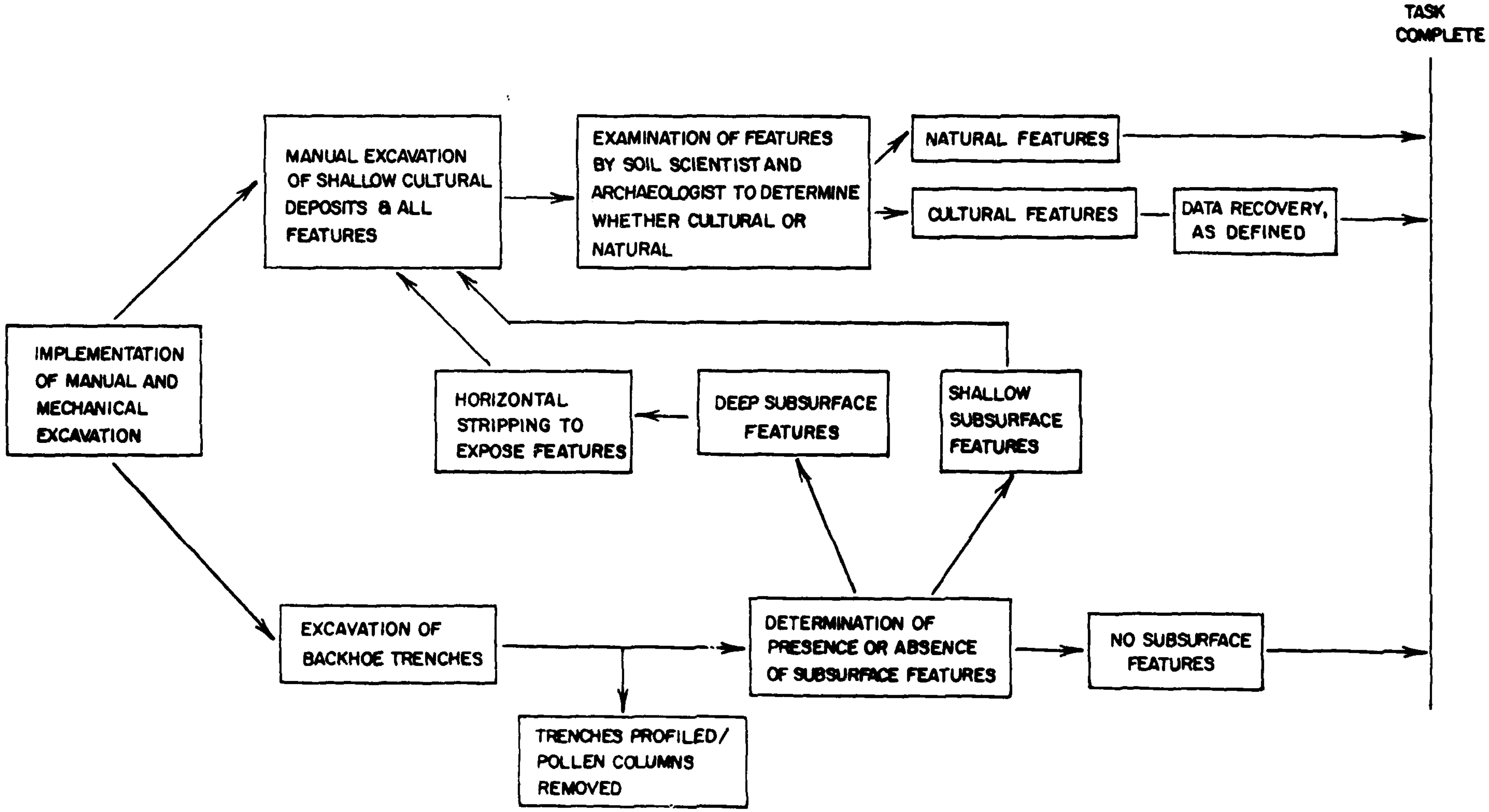


Figure 1-5 EXCAVATION PROCEDURE FLOW CHART

Given a Scope-of-Work that had essentially been geared for shallow excavation, some modifications were made in the data recovery plan to allow for maximizing data retrieval from what was eventually defined as three Oxbow occupation levels. As such, less attention was paid to the disturbed upper components than had originally been planned. The greater emphasis on the Oxbow occupations was justified because of the absence of excavated Oxbow sites in Montana and the shortage of sealed, stratified Oxbow sites. Much remains to be learned about the more recent occupations at the site as well as the Oxbow occupations, since these were only sampled.

Problems in Deep Sampling

Although the scope-of-work called for a stratified random sample of cultural materials, the discovery of deep, subsurface Oxbow occupations forced an abandonment of that strategy. Sampling has always been synonymous with probability sampling in the archeological literature. The literature, however, has ignored the problem of deep-site sampling (e.g., Binford 1964; Ragir 1967). Probability sampling assumes that the limits of occupations are known. The logistics of removal of overburden to expose the deep Oxbow occupations so limited the area uncovered that the extent of these occupations was not exposed. Consequently, nonprobabilitistic sampling was the only alternative.

Asch (1975:191) recommends nonprobability sampling to select a more representative, even though biased, sample when only a few sampling units can be excavated. The unexpected unfolding of three deep Oxbow components necessitated such a sampling approach. An initial nonprobability approach does not, however, compromise the objectivity of a probabilistic sample based upon the results from this prior nonrandom testing phase (Asch 1975:189). Subsequent work on these deep components can indeed utilize stratified random sampling, but only after further testing has defined the limits of these components.

Deep-site excavation will continue to remain opportunistic in conception (Brown 1975:158). Once the deep-site periphery has been defined, however, the initial nonprobabilistic sampling gives way to more controlled procedures. Struever (1968) advises such a play off of the two sampling techniques in investigating stages. The complexities of the multiple components of the Sun River site demand interworking of numerous complex sampling strategies, both for the shallow subsurface materials as well as for the deep deposits. These strategies can only be devised after adequate testing of the deep subsurface occupations.

Problems in Excavating in Clay

Cultural materials at the Sun River site were located in very dense, compact clay, making *in situ* recovery of artifacts and features difficult. Hand picks often were needed to loosen the soil matrix before trowels could be used. This technique, although necessary, displaces artifacts and lessens the possibility of *in situ* recovery of data.

CHAPTER 2

FIELD METHODS AND LABORATORY ANALYSIS

EXCAVATION STRATEGY

The field investigations conducted at site 24CA74 were designed to provide a wide range of information regarding the prehistoric occupants' environments and adaptive systems. Toward these goals, a variety of data collection methods were employed. These included:

(1) Surface reconnaissance and collection;

(2) Manual excavation; and

(3) Mechanical excavation.

The implementation of each method relied on the use of several sampling techniques. The nature of each sampling technique was dependent upon the data requirements as outlined in the technical proposal, the technical limitations as stated in the scope-of-work, and the results of previously conducted sampling during this investigation.

Initial investigation of the site entailed a surface reconnaissance to relocate datum points and excavation units established by HRA in 1979 (McLean 1979) and Professional Analysts in 1981 (Deaver and Morter 1982); and to redefine site boundaries and surface artifact concentrations (Fig. 2-1). The surface reconnaissance entailed walking the entire project area in 10-m interval transects. Flags were placed where artifact concentrations, diagnostic artifacts, and previous excavation units were encountered to mark their locations. A new datum point, coincident with that of Professional Analysts, was established outside of the defined site area, and from this point, a north/south, east/west grid system of 50-m intervals was established, using a transit, to aid in recording and mapping of the site.

With the establishment of the grid system, surface collections and power auger tests were excavated at each 50-m grid point within the borrow area. These 20-cm diameter auger holes were excavated to provide a systematic sample of the project area aimed at locating and determining the distribution of any cultural deposits within 1 m of the surface. Although soils continued to a much greater depth, the length of the auger bit restricted deeper excavations. Auger tests extended to a depth of about 1 m, depending on soil density. A total of 64 auger tests were excavated, but only one, located in the high density surface artifact area, provided indications of shallow subsurface cultural deposits.

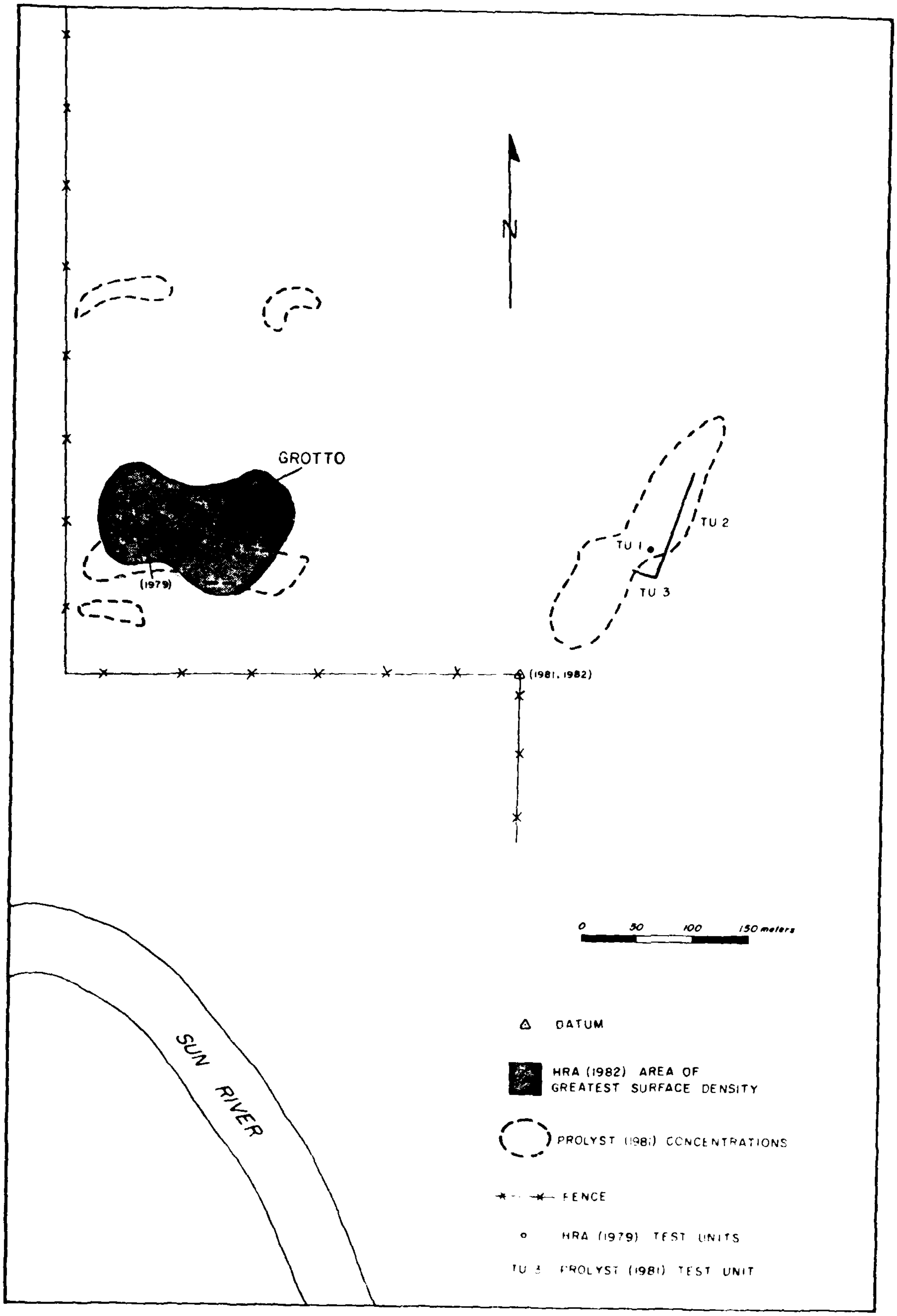


Figure 2-1. Locations of previous work at the site.

Based on the results of these efforts, the horizontal limits of the site's surface were defined (see Fig. 2-1 and Map Pocket). The area of low density artifact concentration is approximately 200 x 175 m. A more restricted area of approximately 200 x 80 m defines the area of moderate surface artifact density and corresponds with the area of intact, shallow subsurface remains. Although artifacts can be seen almost anywhere along the terrace, the site area, as defined here, represents a definable cluster of surface and subsurface artifacts. Separate clusters on the terrace should be designated as separate sites.

Upon completion of the auger testing phase, mechanical and manual excavation techniques were employed to further investigate subsurface artifact distributions. Deep subsurface trenching was initiated to provide stratigraphic information regarding past environments, depositional processes, and the potential occurrence of deeply buried cultural deposits. Shovel tests were initiated to locate and define the boundaries of shallow cultural deposits.

A total of 13 backhoe trenches ranging from 1 to 3 m deep and 3.3 to 91 m long were excavated within the project boundaries for observation of soils and sediments (Fig. 2-2 and Map Pocket). Prior to excavation, trench routes (TT 1, 2, 3) extending into the high artifact density area were delineated by 5-m-wide corridors. Corridors were then divided into 5 m^2 units. Artifacts within each unit were collected and labeled accordingly as part of the overall surface collection. These trenches were excavated after the collection of surface artifacts within their respective corridors.

Alignment of a majority of the trenches was north trending or generally perpendicular to the flow of the Sun River. Location of trenches was determined by differences in surface sediment types as reflected in the vegetation (see Fig. 1-3). Soil sampling sites within the trenches were located to represent the range of observed sediment types according to morphological differences (see Appendix A for discussion). A brief morphological description was made at 12 sites and samples were collected from major horizons or variations in sediment type. Analyses of soil and sediments completed at the Montana State University Soil Testing Lab include:

(1) Particle size distribution of the less than 2 mm fraction based on hydrometer readings; and

(2) A gravimetric determination of calcium carbonate content and measurement of total organic matter based on methods of Sims and Haby (1971).

Three pedons chosen for laboratory analysis were also described morphologically with greater detail than the other nine sites because they represent the three major sediment types observed. One was chosen because of its proximity to cultural remains.

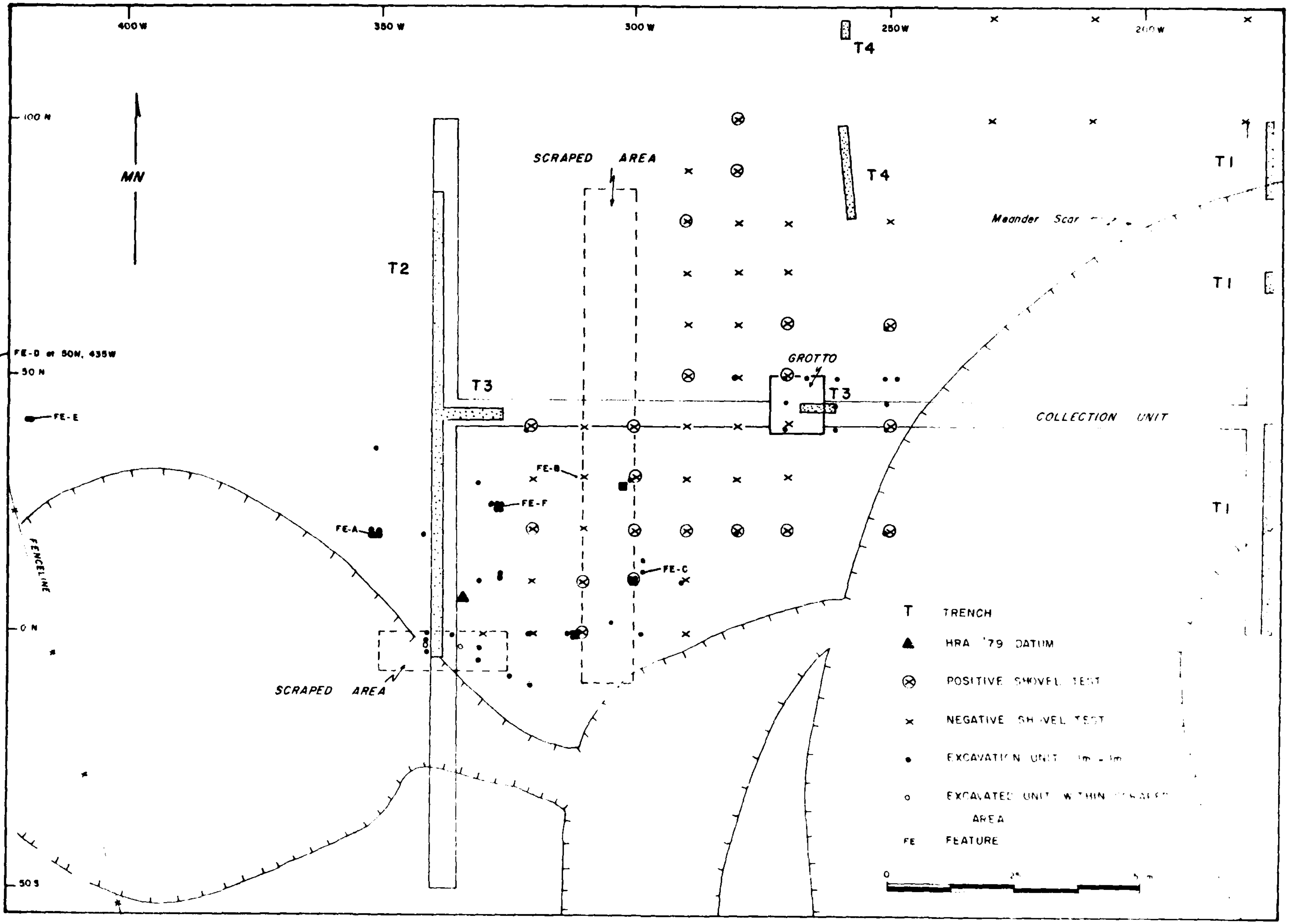


Figure 2-2. Site excavation map.

Shovel tests (30 x 30 cm) within the high surface artifact density area were excavated at 10-m intervals. A total of 66 shovel tests were excavated (see Fig. 2-2), none of which extended more than 30 cm deep in accordance with the stipulations of the scope-of-work. Also in accordance with these stipulations, shovel tests along the levee centerline, near the eastern boundary of the project area, were restricted to 15 cm in depth.

The test trenches and shovel tests resulted in the location of both shallow (0 - 0.75 m below surface) and deeply buried (1.85 - 2.15 m below surface) subsurface cultural materials in the high artifact density area only. No features or anomalies were observed in the trenches outside of this area. These results provided the direction by which subsequent excavations were conducted at the site.

All shovel tests which resulted in the recovery of cultural materials were expanded to 1- x 1-m test units and excavated to further expose subsurface deposits. When indications of subsurface features or large quantities of cultural remains were encountered, additional test units were excavated adjacent to the original unit in an attempt to locate and define features and occupation floors. Test units also were excavated where clusters of surface materials (i.e., fire-broken rock) indicated the possible presence of hearths and where previous investigators had located features.

Generally, two excavators were assigned to each excavation unit. In the shallow deposits, excavation of 2- x 2-m units was initiated in the northeast (NE) quadrant of the unit. If cultural materials were encountered, the remainder of the unit was opened to follow productive deposits. When selected quads proved unproductive, an alternative grid was selected. In the deeper deposits, the entire test area was excavated in 1- x 1-m units.

Excavation was done in arbitrary 10-cm levels, by trowel or skim shovel, until natural or cultural levels were encountered. When natural stratigraphic or cultural levels were encountered, the arbitrary levels were abandoned and an attempt made to expose the new level throughout the quad. When uncovering a cultural level or living floor, all artifacts were left *in situ* (pedestaled) until the entire level was exposed. Also, features were carefully distinguished from the surrounding matrix, and radiocarbon samples collected when possible. Because of heavy clay deposits, picks had tc be used in some areas to loosen the matrix. Although this technique sometimes damaged contextual integrity, it was the only practical means to remove deposits quickly.

After exposure of a complete cultural level, all cultural remains and features were mapped onto graph paper, and then photographed. Artifacts were then removed, bagged, and provided with a label including its provenience and a description of the artifact. After removal of the artifacts, pedestals were excavated and any additional artifacts numbered, point-plotted, mapped, and removed to bags. This procedure was repeated for each level.

Soil from every level of each unit was segregated to maintain horizontal and vertical control of cultural, floral, and faunal remains not recovered in situ. These remains were collected and kept separate from in situ materials. Soil removed from excavation units was dry screened through 1/4-inch mesh. Water screening through fine mesh window screen had been proposed to more effectively filter the hard, compact clays typical of the Sun River Site; however, physiographic features at the site prevented use of this technique.

The vertical and horizontal distance of cultural deposits from the water source (Sun River) was too great to allow either pumping water to the deposits or removal of screened residue to the water source. Without fine screening (requiring water), retrieval of microflakes and microfauna was impossible. An attempt to compensate for the inability to recover such data in the field was made by collecting matrix samples from features and living floors. Portions of these matrix samples were submitted for flotation analysis. Microflakes and microfauna recovered in flotation samples provided a representative sample of these materials present at the site.

The excavations resulted in the definition of three cultural levels (Levels I-III) between the sod zone (Level I) and 40-cm depth. One unit, at the southwest extreme of the site area, produced cultural remains at a depth of 20 - 75 cm. The relationship between this occupation and Levels I-III is unclear; therefore, this unit is not given a level designation. To solve this dilemma would require excavations much more extensive than those conducted.

Two corridors were selected for shallow scraping (see Fig. 2-2). This scraping was conducted by a mechanical "crawler." The intent was to expose the extent of shallowly buried cultural deposits, especially features. Unfortunately, the equipment could not be kept steady, and the resultant gouging was not acceptable. Therefore, this technique was discontinued and the results were uninformative.

Subsurface cultural deposits were encountered at a depth of approximately 1.8 m during the excavation of Test Trench 3 East (Fig. 2-3). To gain access to these deeply buried deposits, horizontal stripping removed overburden from an area approximately 8 x 8 m to within 20 cm of the cultural deposits. This area, affectionately called the "Grotto," was segmented into 1- x 1-m grid units corresponding to the site grid system.

The investigation of this area was initiated by the manual excavation of a 50-cm wide trench extending 6 m west from Test Trench 3 East (Fig. 2-4). This trench was excavated to determine the number of occupation levels present and to provide a general idea of the vertical and horizontal extent of each level. The trench excavation resulted in the identification of three distinct occupation levels (Levels IV-VI), each contained within a dark clay matrix and separated

Figure 2-3. Test Trench 3 East, 4N 264W.

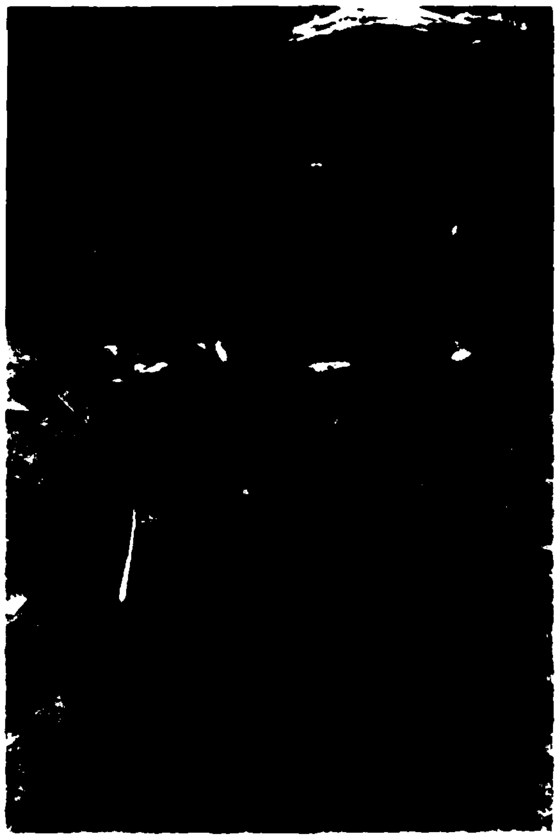


Figure 2-4. 50-cm wide trench extending 6 m west from Test Trench 3 East.

by lighter and siltier clay layers. The horizontal extent of the cultural levels did not appear to exceed 5 m east/west, but the north/south extent remains unknown. The stratigraphy of the trench indicated that the vertical distribution of these levels was encompassed within about 40 cm of deposits. Reflecting these results, excavation of 20 1- x 1-m units ensued. Two excavation units were taken to a depth of 1 m below the Grotto surface (i.e., 2.8 m below the site surface), to ascertain the presence or absence of additional cultural levels. Because no indications of additional occupations were apparent, other units were excavated only a few centimeters beyond Level VI.

LABORATORY ANALYSIS

Cultural remains, consisting of features, lithic artifacts, and faunal and floral remains, are the physical manifestations of human behavior. In archeology, cultural materials constitute the primary data source from which information regarding prehistoric lifeways may be derived. This chapter describes the methods of classification and analysis of cultural remains recovered from the Sun River site.

Analysis of Features

Cultural features are the spatially distinct physical manifestations of a particular activity or set of activities. Features are defined as:

> bounded and qualitatively isolated units that exhibit a structural association between two or more cultural items and types of nonrecoverable or composite matrices (Binford 1972:145).

As such, features provide an ideal analytical unit which in size and complexity is intermediate between the artifact (i.e., the most basic analytical unit) and the activity area within the context of an archeological site.

The analysis of features located at site 24CA74 focuses on the spatial dimensions or morphological aspects of the feature, and the nature of associated cultural items. The integration of these data provides the basis for interpretive inferences regarding feature functions and the cultural activities associated with those features.

Nine features were located during excavations at the Sun River site. Five hearth features were located within 40 cm of the site's surface (Levels I-III), and the remaining four features were located within the deeply buried cultural levels (IV-VI). Four of the five upper hearths were excavated pits filled with fire-broken rock and charcoal. The fifth hearth was defined by a charcoal stain and oxidized earth; it was more amorphous than the other features. Two of the deeply buried features were ash-filled, basin-shaped hearths (one with an intrusive pit); one was dense scatter of charcoal, bone, and fire-broken rock; and one was a dense scatter of bone.

As stated, our analysis focused on feature composition and morphology, and the nature of associated artifacts. Reflecting the types of features that we encountered, we were concerned with the nature and distribution of fire-broken rock, bones, lithic artifacts, charcoal, ash, and oxidized soils in our attempt to explain feature function.

Analysis of Faunal Remains

The analysis of faunal remains from the Sun River site was undertaken with the purpose of reconstructing the represented species, the number and age of animals exploited, and how these animals were butchered. Examination of tooth eruption and wear patterns was important for establishing the season of use of each occupation. Additional data concerning specific uses of bones (e.g., bone tool usage) and taphonomy also were considered.

Methodological and theoretical groundwork laid by previous analysts (Frison 1967, 1970, 1973; Lorrain 1968; Wheat 1972, 1979; White 1952, 1953, 1954) has been employed to analyze this faunal assemblage. Investigators of prehistoric fauna procurement have demonstrated that careful analysis of bone element frequencies, bone breaks, chops, and cut marks contribute greatly to our understanding of the butchering activities and thus, subsistence, of Native Americans.

Our goal in analyzing faunal remains was to reconstruct the butchering activities which determined the character of the bones when they were deposited by the prehistoric inhabitants. In this attempt to attribute certain breaks, cuts, or disproportionate element representation to human activities, we had to address noncultural factors which influenced the final condition of the faunal remains. Cultural and natural processes which influenced the composition and condition of the faunal assemblage include:

(1) Aspects of animal physiology;

(2) Aspects of the kill and subsequent butchering activities; and

(3) Post-depositional natural processes which may have altered the bones subsequent to human activities.

In order to accommodate the notable amount of information recovered from this faunal assemblage of bones and bone fragments, a standardized, coded data collection record was developed (Appendix B). Specifics of data recording for each element include:

(1) Identifying each specimen by element and species, whenever possible;

(2) Recording fragmentation characteristics including evidence of butchering;

(3) Noting evidence of age, when present, e.g., fused or unfused epipheses;

(4) Noting condition of the bone, e.g., evidence of rodents or carnivores having modified the surface or exfoliation indicative of exposure;

(5) Noting burning; and

(6) Identifying bone tools in the collection.

The availability of time-sharing access to the University of Montana's DECSYSTEM-20 computer and the volume of material recovered from the site (almost 2,000 faunal remains and over 1,100 pieces of lithic debris) demanded the computer coding, input, and manipulation of the data. The actual coding framework for the faunal data is presented in Appendix B. The codes were designed to allow the most efficient recall of specified attributes, e.g., the number of humerus diaphysis fragments for a particular level. Furthermore, this system allowed us to assess percentages of various bone elements and to compare these figures among the levels, rapidly and efficiently.

Analysis of Flaked Stone Artifacts

Thousands of lithic artifacts were recovered from the Sun River site, which required systematic treatment in order to provide information regarding the cultural systems represented at the site (see Appendix B). In this endeavor, a technological systems approach based on the works of Davis (1972), Bonnichsen (1977), and others is adopted. A technological system is defined as:

> all the possible techniques explicitly or implicitly available to one or more groups of people who possess a common culture, and which could be combined by them into technological sequences employed to produce classes of artifacts within a certain category (Davis 1972:26).

This perspective provides directionality to the formulation and analysis of artifact classes in that they comprise interrelated data sets which can be examined within the context of a system. Defining the artifact classes and the technical decisions which link them results in the characterization of that system.

The flaked stone technological system consists of the ideas, methods, and techniques possessed by a cultural group for the procurement of raw materials, the modification of those materials into flaked stone tool forms, the use of those tools, and the deposition of tools and by-products (Fig. 2-5). Beyond the specific type of technological system, we also consider the reduction strategies of that system and the technical sequences resulting from those strategies. Consideration of additional subsystems (e.g., heat treatment, storage, hafting, and so on) may be warranted depending on the particular system being examined (cf. Flenniken 1980). The following presentation addresses analytical concerns in terms of the four noted subsystems.

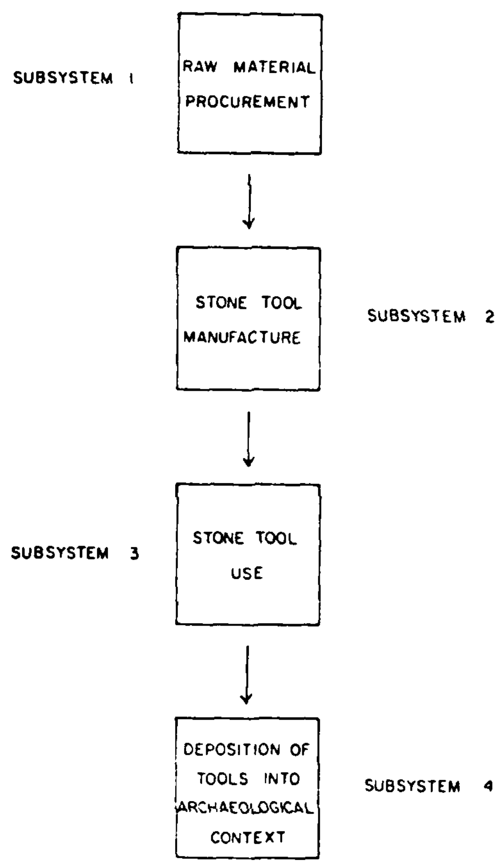


Figure 2-5. Minimal subsystems of lithic technological system.

Raw Material Procurement

The identification of lithic material types is important in the analysis of flaked stone artifacts. Material source identification can provide valuable information regarding procurement strategies, material preference, seasonal movements, and trade networks. Variation in the quality and nature of material types can affect reduction strategies and the types of tools produced.

Diverse material types were recovered from this site. Many of these exhibit indications of procurement from secondary river or glacial deposits and lack sufficient characteristics for identification as to their original source locations. Others, however, are diagnostic of particular source areas. Material types recovered from the site are described below.

(1) Chert is a rock of sedimentary origin composed of silica derived from an original precipitate or as a replacement by-product of calcium carbonate minerals. Preservation of the original textures of the carbonate minerals is common. Chert may occur as nodules, lenses, or layers in limestone and shales (American Geological Institute 1972). Chert artifacts recovered from 24CA74 exhibit a wide range of colors, textures, and lusters, including brown chert with black dendrites and white streaks, creamy beige weathered chert, and greenish-tan chert with black specks, white streaks, and crystalline inclusions. The greenish-tan chert turns red when exposed to heat. A variety of less abundant cherts were identified and are discussed with the appropriate occupation level.

(2) Silicified Sediment is a medium- to coarse-grained material which exhibits significant variability in color, texture, and homogeneity. Colors range from muted, mottled grays to black and white speckled varieties, locally known as "salt and pepper." Reddish plant fossils also may occur in the matrix. The gray specimens are similar to Tongue River Silicified Sediment, TRSS (Ahler 1977), which occurs over a wide geographic area including southwestern North Dakota, northwestern South Dakota, southeastern Montana, and northeastern Wyoming. The origin of TRSS is the Tongue River Member of the Fort Union Formation. However, the entire range of material recovered from the Sun River site occurs in the conglomerate of the Kootenai Formation which outcrops on the flanks of the Little Belt Mountains to the southeast of the site. This area may be the source of the silicified sediment.

(3) Chalcedony is a microscopically crystalized variety of quartz, with individual crystals arranged in slender fibers in parallel bands (Pough 1953). Chalcedony recovered from the Sun River site is a translucent white variety, some with black dendrites.

(4) Quartzite is composed primarily or exclusively of quartz grains, fused together by metamorphic processes. It is opaque and ranges from fine to coarse grained. Tan-gray, white, dark red, and pink varieties, all coarse grained, were found at the Sun River site (Davis 1966).

(5) Porcellanite is the hard, dense, siliceous rock of coal burn origin and has the texture, dull luster, hardness, and appearance of unglazed porcelain (American Geologic Institute 1972). A grey, poor quality porcellanite occurs as outcrops and stream cobbles within the project area. Other sources of this material occur in northeast Wyoming and southeast Montana and include grey, red, yellow, maroon, and black varieties (Fredlund 1976).

(6) Obsidian is a felsic glass that transmits light along thin edges. The obsidian artifacts from 24CA74 are consistently of a dark, homogeneous variety probably derived from the Obsidian Cliffs in Yellowstone National Park (Davis 1972).

(7) Basalt is an aphanitic (microcrystalline) igneous rock having the composition of gabbro and dolorite. Specimens of basalt are opaque even on thin edges (Longwell et al. 1969:645). The Sun River specimens are quite variable in texture and fracturing characteristics. Some specimens may actually be slate due to their plate-like structure.

(13) Other includes any lithic material types not encompassed by the previous material type definitions. Artifacts of "other" material types are described in the text on an individual basis.

Stone Tool Manufacture

A classification scheme for flaked stone artifacts is designed to aid in the description and analysis of the manufacture of stone tools at the Sun River site (Fig. 2-6). Three major categories of artifacts are addressed and detailed: bifaces, unifaces, and debitage.

(1) Bifaces are artifacts modified on two faces to form a bifacially flaked margin. The following bifacial types represent sequential manufacturing stages in projectile point or biface knife manufacture.

Early Stage blanks are bifacially flaked pieces of lithic material with partially established bifacial margins. Percussion flake scars extend from the edges of an Early Stage blank, but may not overlap on the faces. This blank type is asymmetrical and generally does not exhibit platform preparation.

BIFACES	UNIFACES	DEBITAGE
EARLY STAGE BLANKS	UTILIZED AND MODIFIED FLAKES	CORES
MIDDLE STAGE BLANKS	UNIFACIAL TOOLS	CORTICAL FLAKES
LATE STAGE BLANKS		INTERIOR FLAKES
PREFORM		BIFACIAL THINNING FLAKES
POINT OR KNIFE		PRESSURE FLAKES
		SHATTER
		UNDIAGNOSTIC FLAKE FRAGMENT

Figure 2-6. Technological classification scheme of flaked stone artifacts.

Middle Stage blanks are asymmetrical with sinuous or undulating bifacial margins. Percussion flake scars generally extend across both faces giving the artifact a biconvex cross-section. Some platform preparation is usually evident.

Late Stage blanks exhibit well-defined symmetry and straight, well-established bifacial margins. Percussion flake scars usually extend across both faces and platform preparation is evident.

<u>Preforms</u> have the same characteristics as Late Stage blanks, plus evidence of pressure flaking and beveled margins for pressure flake platform preparation. Preforms lack haft elements, as do the preceeding biface stages.

<u>Projectile points</u> and <u>knives</u> have the same characteristics as preforms, plus a sharp tip, sharp lateral margins, and usually exhibit basal modification to facilitate hafting (e.g., basal grinding, notching, or indentations). The lateral edges may display evidence of use-wear.

A majority of the bifacial artifact types are thought to occur in the archeological record because the sequence of projectile point and knife manufacture was not always completed. In some instances, a flaked implement was discarded because of unsuitable qualities of the stone or because of insurmountable manufacturing mistakes. In other instances, an implement may have been used for some task prior to further reduction, then lost or discarded.

(2) <u>Unifaces</u> include the following types:

<u>Utilized and modified flakes</u> have marginal patterned retouch along one or more edges. These edges serve a variety of tasks and may display signs of use-wear.

<u>Unifacial tools</u> are those whose form and working edges have been produced as a result of unifacial flaking over one entire face. Working edges may be convex, straight, or concave, depending upon the intended function.

(3) <u>Debitage</u> includes the following types:

<u>Cores</u> are pieces of flakable raw material modified by and for the purpose of flake removal. Flake removal may be patterned or opportunistic depending on the reduction technique used, the type of flake desired, and to a certain extent, the shape of the flaked piece.

<u>Cortical flakes</u> exhibit cortex (weathered exterior surface) on at least part of their dorsal surface. Usually these have natural platforms and relatively thick cross-sections. Cortical flakes are among the first flake types produced during biface manufacture or core reduction and represent the intentional removal of the extraneous outer covering.

<u>Interior shaping flakes</u> exhibit flake scars on their dorsal surface from previous flake removal. Platforms are unprepared and may exhibit cortex. Interior flakes may be produced during later stages of core reduction or during the initial stages of biface manufacture.

Bifacial thinning flakes exhibit flake scars (often bidirectional or multidirectional) on their dorsal surfaces. These flakes are often curved and possess thin cross-sections and well-prepared platforms. Remnant cortex may occur on part of their dorsal surfaces but they are generally produced during the thinning and shaping process of biface manufacture and are not an important by-product of the decortication process.

Pressure flakes are small thin flakes often exhibiting unidirectional flake scars on their dorsal surfaces. These flakes are often broken transversely during manufacture because of their thinness and fragile nature. Platforms are very small and well-prepared. Pressure flakes are indicative of the final stages of biface manufacture and of tool retouch.

Undiagnostic flake fragments are fragments of flakes too badly broken for reliable assignment to any of the other flake categories.

Shatter refers to irregular and angular shaped pieces of flakable materials which result from inconsistencies (e.g., checks) in the stone, flintknapping mistakes, or exposure to intense heat. These are generally produced during the initial stages of stone tool manufacture.

These artifact categories are considered in terms of the flaked stone reduction strategies--the hierarchically ranked processes by which technical decisions are applied to the manufacture of technologically related products (e.g., bifacial blanks, preforms, and points) and by-products (e.g., cores, flakes, shatter). With each process, by-products are produced and discarded. Products also are produced and may be discarded, used, or subjected to further modification through the application of logically succeeding technical decisions.

Stone Tool Use

Beyond reconstruction of the technological system, archeologists are concerned with functional analysis of flaked stone tools, i.e., how were the tools used? Lithic use-wear analysis (Semenov 1964; Hayden 1979) involves the examination of working edges and faces, in an attempt to discern patterned wear. Types of wear and their placement on a tool, including particular flake patterns, abrasion, polish, and striations, suggest particular categories of use. Wear patterns can be assessed in terms of formal tool categories to reconstruct tool types and uses at particular sites. For the Sun River site assemblage, all tools that retained working edges were examined using a binocular microscope. Observations were made between 10x and 40x magnification. Patterns of use-wear and their location were recorded for each specimen. Notes were made regarding post-depositional edge damage, weather effects, and intentional abrasion for manufacturing purposes, to avoid confusion concerning sources of edge modification.

Deposition of Tools into Archeological Context

Archeologists need to consider the various processes that affect the final deposition of cultural debris prior to interpreting prehistoric behavior (Ascher 1968; Binford 1981; Schiffer 1976). Schiffer (1976) has extensively covered the theoretical and methodological aspects of cultural and natural formation processes and the transformations necessary to convert the static data into dynamic behavior. Sun River data were assessed with these considerations in mind.

After post-depositional modifications were assessed, the analytical emphasis shifted to consideration of tool function, condition, and context. Placement of tools with regard to other cultural remains, including features, was considered for each occupation level in our attempt to discern whether we were dealing with intentional discard of tools or loss in the context of an activity.

Lithic Analysis Summary

To summarize, technological analysis of flaked stone artifacts from the Sun River site focused on three interrelated analytical levels which help us to understand the cultural systems represented at the site. The first, the flaked stone technological system, focused on knowledge of lithic materials. Specifically, this level emphasized the range of information that a people possessed regarding the nature and utility of flaked stone tool materials, and the ways this information was organized and applied in coping with the environment. The second level, the flaked stone reduction strategies, focused on procedures and emphasized the strategies by which technological knowledge was organized and applied in the manufacture of flaked stone tools. The third level, the technical sequences, focused on technical decisions and the ordering of products into a sequential, goal-oriented format. The analysis of flaked stone artifacts, therefore, proceeded from the most substantive analytical level (the reconstruction of technical sequences based on the diagnostic attributes of individual artifacts) to the most abstract analytical level (the characterization of the lithic technological system).

Analysis of Fire-broken Rock

Fire-broken rocks constitute an artifact type that is among the most frequently occurring in the archeological record. Ethnographic and experimental studies (e.g., Driver and Massey 1957; Lorrain 1973; House 1975) have documented and demonstrated the production of fire-broken rocks during a variety of heating and boiling activities. These studies have resulted in the characterization of fire-broken rocks as cobble fragments which exhibit rough, angular and irregular broken surfaces, and by spalls and sloughs.

Recently, controlled experiments using basalt and sandstone cobbles were conducted to determine, among other things, whether the effects of rapid heating, as when rocks are placed in a fire, produced breakage patterns distinguishable from the effects of rapid cooling, as when heated rocks are placed in a water container for stone-boiling purposes (Stanfill 1981). The results of this study indicated that distinctive breakage patterns do occur, that the patterns are attributable to different types of stress fracture, and that these patterns are recognizable in the archeological context. Briefly, cobbles exposed to rapid and intense heating conditions were fractured due to differential expansion.

> That is, the outer surfaces of cobbles are more directly exposed to the intense and rapid heating of a fire than are their interiors. This differential heating process may cause the outer surfaces of cobbles to expand more rapidly than their interiors, thus causing areas of stress or tension parallel to the surfaces of the cobbles. As this differential heating process increases, the stress in the cobbles reaches a critical point where surface areas of the cobble or cobble fragments separate as spalls or pot-lids (Stanfill 1981:7-8).

In contrast, heated cobbles exposed to rapid and intense cooling conditions were subjected to differential contraction. Under these conditions, tension or stress occurs roughly perpendicular to the cobble's surface.

> When the heated cobble was submerged in water, the sudden cooling effect caused the exterior of the cobble to contract more rapidly than the interior because of the proximity of the cooling effects of the water to the exterior of the cobble. Fragmentation occurred when the exterior of that portion of the cobble contracted too rapidly for the maintenance of the cobble's cohesive qualities. The angular and roughly block, wedge, and conical shapes of fragments are a function of the contractive stress which decreases from the exterior toward the interior of the cobble (Stanfill 1981:9).

From a functional perspective, fire-broken rock may be defined as cobbles used for the storage and transfer of heat.

Classification

The distinctions between rapidly heated and rapidly cooled cobbles provide the basis for the classification of fire-broken rock recovered from the site. Fragments which exhibit smooth, even surfaces and spall-like shapes or spall detachment scars result from differential expansion and are attributable to rapid and intense heating conditions. Fragments which exhibit angular fractured surfaces and rough block, wedge, or conical shapes result from differential contraction and are attributable to rapid and intense cooling conditions.

SUBCONTRACTED ANALYSES

In addition to the soils analysis discussed previously, pollen, phytolith, and flotation/macrofloral analyses were subcontracted. Results of each analysis aid in reconstruction of the paleoenvironment through identification of specific plant parts. Pollen analysis was performed by Sue Short of the Institute of Arctic and Alpine Research (INSTAAR), University of Colorado; analysis of opal phytoliths was performed by Rhoda Lewis, of Paleoenvironmental Consultants, Wheatridge, Colorado; and flotation/macrofloral analysis was performed by Meg Van Ness, of Bellemont, Arizona. Reports of these analyses are presented in Appendices C, D, and E, respectively.

CHAPTER 3

SITE STRATIGRAPHY, RADIOCARBON-DATING RESULTS, AND PALEOENVIRONMENTAL CONSIDERATIONS

Excavation at the Sun River site produced evidence of at least six cultural levels. In a limited area of the site, the stratigraphy which incorporated these levels (Fig. 3-1) appeared rather straightforward. However, this alluvial valley, under the influence of the Sun River and a tributary to it, has been subjected to an extremely complex erosional and depositional history. The study of these flood plain processes, accordingly, had to assume primary importance in an examination of the site stratigraphy. (Refer to Appendix A for the background information essential to reconstruct the stratigraphy of the cultural levels.)

SURFACE CHARACTERISTICS

Surface concentrations of cultural materials closely correlated with the source of the alluvium on which they rested. Units A, B, and C (Fig. 3-2) differentiated these deposits by source material. The overbank deposits of the Sun River had both the best predictability for buried surfaces and the best integrity for shallow subsurface deposits. These characteristics enhanced the possibility for recovery of cultural materials with good provenience in both shallow and deep levels. The area of overbank deposits (Unit C) corresponded closely with the area of densest surface concentrations. Because of its potential to yield cultural materials, shovel testing and excavation concentrated in this area (see Fig. 2-2).

The shaded areas of the site map (see Fig. 3-2 and Map Pocket) recorded the relative densities of surface cultural material. Professional Analysts (Deaver and Morter 1982:5-20) noted a relationship at the Sun River Site between topography and surface concentrations. The surface materials clustered by depositional units rather than by topography. Of course, the two cannot be separated; the deposition of these units defined topography while topography influenced the deposition of the units.

As mentioned above, surface materials concentrated in the Sun River overbank deposits. Within the area of these deposits, bare spots appeared (Unit C-1). These bare spots were actually pockets of fan clay in the overbank deposits. The properties of the fan clay, such as low permeability and infiltration, discouraged vegetation.

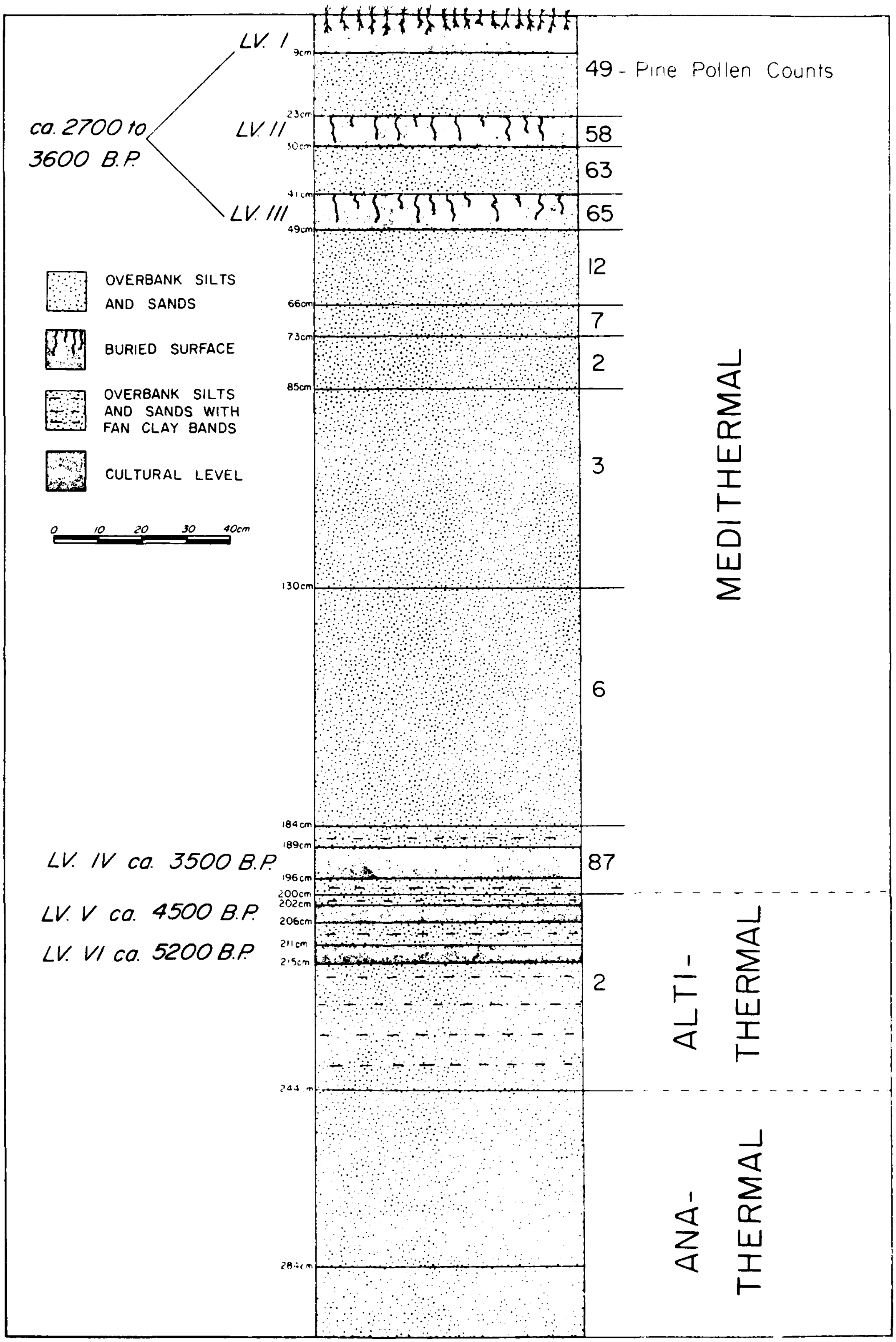


Figure 3-1. Idealized Profile of Trench 3 East

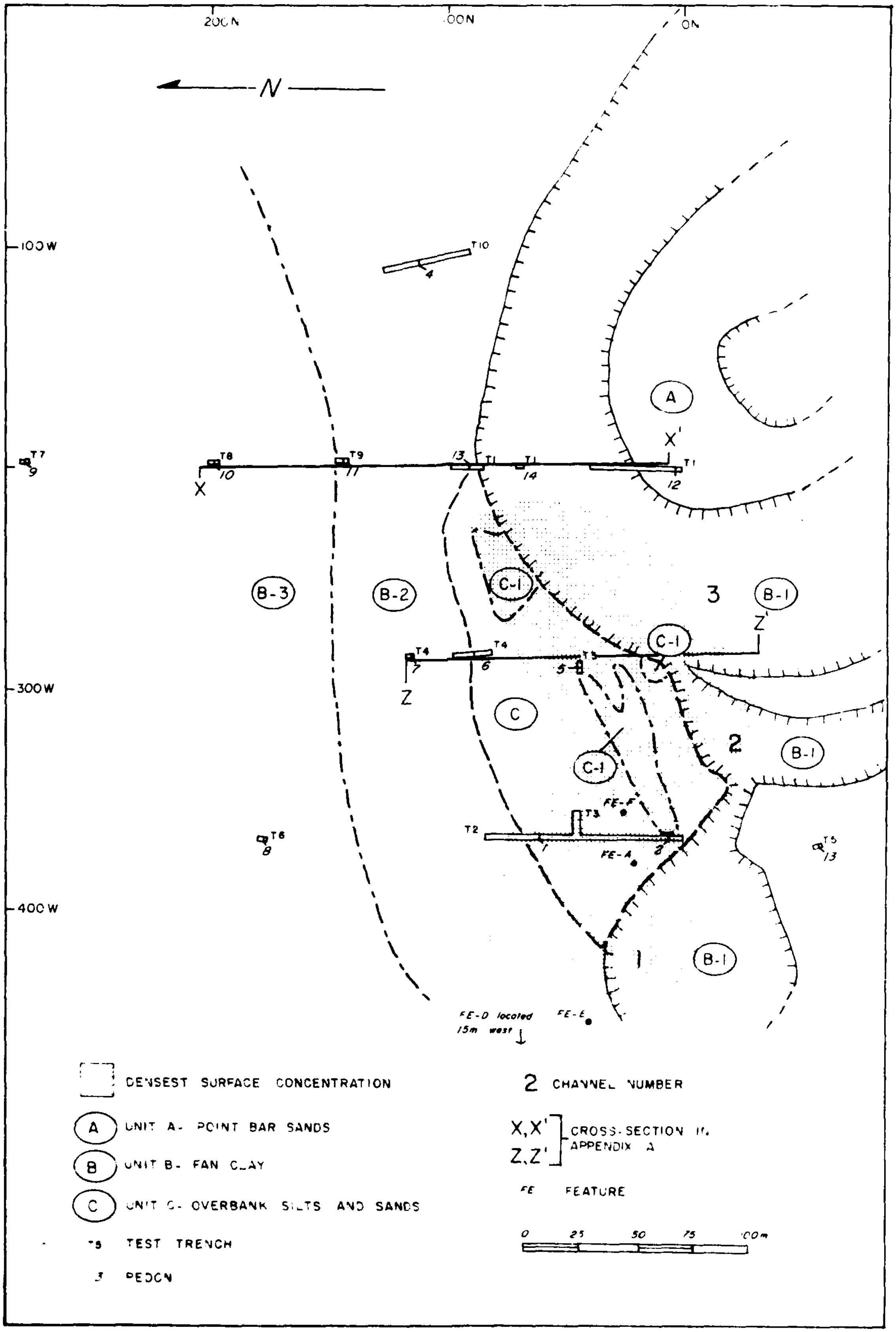


Figure 3-2. Sources of surface soils.

Deaver and Morter (1982:5-15) correlated concentrations of lithic debris with these bare spots, but this correlation may have been more an artifice of increased visibility due to limited vegetation than of denser debris scatters.

Surface materials concentrated in the Sun River overbank deposits for a variety of reasons. The tributary in the northwest corner of the study area deposited fan clays across the northern portion of the site that covered surface cultural materials. The southern portion of the study area lay outside the influence of the tributary deposits. In addition, the distance of 0.4 km from the southern portion of the study area to the Sun River channel effectively removed the area from all but high flood stage overbank deposits. This southern portion, thus, escaped most periods of deposition that would have masked surface deposits.

Projectile points recovered from the surface span a 3,500-year period from Hanna to Late Plains side-notched. The time range of surface projectile points plainly denied the possibility of a single surface component. The intermixing of cultural components on the surface could have resulted from one of three processes: multiple occupation of a long-term stable surface; transport of cultural materials from upstream; or disturbance processes at work on the site (see Wood and Johnson 1978).

If the surface had been exposed for a long period of time, then mixing of cultural components would be expected. Such would be the simplest explanation for the variety of cultural materials represented at the surface. As mentioned above, the site receives little modern deposition from the Sun River. A surface could, consequently, have remained exposed for multiple occupations over time.

Transport of materials could also have accounted for the mixing of cultural debris. The more abundant vegetation on the Sun River alluvium (Appendix A) could have winnowed sediments and, perhaps, cultural materials from the down-valley flow of flood waters. Water leaves the Sun River channel to flow parallel to the main valley only at high to very high flood water stages. Six times in the last century (GFCC 1965; USAED 1978), the Sun River has reached such stages. During such flows, flood waters would transport cultural materials from up valley and then lose them to the sieve of thicker vegetation on the Sun River alluvium.

Disturbance processes at work on the site itself also could explain the surface admixing. Wood and Johnson (1978:319-329) chronicled numerous examples of the havoc rodents and insects can wreak on archeological site stratigraphy. The more friable consistency of the Sun River alluvium has attracted more burrowing rodents than the compacted fan clays. Frost-heaving of artifacts to the surface or wind deflation of the surface to telescope cultural materials could explain the co-occurrence of Hanna, Pelican Lake, and Late Plains side-notched projectile points at the surface. All of these processes assume that subsurface manifestations of these cultural affiliations existed. Of the three shallow subsurface cultural levels, only Level I had a definite Pelican Lake association. Levels II and III contained no diagnostic artifacts.

The surface of the Sun River site exhibited evidence of three cultural affiliations. Whether the surface of the site served as an occupation surface for all three, whether in situ remnants of the occupation associated with the Hanna and Late Plains side-notched projectile points were undiscovered or whether these materials were deposited at the site by flood waters could not be determined. Only a cultural level associated with Pelican Lake projectile points remained undisputed.

Level I

Level I corresponded with the sod zone at 0 to 9 cm below surface (see Fig. 3-1). A sod layer, always weakly developed, appeared in all pedons (Tables A-1 and A-2). Although this sod layer ran continuously across the site, its development in different areas of the site may not have been continuous. Cultural materials clustered in this sod zone in a number of locations across the site.

Groupings of two or more 1- x 1-m excavation units (see Fig. 2-2) represented locations where concentrations of cultural materials in Level I warranted the expansion of that unit into adjacent squares. Most of these expansions fell within the area of densest surface concentrations (Unit C in Fig. 3-2). However, two features, Features D and E, and a series of units at the southern end of Trench 2 fell outside the concentration area in the overbank deposits. An isolated unit at 20N 250W that produced two Pelican Lake projectile points also lay outside the overbank deposits and in the fan clays that filled an abandoned meander channel (see Appendix A).

The aforementioned depressions in the overbank deposits (Unit C-1 in Fig. 3-2) that filled with fan clay introduced another complicating factor in the development of the sod zone. A complex of 1- x 1-m excavation units centered on 11N 299W rested on the edge of one of these fan clay-filled depressions. Given the shallow depth of the clays, the churning action common to the fan clays may have displaced materials in Level I, but not in the lower levels.

The sod zone in the overbank deposits developed differentially in the fan clays and along the boundaries between the two. For this reason, cultural materials within the sod zone may have represented a wide time range even though they fell within the same stratigraphic unit. A wide range of radiocarbon dates from this level confirmed the broad time span of Level I materials. Feature E (see Fig. 3-2), in overbank deposits but closer to tributary fan clay influence, dated to 3570±80 BP (2037±153 BC, corrected). Feature A, in the stable overbank deposits of the dense surface concentration area, had a date of 2790±90 BP (1024±95 BC, corrected). These dates bracketed the other Level I dates.

A close examination of the context of Level I cultural materials revealed the stratigraphic incongruities. A date of 3120±200 BP (1448±207 BC, corrected) from a sample taken at 63-cm depth in the south end of Trench 2 (see Table 3-1) would not seem to correlate with the date from Feature A, where all cultural materials not in the feature lay within 5 cm of the surface. A profile from the south end of Trench 2 (Fig. 3-3) illustrated the slope of strata in this area. The slope was associated with the build-up of natural levee deposits along the channel (see Appendix A). The natural levee deposits would have risen above the channel and above the flood plain north of the channel. After the channel south of Trench 2 was abandoned, sediments would slowly have filled it in. The abandoned channel would have remained a lowland for some time until sediments filled it to its modern level. The strata illustrated in Figure 3-3 sloped up to the north as they left the channel to climb the levee deposits. North of the levee deposits, a downslope to the flood plain may be expected. Given these topographic changes commonplace to the transition from channel to flood plain deposits, the Trench 2 data could not be directly correlated with Level I. However, the two dates did overlap at two standard deviations and may indeed have represented a single occupation.

Two Pelican Lake projectile points came out of the sod layer of 20N 250W, which was situated in an abandoned meander channel filled with fan clays. Topographic changes as complicated as those discussed above undoubtedly applied to this unit, as well. That fan clays composed the upper 50 cm of the units adjacent to the southern end of Trench 2 and that they composed at least the upper 50 cm of 20N 250W (see Table A-1) aggravated the increasing complexity of these two areas. Lateral and vertical displacement of cultural materials characterized the fan clays. Their churning action from repeated wetting and drying destroyed the context of cultural materials and contorted cultural levels beyond recognition. Because of these complications in areas of deep fan clay deposits, Level I discussions and characterizations exclude them. Even with these specific exclusions, without clear stratigraphic differentiation, Level I had to remain a catch-all for what may have been a number of cultural occupations.

Variable deposition rates across the site (see Appendix A) could explain why Features A, E, and F had divergent dates. All of these features rested in overbank deposits and were recognized at the surface by concentrations of fire-broken rock. Yet, as discussed in

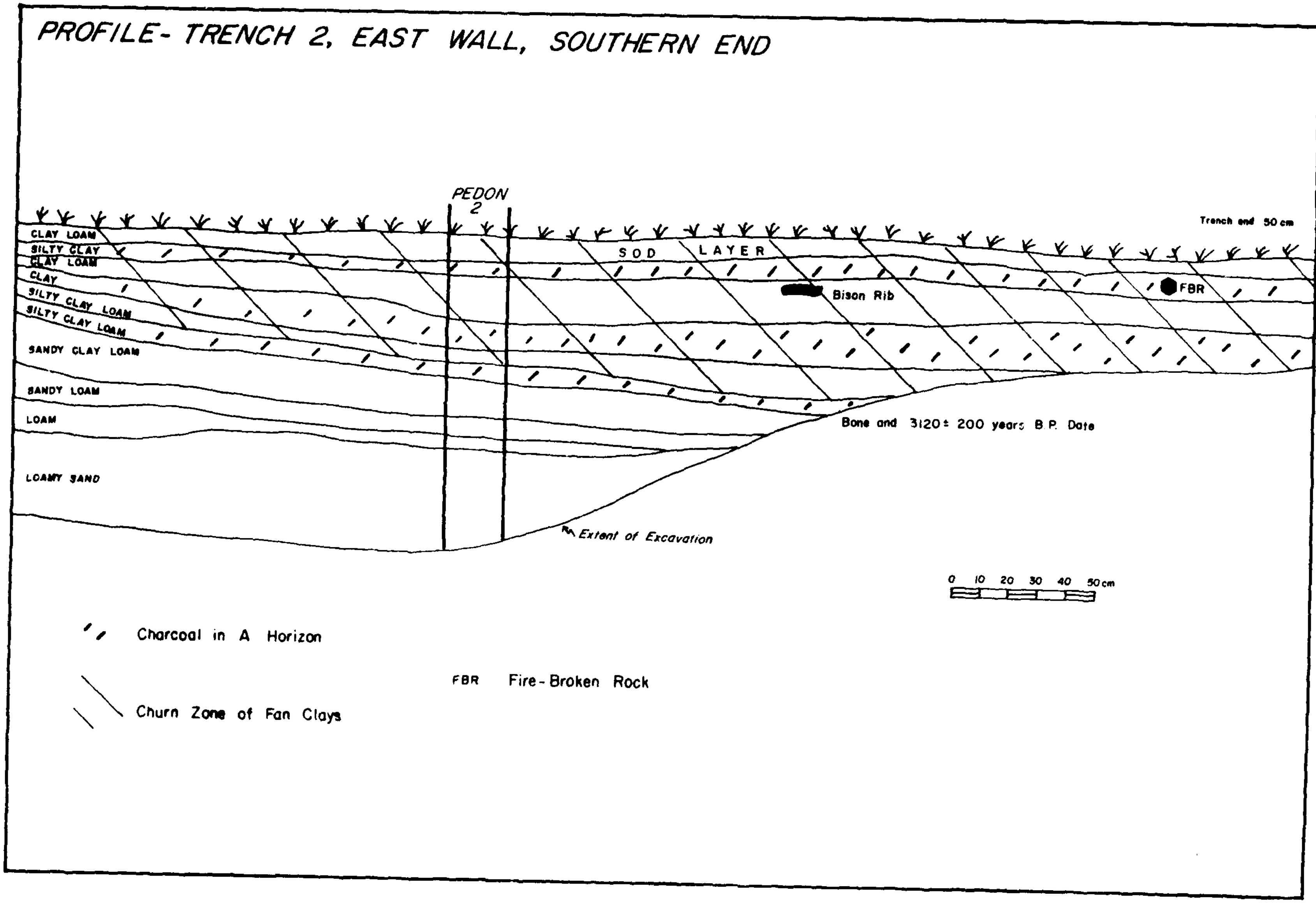


Figure 3-3. Profile from south end of Trench 2.

the following section, the radiocarbon date for Feature A overlapped neither that of Feature F nor that of Feature E at two standard deviations.

In summary, Level I probably represented the mixing of more than one cultural component. Level I had a definite Pelican Lake affiliation as the number of Pelican Lake projectile points and the appropriate radiocarbon dates confirmed. Beyond this, only trenches that link Level I cultural deposits across the site from fan clays to levees to overbank will resolve the questions that Level I's widespread dates provoked.

Level II

Level II was best defined in excavation units centered on 11N 299W. As mentioned above, these units were placed along the edge of one of the fan clay-filled depressions in the overbank deposits. The fan clay had not accumulated to more than a few centimeters thickness in these units. Such a thickness could result in the churning of materials within Level I. Lower levels escaped the displacement caused by churning fan clays. Level II lay in a silty to sandy clay loam characteristic of the overbank deposits (see Tables A-1 and A-2). The level produced no radiocarbon dates but did promise the possibility of a date if further work were to be conducted. Level II in this unit contained a possible hearth, Feature C, with fire-broken rock and charcoal (see Chapter 4).

Level II, in general, began at 10 to 15 cm below surface and continued to 18 or 20 cm below surface. These depths for the level could refer only to those units in stable overbank deposits due to the depositional complexities in other areas, as discussed above. Aside from materials recovered from the 11N 299W area, sparse cultural remains came from Level II in other overbank deposits. Whether these materials belonged to Level II as defined in the units centered on 11N 299W could only be proved by actually tracing the level across the site. Only trenches or excavation of large blocks would permit stratigraphic correlations. Without them, assigning a cultural level had to depend on depth in the overbank deposits.

Level III

Level III was the deepest shallow subsurface cultural level recognized. Materials in Level III came almost exclusively from that complex of units centered on 11N 299W. Level III appeared at greater than 20-cm depth in the overbank deposits. Level III was hastily defined, incompletely exposed, and prematurely abandoned so that excavation could focus on the deep Oxbow occupations. No radiocarbon samples were recovered from Level III, but further excavation could yield a radiocarbon date from a sample of the charcoal stains scattered across its floor. This level was not identified in other units. Other units in the overbank deposits had materials at the greater than 20-cm depth appropriate for Level III, but the materials were so sparse that no floor was noticed. Perhaps Level III exists just in the isolated pocket surrounding 11N 299W. Only the opening of more units to trace the Level III deposits would document its extent.

Just as Level I corresponded with the A horizon of the sod zone, so Levels II and III may have corresponded with buried A horizons. Figure 3-1 recorded the position of these two buried A horizons at 23 to 30 cm depth and 41 to 49 cm depth in Trench 3 East. Two buried A horizons also appeared in Pedon 6 (see Table A-2) at 15 to 27 cm depth and 37 to 45 cm depth. Pedon 6 was also located in the stable overbank deposits in Trench 4 (see Fig. 3-2) north of Trench 3 East. These two buried surfaces most likely correlated between the two trenches (as shown in Fig. A-2). The different depths of the surfaces illustrated the undulating topography of the overbank deposits. That undulating topography accompanied by the general downslope to the south of the site may have explained why the depths of Levels II and III did not match those of the buried surfaces.

The upper two A horizons (Horizons 2-2 and 2-4 in Table A-2) in the south end of Trench 2 (see Fig. 3-3) were probably not associated with the buried surfaces of the overbank deposits. These two horizons were in fan clays. Because the fan clay deposits were finely textured, they accumulated more organic matter (Krumbein and Sloss 1956). Thus, Horizons 2-2 and 2-4 may have represented such accumulations of organic matter and not true pedogenic development of the A horizons seen in Figure 3-1. The third A horizon (Horizon 2-6 in Table A-2) in Pedon 2 may indeed have been equivalent to one of the buried A horizons in the overbanks or to the sod zone. This horizon had a well-developed B horizon below it. The existence of a B horizon implied true pedogenic development in a surface. However, because of the drastically changing slopes associated with the fan clay channel fill, the levee, and the overbank deposits, as described above, this lowermost A horizon in Trench 2 could not be correlated with the developed A horizons of the overbank deposits. As discussed earlier, the churning of the fan clays above Horizon 2-6 had, undoubtedly, mixed materials from this horizon into sediments above it. These materials were tentatively assigned to Level I because the date of 3120±200 BP (1448±207 BC, corrected) from this horizon fell within the range of Level I dates. The slope of 10 cm/m up to the north for the horizon supported the possibility that this buried A horizon could indeed have merged with the sod zone occupied by Feature A to the north. That the Trench 2 date overlaps the Feature A date at two standard deviations (see Fig. 3-5) encouraged this view.

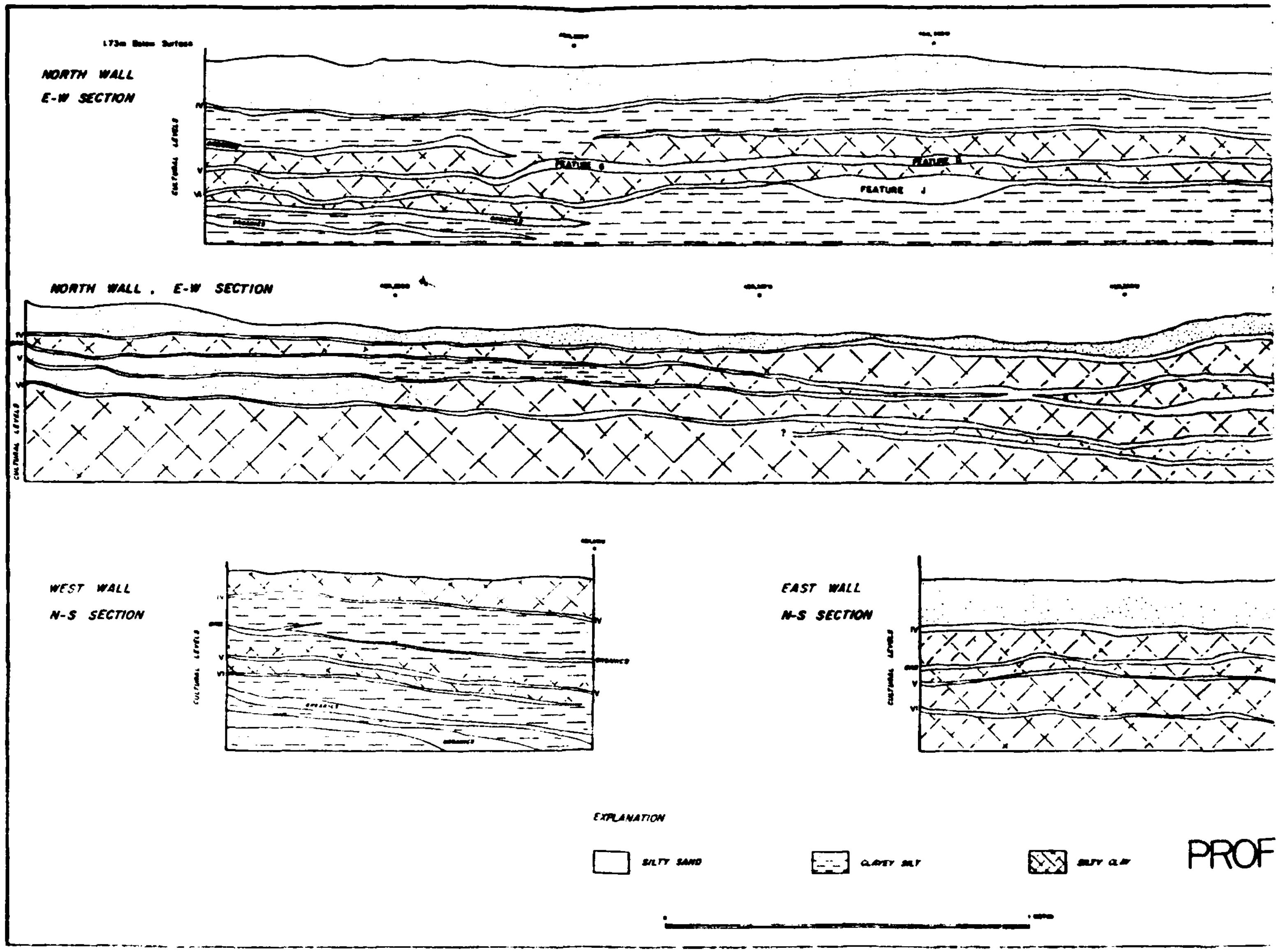
OXBOW OCCUPATIONS

Within the stable overbank deposits, as discussed, occupation surfaces occurred within buried A horizons. During excavation, this association of the cultural levels with buried surfaces was difficult to recognize because of the shallow depth of the deposits. Definable floor areas rather than clear strata delineated the shallow cultural levels. In contrast, the deep Oxbow occupations appeared in recognizable clay bands that exhibited no pedogenic development. These bands had to have been surfaces at some time. Either they were not exposed long enough for pedogenic development or pedogenic development at the time of their exposure was inhibited, perhaps by severe climate.

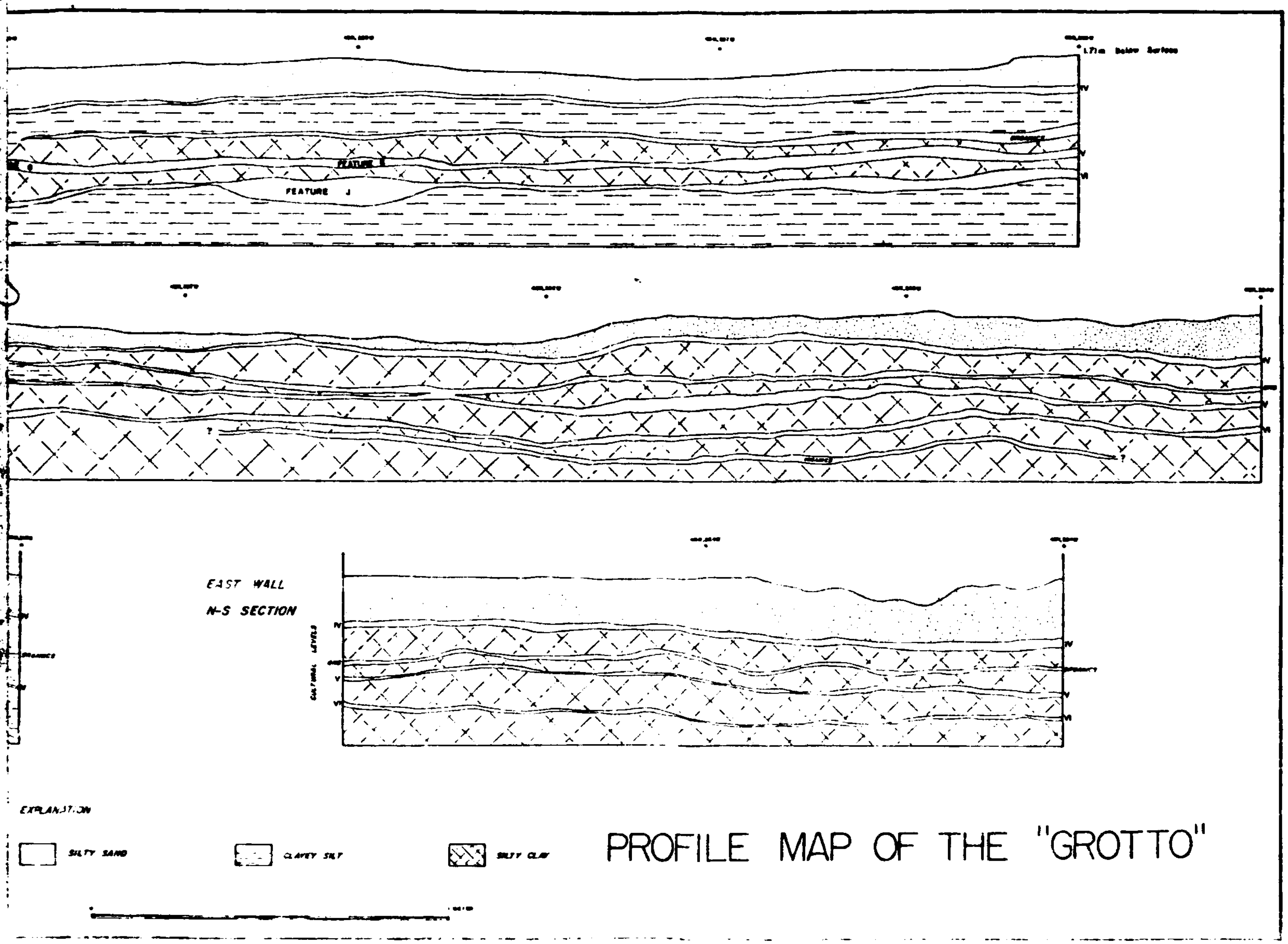
A backhoe trench exposed these deep surfaces. Figure 3-1 represented Pedon 5 (Table A-1) sampled in Trench 3 East where the cultural levels first appeared. The trench first exposed bison bone fragments at 184-cm depth. This depth straddled two horizons of overbank deposits from the Sun River banded with fan clays or with finer-textured Sun River alluvium.

Because the backhoe shovel disturbed the context of the first bone fragments, manual recovery of them required that a surface in the trench be cleared. In clearing that surface, a poorly defined upper cultural level could have been inadvertently missed. Such was a possibility given the discrepancy of 5 cm between the depth of the original bone fragments at 184 cm and the upper limit for Level IV defined in the trench at 189 cm. Given that the gap between Levels V and VI was often less than 5 cm (Fig. 3-4), that same discrepancy between the bone fragments first uncovered and the ultimate definition of a cultural level may indeed have intimated the existence of a cultural level immediately above Level IV.

That the radiocarbon date of 3450±350 BP (1880±353 BC, corrected) for Level IV overlapped all of the Level I dates at two standard deviations elicited two interpretations. The first required that Level IV was an exposed surface at the same time as at least some of Level I. With such an interpretation, the topography of the site at that time clearly had to undulate more dramatically than it does today. An alternative explanation focused on the large standard deviation of the Level IV date. If the true value of the date actually fell one standard deviation from the mean at 3800 BP, then the discrepancy between the Level IV date and the oldest Level I date at almost 3600 BP would be 200 years. The Sun River probably flowed in Channel 3 (Fig. 3-2) after the Level IV occupation. Because Channel 3 lay less than 25 meters from the Grotto area, overflowing waters would have quickly reached the Grotto area to deposit their sediments. Consequently, the 1.5 to 2 m of overburden that separated Level IV from the surface could have been rapidly deposited by a series of floods. Such thick flood deposits are not uncommon (Jahns



1.73m Below Surface
NORTH WALL
E-W SECTION
CULTURAL LEVELS
IV
V
VI
FEATURE 6
FEATURE 8
FEATURE J
NORTH WALL , E-W SECTION
CULTURAL LEVELS
WEST WALL
N-S SECTION
CULTURAL LEVELS
EAST WALL
N-S SECTION
CULTURAL LEVELS
EXPLANATION
SILTY SAND
CLAYEY SILT
SILTY CLAY
PROF



PROFILE MAP OF THE "GROTTO"

2

1947). The overbank deposits of Pedon 5 (see Table A-1) recorded the sequence of widely variable rates of deposition associated with the migration of the Sun River channel proper (see Appendix A).

The meander scars evident on the site map (see Map Pocket) document the migration of the Sun River. Before the Oxbow occupations, the river probably flowed north of the Grotto. The tributary alluvial deposits masked this scar (see Appendix A). During the Oxbow occupations, the Sun River flowed in the channels seen on the site map. For Levels V and VI, the river probably occupied the westernmost channel (Fig. 3-1, Channel 1), then shifted to the central one (Channel 2) during the occupation. After the Level IV occupations ended, the channel migrated to the easternmost channel scar (Channel 3). With the river in this channel, rapid overbank deposition quickly buried the Oxbow cultural levels. The Level I occupations lay farther from this easternmost channel and, thus, out of the range of rapid overbank deposition. The river abandoned the easternmost channel sometime near the time of formation of the lowest A horizon (Horizon 5-4) in Pedon 5 (see Table A-1). Deposition slowed enough at this time to allow pedogenic development. Horizon 5-4, as discussed above, may have been equivalent to the Level III deposits identified in some excavation units (see Fig. 3-1). If such were the case, it is plausible that the deposition of Horizons 5-5 to 5-9 occurred very rapidly and may have represented only two or three flood episodes. Appendix A explains the processes and rates of deposition for the overbank deposits as the Sun River migrated.

Level IV

Level IV extended across the 20 1- x 1 m squares of the Grotto and varied from 1 to 5 cm in thickness. The only date (see Table 3-1) from the level of 3450±350 BP (1880±353 BC, corrected) provided at least an upper limit to the time of occupation of the level (see below). Chapter 5 contains the results of the excavations in this level.

Excavations consistently identified Level IV as a compacted clay sand. These clays came from tributary alluvium or from finer-textured Sun River alluvium. When the front-end loader first expanded Trench 3 East to expose a wider area of the deep levels, it excavated to approximately 20 cm above the cultural deposits. The crew then worked with picks and shovels to remove the remaining overburden. The overburden was the slightly hard loam of Horizon 5-9 (see Table A-1). The reverberation of the pick as it struck the rock-hard silty clay of Level IV signaled the top of the cultural levels. With the overburden removed, excavation of 1- x 1 m units in the Grotto began.

The compactness of the clays of Level IV made *in situ* recovery of lithic and faunal remains difficult. This same compactness also obscured the boundaries of the different fills associated with Feature H (see Chapter 5). The thickness of the clays probably was not great enough to cause much displacement of artifacts due to repeated wetting and drying of the clays. Some displacement, however, may have occurred as evidenced by a few artifacts that did not rest on a horizontal surface but stood on end.

Level V

Between 10 and 20 centimeters of clayey silt and/or silty clay separated Level IV from Level V. This inter-level fill was neither continuous nor discrete nor homogeneous. Figure 3-4 reveals the complexities of the strata. An organic band merged with Level V then separated as seen in the 42N profile. This organic band ran continuously across the Grotto area except for the unconformity in the 45N profile. Excavators consistently described the organic band as sandy. The coarser texture of this band with its accumulated organics may have indicated that the band was a flood deposit. The higher velocity of flood waters would deposit coarser textures farther from the channel. Concomitantly, higher velocity waters also could have scoured deposits.

Level IV dated to approximately 3500 BP. The Level V dates clustered around 4500 BP, as discussed in the following section. A thousand-year hiatus represented by only 10 to 20 cm of deposition indicated either extremely slow deposition or episodes of scouring. After deposition of the clay band, Level V was occupied. The Sun River at the time of occupation probably followed Channel 2 in Figure 3-2. With the channel in this position, flood waters would have reached the location of Level V more easily than when the river flowed in Channel 1. In fact, the clay band of Level V could represent deposition during recession of flood waters. High flood waters would have differentially scoured sediments from Level V. During such stages, sediments from topographic highs would have been scoured and perhaps redeposited in backwater areas. The only feature in Level V, Feature G (see Chapter 6), sloped down to the north. This feature may have been preserved by the scouring of sediments from high spots with the depositing of those sediments in low areas. These sediments would have buried Feature G, thus preserving it.

These flood waters also must have scoured parts of Level V, as the variable thickness of the level may have indicated. The merging of the upper organic band with Level V in the 42N profile of Figure 3-4 documented such scouring. However, the high tractive forces of the fine textured silty clays and clays made them far less vulnerable to scouring than the coarser textured loams and silty sands. Overlying loams or silty sands may have been scoured repeatedly, but the fine textures of Level V, and probably also of Level IV, preserved these levels.

This repeated scouring may not have occurred frequently, if at all. Although the flowing of the Sun River in Channel 2 close to the Grotto location presumably increased deposition at that location, a dry climatic episode could have reduced water levels in the Sun River enough to prevent the river from rarely, if ever, leaving its channel. The lack of pedogenic development in the deep strata in the Grotto supported the idea of a dry climate episode. A dry climate with sparse vegetation would have slowed pedogenic development considerably. During this dry period when water did not leave the channel, overbank deposition ceased. Because bone preservation was good in Feature G, Level V could not have been exposed as a surface for a long period of time. However, once sediment covered Level V, that resulting surface may have existed for a long period of time before flooding scoured it away or deposited more sediment above it. Later episodes of scouring and deposition in the thousand-year gap between Levels IV and V may have removed all traces of such a surface.

Level VI

As much as 10 cm and as little as 3 cm of sediment divided Level V from Level VI. Primarily silty clay composed the inter-level fill, although this silty clay graded into silty sand at the west end of the 42N profile (Fig. 3-5). Level VI also lay within a clay band just as did Levels IV and V. The radiocarbon dates from Level VI clustered around 5200 BP. The dates did not cluster as tightly, however, as did the Level V dates, as is discussed below. With, at most, 10 cm of deposition between Levels V and VI, the 700-year gap between the two levels must have been a time of low water levels in the river, producing little deposition or a time of scouring of units deposited atop Level VI. When Level VI was occupied, the Sun River probably flowed in Channel 1 or possibly in Channel 2 (Fig. 3-2). With the river in Channel 1, overbank deposits would have been thin and infrequent. High flood waters could have differentially scoured the high areas of Level VI and could have deposited sediment in the low areas to preserve cultural materials. The most concentrated cultural materials in Level VI were found near 44N 268W. Excavators in peripheral units noted the slope of Level VI down toward 44N 268W, explaining preservation in this area through deposition. As was true for Levels IV and V, the clay matrix of Level VI also inhibited erosion of the level with its cultural materials.

As illustrated in Figure 3-4, at least one and possibly more organic bands underlay Level VI. Not all units were excavated deeply enough to expose the organic bands. The bands seemed similar to the clay bands that contained Levels IV, V, and VI. In fact, in 43N 266W the organic band approached Level VI so closely that excavators confused the two. The radiocarbon sample they collected from what they recognized as Level VI actually came from this deeper organic band that only revealed itself in profile. One piece of fire-broken rock came from the organic band in this unit. If exposed more completely, the organic band could prove to be a fourth cultural level, although cultural indicators were few in excavated samples. The possibility of even deeper organic bands could be seen in the west wall profile of Figure 3-4.

The cultural stratigraphy of the Grotto presented a complex network of cultural and noncultural lenses. These lenses undulated across the Grotto in variable thicknesses. All three cultural levels consisted of a clay matrix. Although this clay matrix helped to preserve the cultural levels, it also made excavation of the cultural levels a laborious process.

That all three cultural levels shared a clay matrix introduced further complications. The Long Creek site (Wettlaufer and Mayer-Oakes 1960) in southern Saskatchewan provided numerous illustrations of the difficulties that a clay matrix could cause in archeological excavation. A deep subsurface occupation at that site also had a clay matrix (Level 8) (Wettlaufer and Mayer-Oakes 1960:55-56). Clay cracks as it dries. At Long Creek, these cracks filled with a lighter colored, highly calcareous clay. These cracks indicated that occupation probably occurred when the area was dry. The plastic nature of clays preserved the animal tracks that imprinted the level and then filled with debris.

The Oxbow occupations at the Sun River site could have exhibited these same features in the clay, although to a much lesser degree. The late fall/early winter occupation of all three levels (see Chapters 5, 6 and 7) would have been a time of dry, cracked clay. Cultural materials from above could have fallen into these cracks and thus could have appeared to be from a different level. That a few flakes lay in the organic band between Levels IV and V was attributed to the cracking of the Level IV clay matrix and the filling of these cracks with Level IV debris. Animals passing over the moist clays of the cultural levels may have pushed cultural materials into lower levels. Perhaps the piece of fire-broken rock in the organic band below Level IV was pushed down into the band by this process.

The characteristics of the clay matrix of the cultural levels could explain the preservation of the cultural levels as well as the disturbance of them. The time between the cultural levels may have been represented either by an unconformity that resulted from the scouring of sediments and possibly even of cultural levels deposited between levels or by an unconformity that represented little or no deposition due to the low water levels of the Sun River. Before an evaluation of these alternatives is addressed, the radiocarbon dates for the Sun River site are presented and assessed. These radiocarbon dates can then serve to place the occupations within a climatic scheme for paleoenvironmental reconstruction.

RADIOCARBON RESULTS

Radiocarbon dating has become an integral and vital tool in archeological interpretation. Its use is so commonplace that even introductory prehistory textbooks (e.g., Hole and Heizer 1973) describe the physical process of radiocarbon dating. Radiocarbon dating is not, unfortunately, the panacea for stratigraphic and chronological dilemmas. Dates from the Sun River site certainly dash that pipe dream. Butzer (1964), Polach and Golson (1966), and Sheppard (n.d.) all have warned of the potential for contamination and other sources of error in radiocarbon samples. After reviewing these hazards, Butzer (1964:33) concluded that radiocarbon dates can be regarded as "absolute" only in a qualified way.

In accordance with the Scope-of-Work, two radiocarbon laboratories (Beta Analytic and the Center for Applied Isotope Studies at the University of Georgia) processed samples from the Sun River site (Table 3-1). The three University of Georgia results dated consistently older than the Beta Analytic results for samples of the same provenience. The University of Georgia date for Feature G in Level V was 1,100 and 1,300 years older than the two Beta Analytic dates for that feature. The standard deviation for the Georgia date was more than 8 percent of the date. With such a large standard deviation, the date almost overlapped at two standard deviations the older Beta date for Feature G. However, the other two Georgia dates from Feature A and Feature E did not overlap the Beta dates for those features at three standard deviations.

Radiocarbon dates tell when organic material lived; they do not tell when it was used. If the wood burned in hearths was driftwood, or relict timber, or heartwood from a long-lived tree, then radiocarbon dates from this wood would be older than the actual burning of the hearth. Ferguson (1971) reported over a 700-year spread within a single firepit for the radiocarbon dates for the wood or charcoal in that pit. Butzer (1964) commented that different pretreatment techniques may produce different dates. The University of Georgia suggested this as a possible explanation for the variance in the dates. Georgia did not pretreat the samples to eliminate humic acids. However, humic acid contamination from percolation of the acids of a more modern soil to the buried earlier cultural occupations would have produced younger, not older, dates, as did the Georgia samples.

Because more of the radiocarbon samples were processed by Beta Analytic and because the Level I dates corresponded more closely with those expected for the Pelican Lake cultural affiliation of that level, interpretations are based on the Beta Analytic results. Each date had its error plotted at one standard deviation and then at two standard deviations (Fig. 3-5). The true value for the date had a 68.27-percent chance of falling within the one standard deviation range and a 95.45-percent chance of falling within the two standard

TABLE 3-1

RADIOCARBON DATES FROM 24CA74

BETA ANALYTIC LAB DESIGNATION	UNCORRECTED DATE*	CORRECTED DATE* (DAMON ET AL. 1974)	PROVENIENCE	ASSOCIATED CULTURAL LEVEL
Beta - 5526	6750±440 BP (4800 BC)	> 7350 BP (5400 BC)	Trench 3 East charcoal pockets	Levels V & VI?
Beta - 5533	5960±210 BP (4010 BC)	6790±219 BP (4840 BC)	43N 266W	Organic band below Level VI
Beta - 5527	5670±190 BP (3720 BC)	6498±261 BP (4548 BC)	44N 267W Feature I	Level VI
UGa - 4632	5660±470 BP (3710 BC)	6488±503 BP (4538 BC)	45N 268W Feature G	Level V
Beta - 5517	5310±110 BP (3360 BC)	6118±168 BP (4168 BC)	44N 266W	Level VI
Beta - 5519	5040±100 BP (3090 BC)	5818±135 BP (3868 BC)	44N 266W	Level VI

*Dates in radiocarbon years Before Present (BP)

TABLE 3-1. RADIOCARBON DATES FROM 24CA74 (continued)

BETA ANALYTIC LAB DESIGNATION	UNCORRECTED DATE*	CORRECTED DATE* (DAMON ET AL. 1974)	PROVENIENCE	ASSOCIATED CULTURAL LEVEL
Beta - 5520	4640±120 BP (2690 BC)	5350±151 BP (3400 BC)	45N 267,268W Feature J	Level VI?
Beta - 5523	4560±70 BP	5252±116 BP (3302 BC)	44N 268W Feature G	Level V
Beta - 5531	4390±110 BP	5042±161 BP (3092 BC)	43N 265W	Level V
Beta - 5518	4370±110 BP	5017±161 BP (3067 BC)	45N 268W Feature G	Level V
UGa - 4630	4130±60 BP (2180 BC)	4715±118 BP (2765 BC)	43N 419W Feature E bottom	Level I
UGa - 4631	4005±60 BP (2055 BC)	4555±118 BP (2605 BC)	20N 350W Feature A bottom	Level I
Beta - 5522	3570±80 BP (1620 BC)	3987±153 BP (2037 BC)	Feature E bottom	Level I

*Dates in radiocarbon years Before Present (BP)

TABLE 3-1. RADIOCARBON DATES FROM 24CA74 (continued)

BETA ANALYTIC LAB DESIGNATION	UNCORRECTED DATE*	CORRECTED DATE* (DAMON ET AL. 1974)	PROVENIENCE	ASSOCIATED CULTURAL LEVEL
Beta - 5536	3450±350 BP (1500 BC)	3830±353 BP (1880 BC)	43N 265W	Level IV
Beta - 5521	3420±100 BP (1470 BC)	3790±109 BP (1840 BC)	26N 324W Feature F	Level I
Beta - 5525	3320±60 BP (1370 BC)	3659±74 BP (1709 BC)	West of project area, Feature D	Level I
Beta - 5532	3120±200 BP (1170 BC)	3398±207 BP (1448 BC)	Trench 2, south end at 63 cm depth	Level I
Beta - 5524	2790±90 BP (840 BC)	2974±95 BP (1024 BC)	20N 350W Feature A bottom	Level I

*Dates in radiocarbon years Before Present (BP)

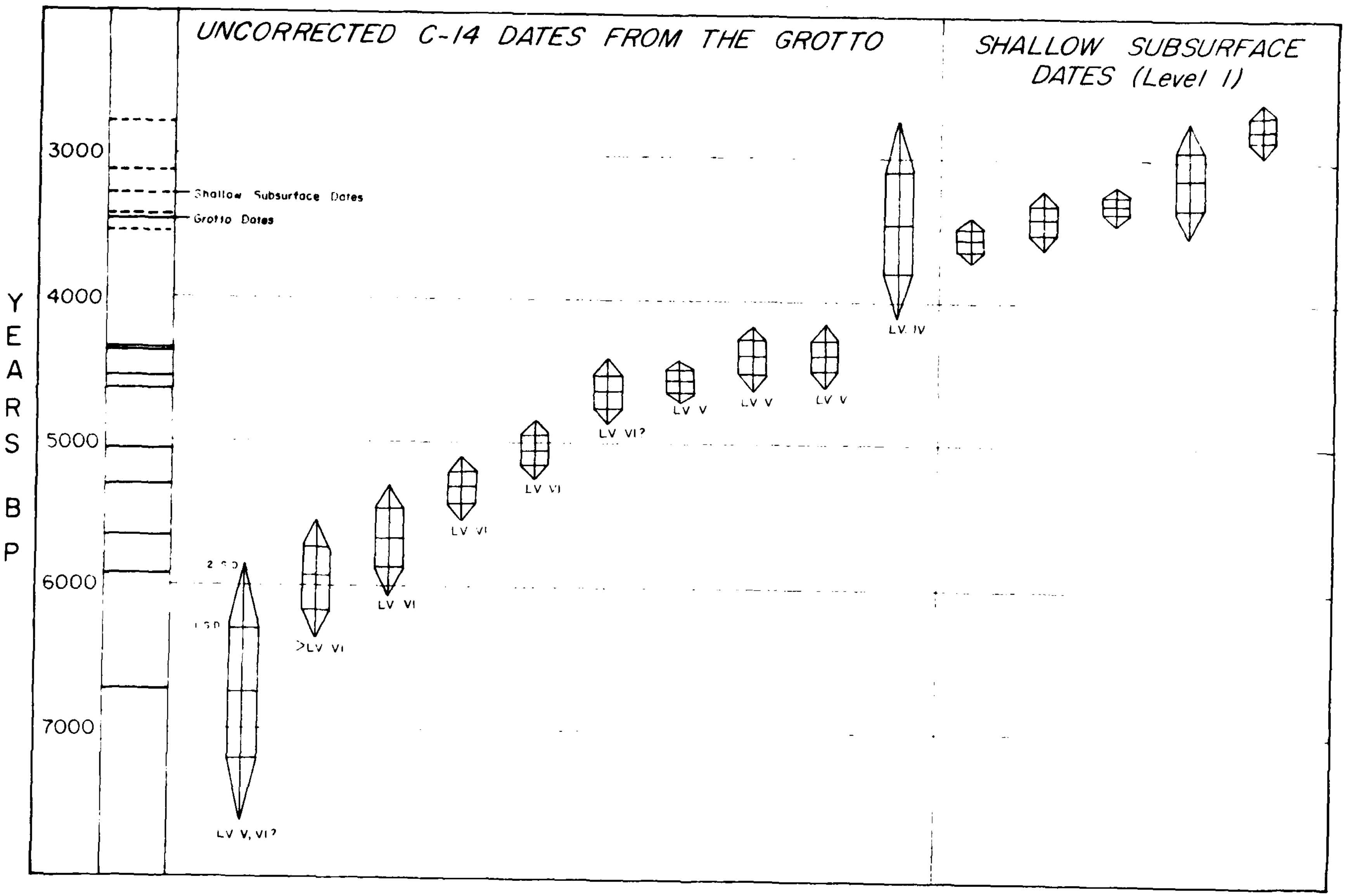


Figure 3-5. Plot of Radiocarbon Dates at Two Standard Deviations.

deviation range. The dates plotted were the uncorrected dates as reported by Beta Analytic (Table 3-1). The dates were in radiocarbon years Before Present (BP). Radiocarbon years were not equivalent to calendar years and, thus, did not represent true times of occupation. Radiocarbon years corrected according to the dendrochronologic calibration of Damon and others (1974) more closely approximated calendar years. Because the archeological literature traditionally compared dates in radiocarbon years, that convention has been maintained in this report. In an effort to encourage the use of dendrochronologically corrected dates as a close approximation of calendar uses, the corrected date followed the uncorrected date in parentheses when the uncorrected date was first reported.

Level I

The Level I dates extended over an 1800-year range, from 2790±90 to 3570±80 BP (1024±95 BC to 2037±153 BC, corrected) (Table 3-1). All of the dates did not overlap at two standard deviations (Fig. 3-5). Because of the aforementioned stratigraphic uncertainty about these dates, they could not justifiably be assigned to a single occupational episode. Most of the dates fell within the accepted range for Pelican Lake cultural affiliations, ca. 1600-3300 BP (Davis 1982). The discovery of Pelican Lake projectile points in Level I lent credence to the assignation of some Level I occupations to Pelican Lake. Without resolution of the stratigraphic questions raised above about Level I, no further interpretations of the Level I dates could be made.

Levels II and III

Levels II and III were best defined in excavation units centering at 11N 299W (see Chapter 4). They did not produce radiocarbon dates. The presence of a poorly defined feature, Feature C, in Level II offered the prospect that more extensive exposure of Level II would produce at least one datable radiocarbon sample. Level III also lacked datable samples. Charcoal stains and fire-broken rock intimated the existence of nearby datable hearths.

Level IV

The uppermost Oxbow occupation, Level IV, dated to 3450±350 BP (1880±353 BC, corrected). The sample for this date was collected from the occupation floor with no specific provenience. For that reason, the date may not represent the actual time of occupation, but only an approximation of when the level was a surface. Because of the contamination possibilities and error sources noted above, a single date was difficult to interpret. That the standard deviation for the date was over 10 percent of the date further diminished the sample's reliability and probably reflected the mixing of material expected on a surface scatter of charcoal. The dating of a surface feature, Feature E, to 3570±80 BP (2037±153 BC, corrected) restricted the upper limit for deep occupation. Because of the stratigraphic complexities discussed earlier, deep subsurface occupations could have continued after 3500 BP but not for a substantial period of time. At best, then, the Level IV date established an upper limit for deep Oxbow occupations.

Level V

The three radiocarbon dates from Level V clustered neatly at 4,500 years ago. Two of these dates were from Feature G, the only feature in Level V. The third sample was collected as a general charcoal scatter in 43N 265W. That the charcoal sampled for these three dates was from the same cultural level at less than 3 m distance and that two of the dates came from the same feature establishes a clear stratigraphic correlation of the date on the same living floor. With such a correlation, Long and Rippeteau (1974) recommended averaging the dates. This averaging technique required that the dates be averaged by weighting them according to their precision of measurement. The resulting averaged radiocarbon date for Level V was 4470±52 BP (3192±128 BC, corrected).

The averaged date may have represented an "instant" of time if Level V in both sampled areas was a single short-term occupation. The averaged date may only have indicated that the Level V dates were of "effectively" the same age, and thus, that Level V contained multiple occupations over a short period of time. Spaulding (1958) advocated the use of an *F*-test to evaluate whether a series of seemingly close radiocarbon dates represented an instant of time or whether they represented a duration of time significant with respect to the precision of analysis. The *F*-value for the Level V dates was insignificant at the 1 percent level of confidence; thus, the probability was less than 1 percent that the dates represented a finite time interval.

Level VI

Five dates defined Level VI. Two of these dates had questionable associations. The oldest date came from a mixed sample that was collected in Trench 3 East after the first deep subsurface bones were discovered. Initially, the cramped (60-cm wide) quarters of the trench obscured stratigraphic relationships. This problem was compounded when the separate radiocarbon collection bags were mistakenly combined by Beta Analytic. Without clear stratigraphic associations, the date had no interpretive value.

The other questionable date in Level VI was from Feature J. This date could not be easily dismissed. The 3- to 5-cm separation between Feature G and Feature J (discussed and illustrated in Chapter 7) did not appear as distinct in the field as it does in the profile. The excavator noted that he troweled through a few centimeters of ash before he defined Feature J. The slope of Feature G down to the northeast (10 to 15 cm over 2 m) brought it closer and closer to the top of Feature J. That the radiocarbon date from Feature J overlapped more closely with Level V dates than with Level VI dates (Fig. 3-5) may have indicated that the sample collected for Feature J was contaminated by Feature G charcoal.

Statistical analysis of the Feature J date as an outlier yielded no results. Long and Rippeteau (1974) demonstrated a technique for rejecting data, which, though statistically valid, untowardly biased a small number of values. The technique involved the use of the weighted average of the radiocarbon dates and of Chauvenet's rejection criteria. Neither when Feature J's date was averaged with the Level V dates nor when the date was averaged with the Level VI dates can it be rejected as a statistical outlier. Because of the substantiated possibility that the Feature J date mixed Level V and Level VI material, interpretations for Level VI (see Chapter 7) excluded this date.

The three other Level VI dates did not cluster as tightly as did the Level V dates (Fig. 3-5). Two of the dates were from floor samples in 44N 266W. Feature I in 44N 267W provided the third date. As discussed above, the stratigraphic correlation of the dates justified the use of the weighted averaging method. The average of the Level VI dates was 5229±69 BP (4067±145 BC, corrected).

Spaulding's (1958) *F*-test yielded a value significant at the 1 percent degree of confidence. The dispersion of values of the dates from Level VI had a greater than 99-percent probability of being due to a finite time interval between the dates. Consequently, the Level VI dates may have implied multiple occupations of the same living surface.

An earlier date from an organic band below Level VI of 5960±210 BP (4840±219 BC) may have represented a lower cultural level. Not all units were excavated deeply enough to expose this band. The band did contain one piece of fire-broken rock and thus may have been a fourth deep subsurface cultural level. Without exposure of the band in more excavation units, no determination could be made.

PALEOENVIRONMENTAL RECONSTRUCTION

The results of pollen column analysis provided the vital connection necessary to place the complex stratigraphy of the Sun River site's micro-environment within a regional framework. Although Short (Appendix C:6) concluded that the pollen record, as a whole, was too sparse to allow paleoenvironmental reconstruction, careful consideration of the fluctuating pine pollen counts from the column in Trench 3 East (Fig. 3-1) revealed some regional climatic variation.

Pollen studies to reconstruct paleoenvironments have traditionally depended on cores from bogs or lake bottoms (see, e.g., Mehringer et al. 1977; Waddington and Wright 1974). In these settings, sediments follow a nearly varve-like pattern of constant deposition. The rapidly fluctuating depositional and erosional cycles of the alluvial and fluvial setting of the Sun River site differ drastically from the varve type of deposition. Only after the effects of differential deposition were understood could paleoenvironmental reconstruction begin.

Following the Oxbow occupations, the Sun River occupied Channel 3 (Fig. 3-2), then migrated perhaps east and south until it occupied its present channel. Because of modern channel distance, the site received deposits only during high floods, allowing pollen from modern vegetation to have collected and concentrated in the upper centimeters. Short (Appendix C:4) explains the discrepancy between the high pollen counts of *Pinus* and Cheno-ams in the topmost sample (Fig. 3-1) and the grass-dominated vegetation present at the site today as due to the overproduction of the *Pinus* and Cheno-ams taxa and to their transport over long distances. Because *Pinus* pollen is present throughout the pollen column and because its transport over long distances makes it an indicator of regional vegetation changes, its frequency serves as the primary aid in paleonenvironmental reconstruction.

The high counts for *Pinus* in the upper 49 cm of the profile reflect both the slow deposition rate for that upper section discussed earlier and the relative stability of environmental conditions (Short, Appendix C:6). The slow deposition rates essentially collapsed the changes of the 2,800 years since Pelican Lake occupation of Level I into an indistinguishable mass. For Levels I, II, and III, then, the low deposition rates did not permit a precise enough breakdown of the pollen sampling units to reveal regional vegetational and, hence, climatic change.

Below Level III (Fig. 3-1), the *Pinus* pollen counts decrease drastically. That decrease did not result from a change in vegetation but from an increase in the rate of deposition. As discussed previously, the Sun River shifted its flow from Channel 2 to Channel 3 (see Fig. 3-2) after the Oxbow occupations. This shift moved the river much closer to the Grotto area and greatly increased deposition.

The increased deposition "diluted" the pollen rain to produce the low *Pinus* counts. Because this dilution effect could not be distinguished from an actual decrease in *Pinus*, the sequence of deposition from 49 cm depth to 184 cm did not yield paleoclimatic information. Only when this sequence was placed within the context of the deeper deposits did it produce such information.

Numerous researchers have contributed to the paleoenvironmental reconstruction of the Holocene. The tripartite division of the Holocene recommended by Antevs (1948, 1955) formed the basis for most of this work: the Anathermal, Altithermal, and Medithermal periods.

(1) The *Anathermal*, which immediately followed the glacial retreat, began with cool and moist conditions and gradually became warmer;

(2) The *Altithermal* was a warm period that was accompanied by maximum aridity in much of the western United States; and

(3) The *Medithermal*, a cooler, moister period, is still in progress.

Radiocarbon dates from the Sun River site (see Table 3-1) fall within the Altithermal and Medithermal periods. Antevs (1948) originally considered the Altithermal to have lasted from about 7,000 to 4,000 years ago in the western United States. Mehringer and others (1977) in their study of the Lost Trail Pass Bog in the Bitterroot Mountains of Montana generally agree with these dates with increased moisture documented around 5000 years BP and complete climatic amelioration achieved by 4000 years BP. Waddington and Wright (1974) in their study of pollen columns from a pond on the east side of Yellowstone Park, Wyoming, place the Altithermal from 9,000 to 4,500 years ago. At Waterton Lakes National Park in Alberta (Christensen and Hill 1971) pollen records indicate modern conditions were in place by 4800 BP. These dates corroborate each other in that they indicate the onset of a Neoglacial episode sometime between 4,500 and 5,000 years ago in the Northern Rockies.

With respect to the Sun River site, the radiocarbon date from Level IV of 3450 ± 350 BP (1880 ± 353 BC, corrected) falls after the Altithermal in what Porter and Denton (1967:205) term the Neoglaciation, or Antevs' Medithermal. The rebirth and/or growth of glaciers and generally cooler temperatures with increased moisture characterize this period. LaMarche and Mooney (1967), LaMarche (1973), and Thompson and Kuijt (1976) all documented treeline shifts attributable to the climatic changes of the Altithermal and Medithermal. If the Altithermal forced treelines to rise, perhaps "off the tops" of some low hills such as the Sweetgrass Hills of Montana (Thompson and Kuijt 1976), then *Pinus* pollen counts for the area would have decreased. The cooling of the Medithermal would have lowered the treeline (LaMarche and Mooney 1967) and would have increased the *Pinus* counts.

The drastic decrease of pollen (see Fig. 3-1) from the 184- to 200-cm sample, which contained Level IV, to the 200- to 244-cm sample, which contained Levels V and VI, reproduced the expected effects of the Altithermal on treelines. The source of Pinus pollen lay in the forests of the northern Big Belt Mountains, the southern Lewis and Clark Range, and the foothills between and adjacent to these ranges (Ross and Hunter 1976). The present prevailing winds at the site come from the southwest. Wendland (1980:141) maintains that general circulation patterns such as prevailing winds remained constant through the Holocene. The Altithermal treeline rise diminished the Pinus populations of the slopes and, consequently, reduced the deposition of Pinus pollen at the Sun River site. The averaged dates for Level VI occupation at 5200 BP fall within accepted dates for the Altithermal. The low Pinus pollen in the stratum that contained this level supports the placing of this occupation within the Altithermal.

The averaged date for Level V of 4500 BP bridges the boundary between the Altithermal and Medithermal periods. Climatic amelioration to the cooler and moister conditions of the Medithermal began at approximately this time. The consequent lowering of treeline in response to the amelioration lagged several hundred years behind the actual climatic change (LaMarche and Mooney 1967:981). Consequently, the Pinus pollen counts of Level V remained low. The lack of pedogenic development in Levels V and VI may have been caused by the severe climate of the Altithermal. The xeric conditions produced by that climate would have slowed pedogenic development by reducing vegetative cover.

The increased Pinus count in Level IV represents the climatic amelioration of the Medithermal. With moister and cooler conditions, Pinus species could have moved down the slopes of the Big Belt Mountains and the southern Lewis and Clark Range to the foothills which they populate today (Ross and Hunter 1976). The lowering of the treeline would have increased Pinus pollen transported to the site. The high pollen count of the strata that contained Level IV documents that treeline lowering.

Additional evidence for the Altithermal-Medithermal climatic change could be the increased sedimentation rate above the Level IV occupation. This rapid sedimentation undoubtedly occurred as a result of the migration of the Sun River closer to the Grotto area. The xeric conditions of the Altithermal reduced vegetation. The sparse vegetative cover encouraged large-scale erosion during wet periods. Episodes of erosion that began when the climate became cooler and moister at the start of the Medithermal may have accelerated the rapid deposition above Level IV. Wettlaufer and Mayer-Oakes (1960:99) noted a post-Altithermal increase in deposition at the Long Creek site in southern Saskatchewan. Certainly with the higher water levels in the river that resulted from the increased moisture of the Medithermal, the Sun River would have overflowed its banks more frequently. The influence of local channel migration and regional climatic amelioration could not be separated in the sediments above the Grotto.

However, the greatly increased *Pinus* count within the same stratigraphic unit from Levels V and VI to Level IV did indeed reflect regional climatic change exclusive of local changes in sedimentation rate.

The earliest occupation documented at the Sun River site dates to the Altithermal climatic episode. The second Oxbow level was inhabited during the increasingly cooler and moister conditions of the late Altithermal and early Medithermal. People lived within 50 to 100 m of the channel proper during these occupations. The uppermost Oxbow occupation occurred in the post-Altithermal period of climatic amelioration. This occupation lay within 50 m of the channel proper. Following the last Oxbow occupation, the Sun River migrated to within 20 m of the Grotto area and caused rapid deposition atop the cultural deposits. The subsequent migration of the Sun River channel to the east and south removed the site from the influence of Sun River alluvium except during high floods. Later occupations of the site occurred at a greater distance from the river. The proximity of occupations to the channel and the reconstruction of the climate during these occupations establishes the framework for interpreting cultural remains.

CHAPTER 4

CULTURAL REMAINS IN LEVELS I-III

Hand excavations to a depth of 40 cm below surface were conducted in 64 1-sq.-m grids, following the results of surface reconnaissance and auger and shovel tests (see Fig. 2-2). As discussed in the previous chapter, cultural remains in these upper deposits were located in three distinguishable levels marked by A horizons in the area paralleling the old channel. As distance to the north and west from the old channel increases, only the upper surface was apparent. This phenomenon is accounted for by soil types and resultant vegetation and how the vegetation, in turn, affects deposition (see Appendix A).

Level I, the sod zone, appears to be a 3,500-year-old surface with evidence of multiple occupations spanning the period between 2800-3600 BP. Because of the multiple occupations and the unclear relationship between one excavation unit and the next, only the specific hearths and associated cultural remains are discussed in detail.

Levels II and III are best defined in a five-square-meter area centered at 11N 299W, and detailed discussions of these levels are limited to this floor area. Complementary data are presented in tabular form. The discussion addresses hearths, faunal remains, and lithic remains, in addition to behavioral inferences.

CULTURAL LEVEL I

Level I was present throughout the defined site area and is known to extend to the west. Other limits have not been defined. The area where Level I is thought to be best preserved correlates with the stable sediments just north of the old channel (Fig. 4-1). Outside of this area, the thick clays are subject to argilliturbation and a resultant loss of context for archeological remains.

Five Level I hearths have been investigated (Table 4-1). Two of these features (A and B) were first encountered by the 1978 crew (McLean 1979), one of which (A) was further investigated by HRA in 1982. Feature B was not relocated in 1982 due to time limitations, since most of our efforts focused on the Oxbow occupations once they were discovered. McLean (1979) also had recorded a "fire floor" north

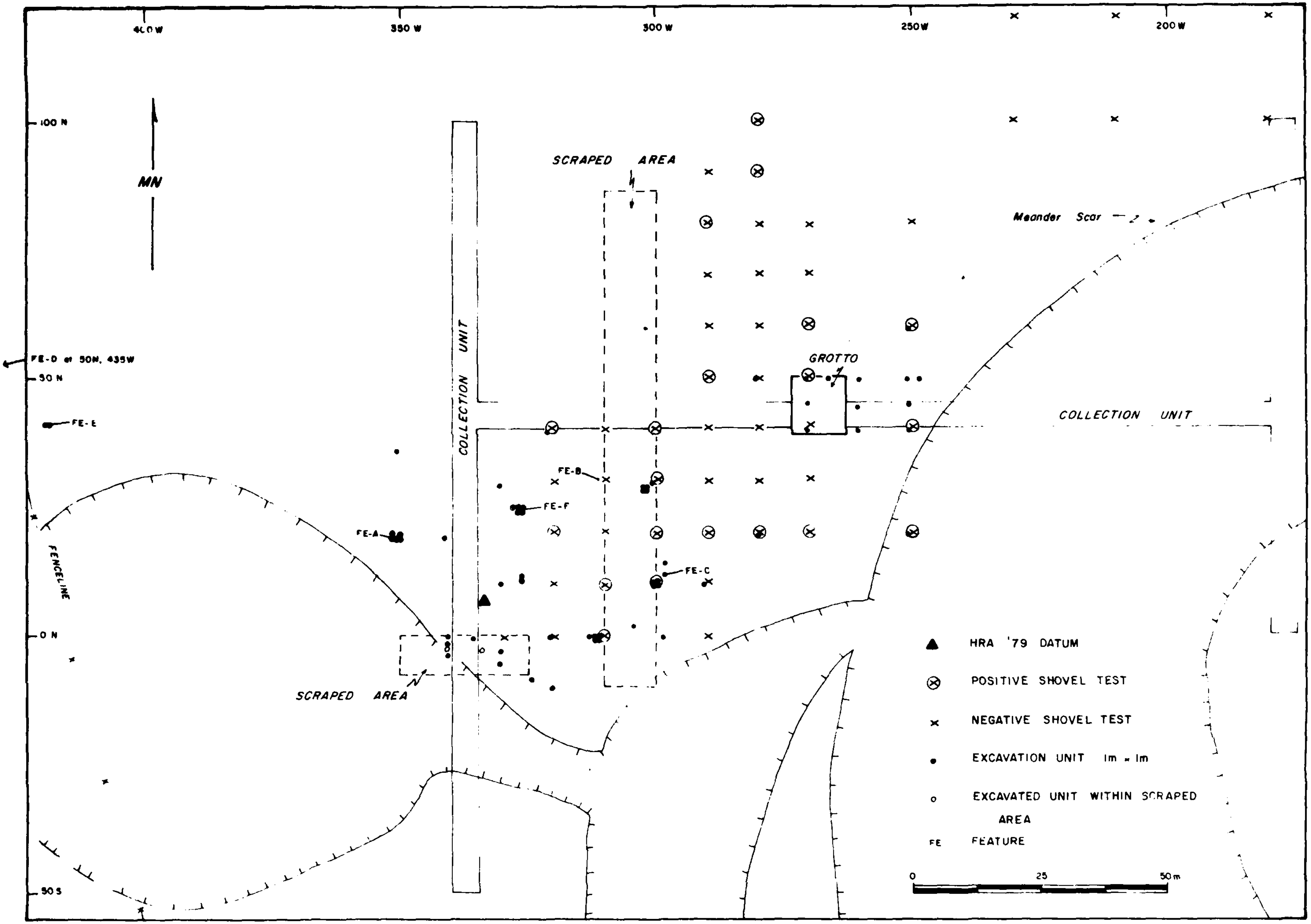


Figure 4-1. Distribution map of Level I hearths.

TABLE 4-1

CULTURAL LEVEL I FEATURE SUMMARY

FEATURE	LOCATION	CULTURAL LEVEL/DEPTH	TYPE	DIMENSIONS	MATRIX COMPOSITION	ASSOCIATED CULTURAL ITEMS	C-14 DATE/LAB NO.	COMMENTS
A HRA '79 and '82	19N 350W 20N 350W, S1/2 19N 351W, E1/2	I 3-35 cm below surface	Rock-filled basin-shaped hearth	1.1 m NS x 1.4 m EW x 22 m deep	Charcoal and clay overlying oxidized soil	Fire-broken rocks, bone fragments, lithic debitage	2790±90 BP	Flotation samples (2): no lithic remains or bone
B HRA '79	32N 309W	I 5-7 cm	Rock-filled, basin-shaped hearth	Undetermined	Charcoal and ash overlying oxidized soil	Fire-broken rock, lithic debitage and tools	None collected	Only partially excavated in 1979
D HRA '82	50N 435W	I 7-35 cm below surface	Rock-filled basin-shaped hearth	70 cm NS x 70 cm EW x 30 cm deep	Charcoal and silty sand overlying oxidized soil	Fire-broken rocks	3320±60 BP	Feature encountered by neighboring farmer while leveling his field
E HRA '82	43N 418W, SW1/4 43N 419W 42N 418W, NW1/4 42N 419W, NE1/4	I 0-15 cm below surface	Rock-filled pit hearth	1.3 m NS x 1.1 m EW x 15 deep	Charcoal and mottled clay overlying oxidized soil	Fire-broken rock, core fragment, flakes (Float--one small burned bone)	3570±80 BP	Flotation samples (2): no lithic remains and only one small mammal bone which was burned
F HRA '82	26N 325W, SE1/4 25N 325W, N1/2	I 5-27 cm below surface	Rock-filled, basin-shaped hearth	65 cm NS x 70 cm EW x 22 cm deep	Charcoal and ash, burned earth and clay overlying oxidized soil	Fire-broken rock, flakes, bone fragments	3420±100 BP	Flotation sample (1): no cultural remains; two episodes of use in evidence

of Feature A which he referred to as Feature C. Investigations in 1982 determined that this was not a feature but rather a thin charcoal lens with no cultural association that may have been the result of a grass fire. (Feature C has been re-assigned to a feature in Level II.)

Features

Feature A was a circular (1 m diameter), basin hearth that was encountered about 3 cm below the present site surface (Fig. 4-2). A radiocarbon date of 2790±90 BP was derived from charcoal. The fill was sandy clay with charcoal flecks in the upper part of the hearth, with charcoal increasing toward the bottom. Defining the bottom of the pit was a 2-cm thick band of oxidized earth (Fig. 4-3). Approximately 200 rounded, water-worn sandstone and quartzite cobbles were removed from the hearth fill, many of which were fractured.

Within the upper hearth matrix, McLean (1979) reported finding lithic debitage and a number of bones from an adult bison, including one mandible, a thoracic vertebra, and one first and one second phalange, representing opposite sides. Additional fragments of bison bone include three rib fragments and two tooth fragments. From the 1982 excavations, additional bison bone included a phalange (smaller than the others), a radius fragment and skull fragments. A chert core was also recovered in 1982. Interestingly, none of the bones showed evidence of burning, indicating that they were deposited in the hearth after the coals had cooled. A few tiny fragments of charred bone were retrieved from a 3-1 flotation sample.

This hearth, based on the presence of quantities of fire-broken rock, is interpreted as having served to heat rocks for stone boiling. The rocks displayed evidence of both expansion and contraction fractures, indicating that some broke as a result of being heated and others broke as a result of being cooled, presumably in cold water. When the stone boiling activities were completed, the rocks were deposited back into the pit. Perhaps the bone also was deposited at this time.

Feature B, based on McLean's (1979:23) description, has basically the same morphological attributes as Feature A. At 10 cm, the excavators encountered quantities of fire-broken rock in a charcoal-flecked matrix. Based on results of partial excavation, in cross-section the hearth appeared to be basin-shaped. No charcoal was collected, nor were matrix samples. Little more can be said about this feature other than it is presumed to have served to heat stones for boiling food.

Feature D was located by an adjacent landowner to the west during land-leveling activities. He contacted our crew, who quickly excavated the feature and recovered samples. Like the previous two

Figure 4-2. Photograph of Feature A.

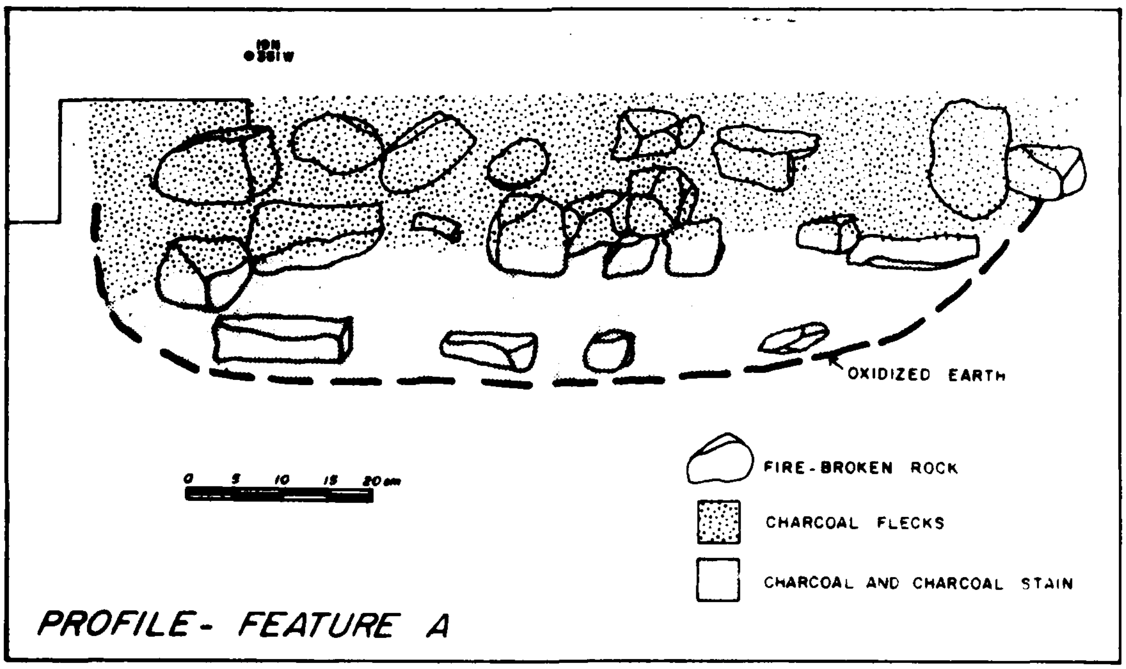


Figure 4-3. Profile of Feature A.

features, Feature D was a circular, steep-sided, basin-shaped hearth, with a diameter of approximately 70 cm (Fig. 4-4). The fill was comprised of charcoal stain and charcoal which was densest at the bottom, overlying a 2-cm thick zone of oxidized earth which defined the hearth periphery. Within and above the charcoal layer were approximately 50 large, water-worn cobbles measuring 10-30 cm across. Many of these cobbles were fractured. No cultural remains were associated with the feature. A radiocarbon date of 3320±60 BP was derived from charcoal from the lower hearth matrix. Again, this hearth is interpreted as having heated stones for boiling food.

Feature E was visible on the surface at the west edge of the project area, as evidenced by fire-broken rock. Generally shallower than the previously discussed hearths, Feature E had no well-defined basin profile, but rather was asymmetrical in cross-section (Fig. 4-5). The shape in plan view was not distinctive due to surface erosion. Around the periphery of the hearth was a barely perceptible zone of oxidized earth. This oxidized zone was overlain with a dark-charcoal-enriched clay sediment. Within and above this sediment were about 50 water-worn cobbles and fire-broken fragments of quartzite. No indications of hearth reuse were observed. However, the dense scattering of fire-broken rock and charcoal-darkened sediments around the outside of the hearth pit indicate disturbance either from deliberate emptying of part of the hearth contents or from post-occupational disturbances (e.g., trampling, erosion).

Associated artifacts included a core fragment and six flakes, all of which were recovered from within the hearth matrix. A radiocarbon date of 3570±80 BP was derived from charcoal recovered from the lower hearth matrix. Like the other Level I hearths, Feature E is interpreted as having served to heat stones for boiling food.

Feature F was a circular, basin-shaped hearth, originally identified on the basis of surface-visible fire-broken rock (Fig. 4-6). The hearth was comprised of a basal zone of reddened, burned earth which extended up the sides of the hearth pit. However, this oxidized zone became indistinct as it sloped upward toward the surface. A layer of charcoal overlay much of this zone in the western portion of the hearth, and a thin lens of this layer extended 20 cm westward outside the oxidized zone. In the eastern portion, the charcoal layer sloped upward and was separated from the oxidized earth zone by an intrusive lens of gray ashy clay. A similar ashy lens overlay the charcoal layer in the western side of the hearth pit. The charcoal and ashy layers were overlain by a matrix of burned earth, charcoal flecks, gray clay, and fire-broken rocks.

The extension of the charcoal layer outside the oxidized earth zone, the discontinuity of the ashy lenses, and the presence of burned earth and charcoal flecks within the overlying matrix suggest that the hearth was partially emptied and reused at least once.

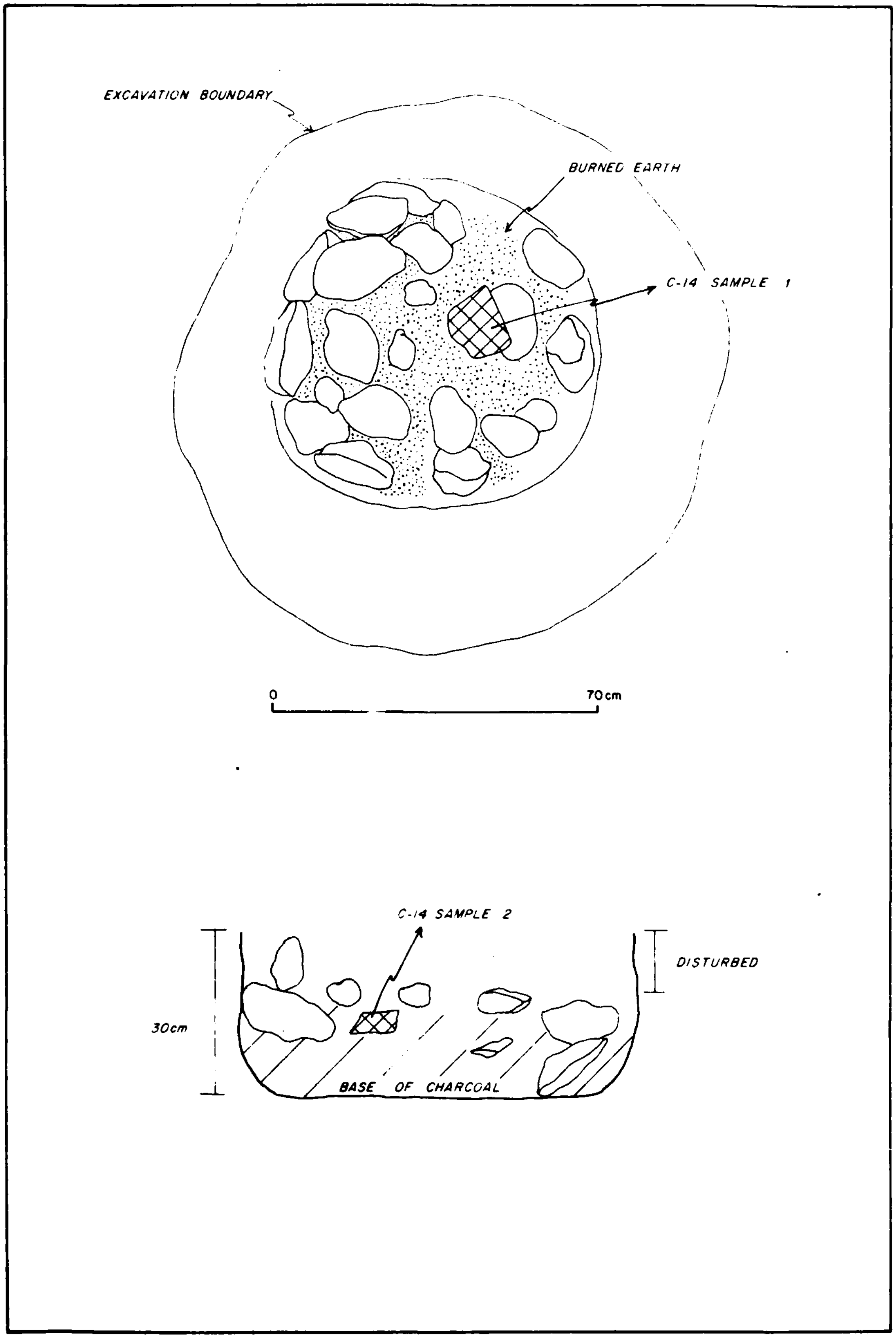


Figure 4-4. Feature D Plan View and Profile.

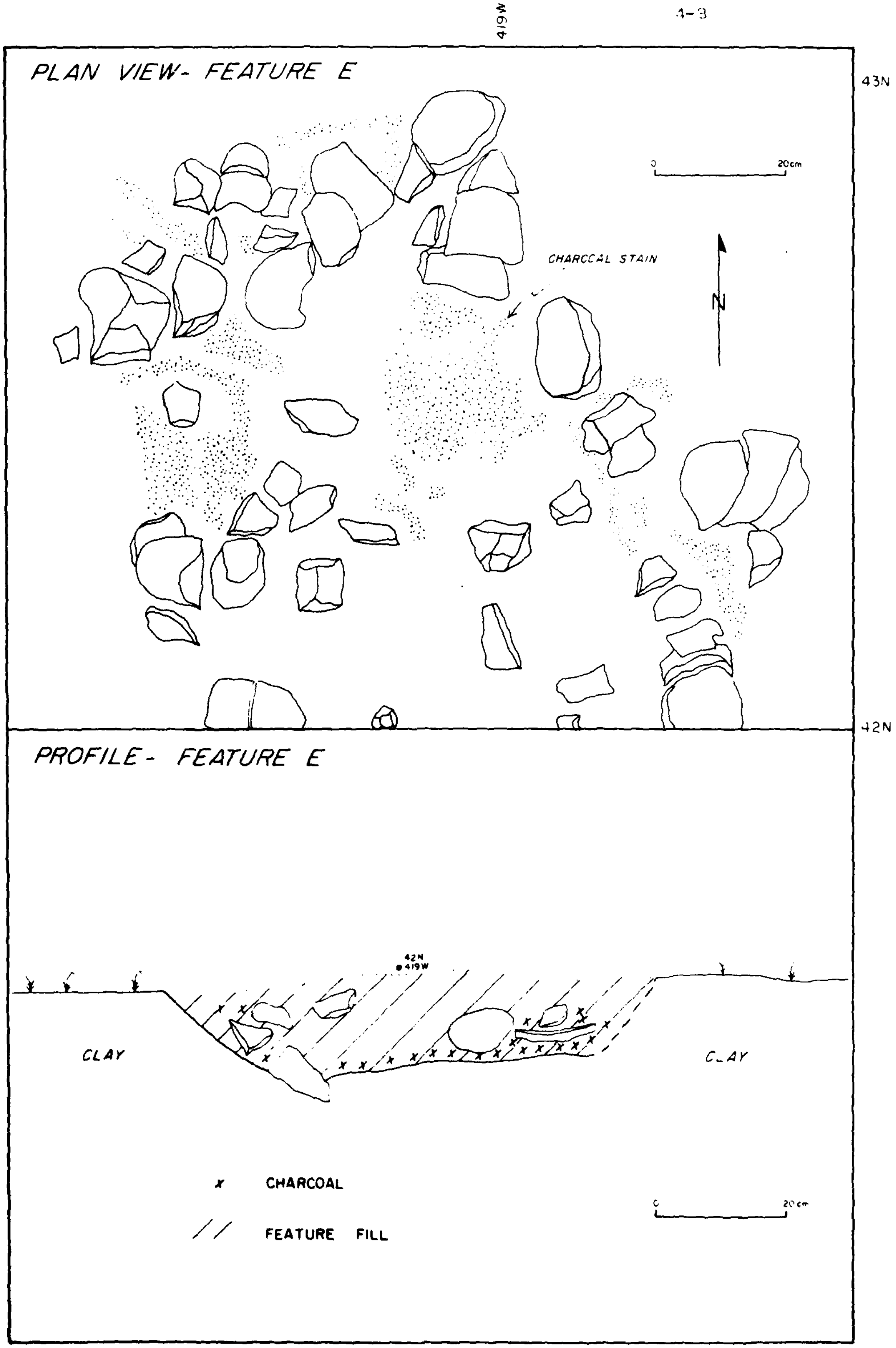


Figure 4-5. Feature E Plan View and Profile.

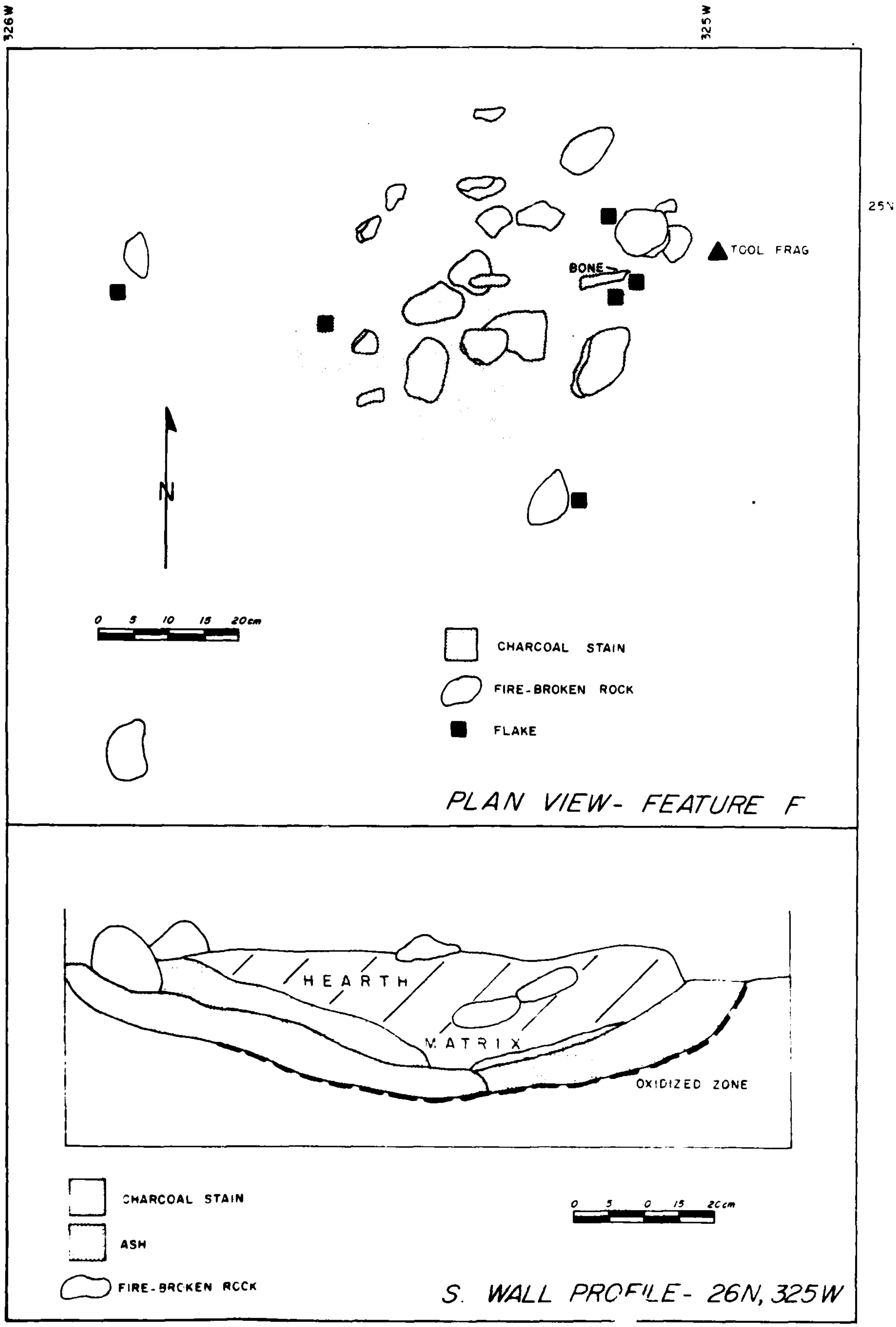


Figure 4-6. Feature F Plan View and Profile of South Wall.

Several flakes and bone fragments were recovered from the upper 10 cm of the hearth matrix. Fire-broken rock was less numerous than in Features A, B, and D, although the hearth function may have been the same. A light scatter of fire-broken rock extended 50 cm to the southwest of the feature. A date of 3420±100 BP was derived from charcoal extracted from the lower part of the matrix.

In addition to these defined features, a few small clusters of fire-broken rock were noted on the surface which were indistinguishable from the surface characteristics of Features E and F. However, upon testing, no indications of hearth construction were encountered.

It is impossible to estimate the number of features which may remain in Level I. Only a small fraction of the area was excavated and since two of the hearth features were not surfacially visible, we would expect a large number of additional hearths. Furthermore, these hearths filled with fire-broken rock were the most visible. Other, less obvious features also are expected to occur in substantial numbers.

Faunal Remains

Surface collection and excavations between 0 and 10 cm below surface produced 414 bones and bone fragments (Table 4-2). A total of 239 (56.5 percent) of these bones were identified as bison. More importantly, nearly 97 percent of identifiable bones were identified as bison. Remains of pelecypods (freshwater mussels), deer, and rodent also were identified. A single heavily mineralized bone fragment was recovered. Flotation samples produced eight bone fragments, only one of which was identifiable. All faunal remains, except the fossilized fragment, represent economic species.

Taphonomy, Aging, and Season of Use

Most bones from Level I were heavily fragmented as a result of butchering and exposure on or near the present ground surface. In most cases, bones were too fragmented to make specific observations for exfoliation or root etching. Evidence of scarring or bone loss from chewing by carnivores was also quite limited. The only obvious example was the thoracic vertebra found by McLean (1979) in Feature A.

Another Feature A bone, the bison mandible (McLean 1979), provided the only indication of age of animals exploited and season of kill. Based on tooth eruption and wear (Frison and Reher 1970; Reher 1973, 1974), it appears that the mandible is from an 8-year-old bison killed in the spring. However, a single specimen does not provide an adequate sample.

TABLE 4-2

SUMMARY OF LEVEL I EXCAVATED AND FLOTATION SAMPLE BONE

SPECIES	NUMBER OF EXCAVATED BONES AND FRAGMENTS	NUMBER OF FLOTATION SAMPLE BONES AND FRAGMENTS	TOTAL	PERCENT OF TOTAL
Bison	239 2 burned	0	239	56.50
Pelecypod	4	0	4	0.95
Deer	2	0	2	0.47
Rodent	1	1	2	0.47
Fossil Bone	1	0	1	0.24
Unidentifiable	167 6 burned	8	175	41.37
TOTAL N	414	9	423	100.00

Butchering and Bone-processing Activities

Due to the scattered sample of excavation units, it is difficult to determine the number of animals represented by the bone. Given the fact that bone was recovered from two Level I features with 600 years separating their radiocarbon dates, we cannot address the faunal remains from Level I as a single unit. Therefore, further discussion will concentrate on those remains from the floor area centered at 11N 299W. Although the sample is small, a continuous floor was defined which was clearly distinguished from Levels II and III.

Recovered bone from the specified area was primarily bison, with a single rodent tooth and freshwater mussel clam also recovered. The bison bone fragments were from the skull, ribs, and front leg. A total of eight burned bone fragments, the only ones from Level I, occurred in this area.

Although evidence was generally lacking, we assumed that a stylized butchering sequence of hide removal, muscle removal, general disarticulation of elements, and processing of individual bones for marrow and/or grease was followed. The generally fragmented nature of the bone would support this reconstruction. The limited number of specimens in addition to the absence of articulations and the dearth of complete elements makes reconstruction of the actual sequence impossible. If the interpretation of the cobble-filled features as boiling pits is correct, we can assume that meat was cooked and grease may have been rendered, as well.

Given that Level I was occupied a number of times and that these occupations cannot, at this time, be differentiated, it is not possible to make estimates regarding the number of people and butchered animals represented per occupation. Much more extensive excavation would be required to acquire enough data for such estimates.

Flaked Stone Artifacts

Four Pelican Lake projectile points were recovered from excavated context in Level I (Fig. 4-7), in addition to two biface fragments, one core remnant, and a variety of flakes representing the full range of reduction. Table 4-3 summarizes all flaked stone artifacts recovered from the surface to 10 cm in depth. As discussed above, it was impossible to discriminate among multiple occupations across the site, so the limitations of these data should be recognized.

Silicified sediment was the most common lithic material, followed by chert and chalcedony, with limited amounts of obsidian, quartzite, agate, and basalt. Because so much of Level I was contained in the sod, which was shovel skimmed rather than trowled, little of this material was recovered in situ. Furthermore, according to local ranchers, the site has been surface collected for years, resulting in the removal of an unknown percentage of the Level I tools. Accordingly, distributions of artifacts will not be discussed.

Figure 4-7. Level I Pelican Lake projectile points (full scale).

TABLE 4-3

FLAKED STONE ARTIFACTS FROM SURFACE AND LEVEL I

ARTIFACT CATEGORY	LITHIC MATERIAL TYPES* CHT	SS	CHL/AGATE	QTZ	OBS	BAS	TOTAL
Cores	1	3	0	0	0	0	4
Flakes	97	132	74	20	11	6	340
Biface Blanks	1	1	0	2	0	0	4
Preforms	1	1	1	1	0	0	4
Projectile Points	7	3	1	0	1	1	13
Modified Flakes	5	1	0	0	0	0	6
TOTAL	112	141	76	23	12	7	371

*LITHIC MATERIAL TYPES KEY: CHT = Chert
SS = Silicified Sediment
CHL/AGATE = Chalcedony/Agate
QTZ = Quartzite
OBS = Obsidian
BAS = Basalt

Level I Summary

Level I appears to have been a long-lived surface which was occupied a number of times during the centuries between 2800 and 3600 BP. From the five features, generally thought to represent hearths where stones were heated, in context with butchered bison remains, the most obvious activities carried out by past occupants revolved around bison processing.

CULTURAL LEVEL II

The second living surface was more easily defined than the first because it was buried rather than surficial and it was exposed for a shorter period of time. The limits of Level II are thought to be defined by the extent of overbank deposits from the Sun River when the channel was situated to the southeast of the site. More excavation is required to actually determine the limits. As mentioned, the excavation units centering at 1N 299W were productive and provided the best definition of Level II currently available (Fig. 4-8).

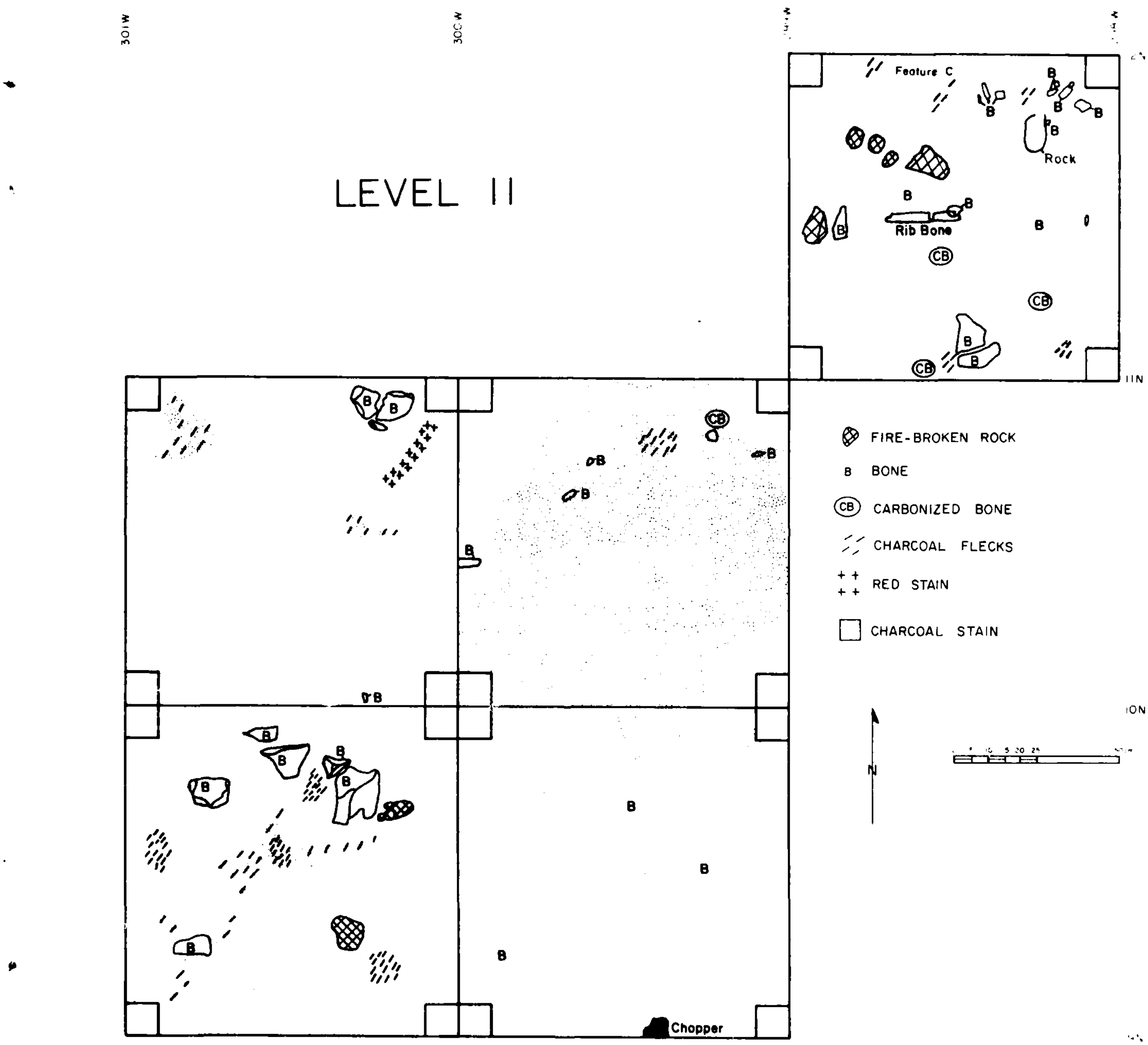


Figure 4-8. Level II Floor Plan.

Features

Only one poorly defined feature, Feature C, was located on Level II (Fig. 4-9). Feature C appears to have been a basin-shaped hearth, with an 80-cm diameter, as indicated by the rim of oxidized earth and the charcoal flecks in the matrix. Unfortunately, the charcoal was too limited for radiocarbon dating. Much of the matrix was oxidized, indicating that the matrix was part of the represented activity, rather than subsequent fill. Pockets of ash were scattered through the matrix, as well. Unburned bone fragments were recovered from the upper matrix. A few pieces of fire-broken rock were scattered to the southwest of the feature and carbonized bone was scattered throughout the 1-m unit.

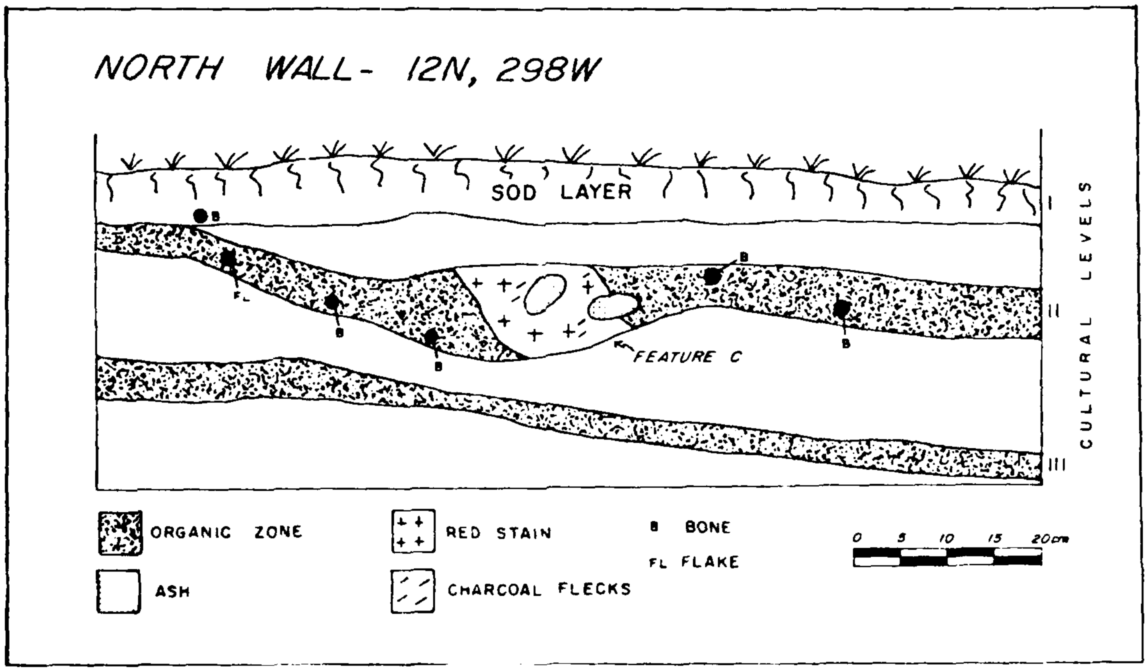


Figure 4-9. Level II, Feature C profile.

Faunal Remains

Level II excavations produced a total of 382 bones and bone fragments, 37 percent of which were identified as bison (Table 4-4). Bison represents nearly 92 percent of the identified bone. Remains of rabbit or hare, pronghorn, pelecypod, and prairie dog also were identified on this level. The prairie dog may have been intrusive, whereas the other species are believed to have been of economic value to the former inhabitants. Flotation samples for this level did not yield any faunal remains.

TABLE 4-4

SUMMARY OF LEVEL II EXCAVATED AND FLOTATION SAMPLE BONE

SPECIES	NUMBER OF EXCAVATED BONES AND FRAGMENTS	NUMBER OF FLOTATION SAMPLE BONES AND FRAGMENTS	TOTAL	PERCENT OF TOTAL
Bison	139	0	139	36.39
Rabbit or Hare	6	0	6	1.57
Pronghorn	4	0	4	1.05
Pelecypod	2	0	2	0.52
Prairie Dog	1	0	1	0.26
Unidentifiable	230	0	230	60.21
TOTAL N	382	0	382	100.00

Taphonomy, Aging, and Season of Use

Most bones from this level were fairly fragmented due mainly to butchering. Exfoliation was the only obvious natural process which acted on the bone and it was observed only in very few cases.

Indications of age of animals or season of use was very limited. Two large long bone epiphyses were unfused, indicating a subadult bison. In addition, a very small vertebra fragment, possibly fetal and probably bison, was recovered. It was the size one might expect for a midterm fetus, indicating possible winter occupation. The evidence is much too limited to be more than speculative, however.

Butchering and Bone-processing Activities

As with Level I, Level II faunal remains were so limited and fragmented that discussion of butchering or bone processing would be speculative at best. It appears that the occupants exploited one adult and one fetal bison (possibly related), and one of each of the remaining species. Given that the extent of Level II is unknown and that the sample was too limited to establish patterns of bone dispersal, estimates of the total number of animals represented were precluded.

Flaked Stone Artifacts

No diagnostic artifacts were recovered from Level II. Within the defined floor area pictured in Figure 4-8, lithic artifacts consisted of a variety of flakes predominated by silicified sediment and obsidian (Table 4-5). Flake categories representing early reduction stages were best represented, and no pressure flakes were recovered. The absence of fine-screening undoubtedly skewed this sample.

TABLE 4-5

DEBITAGE SUMMARY FOR LEVEL II

DEBITAGE TYPE	MATERIAL TYPE*					TOTALS
	CHT	SS	CHL	QTZ	OB	
Cortical Flake	1	1	1	1		4
Interior Flake		2			2	4
Bifacial Thinning Flake		1		2	1	4
Pressure Flake						0
Shatter	4	1			1	6
TOTALS	5	5	1	3	4	18

*MATERIAL TYPES: CHT = Chert
SS = Silicified Sediment
CHL = Chaldedony
QTZ = Quartzite
OB = Obsidian

A quartzite chopper was recovered from the southeast corner of the excavation area. This chopper was bifacially flaked at one end to form a sharp edge (Fig. 4-10a), which had subsequently been dulled through use. The opposite end of this tool displayed battering on the portion which had not been removed through previous heat spalling (Fig. 4-10b).

Level II Summary

Generally, little is known about the occupation of Level II, not even the cultural group represented. Two sources of information, however, aided in the assessment of the cultural group: (1) its position between Pelican Lake and Oxbow occupations and (2) the presence of Hanna projectile points and the absence of McKean or Duncan points on the site's surface. From these data we suggest that this level was occupied by Pelican Lake or Hanna people between 2800 and 3500 BP. Limited data suggest this occupation may have occurred in the spring when a variety of fauna and presumably flora were exploited.

CULTURAL LEVEL III

Like Level II, Level III was limited by the extent of overbank deposits from the Sun River when the channel was situated just to the southeast of the site. The same excavation area, centered at 11N 299W, best illustrates the types of remains found in Level III (Fig. 4-11).

Features

No obvious features were encountered in Level III. However, charcoal stains and fire-broken rock undoubtedly indicate the presence of hearths in adjacent grids.

Faunal Remains

Level III excavations produced a total of 277 bones and bone fragments, 57 percent of which were identified as bison (Table 4-6). This was a drop from previous levels to just under 84 percent of the total identified bone. However, the misleadingly high number of pronghorn remains actually represented only two extremely fragmented elements. Accordingly, the pronghorn percentage is inflated and the bison percentage, in turn, is deflated. Other represented species, all of potential economic value, included bird, deer, and pelecypod. No flotation samples were processed from this level.

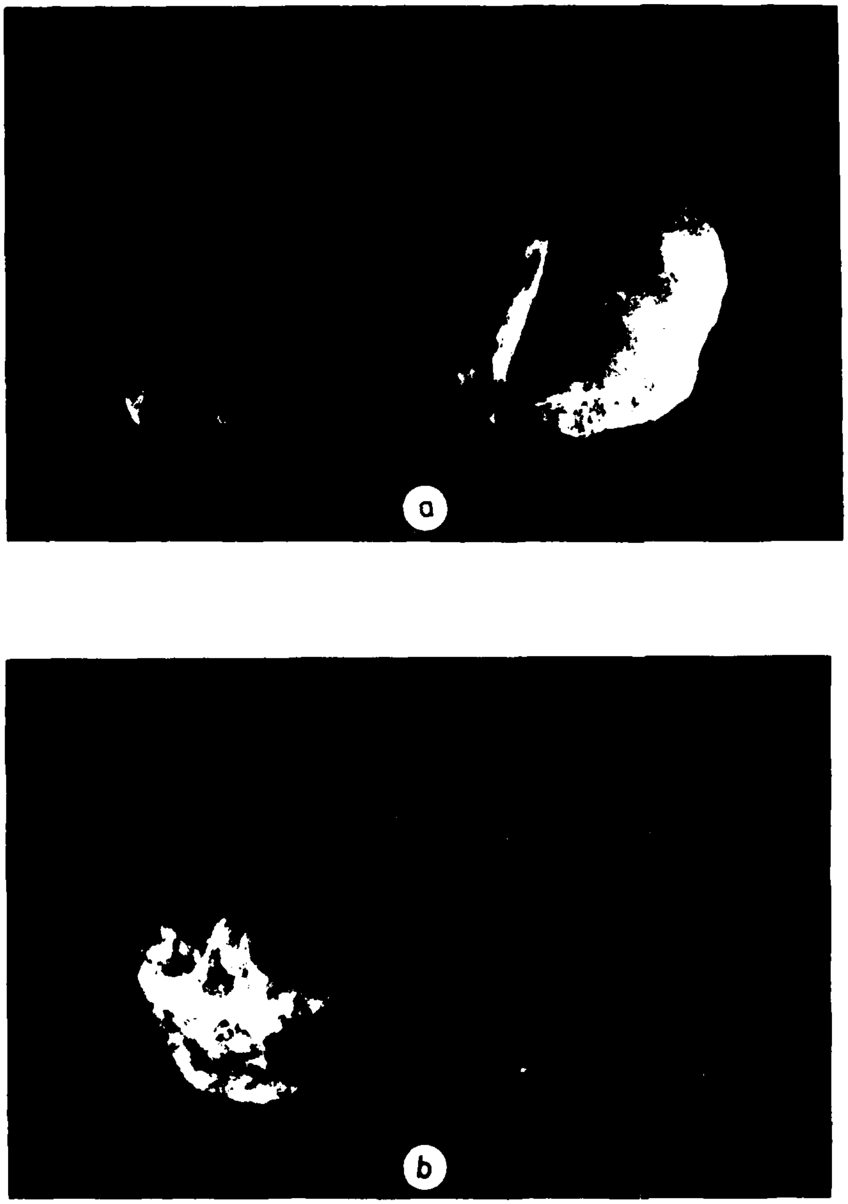


Figure 4-10. Level II Quartzite Chopper (full scale):
(a) bifacially flaked end
(b) battered end

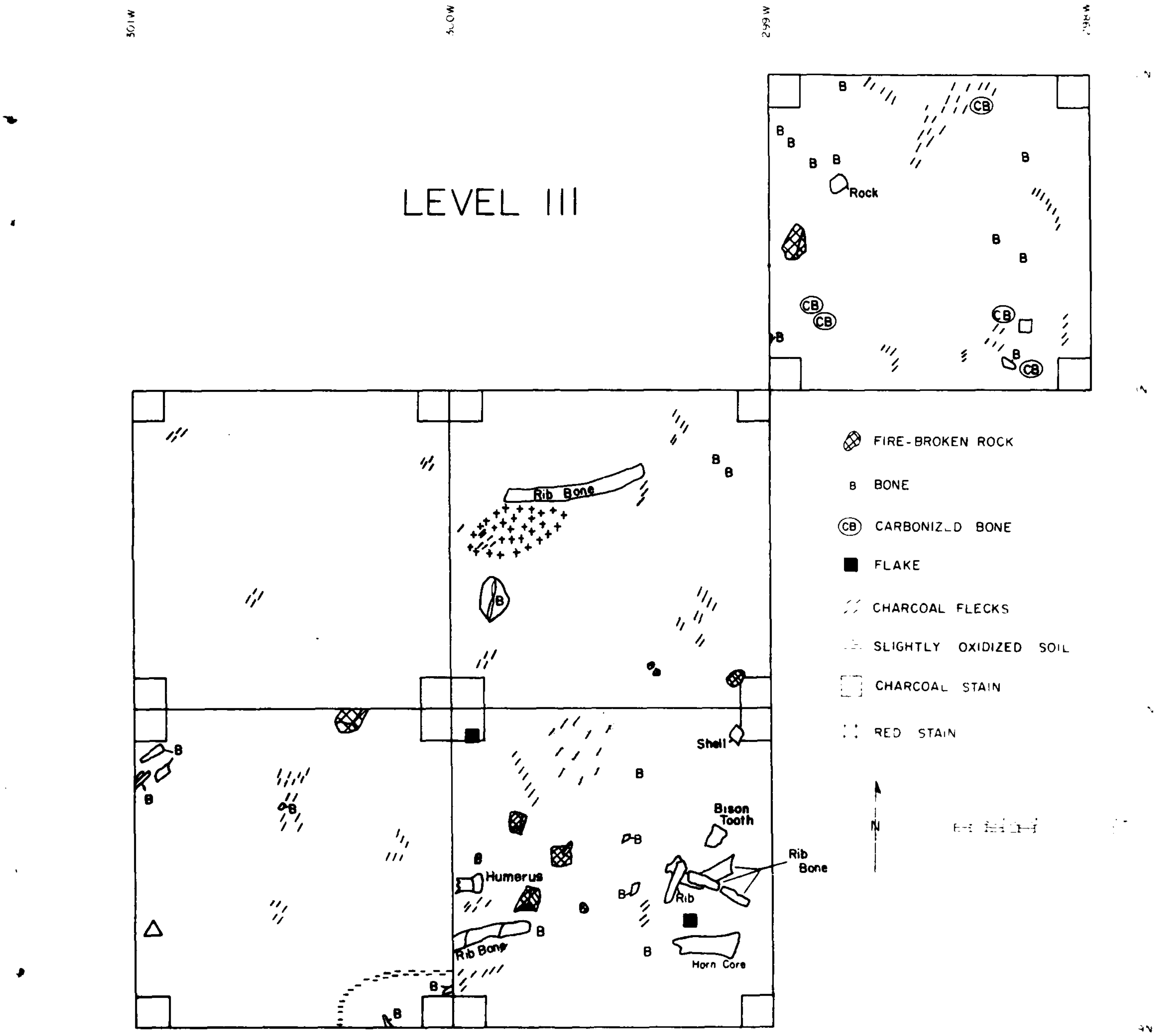


Figure 4-11. Level III Floor Plan.

TABLE 4-6

LEVEL III EXACAVATED BONE SUMMARY

SPECIES	EXCAVATED BONE (number)	PERCENTAGE OF TOTAL
Bison	157	56.69
Pronghorn	22	7.94
Bird	4	1.44
Deer	2	0.72
Pelecypod	2	0.72
Unidentifiable	90	32.49
TOTAL	277	100.00

In addition to the excavated faunal sample, there also was a sample of bone collected from the scraper area between 8N 302W and 10N 298W. This area produced 23 bison bones and bone fragments and a deer mandible fragment. Of the bison bone, 12 were complete articulator ends, carpals, tarsals, phalanges, scapula, and maxilla. A premolar and first and second molars fit the third molar recovered from Level III, in 10N 299W. Hence, even though precise provenience for the scraper area bones is not available, they are considered in the Level III discussion.

A second scraped area, labelled the "dugout," also yielded faunal remains. As discussed in Chapter 3, these remains cannot be linked with any specific level, due to differential rates of deposition and variable slope. Recovered were bison bones, including a proximal scapula, radius, rib, and a complete carpal; a deer innominate; and a large fragment of a wolf's upper third molar (carnassial) (Fig. 4-12a). This tooth fragment is of interest because it could be interpreted as evidence of wolves scavenging the site.

Taphonomy, Aging, and Season of Use

The Level III and scraper area bones had little or no exfoliation or acid etching. Regarding carnivore action on bone, a bison proximal scapula had been punctured. The good condition of the bone was interpreted as evidence of rapid burial.

Regarding cultural modification of bone, it appeared that bone cracking for marrow took place as evidenced by the quantity of long bone shank fragments in the 1 1N 299W area, whereas intact articulator ends from the scraper area indicate that bone grease processing may not have been conducted.

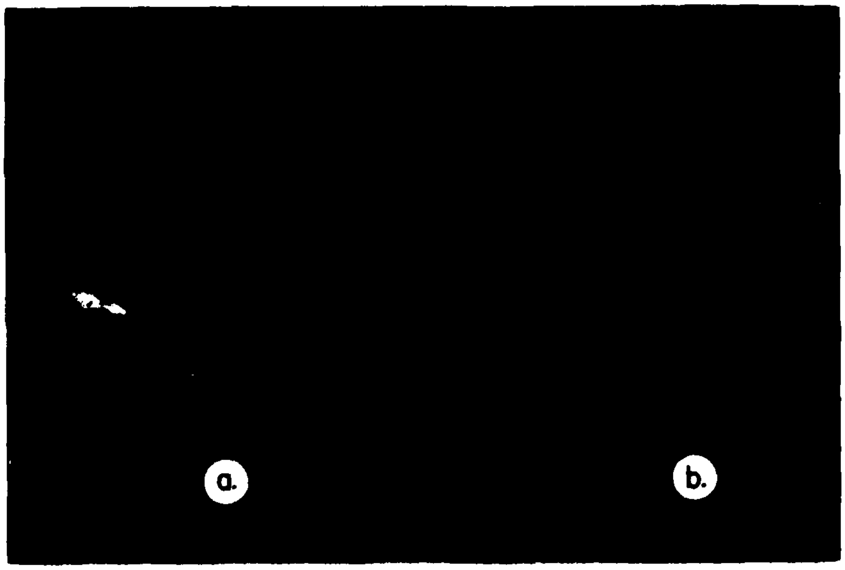


Figure 4-12. (a) Wolf molar and (b) antler tip from Level III.

The maxilla appeared to have come from a 2.5-year-old animal, based on tooth eruption and wear. This age would suggest that it met its demise in the fall.

Tentatively identified fetal bison bone fragments were excavated from 0N 311W. Bone development would suggest a mid- to late-term fetus. Since calving season is, and was, in the spring, fetal development is interpreted as having stopped in the winter or early spring. Thus, the mature bison and the fetus are not believed to have been a "pair." Accordingly, two seasons of use may be represented on this level.

The deer mandible from the scraper area unfortunately only retained a moderately worn third molar. Thus, it could only be classified as a mature individual of unknown season of death.

Butchering and Bone-processing Activities

As mentioned above, it appeared as though the 11N 299W area may have served as a center for cultural activities. The fragmented long bone shanks in this area indicated that bone marrow was extracted. In the same area, the presence of an upper molar and horn core, both from bison, indicated that a skull may have been processed for brains and grease. Also of interest is the clustering of all of the nonbison remains, except the highly fragmented pronghorn bone in this area.

Estimates of the pounds of meat available, the number of occupants, and the length of stay are untenable for Level III due to the indications of multiple occupations. The limited sample size further obscures such conclusions.

Bone Tools

The tiny tip of a deer antler tine may represent a tool fragment (Fig. 4-12b). Antler tines were used as pressure flakers for stone tool manufacture and probably served a number of other functions.

A second bone tool from Level III is the proximal section of a rib from 0N 310W (Fig. 4-13) that was separated from the shank while fresh, creating an extremely sharp point on the distal end. This point had not been modified by flaking or grinding, but some slight polish and edge rounding was present just in from the tip. Based on general size and morphology, the bone would have made a perfect awl.

Flaked Stone Artifacts

Unfortunately, no diagnostic artifacts were retrieved from Level III. A broken quartzite biface was the only recovered tool (Fig. 4-14). Debitage consisted of a limited number of flakes, primarily representing early stages of reduction (Table 4-7). Again, the absence of small retouch and pressure flakes is thought to be directly related to the absence of fine screening.

Figure 4-13. Bison rib tool (0N 310W-9) (full scale).

Figure 4-14. Quartzite biface knife (full scale)

TABLE 4-7

DEBITAGE SUMMARY FOR LEVEL III

DEBITAGE TYPE	MATERIAL TYPE*					TOTALS
	CHT	SS	CHL	OB	BAS	
Cortical Flake	1	1			1	3
Interior Flake	1	2		2		5
Bifacial Thinning Flake			1			1
Pressure Flake						0
Shatter			1			1
TOTALS	2	3	2	2	1	10

*MATERIAL TYPES: CHT = Chert
SS = Silicified Sediment
CHL = Chaldedony
OB = Obsidian
BAS = Basalt

Level III Summary

The characterization of Level II is pertinent for Level III as well. Little is known about the range of represented activities or even the number of occupations. The occupants, thought to be Pelican Lake or Hanna people, camped here sometime between 2800 and 3500 BP. Limited data suggest that both late winter and fall occupations may have taken place, during which times a variety of fauna, and presumably flora, were exploited.

CHAPTER 5

CULTURAL LEVEL IV

The results of the excavation and analysis of Level IV are presented in terms of features, faunal remains, and flaked stone artifacts, incorporating a discussion of the distribution of these remains across the living surface. Interpretations of represented activities also are presented.

Cultural Level IV was occupied by Oxbow people approximately 3,500 years ago based on the presence of four diagnostic Oxbow projectile points and three preforms, and on a single radiocarbon date of 3450±350 BP (1880±353 BC, corrected). Approximately 20 sq. m were excavated to expose a living floor concentrated in the eastern half of the excavation area and undoubtedly extending further to the east (Fig. 5-1).

As stated in Chapter 2, no other trenches contained cultural remains. Accordingly, we know that the site does not extend as far as 70 m to the west and, due to the meander scars, we know the occupations would not be intact 40 m to the south and 20 m to the east. The northern boundary is undetermined.

LEVEL IV FEATURES

The single feature recognized on Level IV, Feature H, is a basin-shaped, oblong hearth which contains a sand-filled pit (Fig. 5-2). The base of the hearth exhibits an oxidized earth zone which defines its basin shape. The upper hearth matrix is primarily ash, ranging from 5-14 cm thick. Small charcoal flecks were noted in the lower part of the matrix but not in sufficient quantity for removal of a sample for radiocarbon dating.

The associated pit was not apparent until a few centimeters of ash were cleared away. The cross-section of this sand-filled pit was observed in the east wall of 43N 266W at the south edge of the hearth (Fig. 5-3) and in the north wall of 43N 265W (Fig. 5-4). Unfortunately, in plan view, only the portion of the pit in 43N 266W was clearly observed during excavation. In 43N 265W, which had been excavated two days previously, the outline of the pit was not obvious, although the excavator noted sandy fill in the northwest corner and subsequently drew the pit in profile. This differential exposure and observation is attributed to the fact that 43N 266W was exposed to drying conditions longer than 43N 265W. As the surface of the excavation unit dried, the interface between the pit fill and the surrounding matrix separated, thus exposing the semicircular outline of the pit perimeter. The pit is thought to have measured approximately 60 cm NS and 40 cm EW. Depth ranged from 12-17 cm.

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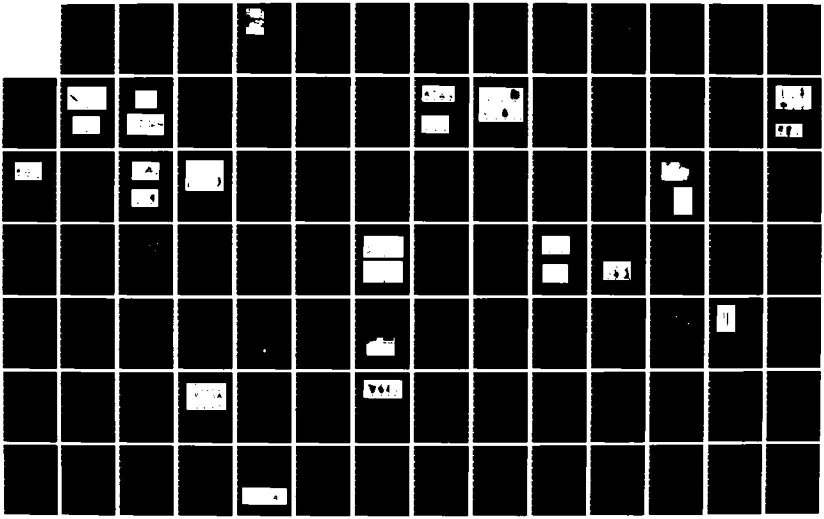

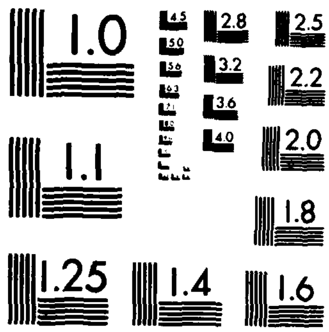

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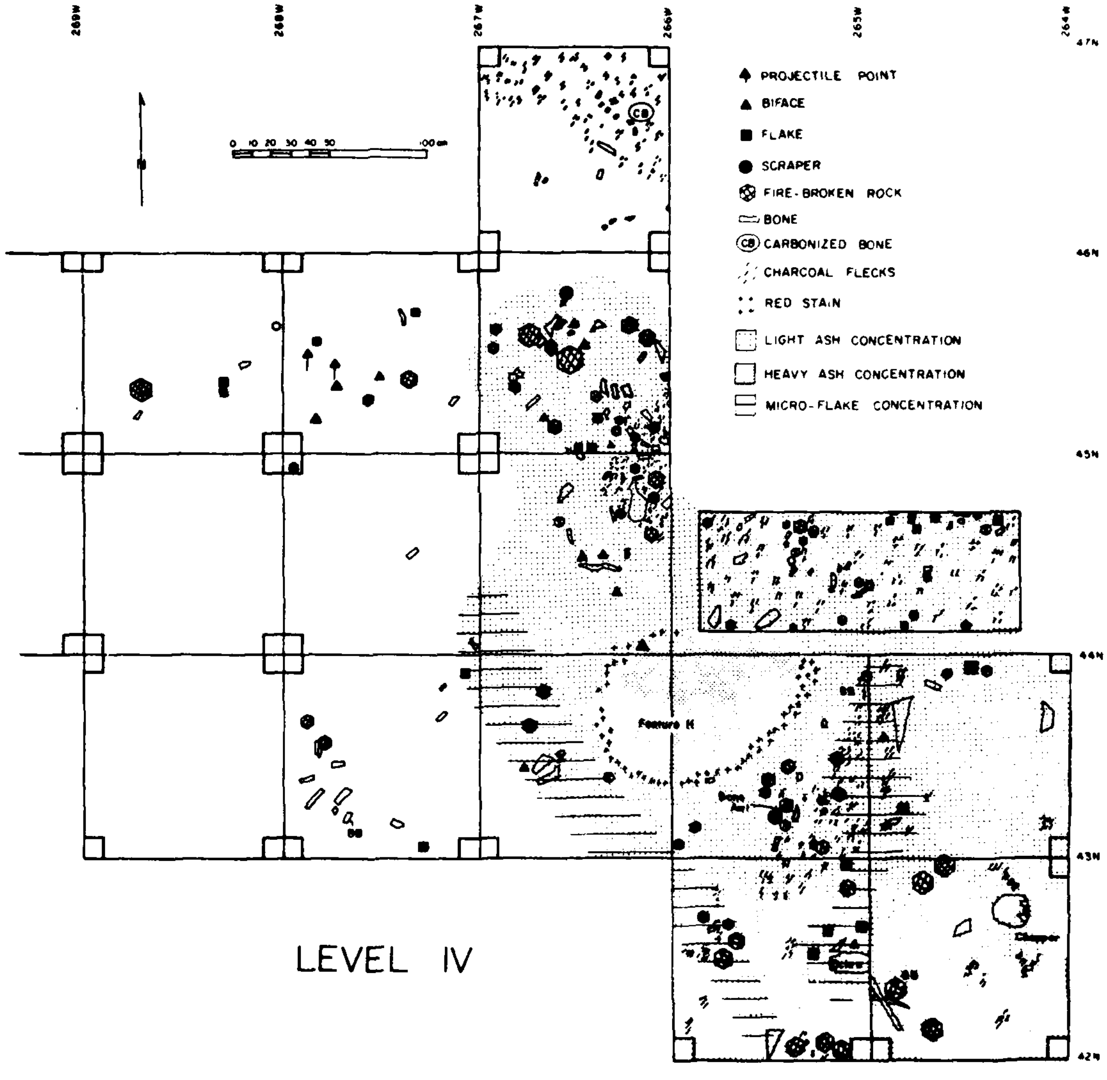

Figure 5-1. Floor plan, Level IV

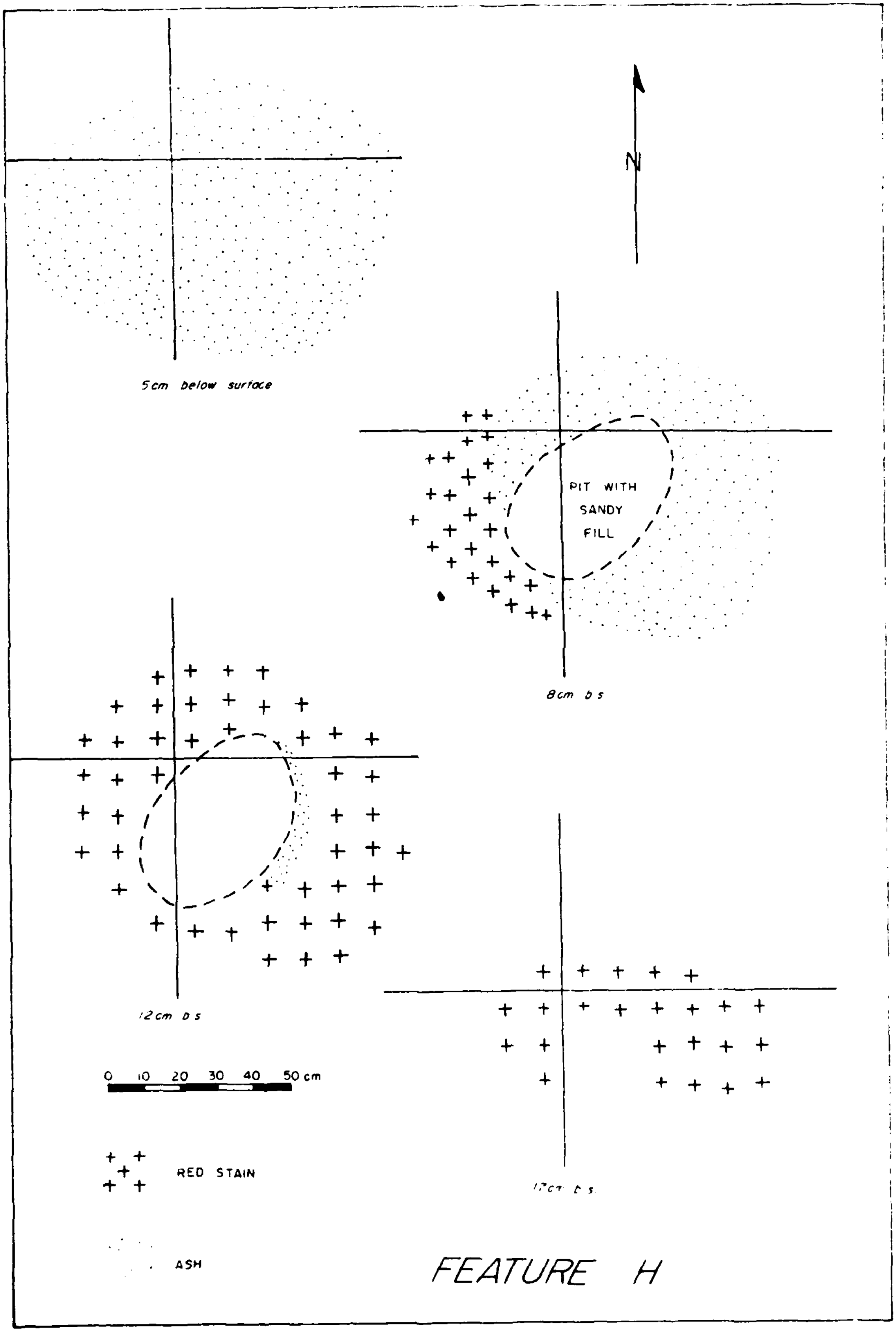

Figure 5-2. Feature H Plan View.

Figure 5-3. Feature H.

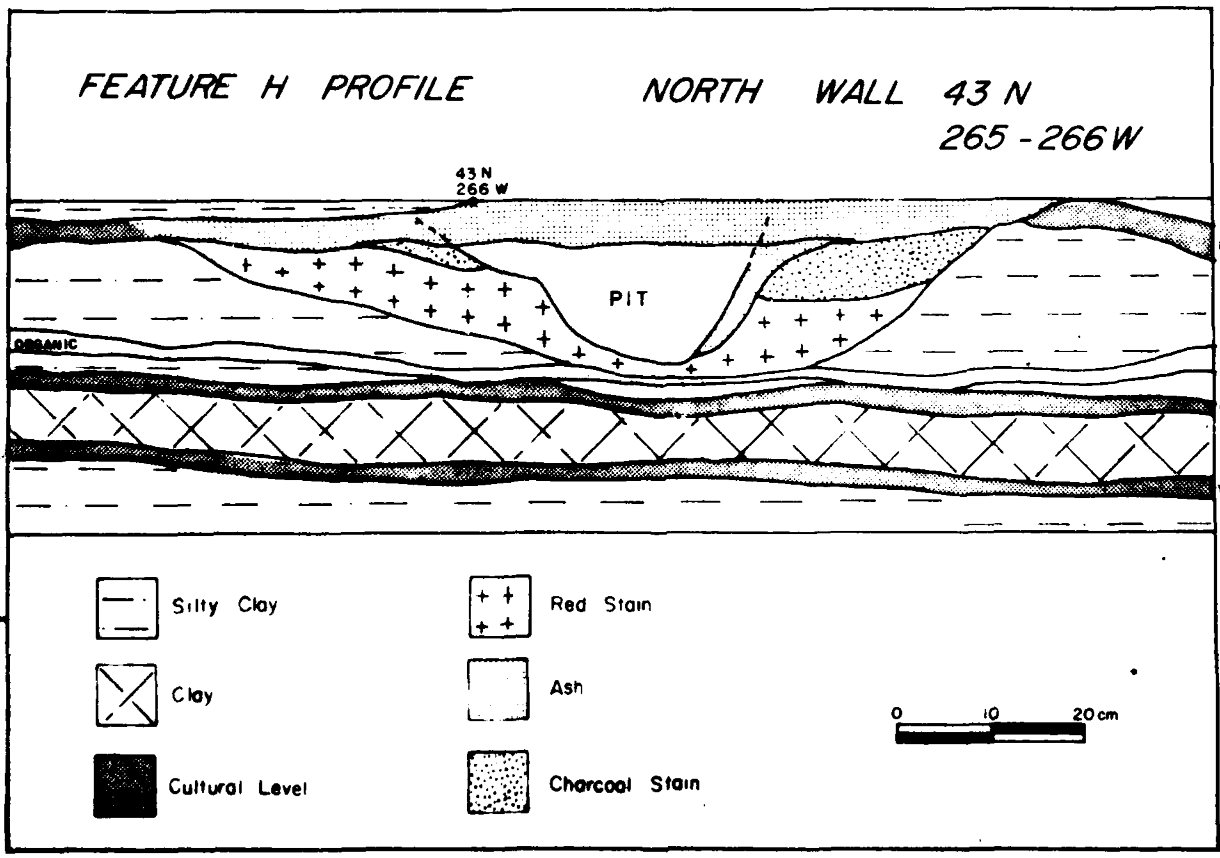

Figure 5-4. Feature H profile.

The pit apparently was constructed after the hearth basin was excavated and initially used, since the pit intruded into the hearth basin and had disturbed a portion of the burned earth flooring. A scatter of charcoal, fire-broken rock, and burned bone to the southeast of the feature may be the hearth fill that was removed when the pit was excavated. If so, the hearth may have served as an oven or barbeque for roasting meat. The large size of the fired cobbles located just southeast of the feature supports this possibility. Plains Indians placed large stones around the perimeter of a hearth, then suspended segments of the carcass across the stones, over the hot coals (Henry 1965).

Another activity which would have resulted in an ash-filled pit was described by Morgan (1959:36) as a part of the pemmican preparation process. He stated that after thin sheets of meat had been sun-cured,

> a fire is built and when the wood is reduced to coals, a frame of cross pieces of limbs is built over the fire, and the meat is placed over the fire until it is thoroughly dried. After that it is broken or cut into small pieces, and these are placed in a buffalo skin and pounded with a flail, until it is well-pulverized; the flail consists of a heavy stick attached to another which is used as a handle.

Turney-High (1937:121) noted that the Flathead smoked and dried the flesh over a fire of non-resinous wood, in preparation for pemmican pounding.

Finally, Wettlaufer and Mayer-Oakes (1960:67) suggested that the ash-filled pits on Level 8 at the Long Creek site might have been used as part of the hide-tanning process. Support for this explanation comes from the presence of end scrapers and an awl just to the south of Feature H.

It is difficult to ascertain the function of the pit since no cultural materials were observed in the fill. From a 1.75-l matrix sample which was submitted for flotation analysis, only a trace of charcoal was noted in addition to a single flake and a single, tiny, burned bone fragment. The time frame for the sequence of activities associated with the feature also is difficult to determine. The pit may have been excavated into the hearth after the coals had cooled -- representing an entirely separate event. In this context, the pit may have served for storage of some commodity which was subsequently removed. However, the reason for introducing the sandy fill remains unclear.

A second explanation is that the hearth and pit are directly associated and thus represents a single event. The pit may have been excavated into the hot coals with the intention of heating something in a sandy fill. Possible activities which come to mind from ethnographic examples include vegetable roasting and heat treatment of lithic material, either of which may have been undertaken at Feature H.

Tenuous evidence supporting vegetable processing came from the phytolith results (see Appendix D). An ash sample collected from the upper part of the hearth fill contained a high enough frequency of Elongate phytoliths to "postulate that some cultural activity relating to plants probably took place here" (Lewis, Appendix D:10). Unfortunately, the plants represented by these Elongate phytoliths could not be identified and no pollen corollary was reported from this feature (see Appendix D). The plant remains from Feature H, as suggested by Lewis (Appendix D:12), "may have resulted from numerous activities such as food preparation, basket making, or even the remains of grass pad used as bedding." The awl found just southeast of Feature H could have been used in basket making. It is important to note that a sample of sandy fill from deep in the pit produced no phytoliths. No macroflora nor culturally significant pollen were observed in matrix samples.

Based on the luster and color of specimens, there was some indication that intentional heat treatment of lithic material may have been conducted at the site. Sand is a well-proven matrix for conducting even heat, a prerequisite for successful heat treatment of many lithic materials. It was of interest that thick concentrations of microflakes extended along both sides and to the south of Feature H (see Fig. 5-1). From 7.6 l of matrix samples, 1,047 flakes were recovered. Given that these matrix samples comprised less than one-tenth of the total area of microflake concentrations, we may postulate that more than 10,000 flakes were clustered in this area. It is not unreasonable to consider the possibility that Feature H served as the center of some stone tool manufacturing activities, possibly including heat treatment.

After abandonment, the entire hearth was covered with ash. Because there was no oxidation atop the pit, this ash scatter is thought to have been derived from the hearth and dispersed haphazardly; it is not thought to represent another phase of use of the hearth.

No other features were located on Level IV. Scatters of charcoal and fire-broken rock to the north and northeast of Feature H may have represented refuse cleaned from an unidentified hearth in an unexcavated area. Because the majority of the fire-broken rock in this area had fractured from differential contraction, stone boiling activities are thought to have occurred (see following discussion).

LEVEL IV BONE

The Level IV living surface produced 675 bones and bone fragments. A total of 406 (52.31 percent) of these bones were identified as bison, which comprised 95 percent of the identifiable bone. The remaining identifiable bones include pronghorn, pelecypod, fox, small rodents, and a gastropod. A total of 249 fragments were unidentifiable as to species (Table 5-1). From flotation samples, an additional 87 bone fragments were recovered (see Appendix E), including bison, rodent, rabbit or hare, fish or amphibian, and unidentifiable fragments. All but the gastropods and possibly the fox are believed to represent species exploited for food. The presence of the two fox teeth may be explained at the result of a scavenger losing teeth while dining rather than being a victim of the prehistoric occupants or the teeth may have served as adornments.

TABLE 5-1

SUMMARY OF LEVEL IV EXCAVATED AND FLOTATION SAMPLE BONE

SPECIES	EXCAVATED BONE NO.	FLOTATION SAMPLE BONE NO.	TOTAL	PERCENT OF TOTAL
Bison	405	1	406	53.28
Pronghorn	12	0	12	1.57
Rodent	2	4	6	0.79
Pelecypod	4	0	4	0.52
Fox	2	0	2	0.26
Gastropod	1	0	1	0.13
Rabbit or Hare	0	1	1	0.13
Fish & Amphibian	0	1	1	0.13
Unidentifiable	249	80	329	43.18
TOTAL N	675	87	762	99.99

Taphonomy, Aging and Season of Use

Most bones recovered from Level IV were heavily fragmented as a result of cultural activities such as butchering, marrow removal, and bone grease processing. The effects of certain noncultural taphonomic or post-mortem processes also were apparent. About 17 percent of the excavated bones were exfoliated or acid etched. Exfoliation is a process by which bone layers come apart as a result of exposure for at least one year (Miller 1975). Acid etching is grooving on the surface of bones by plant rootlets. About 80 percent of the exfoliated bones also were acid etched. These data suggest that bone burial was relatively rapid, i.e., a few years; then bones were subjected to rootlet action.

No evidence of rodent gnawing was observed on bones. Limited carnivore gnawing (four cases) was observed in the form of canine tooth puncture holes and tooth rotational scars from chewing. As mentioned above, a single fox may have been responsible for this limited bone modification.

The bison bones, primarily fragments that were identifiable as to element and/or side, total 184 (Table 5-2). The remaining 221 fragments were too small or did not contain any identifiable landmarks which would allow for element categorization. Analysis of the identifiable elements indicate that parts from three bison were present. The two patellae represent two individuals, an adult and a subadult from 1.5 to 2 years old. The maxilla represents a calf with the deciduous teeth still in place and the permanent first molar just erupting with no wear yet visible. Wilson's (1974:153-155) description of the 0.6-year-old maxillae from the Casper site is applicable for the one under examination:

> <u>Group II: 0.6 Years Old</u>. In animals of the first year there is a fair range of variation in metric attributes and degree of eruption of teeth; nevertheless, a clustering of these attributes is clear.
>
> DP^2 is well into wear, with a sloping planar facet. . . . The enclosed fosette in less worn specimens may be a single long, narrow oval area; however, most 0.6-year-olds have progressed beyond this stage and show division on the area into two fossettes, the anterior one being the smaller of the two. DP^2 roots are visible at the alveolus. . . .
>
> DP^3 is well into wear. . . . The roots are visible at the alveolus. . . .
>
> DP^4 is well into wear, with a worn lingual style prominently visible in most specimens. . . . The uneven wear surface is more accentuated in DP^4 than in DP^3, giving this tooth as well a bilophodont appearance. . . .
>
> M^1 is almost fully erupted, and is starting to wear. . . . A lingual style is barely visible at the level of the alveolus, or is still obscured by bone. . . .

TABLE 5-2

LEVEL IV BISON BONE BY ELEMENT AND SIDE

BISON BONE	RIGHT	LEFT	UNASSIGNED
Maxilla		1 nearly complete	
Skull fragments			1 fragment
Thoracic			1 complete
Rib			65 fragments representing 8 ribs
Caudal			1 complete
Scapula	2 fragments		5 fragments
Humerus			
Shank	6 fragments	4 fragments	7 fragments
Radius/Ulna			
Shank			3 fragments
Distal	1 complete		
Carpals	5 complete	1 complete	
Metacarpal			
Proximal	1 complete		
Femur			
Shank	6 fragments	2 fragments	39 fragments
Patella		2 complete	
Tibia			
Shank	4 fragments	9 fragments	11
Distal	4 fragments of 1 distal		
Tarsals	1 complete		
Phalanges		1 complete	1-1st
Sesamoid			1

The lack of wear on the molar (M^1) might place the Level IV maxilla at 0.5 years old. Regardless, what was important from this information is that, assuming a spring birth, this placed the time of death and the occupation of Level IV in the fall.

The gross underrepresentation of the bones and bone fragments, even considering marrow and bone grease processing, suggested that we did not have a complete sample (Fig. 5-5). That is, additional butchered remains were located in unexcavated portions of this living floor. Generally, the least-represented portion of the bison was the axial skeleton.

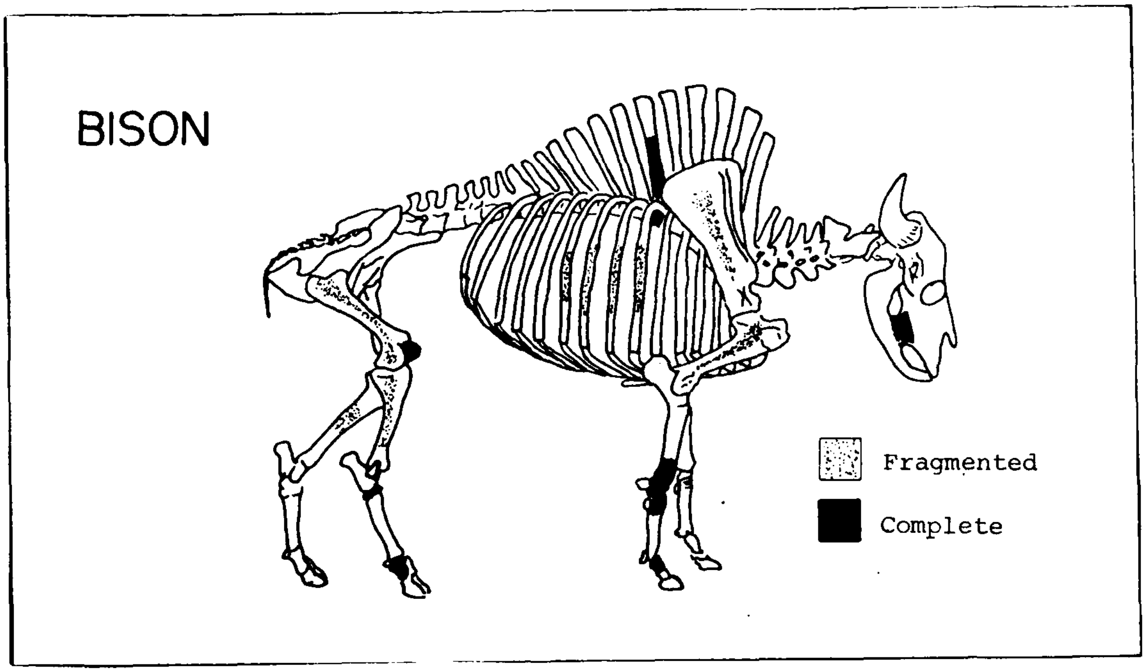

Figure 5-5. Bison bones represented in Cultural Level IV.

The pronghorn bones identified by element include an upper right molar, a right scapula fragment, three femur fragments, and a tibia fragment. The tooth shows sufficient wear to be from an adult. The elements and fragments probably represent a single individual. Again, the underrepresentation of elements indicats that we retrieved only a portion of the living floor.

The remaining species that were exploited by prehistoric occupants are represented by extremely limited remains and added little to the above discussion. The pelycypod consists of four shell fragments, probably from one individual. The rodent bones are several limb fragments and the rabbit or hare is represented by a single tooth. A single centrum represents the fish or amphibian. The fox remains include one tooth and one tooth fragment.

Bone-processing Activities

As discussed, a single hearth feature, Feature H, was located on Level IV. The majority of burned bone from the level (84 percent) was located within 1 m of Feature H, primarily to the south (Table 5-3). The burning of bone was not part of any known bone processing activities. If bone was burned, it was probably due to general discard of camp debris into a fire. Thus, the distribution and concentration of most of the burned bone for this level may have been related to periodic cleaning of this feature.

TABLE 5-3

LEVEL IV BURNED AND UNBURNED BONE BY GRID AND SPECIES
(burned/unburned)

GRID COORDINATES NORTH	 WEST	BISON BONE	PRONGHORN	FOX (F) RODENT (R) PELECYPOD (P) GASTROPOD (G)	UNIDENTIFIABLE	TOTAL
42	264	0/9		0/1 F	0/2	0/12
42	265	2/15			0/1	0/16
43	264	0/16	0/1		0/4	0/21
43	265	16/15		2/0 R	55/0	73/15
43	266	0/6			33/0	33/6
43	267	1/8			47/1	48/9
44	264	0/11		0/1 F		
				0/4 P	0/37	0/53
44	265	0/9	0/2		15/31	15/42
44	266	32/46	0/1		0/10	32/57
44	267	0/2			3/0	3/2
44	269	1/5				1/5
44	270			0/1 G	0/2	0/3
44	271		0/1			0/1
45	266	1/142	0/4			1/146
45	267	0/3			0/2	0/5
45	268	0/12				0/12
45	269	0/8				0/8
46	266	19/22			4/2	23/24
TOTAL		72/329	0/9	2/7	157/92	231/437
FLOTATION SAMPLE RECOVERY						
43	264	0/1		0/1 Lagomorph Incisor 3/1 R	5/39	
43	266a			1/0 Fish or Amphibian		
43	266b				2/0	
43	266c				0/1	
(Feature H)						
44	266				1/0	
44	267				1/0	
45	266b				2/29	
TOTAL		0/1		4/2	11/69	

Examination of the fragmentation of bones helps researchers to understand the butchering process. Generally, high frequencies of identifiable or unidentifiable long bone diaphysis (shank) fragments indicate bone cracking for marrow removal. Lack of or low frequences of identifiable epiphyses (articular ends), together with high frequencies of cancellous fragments, indicate bone grease processing. These activities can be viewed as phased processes.

Once bones had meat removed and were disarticulated, they were basically ready for marrow processing. Marrow bones, predominantly long bones, initially were carefully cleaned of periosteum prior to breaking. In some cases, they were heated to loosen the marrow prior to cracking. In other cases, the marrow may have been remove' cold, then added to a stew. The shank was then shattered using ei . a double anvil or a single anvil with a hammerstone. Once the ırrow cavity was exposed, long, thin sticks or bones were used to ve the marrow for cooking, consumption or storage (Binford 1978; Bo hsen 1973).

Once marrow was removed, the long bone shanks and shank gments no longer had any economic utility. Attention then shifted to removal of all shank remnants from the articular ends. When the articular ends were ready, they were crushed on a large, flat anvil using a hammerstone. Porous or cancellous bone such as vertebrae, ribs, phalanges, and the illium, ischium and pubis were crushed. The crushed mass was then placed in a container of water, heated, and the grease would float to the surface to be skimmed off for consumption or storage (Binford 1978; Bonnichsen 1973; Dorsey 1884; Leechman 1951; Vehik 1977). The remaining broth could be immediately consumed. Bone grease, an easily preservable concentrated energy source, had many uses including pemmican, where it was mixed with dried meat, as butter, and in tanning (Vehik 1977).

Even considering differential bone density and its influence on bone preservation (Binford and Bertram 1977), the high frequency of long bone diaphysis fragments on Level IV, coupled with the gross underrepresentation of articular ends, vertebrae, and innominates (see Table 5-2) indicate that marrow and bone grease processing were undertaken. However, no concentrations of crushed bone were noted during excavation, suggesting either that bone grease processing was carried out elsewhere at the site or that the bones preferred for bone grease were removed from the site for processing elsewhere.

From the foregoing analysis of bison-processing activities by occupants of Level IV, we estimate the amount of meat and grease prepared. Based on data accumulated by Wheat (1972:114), the three bison would have yielded approximately 725 pounds (330 kg) of fresh meat (145 pounds dried) and 56 pounds (25 kg) of grease and tallow (Table 5-4). A limited amount of additional meat and grease would have been derived from the pronghorn. Based on the estimated consumption of 3.5 to 5 pounds of meat per person per day, 25 people could have been supported by this meat supply for from six to nine days.

TABLE 5-4

AMOUNT OF USABLE MEAT AND GREASE TALLOW

ANIMAL SIZE	USABLE MEAT	GREASE TALLOW	DRIED MEAT
Adult	216 kg (475 lbs)	18 kg/(40 lbs)	43 kg (95 lbs)
1.5- to 2-year-old	91 kg (200 lbs)	5 kg (12 lbs)	18 kg (40 lbs)
Calf	23 kg (50 lbs)	2 kg (4 lbs)	5 kg (10 lbs)
TOTAL	330 kg (725 lbs)	25 kg (56 lbs)	66 kg (145 lbs)

As discussed in the previous section and illustrated in Figure 5-1, concentrations of microflakes, ash, and charcoal also were distributed around the southern half of Feature H and extended over 1.5 m to the south. Given the character and diversity of cultural remains in this area, these accumulations are thought to have been refuse.

The majority of the unburned bone was recovered from grids 44-45N 266W, to the north of the feature. A total of 221 bison bone fragments, representing 55 percent of the Level IV bison bone sample, were recovered from these two grids. The identifiable bison bones from this area (71) include skull, rib, scapula, ulna, femur, and tibia fragments, in addition to a complete distal tibia in four pieces and one articulating tarsal, the lateral maleolus.

The identifiable unburned bison bones from the area to the south of Feature H total 52. These include a caudal vertebra, rib, humerus, tibia, and femur fragments. In addition, a complete left patella and a right side articulation unit of distal radius/ulna, four carpals, and proximal metacarpal were recovered.

On the north edge of the excavated area (46N 266W), 3 m from Feature H, was a portion of another bone and charcoal concentration. In this area, the ratio of unburned to burned bone (24/33) was nearly equal. The burned bone and charcoal were spatially segregated from the burned bone in 44N 266W by over a meter. This concentration may represent a dump from a feature not encountered rather than having been associated with these other activity areas. If we assume that dump areas were located consistently to one side of the hearths, reflecting a concern for the prevailing wind (presently from the southwest), we would suggest that this second hearth would have been situated just north of the excavated area.

Evidence of Butchering and Tool Use

Because bone was reduced to an extremely fragmented state, there remained little direct evidence of the actual butchering process. Specifically, evidence of cut marks was limited. Only seven pieces of bone were identified which retained evidence of cut marks reflecting butchering (Fig. 5-6a,b). These cut marks occurred at or near muscle or ligament attachments. Such cut marks may have been derived from the disarticulation process or, as noted by Witter (Binford 1978:153-155), from cleaning of bone in preparation for marrow cracking.

A single bone tool, an awl tip, was recovered from Level IV (Fig. 5-7). The small size (54 x 14 x 6.5 mm) and the green break on the proximal end indicated that this tip segment broke from the main body during use. The handle was not recovered, but may have been resharpened for use or discarded in a different part of the site. Striations perpendicular to the grain of the tool evidenced that the tip was heavily ground, probably using a coarse sandstone abrader to form a 1-mm point. Strengthening of the tip through heat treatment was apparent.

The radius/ulna/carpal/metacarpal articulation (Fig. 5-8) resembles previously reported rear leg unit articulations used as tools at bison kill sites (Frison 1970, 1973, 1974). Because there was no use-wear on the presumed working end, this unit may have been prepared for use as a tool but never used, or only minimally used. Possibly the working end broke during use and was not recovered during excavations.

Faunal Summary

The most striking features of the Level IV bone assemblage are the highly fragmented nature of the bone and the underrepresentation of most elements. Even considering fragments, there is not nearly enough bone for three bison, a pronghorn, a fox, a rabbit or hare, and a rodent. To explain this under-representation of bone, we suggest that a combination of cultural and natural factors acted on the assemblage. Specifically, the animals were killed elsewhere and only particular portions were returned to camp for processing; processing included bone cracking for marrow and crushing of high bone-grease-content elements. Furthermore, because densities of bone vary and survival rates

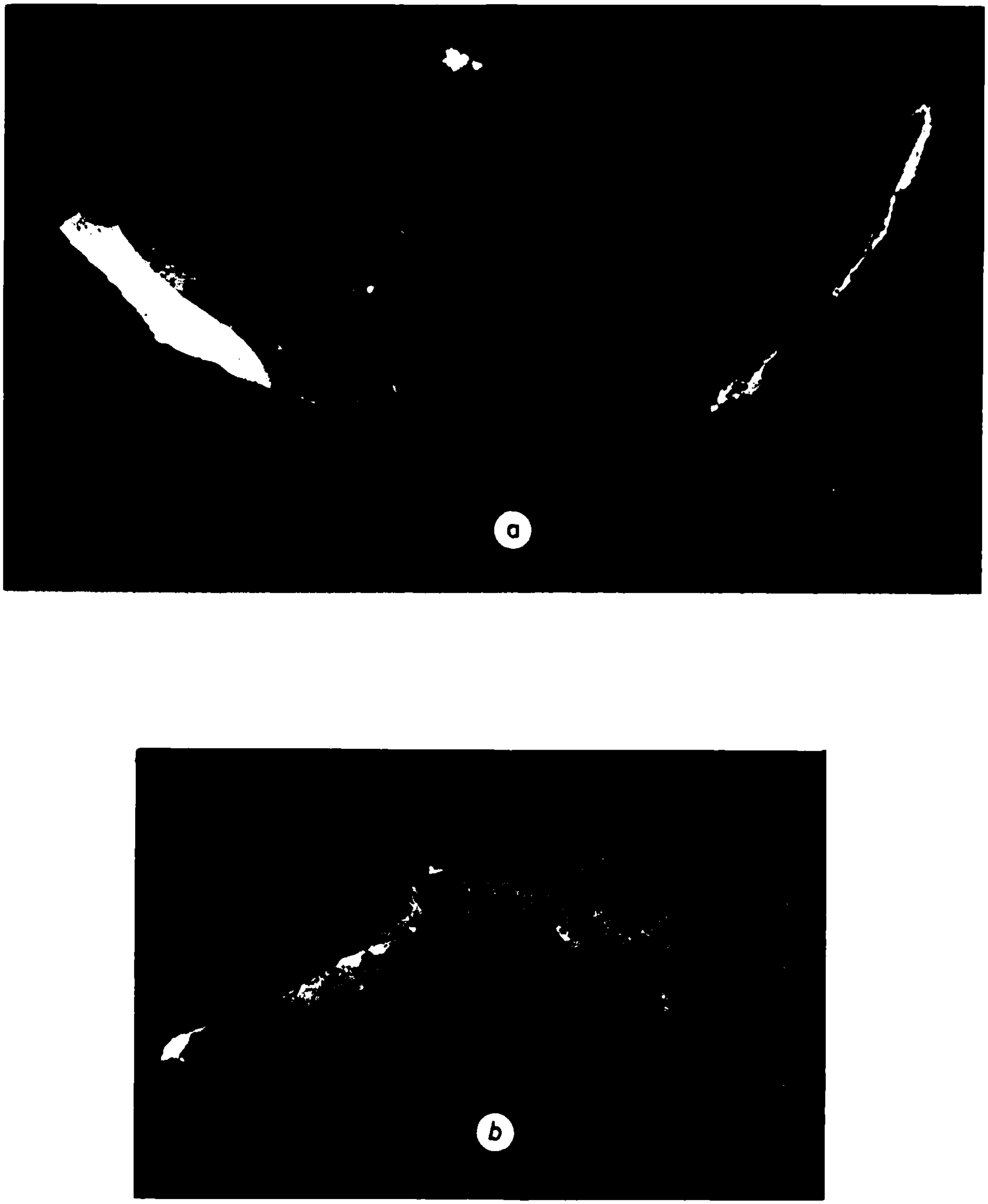

Figure 5-6. Level IV bone evidencing cut marks (full scale).

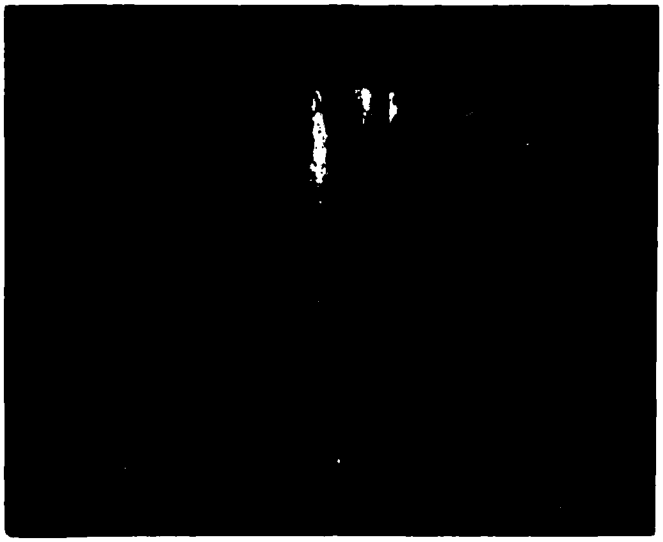

Figure 5-7. Bone awl from Cultural Level IV (full scale).

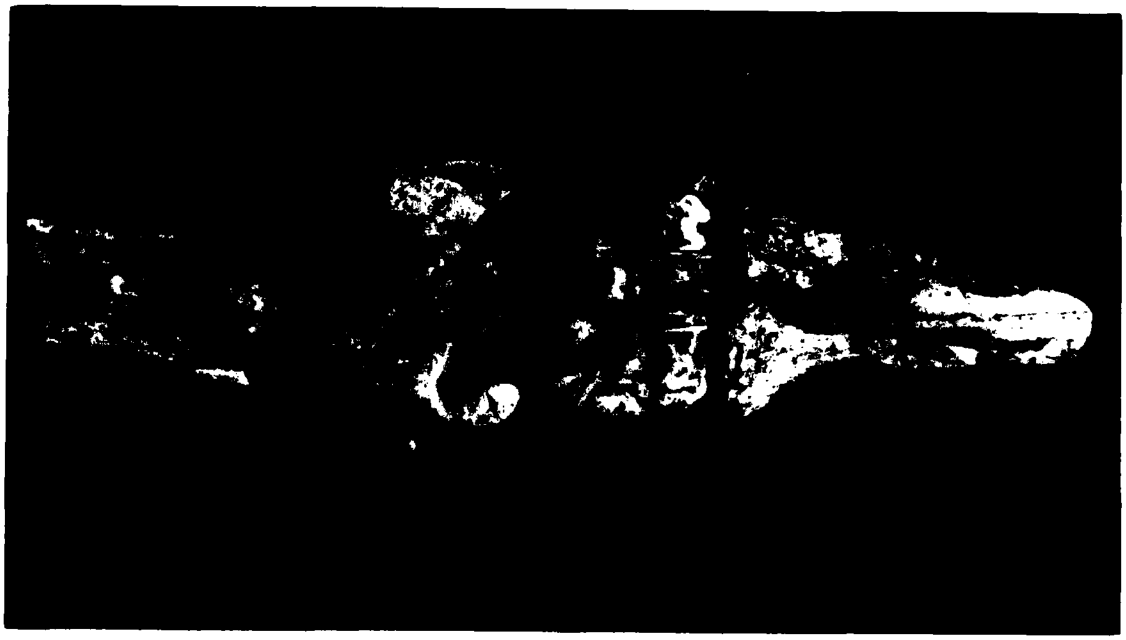

Figure 5-8. Rear leg articulation (radius/ulna/carpal metacarpal) (½-scale).

are strongly correlated (Binford and Bertram 1977), factors such as weathering and chewing or gnawing by carnivores or rodents act differentially on bones depending on their density. As mentioned, limited gnawing marks were observed on the bones. Finally, the burning of 33 percent of the recovered bone indicates another human activity to which the bones were intentionally or accidentally subjected.

FLAKED STONE ARTIFACTS

Level IV yielded 36 flaked stone tools and tool fragments and 670 pieces of debitage (Table 5-5). An additional 1,047 flakes were recovered from flotation samples. The tool assemblage consists of 17 bifaces including points, preforms, and blanks, and 19 unifaces including 4 end scrapers, 14 side scrapers and utilized flakes, and 1 unifacially modified chopper.

TABLE 5-5

LEVEL IV ARTIFACT CATEGORIES BY LITHIC MATERIAL TYPE

ARTIFACT CATEGORY	LITHIC MATERIAL TYPES*							TOTAL	PERCENT
	CHT	SS	CHL	QTZ	BA	BAS	OTR		
Debitage	388	104	25	33	0	116	4	670	95.0
Unifaces	7	4	3	2	2	1	0	19	2.7
Biface Blanks	1	0	0	5	0	3	0	9	1.3
Projectile Points	4	1	0	0	0	0	0	5	0.7
Preforms	0	1	0	0	0	2	0	3	0.4
TOTAL	400	110	28	40	2	122	4	706	--
PERCENT	56.6	15.6	4.0	5.6	0.3	17.3	0.6	--	100

*LITHIC MATERIAL TYPES KEY: CHT = Chert; SS = Silicified Sediment; CHL = Chalcedony; QTZ = Quartzite; BA = Brown Agate; BAS = Basalt; OTH = Other

Among the lithic material types are a minimum of three varieties of chert (57 percent), several of which may have been derived from the same source, in addition to silicified sediment (16 percent), basalt (17 percent), quartzite (6 percent), chalcedony (4 percent), and negligible quantities of agate and silicified sandstone. The most abundantly represented chert is a beige, weathered material with calcareous spheres evident. Also common is a tannish-green chert with black specks, white streaks, and crystalline inclusions. This material turns red when exposed to heat as evidenced by two pieces of one flake -- one green and one red. Another well-represented chert is brown with black mottling, and some with black dendrites and white streaks. The silicified sediment grades from a well-sorted gray-to-pink material to a variable grained "salt and pepper" material with a gray or pink ground mass. The basalt sample contains diverse materials ranging from fine- to coarse-textured stone, to a slate-like material.

Several factors indicate that local sources were exploited. The wide variety of lithic materials is significant; generally, if particular quarries were regularly visited, their products would have dominated the lithic inventory. The presence of modified river and glacial cobbles further support the inference that the occupants exploited nearby gravel bars and glacial deposits. The best-represented cherts and the silicified sediment probably were derived from outcrops of the Madison and Kootenai Formations, respectively.

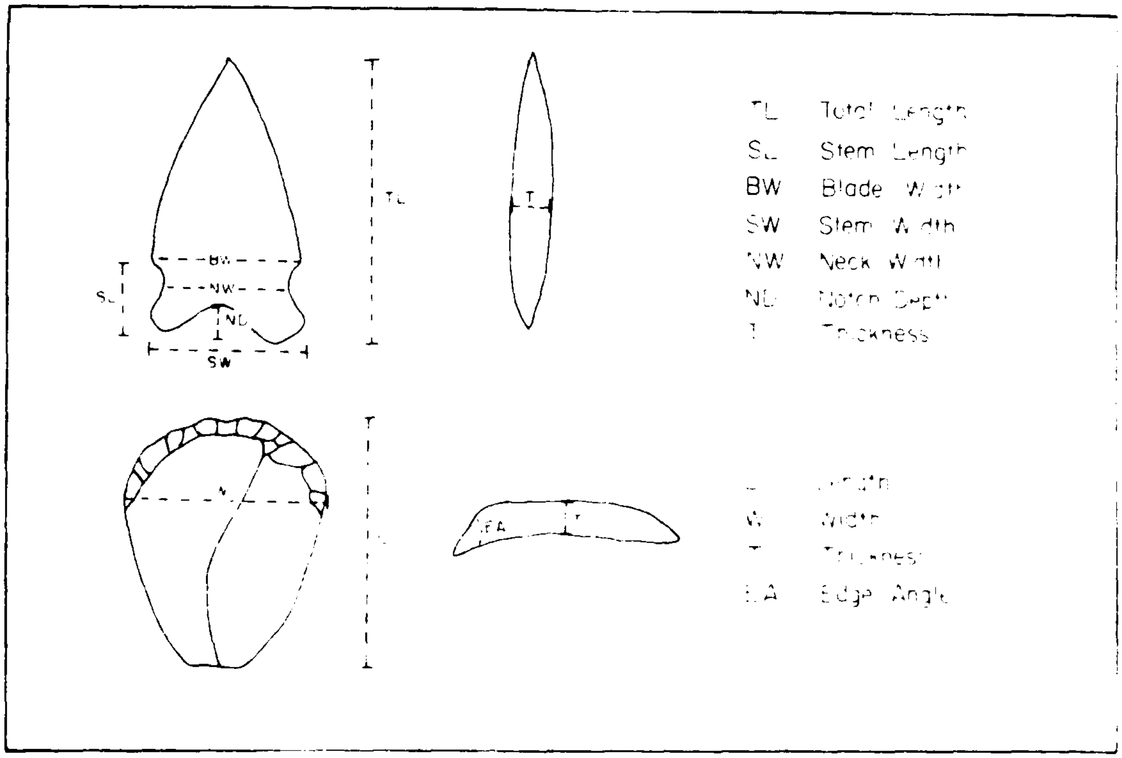

Figure 5-9. Formal attribute measurements for lithic tools.

Following are summary descriptions of the flaked stone tools recovered from Level IV, including dimensions (Fig. 5-9), lithic materials, and pertinent morphological and functional attributes for each tool. Description and discussion of the technological system are deferred to Chapter 8, where they will be discussed jointly for all three Oxbow occupations.

Bifaces

Seventeen specimens representing sixteen bifaces were recovered from Level IV, representing all stages of the biface manufacturing sequence (Table 5-6). The diagnostic projectile points from Level IV (one complete and three fragmentary) (Fig. 5-10) are side-notched and basally thinned. Basal concavities range from slight to deep, with light basal grinding around the "ears" evident on the complete specimen. The slightly convex lateral edges are interrupted toward the proximal end by shallow notches. The longitudinal cross-section is biplano to biconvex. These characteristics fit well with previous definitions of Oxbow projectile points (Dyck 1976; Nero and McCorquodale 1958; Wormington and Forbis 1955). A small tip fragment is thought to have broken from a point. Four of the specimens are chert and one is salt and pepper silicified sediment. Two of the chert specimens have no lithic material counterpart in the debitage, indicating that they were brought into the site in a finished state.

The three preforms (Fig. 5-11) display the same general attributes described for the points except that they lack side notches, thus, they are lanceolate with concave bases. Accordingly, they lack the characteristic "ears." Two specimens are basalt and one is gray silicified sediment. None of the dark gray silicified sediment appears in the debitage.

The nine blanks and blank fragments (Fig. 5-12) range from crude cortical flakes with elementary bifacial modification to subtriangular specimens with flake scars extending completely across both faces, yet lacking the refined shape of a preform. Four specimens are of quartzite, each material differing in color and grain size. One quartzite Middle Stage blank was found in two sections, about 25 cm apart (Fig. 5-12d). Several flakes of this same material also were found nearby. The remaining specimens are of basalt (4) and black chert (1). None of the black chert was observed in the debitage.

The distinct difference in material types between blanks and preforms vs. the projectile points is intriguing. One would expect particular materials to be preferred for the manufacture of bifaces and that proportions of blanks, preforms, and finished tools would be similar. However, it may have been that the flintknappers were more often successful with the finer-grained materials, thus leaving fewer

TABLE 5-6

LEVEL IV BIFACES

TOOL NO.	GRID LOCATION NO.	GRID LOCATION SO.	ILLUS. NO.	ARTIFACT TYPE	MATERIAL TYPE	DIMENSIONS (mm) LENGTH	WIDTH	THICKNESS	BLADE LENGTH (mm)	DEPTH OF BASAL CONCAVITY (mm)	NECK WIDTH (mm)	BLADE WIDTH (mm)	USE-WEAR/COMMENTS
28	45	266	5-10a	Projectile point	Chert	28	20	5	21	5	17	20	Modified complete (whole and rejuvenated)
25	44	266	5-10b	Projectile point	Chert	--	--	5	--	5	--	--	Longitudinal projectile point fragment
9	42	265	5-10c	Projectile point	Chert	--	--	3	--	2	12	22	Basal fragment
27	44	266	5-10d	Projectile point	Chert	--	--	3	--	--	--	--	Biface tip fragment
17	43	266	5-10e	Projectile point	Silicified sediment	--	--	--	--	3	--	--	Basal fragment
35	45	267	5-11a	Preform	Basalt	38	22	6	30	3	--	19	Unmodified complete (no rejuvenation)
16	43	266	5-11b	Preform	Basalt	27	23	6	--	2	--	--	Unmodified complete (no rejuvenation)
36	45	267	5-11c	Preform	Silicified sediment	32	23	6	--	3	--	--	Unmodified complete (no rejuvenation)
38	45	267	5-12a	Early Stage blank	Chert	55	45	11	--	--	--	--	Cortical flake; unmodified complete (no rejuvenation)
41	45	257	5-12b	Early Stage blank	Basalt	41	37	7	--	--	--	--	Cortical flake; unmodified complete (no rejuvenation)
40	45	267	5-12c	Early Stage blank	Quartzite	47	40	10	--	--	--	--	Unmodified complete (no rejuvenation)
29	45	266	5-12d	Middle Stage blank	Quartzite	64	40	9	--	--	--	--	Unmodified fragment (no rejuvenation)
34	45	267	5-12e	Late Stage blank	Quartzite	50	28	7	--	--	--	--	Unmodified complete (no rejuvenation)
14	43	265	5-12f	Middle Stage blank	Quartzite	37	28	10	--	--	--	--	Unmodified complete (no rejuvenation)
26	44	266	5-12g	Early Stage blank	Basalt	35	18	16	--	--	--	--	Unmodified complete (no rejuvenation)
24	44	266	5-12h	Unidentifiable biface fragment	Basalt	--	12	4	--	--	--	--	Fragment

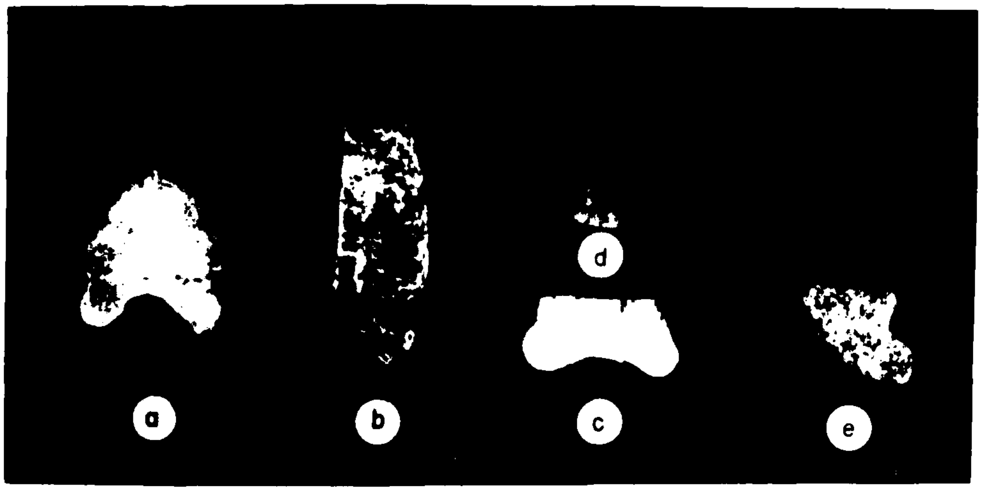

Figure 5-10. Level IV projectile points (full scale):
a: Tool #28, 45N 266W, chert
b: Tool #25, 44N 266W, chert
c: Tool #9, 42N 265W, chert
d: Tool #27, 44N 266W, chert tip
e: Tool #17, 43N 266W, silicified sediment

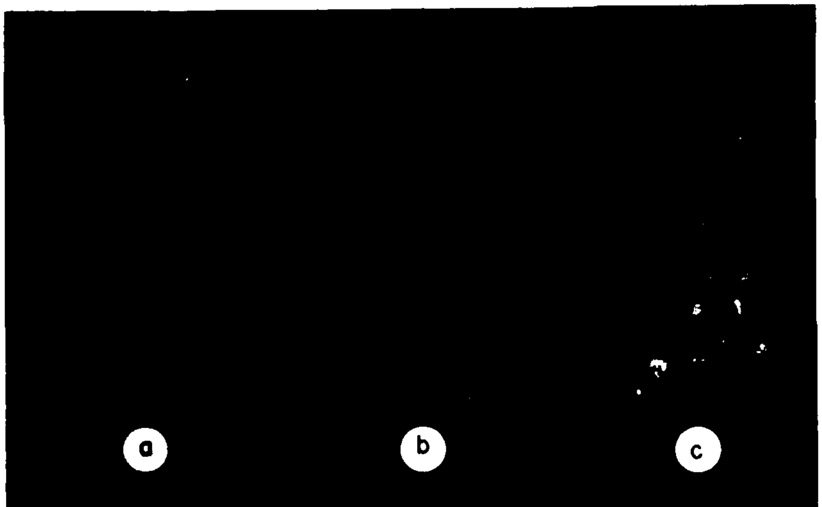

Figure 5-11. Level IV preforms (full scale):
a: Tool #35, 45N 267W, basalt
b: Tool #16, 43N 266W, basalt
c: Tool #36, 45N 267W, silicified sediment

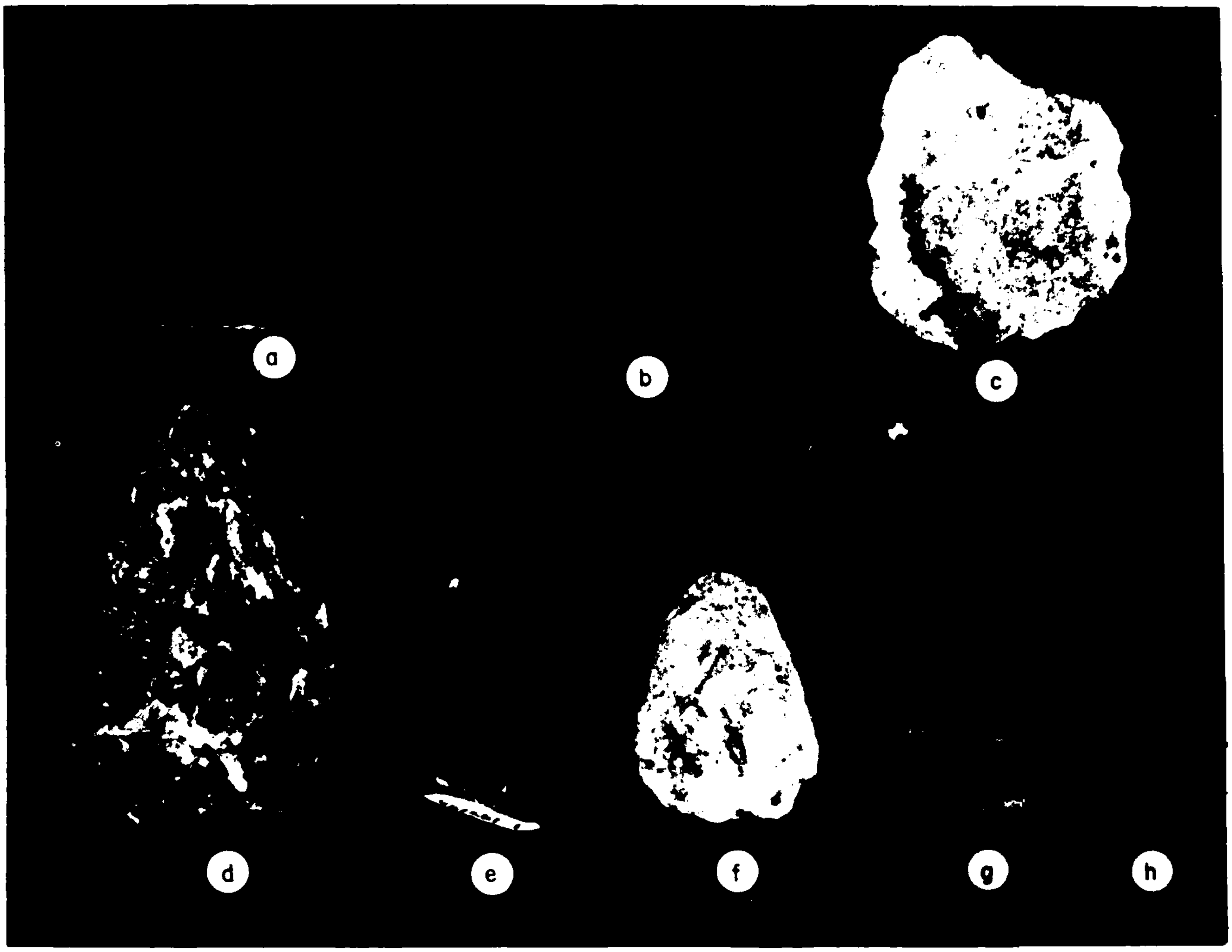

Figure 5-12. Level IV blanks and blank fragments (full scale):
a: Tool #38, 45N 267W, chert, Early Stage
b: Tool #41, 45N 267W, basalt, Early Stage
c: Tool #40, 45N 267W, quartzite, Early Stage
d: Tool #29, 45N 266W, quartzite, Middle Stage
e: Tool #34, 45N 267W, quartzite, Late Stage
f: Tool #14, 43N 265W, quartzite, Middle Stage
g: Tool #26, 44N 266W, basalt, Early Stage
h: Tool #24, 44N 266W, basalt, unidentifiable fragment.

or no rejects behind. An alternative explanation is that the larger, coarse-grained bifaces were never intended for further reduction. Similar bifaces at the Harder Oxbow site were interpreted by Dyck (1976:135-136) as having been suited to a:

> heavy-handed, cutting-sawing motion. In a bison hunter's campsite, such a tool would be useful in the dissection of cuts of beef brought into camp. ... Each biface is large enough to be conveniently hand-held and sufficiently rough textured to assure a firm grip between thumb and fingers, even under greasy conditions.

This description may be appropriate for the Sun River specimens as well.

Indications of use-retouch, abrasion, and polish on the margins of the Middle and Late Stage blanks (#14, 29, 34) are thought to be attributable to knife usage. All three of these specimens are quartzite. Rounding and polish on proximal corners may reflect gripping the knife with a hide, rather than hafting the tool. The Early Stage blanks show no evidence of use-wear.

The condition of a number of these artifacts indicates that they were not suitable for further technical refinement. With one exception, the blanks and preforms exhibit technical problems. One Middle Stage blank (#29) is transversely broken and not suitable for further reduction. Other blanks (e.g., #14, 40) and all three preforms exhibit stacked step fractures which inhibited further technical refinement. The single complete projectile point (#28) (45N266W-3) exhibits extreme bi-beveling of lateral margins as a result of resharpening and probably represented a functionally exhausted form. The projectile point fragments broke either (1) during the hunt, leaving the basal portion in the haft to be discarded when a replacement was manufactured, or (2) during manufacture. Most, if not all, of the bifaces from this level exhibit obvious technical problems which prohibited or discouraged further reduction. Prior to deposition, however, many were used as general butchering tools, as evidenced by use-wear indications on a number of specimens.

Unifaces, Modified Flakes, and Utilized Flakes

Nineteen uniface tools, modified flakes, and utilized flakes, with evidence of intentional or use-modification, or fragments of such, were recovered from Cultural Level IV (Table 5-7). These 19 pieces represent 18 individual tools. Seventeen of these are tools made on flakes and one is a large, unifacially modified cobble, which will be discussed separately, below.

TABLE 5-7

LEVEL IV UNIFACE TOOLS

TOOL GROUP	ARTIFACT NUMBER/ GRID LOCATION	ILLUST. NUMBER	ARTIFACT TYPE	MATERIAL TYPE	DIMENSIONS (mm)			WORKING EDGE SHAPE AND ANGLE			USE-WEAR/COMMENTS
					LENGTH	WIDTH	THICKNESS	CONVEX	STRAIGHT	CONCAVE	
A	18 43N 267W	5-13a	Interior flake	Tan chert	42	13	3	40°	--	--	Fractured edge-retouch and extreme rounding on edge remnants/lateral margin retouch
A	22 44N 264W	5-13b	Interior flake	Tan chert	37	17	3	(backed on curve)	50°	--	Use-retouch with light rounding on convexities/lateral margin retouch; unmodified complete (no rejuvenation)
A	39 45N 267W	5-13c	Bifacial thinning flake	Weathered chalcedony	39	18	3	(backed on curve)	50°		Use-retouch w/light rounding on convexities/combination retouch; unmodified complete (no rejuvenation)
A	20 44N 264W	5-13d	Interior flake	Tan chert	31	27	7	--	distal - 45° lateral - 40°	--	Use-retouch and light rounding on convexities (both edges)/combination retouch; unmodified complete (no rejuvenation)
A	37 45N 267W	5-13e	Interior flake	Tan chert	31	22	3	--	34°	--	Use-retouch and light rounding on convexities (both edges)/combination retouch; unmodified complete (no rejuvenation)
A	32 45N 266W	5-13f	Bifacial thinning flake	Tan chert	13	23	4	--	42°	--	Use-retouch and light rounding on convexities (both edges)/lateral margin retouch; unmodified complete (no rejuvenation)
B	30 45N 266W	5-14a	Interior flake	Chalcedony	24	18	5	45° - 60°	--	--	Use-retouch, crushing with subsequent light rounding/combination retouch; unmodified complete (no rejuvenation)
B	31 45N 266W	5-14b	Interior flake	Fossiliferous chert	40	22	5	--	57°	[illegible]°	Straight: use-retouch and light rounding on convexities (both edges); Concave: use-retouch and light rounding on convexities (both edges)/combination retouch; unmodified complete (no rejuvenation)

TABLE 5-7. LEVEL IV UNIFACE TOOLS (continued)

TOOL GROUP	ARTIFACT NUMBER/ GRID LOCATION	ILLUST. NUMBER	ARTIFACT TYPE	MATERIAL TYPE	DIMENSIONS (mm)			WORKING EDGE SHAPE AND ANGLE			USE-WEAR/COMMENTS
					LENGTH	WIDTH	THICKNESS	CONVEX	STRAIGHT	CONCAVE	
B	11 43N 264W	5-14c	Interior flake	Basalt	26	23	5	--	54°	--	Use-retouch and light rounding on convexities (both edges)/lateral margin retouch; unmodified complete (no rejuvenation)
C	15 43N 266W	5-15a	Cortical flake	Chalcedony	18	15	4	75°	--	--	Extensive step flaking and crushing/ distal retouch; unmodified complete (no rejuvenation)
C	23 44N 266W	5-15b	Interior flake	Fossiliferous agate	24	22	5	62°	--	--	Extensive step fracturing with rounding and polish on edge remnant/ combination retouch; unmodified complete (no rejuvenation)
C	13 43N 265W	5-15c	Cortical flake	Quartzite	33	27	5	63° - 68°	--	--	Step fractures with rounding of extreme edges/distal retouch; unmodified complete (no rejuvenation)
--	33 45N 266W	5-16	Cortical flake	Silicified sediment	105	54	37	60°	--	--	Step flaking and slight rounding/ combination retouch
--	10 42N 265W	5-17a	Interior flake	Quartzite	28	29	6	--	31°	--	Use-retouch/distal retouch; unmodified complete (no rejuvenation)
--	21 44N 264W	5-17b	Cortical flake	Chert	36	33	11	55°	--	--	Polish 3 mm up from and paralleling edge/distal retouch
	19 42N 264W		Cobble tool	Quartzite	166	119	97				
	12 43N 265W		Cortical flake	Silicified sediment	30	25	6				lateral margin retouch

As previously discussed, the manufacture of these tools required little time, skill, or effort. Generally, this entailed the selection of suitable flakes during various early stages of the reduction strategy. Selected flakes were then retouched along one or more margins by the systematic removal of short, closely spaced flakes until the desired configuration and sharpness (or bluntness) of the working edge was attained. For such tools, servicable edges required only a matter of seconds to prepare and little flintknapping skill. Therefore, these tools may be viewed as impromptu, easy to manufacture when needed, and requiring little effort to replace in comparison with biface tools.

The 15 tools complete enough for analysis were initially categorized according to the placement of intentionally modified flakes and/or use-wear. Of these, seven exhibit lateral margin(s) retouch, one exhibits only distal margin retouch, six exhibit a combination of lateral and distal margin retouch, and one exhibits use-wear along one lateral edge, but no retouch.

In addition to location of retouch, tools were categorized by thickness, working edge shape, and working edge angles. From the analysis of associations among these categories, three tool groupings emerged:

(1) Group A tools (Fig. 5-13) are thin flakes (<4 mm) with straight to slightly convex working edges and edge angles of less than 50°. All the working edges are lateral, with the exception of one tool which has both a lateral and a distal working edge. All six of these tools are of high quality, microcrystalline materials; five are tan chert and one is a weathered chalcedony, all of which are represented in the debitage.

(2) Group B tools (Fig. 5-14) are moderate flakes measuring between 5-7 mm in thickness, with straight to slightly convex lateral working edges, and edge angles of between 50° and 60°. These three tools are of generally dense materials, tougher than those of Group A tools, two of which are represented in the debitage.

(3) Group C tools (Fig. 5-15) are flakes measuring between 4-6 mm in thickness with slightly to highly convex distal working edges, and edge angles of between 62° and 75°. Material types are variable, and only one of these materials, the white chalcedony, may have been represented in the debitage.

Three tools and one edge of a Group B tool did not fit into these categories.

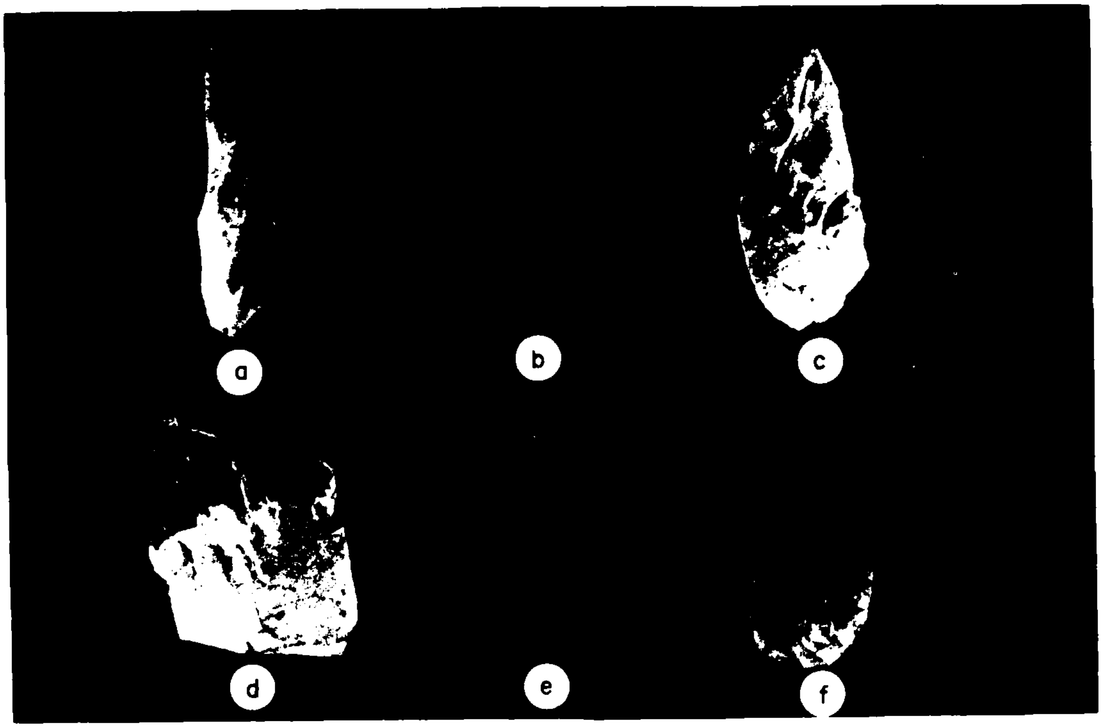

Figure 5-13. Level IV uniface tools, Group A (full scale):
a: Tool #18, 43N 267W, tan chert, interior flake
b: Tool #22, 44N 264W, tan chert, interior flake
c: Tool #39, 45N 267W, chalcedony, bifacial thinning flake
d: Tool #20, 44N 264W, tan chert, interior flake
e: Tool #27, 45N 267W, tan chert, interior flake
f: Tool #32, 45N 266W, tan chert, bifacial thinning flake

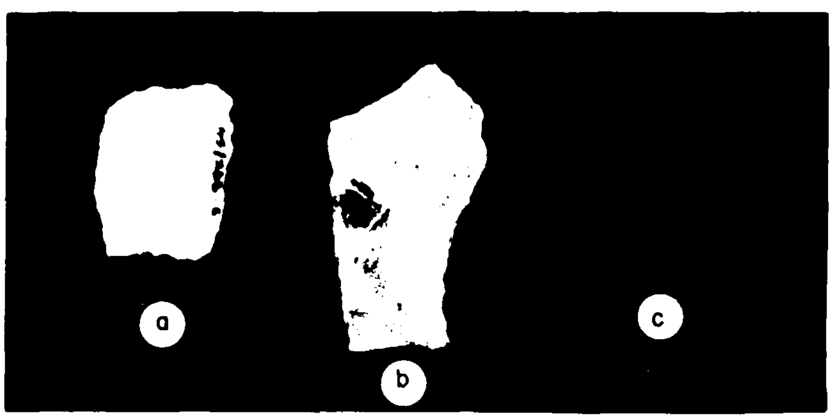

Figure 5-14. Level IV uniface tools, Group B (full scale):
a: Tool #30, 45N 266W, chalcedony, interior flake
b: Tool #31, 45N 266W, chert, interior flake
c: Tool #11, 43N 264W, basalt, interior flake

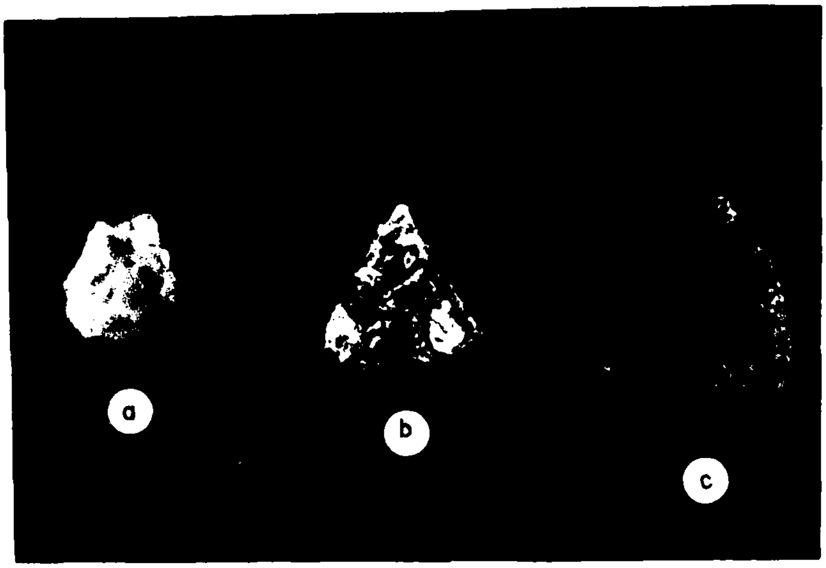

Figure 5-15. Level IV uniface tools, Group C (full scale):
a: Tool #15, 43N 266W, chalcedony, cortical flake
b: Tool #23, 44N 266W, agate, interior flake
c: Tool #13, 43N 266W, quartzite, cortical flake

Use-wear observations supported and enhanced the resultant tool categories. Six of the seven working edges on the six tools in Group A display use-retouch and slight crushing of edge projections. One specimen (#18), in contrast, displays notable rounding on the remaining remnants of this fractured working edge. Two of these specimens (#22 and 39) appear to have been intentionally backed on the curves opposite the working edges. One of these tools (#39) exhibits bilateral, unifacial retouch forming a sharp tip at its distal end. This sharp projection added to the utility of this tool, as it could have served for a variety of butchering and hide-processing tasks.

Tools of the Group A type are common occurrences at Oxbow sites (Dyck 1976; Wettlaufer and Mayer-Oakes 1960). Group A tools from Sun River, on the basis of edge retouch and use-wear, are interpreted as scraping tools. The absence of edge rounding on all but one specimen indicates that they were used on a rigid material, such as wood or bone. The single tool which displays edge rounding and polish was probably used on a softer material. An alternative functional explanation has been offered by Dyck (1976:129), who categorized these thin flake tools as small, incising knives. On the Harder specimens, Dyck

(1976:130) observed "use-wear on both ends of the working edge, but never in the middle." This pattern of use-wear is not present on the Sun River specimens; thus, the scraping interpretation is retained.

Group B tools display use-wear similar to Group A tools, yet their greater thickness and edge angle and their more resilient materials suggest that they would have been selected for different tasks. Like Group A, use-retouch is unifacial, indicating scraping rigid material. One of these tools (#31) also has a concave scraping edge which displays step fracturing and edge crushing. This edge shape and use-wear is typical of woodworking tools known as "spokeshaves."

Group C tools fall within the traditional morphological category of end scrapers, which are generally thought to have been used for scraping hides. Two of these specimens (especially #15) are quite small in comparison with most collections of end scrapers. Interestingly, for the Harder site, Dyck (1976:112) noted that many of the end scrapers were so small "that it is hard to imagine how they could have been held and used." Oxbow people may have had some special purpose for these extremely small end scrapers of which archeologists are not yet aware.

Of the three specimens, two display multiple step fractures and edge crushing, and one also displays rounding of the extreme edge. The remaining specimen displays step fractures and notable edge rounding typical of end scrapers commonly associated with hide-scraping activities. The two specimens which lack this characteristic use-wear display evidence of resharpening, probably more than once, on the basis of their small size and edge characteristics. These exhausted tools were probably intentionally discarded.

The remaining uniface tools include: (1) one heavy-duty scraper (Fig. 5-16), the distal edge of which displays step fracturing and slight rounding; (2) one flake (Fig. 5-17a) with use-retouch along an unworked distal edge; and (3) a cortical flake (Fig. 5-17b) with polish extending from one lateral edge, 5 mm onto the ventral face.

A unifacially modified cobble tool (Fig. 5-18) is believed to have been a chopper, based on edge configuration. It may have served as an anvil, as well, as evidenced by the battering on its upper surface.

Tool Distributions

Spatial clusterings of the biface and uniface artifact categories are of interest in assessing their use and deposit into the archeological record (Fig. 5-19). The most fragmentary and worn tools tended to be located within 1 m of Feature H, primarily to the south, in the area thought to have served as a dump on the basis of dense scatters of burned bone, microflakes, and charcoal.

Figure 5-16. Tool #33, Level IV heavy-duty scraper (full scale).

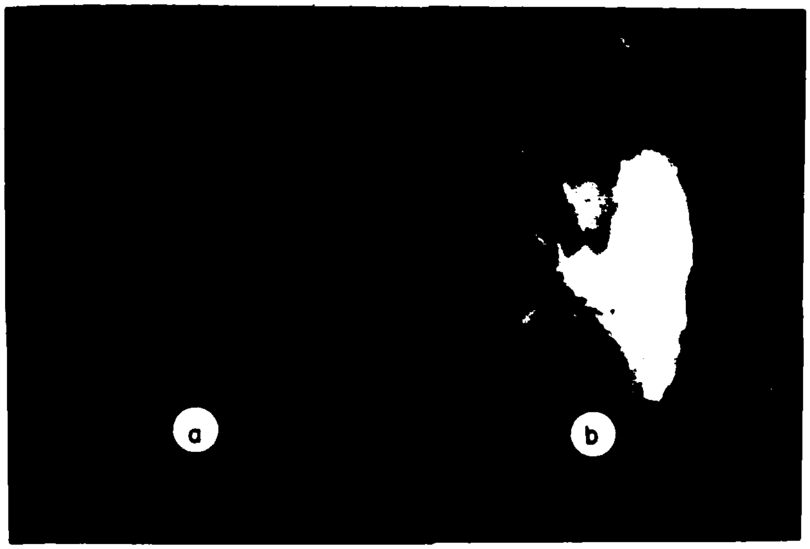

Figure 5-17. Level IV modified flakes (full scale):
a: Specimen #10
b: Specimen #21

Figure 5-18. Unifacially modified cobble (full scale). Note battering above worked edge.

The more complete tools which retained usable edges tended to be situated farther than 1 m from Feature H. The majority of these clustered to the northeast and northwest of Feature H in an area dominated by long bone shank fragments. As discussed in the preceding section on faunal remains, this area is believed to represent general bison butchering activities, including cracking long bones for marrow. Tools in this area included five of the six thin flake scrapers (Group A), two of the moderate flake scrapers (Group B), the heavy-duty end scraper, all of the complete biface blanks, two of the three preforms, and the single complete projectile point. A battered cobble was found in association with bison bone to the northeast of Feature H. This may have served to crack the bones for marrow and/or to crush bones for grease.

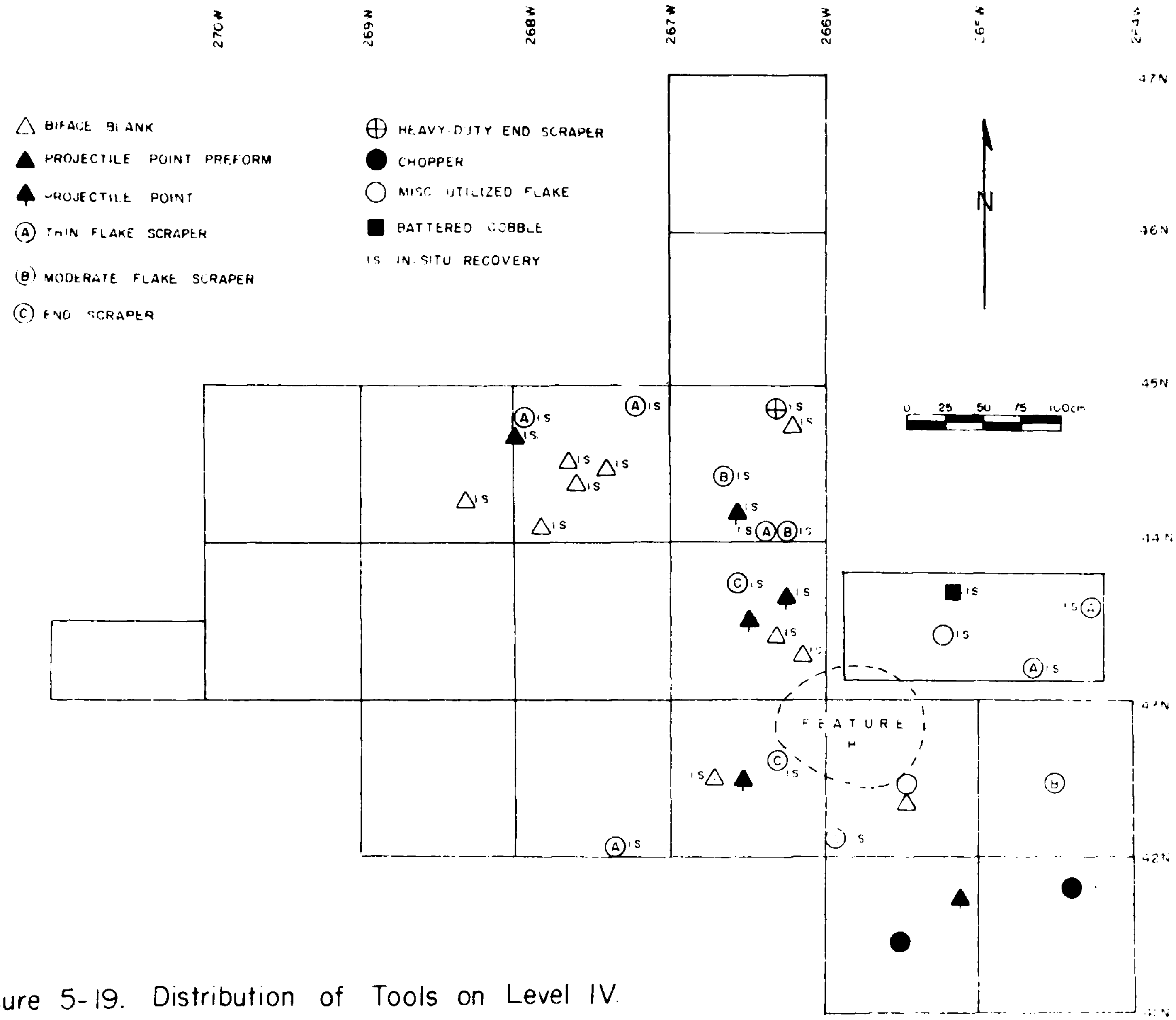

Figure 5-19. Distribution of Tools on Level IV.

These tools are believed to represent the toolkit used for butchering the three bison evidenced on Level IV. The biface tools, including blanks, may have served as general butchering tools. They would have been suited for removing the hide, separating meat packets, and severing ligaments. The Group A scrapers may have been used to clean the bones in preparation for marrow cracking. The heavy-duty scraper may reflect early stage hide scraping.

The chopper was located in the southeast corner of the excavated area in association with bison bone. Another butchering activity may have been centered in this area, only a segment of which was excavated.

Debitage

The debitage from Cultural Level IV indicates an emphasis on the late stages of biface tool manufacture and tool resharpening (Table 5-8). Of the recovered debitage (excluding the flotation samples), just over half (53 percent) are classified as bifacial thinning flakes and pressure flakes. Eighty cortical flakes comprise 13 percent of the excavated sample, and interior flakes, not identified as bifacial thinning flakes, comprise only 7 percent. The remaining 27 percent of the debitage are unclassifiable.

TABLE 5-8

LEVEL IV SUMMARY OF DEBITAGE AND MATERIAL TYPES

ARTIFACT CATEGORY	LITHIC MATERIAL TYPES*							TOTAL	PERCENT
	CHT	SSD	CHL	QTZ	BA	BAS	OTH		
Pressure Flake	106	42	11	3	0	34	0	196	29.2
Bifacial Thinning Flake	111	23	4	4	0	16	0	158	23.6
Cortical Flake	45	5	1	10	0	24	3	88	13.1
Interior Flake	21	11	2	8	1	2	0	45	6.7
Shatter	4	0	3	1	0	2	0	10	1.5
Core	0	1	0	0	0	0	0	1	0.1
Unidentified Flake Fragments	100	24	4	6	0	38	0	172	25.7
TOTAL	387	108	25	42	1	121	3	670	--
PERCENT	57.7	16.1	3.7	6.3	0.1	18.1	4.4	--	100

*LITHIC MATERIAL TYPES KEY: CHT = Chert; SSD = Silicified Sediment; CHL = Chalcedony; QTZ = Quartzite; BA = Brown Agate; BAS = Basalt; OTH = Other

As discussed in the context of Feature H, the projection for additional biface thinning and pressure flakes is some additional 9,000 flakes, given the flotation results. This estimate increases the proportion of biface thinning and pressure flakes to approximately 92 percent of the total debitage from this level, with cortical flakes dropping to 4 percent and interior flakes dropping to less than 1 percent.

As previously indicated, these flake categories reflect the continuum of the lithic reduction strategy. Cortical and interior flakes were generally produced during the initial stages of this strategy while bifacial thinning and pressure flakes were generally produced during the later stages. Ideally, as the strategy progressed, the frequency of each succeeding flake type increased. Deviations from this general trend may have behavioral implications. The lower frequency of interior flakes to cortical flakes is one such deviation and probably reflects the preferential selection of interior flakes for the manufacture of flaked stone tools, thus reducing the relative frequency of anticipated interior flakes.

The occurrence of a single core and cortical flakes of several material types may indicate that blanks rather than cores were generally transported to the site. If several cores had been completely reduced, a greater number of exhausted cores and cortical flakes would have been expected. Another explanation may be sampling error.

The high frequency of bifacial thinning and pressure flakes of various material types indicates that several biface tools, including projectile points, were manufactured and rejuvenated during this occupation. For example, nearly 500 flakes of a distinctive creamy beige chert were recovered from four adjacent excavation units and, although dominated by pressure flakes, the sample includes the full range of flake types. A point base (#9) and point tip (#27) of the same material also were recovered from this area. Both the tip and base exhibit bending fractures which commonly occur during projectile point manufacture. Probably, the point snapped during the notching process because of improper support. The blade of this point was not recovered. Presumably, it was discarded in an unexcavated portion of this cultural level.

The debitage was overwhelmingly clustered in the southeast quarter of the excavated area. As discussed in the context of Feature H, this debitage was concentrated on both sides of the feature and extended south for about 1 m. These flakes and the associated charcoal, bone, and fire-broken rock are interpreted as intentional discard, i.e., trash. Eighty-nine percent of the excavated debitage and 95 percent of the flotation sample debitage fell within these clusters. Debitage was sparse throughout the rest of the living floor.

Flaked Stone Artifact Summary

The flaked stone artifact assemblage recovered from Cultural Level IV produced a wide variety of artifact types and lithic material types. Artifact types include the full range of products and by-products of the flaked stone reduction strategy including several unifacial tool types.

Material types include a wide variety of chert, silicified sediment, chalcedony, quartzite, and basalt. All of the material types recovered from this cultural level were probably available in local glacial deposits, stream gravels, and outcrops. No evidence of an extensive trade network dealing in lithic raw materials or a wide-ranging material procurement system was indicated.

The spatial distributions of flaked stone artifacts from this cultural level indicates that activities represented by these artifacts tended to center around the hearth (Feature H). Flaked stone tool manufacture was well represented by extensive debitage to the south and west of Feature H. Hide-, meat-, and bone-processing activities were centered about 1 m north-northeast of the feature.

The occurrence of several lithic material types among the debitage which are not represented among the bifacial and unifacial implements of the assemblage indicate curation of manufactured products. Several tools manufactured during this occupation were apparently removed from the site, presumably to be used elsewhere.

LEVEL IV CONCLUSIONS

The occupation of Level IV by Oxbow people took place in the fall some 3,500 years ago. The occupation focused on the processing of bison products including meat, marrow, grease, and hides. The people, camped near the banks of an oxbow lake or slow-moving meander, processed at least three bison, one pronghorn, one rabbit or hare, and one rodent. They also exploited aquatic resources as evidenced by the fresh water mussel shell and the remains of fish or amphibian.

The high degree of bone fragmentation and the characteristics of bone breaks indicated that the animals were thoroughly used. Such extensive processing usually is interpreted as an indication of food scarcity. Some of the meat may have been dried for winter storage rather than consumed on the spot. Long bones were cracked for marrow. Articulator ends, vertebrae, and innominates, based on their absence, are believed to have been processed for bone grease. Hides were dressed and clothing may have been prepared, as evidenced by end scrapers and an awl.

In addition to animal-processing activities, the occupants manufactured and refurbished a variety of tools reflecting a generalized butchering tool kit. Lithic material types were many and varied, indicating a local procurement strategy. The clustering of debitage with charcoal, fire-broken rock, and worn tools in the southeastern portion of the excavated area is interpreted as refuse. In order to relocate microflakes to a trash area, the flintknapper(s) must have worked over a hide which could be emptied periodically.

No evidence of vegetable processing was recognized, i.e., no economic floral remains were observed through macro- and microfloral analyses and no grinding stones were recovered. The absence of floral remains or suspected plant processing tools is not interpreted as evidence that these people did not exploit plant foods but rather, that plant foods were not the focus of this particular occupation.

No evidence of habitation structures was encountered. Rather than assume the lack of dwellings, this absence may be due to sampling error or it may be that no evidence of tent pegs or brush shelters remained.

To conclude, we estimate that 20 to 25 people could have subsisted on the products of the represented fauna for 6 to 10 days. Rather than representing a 10-day encampment, the Level IV occupation is interpreted as a location where winter stores were prepared. The relatively limited accumulation of tools and debris suggests an occupation of perhaps, two to three days.

CHAPTER 6

CULTURAL LEVEL V

Cultural Level V was occupied by Oxbow people approximately 4,500 years ago based on the presence of a single Oxbow projectile point and three radiocarbon dates (see Table 3-1). Approximately 20 sq. m were excavated to expose an undetermined portion of the living floor. The floor appears to continue in all directions (Fig. 6-1).

LEVEL V FEATURES

Cultural Level V contained a 1- x 2-m, dense charcoal layer, 1 to 3 cm thick (Figs. 6-2 and 6-3), which sloped notably downward toward the northeast. Fire-broken rocks, burned and unburned bison and pronghorn bones, and a few flakes were contained within this concentration area, which is referred to as Feature G (Fig. 6-4). However, because of the shallow dispersal of debris with no evidence of excavation and no evidence of burning in the form of oxidized soil, this is not believed to represent an excavated hearth. Rather, the dense scatter probably represents debris cleaned out from a nearby hearth, one which was not encountered during excavation. Such a hearth may have been located immediately to the north of Feature G or, given the slope downward to the northeast, we might postulate that the hearth was located to the southwest, on higher ground.

Of the 31 fire-broken rocks recovered from this feature, all exhibited fractures resulting from differential expansion, indicating rapid exposure to heat. Apparently stones were heated, possibly for roasting, then discarded. Rocks broken through differential contraction were recorded to the southwest of Feature G, indicating that stone boiling activities also occurred. These activities may have been centered outside the excavated area and may not be associated with Feature G. A 3-l flotation sample produced abundant charcoal, 1 flake, and 114 large mammal bone fragments, 28 of which were burned. No vegetal information was retrieved from the pollen, phytolith, or macrofloral studies.

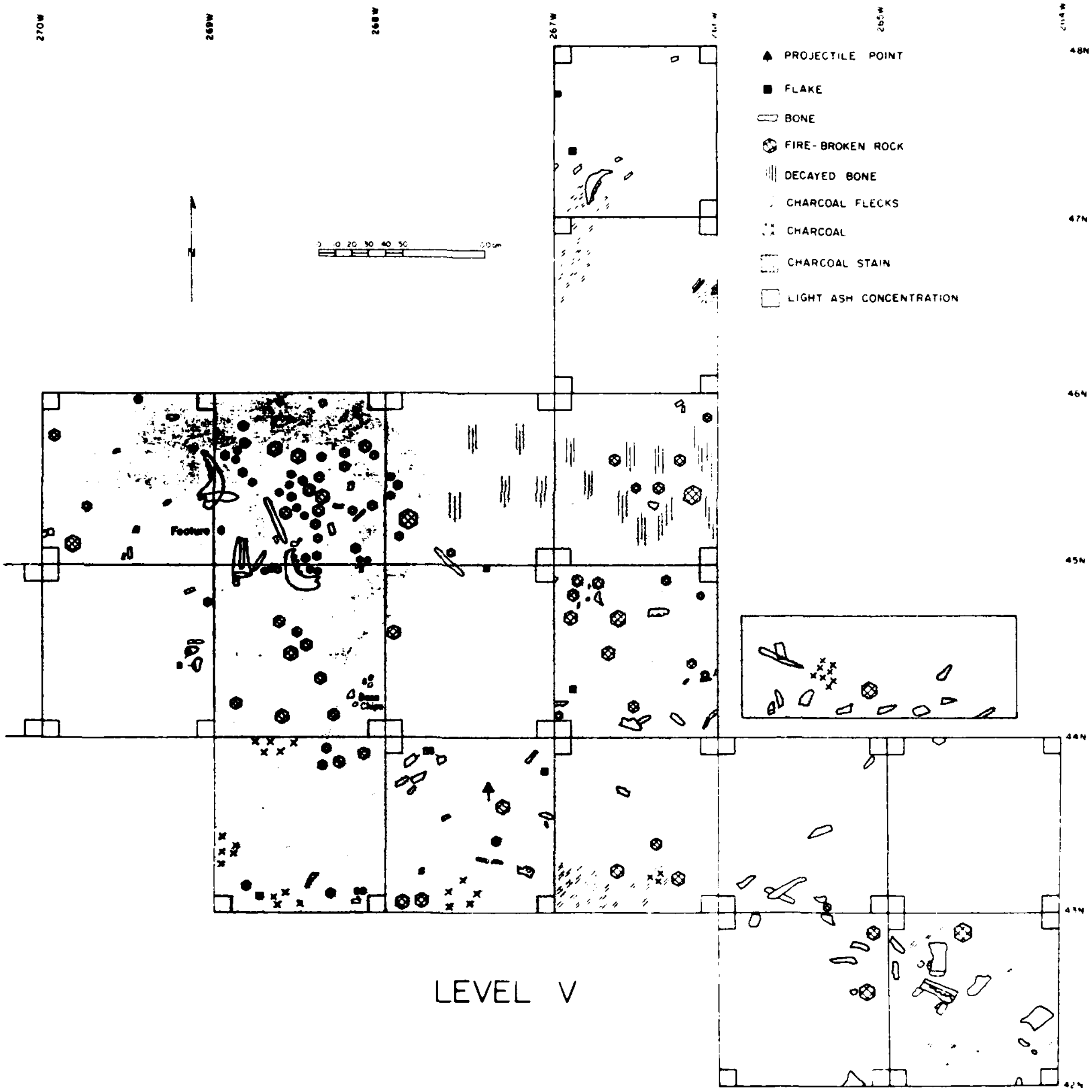

Figure 6-1. Floor Plan, Level V

Figure 6-2. Photograph of Feature G (incomplete).

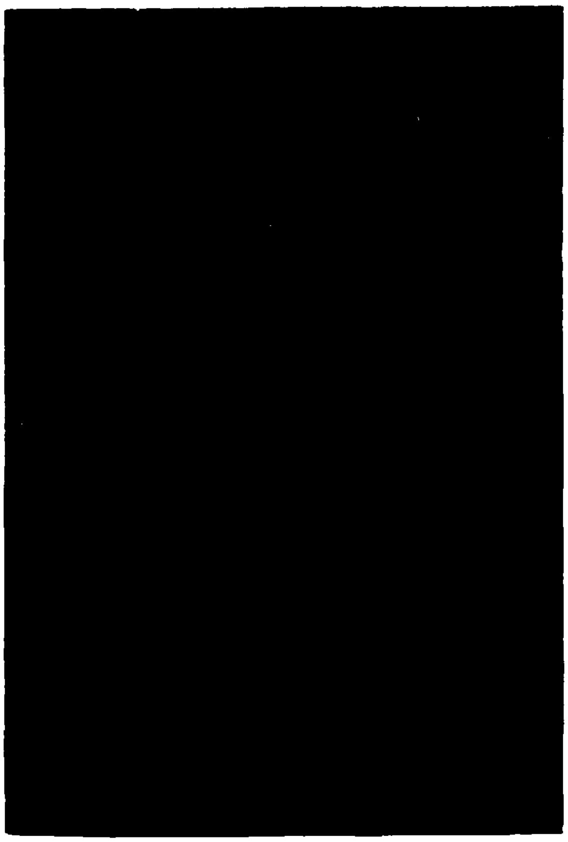

Figure 6-3. Photograph of Feature G.

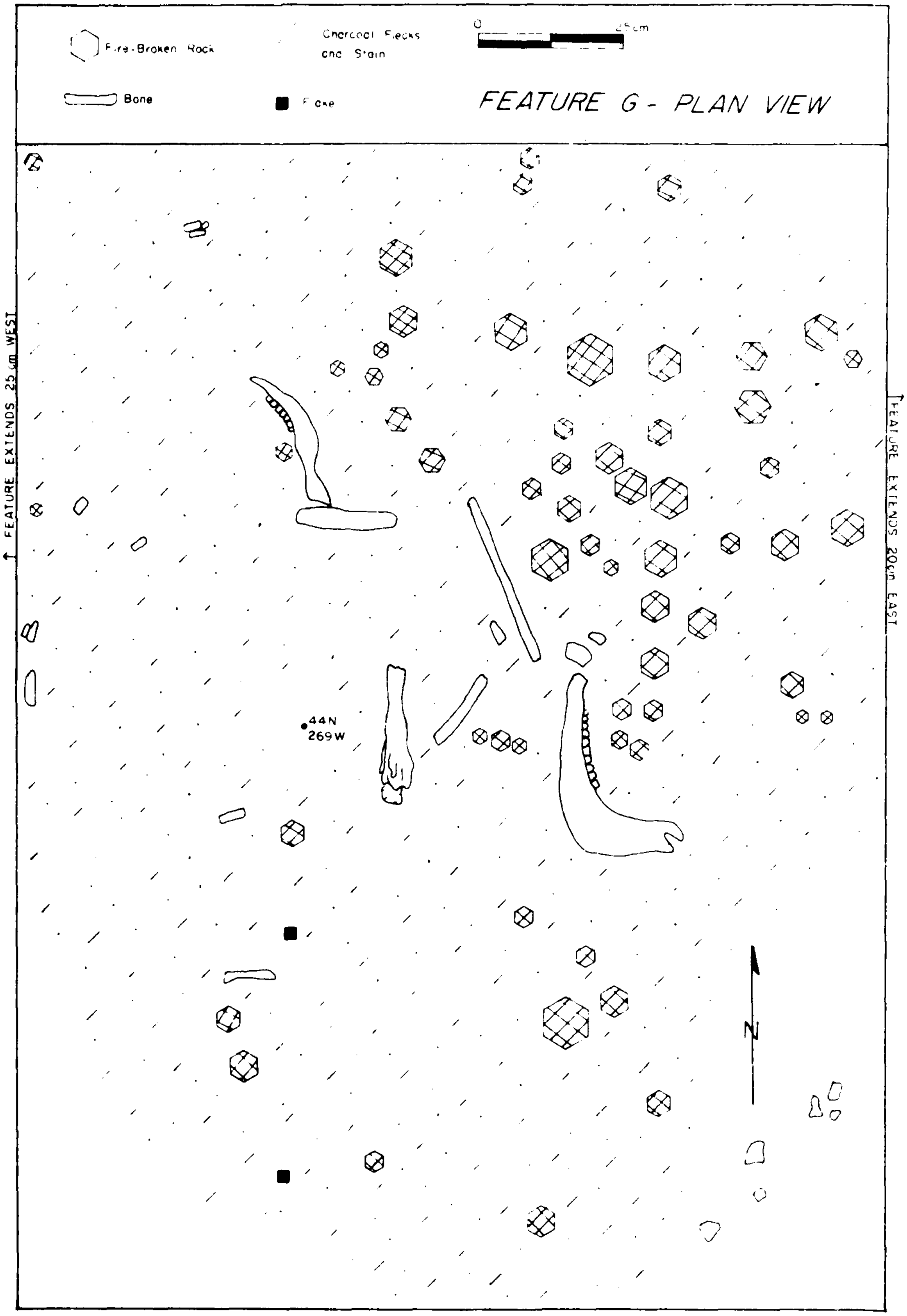

Figure 6-4. Feature G Plan View.

LEVEL V BONE

The excavated sample from the Level V living surface produced 513 bones and bone fragments. A total of 241 (38.38 percent) of these bones have been identified as bison, which comprises 65 percent of the identifiable bone. The remaining identifiable bones included pronghorn (21 percent of identifiable bone), wapiti, deer, bird, and gastropods. Fragments, unidentifiable as to species, totaled 143 (Table 6-1). As noted previously, from flotation samples an additional 114 bone fragments were recovered, which are identified only as large mammal. All but the gastropods are believed to represent animals exploited by the site's occupants.

TABLE 6-1

SUMMARY OF LEVEL V EXCAVATED AND FLOTATION SAMPLE BONE

SPECIES	EXCAVATED BONE NO.	FLOTATION SAMPLE BONE NO.	TOTAL	PERCENT OF TOTAL
Bison	241	0	241	38.38
Pronghorn	76	0	76	12.10
Wapiti	26	0	26	4.14
Deer	19	0	19	3.03
Bird	7	0	7	1.11
Gastropod	2	0	2	0.32
Unidentifiable	143	114	257	40.92
TOTAL N	514	114	628	100.00

Taphonomy, Aging and Season of Use

Heavy fragmentation of bone was evidenced on Level V, as on Level IV. Maxillae and mandibles, including the pronghorn, tended to be less fragmented during processing than other bones, but excavation resulted in rapid deterioration of the maxillae and the younger mandible.

About 21 percent of the excavated bones were exfoliated and 17 percent were acid etched. Nearly 50 percent of the exfoliated bones also were acid etched. Over 50 percent of the exfoliated bones were located in the southern part of the excavated area. As discussed in the context of Feature G, this area was higher; hence, the bones here were exposed a few years longer.

As with Level IV, no rodent gnawing was observed. On this level, 16 cases of canine tooth puncture holes and rotational scars were observed, verifying the presence of carnivores. The extent of impact on the bone assemblage caused by carnivores is unknown. Wolves and other carnivores may have been responsible for removal of a number of bone elements from the living floor.

A total of 184 bison bones, primarily fragments, were identifiable as to element or side (Table 6-2). The remaining 57 bison bone fragments could not be specifically identified. Maxillae were the most frequent element identified and sided for Level V. However, the four maxillae and three mandibles were actually from six separate individuals who, based on tooth eruption and wear of the younger ones, appear to have been killed and butchered in the late fall or early winter. Using Frison and Reher (1970); Frison, Wilson, and Wilson (1976); Wilson (1974); and Reher (1973, 1974) for comparison, the six individuals were identified on the basis of the following data:

(1) A left maxilla having more wear on the first molar than the specimen from Level IV and those described by Wilson (1974), and is larger than the Level IV specimen. Accordingly, this specimen was approximately 0.5 year old at the time of death;

(2) A right maxilla and an unbutchered, right mandible are believed to represent one 2.5-year-old specimen on the basis of molar wear and tooth budding;

(3) A left mandible with a near fully erupted fourth premolar and no wear on the posterior lobe of the third molar is attributed to a 3.5-year-old specimen. The ventral border of the mandible was removed during butchering. This is a classic pattern (Frison and Reher 1970; Reher 1973, 1974). The teeth in this mandible show definite signs of crowding. The erupting fourth premolar was growing into the first molar, and the third molar has an abnormal S-curve and is extensively overlapping the external side of the second molar;

(4) A right maxilla with all teeth present and showing wear probably represents a 6.5-year-old specimen. This interpretation is based on the location of wear on the molars, especially on the styles;

(5) A left mandible with a heavily worn first molar and notable wear on all teeth represents a 7.5-year-old specimen. The ventral border was removed from this mandible also; and

(6) A left maxilla with all teeth present and moderately worn probably represents an 8.5-year-old specimen. This interpretation is based on the presence of wear on all molars and styles (the first molar is slightly cupped and the style is worn off).

TABLE 6-2

LEVEL V BISON BONE BY ELEMENT AND SIDE

BISON BONE	RIGHT	LEFT	UNASSIGNED
Maxilla	2 fragments	2 fragments	
Mandible	1 complete	2 fragments	
Skull fragments			19 fragments
Incisors			3 fragments
Thoracic			2 fragments
Rib			78 fragments from 3 ribs
Humerus			
Shank	7 fragments	9 fragments	1 fragment
Distal	4 fragments of 1 distal		
Radius/Ulna			
Proximal		6 parts of 1 com-	
Shank		plete radius/ulna	2 fragments
Distal			
Carpals	1 complete		
Metacarpal			
Distal		1 unfused and nearly complete	
Femur Shank	2 fragments	8 fragments	19 fragments
Tibia Shank	3 fragments	1 fragment	1 fragment
Metatarsals			
Shank	3 fragments		2 fragments
Distal		1 complete	
Phalanges	1-1st complete	1-1st complete	1 fragment
Sesamoid			1 complete

As was the case with Level IV faunal remains, most elements were under-represented (Fig. 6-5).

The pronghorn bones represented a single individual. Only the left mandible and teeth were complete enough to get any idea of age. Based on tooth eruption and wear patterns (Nimmo 1971), the first molar has proper wear for a 2.3-year-old specimen, which would place time of death in mid- to late fall, complementing the bison data.

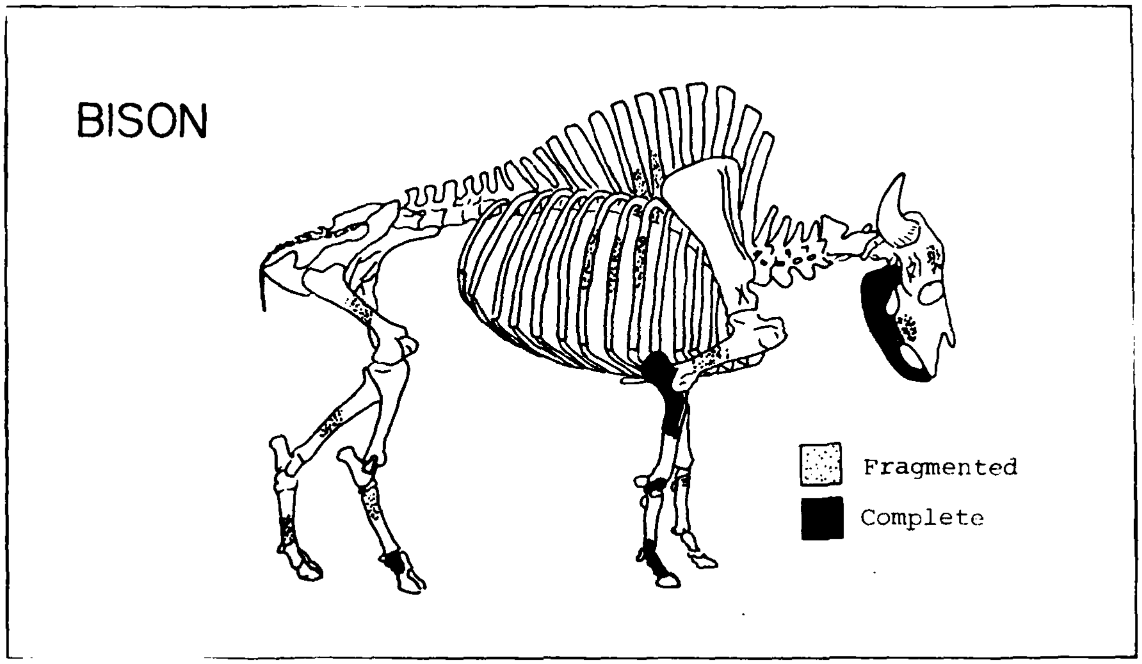

Figure 6-5. Bison bones represented in Cultural Level V.

TABLE 6-3

LEVEL V PRONGHORN BONE BY ELEMENT AND SIDE

PRONGHORN BONE	RIGHT	LEFT	UNASSIGNED
Mandible	1 very fragmentary	1	
Skull fragments			3
Thoracic			4
Humerus Shank			2
Metacarpal Shank			1
Femur Shank	2	1	14
Tibia Shank	2		21
Phalanges			3

It should be mentioned that the ages assigned are believed to be close approximations, although large samples are more desirable. Nonetheless, the above interpretations allow for general seasonal reconstruction.

Other species identified on Level V include wapiti rib, radius, tibia, and right metatarsal fragments; deer left and right femur fragments; and bird femur and unidentifiable fragments. It appears that at least wapiti and deer quarters were being processed during occupation.

Bone-processing Activities

As mentioned above, Feature G was probably a concentration of discarded cultural debris which included a large amount of bison and pronghorn bones and fragments. More than 81 percent of the burned bone and 50 percent of the unburned bone (Table 6-4) were from or within 1 m of the feature (40 percent of the excavated area of this level). A left distal humerus and left proximal radius/ulna, probably from the same bison, were located 1 m apart from each other within the feature. Other bones from the feature, except for two bison mandibles, were heavily fragmented. The large number of bison maxillae and mandibles and the lack of recovered petrous (inner ear) bones indicates that specialized processing of the skulls was undertaken. The petrous is an extremely compact, enamel-like, bone from inside the skull which preserves long after other skull fragments deteriorate. It would appear that maxillae and mandibles were removed from the skull to be processed for meat, marrow or grease. At the same time, an opening into the brain cavity would have provided access to the brain which could be removed for eating or tanning of hides.

The discussion of bone fracturing for marrow and grease production presented in Level IV applies here also. Marrow processing is reflected in the high number of long bone shank fragments. Bone grease processing is believed to have taken place within grid 45N 266W. The recovered fire-broken rock displayed differential contraction fractures, presumably as a result of stone boiling, as described above. In addition, the excavators noted that deteriorated bone fragments were scattered across the grid. According to Brumley (1981:36-39), "Containers most commonly mentioned in accounts of stone boiling were simply a piece of skin either stretched across a stick framework on the ground surface or an excavated earth pit." On the east side of 45N 266W was an area nearly devoid of cultural material where an above-ground skin container may have been located. Adjacent unexcavated grids may also contain locations for surface or subsurface containers.

TABLE 6-4

LEVEL V BURNED AND UNBURNED BONE BY GRID AND SPECIES
(burned/unburned)

GRID COORDINATES NORTH	WEST	BISON BONE	PRONGHORN	WAPITI (W) DEER (D) BIRD (B) GASTROPOD (G)	UNIDENTI-FIED	TOTAL
42	264	1/13				1/13
42	265	0/7				0/7
43	265	0/15		0/17 (W) 0/6 (B)		0/38
43	266	0/1	0/3	3/6 (W) 1/3 (D)		4/13
43	267	2/12	0/21	0/4 (D) 0/2 (G)	6/11	/50
43	268	22/0	1/1	0/4 (D)	3/10	26/5
44	264	0/3		0/3 (D)		0/6
44	265	0/54				0/54
44	266	0/27		0/4 (D)	20/15	20/46
44	267		7/9			7/9
44	268	0/12			4/17	4/29
44	269		0/6		3/6	3/12
44	270		0/2			0/2
45	266	0/14				0/14
45	267	0/1		0/1 (B)	0/3	0/5
45	268	0/45			38/0	38/45
45	269	9/1	0/5		2/0	11/6
46	266		0/8		0/3	0/11
47	266	0/2	0/13		0/12	0/27
TOTAL		34/207	8/68	4/50	76/67	122/392
FLOTATION SAMPLE RECOVERY						
43 (Feature G)	268				55/8	
44 (Feature G)	268				31/20	
TOTAL					86/28	

Again using Wheat's (1972) meat and grease estimates for the bison on Level V, approximately 2,150 pounds of meat and 176 pounds of grease were available from the six bison (Table 6-5). The pronghorn, assuming a complete individual was exploited, would have provided an additional average of 45 pounds of meat and 2-plus pounds of fat and grease (Frison 1971). Based on an estimate of 3.5 to 5 pounds of meat per person per day, 25 people could have been supported by this meat supply for about 17 to 25 days. Of course, the wapiti and deer products would have added approximately two more days' worth of food. Occupation of the site is not thought to have been nearly this long. Rather, the people are believed to have rapidly processed the meat and grease for winter stores.

TABLE 6-5

MEAT AND GREASE ESTIMATE FOR LEVEL V BISON

ANIMAL SIZE	USABLE MEAT	GREASE TALLOW
Four Adults	864 kg (1,900 lbs)	72 kg (160 lbs)
One 2.5 year old	91 kg (200 lbs)	5 kg (12 lbs)
Calf	23 kg (50 lbs)	2 kg (4 lbs)
TOTAL	978 kg (2,150 lbs)	79 kg (176 lbs)

Evidence of Butchering and Tool Use

On this level, as on Level IV, the actual number of bones with visible cut marks was quite limited. Eight bone fragments with observable cut marks include bison left and right femur fragments (Fig. 6-6a,b), two tibia fragments and a rib fragment; fragments of a wapiti tibia and rib; and a deer femur fragment. No identifiable formal or impromptu bone tools were recovered from this level.

Faunal Summary

As on Level IV, Level V faunal remains appear to under-represent the actual number of individual animals that were exploited. We would expect a much greater amount of complete or fragmented bone from four bison, a wapiti, a deer, a pronghorn, and a bird. Because of evidence of post-depositional carnivore action, we assume that differential representation of bone reflects both human and animal selection and processing of the carcasses. Like Level IV, the bone was heavily fragmented, indicating marrow and bone grease processing. An interesting distinction between Levels IV and V is the relatively equal number of bone fragments, representative of twice as many animals in Level V. The degree of fragmentation is essentially the same; presumably, sampling error accounts for this distinction.

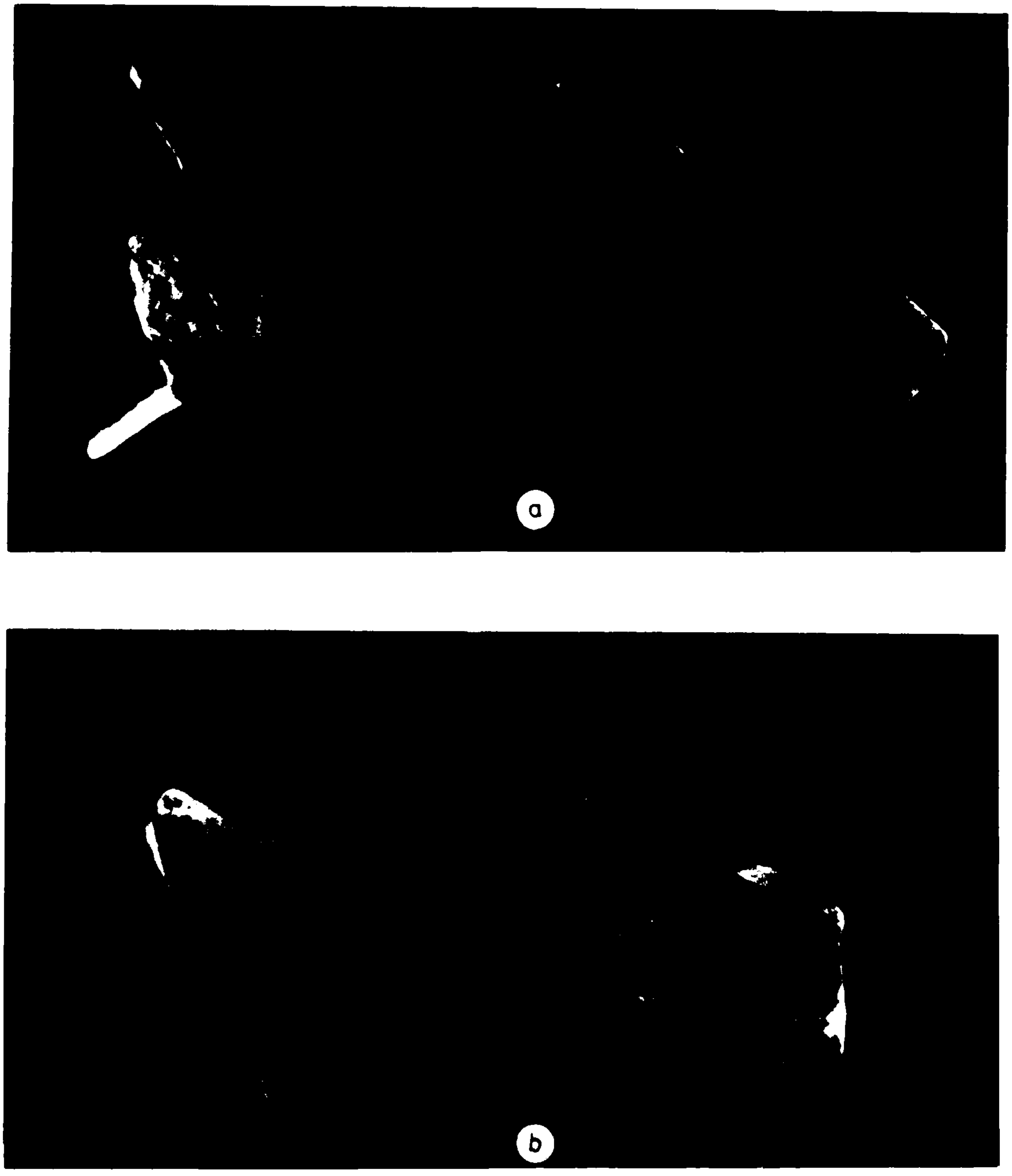

Figure 6-6. Level V bone evidencing cut marks (full scale):
(a) and (b) -- bison femur fragments

Fifty percent of the bone was burned, presumably because bone scraps were tossed into hearths when processing was complete. The relatively high number of mandibles and maxillae may represent a chance encounter with a skull-processing area or this high number may represent some activity not represented in Level IV.

FLAKED STONE ARTIFACTS

Excavation of Level V recovered 7 flaked stone tools and 35 pieces of debitage (Table 6-6). Only one additional flake was recovered from a flotation sample. The tool assemblage consisted of one projectile point, two biface blanks, and four unifacially modified flake tools. In contrast to Level IV, only 12 percent of the lithic material from Level V was chert. The predominant material was basalt (31 percent), followed by silicified sediment (26 percent), quartzite (21 percent), chalcedony (7 percent), and brown agate (2 percent), in addition to the chert. The brown agate is similar to, and may be mistaken for, Knife River Flint (Clayton et al. 1970). However, Maynard Shumate (1982, personal communication) has observed brown agate cobbles eroding from glacial deposits in the area, thus this material from Level V is thought to have been derived from local sources. Other materials also are believed to have been derived from local glacial and river cobbles as well as from outcrops in the area.

TABLE 6-6

LEVEL V ARTIFACT CATEGORIES BY LITHIC MATERIAL TYPES

ARTIFACT CATEGORY	LITHIC MATERIAL TYPES*						TOTAL	PER-CENT
	CHT	SS	CHL	QTZ	BA	BAS		
Debitage	3	9	2	9	0	12	35	83.3
Unifaces	1	2	0	0	1	0	4	9.5
Biface Blanks	0	0	1	0	0	1	2	5.8
Projectile Points	1	0	0	0	0	0	1	2.4
TOTAL	5	11	3	0	1	13	42	--
PERCENT	11.9	26.2	7.1	21.4	2.4	30.9	--	100

LITHIC MATERIAL TYPES KEY:

CHT = Chert
SS = Silicified Sediment
CHL = Chalcedony
QTZ = Quartzite
BA = Brown Agate
BAS = Basalt

An interesting contrast is apparent between the lithic materials from Levels IV and V. Few material types are present in both levels. The limited number of chert specimens from Level V does not include the tannish-to-green chert so common in Level IV. In addition to the silicified sediment described for Level IV, Level V contains a light grayish-green silicified mudstone. The quartzite and basalt appear similar between levels. Given the substantial period of time between occupations (approximately 1,000 years), differential exploitation of lithic materials is not surprising.

Bifaces

Three bifaces were recovered from Level V (Table 6-7), comprised of two Early Stage blanks (Fig. 6-7) and one projectile point (Fig. 6-8). One of the Early Stage blanks is of basalt and the other is of gray translucent chalcedony, which appears to have been heat treated. The projectile point is of a pink chert. The point (#44) is classified as Oxbow, although it exhibits significant technological differences reflective of the resharpening processes to which this tool was subjected.

Of the two biface blanks, the basalt specimen (#45) is complete, yet appears to have posed many technical problems attested to by multiple step fractures. Presumably this is why the blank was not reduced further. The chalcedony blank (#43) was never completed because it broke during manufacture.

Of the three biface artifacts, the two blanks had comparable material present, although limited, in the debitage. The pink chert projectile point may have been brought to the site in its present state. However, the absence of comparable debitage may be attributed to sampling error.

TABLE 6-7

LEVEL V BIFACES

TOOL NO.	ILLUS. NO.	GRID LOCATION NO.	GRID LOCATION SO.	ARTIFACT TYPE	MATERIAL TYPE	DIMENSIONS (mm) LENGTH	DIMENSIONS (mm) WIDTH	DIMENSIONS (mm) THICKNESS	BLADE LENGTH (mm)	BASAL DEPTH	NECK WIDTH (mm)	BLADE WIDTH (mm)	COMMENTS
43	6-7a	45	266	Early Stage Blank	Chalcedony	36	28	6	--	--	--	--	Unmodified fragment (no rejuvenation)
45	6-7b	45	267	Early Stage Blank	Basalt	45	27	9	--	--	--	--	Unmodified complete (no rejuvenation)
44	6-8	43	267	Projectile Point	Chert	28	18	5	20	5	14	16	Modified complete (whole and rejuvenated)

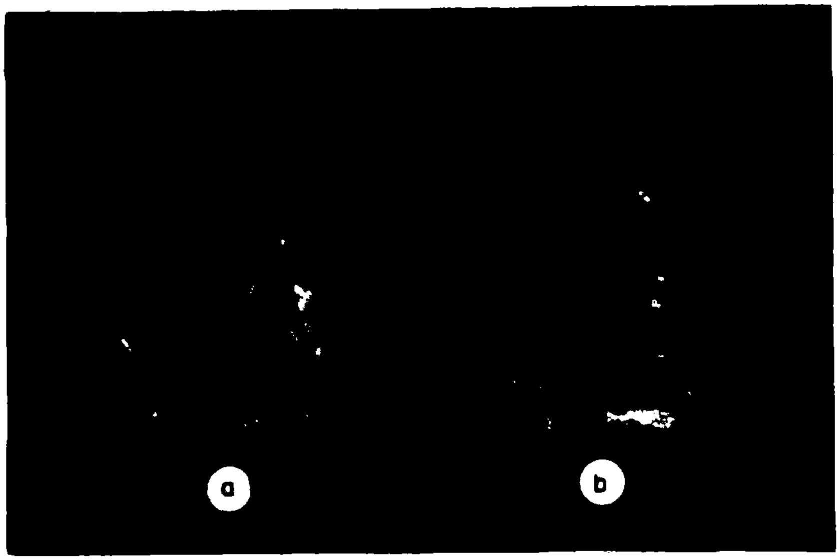

Figure 6-7. Level V bifaces, Early Stage blanks (full scale):
a: Tool #43, 45N 266W, chalcedony
b: Tool #45, 45N 267W, basalt

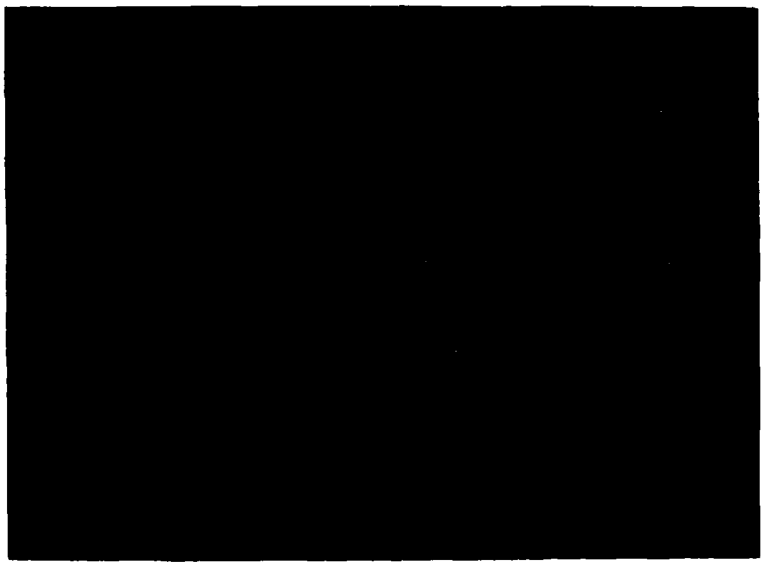

Figure 6-8. Level V projectile point (full scale):
Tool #44, 43N 267W, chert.

Unifaces and Modified Flakes

Four unifacially modified flakes were recovered from Cultural Level V (Table 6-8). One of these tools (#64) was categorized as a Group A tool, as defined in the Level IV discussion, because it was a thin flake scraper with a low edge angle (Fig. 6-9a). Use-wear along the single modified edge of this brown agate flake was scalar retouch and edge rounding. All three remaining tools were classified as Group B flake scrapers due to their moderate thickness and somewhat greater edge angles (Fig. 6-9b-d). One of these was of silicified sediment, one was a weathered tan chert, and the other was a mottled tan chert.

Two of these unifacial tools were produced from cortical flakes (#48 and #65). Only the silicified sediment specimen (#48), however, was of a material type represented among the debitage. The other three tools may have been brought to the site in their present form, rather than having been manufactured there.

All four of the unifacially modified flakes exhibit straight to slightly convex worked edges. Three specimens were worked on one lateral edge, whereas #48 was worked on one lateral and the distal margins. These margins originally came together to form a sharp tip, but this tip, which may have been a perforator or graver, was broken.

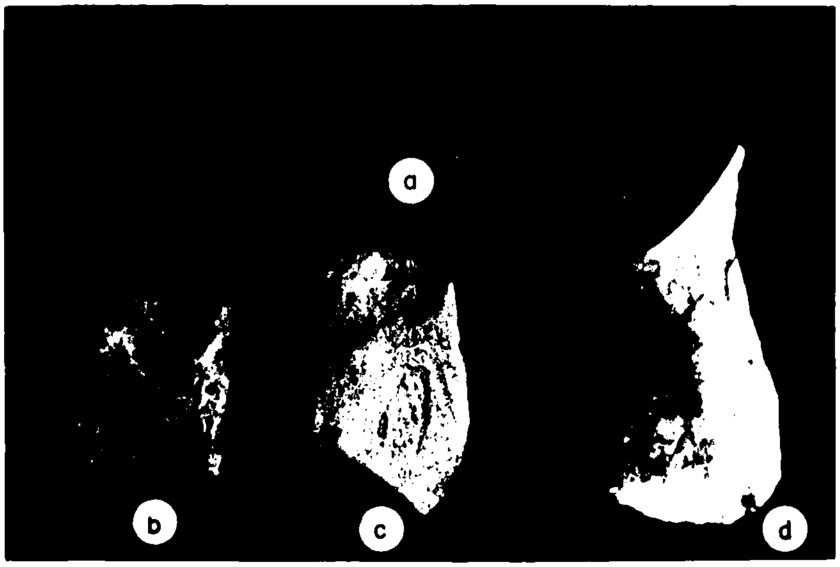

Figure 6-9. Level V uniface tools (scrapers) (full scale):
a: Group A, Tool #64, brown agate
b: Group B, Tool #42, mottled and speckled chert
c: Group B, Tool #65, silicified sediment
d: Group B, Tool #48, weathered tan chert

TABLE 6-8

LEVEL V UNIFACE TOOLS

TOOL GROUP	ARTIFACT NUMBER/ GRID LOCATION	ILLUST. NUMBER	ARTIFACT TYPE	LITHIC MATERIAL	DIMENSIONS (mm)			WORKING EDGE SHAPE AND ANGLE			USE-WEAR/COMMENTS
					LENGTH	WIDTH	THICKNESS	CONVEX	STRAIGHT	CONCAVE	
A	64	6-9a	Scraper	Brown Agate	32	18	2	50°	--	--	Use-retouch and edge rounding/distal retouch
B	42	6-9b	Scraper	Mottled and speckled chert	27	25	5	--	53°	--	Light use-retouch/ lateral margin retouch
B	65	6-9c	Scraper	Silicified Sediment	37	22	6	60°	--	--	Use-retouch/lateral margin retouch; unmodified complete (no rejuvenation)
B	48	6-9d	Scraper	Weathered tan chert	49	38	7	--	56°	--	Use-retouch, light crushing and rounding/combination retouch; unmodified complete (no rejuvenation)

Use-wear on all three tools was in the form of scalar-retouch, with the addition of light crushing and subsequent rounding on the lateral edge of #48. These flake scrapers are thought to have been used in the context of butchering, possibly including skinning, bone cleaning, and perforating hide or engraving bone (#48).

Tool Distributions

Due to the limited number of broadly scattered tools, assessment of tool distributions, per se, is uninformative (Fig. 6-10). However, taken in context with the bone data, there is overlap between the two data sets.

Debitage

Only 35 artifacts from this level were classified as debitage, the greatest percentage of which was cortical flakes (29 percent) (Table 6-9). Interior flakes comprised 14 percent, bifacial thinning flakes --21 percent, and pressure flakes--14 percent. The remaining 12 percent of the debitage was shatter or unidentifiable flake fragments. Again, the lower frequency of interior flakes to cortical flakes probably reflects the preferential selection of interior flakes in the manufacture of flaked stone tools. Thus, the relative frequency of interior flakes is less than might be anticipated.

TABLE 6-9

LEVEL V DEBITAGE SUMMARY

ARTIFACT CATEGORY	LITHIC MATERIAL TYPES*						TOTAL	PERCENT
	CHT	SS	CHL	QTZ	BA	BAS		
Cortical flakes	0	0	2	7	0	1	10	28.6
Bifacial thinning flakes	2	2	0	0	0	4	8	22.8
Pressure flakes	1	3	0	0	0	2	6	17.1
Interior flakes	0	4	0	1	0	0	5	14.3
Core	0	0	0	1	0	0	1	2.9
Unidentified flake fragments	0	0	0	0	0	5	5	14.3
TOTAL	4	9	3	9	0	13	35	--
PERCENT	16.4	25.7	8.6	25.7	0	37.1	--	100

LITHIC MATERIAL TYPES KEY:

CHT = Chert
SS = Silicified Sediment
CHL = Chalcedony
QTZ = Quartzite
BA = Brown Agate
BAS = Basalt

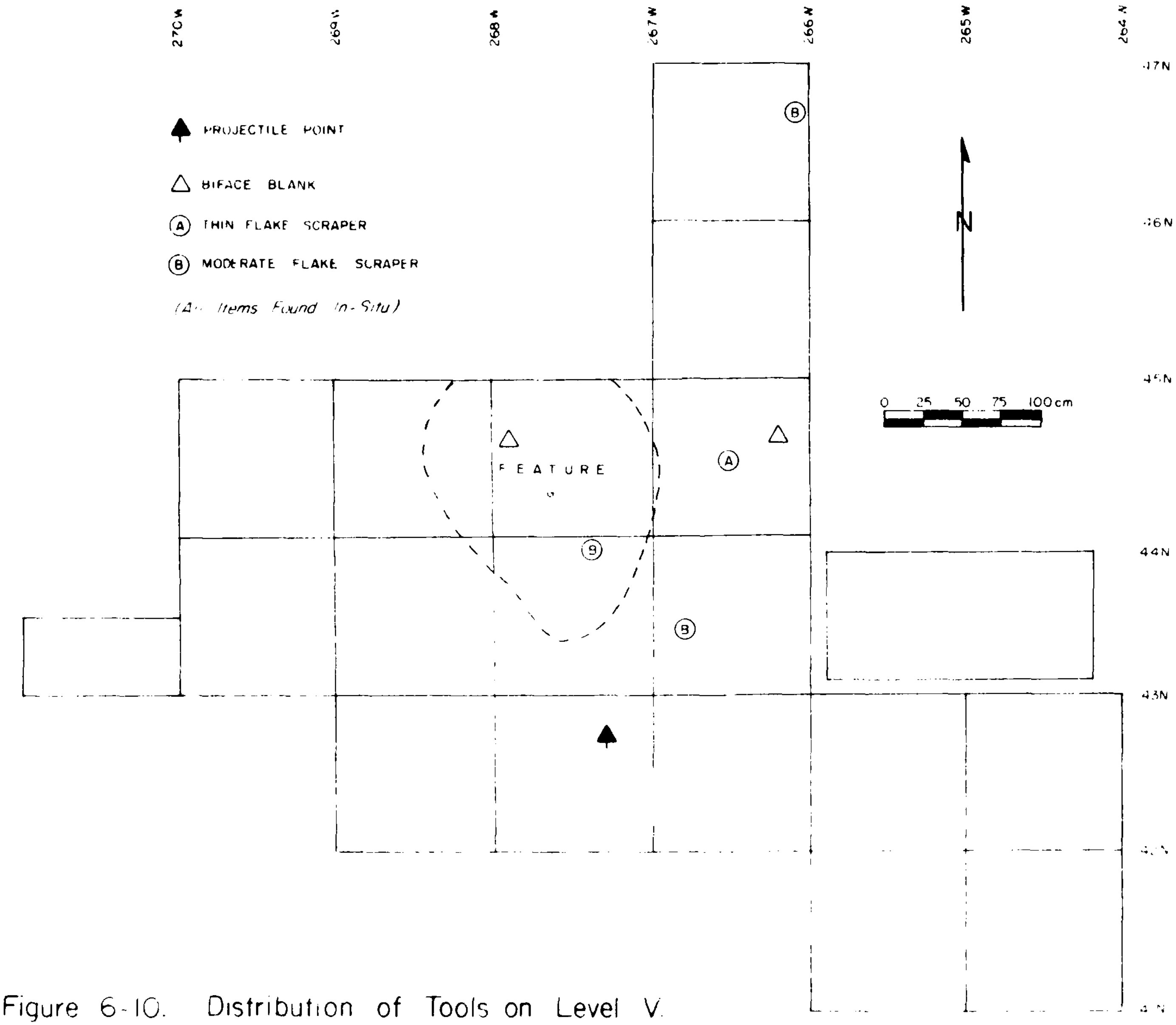

Figure 6-10. Distribution of Tools on Level V.

The occurrence of a single quartzite core fragment and a significant portion of cortical flakes of several different material types indicates that cores were only partially reduced and transported elsewhere for further reduction, or that blanks rather than cores were generally transported to the site, or again, that the dearth of cores is attributable to sampling error. Since two Early Stage blanks were recovered from this occupation level, the middle alternative seems most probable.

No dense clusters of debitage such as characterized Level IV were present in Level V. Of the limited debitage, 99 percent was located in the southern half of the excavation area, and 80 percent was in the southwestern quarter. In contrast, most of the tools occurred in the central portion of the site, to the northeast of the debitage.

Four lithic materials were present in the debitage that were not present in the tool assemblage. Presumably, these flakes represent tools which were removed from the site or which were not in the excavated sample. Most of these flakes were categorized as bifacial thinning and pressure flakes.

Flaked Stone Artifact Summary

The flaked stone artifact assemblage from Cultural Level V was extremely limited in comparison with Level IV. Given the paucity of tools in relation to the notable amount of bone and the occurrence of debitage not related to the sample of tools, we might conclude that tools were heavily curated, e.g., tools that were still usable were carried away with the occupants; what tools remained then were either exhausted or lost.

Material types were dominated by basalt, silicified sediment and quartzite. Chert, chalcedony and agate were also recorded. As with Level IV, based on the presence of diverse, locally available materials, the lithic procurement strategy might be interpreted as expedient.

Tools were too few in number to suggest patterns of use. A limited variety of scraping tools were present with end scrapers and knives notably absent.

LEVEL V CONCLUSIONS

The occupation of Level V by Oxbow people took placed in the late fall or early winter, some 4,500 years ago. The occupants exploited a wide range of ungulates dominated by bison, but also including pronghorn, wapiti, and deer. Bird remains suggest their exploitation as well. The notable degree of bone fragmentation suggests the type of processing which was carried out in times of need. Presumably, meat was dried and marrow and grease were extracted.

Although twice as many animals were processed during the Level V occupation, the limited amounts of lithic debris and other refuse suggest that the duration of occupation was shorter than for Level IV. Of course, sampling error must be considered, but it appears that food and grease processing were the only activities undertaken. Absent from the tool assemblage were scrapers and awls, from which we infer that hide processing did not take place. Wheat (1972:109-110) discusses ethnographic records that indicate a fast worker could completely butcher a bison in about an hour. If hunting parties brought in all the animals in one day, the task of butchering could have easily been accomplished by 15 adults in one day.

Other distinctions between Levels IV and V include: (1) the absence of any excavated hearths in our Level V sample; (2) the absence of trash areas with large quantities of microflakes; and (3) the distinctive proportions of lithic materials between levels.

Similarities between the levels include: (1) the variety in lithic materials; (2) the thorough processing of animals; (3) the absence of economic floral remains or plant processing tools; and (4) the absence of evidence of habitation structures. The absence of dwellings would, of course, be expected if the people occupied the site for less than a day.

CHAPTER 7

CULTURAL LEVEL VI

Based on the presence of seven Oxbow points and three radiocarbon dates (see Table 3-1), Cultural Level VI is believed to have been occupied by Oxbow people approximately 5,200 years ago. As with the previous two levels, approximately 20 sq. m were excavated to expose a living floor concentrated in the northern two-thirds of the area (Fig. 7-1). This floor clearly extended to the north, but its overall dimensions are unknown.

LEVEL VI FEATURES

Two features were designated in Cultural Level VI. One of these, Feature I, is considered to represent a bone-processing activity area, and Feature J was an excavated hearth.

Feature I was an extremely dense concentration of bone fragments in association with a limited number of flakes and fire-broken rocks (Fig. 7-2). The bone layer, which incorporated nearly 1 sq. m, was 2-3 cm thick within a mottled gray and brown clay matrix (Fig. 7-3). Flecks of charcoal and small areas of ash were included within the matrix. The floor level in this 1-sq.-m area sloped downward to the north as much as 6 cm.

Collected from the feature were a number of pronghorn bone fragments, primarily from long bones, and several rodent bones. None of these bones recovered during excavation showed evidence of burning. However, of the 121 tiny bone fragments recovered from a 2.75-l flotation sample, 74 were burned. In addition to the bone, 91 flakes were retrieved from the sample. No phytoliths or pollen grains were observed in a matrix sample from the feature.

A single radiocarbon date of 5670±190 BP, corrected to 4548 BC, was obtained from scattered charcoal from this feature. The large standard deviation is thought to be the result of the very small amount of carbon in the submitted sample.

From the clustered bone, dominated by long bone fragments, we may infer that this feature was the end product of marrow-processing activities, as discussed previously. Feature J, which will be discussed below, may have provided the heat to warm the marrow.

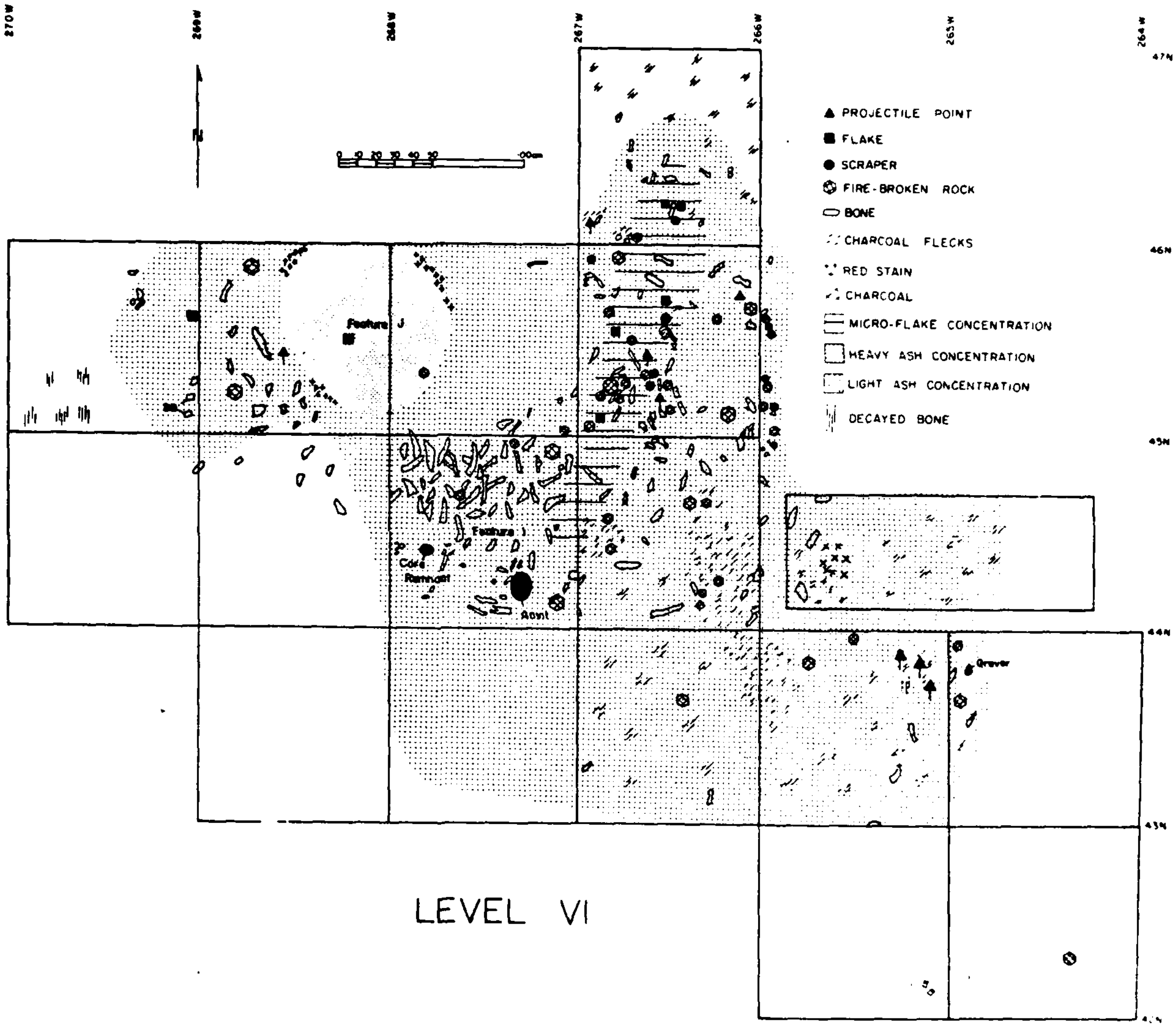

Figure 7-1. Level VI Floor Plan.

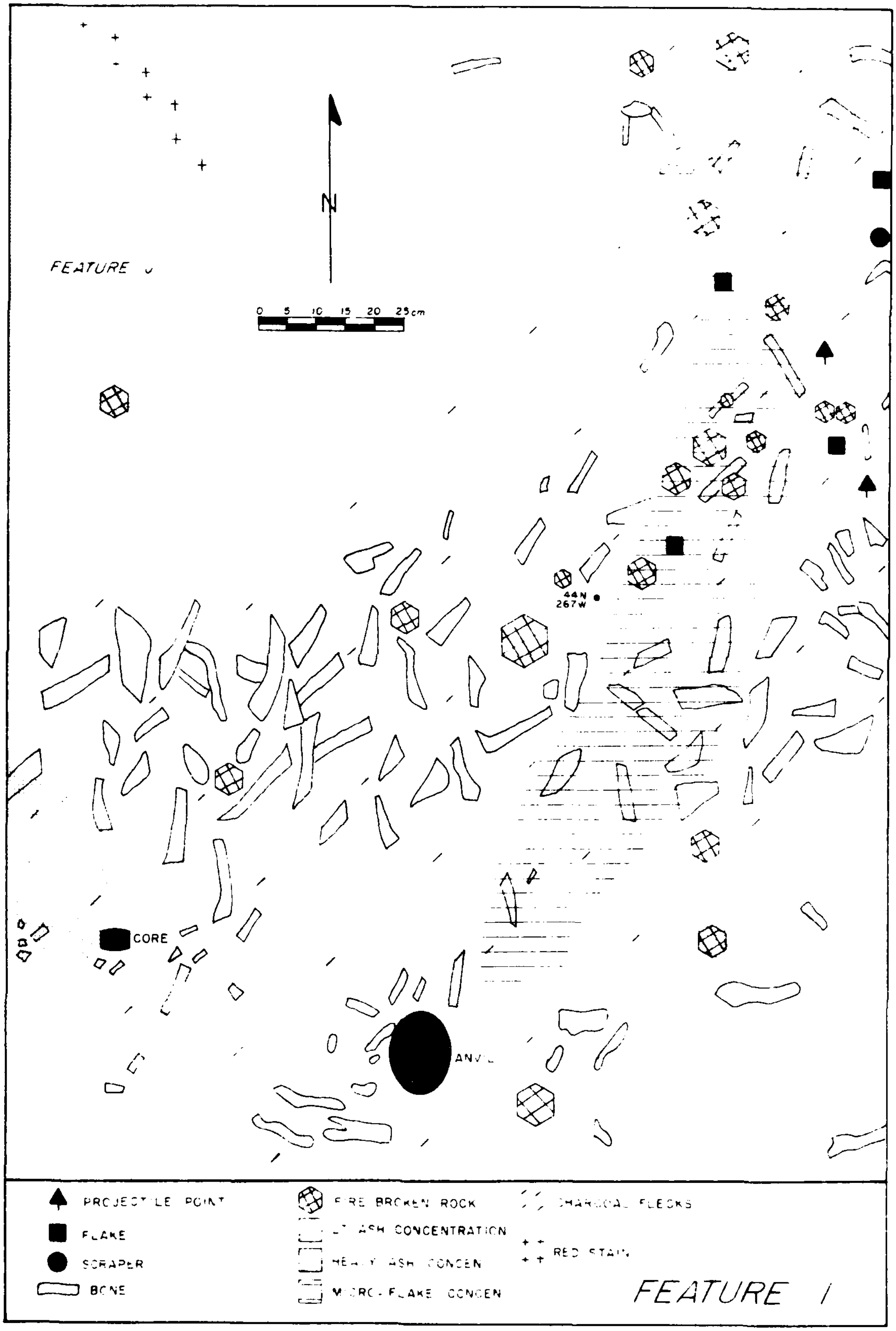

Figure 7-2. Feature I Plan View.

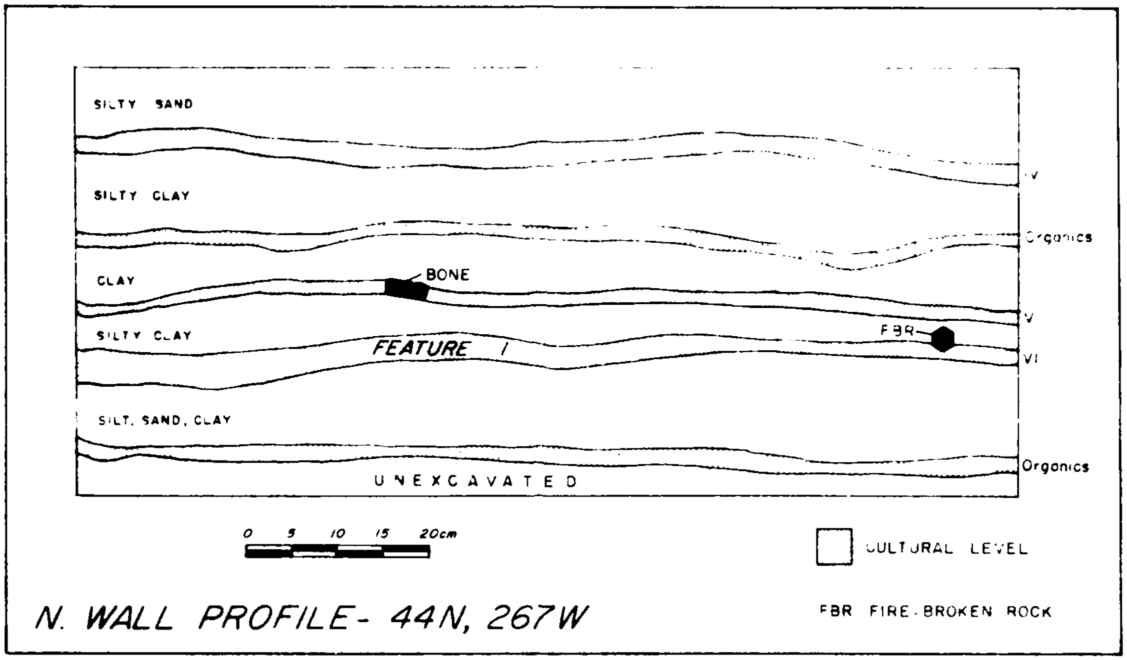

Figure 7-3. Feature I profile.

The marrow-processing inference was strengthened by the presence of a large stone on the south edge of the feature, which may have served as an anvil (see Fig. 7-2). In his discussion of bone cracking for marrow in a field situation (i.e., not a base camp), Witter (Binford 1978:153) described three methods of bone cracking, two of which required an anvil stone.

> Bones of the upper leg . . . are always freed of articulations, cleaned, and . . . cracked with blows directed at the neck directly below the articulated end. This may be accomplished in three ways: (a) by directing a blow down on the bone using a percussion tool while the bone is hand-held, (b) by striking the bone across a hand-held anvil, or (c) by striking the bone down onto the edge of a stationary anvil rock.

The last option seemed the most likely analogue for Feature I. Certainly, other explanations for this feature were possible; however, the types of bone fragments present in Feature I were best explained by marrow-processing activities.

Feature J was a circular, basin-shaped hearth, with a diameter of 80 cm and a 13-cm depth (Fig. 7-4). The base of the feature was defined by a 2-cm zone of oxidized soil (Fig. 7-5) and the fill was comprised of ash, with scattered charcoal flecks, burned bone fragments, and small flakes. The clumps of oxidized earth and charcoal-enriched sediments at the bottom of the pit may have indicated that the hearth had been cleaned out previously, leaving uneven remnants of charcoal and burned flooring. Only one fragment of fire-broken rock occurred within the hearth matrix, and only two others occurred within 50 cm of the hearth edge; however, the area to the north was not excavated. The possible use of rocks for heating or boiling in relation to this feature could not be addressed.

Recovered from a 9.5-l flotation sample were 486 tiny bone fragments, 464 of which were heavily calcined. Represented fauna included pronghorn, jackrabbit, and unidentified bird remains.

Feature J produced the greatest number and diversity of phytoliths from features at the site. Based on these results, Lewis (Appendix D: 11) suggested that some cultural activity involving grasses may be postulated. Pollen results were inconclusive.

Figure 7-4. Level IV, Feature J.

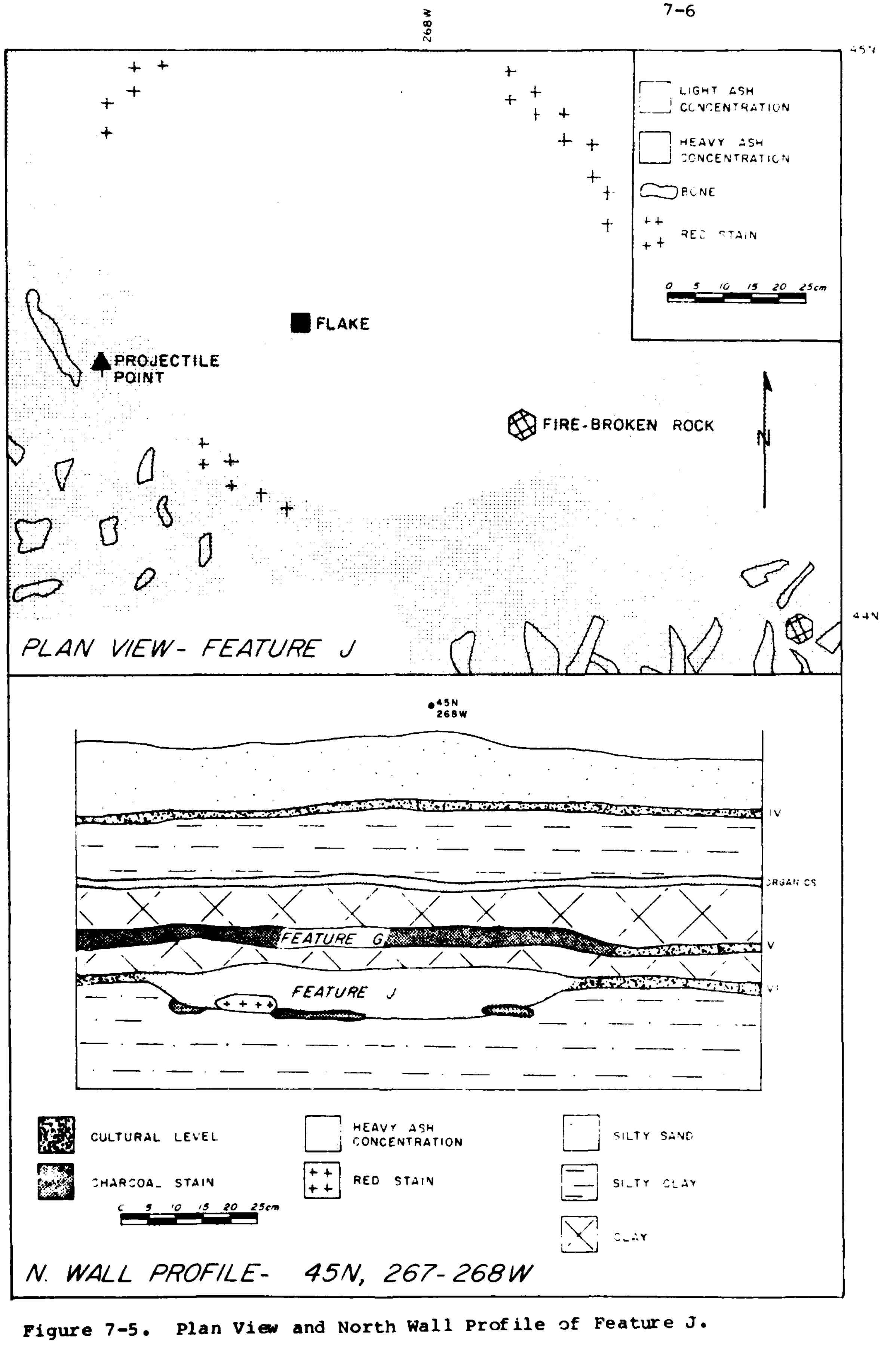

Figure 7-5. Plan View and North Wall Profile of Feature J.

The single radiocarbon date from Feature J, 4640±120 BP (3400±151 BC, corrected), is considered too young for Cultural Level VI, given other dates from the level. We suggest that the sample was contaminated by charcoal from Feature G in Level V, which lay directly above Feature J (see Fig. 7-5). The date was generally in keeping with other Level V dates.

As described for Feature H in Level IV, ash-filled pits may have resulted from activities associated with preparing meat for pemmican. It also may have served as a source for heating the marrow in the bones subsequently cracked and abandoned in Feature I.

LEVEL VI BONE

Excavation of the Level VI living surface produced 770 bones and bone fragments (Table 7-1). A total of 299 (22.14 percent) of these bones were identified as pronghorn. The remaining identifiable bones included bird, deer, rodent, bison, jackrabbit, and wolf. Unidentifiable fragments total 407. An additional 621 fragments, including pronghorn, bird, jackrabbit, rodent, and unidentified, were recovered from the flotation samples from Features I and J (see Table 7-1). Pronghorn remains comprised 78.2 percent of the identifiable sample, with bison representing only 3.3 percent.

TABLE 7-1

SUMMARY OF LEVEL VI EXCAVATED AND FLOTATION SAMPLE BONE

SPECIES	EXCAVATED BONE NO.	FLOTATION SAMPLE BONE NO.	TOTAL	PERCENT
Pronghorn	299	9	308	22.14
Bird	17	13	30	2.16
Rodent	14	3	17	1.22
Deer	15	0	15	1.08
Bison	13	0	13	0.93
Jackrabbit	3	6	9	0.65
Wolf	2	0	2	0.14
Unidentifiable	407	590	997	71.68
TOTAL N	770	621	1,391	100.00

Taphonomy, Aging and Season of Use

Extensive fragmentation was characteristic of the Level VI bone. The most frequent elements, pronghorn maxillae and mandibles, were fragmented during butchering, presumably to maximize marrow retrieval.

Only 4.5 percent of the excavated bones in this level were exfoliated, while 10.5 percent were acid etched. No concentration of exfoliated bone was apparent. More than half of the acid-etched bone occurred in the southeast part of the level, indicating a depression where burial was rapid, followed by surface stabilization and plant growth.

As with the other levels, no rodent gnawing was observed. Fourteen carnivore-punctured or -chewed bones were observed. Other evidence of carnivores was in the form of two bones tentatively identified as wolf.

A total of 180 pronghorn bones and fragments were identified as to element or side (Table 7-2). The remaining 128 pronghorn bone fragments were too fractured for identification. Maxillae were the most frequent element identified and sided. In combination with three mandibles, the five maxillae were examined to determine that a minimum of four pronghorn were killed and butchered in the fall or early winter. Although the upper and lower tooth rows were heavily fragmented due to butchering and subsequent noncultural taphonomic processes, reasonably accurate identifications, siding, and approximate aging were still possible using data accumulated by Dow and Wright (1962) and Nimmo (1971), and a reference collection. The four individuals were identified on the following tooth eruption and wear data:

(1) A 0.3-year-old calf was identified on the basis of an upper right deciduous premolar and permanent molar and upper left first and second molars from Feature J.

(2) A 2.3-year-old animal was identified on the basis of an upper left first molar and lower right deciduous premolar and all the permanent molars. The upper tooth was located 3 meters from the lower teeth.

(3) An animal about 3.3 years old was identified on the basis of scattered teeth including an upper right third molar, a lower right deciduous third premolar, and two upper premolars and a molar; plus, from 1 meter away, an upper left third molar.

(4) An adult over 5 years old was identified on the basis of a heavily worn lower left premolar.

TABLE 7-2

LEVEL VI PRONGHORN BONE BY ELEMENT AND SIDE

PRONGHORN BONE	RIGHT	LEFT	UNASSIGNED
Maxilla (teeth)	2 fragments	3 fragments	
Mandible (teeth)	2 fragments	1 fragment	
Rib			9 fragments representing 2 ribs
Caudal			5 fragments
Scapula	1 blade (1)		1 proximal fragment
Humerus			
Shank	13 fragments		16 fragments
Distal	1 complete (1) and 2 pieces	1 fragment	
Radius/Ulna			
Proximal	1 complete ulna (2)	1 complete ulna (2)	
Shank	1 fragment	3 fragments	9 fragments
Carpals			2 complete
Metacarpal			
Shank	1 fragment		5 fragments
Innominate		2 pieces of 1	
Femur Shank		3 fragments	64 fragments
Patella	1 complete		
Tibia Shank	9 fragments	2 fragments	
Phalanges	1 fragment 1st distal(1) 3rd complete (1) and 1 proximal (1)		2nd proximal (1) 13 fragments
Metatarsal			
Distal			1 fragment

As was the case with bison on the previous two levels, most pronghorn bone elements were notably under-represented, some to the extreme (Fig. 7-6).

Identifiable bones from other species included bison ulna and femur fragments; bird femur, tibia and phalange fragments; deer rib and femur fragments; rodent humerus and tibia fragments; and unidentifiable fragments of wolf bone. It should be noted that some identifications, such as the bird and wolf bones, were based on general size comparison and may not be totally accurate.

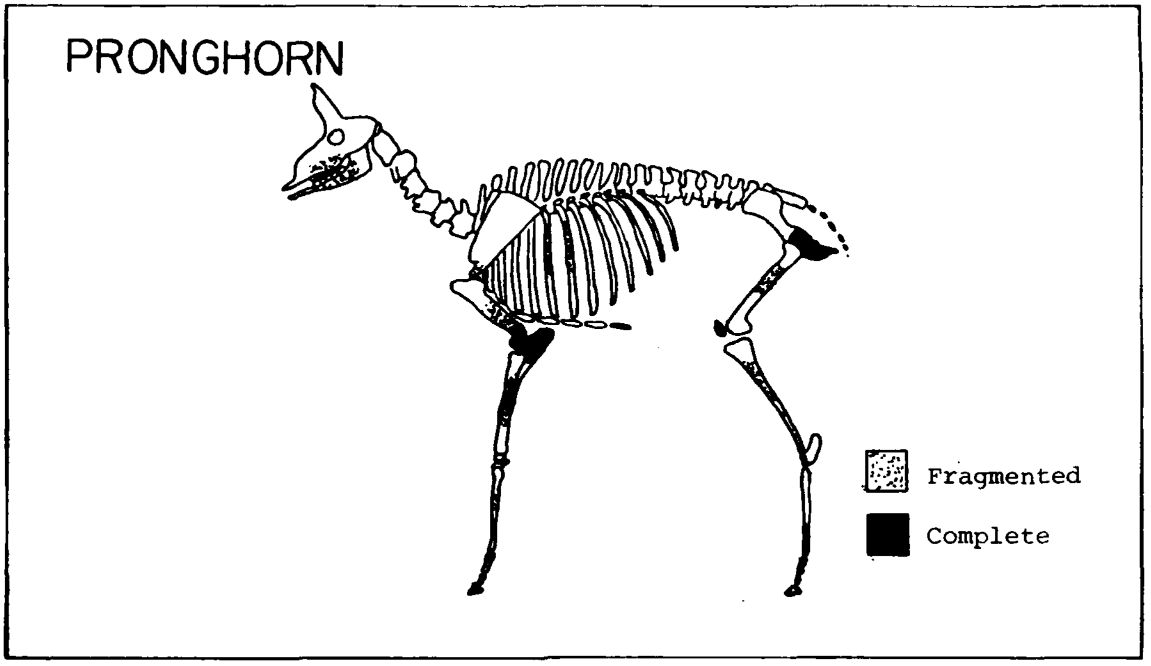

Figure 7-6. Pronghorn bones represented in Level VI.

Only limited direct evidence of butchering was observed in the form of cut marks on bone. Five bones with observable cut marks included pronghorn humeri (2), femur, and tibia (Fig. 7-7), and a wapiti rib. No identifiable bone tools of any kind were recovered from this level.

Butchering and Bone-processing Activities

As mentioned above, Feature I was a concentration of mostly fragmented pronghorn bone, in association with limited quantities of fire-broken rock, charcoal, ash, flakes, and an anvil stone. Feature J, a hearth, was located in the adjacent grids to the north and northwest of Feature I. More than 85 percent of the burned bone and 77 percent of the unburned bone (Table 7-3) were from or within 1 m of the two features (40 percent of the excavated area of this level). Due to heavy fragmentation, no positively articulating elements were identified within this area. However, teeth thought to represent two pronghorns were scattered throughout the grids associated with the features.

Based on the presence of bone fragments primarily unburned, in Feature I in association with the anvil stone, it is assumed that the feature's primary function was bone cracking for marrow removal. The area north and east of Feature I may have subsequently served as a

Figure 7-7. Level VI bone evidencing cut marks (pronghorn left tibia shank fragment) (full scale)

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dump based on the amount of burned bone, charcoal flecks and fire-broken rock. Based on the large amount of burned bone, Feature J apparently served as a dump for bone coincidentally with its primary function.

If boiling of bone for grease removal was one of the activities in this level, there is no clear evidence in the excavated area. However, if the wood frame suspended hide containers for boiling were used (as discussed with Level V), a relatively open area just east of Feature J and north of Feature I would have been an ideal location.

Based on the preceding analysis of pronghorn processing on this level, we can estimate the amount of meat and grease prepared. Frison (1971) has estimated that the average pronghorn would produce 45 pounds of meat and over 2 pounds of fat and marrow. The four pronghorn on this level would have yielded approximately 180 pounds of meat and over 8 pounds of fat and marrow. Using an average estimate of the consumption of 3.5 to 5 pounds of meat per person per day, the pronghorn meat would have provided 51.5 person days of meat, or 25 people with meat for two days. Of course, if the limited bison and deer remains represent complete animals that were butchered elsewhere in the site, this estimate of pounds of meat would triple.

TABLE 7-3

LEVEL VI BURNED AND UNBURNED BONE BY GRID AND SPECIES
(burned/unburned)

GRID COORDINATES NORTH	WEST	BISON	PRONGHORN	JACKRABBIT(J) WOLF (W) RODENT (R) DEER (D) BIRD (B) PELECYPOD (P) GASTROPOD (G)	UNIDENTI-FIABLE	TOTAL
42	265		0/6			0/6
43	264				0/4	0/4
43	265		16/50	5/10 R 0/4 D		21/54
43	266		0/1	3/4 D		3/5
43	268			1/0 D	1/4	2/4
44	264			0/1 B	2/17	2/18
44	265			0/3 D	0/5	0/8
44	266		0/39	0/2 J	0/68	0/109
44	267		0/35	0/2 R		0/37
44	268		6/22		11/11	17/33
45	266		0/39		35/64	35/103
45	267		7/15	12/3 B 0/7 R 0/2 W 0/1 J	139/0	158/28
45	268		15/25		7/7	22/32
45	269		0/1	0/1 B	13/9	13/11
46	266	1/12	4/18		0/7	5/37
47	266				0/3	0/3
TOTAL		1/12	48/251	21/30	208/199	278/492
FLOTATION SAMPLE RECOVERY						
45	266a			3/0 R	6/5	
44 (Feature I)	267		0/1		47/73	
45 (Feature J)	267-268		6/10	6/0 J	340/0	
45 (Feature J)	267			6/3 B	42/0	
45 (Feature I)	268		1/1	2/2 B	61/16	
TOTAL			7/2	17/5	496/94	

Summary of Faunal Remains

The primary distinguishing factor of the Level VI faunal remains is that the majority of identifiable bone and bone fragments were pronghorn rather than bison. As with the previous levels, actual counts of elements and fragments fell far short of what would be expected, given the variety of species and number of individuals represented.

The extremely fragmented nature of the pronghorn bones, even down to the mandibles and phalanges, fit well with other documented pronghorn-processing sites (Davis 1976; Davis and Aaberg 1978; Frison 1971). Davis (1976:51) stated, "Such efficient food consuming behavior usually indicates that intense population pressure was exerted on a limited food supply." For an ethnographic analogue, Binford (1978:50) related a saying of Nunamiut Eskimos regarding intensive processing of caribou mandibles: "The wolf moves when he hears the Eskimo breaking mandibles for marrow." Binford went on to say:

> In my experience, the number of broken mandibles is a fair measure of the food security of the group in question. If many are broken, then little animal food is regularly available and the people are utilizing morsels of very limited utility.

The sample of bone recovered from Level VI was calculated to have minimally provided 25 people with meat for 2 days. Only six fragments were observed with punched holes or rotational scars resulting from carnivore chewing, and weathering did not appear to have been a major factor in assemblage modification. Intensive breakage and underrepresentation of elements was attributed to the activities of the human occupants.

FLAKED STONE ARTIFACTS

Collected from Level VI were 308 lithic artifacts, 95 percent of which were debitage (Table 7-4). An additional 177 microflakes were recovered from 13.75 l of flotation samples. Tools included six projectile points, four small biface fragments, and four unifacially modified flakes. Lithic materials included silicified sediment (45 percent), basalt (31 percent), various cherts (15 percent), chalcedony (5 percent), and small amounts of brown agate, quartzite, and silicified sandstone. The silicified sediment category included the pink-to-gray material ranging from well-sorted, fine-grained stone to the "salt and pepper" variety in addition to the grayish-green silicified mudstone which also was present in the Level V assemblage. The cherts and chalcedony basically duplicated the range discussed for Level IV.

The basalt ranged from fine to coarse textured and, as in the other levels, some was slate-like and may actually represent a distinctive lithic material.

TABLE 7-4

LEVEL VI ARTIFACT CATEGORIES BY LITHIC MATERIAL TYPES

ARTIFACT CATEGORY	LITHIC MATERIAL TYPES* CHT	SSD	CHL	QTZ	BA	BAS	OTH	TOTAL	PER-CENT
Debitage	43	131	15	3	7	91	2	292	94.8
Projectile Points	1	4	0	0	0	2	0	7	2.3
Biface Fragments	2	2	0	0	0	1	0	5	1.6
Unifaces	1	1	1	0	0	1	0	4	1.3
TOTAL	47	138	16	3	7	95	2	308	--
PERCENT	15.3	44.8	5.2	1.0	2.3	30.8	6.5	--	100

*LITHIC MATERIAL TYPES KEY:
CHT = Chert
SSD = Silicified Sediment
CHL = Chalcedony
QTZ = Quartzite
BA = Brown Agate
BAS = Basalt
OTH = Other

Bifaces

Seven Oxbow projectile points and five undiagnostic biface fragments comprised the biface sample from Level VI (Table 7-5, Fig. 7-8). Silicified sediment was the most highly represented lithic material among the bifaces (50 percent), followed by basalt and chert (25 percent each).

Five of the seven projectile points were complete and exhibited indications of systematic patterns of resharpening. Depending on the degree of resharpening, these points exhibited slightly convex to straight margins and shallow to obliterated notches. The specimens became narrower with each resharpening sequence. These worn, exhausted tools are believed to have been intentionally discarded because of their lack of further utility.

Specimen #51 was an interesting example of resharpening, breakage, and discard. In the field, this broken basalt and its missing ear were located more than 3 m apart. Apparently, this point broke during

TABLE 7-5

LEVEL VI BIFACES

TOOL NO.	ILLUS. NO.	GRID LOCATION NO.	GRID LOCATION SO.	ARTIFACT TYPE	MATERIAL TYPE	DIMENSIONS (mm) LENGTH	DIMENSIONS (mm) WIDTH	DIMENSIONS (mm) THICKNESS	BLADE LENGTH (mm)	DEPTH OF BASAL CONCAVITY (mm)	NECK WIDTH (mm)	BLADE WIDTH (mm)	COMMENTS
47	7-8a	46	266	Projectile point	Silicified sediment	46	--	5	38	5	--	--	Fragment
58	7-8b	45	266	Projectile point	Silicified sediment	26	22	4	20	5	18	20	Unmodified complete (no rejuvenation)
56	7-8c	44	267	Biface fragment	Silicified sediment	--	--	--	--	--	--	--	Tip fragment
60	7-8d	45	266	Projectile point	Silicified sediment	28	21	4	22	4	16	18	Tool condition undetermined
63	7-8e	45	268	Projectile point	Silicified sediment	23	21	4	15	4	18	18	Modified complete (whole and rejuvenated)
52	7-8f	43	265	Projectile point	Chert	29	20	5	22	4	16	19	Modified complete (whole and rejuvenated)
57	7-8g	45	266	Projectile point	Basalt	27	22	4	20	4	17	18	Unmodified complete (no rejuvenation)
51	7-8h	43	265	Projectile point	Basalt	26	--	4	--	4	--	--	Tip fragment
55	7-8i	44	266	Biface fragment	Basalt	--	--	--	--	--	--	--	Tip fragment
53		43	268	Biface fragment	Chert	--	--	--	--	--	--	--	Fragment
54		44	266	Biface fragment	Silicified sediment	--	--	--	--	--	--	--	Fragment
61		45	267	Biface fragment	Chert	--	--	--	--	--	--	--	Fragment

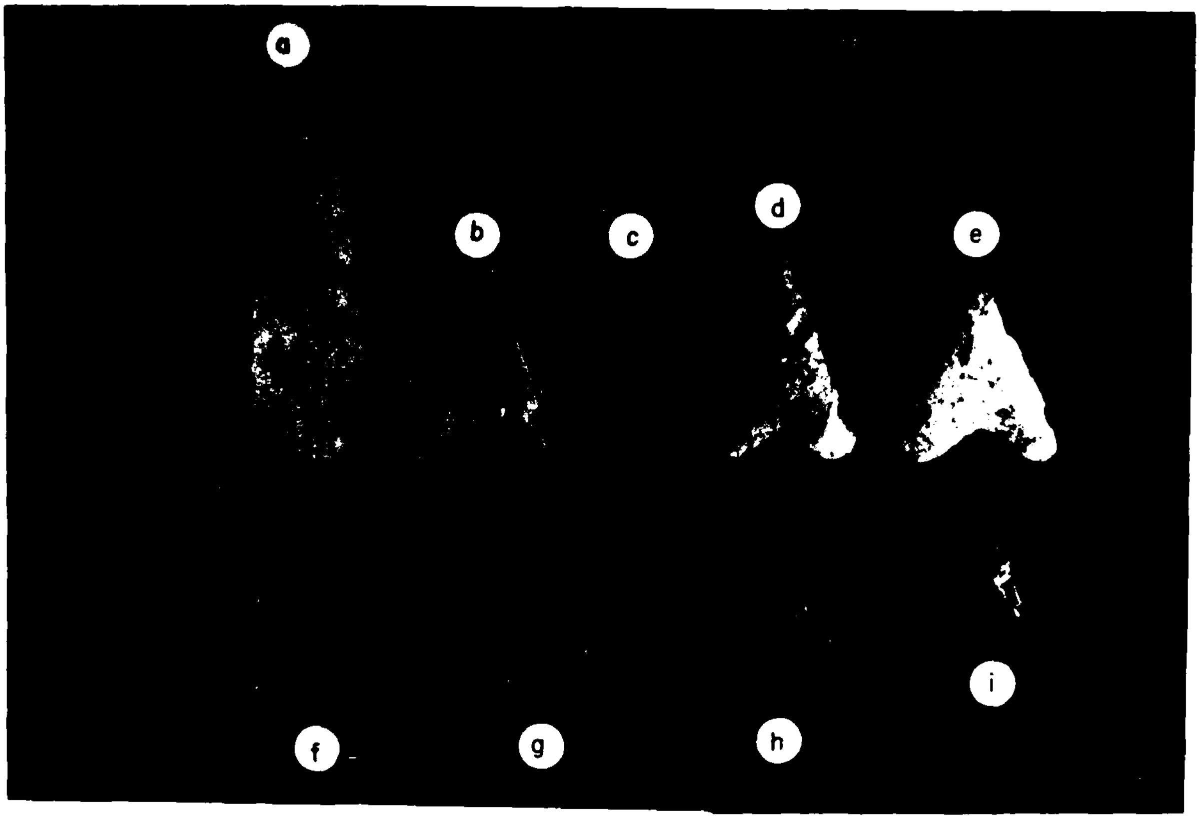

Figure 7-8. Level VI bifaces (full scale):
a: Tool #47, 45N 266W, silicified sediment projectile point
b: Tool #58, 45N 266W, silicified sediment projectile point
c: Tool #56, 44N 267W, silicified sediment biface fragment
d: Tool #60, 45N 266W, silicified sediment projectile point
e: Tool #63, 45N 268W, silicified sediment projectile point
f: Tool #52, 43N 265W, chert projectile point
g: Tool #57, 45N 266W, basalt projectile point
h: Tool #51, 43N 265W, basalt projectile point
i: Tool #55, 44N 266W, basalt biface fragment

the resharpening process as a result of an attempt to remove stacked step fractures along one margin. The attempt failed when too much pressure was applied, resulting in a bending fracture (evidenced by a curved surface) that inadvertently removed the ear of the point.

The biface fragments are believed to have been derived from preforms or projectile points due to their degree of refinement. Three were tip sections and two were small edge fragments. One of the small tips fit with a point (#47) which broke longitudinally during manufacture (see Fig 7-8a), in similar fashion to #25 from Level IV. Dyck (1976:77) noted this same breakage pattern on a number of specimens from the Harder Oxbow site in Saskatchewan.

All of the biface tools had counterparts in the debitage. This was an interesting contrast to the other levels, where many of the biface materials were not duplicated in the debitage. Presumably, the recovered tools were produced and/or rejuvenated at the site. In the other levels, more of the tools appeared to have been brought to the site in finished, or final, form. Another contrast with the other Oxbow levels was the high number of projectile points and the total absence of blanks and preforms.

Unifaces and Modified Flakes

Four unifacially modified flakes were recovered from Cultural Level VI (Table 7-6, Fig. 7-9). Two of these tools were classified as Group A scrapers and the other two as Group B scrapers. No classic end scrapers (Group C) were found. All four tools displayed straight scraping edges. Each of the four represented material types, chert, basalt, chalcedony, and silicified sediment, were present in the debitage. As with Group A and B tools from previous levels, these scrapers are thought to have been used in the context of butchering.

One of the Group A tools (#59) was modified on all three edges, forming a triangle with one sharp vertex (Fig 7-9d). (One vertex was missing which may also have formed a sharp point.) This chalcedony uniface was classified as a Group A tool on the basis of its thinness and relatively low scraping edge angle. In addition to scraping, this tool may have served as a graver or perforator. The other Group A tool (#62) was a very thin flake of basalt, that had one modified lateral edge which showed evidence of scalar retouch and edge rounding (Fig. 7-9a). This tool also had a projecting tip which may have originally been sharper.

The two Group B scrapers had worked lateral edges marked by use-retouch and rounding. Both tools also had sharp projections. The extreme tip was broken from #49 (Fig. 7-9b), possibly as a result of use. The sharp projection on #46 (Fig. 7-9c) displayed use-retouch, rounding and polish, evidencing its use as a perforating tool. The rounding and polish would result from perforating a soft material such as hide.

TABLE 7-6

LEVEL VI UNIFACE TOOLS

TOOL GROUP	ARTIFACT NUMBER/ GRID LOCATION	ILLUST. NUMBER	ARTIFACT TYPE	LITHIC MATERIAL	DIMENSIONS (mm)			WORKING EDGE SHAPE AND ANGLE			USE-WEAR/COMMENTS
					LENGTH	WIDTH	THICKNESS	CONVEX	STRAIGHT	CONCAVE	
A	62 45N 268W	7-9a	Cortical flake	Basalt	37	34	2	--	48°	--	Use-retouch and crushing of convexities/proximal re-touch; unmodified complete (no rejuvenation)
B	49 43N 264W	7-9b	Interior flake	Silicified sediment	36	24	6	--	72°	--	Step flaking, crushing, and rounding of convexities; sharp projection has extreme tip broken off/combination retouch; unmodified complete (no rejuvenation)
B	46 46N 266W	7-9c	Interior flake	Chert	43	15	5	--	56° - 67°	--	Use-retouch and rounding along edge; sharp projection has use-retouch, rounding, and polish/lateral margin retouch; unmodified complete (no rejuvenation)
A	59 45N 266W	7-9d	Interior flake	Chalcedony	28	23	4	--	47°	--	Use-retouch and crushing; sharp projection displays single use-retouch flake/ combination retouch; unmodi-fied complete (no rejuvena-tion)
	50 43N 265W	--	Cortical flake	Chert	24	21	5	--	--	--	Combination retouch; unmodified complete (no rejuvenation

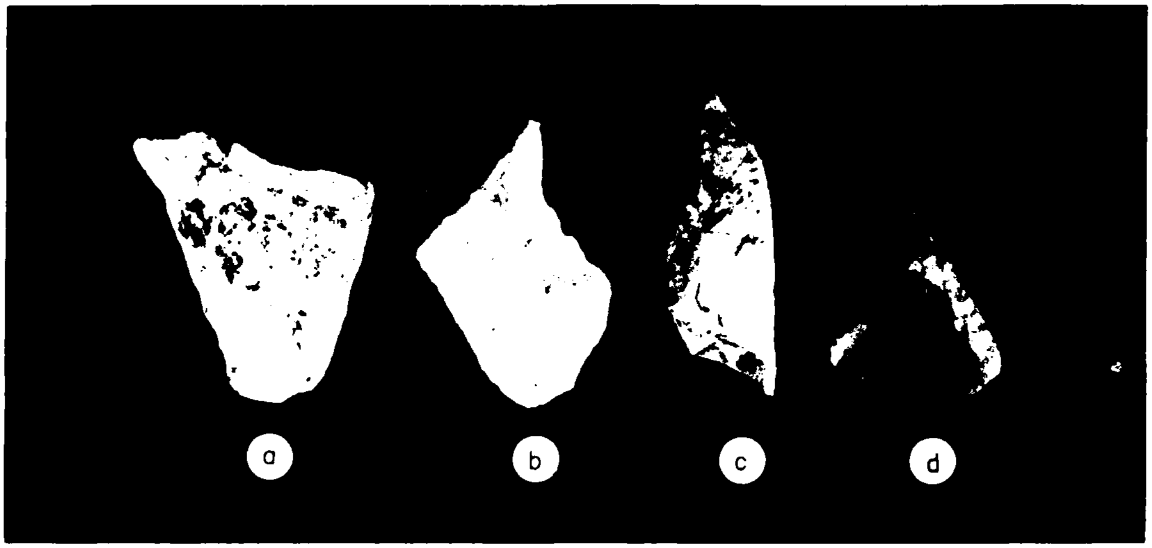

Figure 7-9. Level VI uniface tools (full scale):
a: Tool #62, 45N 268W, basalt cortical flake
b: Tool #49, 43N 264W, silicified sediment interior flake
c: Tool #46, 46N 266W, chert interior flake
d: Tool #59, 45N 266W, chalcedony interior flake

Tool Distributions

The majority of the Level VI tools clustered in the northeastern part of the excavated area (Fig. 7-10). Another small cluster was located in the southeastern part of the area. Projectile points and scrapers tended to co-occur.

Distinctive activity areas were difficult to discern. The projectile points and biface fragments which clustered to the north and east of Feature I correlated with a microflake concentration (see Fig. 7-1), and together, these items may represent a flintknapping location. Three tools, found in or immediately adjacent to Feature J, are believed to have been intentionally discarded along with the large number of microflakes retrieved from flotation samples. However, the reason for deposition of the complete, apparently usable tools is unclear.

Debitage

A total of 292 pieces of debitage was recovered during excavations (Table 7-7), and an additional 176 microflakes came from flotation samples. Generally, the lithic materials from the flotation samples mimicked the excavated sample.

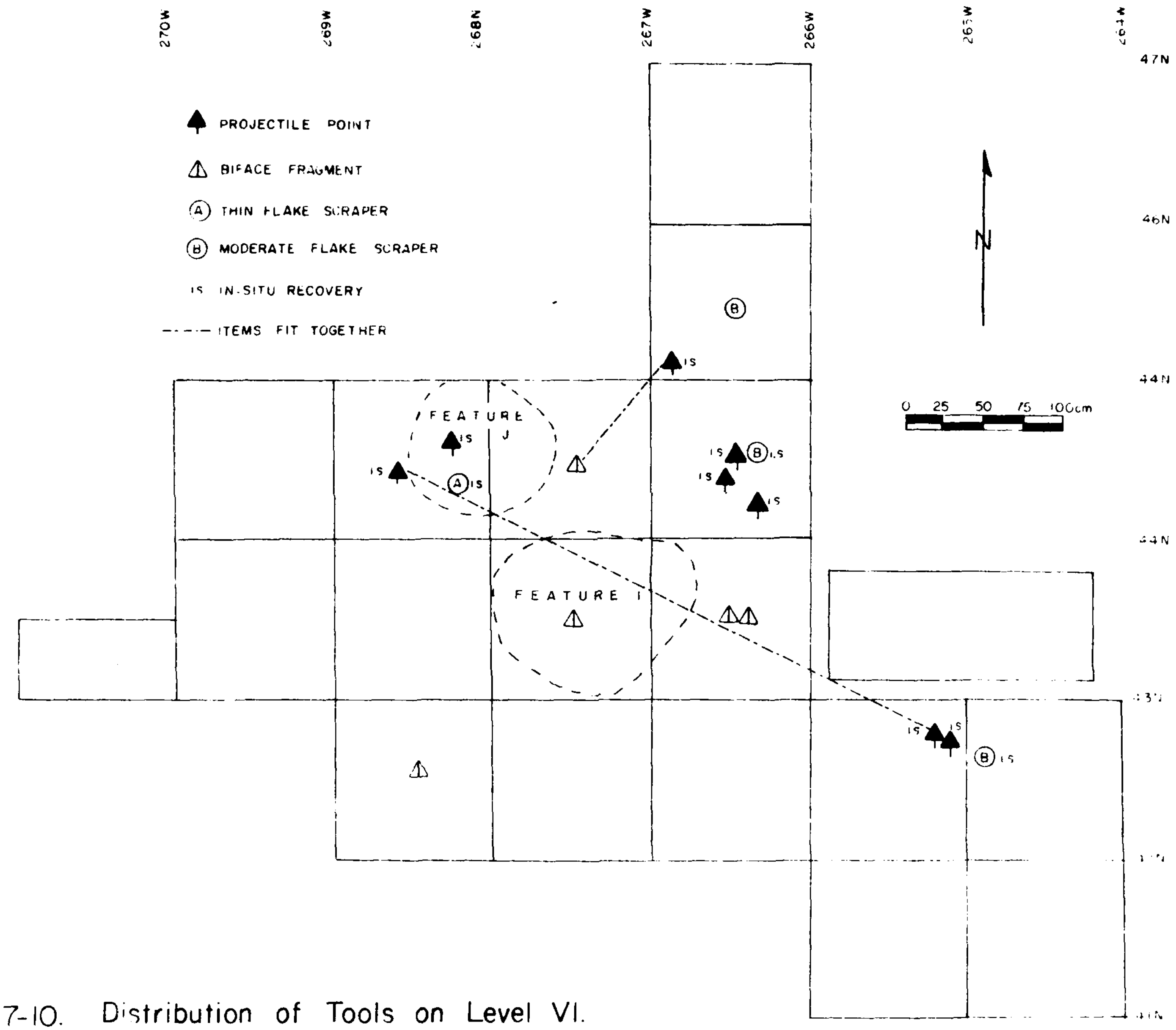

Figure 7-10. Distribution of Tools on Level VI.

TABLE 7-7

LEVEL VI DEBITAGE SUMMARY

ARTIFACT CATEGORY	LITHIC MATERIAL TYPES* CHT	SS	CHL	QTZ	BA	BAS	OTH	TOTAL	PER-CENT
Pressure Flake	27	57	8	1	2	31	0	126	43.1
Bifacial Thinning Flake	6	39	4	0	4	22	0	75	25.7
Interior Flake	0	0	1	2	1	2	0	6	2.1
Shatter	2	0	0	0	0	1	0	3	1.0
Cortical Flake	0	0	1	0	0	0	1	2	0.7
Core	0	0	1	0	0	0	0	1	0.3
Unidentified Flake Fragments	7	35	1	0	0	35	1	79	27.1
TOTAL	45	137	16	3	7	95	2	292	--
PERCENT	15.4	46.9	5.5	1.0	2.4	32.5	0.7	--	100

*LITHIC MATERIAL TYPES KEY:

CHT = Chert
SS = Silicified Sediment
CHL = Chalcedony
QTZ = Quartzite
BA = Brown Agate
BAS = Basalt
OTH = Other

The high proporation of bifacial thinning flakes (26 percent) and pressure flakes (43 percent)--95 percent of the diagnostic flakes--indicate that final thinning, edge trimming, and resharpening of bifaces were the predominant activities associated with stone tool manufacture and maintenance. Only one core and two cortical flakes were recovered. The low representation of these debitage categories and the characteristics of the bifacial thinning flakes indicated that Late Stage blanks, preforms and probably finished tools were brought to the site, rather than cores and Early Stage blanks.

A large percentage of the debitage (55 percent) was located within 0.5 m south and east of Feature J. The rest of the debitage was evenly distributed throughout the excavated area, with the exception of 43N 266-267W, where only three flakes were found.

The association of an ash-filled basin with quantities of debitage has already been discussed in the context of Feature H on Level IV. Interestingly, in both cases the debitage was tightly clustered, in association with charcoal, buried bone, and fire-broken rock, to the southeast of the feature. In the case of Feature H, these clusters were interpreted as intentionally discarded refuse and the same interpretation is offered for the microflake concentrations southeast of Feature J.

Summary of Flaked Stone Artifacts

The flaked stone artifact assemblage from Cultural Level VI was similar to Level IV in the number of tools and debitage, yet distinctive. Only finished projectile points and tiny fragments comprised the biface sample and all four scraping tools had sharp projections, presumably used for puncturing hide. Like Level IV, the microflakes were concentrated near an ash-filled hearth in association with charcoal, burned bone, and fire-broken rock. The reason for disposition of a number of complete tools is unknown.

Material types were dominated by varieties of silicified sediment and basalt. Chert, chalcedony, quartzite, and agate also were recovered. These materials, as with the previous levels, are believed to have been procured locally from river terraces, glacial gravels, and outcrops.

The toolkit was somewhat of an enigma. No knives were discerned, and none of the projectile points showed evidence of use as cutting tools. Only four multi-purpose scraping and perforating tools appear to have comprised the animal-processing assemblage. Given the quantity of meat and bone that were processed, this limited representation must be due to sampling error or intensive curation practices.

LEVEL VI CONCLUSIONS

The occupation of Level VI by Oxbow people took place in the late fall or early winter some 5,200 years ago. The occupants' primary task was the processing of four pronghorn. Additional species exploited by the occupants included deer, bison, jackrabbit, rodent, bird, and possibly wolf. The degree of butchering was notable -- even the phalanges were broken -- indicating a scarce food supply.

The Level VI toolkit was distinctive due to the substantial number of complete projectile points and the limited array of other tools, notably unifaces with perforators. The nature of the debitage was similar to Level IV, especially in the abundance of microflakes clustered near an ash-filled hearth in association with refuse. Like Levels IV and V, the occupants of Level VI had eclectic taste in lithic materials. The various materials, predominated by silicified sediment and basalt, are thought to have been derived from local sources.

The amount of meat available from the butchered pronghorn would have provided 25 people with meat for two days. The bison and deer, if they represent complete processing at the site, would have provided an additional 550 pounds of meat -- food for another five to six days. Like the other Oxbow occupations, no evidence of plant foods, or processing thereof, was encountered. Finally, no evidence of dwellings was apparent. The amount of debris is interpreted as representing a short occupation, perhaps one or two days, when winter stores were prepared.

CHAPTER 8

PREHISTORIC OCCUPANTS OF THE SUN RIVER SITE

INTRODUCTION

Projectile points from the Sun River site indicate that the site was occupied sporadically during the last six millenia. Radiocarbon dates confirm a number of occupations dating between ca. 2800 and 5200 BP; the Pelican Lake, possibly preceded by Hanna occupations, dating from 2800-3500 BP; and the Oxbow occupations dating from 3500-5200 BP (Fig. 8-1). Comparing these dates with the existing chronology for the Northwestern Plains (Fig. 8-2), they are generally in keeping. Using corrected dates, the actual span of the occupations was ca. 3000-6000 BP.

All of the ocupations were characterized by flaked stone artifacts in association with butchered faunal remains. The factor which best discriminated between the Upper (I-III) and Lower (IV-VI) levels, besides projectile points and 1.5 m of alluvial deposits, was the presence of large stone-filled, basin-shaped hearths in the Upper Unit in contrast to the ash-filled, basin-shaped hearths in the Lower Unit. These features have been discussed in detail in the preceding chapters. Presented below is a discussion of lithic technology as represented in the Upper and Lower Units of the site, followed by a discussion of settlement and subsistence considerations as they reflect paleoenviroments.

LITHIC TECHNOLOGY

The discussion of lithic technology will address the four subsystems described in Chapter 2: lithic procurement, tool manufacture, tool use, and discard. Because of the substantially greater information for the Oxbow levels, these will be emphasized over the Upper Unit.

Lithic Procurement

Lithic material procurement strategies are discussed here for the two units, with specifics regarding each Oxbow component. Too little is known about Levels I-III to discriminate among them; however, they provide an interesting comparative base for the Oxbow data.

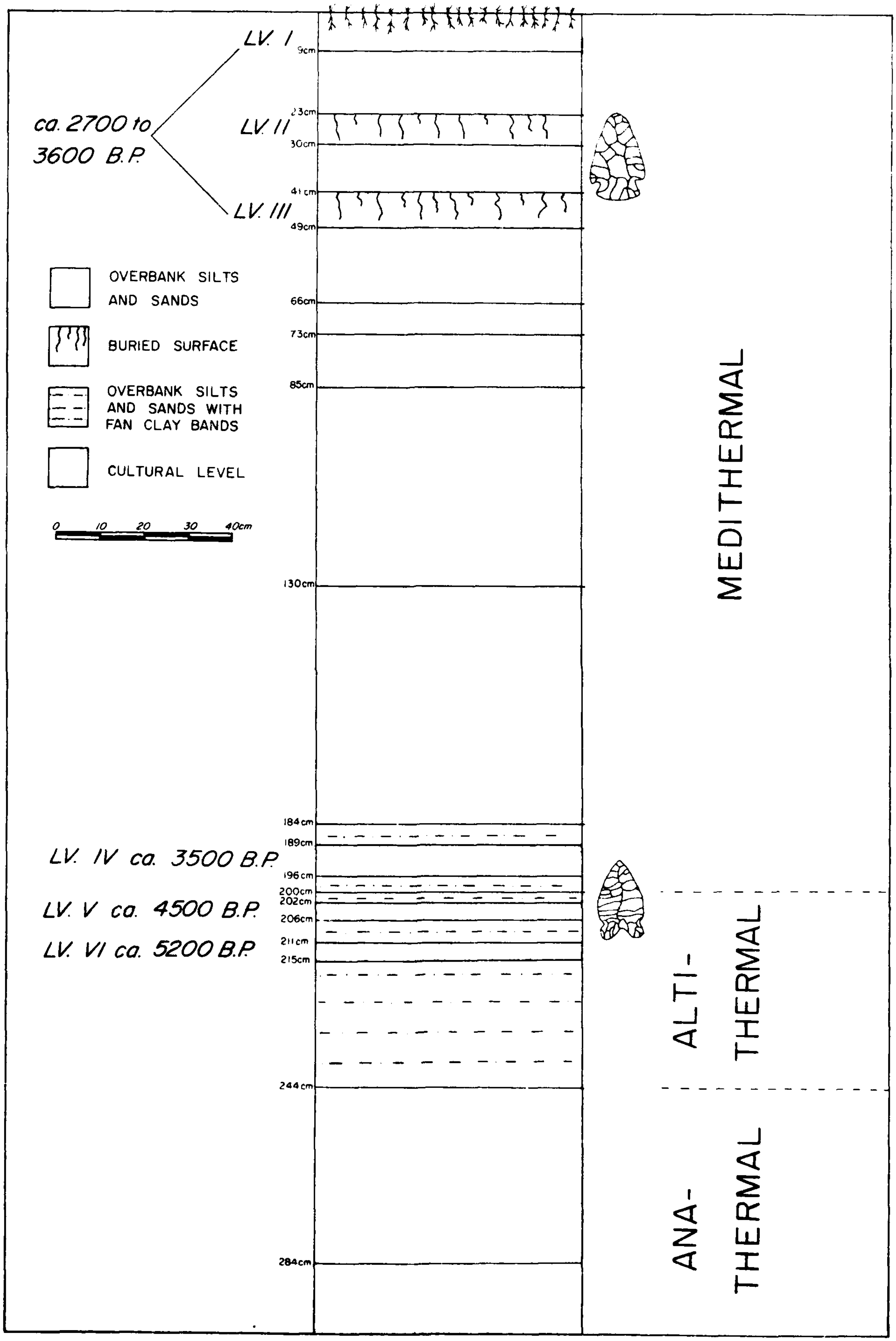

Figure 8-1. Idealized Profile with Points Added

AGE	CLIMATIC EPISODE (Bryson & Wendland '67)	CLIMATIC CONDITIONS	CULTURAL PERIOD (Mulloy '58)	COMPLEXES/PROJECTILE POINT TYPES
AD 1850			Historic	
AD 1550	Neo-Boreal	cold, moist; cool summers	Late Prehistoric	Plains side-notched, tri-notched
AD 1450	Pacific II	warm, moist		
AD 1250	Pacific I	drier, cooler		
AD 870	Neo-Atlantic	warm, moister		Prairie side-notched, corner-notched
AD 280	Scandic	warm, arid	Late Middle Prehistoric	Avonlea → Besant
BC 950	Sub-Atlantic	cool, cloudy; wet summers		Corner-notched – Pelican Lake
BC 2730	Sub-Boreal	cooling trend; increased moisture; essentially modern	Early Middle Prehistoric (hiatus?)	McKEAN: Yonkee, Hanna, Duncan, McKean Oxbow
BC 4050	Atlantic IV	return to maximal warm temperatures		Oxbow
BC 4500	Atlantic III	increased precipitation		Early Side-Notched → Hawken
BC 5780	Atlantic II	maximal warm temperatures and aridity		
BC 6500	Atlantic I	shift to summer-dominant storms, warming trend	Early Prehistoric	Pryor-stemmed Lusk Frederick
BC 7700	Boreal	wind intensity peaks; drying and seasonality trends continue		Plano: CODY: Scottsbluff, Eden, Alberta Agate Basin/Hell Gap
BC 8550	Pre-Boreal	cold, drying winds, increased seasonality, (winters colder, summers warmer)		Folsom/Midland
BC 10,000	Late-Glacial	warming trend-glacial melt, winter-dominant storms, relative low seasonality		Clovis Goshen

Figure 8-2. Chart of paleoenviromental and prehistoric cultural periods on the Northwestern Plains.

For each Oxbow occupation, eclectic taste in lithic materials was apparent (Table 8-1, Fig. 8-3). A variety of cherts was strongly favored in Level IV; basalt, silicified sediment, and quartzite were popular in Level V (although the small sample may be biased); and silicified sediment and basalt were the clear favorites of the Level VI occupants. Such distinctions in lithic materials are not surprising given the centuries between occupations.

TABLE 8-1

COMPARISON AMONG OXBOW LEVELS OF LITHIC MATERIAL PREFERENCE

LITHIC MATERIAL	LEVEL IV	LEVEL V	LEVEL VI	TOTAL
Chert	388	3	42	433
Silicified Sediment	104	9	131	244
Basalt	116	12	91	219
Quartzite	32	9	3	44
Chalcedony	25	2	15	42
Brown Agate	0	0	7	7
Other	3	0	2	5
TOTAL	688	35	291	994

x^2 = 276.727 Probability <0.0005 that the materials were
df = 10 randomly distributed among cultural levels.

The occupants of each Oxbow level can be characterized as having had an expedient approach to lithic material procurement. Of the three best-represented lithic categories, basalt and silicified sediment are known to occur within 50 miles of the site in the Little Belt Mountains. Basalt also occurs in the Big Belts, the Spokane Hills, and in various lacoliths that commonly occur in central and southwestern Montana. The cherts and possibly the quartzites are believed to have been derived from the Madison Group of Mississippian age, which occurs widely in central Montana, especially in the Little Belt Mountains. All of these materials also would have been available in secondary gravels. From a review of Oxbow assemblages reported in the literature, we conclude that this tendency to exploit a variety of local, readily available lithic materials was characteristic of Oxbow people (Brumley 1981; Davis and Helmick 1982; Dyck 1976; Husted and Edgar n.d.).

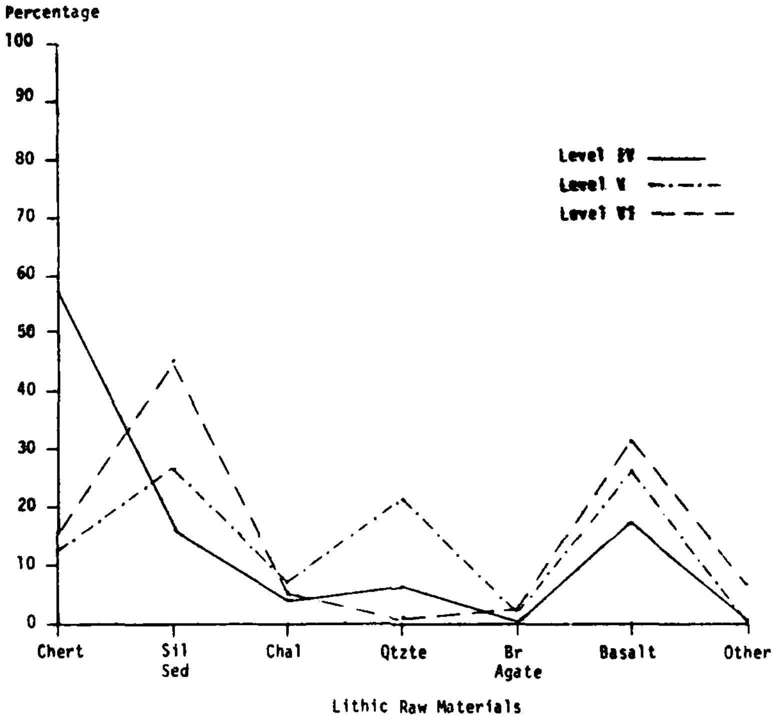

Figure 8-3. Graph of Oxbow lithic material represented.

Some interesting contrasts are apparent in the selection of lithic materials between the Upper and Lower Units (Fig. 8-4). The proportions of chert and silicified sediment are essentially reversed, with the Oxbow people favoring chert and subsequent occupants favoring silicified sediment. Basalt is much more common in the Oxbow levels, whereas obsidian only occurs in the Upper Unit, as does porcellanite.

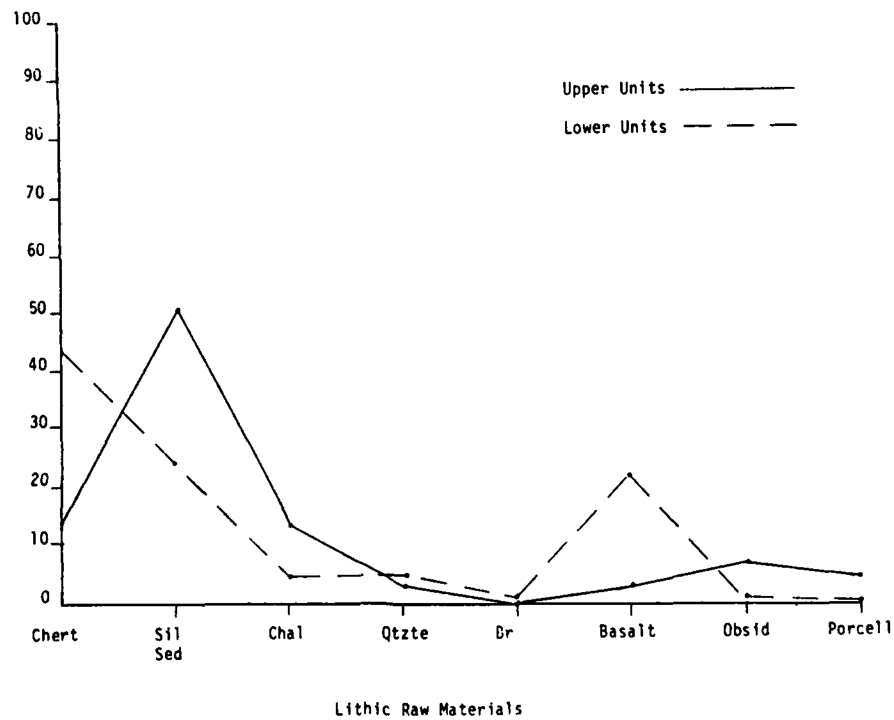

Figure 8-4. Comparison of the selection of lithic raw materials between the Upper (I-III) and Lower (IV-VI) Units.

These patterns are reinforced by data from large projectile point assemblages from a number of sites at Canyon Ferry Reservoir (Davis and Helmick 1982), where obsidian comprises a very minimal proportion of the Oxbow collection, yet is the dominant material in both the Hanna and Pelican Lake collections.

The appearance of obsidian in the Upper Unit and its absence in the Lower Unit may be interpreted as evidence of Pelican Lake and Hanna people placing a greater emphasis on planned procurement than did Oxbow people. Such procurement strategies could have involved treks to source locations or dependence on a trade network. Evidence for procurement at the source has been demonstrated at the Schmitt Chert Mine (Davis 1982), located some 125 miles south of Sun River, where an extensive quarry operation was conducted by Pelican Lake people for 12 centuries.

Tool Manufacture

The technical sequence and reduction strategy involved in the manufacture of projectile points can only be addressed for Oxbow points. Too few bifaces were recovered from the Upper levels to address the manufacturing particulars of Pelican Lake points. The Lower Unit, attributable to the Oxbow culture, produced 36 bifaces and biface fragments. Of these, 24 exhibit sufficient diagnostic attributes for the formulation of the technical sequence involved in the manufacture of Oxbow projectile points at the site. The remaining 13 bifaces are too fragmentary for reliable assignment to a particular reduction stage within this sequence.

Oxbow Technical Sequence

Determining reduction stages depended on the technological attributes exhibited by each biface. Technically related bifaces were grouped into classes, and classes were then sequentially ranked as progressive reduction stages. Attributes examined for determining reduction stages included:

(1) Type of flaking (i.e., percussion vs. pressure);
(2) Presence of cortex;
(3) Presence of remnant detachment flake scar on ventral surface of biface;
(4) Extent of bifacial margin development;
(5) Shape of margins (i.e., undulating vs. straight);
(6) Presence and extent of platform preparation;
(7) Extention of flake scars across faces;
(8) Symmetry; and
(9) Presence of haft element.

A biface technical sequence was reconstructed based on the exhibited attribute patterns (Figs. 8-5, 8-6). The sequence accounts for all the technological variability observed among bifaces from all three Oxbow components and depicts the stages of manufacture involved in the production of Oxbow projectile points at the site.

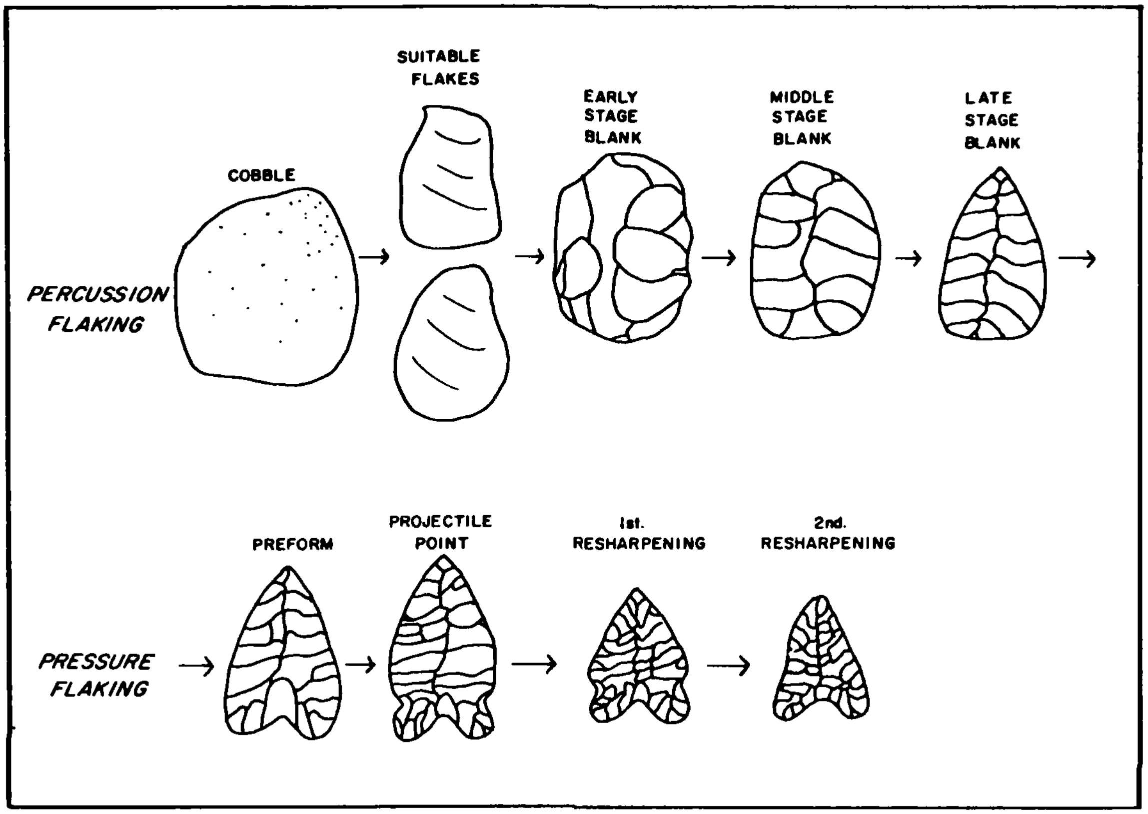

Figure 8-5. Reconstructed Oxbow sequence.

Figure 8-6. Reconstructed Oxbow sequence (full scale).

Comparison of the reduction strategy and technological sequence employed at the Harder site (Dyck 1976), an Oxbow complex encampment in Saskatchewan, with materials from the Sun River site indicates similarities between the two technical sequences. Both sequences entailed flake production from variously shaped cores, bifacial reduction through blank stages, apparent pressure thinning of preforms with concave bases, and final notching and grinding for hafting.

The Sun River sequence entailed the production of suitable flakes from a core as the initial stage of production. Suitable flakes were modified by percussion flaking through three successive bifacial blank stages. Each succeeding blank stage was technically more refined than the preceeding and exhibited decreasing size and increasing symmetry. The Late Stage blank was followed by a preform stage. Preforms exhibited increased symmetry and thinness, and were characterized by pressure flake scars which extended from the margins of both faces approximately to the centerline of the biface. The base was also thinned by the removal of large pressure flakes such that it acquired a concave shape. The succeeding projectile point stage was characterized by the presence of notches situated a few millimeters above the base of the point. Notches either were oriented obliquely or perpendicular to the longitudinal axis of the point. The position of the notches and the basal concavity imparted an "eared" appearance to the Oxbow point type.

Resharpening or rejuvenation attributes were evident on six of the points in the collection. At least two resharpening events were indicated. The first event resulted in a narrowing and probable shortening of the blade as compared to the completed point stage. Blade margins were straighter and, in some case, beveled. Notch depths appear shallower because of the reduction in blade width. The second resharpening event reflected a continuation of these trends resulting in significant narrowing and shortening of the blade. For one specimen, resharpening obliterated the notches and the point acquired a lanceolate shape with excurvate margins.

The preform stage and the final resharpening stage exhibit similar morphological characteristics. Although these stages occurred during the latter portion of the sequence involving Oxbow projectile point manufacture, neither exhibit the characteristic side notches of the Oxbow point type. Both stages, however, were pressure flaked, symmetrical, and possessed a concave base resulting in a lanceolate shape reminiscent of the McKean lanceolate point type. The stage is identified primarily on the basis of flaking pattern characteristics. It is possible that such preforms and resharpened points have been misidentified as McKean points, thus promoting the notion that Oxbow and McKean peoples coexisted.

Oxbow Reduction Strategy for the Biface Technical Sequence

The technical sequence outlined above provided the basic data by which the following biface reduction strategy was formulated. Data regarding the various types of debitage associated with Cultural Levels IV-VI also were incorporated into the research strategy. As previously indicated, the analysis of reduction strategies places an emphasis on the hierarchically ranked processes followed in the manufacture of tools. These are presented as a continuum of patterned, behavioral processes which reflect the strategy involved in producing technologically related products and by-products. Reduction strategies, therefore, establish the interrelationships between processes, products, and by-products within a hierarchically ranked format.

The initial step in the biface technical sequence (Fig. 8-7) was the selection of suitable cobbles. The selection process entailed the removal of cortical flakes as a test to determine the quality and homogeneity of the stone for knapping purposes. Once a cobble-sized piece was flaked, it became a core. Unsuitable cores, cortical flakes, and shatter fragments were discarded as by-products. Suitable cores were selected as products for further modification.

Selected cores were prepared for the production of suitable flakes. The limited data available indicate that core preparation may have been either opportunistic or systematic. One example of a water-worn cortical flake exhibits attributes indicative of bipolar production from a rounded, water-worn cobble. Several other cortical flakes with both prepared and unprepared platforms indicate opportunistic production by direct free-hand percussion of subrounded glacial cobbles. Apparently, a variety of flake production techniques were used, reflecting the shape of the original parent material and the desired products.

Flakes were produced from a core until one of three possible outcomes occurred:

(1) A sufficient number of suitable flakes were produced;
(2) The core was reduced in size to the point where suitable flakes could no longer be produced; or
(3) Insurmountable manufacturing mistakes or inconsistencies in the core's material precluded further flake production.

By-products resulting from this process included rejected and exhausted cores, cortical flakes, interior flakes, and shatter fragments. Products were flakes suitable for biface manufacture, uniface manufacture, or for impromptu tools.

Flakes selected for biface manufacture were modified into Early Stage blanks. Early Stage blanks resulted from percussion flaking and reflected the initial process of shaping, thinning, and establishment

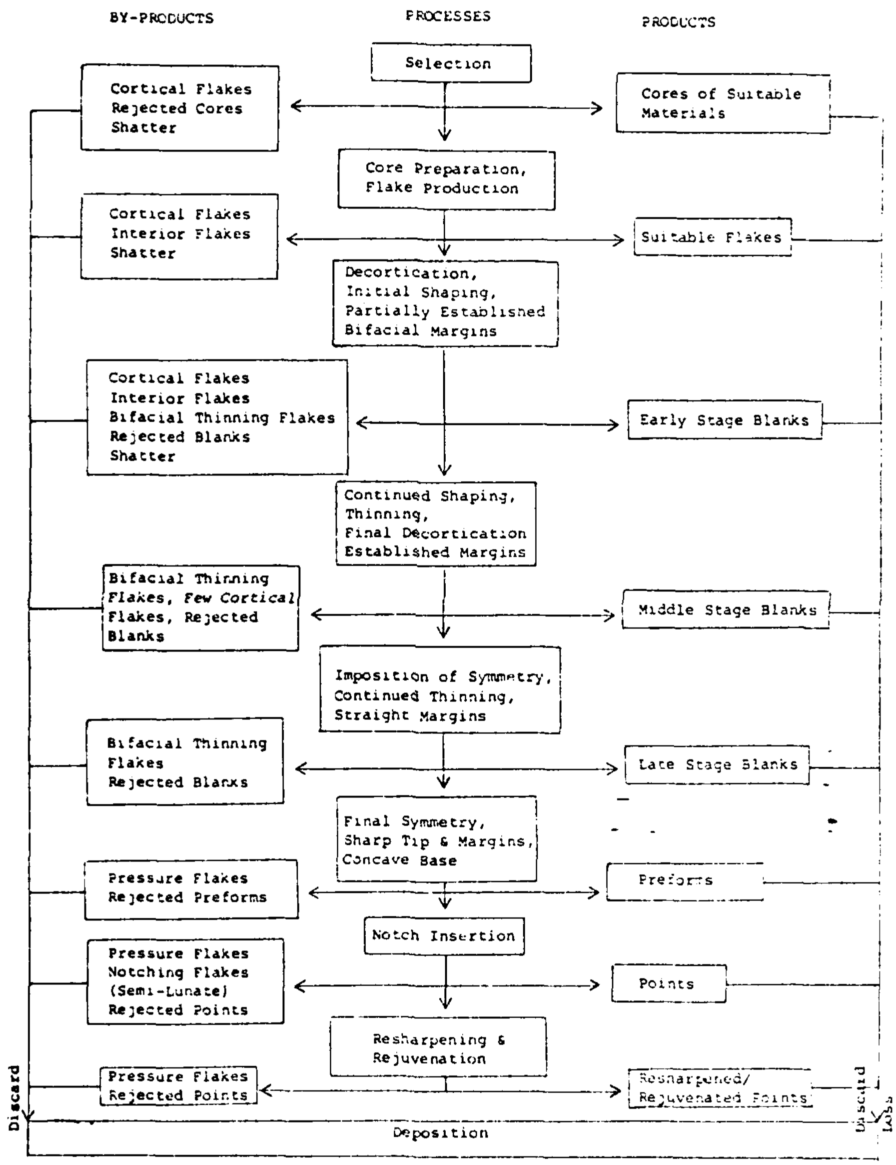

Figure 8-7. Generalized flow chart of Oxbow flaked stone reduction strategy for biface technical sequence.

of bifacial margins. By-products resulting from this included cortical flakes, interior flakes, bifacial thinning flakes, rejected blanks, and shatter. Products included Early Stage blanks and flakes selected for modification into unifacial tools or as impromptu tools. Complete Early Stage blanks may have been selected for continued modification, use, or curation pending further modification or use.

Selected Early Stage blanks were subjected to shaping and final decortication. Intentional thinning was also initiated during this process. As natural platforms were removed, the margins may have assumed a sinuous or undulating shape. Platform preparation was restricted to individual flake platforms and was not applied to the entire length of the margin. Percussion flake scars often extended across both faces, giving the implement a biconvex cross-section. This process resulted in the production of bifacial thinning flakes, a relatively few cortical and interior flakes, and rejected or broken blanks as by-products. Products included Middle Stage blanks and flakes selected for modification into unifacial tools or as impromptu tools. Middle Stage blanks were selected for further modification or were curated.

Selected Middle Stage blanks were subjected to continued shaping and thinning. The intent of this process was the establishment of straight lateral margins and imposition of symmetry. Platform preparation was applied to the entire length of the margins and percussion flake scars extended across both faces. This process resulted in the production of bifacial thinning flakes and rejected blanks broken during manufacture as by-products. Products were Late Stage blanks which may have been selected for further modification or curated.

Selected Late Stage blanks were subjected to continued thinning and the final imposition of symmetry. This was accomplished by nonsystematic pressure flaking. Pressure flaking entailed the establishment of prepared platforms along the length of the basal and lateral margins. By placing the sharpened tip of a bone or antler tool on the edge of the prepared margins, flakes were removed with a pushing motion directed toward the longitudinal axis of the biface.

The removal of pressure flakes along the base was conducted for thinning and shaping purposes. This entailed an emphasis on the removal of flakes from the center portion of the base and resulted in a thinned center, slightly thicker ears, and a concave shape.

Pressure flaking represents an important technical shift in the reduction process and provides several advantages over percussion flaking, including:

(1) Better control of the length and direction of flakes;
(2) Sharper lateral margins and tip;
(3) Eliminates percussion flake scar ridges; and
(4) Provides for the imposition of greater symmetry and an even configuration to the biface.

This process resulted in the production of pressure flakes, rejected or broken preforms as by-products, and complete preforms as products.

Preforms may have been selected for further modification or curated. Selected preforms were subjected to the imposition of notches; these were situated just above the apex of the basal concavity and were oriented either perpendicular or oblique to the longitudinal axis of the point. Notch and basal grinding was evident on many of the points in the collection. Apparently, basal grinding often was conducted immediately after notching and represents an effort to eliminate sharp edges. Thus, hafting may have been accomplished without the threat of damage to bindings or, subsequently, by splitting the shaft upon impact.

The notching process resulted in the production of pressure flakes, notch flakes (semilunate in shape), and broken projectile points as by-products. Completed projectile points were produced as products.

Subsequent to completion, projectile points were resharpened, as needed. Resharpening was a deliberate attempt to extend the use-life of a tool, thereby conserving material and the time and energy required to manufacture a new point. Resharpening may have been warranted when a break occured at or near the tip, or when edges became dulled or damaged through use or accident. The nature of the damage determined the nature of resharpening. In all cases, resharpening altered the original shape of the point to some degree. In some instances, this alteration was quite drastic, particularly if the damage had been severe or if more than one resharpening episode was involved.

A microscopic examination of flake scars on the Oxbow points provided indications of a variety of resharpening processes. Some of the resharpened points exhibit small, tightly spaced flake scars that extend from the margins only part way to the longitudinal axis of the point. In some cases this entailed bidirectional beveling of opposite margins, while for others, both margins were bifacially flaked. Several of the resharpened points also exhibit indications that the resharpening process included modification of their bases. Specifically, the ears on many of these exhibit flake scars extending from their margins and overlapping the notching flake scars. The inclusion of the ears in the resharpening of some points indicates that these were probably removed from their haft prior to resharpening. The reason for this is unknown but it may indicate that the shafts on which the points were hafted were subject to damage and required replacement.

The resharpening of Oxbow projectile points resulted in several modifications to their original shapes. As indicated, the degree of morphological alteration was dependent upon the original shape of the point and the nature and extent of resharpening. In general, these morphological alterations may be characterized as tendencies within a range of acceptable functional and stylistic variability. These include:

(1) Gradual narrowing of blade width;
(2) Gradual alteration of margin shape from convex to straight;
(3) A tendency toward shortening of blade length;
(4) Gradual narrowing of base width;
(5) Increasingly shallower notch depths;
(6) Occasional reorientation of ears from oblique to more nearly parallel with the longitudinal axis of the point; and
(7) Gradual alteration of side-notched to more lanceolate shaped point.

The morphological variability that occured among Oxbow points at the site, therefore, was a function of the intended shape of the completed product, as well as the effects of resharpening.

The reduction strategy and technical sequence presented here provide the basis for the following generalizations about the Oxbow projectile point technology as represented at the site:

<u>Metrics and Projectile Point Variability</u>

(1) Variability of length was not a significant variable in terms of type characterizations; length had no dependent variables and was a dependent variable only of flake length;
(2) Depth of notches was not critical in terms of function;
(3) Width between notches was probably critical;
(4) Placement of notches was probably dependent on the depth of the basal concavity;
(5) Depth of basal concavity and thickness of point base was dependent on the shape of the proximal end of haft and the point thickness that each shaft provided; and
(6) Haft elements varied in response to particular shapes and requirements of the haft (it was easier to reorient the haft element of a point than to reorient the haft).

In sum, the lithic debitage and tools recovered from the three Oxbow levels illustrate a technological sequence which progressed from the production of flakes from core materials, then of bifaces and unifaces from flakes. Bifaces were percussion flaked into their intended rough shape, then pressure flaked into final form.

Tool Use and Discard

Few tools were recovered from the upper levels, rendering comparison between units impossible. Within the Lower Unit, the Oxbow toolkits were similar in that each level contained Oxbow projectile points and unifacially modified flakes (Table 8-2). None of the projectile points displayed evidence of knife usage. Beyond this basic level of similarity, notable characteristics distinguish the levels.

TABLE 8-2

COMPARISON AMONG OXBOW LEVELS OF FLAKED STONE ARTIFACTS

	LEVEL IV	LEVEL V	LEVEL VI	TOTAL
Unifaces	19	4	4	27
Projectile Points	5	1	7	13
Blanks/Knives	6/3	2	0	11
Biface Fragments	0	0	5	5
Preforms	3	0	0	3
Debitage	670	35	292	999
TOTAL	706	42	308	1,056

Level IV was the only level that contained biface knives. Furthermore, the six thin flake scrapers from Level IV probably represent a particular activity not represented in the other samples. As discussed, use-wear patterns were interpreted as indicating light scraping of a rigid material. Similar tools from the Harder Oxbow site were interpreted by Dyck (1976) as cutting tools for hides. Level IV was further distinguished by the presence of three end scrapers from which we inferred hide working. The bone awl recovered from Level IV may have been used for clothing or basket manufacture. The remaining tools include an array of modified and utilized flakes thought to have been used in general butchering activities. Most of the tools were abandoned on the site because they were broken or exhausted and of no further utility. One end scraper, which retained a usable working edge and was of sufficient size to have been hafted, is believed to have been lost. The majority of obviously exhausted tools, for which replacements were probably manufactured, were discarded intentionally in a trash area. On the other hand, tools which broke during use or were no longer needed appear to have been discarded in their place of use.

The limited Level V sample consists of four marginally retouched flake scrapers and one resharpened projectile point. No bone tools were encountered. Use-wear on the scraping tools is interpreted as light scraping on rigid materials; they probably served a variety of butchering tasks. No pattern of discard was observed.

Level VI is in interesting contrast to the other levels because of the presence of a number of complete projectile points and a number of specialized, unifacial scraping/perforating tools, comprising the entire toolkit of our sample. No cutting tools were recovered and none of the points displayed evidence of such use. The scraping/perforating tools are interpreted as multipurpose butchering and hide-working tools. Many of the tools appear to have been intentionally discarded in a trash area, whereas others were left in their activity context.

To summarize, interesting patterns distinguish the Oxbow toolkits from each other. Unfortunately, the samples are too small to be able to adequately interpret the ramifications of these differences. The common bonds, as mentioned, are projectile points and multipurpose unifacial butchering tools.

PALEOENVIRONMENT, SUBSISTENCE, AND SETTLEMENT

In order to understand prehistoric adaptations, it is first necessary to know something about the environment to which particular people were adapted. he range of subsistence and settlement possibilities is influen . by the degree of diversity of exploitable resources within particular habitats (Schiffer 1975). Thus, to understand prehistoric occupations at the Sun River site, we will initially review paleoclimate which dictated the range of faunal and floral resources in the past.

Paleoclimate

Plains archeologists generally agree that the post-glacial climate can be divided into three major periods, as originally proposed by Antevs (1948, 1955) and discussed in Chapter 3. Bryson and Wendland (1967) have proposed a more complex model of post-glacial climate based on geographic variations of the seasonal mean frontal positions of the various air masses which control the continental climate (Fig. 8-8).

The climatic episodes with which we are concerned are the Altithermal (Atlantic) and the Medithermal (Sub-Boreal and Sub-Atlantic). As discussed in Chapter 3, pollen spectra from the Northwestern Plains and Northern Rockies (Baker 1970; Christensen and

AGE	BLYTT-SERANDER CLIMATIC EPISODES (Baerreis & Bryson 1965)	GENERAL CLIMATIC TRENDS	ANTEVS' CLIMATIC STAGES (Antevs 1955)
Present			
	Recent		
100 BP			
	Neo-Boreal	ESSENTIALLY MODERN	
400 BP			
	Pacific		
700 BP			
	Neo-Atlantic		
1,080 BP			
	Scandic		MEDITHERMAL
1,670 BP			
	Sub-Atlantic		
2,900 BP			
	Sub-Boreal		
4,680 BP			
	Atlantic IV		
6,080 BP			
	Atlantic III		
7,050 BP		DRIER	ALTITHERMAL
	Atlantic II		
7,730 BP			
	Atlantic I		
8,450 BP			
	Boreal		
9,650 BP			
	Pre-Boreal		
10,500 BP			
	Late-Glacial	MOISTER	ANATHERMAL
13,000 BP			

Figure 8-8. Chart of late-glacial and post-glacial climatic episodes (after Greiser 1980:34).

Hill 1971; Driver 1978; Hansen 1939, 1948; Mehringer *et al.* 1977; Reeves and Dormaar 1972; Waddington and Wright 1974) document a warm and, in most cases, dry period dating between approximately 7,000 and 5,000-4,000 years ago, based on increased grasslands at elevations which are today forested, in addition to increases in *Artemesia* (sagebrush), *Chenopodia* (goosefoot), and *Amaranthus* (pigweed) pollens -- indicators of aridity. The time of maximal warmth and aridity

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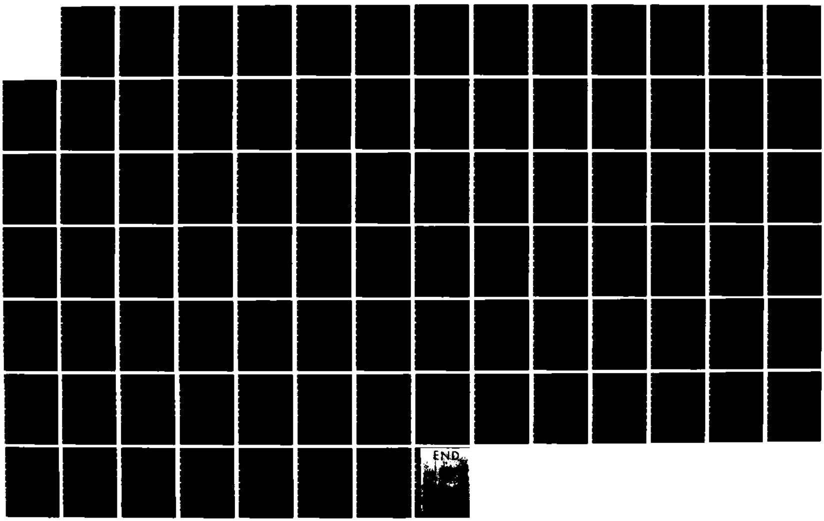

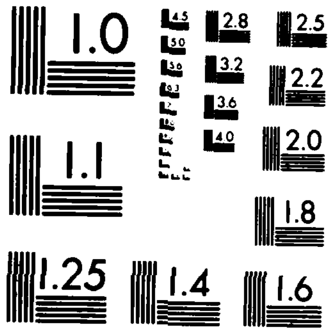

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

appears to have occurred between 6,500 and 6,000 years ago. At this time, lower treelines would have reached their greatest altitude and some species would have moved completely out of the sequence due to intolerance to heat or aridity. For example, Picea (spruce) requires moist ground to germinate seeds.

A shift back to coniferous pollen throughout the region around 4500 BP marked the end of the Altithermal and the onset of Medithermal, or specifically, Sub-Boreal conditions. At Waterton Lakes National Park, subalpine forests may have dropped below modern elevations (Christensen and Hill 1971). According to Driver (1978), until approximately 2800 BP, although conditions had improved substantially when compared to modern conditions, it was still slightly warmer and drier.

Around 2800 BP, many pollen cores document a sudden and dramatic increase in coniferous pollen. At Crowsnest Lake, this episode was the coldest and wettest of the entire sequence (Driver 1978). It roughly correlated with the proposed Twin Lakes advance at Waterton dating between 2500-1700 BP (Reeves 1972). The Sub-Atlantic climatic episode, as defined by Bryson and Wendland (1967), dated to ca. 2,900-2,200 years ago and was characterized by cool, cloudy and wet conditions.

In summary, the regional pollen data generally support the model proposed by Bryson and Wendland (1967). Pollen shifts document the warm and dry Atlantic episode, the increased moisture and cooling trend of the Sub-Boreal, and the maximal moisture of the Sub-Atlantic. Pollen data from the Sun River site also tend to support these regional studies (see Chapter 3 and Appendix C).

Apparent from these comparisons is that Cultural Level VI at the Sun River site, occupied around 5200 BP, falls within the Atlantic climatic episode. Although conditions were warm and dry, the period of maximal warmth was over and conditions were slowly improving. Level V occupants straddled the Atlantic/Sub-Boreal transition around 4500 BP. Conditions probably were rapidly improving. Level IV, occupied sometime between 3800 and 3500 BP, dates to the Sub-Boreal climatic episode, when conditions are believed to have been similar to those of modern times.

Atop 1.4 m of post-3800-BP alluvial fill lie Levels I-III, which date between 3600 and 2800 BP. These centuries also date to the Sub-Boreal climatic episode. Our information regarding the last 2,800 years at the site unfortunately is limited to surface finds of projectile points.

Settlement Considerations

It is intriguing that this particular location, on the north bank of the meandering Sun River, was occupied so sporadically for such a long time. Perhaps, because this was the first location of deep testing for archeological sites (i.e., greater than 1 m) along old meander channels of the Sun, we might postulate that this was not the only preferred location, but rather that similar sites abound along both banks of the river. Presumably, the location attracted game animals, which in turn attracted the people who depended upon them.

From ethnographic data compiled by Jochim (1976), specific campsite locations were selected for nonfood needs such as water, fuel, and shelter within an area of reliable food resources. It follows, then, that this particular location filled these needs at least sporadically for several thousand years (Table 8-3). Of interest is the suggested pattern of fall occupations by Oxbow people and winter or early spring occupations by later residents. This altered pattern of site use could reflect the shift from Atlantic to Sub-Boreal environmental conditions.

TABLE 8-3

ESTIMATED SEASONS OF USE, LENGTH OF OCCUPATIONS, AND RELATED DATA

CULTURAL LEVEL	ESTIMATED SEASON OF USE	ESTIMATED LBS. OF MEAT REPRESENTED	ESTIMATED PERSON-DAYS OF MEAT (3.5-5 lbs/ person/day)	ESTIMATED LENGTH OF OCCUPATIONS
Level I	Multiple occupations; at least one in the spring	--	--	Unknown
Level II	Winter/early spring(?)	--	--	Unknown
Level III	Winter/early spring(?) Fall	--	--	Unknown
Level IV	Fall	770 lbs	154-220	2-3 days
Level V	Fall	2,400 lbs.	480-685	1 day
Level VI	Fall	180-750 lbs.	36-214	1-2 days

Within a territory, there is a close relationship between task group organization and mobility to patterns of seasonal availability and spatial distribution of resources (Wilmsen 1973). For the Great Plains during pre-horse days, several extended families numbering between 40 and 75 individuals came together during the fall when resources were most concentrated. As resources became less concentrated, from winter through summer, bands divided into smaller task units numbering between 10 and 25 individuals, in response to resource dispersal. The seasonal distinction between the Upper and Lower Units at Sun River may reflect differential patterns of resource dispersal in response to climatic conditions.

A proposed reconstruction of seasonal adaptations and the Sun River occupants is as follows: During Atlantic times, this location was a place where ungulates congregated during the fall, for breeding, which attracted Oxbow hunters. The number of locations where ungulates could be found was limited due to the restricted sources of water and grassland vegetation. The site was probably one of a limited number of "oases" (Frison et al. 1976), where game remained somewhat secure. Because of the precarious nature of the food supply during these times, the people had to maximize their chances of procuring enough food for the winter and this site offered that possibility. During the spring and summer, Oxbow people moved into higher elevations following the succession of ripening plant foods, as did the large ungulates.

During Sub-Boreal times when water and grasslands were plentiful, food resources and fall campsite locations were plentiful, as well. The site location probably remained attractive during much of the year, especially in the spring, when roots and young shoots in addition to mussels could be gathered along the river.

Assuming that this model has some basis in reality, we might postulate that Levels IV-VI were occupied by 25 to 75 Oxbow people. Given the nature and quantity of the occupational debris, the lower estimate is favored: they are believed to have stayed only a short time of one to three days. These estimates are merely guesses. As discussed in Chapter 1, the horizontal limits of the occupations are unknown and our "sample" has no statistical value. Using ethnographic data and comparative information from the Southridge site (Brumley 1981), a similar, excavated Oxbow occupation, we can consider what the extent of the site may have been. Based on overall dimensions, number of features, and quantities of cultural debris, considered in concert with an average extended family band size of 25 persons, we would estimate that the 1982 Sun River excavations exposed between 15-33 percent of the total floor areas for the Oxbow levels. Thus, rather than considering our sample as complete, perhaps all data sets should be multiplied by five to provide a more adequate estimate of represented activities.

At Southridge, the floor area was approximately 10 x 20 m, with five features, 3,200 pieces of bone, and 2,500 pieces of debitage. Compared to Level IV, Southridge had approximately 7.5 times the floor area, 5 times the number of features, 5 times the number of bones, yet only 3.5 times the number of flaked stone artifacts (excluding flotation samples). Furthermore, Brumley reported roughly three times the number of biface blanks, preforms, and points, and five times the number of unifaces and modified flakes as recovered from Level IV. These data support the contention that the excavated area of Level IV, as a representative sample, incorporates between 15-33 percent of the actual living floor. Similar findings result from a comparison of Southridge with Levels V and VI.

As discussed in Chapter 4, little can be said about the extent of the Upper levels or the number of occupations due to our limited sample.

Subsistence Considerations

All of the prehistoric occupants of the site focused on processing the products of large ungulates. In the assessment of species composition per level (Table 8-4), there was general continuity through time. Distinctions included: (1) the relative proportions of bison to pronghorn; (2) the degree of species diversity; and (3) the presence or absence of aquatic resources.

Bison remains comprise more than 85 percent of the identifiable fauna in Levels I-IV, dating between 2800-3600 BP. Pronghorn is absent or minimally represented in these levels. At 4500 BP (Level V), bison comprises 65 percent of the sample and 21 percent is identified as pronghorn. In sharp contrast, at 5200 BP (Level VI), bison comprises only 3 percent of the sample and pronghorn comprises 78 percent.

Examining species diversity, all of the site's occupants exploited a variety of fauna. The two lowest levels showed greater diversity in ungulates than Levels I-IV. Level V produced the remains of four ungulate species (bison, pronghorn, deer, and wapiti), and Level VI produced three (pronghorn, bison, and deer). Level III also contained remains of three ungulate species (bison, deer, and pronghorn), but more than one occupation is thought to be represented.

Another distinction which may be especially important for possible climatic implications is the occurrence of aquatic resources only in Levels I-IV, post-dating 3,800 years ago (considering the sigma for the Level IV date). Freshwater mussels and fish or amphibians were exploited by the more recent occupants of the site and, as far as we know, not by the occupants of Levels V and VI. These data may reflect the moister conditions of the Sub-Boreal over the Atlantic episode.

TABLE 8-4

SPECIES COMPOSITION PER LEVEL

UNIT	LEVEL	DATES	CULTURE	CONSTRUCTED FEATURES	FAUNAL REMAINS
UPPER	I	2800- 3600 BP	Pelican Lake	5 stone heating pits	97% bison freshwater mussel deer rodent
	II	2800- 3600 BP	?	1 basin-shaped hearth; function unknown	92% bison rabbit or hare pronghorn freshwater mussel
	III	2800- 3600 BP	?	None encountered	bison
LOWER	IV	ca. 3500 BP	Oxbow	1 ash-filled, basin-shaped hearth; possible functions:	95% bison 3% pronghorn rodent freshwater mussel fish or amphibian fox rabbit or hare
	V	ca. 4500 BP	Oxbow	Hearth refuse-- no constructed hearth encountered	65% bison 21% pronghorn deer wapiti bird
	VI	ca. 5200 BP	Oxbow	1 ash-filled, basin-shaped hearth and one area of concentrated bone; possible functions as described above for Level IV	90% pronghorn 3% bison bird deer jackrabbit rodent wolf

Aside from these species distinctions, the most obvious discriminating characteristic of the faunal assemblages between the Upper and Lower Units was the noticeably greater fragmentation resulting from butchering in the Lower Unit. This pattern is interpreted as indicating greater resource abundance after 3500 BP than before, as would be expected by reference to the climatic model. The more recent site occupants did not extract every last morsel of nutrition from their prey, as evidenced by some complete bones and only moderate fragmentation of others.

The results of pollen, phytolith, and macrofloral studies reveal little information concerning subsistence practices. However, as noted by Service (1966:10), "only in a few instances is the hunting of animals as productive as the gathering of seeds, roots, nuts, and berries." Meggit (1964), in a study of aboriginal Australians, supported this thesis of a vegetarian stress in hunting-gathering societies. He noted that even in habitats where fish and game are abundant, vegetables comprise 70 to 80 percent of the diet.

Archeologists, at times, find it difficult to deal with aspects of prehistoric culture that are not preserved in the archeological record. Typically, in the literature, sites with grinding stones are interpreted as sites where plant processing took place. The absence of grinding stones, in turn, is interpreted as an absence of plant processing. However, grinding stones were only required to prepare meal from particular types of seeds. A great number of plant foods, including roots and tubers, fruits, young shoots, and greens, require little or no processing and they generally leave no trace, once consumed. Accordingly, it is likely that the occupants of the Sun River site collected and consumed the full range of edible plants common to the plains, foothills, and mountains. During the fall, fruits and berries such as chokecherries and rosehips may have been collected at or near the site.

CONCLUSIONS

Successive prehistoric occupants of the Sun River site witnessed major environmental changes during the 2,500-year period through which the site was occupied. These changes have been documented in the archeological record which they left behind. All occupants were hunter-gatherers who hunted large and small game, gathered aquatic resources and, presumably, wild plant foods. Differences in settlement and subsistence practices, as summarized in Figures 8-9 and 8-10, reflect environmental differences through time.

The earliest known site occupants emphasized pronghorn, perhaps as a reflection of the pronghorn's adaptation to the drier portions of the short grass plains. Greiser (1980:103), for the Atlantic climatic episode, hypothesized that climatic trends impacted ungulate populations in the following ways:

SETTLEMENT PATTERNS

ECONOMIC SEASONS	GENERAL SETTLEMENT TYPE	ESTIMATED NUMBER OF OCCUPANTS	LOCATIONAL DETERMINANTS: IMMEDIATE	LOCATIONAL DETERMINANTS: GENERAL	ASSOCIATED ACTIVITIES: BASE CAMP	ASSOCIATED ACTIVITIES: CATCHMENT AREA
LATE SPRING-EARLY SUMMER	DISPERSED	25±	WATER, VIEW, FUEL, SHELTER	SMALL GAME, VEGETABLE FOODS	Daily Maintenance Tasks	Gathering berries & shoots; Hunting small-game; Snaring grouse; Gathering eggs & young; Hunting big-game
LATE SUMMER-EARLY FALL	DISPERSED	12±	WATER, VIEW, FUEL, SHELTER	SMALL GAME, VEGETAL FOODS	Daily Maintenance Tasks	Gathering fruits, nuts, roots, tubers, seeds, and berries; Hunting small-game; Hunting big-game
LATE FALL-EARLY WINTER	CONGREGATED	75±	WATER, SHELTER, FUEL, VIEW	BIG GAME, VEGETAL FOODS	Daily Maintenance Tasks; Preparing & caching storable food resources; Making & repairing winter gear & clothing	Gathering berries, nuts and seeds; Hunting small-game; Hunting big-game; Trapping fur-bearers
LATE WINTER-EARLY SPRING	DISPERSED	25±	SHELTER, FUEL, WATER, VIEW	BIG GAME, SMALL GAME	Daily Maintenance Tasks; Preparing storable food resources	Collecting firewood; Hunting small-game; Hunting large-game; Trapping fur-bearers

Figure 8-9. Subsistence and settlement patterns of Atlantic II-IV hunter-gatherers on the Great Plains (from Greiser 1980: 109).

SETTLEMENT PATTERNS

ECONOMIC SEASONS	GENERAL SETTLEMENT TYPE	ESTIMATED NUMBER OF OCCUPANTS	LOCATIONAL DETERMINANTS: IMMEDIATE	LOCATIONAL DETERMINANTS: GENERAL	ASSOCIATED ACTIVITIES: BASE CAMP	ASSOCIATED ACTIVITIES: CATCHMENT AREA
LATE SPRING-EARLY SUMMER	DISPERSED	25±	SHELTER, FUEL, WATER, VIEW	SMALL GAME, VEGETABLE FOODS	Daily Maintenance Tasks	Gathering greens & shoots; Hunting small-game; Snaring grouse & waterfowl; Gathering eggs & young animals; Hunting big-game
LATE SUMMER-EARLY FALL	DISPERSED	25±	WATER, VIEW, FUEL, SHELTER	SMALL GAME, VEGETABLE FOODS	Daily Maintenance Tasks	Gathering greens, nuts, fruits, roots, tubers, and seeds; Hunting small-game; Hunting large-game
LATE FALL-EARLY WINTER	CONGREGATED	100-200±	SHELTER, FUEL, WATER, VIEW	BIG GAME, VEGETABLE FOOD	Daily Maintenance Tasks; Preparing & caching storable food resources; Making & repairing winter gear & clothing	Gathering berries, nuts and seeds; Hunting small-game; Hunting large-game including cooperative hunts; Trapping fur-bearers
LATE WINTER-EARLY SPRING	DISPERSED	25-100±	SHELTER, FUEL, WATER, VIEW	BIG GAME	Daily Maintenance Tasks; Preparing storable food resources	Hunting big-game; Trapping fur-bearers

Figure 8-10. Subsistence and settlement patterns of Sub-Boreal hunter-gatherers on the Great Plains (from Greiser 1980: 118).

> On a specific level, large herbivore populations were more drastically reduced than other species. Bison populations were more seriously affected than pronghorn's because pronghorns are adapted to the drier portions of the shortgrass plains where they consume scrub vegetation. Sagebrush, which proliferated under the arid conditions of the Atlantic episode, is a staple in the pronghorn's diet. Bison, on the other hand, generally shifted eastward in pursuit of shortgrass vegetation. However, a few "oasis" areas within the Central High Plains provided sustenance for limited numbers of bison.

Regarding settlement considerations, "settlement emphasis was shifted to peripheral ecotones and oases along major streams and near permanent springs and ponds where resources were most abundant" (Greiser 1980:107). These considerations may explain, in part, why Oxbow people did not exploit major lithic quarries. The need to have restricted movement to areas of secure water may have precluded journeys to upland source areas.

Occupation of the site in the fall was in response to the congregation of large herbivores during the breeding season. Several families probably came together to exploit these resources.

The latter two Oxbow occupations witnessed increased moisture and decreased temperatures. As grassland carrying capacity increased, bison populations resurged. The increasingly greater proportion of bison remains in these occupations reflects this trend. Oxbow people continued to visit the site in the fall to accumulate winter stores.

The 50- to 200-year episode when significant quantities of alluvial fill were deposited atop Level IV marks the end of Oxbow occupation of the site. From surface evidence, we know that Hanna people visited the site and, from shallowly buried deposits, we know that Pelican Lake people occupied the site during Sub-Boreal times. Conditions were much like today and grasslands flourished, as did the bison.

The Sub-Boreal occupants of the site also focused on bison, but exploited a variety of other resources. A majority of these occupations took place during the late winter or early spring, and probably consisted of 10 to 25 people per occupation. The stone-boiling pits are believed to have been used for cooking meat rather than extensive bone grease processing, an activity generally conducted in the fall. Resource distribution and abundance is believed to have been similar to those described by Lewis and Clark during early historic times, and extensively quoted in Chapter 2.

It is of interest that the most recent date from the site corresponds to the termination of the Sub-Boreal episode and the onset of extremely moist conditions of the Sub-Atlantic. Perhaps adaptation to Sub-Atlantic conditions included a change in the seasonal round or some other adjustment that resulted in termination of a 2,500-year pattern of site use. Of course, this suggestion is based on pure speculation.

Another factor which probably influenced site avoidance was the accumulation of thick deposits of tributary clays over much of the site during the last 3,000 years. As discussed in Appendix A, these clays are nearly impermeable and stay wet for long periods of time. During Sub-Atlantic times, moist conditions may have rendered the site virtually uninhabitable.

CHAPTER 9

OXBOW REVISITED

A review of the readily available Oxbow literature does not require much time. Archeologists know relatively little about the Oxbow culture. The distribution of Oxbow sites appears to be bounded on the southwest by the headwaters of the Missouri River, on the southeast by the Middle Missouri River of South Dakota, and extends north from the Yellowstone River into the Boreal Forest of central Canada (Fig. 9-1, Table 9-1). As Reeves (1973) has discussed, sites dating between 5000 and 3500 BP are concentrated along the western periphery and northern parkland edge of the Northwestern Plains. The eastern plains/prairie border was also occupied. Suggested origins for Oxbow include the eastern woodlands (Mayer-Oakes 1960) and the Rocky Mountains (Reeves 1969). Mayer-Oakes proposed that Oxbow projectile points represent a unit out of a changing continuum of notched projectile point styles characteristic of the Eastern Archaic Tradition (ca. 5000-8000 BP). Reeves, on the other hand, categorizes Oxbow as part of the Mummy Cave Complex, an intermountain tradition also characterized by a changing continuum of side-notched points.

What ultimately became of Oxbow people is also unclear. Indications exist that Oxbow may have continued into the Christian era in central Canada (Gibson 1981). Reeves (1983) recently has suggested that the side-notched tradition of which Oxbow was a part continued in the form of Sandy Creek and eventually Besant. As noted by Millar (1981:159),

> Although there are numerous differences in the ceramics, drills and bison procurement, there are also a number of similarities in the mortuary complex, the general notching of the projectile points, ground stone mauls, the large side-notched bifacial knife blades, the use of chalcedony and obsidian. The distribution of the Besant complex is roughly similar to that of Oxbow but with more southerly orientation toward the plains proper and out of the parkland-forests. In the absence of an acceptable successor to Oxbow and suitable ancestor to Besant this seems to be an efficient hypothesis.

Investigations of the distributions of the Oxbow complex through time and space by Spurling and Ball (1981) indicate that Oxbow technology entered the grassland of the Northwestern Plains about 5,000 years ago from both the southwestern foothills and the southeastern prairies. Through time, Oxbow groups moved northward, exploiting the Boreal Forest and parkland, and eventually became fully adapted to the Boreal Forest. The authors caution the reader about oversimplification; however, the general trends of northward expansion and Boreal Forest adaptation seem supported here.

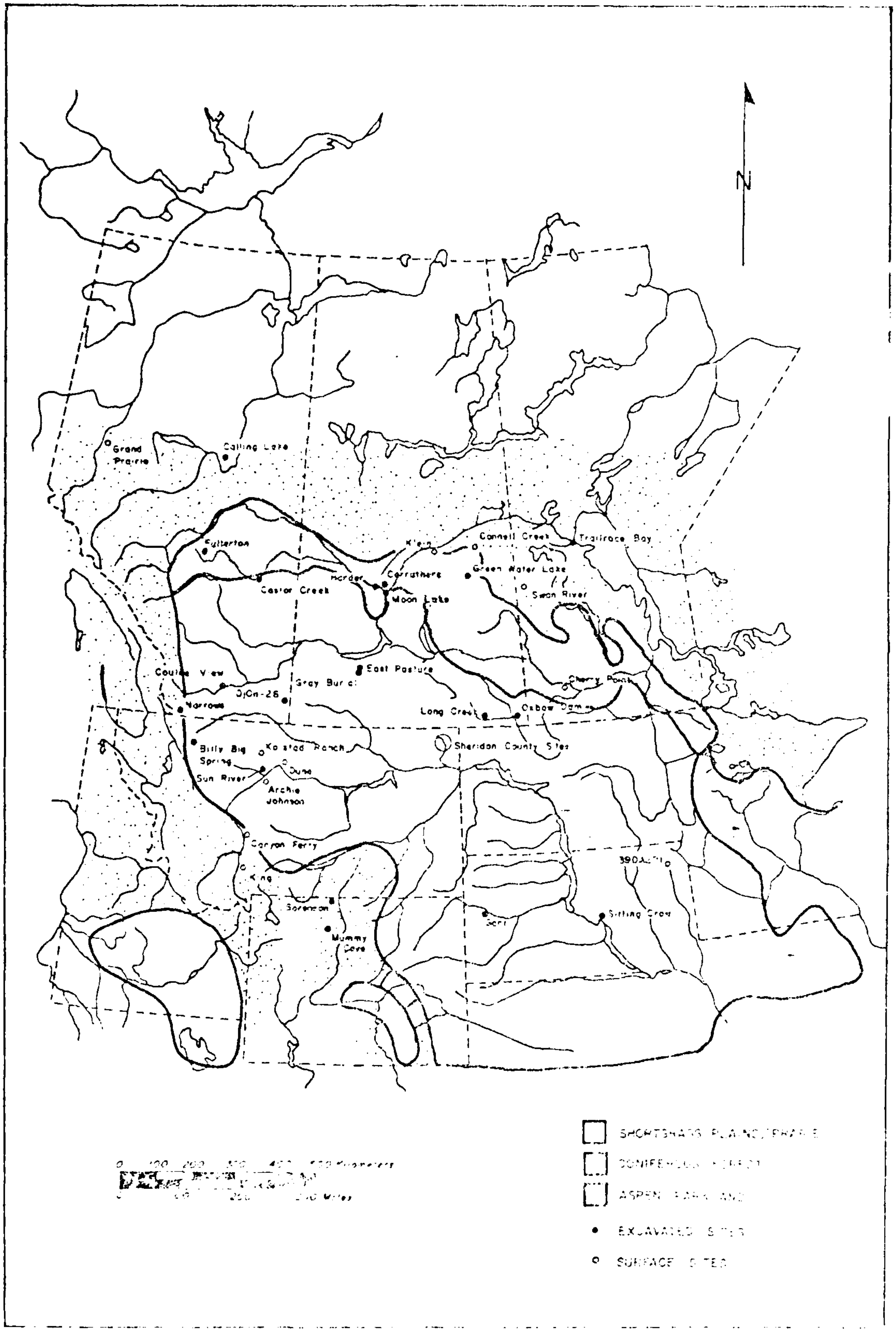
N
Grand Prairie
Calling Lake
Fullerton
Castor Creek
Harder
Carruthers
Moon Lake
Klein
Connell Creek
Tailrace Bay
Green Water Lake
Swan River
Coulee View
DjOn-26
Gray Burial
East Pasture
Cherry Point
Narrows
Long Creek
Oxbow Dam
Sheridan County Sites
Billy Big Spring
Sun River
Dune
Archie Johnson
Canyon Ferry
King
Sorenson
Mummy Cave
Sitting Crow
Miles
EXCAVATED SITES
SURFACE SITES

Figure 9-1. [illegible]

TABLE 9-1

SELECTED OXBOW SITES
(after Reeves 1973; Spurling and Ball 1981)

SITE	DATES	REFERENCE
MANITOBA		
Swan River*	---	Gryba (1968)
Trailrace Bay	---	Mayer-Oakes (1970)
Cherry Point	2860±205 BP 2885±260 BP 2060±130 BP 1940±100 BP	Haug (1976)
SASKATCHEWAN		
Oxbow Dam	5040±130 BP	Nero & McCorquodale (1958)
Long Creek	4993±150 BP	Wettlaufer & Mayer-Oakes (1960)
Klein	---	Nero (1957)
Connell Creek*	---	Meyer & Dyck (1968)
Moon Lake	4100±90 BP	Dyck (1970)
Harder	3360±140 BP	Dyck (1970, 1977)
East Pasture	4235±55 BP	Wilson (1972)
Gray Mass Burial	4955±165 BP 2915±85 BP 3415±105 BP 3485±195 BP 3550±295 BP 3750±180 BP 3755±100 BP 4340±250 BP 5100±390 BP	Millar (1978)
Carruthers	3130±80 BP	Haug (1976)
Greenwater Lake Burial	4390±105 BP	Hartney & Walker (1974)

*surface

TABLE 9-1. SELECTED OXBOW SITES (Continued)

SITE	DATES	REFERENCE
ALBERTA		
Castor Creek	4475±1000 BP	Wormington & Forbis (1965)
Narrows	4930 BP	Milne-Brumley (1971)
Grand Prairie*	---	Thompson (1973)
Coulee View	---	Forbis (1970)
Cypress Hills	---	Gryba (1972)
Fullerton	---	Taylor (1969)
Calling Lake	---	Gruhn (1969)
Strathcona Science Park	2020±105 BP 2045±45 BP 3730±80 BP	Pollock (1981)
MONTANA		
Billy Big Spring	---	Kehoe (1955)
Sun River	6750±440 BP 5960±210 BP 5670±190 BP 5660±470 BP 5310±110 BP 5040±100 BP 4640±120 BP 4560±70 BP 4390±110 BP 4370±110 BP 3450±350 BP	Greiser *et al.* (this volume)
Kolstad Ranch*	---	Davis (1972)
Dune*	---	Davis (1976)
Archie Johnson*	---	Shumate (1972)
Canyon Ferry	---	Greiser *et al.* (1983)
King*	---	Davis (1972)
Sheridan County Sites*	---	Joyes & Jerde (1970)

*surface

TABLE 9-1. SELECTED OXBOW SITES (continued)

SITE	DATES	REFERENCE
WYOMING		
Sorenson†	4900±250 BP	Husted (1969)
Mummy Cave†	5255±40 BP 4420±150 BP	Wedel, Husted & Moss (1968)
SOUTH DAKOTA		
39DA201	---	McNerney (1970)
Gant†	4130±130 BP	Gant and Hurt (1965)
Sitting Crow†	4400±250 BP	Neuman (1964)

†mixed deposits

As most investigators agree, early Oxbow sites are in grassland settings. Oxbow Dam (Nero and McCorquadale 1958) and Long Creek (Wettlaufer and Mayer-Oakes 1960) are the most often-cited examples. Interestingly, the earliest "Oxbow" levels from both of these sites contain side-notched points with straight bases. The absence of the basal concavity precludes the "eared" effect which is the Oxbow point's most distinguishing attribute. These occupations would more appropriately be assigned to the Early Plains Archaic period as defined by Frison (1978). The only level at Long Creek which truly belongs to the Oxbow complex is Level 7, their "Upper Oxbow" which dates to 4643 BP. The earlier dates at both Oxbow Dam and Long Creek are not believed to date Oxbow occupations and should cease appearing as such in the literature.

The earliest dates for an Oxbow complex occupation are from Level VI at the Sun River site, ranging from approximately 5,000 to 5,700 years ago (see Table 3-1), which falls within the Atlantic climatic episode. No other Oxbow sites thus far discovered date to this climatic episode. A significant cluster of Oxbow dates fall within the centuries between 3,500 and 4,800 years which correlate with the Sub-Boreal climatic episode. Occupations which post-date these centuries occur only in the Boreal Forest to the north.

Buchner (1981:142) presents an interesting hypothesis regarding climatic changes and forest adaptations:

> Stated in its most simple terms, the anomalous winter hypothesis suggests that the increasing frequency of severe winters, in which bison did not arrive in their usual wintering grounds, brought about a gradual increase in the dependence on forest resources. In all probability, this initially occurred only during the winter months, but over time Oxbow peoples became more fully adapted to the forest environment.

In the Northwestern Plains during Sub-Boreal times, Oxbow coexisted, at least for a short time, with people of the McKean Complex. Data presented by Brumley for the Cactus Flower McKean site (1975) and the Southridge Oxbow site (1981) clearly indicate some temporal overlap and thus at least partial contemporaneity of McKean and Oxbow phase groups within southeastern Alberta.

> However, there is no intermixing of the diagnostic and distinctive projectile point styles characterizing each of these phases at Southridge or at Cactus Flower,... In addition to projectile points, a number of other distinctive tool types tend to differentiate occupations of the two phases in the area. It thus seems that the Oxbow and McKean phases reflect two different cultural traditions rather than serial phases of a single cultural tradition (Brumley (1981:136).

With regard to the McKean question, it is of interest that no McKean complex points were found at Sun River. Furthermore, notable quantities of Oxbow and Hanna projectile points were recovered from Canyon Ferry Reservoir (Davis and Helmick 1982) to the south of Sun River on the Missouri River; yet McKean points were virtually nonexistent. This trend may indicate territorial patterns, i.e., Oxbow and McKean peoples had separate territories. When these point types co-occur in the archeological record, such as at Mummy Cave (McCracken _et al._ 1978), they probably represent separate events, with the McKean materials generally post-dating the Oxbow. Given the preceding statement about territories, sites with both cultures represented might reflect changing territorial boundaries.

Little is known regarding subsistence patterns of Oxbow people. Most authors agree that bison were an important resource, although they are usually few in number. The Harder site (Dyck 1976) is the only excavated Oxbow site which produced remains representing large numbers of bison. Dyck (1976:55-56) suggests that the estimated 93 bison which were processed at the site reflect "a communal affair such as a pound or a pedestrian version of the surround ...."

Considering faunal collections from a number of excavated Oxbow assemblages (Table 9-2), the predominance of bison is clear. The only site for which pronghorn was reported is Sun River, reflecting its grassland location. Most assemblages contain the remains of a number and variety of faunal resources including other large ungulates, various canids, small mammals, rodents, birds, fish, frogs, and freshwater mussels. Dyck (1976:69-70) notes the prominence of the wolf-dog-coyote-fox series, and, based on evidence from the Harder site, interprets their exploitation as having been for food and the dogs as beasts of burden.

TABLE 9-2

FAUNAL ASSEMBLAGES FROM SELECTED OXBOW SITES

	SUN RIVER			SOUTH-RIDGE	OXBOW DAM	LONG CREEK	STRATH-CONA	HARDER	MOON LAKE	NARROWS
	IV	V	VI							
PRONGHORN	1	1	4							
BISON	3	6	X	2	6	5	1	17	X	
DEER		X	X							
WAPITI		X			1					
MOOSE								1		
SMALL MAMMALS	X		X					1		
BIRDS		X	X		1				1	
FISH/AMPHIBIANS	X				1					X
RODENTS	X		X							
WOLF			X		1			4		
FOX	X				2			1		
DOG								X		
COYOTE					1			1		
MUSSELS	X				1					

X = unknown number

Fishing may have been of notable importance to Oxbow people. In addition to the Narrows fishing station site in Waterton Park (Milne-Brumley 1971), fish remains have been reported from the Mace site near Edmonton, Alberta (Pollock 1981), thought to be assignable to Oxbow, and from several sites in Saskatchewan (Millar 1981).

Considering the Sun River site in light of the foregoing discussion, its importance is exceedingly obvious. This is the only site south of Canada in the Northwestern Plains with dates that can be definitely attributed to Oxbow occupations. The earliest component at Sun River is the earliest-dated Oxbow component on record. Oxbow is generally characterized as the first post-Altithermal culture on the Plains, yet Sun River demonstrates that Oxbow people were originally adapted to Altithermal conditions.

Sun River and Southridge are the only pure Oxbow components in a Plains grassland setting. Other sites are either mixed with McKean complex tools or are located in the mountains, parkland, or forest. These uncontaminated samples are essential to reconstructing Plains Culture history.

The research potential of the Sun River site remains high. Paleoenvironmental data for most of the Holocene sequence are preserved at the site. The majority of pollen studies conducted to date have been at much higher elevations and Plains archeologists have had to extrapolate from these studies. The prospect of learning more about human adaptations in response to changing environments is exciting. Deeper excavations at the site could encounter Paleo-Indian remains, with the possibility of bridging the sequence through a number of major climatic shifts.

CHAPTER 10

MANAGEMENT SUMMARY AND RECOMMENDATIONS

On June 7, 1982, HRA was awarded Contract Number DACW 45-82-C-0182 for mitigation of potential adverse impacts to site 24CA74. Adverse impacts might include total removal of the previously defined site area (McLean et al. 1978; McLean 1979), as borrow material for a levee on the U.S. Army Corps of Engineers' Sun River Flood Protection Project.

The work HRA was contracted to do at site 24CA74 was intended to be, although not specifically stated as such, the second phase of a two-phase mitigation program recommended by Newell and McLean (1980). The first phase entailed testing to more precisely define site boundaries and depth and to ascertain the variety of subsurface deposits (Newell and McLean 1980). The second phase called for mitigation of adverse impacts to that portion of the site located within the proposed borrow area.

In the fall of 1981, Professional Analysts of Eugene, Oregon, was contracted to conduct a re-evaluation of that portion of the site located within the proposed borrow area. However, due to lack of previous data, contract deadlines, and inclement weather, the goals of the proposed testing were not met. Specifically, the extent and nature of the cultural remains were not defined (Deaver and Morter 1982). The results of this testing were that the site was indeed a National Register eligible site; relatively dense cultural material including lithics, bone, and fire-broken rock was concentrated in the first 10 cm below the current surface; and at least eight hearths or hearth-like features with no associated cultural material were located between 1 and 1.7 m below the surface.

Thus, in July of 1982, HRA was contracted to return to site 24CA74 to mitigate potential adverse impacts. Our first task was to define site boundaries and depth within the borrow area. It was during deep backhoe testing that three Oxbow levels were encountered at greater than 1.8 m below the surface. At that time, in consultation with the Omaha District, certain changes in the scope-of-work were planned. It was determined that an area of about 8 x 8 m could be mechanically excavated to a depth of 1.5 m. Then manual stripping to the culture-bearing levels would allow data recovery from the deep cultural levels limited to this area. Of course this strategy did not result in the definition of the horizontal limits of the deep components, nor did it allow us to collect a statistically valid sample. However, the extensive work required to accomplish these goals was not provided for in the budget. Furthermore, investigations of the extensive upper components were slighted in favor of concentrating on the Oxbow remains.

As can be seen from the floor plan maps and read in the discussions of Levels IV, V, and VI, the living floors extended beyond the limits of excavation. In addition, data available from the South Ridge Site (Brumley 1981) show that a similar Oxbow occupation site has a floor area about five times that exposed at 24CA74. Given the results of our intensive analysis and literature review, we suggest that only a small and possibly nonrepresentative sample (possibly 15-20 percent or less) of each Oxbow level was recovered.

Results which were more rewarding than expected were those of the paleoenvironmental studies. The site retains great potential for providing additional important information about past climate in central Montana which is currently unavailable to researchers.

It is our opinion that data recovery from 24CA74 is incomplete and that potential adverse impacts to the site, as now defined, have not been mitigated. There is yet unretrieved data of extreme importance to the prehistory of Montana and the Northwestern Plains. The results of our work can be used to develop a precise and efficient plan for further recovery of both cultural and paleoenviromental data from the site.

At this time it appears that the proposed borrowing of materials from the site area will not be needed. If it becomes necessary to borrow, we urge the COE to start at the northern half of the area and not borrow from the southern half at all due to the position of known cultural remains in the southwest quadrant of the project and the possibility of additional remains in the southeast quadrant. HRA will monitor the borrowing activities should they happen.

We urge the COE to make all efforts to preserve and protect site 24CA74 until or unless additional mitigation funds or research funds become available. Due to the depth of the Oxbow deposits, they are not in immediate danger from erosion or nonprofessional excavation. However, if the meander to the southwest of the site shifts northward, it is possible that the entire site would be eradicated. At this time, rip-rapping has deterred such shifting. If the site becomes threatened, additional data recovery should be implemented.

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APPENDIX A

SOIL AND LANDFORM DEVELOPMENT

AT THE SUN RIVER SITE

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APPENDIX A

SOIL AND LANDFORM DEVELOPMENT

The Sun River archeological site, as the name implies, is located in an alluvial valley. Because of the location, both soil and landform development are dependent on the erosional and depositional forces of water. The depositional environment can be interpreted from the nature of the sediment (Krumbein and Sloss 1956). Soil development is also determined by type of sediment or parent materials, in addition to topography, time, climate and organisms (Jenny 1941). Degree of soil development can indicate length of exposure to weathering, while texture and other morphological properties can infer the mode of deposition. Properties of the soil will be used to describe a history of development of the Sun River site.

Geologic and Geomorphic Background

The Sun River drainage originates in the steeply dipping, upturned sediments of the Lewis and Clark Range, while almost half of the remaining area is composed of the nearly flat-lying sediments of the prairies (Ross et al. 1955). The dominant rocks of the mountainous western portion of the watershed are from the Kootenai sandstones and the partially metamorphosed sandstones and siltstones of the Precambrian (Ross et al. 1955). Glacial and alluvial deposits derived from the relatively coarse textured bedrocks are also important in the upper watershed. About 30 percent of the precipitation in the 1,900-square-mile drainage falls on soft shales and minor amounts of sandstones, mainly from the Colorado and Two Medicine Formations (Ross et al. 1955). Surficial sediments on the lower portions of the watershed include both glacial till from Continental ice sheets (Ross et al. 1955) and early Quaternary terrace gravels (Alden 1932). Terrace gravels recognized by Alden (1932) on the Sun River (Ulm) Bench to the south of the site may be from early Missouri River deposits. If so, they may be expected to contain a wider variety of rock types than the sedimentary rocks which dominate the Sun drainage. Gravel pits on the terraces north of the Sun River (USGS 1965) are at slightly lower elevations but appear to match those to the south on the Sun River bench. Most of the rest of the 15,000-acre tributary drainage forming the fan in the north portion of the site is mapped as dark gray shales of the Colorado Formation (Fisher 1909). Any glacial till deposited in the lower Sun River watershed as recognized by Ross and others (1955) was too thin to be recognized by Fisher, who placed the till boundary east of Great Falls. The study area lies on the Sun River Valley and is entirely underlain by alluvial valley fill (Fisher 1909), which Alden (1932) recognized as glacial lacustrine deposits, but probably has Recent alluvium on top.

The development of the Sun River Valley and associated sediments in the vicinity of the study site is closely tied to the development of the Missouri River at about the same elevation and only 3 to 4 miles away. The terrace benches on either side of the 1- to 2-mile-wide lower Sun River Valley are from 300 to 400 feet high (USGS 1965). The valley may have been up to 200 feet deeper during the Pleistocene if the Sun River gradient has been as closely adjusted to the Missouri as it is today. A Wisconsin or late Illinoian age advance of the Keewatin Ice Sheet dammed a once-deeper Missouri River and diverted a pre-glacial Missouri channel which flowed east in what is now Sand Coulee (Alden 1932). Alluvial valley fill, based on well records, is from 212 feet deep on the Odell Ranch south of Great Falls to 270 feet deep at Ulm (Alden 1932). At the Odell Ranch, the following sequence was recorded: soil 0-20 feet; quicksand 20-145 feet; clay 145-205 feet; and gravel 205-212 feet. In reverse order, these sediments are interpreted to be channel gravels of a preglacial Missouri, glacial lacustrine "clay," post-glacial lake fill and flood plain or terrace deposits in later stages as base level began lowering. The Missouri River at Ulm has a meander pattern suggesting a relatively stable base level, a gentle slope, and a probable fine bedload such as the sands at the Odell Ranch.

A meander pattern is characteristic of the Sun River in modern history (USGS 1965) and may indicate a base level stability similar to the Missouri. Evidence of historical meanders can be seen in a comparison of a 1909 geological map of the area (Fisher 1909) and the 1965 topographic map (USGS 1965). In Section 6 in which the study area lies, the river has migrated from the middle of the southwest fourth to the center of the west half of the section or 300 to 400 yards in about 50 years. Meander scars and some oxbow lakes are distributed throughout the width of the lower Sun River Valley (USGS 1965). The Sun River Valley sediments are expected to have a texture and history of redistribution that is characteristic of a meandering system.

The modern Sun River also has a history of flooding. The average discharge over the last 46 years is 733 cubic feet/second (cf/s) and is considered to be at flood stage when flows are greater than 10,000 cf/s (USGS 1981; USAED 1978 and GFCC 1965). Recently recorded floods have occurred in 1908, 1916, 1948, 1953, 1964 and 1975 (GFCC 1965 and USAED 1978). Heavy rains on top of snowmelt were considered responsible for the 60,000-cf/s maximum recorded discharge and $4.4-million flood damages in 1964 (USAED 1978). Sediment types in the study area are expected to represent the effects of floods, a meandering channel and tributary deposits.

Soil Development

Surface soils and buried soils both have very weak pedogenic development related to the setting in semiarid flood plain and fan positions. Three soils represent the local variability in parent materials and landform position that was not possible to recognize on the larger-scale Soil Conservation Service soil survey (USDA SCS 1981). All three major soils are classified as Entisols, the soil order with the weakest soil development. No diagnostic horizons which would represent significant soil development are present in Entisols. Pedon 5 is classified as an Ustic Torrifluvent, fine-loamy-mixed family, and is very similar to the Havre soil series mapped in other parts of Cascade County (USDA SCS 1981). Soils with this classification are dry and contain buried organic-rich horizons from regular flood deposition (Soil Survey Staff 1975). Pedon 8 is an Ustertic Torriorthent, fine-montmorillonitic family, and is similar to the Marvan soil series. The presence of wide cracks when dry and the associated self-churning similar to soils in the Vertisol soil order is recognized by the name Ustertic. Vertisols are inverted as the dark clays which have fallen down the cracks expand during wet periods, causing strong outward and upward forces. Pedon 12 is a Typic Ustorthent, coarse-loamy family, and is similar to the Dast soil series. A Torric (aridic) moisture regime is not recognized because high rates of infiltration, deep percolation, and low rates of capillary flow to the evaporating surface allow these sandy soils to remain moist longer than the other two finer textured soils of the area. Microsite variations from these three major soils, such as the moister conditions of the meander scar, will result in minor variations in the classification. Very short exposure to a weak weathering environment has resulted in only a minimal amount of soil development.

Buried soils are common in areas represented by Pedon 5 and were observed in areas represented by Pedon 8 but are very shallow or absent in soils represented by Pedon 12 (Table A-1). In Pedon 5, the first buried A horizon (5-2 A11b) has more organic matter than the surface but was not dark enough or thick enough to have been classified as a Mollisol when exposed as the surface (Tables A-1 and A-2). Mollisols have a thick, dark, organic-rich surface horizon typical of soils with a grassy vegetation. Buried A horizons below 5-2 are generally weaker expressions of grassland soil development and would also be classified as Entisols. Pedon 2 in the same map unit as Pedon 5 has a B2t horizon with clay accumulation attributed to pedogenesis. The buried surface at 44 cm would probably be an Alfisol soil order, which represents soils with significant amounts of silicate clay translocation from the A to the B horizon. Pedon 8 has the greatest organic content in the surface, with decreasing amounts below. Some other buried A horizons in this map unit, such as 4-8 and 7-5, were darker but thinner than surface A horizons (see Table A-2). The apparently higher organic matter levels in these horizons were usually associated with accumulations of charcoal (see Table A-1). Classification of buried surfaces in the area represented by Pedon 8 would also be in the weakly developed Entisol order. Except for the potential Alfisol in Pedon 2, buried soils have weaker development than the Entisols of the surface.

TABLE A-1

MORPHOLOGY OF SELECTED PEDONS AT THE SUN RIVER SITE

NUMBER	HORIZON DESIG.	DEPTH (cm)	MUNSELL DRY COLOR	TEXTURE*	STRUCTURE	CONSISTENCY OR OTHER				ORIGIN†
						DRY	MOIST	WET	WET	
PEDON 5 (Trench 3 East)										
5-1	A-C	0-23	2.5Y 6/2	cl	weak platy and weak subangular blocky	slightly hard	firm	very sticky	plastic	OB
5-2	A11b	23-30	10YR 6/1	sicl	moderate subangular blocky	very hard	friable	sticky	slightly plastic	OB
5-3	A-C2	30-41	2.5Y 6/2	sicl	massive (banded)	very hard	firm	sticky	plastic	OB
5-4	A12b	41-49	10YR 6/1	l	weak blocky (banded)	hard	friable	sticky	slightly plastic	OB
5-5	C1	49-66	2.5Y 6/2	sl	massive (weakly banded)	hard	friable	sticky	non plastic	OB(L)
5-6	C2	66-73	2.5Y 6/2	l	massive (banded)	hard	friable	slightly sticky	slightly plastic	OB
5-7	C3	73-85	2.5Y 6/3	sl	massive	very soft	very friable	non sticky	non plastic	OB(L)
5-8	C4	85-130	2.5Y 6/2	l	massive (banded)	hard	friable	slightly sticky	non plastic	OB
5-9	C5	130-185	2.5Y 6/2	l	massive (banded)	slightly hard	friable	slightly sticky	slightly plastic	OB
5-10	C6	185-245	2.5Y 6/2	sic	massive (banded)	hard	firm	sticky	plastic	OB
5-11	C7	245-285	2.5Y 6/2	sl	single grain	soft	friable	non sticky	non plastic	OB(L)
5-12	C8	285-300	2.5Y 6/2	l	massive (banded)	slightly hard	firm	slightly sticky	slightly plastic	OB

*TEXTURE: l = loam; sicl = silty clay loam; sic = silty clay; c = clay; cl = clay loam; sl = sandy loam; ls = loamy sand; sil-l = silty loam

†ORIGIN: FC = fan clay; OB = overbank; PB = point bar; L = levee

TABLE A-1. MORPHOLOGY OF SELECTED PEDONS (continued)

NUMBER	HORIZON	DEPTH (cm)	MUNSELL DRY COLOR	TEXTURE*	STRUCTURE	CONSISTENCY OR OTHER				ORIGIN†
						DRY	MOIST	WET	WET	
PEDON 8 (Trench 6)										
8-1	A-C	0-15	5Y 6/1	c	moderate granular and vesicular	extremely hard	very firm	very sticky	very plastic	FC
8-2	C1	15-50	5Y 6/1	c	moderate blocky	extremely hard	extremely firm	very sticky	very plastic	FC
8-3	C2	50-90	5Y 6/1	c	moderate angular blocky (some slickensides)	extremely hard	extremely firm	very sticky	very plastic	FC
8-4	C3	90-120	2.5Y 6/2	c	moderate angular blocky	very hard	very firm	sticky	very plastic	FC+OB
8-5	IIC4	120-150	2.5Y 7/2	sic	moderate subangular blocky (banded)	very hard	firm	slightly sticky	slightly plastic	OB
8-6	IIC5	150-200	2.5Y 6/2	l	massive (banded)	soft	very friable	non sticky	non plastic	OB
8-7	IIIC6	200-230	2.5Y 6/2	sl	single grain	soft	loose	non sticky	non plastic	OB or PB
PEDON 12 (Trench 1 South)										
12-1	A1	0-10	2.5Y 6/3	l	moderate subangular blocky and granular	hard	friable	sticky	plastic	OB
12-2	C1	10-40	2.5Y 6/2	l	weak prismatic	hard	friable	slightly sticky	slightly plastic	PB or OB
12-3	IIC2	40-80	2.5Y 6/2	sl	weak to moderate subangular blocky	hard	friable	slightly sticky	non plastic	PB
12-4	IIC3	80-150	2.5Y 6/2	sl	massive	hard	friable	non sticky	non plastic	PB
12-5	IIC4	150-240	2.5Y 6/2	sl	single grain	slightly hard	friable	non sticky	non plastic	PB
12-6	IIIC5	240-300	2.5Y 6/2	sl	single grain	slightly hard	friable	non sticky	non plastic	PB

*TEXTURE: l = loam; sicl = silty clay loam; sic = silty clay; c = clay; cl = clay loam; sl = sandy loam; ls = loamy sand; sil-l = silty loam

†ORIGIN: FC = fan clay; OB = overbank; PB = point bar; L = levee

TABLE A-2

BRIEF MORPHOLOGICAL DESCRIPTION OF PEDONS

NUMBER	DESIGNATION	HORIZON DEPTH (cm)	MUNSELL DRY COLOR	TEXTURE†	STRUCTURE	OTHER	ORIGIN*
PEDON 1 (Trench 2 North)							
1-1	A-C	0-1	2.5Y 6/2	cl	vesicular crust		OB w/FC
1-2	A11b	1-6	2.5Y 6/3	cl	weak platy, fine granular		OB
1-3	C1	6-27	2.5Y 6/2	l	weak blocky		OB
1-4	C2	27-53	2.5Y 5/2	c	prismatic and blocky	gypsum crystals	FC
1-5	C3	53-94	5Y 5/1	c	moderate blocky	gypsum crystals	FC
1-6	C4	94-114	5Y 5/1	scl	moderate, fine angular blocky	small pockets of salt	FC w/OB
1-7	C5	114-141	2.5Y 5/2	c	moderate blocky		FC
1-8	C6	141-156	2.5Y 6/2	c	weak blocky	banded	FC w/OB
1-9	C7	156-170	2.5Y 6/2	sicl	platy to massive	banded	OB
1-10	C8	170-185	2.5Y 6/2	cl	blocky	banded	OB
1-11	C9	185-203	2.5Y 5/2	c	massive to blocky	banded	FC
1-12	C10	203-216	10YR 7/1	l	platy	banded, mottles	OB
1-13	C11	216-285	2.5Y 6/3	cl	massive and blocky	banded	FC+OB
1-14	C12	285-300	2.5Y 5/2	cl	blocky	banded	FC+OB
PEDON 2 (Trench 2 South)							
2-1	A-C	0-9	2.5Y 6/2	cl	massive to blocky		OB+FC
2-2	A11b	9-14	10YR 5/1	sic	granular	charcoal	FC w/OB
2-3	C1	14-31	2.5Y 6/2	cl	prismatic and blocky		FC+OB
2-4	A12b	31-39	2.5Y 6/1	c	angular blocky	charcoal	FC
2-5	C2	39-44	10YR 6/2	sicl	massive		OB+FC
2-6	A13b	44-50	2.5Y 5/2	sicl	massive	charcoal	OB+FC
2-7	B2t	50-63	10YR 6/4	scl	prismatic to blocky	clay skins	OB
2-8	C3	63-71	10YR 6/2	sl	massive		OB
2-9	C4	71-74	10YR 6/2	l	subangular blocky	clay bands	OB+FC
2-10	C5	74-108	10YR 6/2	ls	single grain		PB or OB(L)
PEDON 3 (Trench 1 North)							
3-1	A-C1	0-2	2.5Y 7/2	sil-l	vesicular		OB
3-2	IIA-C2b	2-15	2.5Y 6/2	c	subangular blocky		FC
3-3	IIC1	15-28	2.5Y 6/3	c	subangular blocky	salt crystals	FC
3-4	IIC2	28-48	5Y 5/1	c	angular blocky	slickensides	FC
3-5	IIC3	48-68	2.5Y 7/3	c	angular blocky	salt crystals	FC
3-6	IIIA11b	68-72	2.5Y 6/1	l	massive	buried A	OB
3-7	IIIA-C3b	72-82	2.5Y 7/2	cl	prismatic	charcoal	FC+OB
3-8	IIIC4	82-97	2.5Y 7/3	l	prismatic		OB
3-9	IIIC5	97-137	2.5Y 7/3	sicl	massive	banded	FC w/OB
3-10	IIIC6	137-207	2.5Y 6/3	cl	massive	orange mottles	OB w/FC
3-11	IIIC7	207-300	2.5Y 6/4	cl	massive		OB

†TEXTURE: l = loam; sicl = silty clay loam; sic = silty clay; c = clay; cl = clay loam; sl = sandy loam; ls = loamy sand; sil-l = silty loam

*ORIGIN: FC = fan clay; OB = overbank; PB = point bar; L = levee

TABLE A-2. BRIEF MORPHOLOGICAL DESCRIPTION OF PEDONS (continued)

NUMBER	DESIGNATION	HORIZON DEPTH (cm)	MUNSELL DRY COLOR	TEXTURE†	STRUCTURE	OTHER	ORIGIN*
PEDON 4 (Trench 10)							
4-1	A-C1	0-15	2.5Y 5/2	c	vesicular and blocky		FC
4-2	IIC1	15-24	10Y 6/4	sl	subangular blocky		OB
4-3	IIIC2	24-37	2.5Y 6/2	c	angular blocky		FC
4-4	IIIC4	37-48	2.5Y 5/2	c	angular blocky		FC
4-5	IIIA11b	48-54	5Y 4/2	c	subangular blocky		FC
4-6	IIIC5	54-60	5Y 4/2	c	angular blocky		FC
4-7	IIIC6	60-80	2.5Y 4/2	c	massive		FC
4-8	IVA12b	80-88	2.5Y 4/1	sicl	blocky	banded, charcoal	OB
4-9	IVC7	88-100	2.5Y 6/2	c	angular blocky		FC+OB
4-10	IVC8	100-250	2.5Y 4/2	sicl	massive	banded	OB
4-11	VC9	250-270	2.5Y 4/2	c	angular blocky	mottled	FC
4-12	VIC10	270-300	-	ls	single grain	6/0,6/6 mottles	PB
PEDON 6 (Trench 4 South)							
6-1	A-C	0-15	2.5Y 6/3	l	vesicular and blocky		OB
6-2	A11b	15-27	2.5Y 5/1	l	angular blocky	buried A	OB
6-3	C1	27-37	2.5Y 6/2	sicl	prismatic to blocky		OB
6-4	A12b	37-45	2.5Y 5/1	sicl	prismatic to blocky	buried A	OB
6-5	C2	45-80	2.5Y 6/2	l	prismatic to blocky		OB
6-6	C3	80-100	2.5Y 6/4	ls	single grain		OB(L)
6-7	C4	100-130	2.5Y 6/3	l	massive to blocky	lime	OB
6-8	C5	130-149	2.5Y 6/3	sil	subangular blocky	banded	OB
6-9	C6	149-159	2.5Y 6/2	sicl	massive	clay bands	OB
6-10	C7	159-189	2.5Y 6/3	l	subangular blocky		OB
6-11	C8	189-259	2.5Y 6/3	l	massive	banded	OB
6-12	C9	259-369	10YR 6/4	ls	single grain	6/6 mottles	PB or OB(L)
PEDON 7 (Trench 4 North)							
7-1	A11	0-17	2.5Y 5/3	c	vesicular and prismatic		FC
7-2	C1	17-37	2.5Y 4/2	c	blocky	slickensides	FC
7-3	C2	37-58	2.5Y 4/2	c	massive to blocky		FC
7-4	C3	58-86	5Y 4/1	c	subangular blocky		FC
7-5	A12b	86-95	5Y 4/1	c	angular blocky	charcoal	FC
7-6	C4	95-105	2.5Y 5/2	cl	subangular blocky		FC w/OB
7-7	C5	105-135	5Y 4/2	c	subangular blocky		FC
7-8	C6	135-170	2.5Y 6/3	sicl	massive	clay bands	OB w/FC

†TEXTURE: l = loam; sicl = silty clay loam; sic = silty clay;
c = clay; cl = clay loam; sl = sandy loam; ls = loamy sand;
sil-l = silty loam

*ORIGIN: FC = fan clay; OB = overbank; PB = point bar; L = levee

TABLE A-2. BRIEF MORPHOLOGICAL DESCRIPTION OF PEDONS (continued)

NUMBER	DESIGNATION	HORIZON DEPTH (cm)	MUNSELL DRY COLOR	TEXTURE†	STRUCTURE	OTHER	ORIGIN*
					PEDON 9 (Trench 7)		
					Like pedon 8 except for a layer of charcoal at about 150 cm.		
					PEDON 10 (Trench 8)		
10-1	A-C/C1	0-130	About 50 cm churned angular clay over dark massive			FC	FC
10-2	IIC2	130-180	2.5Y 6/3	l	massive	banded	OB
10-3	IIC3	180-230	2.5Y 6/1	l	massive	banded	OB
10-4	IIC4	230-300	2.5Y 6/4	l	single grain		OB
					PEDON 11 (Trench 9)		
11-1	A-C	0-70	2.5Y 5/2	c	blocky	churned	FC
11-2	IIC1	70-100	2.5Y 6/3	sicl	massive	banded	OB
11-3	IIA11b	100-108	2.5Y 6/1	l	massive	banded	OB
11-4	IIC2	108-178	2.5Y 6/3	l	massive	banded	OB
11-5	IIIC3	178-198	2.5Y 6/2	c-cl	blocky		FC w/OB
11-6	IVC4	198-250	2.5Y 6/3	cl	massive	clay bands	OB
11-7	IVC5	250-290	2.5Y 6/3	sl	single grain	few bands	OB(L)
					PEDON 13 (Trench 5)		
13-1	A-C	0-30	2.5Y 5/2	c	blocky		FC
13-2	IIC1	30-50	2.5Y 6/3	l	massive	banded	OB
13-3	IIIC2	50-60	2.5Y 5/2	c	blocky		FC
13-4	IVC3	60-280	2.5Y 6/2	ls	single grain		PB
					Pedons 5, 8 and 12 described in Table A-1.		
					PEDON 14 (Trench 7 Middle)		
					Not submitted for analysis		

†TEXTURE: l = loam; sicl = silty clay loam; sic = silty clay; c = clay; cl = clay loam; sl = sandy loam; ls = loamy sand; sil-l = silty loam

*ORIGIN: FC = fan clay; OB = overbank; PB = point bar; L = levee

Parent Material Origin

Two major alluvial deposits are recognized in the study area by color and texture (Fig. A-1). Alluvial fan deposits from the tributary drainage north of the site are the dark gray clays of Map Unit B (Fig. A-1), represented by Pedon 8. A minor variation is found as fill in an abandoned meander channel observed in the trench north of Pedon 12 (Fig. A-2). Colorado shales, which dominate the upper drainage (Fisher 1909), produce the montmorillonitic soils due to the common bentonite beds in the Colorado Formation (Veseth and Montagne 1980).

Other alluvial deposits have lighter colors and coarser textures associated with the materials in the Sun River drainage. Sun River deposits are subdivided into overbank flood deposits (vertical accretion), indicated by thin horizontal banding, and channel or point bar deposits (lateral accretion), indicated by absence of visible banding (Fig. A-3). In addition to morphological differences, the relation to the abandoned river channels visible on aerial photos was used to distinguish types of Sun River alluvium. Overbank deposits are on the outside of the meander curve and represented by Pedon 5 in Unit C (see Fig. A-1). Point bar deposits are on the inside of the meander curve and represented by Pedon 12 of Unit A. The relationships are displayed in Figure A-2.

Soil/Vegetation Relationships

Soil texture is apparently a strong influence on vegetation community composition at this site and is used to delineate map unit boundaries. The finest textures are associated with the montmorillonitic fan clays of Unit B. Infiltration and permeability are very low in these soils, causing water to stand where the surface is flat. Runoff is rapid on steeper slopes, resulting in little leaching and a buildup of salts near the surface. Water that does go into the soil is held tightly by the small particles, reducing the amount of water available to plants. Capillary movement is also rapid because of the fine texture, so evaporation loss is great. These factors have resulted in a plant community dominated by western wh[illegible]ass (Agropyron smithii). Other plants peculiar to this site include wormwood (Artemisia dranunculus) and saltbush (Atriplex sp. -- probably nutallii). Grazing has severely reduced the size and abundance of saltbush but small plants are common in the unit. Patches of bare ground from 0.5 to 1.5 m are present and are attributed to high salt content and possibly compaction and don't have the dispersed organic matter of a sodic "pan" spot.

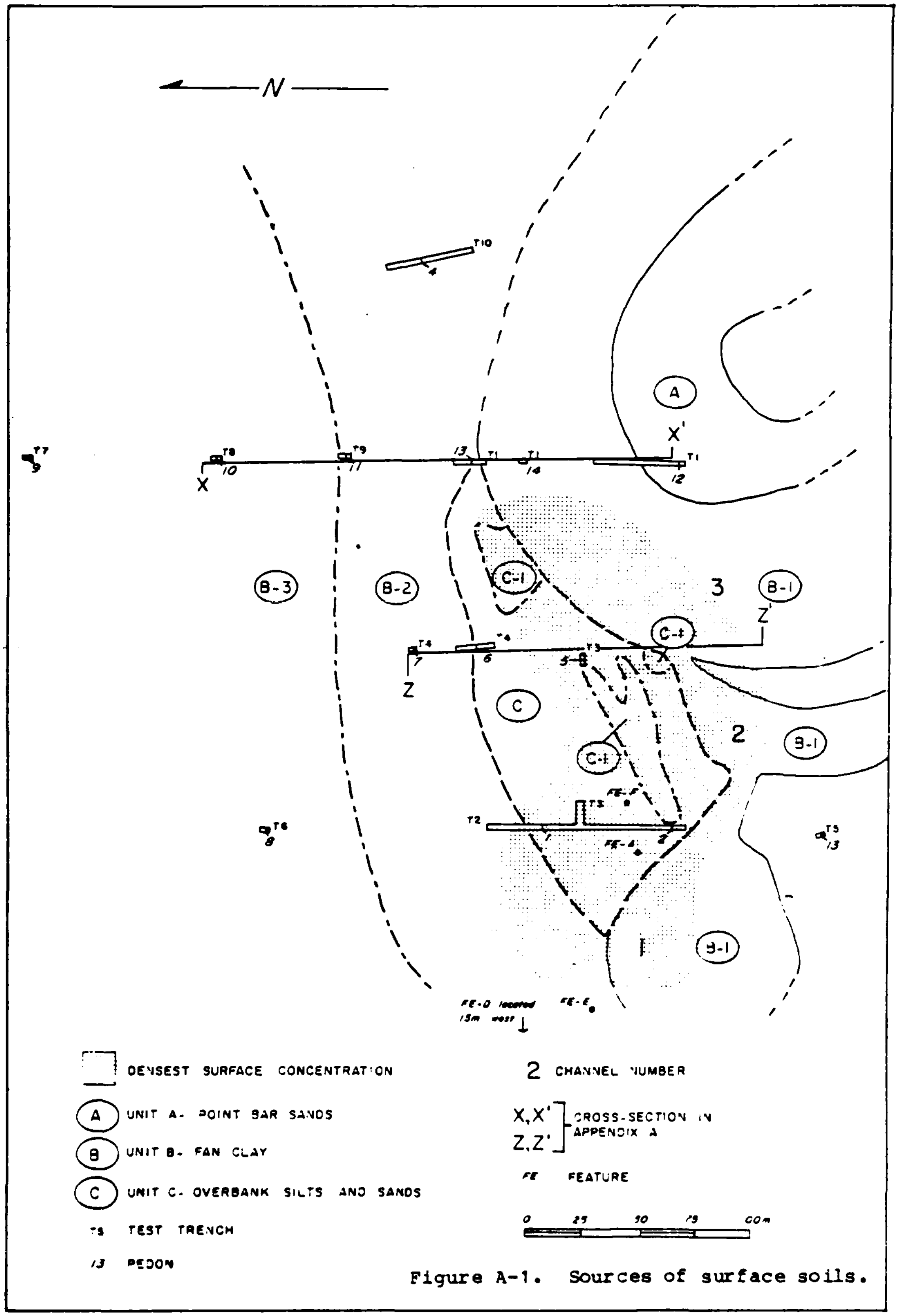

Figure A-1. Sources of surface soils.

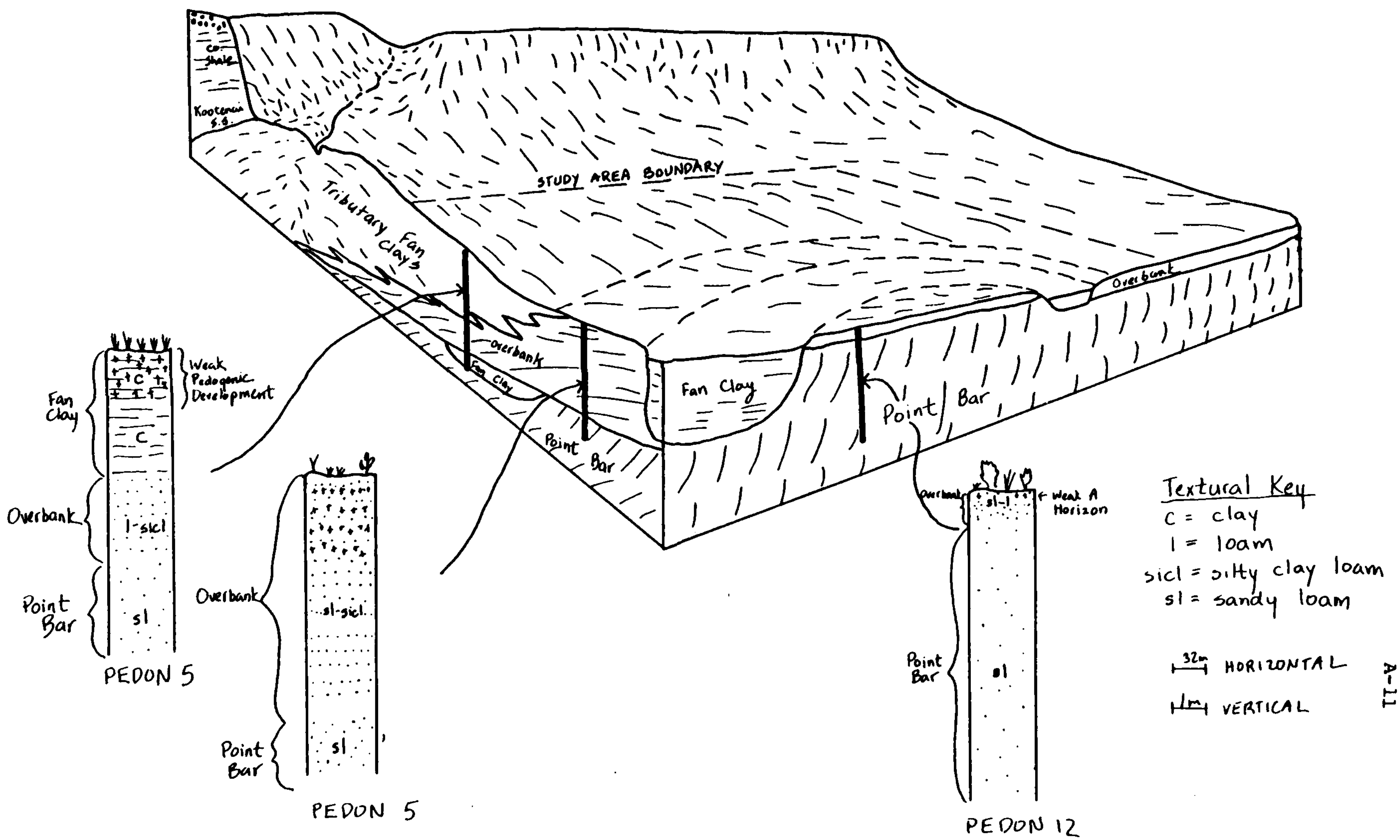

Figure A-2. Idealized block diagram of the study area.

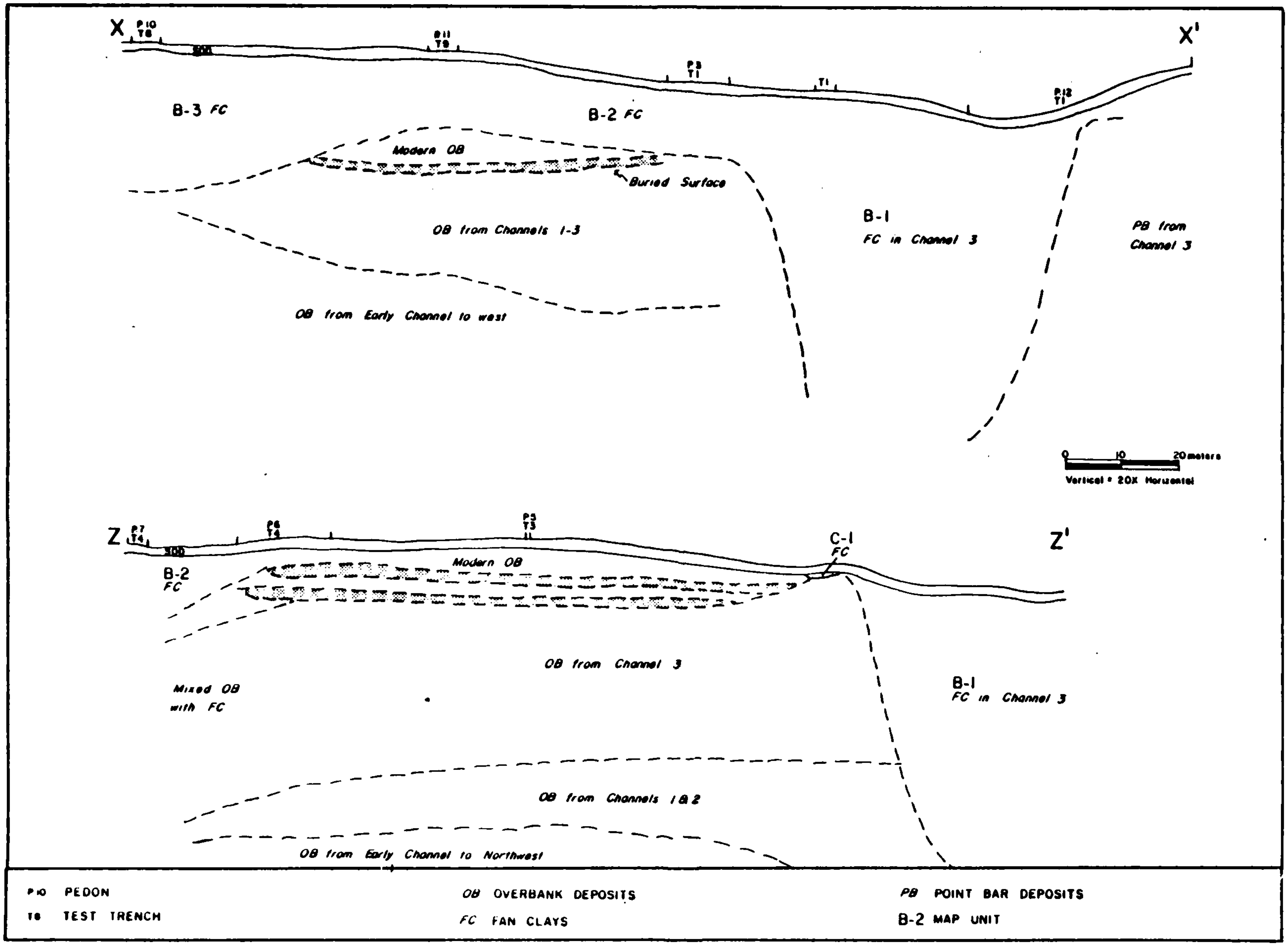

Figure A-3. Alluvial deposits as seen from two trench series across the site (x-x' and z-z'; see Fig. A-1).

Point bar sands of Unit A (see Fig. A-1) have lower total water-holding capacity but more input and lower surface tensions, resulting in greater though deeper amounts of available water. Salt content is also lower and with amount and depth of water has resulted in a shrubby plant community. Major indicators of these sandy soils are: wild rose (Rosa woodsii), snowberry (Symphorocarpos albus), needleand-thread grass (Stipa comata), Indian ricegrass (Oryzopsis hymenoides) and bluegrass (Poa sp.).

Intermediate texture and an intermediate kind of plant community are both associated with Unit C, represented by Pedon 5. Western wheatgrass and blue grama (Bouteloua gracilis) are found in Unit C as well as other units. Relative abundance is the key to their indicator value. Blue grama is in both Units A and C but more abundant in Unit C. Western wheatgrass is in both Units B and C but much more abundant in Unit B. Green needlegrass (Stipa viridula) and silver sage (Artemisia cana) are more abundant in Unit C than either of the other units. Variability in species distribution appears to be relatively high in Unit C compared to either A or B. Portions of Unit C have bare ground and there are patches of dense western wheatgrass like in Unit B. Both conditions suggest local areas of fine-textured and possibly salty soils. Shrubs common to Unit A are, however, not found in Unit C, so pockets of sandy soils are not expected in Unit C.

Environmental Setting of Buried Surfaces

The primary area where buried surfaces are found is in Unit C (see Fig. A-1). Migration of the channel has removed buried surfaces to at least a 10-foot depth in Unit A. The alluvial fan (Unit B) contains buried surfaces which are only intact below the churning zone or approximately the upper 50 to 100 cm. The abandoned meander channel (Unit B-1) had little or no sign of buried surfaces even though the moistness of the site should have prevented significant churning or mixing. This may be due to rapid filling at some point by fan material. Sun River overbank deposits found below the fan may contain buried horizons, but the location and depth are not predictable due to the thick layer of fan clays. The following discussion of depositional environments will be centered on the overbank deposits of Unit C, where most cultural material both at the surface and at depth have been found.

Deposition type and rate and resulting microtopography of the surface are affected by velocity of water, which, in turn, is affected by the type of vegetation on-site. At low to intermediate flood stages, coarse materials will fall out near the channel, forming a relatively narrow levee. Smaller particles fall out at greater distances and in much thinner layers. Clays will not settle unless the water is still, as in a backwater pond or receeding flood. At high to very high stages, the water may leave the channel and flow parallel to the main valley. Fast velocity may occur in chutes at varying distances from the main channel. At all stages the water velocity can be reduced by thick vegetation, thus creating differential deposition rates not associated with distance from channel. Scouring may actually take place where vegetation is sparse and particle size corresponds with the traction velocity. The areas in the study area with sparse vegetation are often associated with clay textures and, because of the high cohesive forces of clay, may result in little or no scouring, but also little or no deposition. This may explain why Unit B-1 and bare areas of C have a slightly lower elevation (Fig. A-1) and do not have the recent high-stage Sun River deposits that are present where vegetation is thicker. Depth of buried surfces may be significantly affected by differential deposition rates, which may explain enigmatic depths of some radiocarbon dates in the study area (see Chapter 5).

Overbank deposits in Unit C are adjacent to meander channels represented by the abandoned channel scars to the south that show the presence of levee deposits. Thickness of levee deposits, as well as deposition of thinner and finer sediments away from the levee, will depend on distance from the active channel. Based on the relative distinctness of the channel shape in the overlap zones of the three meanders, it appears that an eastward progression of the meanders occurred. The oldest meander of the three channels in the south would be Channel 1 on the west end (see Fig. A-1). The most recent levee deposits would therefore be Channel 3 on the east end of Unit C.

The zone of cultural activity in the Grotto area southwest of and adjacent to Pedon 5, containing the three major occupied surfaces (IV-VI), is associated with Horizon 5-10 or C6 in Pedon 5 from 185 to 245 cm (see Table A-1). Silty clay is the average texture of Horizon 5-10, that contains thin bands of clay interspersed between thick bands of lighter, more loamy textures. The sandy loams and loams in the 41- to 185-cm zone above 5-10 are interpreted to be levee deposits and other overbank deposits when Channel 3 was active. Above 41 cm would be from overbank deposition since abandonment of Channel 3.

Pedon 2 in the west end of Unit C would probably be receiving levee deposits when Channel 1 and probably 2 were active. The sandy deposits represented by Horizons 2-7, 2-8, and 2-9 in the 50- to 74-cm depth are the most likely representatives of levee deposits when Channel 1 was active. As Channels 1 and 2 were abandoned and Channel 3 became active, Pedon 2 would receive finer and thinner overbank deposits due to distance from the channel. The thin deposition rates would become accentuated by the effects finer textures would have on vegetation density. Rolling surfaces for buried horizons, as seen in the Grotto, could be explained by differential deposition due to vegetation density. Low, bare spots occur on the present surface of Unit C next to higher areas with denser vegetation, thus creating a rolling surface that could match previous conditions.

Summary and Conclusions

The Sun River archeological site is located in a valley which was cut during the early to mid Pleistocene time period. Partial filling occurred during the late Pleistocene, when a Continental ice sheet dammed the Missouri River, forcing it to a new channel near the present confluence with the Sun River. During Recent times, as the new Missouri channel at Great Falls slowly cut to lower elevations, the Sun River meandered back and forth across the valley, distributing the sandy valley fill on a gently sloping valley floor. In the study area which is on the north side of the valley, the distance the migration would travel to the north was becoming shorter. The formation of a tributary fan in the northern portion of the study area may have blocked northward migrations, or the lowering of the base level at Great Falls may have caused the Sun channel to meander less as its slope increased.

Overbank flood deposits near the outside of the meander curve appear to be favorable areas for prehistoric human occupation as indicated by the amount of cultural remains found on the overbank deposits at the Sun River site, both on and near the surface and at greater depths. The sandy loams and loams of the overbank deposits of the Sun River have drainage and vegetation properties which may make it a more favorable site compared to the clay-rich fan deposits of the northern parts of the study area. The light-textured Sun deposits are softer and more friable when wet and become cracked and hard when dry. The vegetation is generally thicker on the sandier soils next to the channel and may have included willow or cottonwood. The resulting greater accumulation of sediments in thick vegetation during flooding may have increased the potential for site preservation comparative to sparsely vegetated areas of the clayey soils.

These localized processes took place about 3,000 to 4,000 years ago near the Grotto, but at positions farther to the north during earlier times, as indicated by materials in deep trenches. It is impossible to locate previous meander channels from surface indications due to the masking effects of the tributary fan deposits covering the north 75 percent of the site. Recent meandering has removed much of the material to the south, leaving a very narrow band of culturally rich material.

Radiocarbon Results

Radiocarbon dates of about 3000-4000 BP were found at relatively shallow depths near Pedon 2 and in the deep occupied zones of the Grotto near Pedon 5. If the sands found below 50 cm in Pedon 2 were deposited as levee deposits at the same time finer overbank materials were deposited on the surfaces in the 185- to 245-cm zone of Pedon 5, the radiocarbon dates of about 3000 BP would fit. Deposition rates in the upper 50 cm or for the last 3,000 years in Pedon 2 would have to be about 1.5 mm/year and rates above 185 cm in Pedon 5 would be about 6 mm/yr. Activation of Channel 2 or 3 and abandonment of Channel 1 about 3,000 years ago could explain a transition from thin overbank to thicker levee deposits at Pedon 5 and the reverse at Pedon 2. The continued thick deposition after abandonment of Channel 3 could be explained by the thicker vegetation on sandier levy deposits of Pedon 5, compared to the sparser vegetation associated with finer overbank deposits already present at Pedon 2. Vegetation near Pedon 2 is less dense now compared to Pedon 5. Textures are finer near the surfaces, as indicated by the field characterization as fan clay above 39 cm in Pedon 2.

The differential deposition due to texture is probably why the 3,000-year-old, radiocarbon-dated material in the sandy Grotto area is so much deeper than similar age materials found in finer textures to the west. The process of differential deposition was probably started prior to a major southward channel migration when the Grotto was in a levee position, and the features to the west were in a backwater position, being covered by finer textured overbank deposits and fan clays.

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APPENDIX B

HRA COMPUTER CODING SYSTEM FOR LITHIC MATERIALS AND FAUNAL REMAINS FROM 24CA74

COMPUTER CODING SYSTEM FOR LITHIC MATERIALS

Columns	
1-7	Location by 1- x 1-m unit recorded as north and west. For example, Unit 43N 265W is coded as 0430265.
8-14	Provenience of artifact as south and west of northeast corner stake of the 1- x 1-m excavation unit. For example, a flake at 90S 55W is coded as 090055.
15-17	Depth below surface of northeast corner.
18	Cultural level.
19-21	Artifact number assigned in lab.
22-23	Material type: 1 = chert 2 = silicified sediment 3 = chalcedony 4 = quartzite 5 = porcellanite 6 = obsidian 7 = vitriphere 8 = argillite 9 = sandstone 10 = brown agate 11 = salt and pepper silicified sediment 12 = slate 13 = basalt 14 = other.
24-25	Artifact type: 1 = core 2 = cortical flake 3 = interior flake 4 = bifacial thinning flake 5 = pressure flake 6 = shatter 7 = unidentifiable flake fragment 8 = Early Stage blank 9 = Middle Stage blank 10 = Late Stage blank 11 = preform 12 = point 18 = cobble tool 19 = fire-broken rock 20 = unidentifiable biface fragment 21 = unmodified cobble.

27-28 Continued artifact type:

13 = lateral margin retouch
14 = proximal retouch
15 = distal retouch
16 = combination retouch
17 = remnant working edge on platform.

Thus, 02_15 is a cortical flake with distal retouch and 08_02 is an Early Stage blank on a cortical flake.

29 Tool condition:

1 = unmodified complete (no rejuvenation)
2 = unmodified fragment (no rejuvenation)
3 = modified complete (whole and rejuvenated)
4 = modified fragment (rejuvenated fragment)
5 = undetermined.

30 Point type:

1 = Oxbow
2 = McKean Complex (Hanna)
3 = Pelican Lake
4 = Besant
5 = Prairie side-notched
6 = Plains side-notched
7 = Other
8 = Unidentifiable fragment.

31-36 Modification/Use-Wear:

1 = polish
2 = rounding/edge preparation
3 = faceting
4 = step-fractures/edge preparation
5 = crushing/edge preparation
6 = retouch (margin)
7 = other.

37-39 Maximum length.

40-42 Maximum width.

43-45 Maximum thickness.

46-48 Blade length.

49-51 Depth of basal concavity.

52-54 Width between notches.

55-57 Blade width.

58-59 Number of flakes represented by entry (if from screen bag).

60-61 Tool number.

COMPUTER CODING SYSTEM FOR FAUNAL REMAINS

Columns	
1-7	Location by 1- x 1-m unit recorded as north and west. For example, Unit 43N 265W is coded as 0430265.
8-14	Provenience of artifact as south and west of northeast corner stake of the 1- x 1-m excavation unit. For example, a bone at 90S 55W is coded as 0900055.
15-17	Depth below surface of northeast corner.
18	Cultural level.
19-20	Specimen number assigned in lab.
21	Probability (of species): 1 = definite 2 = possible 3 = unknown.
22-24	Element symmetry:
22	1 = right, 2 = left.
23	1 = lateral, 2 = axial, 3 = medial.
24	1 = proximal, 2 = diaphysis, 3 = distal.
25	Fragmentation: 1 = break 2 = chop/chipped 3 = crushed 4 = whole element 5 = cut.

26-50 Elements (0 = absent, 1 = present):

26	Humerus	42	Sternebra
27	Radius	43	Skull
28	Ulna	44	Jaw
29	Femur	45	Teeth
30	Tibia	46	Skull fragments
31	Metacarpal	47	Carpal
32	Metatarsal	48	Tarsal
33	Phalange	49	Patella
34	Scapula	50	Sesamoid
35	Innominate	51	Unidentifiable: 1 = unidentifiable; 2 = large mammal; 3 = small mammal
36	Caudal		
37	Cervical		
38	Thorasic		
39	Lumbar	52	Age: 1 = adult; 2 = subadult; 3 = fetal.
40	Sacrum		
41	Rib		

53-60 Bone modification (0 = absent, 1 = present):

53 Exfoliated
54 Acid etched
55 Punched holes
56 Striated
57 Rotationally scarred
58 Rodent gnawed
59 Tool
60 Burned
61 Horn
62 Antler

63-64 Species:
1 = Bison
2 = Cervis
3 = Odocoileus
4 = Antilocapra
5 = Canis vulpes
6 = Canis lupus
7 = Rodenta
8 = Lepus
9 = Aves
10 = Gastropoda
11 = Pelecypoda
12 = Unidentifiable.

65-66 Total number of fragments represented by entry.

APPENDIX C

PALYNOLOGICAL ANALYSES,

SUN RIVER (24CA74), MONTANA

Prepared for

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PALYNOLOGICAL ANALYSES, SUN RIVER (24CA74), MONTANA

Introduction

Thirty soil samples from the Sun River archeological site (24CA74), Montana, were submitted for pollen analysis. The samples can be divided into two groups: (1) 14 samples, #2 through #15, collected from the surface to a depth of 260 cm in a test trench (T3E); and (2) 16 samples, #16 through #31, collected from selected features within the excavation. The test trench column samples were collected to serve as a control for the prehistoric samples, which were submitted to recover information about the past physical environment and also to recover data on prehistoric diet, if possible. To this end, after removing material for pollen analysis, the 30 samples were analyzed for plant remains.

Laboratory Methods

Pollen was extracted from the soil samples following procedures adapted from Mehringer (1967) and Schoenwetter (personal communication). These involve flotation and screening of the sample, solution of the inorganic fraction in hydrochloric acid and hydrofluoric acid, and reduction of the organic fraction with caustic soda and Erdtman's acetolysis, with increased boiling times to allow for the elevation of the Institute of Arctic and Alpine Research (INSTAAR) Palynology Laboratory.

Counting and Analysis

Pollen preservation was fair to poor, and approximately half of the samples yielded sufficient pollen for analysis. Common to many archeological samples, there was a large amount of debris on the slides; charcoal fragments were especially common in the feature samples. Counting was slow and difficult due to this problem and also due to the low pollen densities. Although the surface sample (#3) contained sufficient pollen to be counted at high power (500x), the remainder of the samples were counted at low power (200x). Indeed, densities were so low and preservation so poor in many of the samples that often only half of the slide was analyzed. However, by comparing the pollen counts at the halfway mark on a slide and also at the end of the count in several samples (e.g., #15, #5, #8, #18, and #21), it was concluded that in samples containing very few taxa, half-slide counts were accurate. Pollen count data for all 30 samples are summarized in Table C-1.

TABLE C-1

SAMPLE AND POLLEN DATA, 24CA74, MONTANA

SAMPLE NO.	PROVENIENCE	NO. GRAINS	NO. TRAVERSES	ABI	ALN	PIC	PIN	AMB	ART	CHE	COL	CLG	CST	EPT	EPI
3	Surface	100	2.39				60 60%	1 1%	6 6%	15 15%		1 1%	7 7%	1 1%	
7	T3E, 0-23 cm	100	13.82				49 49%	2 2%	2 2%	26 26%	1 1%	1 1%	6 6%		
15	T3E, 23-30 cm	100	27.01		1 1%	1 1%	58 58%		1 1%	20 20%	1 1%	1 1%	2 2%		1 1%
2	T3E, 30-41 cm	100	22.37				63 63%			19 19%			3 3%	1 1%	
5	T3E, 41-49 cm	100	28.01		1 1%	1 1%	65 65%	1 1%	4 4%	19 19%					
14	T3E, 49-66 cm	31	18.85				12 39%		1 3%	8 26%			1 3%		
10	T3E, 66-73 cm	23	20.27				7 30%			6 26%			4 17%	1 4%	
12	T3E, 73-85 cm	6	18.85				2 33%			1 17%					
13	T3E, 85-130 cm	6	18.85				3 50%						2 33%		
11	T3E, 130-150 cm	9	19.12				5 56%			1 11%					
4	T3E, 150-184 cm	1	18.94				1 100%								
8	T3E, 184-200 cm	100	29.03	2 2%		1 1%	87 87%			2 2%		1 1%			
9	T3E, 200-244 cm	4	18.05				2 50%								
6	T3E, 244-260 cm	1	21.06							1 100%					
23	20N350W, Feat A, 20-30 cm	3	20.35				1 33%			1 33%					

TABLE C-1. SAMPLE AND POLLEN DATA (continued)

SAMPLE NO.	GAU	GRA	LEG	OPT	PRU	ROS	RUM	SPA	UNK	FIL	LYC	TRI	UND	PRQ
3		5 5%	1 1%		1 1%	1 1%			1 1%					
7		7 7%		1 1%		2 2%		1 1%	2 2%					
15		10 10%	1 1%			2 2%				1 1%				
2		9 9%							2 2%	3 3%			2 2%	
5		4 4%				2 2%		1 1%		1 1%		1 1%	4 4%	
14		7 23%				1 3%						1 3%		3 10%
10		2 9%				2 9%				1 4%				2 9%
12						1 17%			2 33%				1 17%	3 50%
13										1 17%			1 17%	4 67%
11		2 22%								1 11%				4 44%
4														2 200%
8		4 4%					1 1%		2 2%				1 1%	12 12%
9		1 25%									1 25%			3 75%
6														2 200%
23	1 33%												1 33%	

TABLE C-1. SAMPLE AND POLLEN DATA (continued)

SAMPLE NO.	PROVENIENCE	NO. GRAINS	NO. TRAVERSES	ABI	ALN	PIC	PIN	AMB	ART	CHE	COL	CLG	CST	EPT	EPI
27	44N418W, Feat E, sw unit bottom	35	19.82			3 9%	28 80%			2 6%		1 3%		1 3%	
20	26N324W, Feat F	8	20.09				5 63%			1 13%			1 13%		
29	43N266W, Level IVash, Feat H	5	20.18				5 100%								
30	43N266W, Feat H, pit fill, Level IV	19	18.85			1 5%	8 42%			2 11%		7 37%			
28	43N266W, 2 cm, Level IV	39	18.85			2 5%	32 82%			1 3%			2 5%		
22	44N266W, sw corner, Level IV	7	19.03				5 71%			1 14%					
18	43N264W, 0-11 cm, Level IV	100	33.56		1 1%	3 3%	88 88%			3 3%			1 1%		
16	45N266W, 17-21 cm, Level IV	9	19.03			1 11%	7 78%			1 11%					
25	44N268W, Feat G, Level IV	3	23.19				3 100%								
26	43N268W, Feat G Level IV	24	18.94				21 88%			2 8%					
24	44N267W, 28-31 cm, Feat I, Level VI	17	18.94				14 82%								
19	45N267W, 31-33 cm, Feat J, Level VI	4	19.29				4 100%								
21	45N268W, 39 cm. Feat J, Level VI	71	35.4			1 1%	51 72%			8 11%		1 1%			
31	45N267W, 45N268W, 35-40 cm, Feat J, Level VI	1	19.20				1 100%								
17	45N266W, 37-39 cm, Level VI	21	20.09				16 76%			2 10%					

TABLE C-1. SAMPLE AND POLLEN DATA (continued)

SAMPLE NO.	GAU	GRA	LEG	OPT	PRU	ROS	RUM	SPA	UNK	FIL	LYC	TRI	UND	PRQ
27													1 3%	
20		1 13%												1 13%
29														
30		1 5%												1 5%
28		1 3%								1 3%				2 5%
22										1 14%				
18		3 3%								1 1%				3 3%
16														3 33%
25														
26										1 4%				2 8%
24		2 12%				1 6%								1 6%
19														
21		9 13%										1 1%		4 6%
31														
17		1 5%								2 10%				2 10%

Sparseness of pollen in archeological soil samples is not uncommon due to problems of alkaline soils, differential destruction of pollen grains, "dilution" of the pollen rain by the soil, and also because of the destructive effect of fire on pollen grains (see Dimbleby 1957). However, the low recovery rates in this study are especially disappointing.

Pollen researchers generally exclude various pollen types from their total sum, according to their research design. In most cases, they are interested in separating out the effect of human activity from climatic change. There is, however, no consensus on what to exclude from the pollen sum or what constitutes an economic pollen type. In this study, only grains which could not be identified due to poor condition (UND = Unidentifiable) and the pre-Quaternary reworked pollen and spores (PRQ) were excluded from the count.

Twenty-four other taxa (including unknown grains = UNK) were recovered in this study. Common names for these plus the abbreviations used in Table C-1 are listed in Table C-2. The two most important taxa in this study are *Pinus* (pine) and Cheno-ams (goosefoot-pigweed group). At least four species of pine grow at higher elevations west and north of 24CA74. The size of pine pollen is often used in the Southwest as an index to species identification (Hansen and Cushing 1973). However, because of the fragmentary condition of many of the grains and because a study of the modern pine size variation for the region was not undertaken, no attempt was made to classify the pine grains to species.

The Cheno-am group combines the pollen of the Chenopodiaceae (goosefoot family) and *Amaranthus* (pigweed); it is almost impossible to distinguish the pollen types of this group with a light microscope, and the two are generally combined in pollen studies.

The pollen data are presented in Table C-1 which lists sample information, raw counts, and pollen percentages.

Pollen Analyses

Test Trench

The surface sample (#3) and the topmost test trench sample (#7) contain moderate to large amounts of pollen and are dominated by *Pinus* and Cheno-am percentages. Pollen from the Gramineae (grass family) and short-spined Compositae (sunflower family) are of secondary importance, and *Artemisia* (sage) is important in the surface sample. This pollen spectrum does not accurately represent the climax vegetation present at the site today, which is dominated by grasses rather than by pines; members of the Compositae, the Cheno-ams, and *Artemisia* spp. are present in the contemporary vegetation but are less important.

TABLE C-2

COMMON NAMES AND ABBREVIATIONS OF TAXA
RECOVERED AT 24CA74, MONTANA

Abbreviation	Taxa	Common Name
ABI	Abies	Fir
ALN	Alnus	Alder
AMR	Amaranthus	Pigweed
AMB	Ambrosia	Ragweed
ART	Artemisia	Sage
CHE	Cheno-am	Goosefoot-pigweed group
COL	Compositae-Liguliflorae	Sunflower family
CLG	Compositae-Tubuliflorae (long spine)	
CST	Compositae-Tubuliflorae (short spine)	
EPT	Ephedra torreyana type	Mormon tea
EPI	Epilobium	Fireweed
FIL	Filicales	Ferns
GAU	Gaura	Gaura
GRA	Gramineae	Grass family
LEG	Leguminosae	Pea family
LYC	Lycopodium	Clubmoss
OPT	Opuntia	Prickly pear
PIC	Picea	Spruce
PIN	Pinus	Pine
PRQ	Pre-Quaternary	
PRU	Prunus type	Cherry, plum
ROS	Rosaceae type	Rose family
RUM	Rumex	Dock
SPA	Sparganium	Bur-reed
TRI	Trilete spore	
	Typha	Cattail
UND	Undeterminable	
UNK	Unknown	

The dominance of Pinus and Cheno-ams reflects the problem of overproduction by these taxa, especially pine pollen, which can be transported over very long distances and thus is often overrepresented in pollen spectra.

Pollen densities are moderate through the 49-cm depth (sample #5), low between 49 cm and 73 cm, and very low, with one exception, below the 73-cm depth. A pollen spectrum similar to that observed in the surface samples is seen through the 49-cm depth; subsequently, percentages fluctuate wildly due to the low counts, and no trend can be identified. Increased representation of the pre-Quaternary pollen and spores is observed in the deeper samples in the section.

Sample #8, 184-200 cm, is distinguished by moderate pollen densities (e.g., a 100 count was achieved) and by a very large Pinus value (87 percent). The amount of pollen recovered in this sample suggests that it represents an occupation level.

Features

Features A through F belong to the Pelican Lake occupation of site 24CA74, which has radiocarbon dates of ca. 3000 to 4000 years BP; three samples were collected from this occupation. Pollen recovery was poor in #23 and #20, and these samples cannot be interpreted. Thirty-five grains were counted in #27 (Feature E); the sample is dominated by Pinus (80 percent) and two Cheno-am and three Picea (spruce) pollen grains were also counted.

Features G through J belong to the Oxbow occupation of the site, which has produced dates greater than 5000 BP; 13 soil samples were submitted from this occupation for pollen analysis. Pollen densities and preservation vary greatly in these samples, and charcoal fragments were occasionally a problem in counting. Pinus is generally the dominant taxa in all of the samples, reflecting both its overproduction and also probably its greater resistance to destruction, but the percentages in many samples are hard to interpret due to very low counts. In those samples with sufficiently high counts (#17, #18, #21, #26, #28), Pinus values range from 72 percent to 88 percent. Other taxa of secondary importance include the Cheno-ams, the Compositae, and the Gramineae, but values are usually small due to the very large pine percentages.

Discussion

The 30 soil samples submitted from 24CA74 generally support an interpretation of environmental conditions not greatly different from the present. In general, the same taxa are found both in the control samples and in the archeological samples; as noted above, the site vegetation dominants are poorly represented in both samples. Only a very few taxa are recorded in sufficient numbers to be useful in the interpretation of the data. The values recorded for Pinus in the occupation levels are 10 to 20 percent larger than those recorded in the control surface samples and in the test trench. This increase in the prehistoric samples may reflect a real increase in tree cover in the nearby mountains and plateaus represented by a lowered treeline. However, samples from both occupations (although sample size is especially small for the most recent period) provide this interpretation, and this is in conflict with paleoecological and paleoclimatological studies in the region (Bright 1966; Baker 1976) which put the diversion between a period of maximum warmth and dryness (higher treeline) and the post-optimum cool period (lowered treeline) at around 3500-4500 BP (Baker 1976:Table 6).

Therefore, the data suggest that the larger pine percentages recovered during the occupation phases are an artifact of differential pollen preservation, and cannot be interpreted as having paleoecological significance at this time. Poor pollen recovery (and thus a small sample size) does not permit the alternative explanation discussed above at this time. The problem of differential preservation can be seen in another sample from this study: two taxa representative of the river enviroment, _Sparganium_ (bur-reed) and Filicales (ferns), were recovered in the control samples, but only Filicales continued to occur in the prehistoric samples. Phytoliths of _Typha/Sparganium_ spp. have been recovered from Level VI (Greiser, personal communication), but the pollen grain is fragile and thus does not survive.

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APPENDIX D

PHYTOLITH RESULTS FROM

THE SUN RIVER SITE (24CA74), MONTANA

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PHYTOLITH RESULTS FROM THE SUN RIVER SITE (24CA74), MONTANA

ABSTRACT

Opal phytolith studies were conducted on 30 soil samples collected at 24CA74. Opal phytolith evidence was poor in the majority of samples studied. Based on the phytolith information, no prediction can be made regarding the past vegetation and environment in the area of the site. Four samples containing a significant number of phytoliths were collected from Features H and J. The phytolith evidence from those samples appears to indicate cultural activity involving grass utilization at the two features.

INTRODUCTION

One phase of the overall attempt to reconstruct the past environments at archeological sites has dealt with paleobotanical remains. Palynology and seed flotation and analysis have been used extensively across the Plains for several years. More recently, phytolith analysis has expanded out of the realm of soil scientists and agronomists and into the field of archeology. Opal phytoliths are minute silica bodies which are formed in plants during the maturation process. Soluble silica in the ground water is absorbed by the roots and carried up into the plant via the vascular system. Evaporation and metabolism of this water result in precipitation of the silica in and around the cellular walls. These distinct and decay resistant plant remains are deposited in the soil as the plant or plant parts die and break down.

Phytolith studies have been an aid to the archeologist in determining the paleo-environment of sites on the High Plains (Lewis 1978a, 1978b, 1979a, 1979b, 1981, 1982; McDonald 1974) and Southern Plains (Robinson 1979a, 1979b, 1979c; Shafer and Holloway 1977). These studies have indicated climatic changes and demonstrated cultural patterns.

DESCRIPTION AND CLASSIFICATION

Nomenclature used in classifying phytoliths has a morphological rather than a genetic basis. Early work by Twiss, Suess, and Smith (1969:111-112) produced a morphological classification of grass phytoliths which is the basis for identification used by many researchers today. Twiss et al. (1969) distinguished three groups of subfamilies of Gramineae and developed a classfication which is divided into four classes. Rovner (1971) identified two distinct classes of grasses: Poacoid and Panicoid. The Panicoid resembles closely the third category identified by Twiss et al. (see below). The Poacoid class includes Twiss' Festucoid class and what Rovner considers a subclass, Chloridoid.

The Festucoid class has eight types of phytoliths which are either circular, rectangular, elliptical, or oblong in shape. The Festucoid class phytoliths correspond to the subfamily Festucoideae which includes the tribes Festuceae, Hordeae, Aveneae, and Agrostideae. Twiss et al. (1969:111) state that these tribes include the common domestic grasses of humid regions. For the purpose of this study, it should be noted that the grasses of these tribes are common over the High Plains region and not always associated with a humid regional environment. Table D-1 presents the scientific genera and common names of the grasses in the four tribes associated with the Festucoid class phytoliths.

TABLE D-1

GRASSES ASSOCIATED WITH THE FESTUCOID-CLASS PHYTOLITHS
(after Beetle and May 1971; Porter 1964)

TRIBE	GENERA	COMMON NAME
Festuceae	Lolium	Darnel
	Festuca	Fescue
	Vulpis	Sixweekgrasses
	Hisperochloa	Spike Fescue
	Dactylis	Orchardgrass
	Poa	Bluegrass
	Milica	Milic
	Scolochloa	Rivergrass
	Schizachne	Falsemelic
	Glyceria	Mannagrass
	Puccinellia	Alkaligrass
	Catabrosa	Brookgrass
	Torreyochloa	Falsemanna
	Bromus	Brome
	Phragmites	Common Reed

TABLE D-1. GRASSES ASSOCIATED WITH FESTUCOID-CLASS PHYTOLITHS (cont.)

TRIBE	GENERA	COMMON NAME
Hordeae	Elymus Agropyron Sitanion Eremopyrum Triticum Secale Hordeum	Wildrye Wheatgrass Squirreltail Falsewheatgrass Wheat Rye Barley
Aveneae	Deschampsia Trisetum Avena Arrhenatherum Helictotrichon Koeleria Danthonia	Hairgrass Trisetum Oats Falseoat Wedgescale Koeleria Oatgrass
Agrostideae	Polypogon Cinna Calamagrostis Phleum Agrostis Phippsia Alopercurus Oryzopsis Stipa Aristida	Beardgrass Woodreed Reedgrass Timothy Bent Icegrass Foxtail Ricegrass Needlegrass Three-awn

Rovner (1971) identified phytolith shapes from Festucoid (Poacoid) type grass not observed by Twiss et al. (1969). These include trapezoids, long-handled spatulates, and conical caps.

The Chloridoid class had two types of saddle-shaped or double edge, battle ax-shaped phytoliths. The saddle-shaped bodies are distinctive to and common in the short grass region of the prairies. Rogers (1980) identifies the western third of South Dakota as a short grass area. This area receives 14-16 inches of annual precipitation. These phytolith forms may be a part of the subfamily Panicoideae or the proposed subfamily Erogrostoidea which includes the tribes Chlorideae, Eragrosteae, and Sporoboleae (Twiss et al. 1969:111). The scientific genera and common names associated with the above three tribes are presented in Table D-2.

TABLE D-2

GRASSES ASSOCIATED WITH THE CHLORIDOID-CLASS PHYTOLITHS
(after Beetle and May 1971; Porter 1964)

TRIBE	GENERA	COMMON NAME
Chlorideae	Bouteloua Buchloe Schedonnardus Spartina Hilaria	Grama Buffalograss Tumblegrass Cordgrass Hilaria
Eragrosteae	Distichlis Calamovilfa Eragrostis Munroa Redfieldia	Saltgrass Sandreed Lovegrass Falsebuffalograss Blowoutgrass
Sporoboleae	Sporobolua Muhlenbergia	Dropseed Muhly

The third class of distinctive phytoliths is the Panicoid class which has eleven types of cross and dumbell shapes. They are in the subfamily Panicoideae and associated with three tribes: Angropogoneae, Paniceae, and Maydeae (Twiss et al. 1969). The scientific general and common names associated with the above tribes are presented in Table D-3. These grasses are commonly associated with the tall grass prairies. The tall grass prairie in South Dakota covered the eastern third of the state, where annual precipitation averages over 20 inches (Rogers 1980).

The fourth phytolith class is the Elongate class which contains five types. The Elongate phytoliths have no subfamily or tribal characteristics and do occur in all grasses (Twiss et al. 1969). Rovner (1971) identified 10 Elongate-type phytoliths and attempted to associate them with either Panicoid or Poacoid classes. The distinguishing criteria are tenuous; basing plant identification on the evidence would be highly conjectural. Rovner (1971) found that Elongate phytoliths were the only morphological types present in Typha latifolia (cat-tail) and that they constituted the majority of phytoliths present in Juncus sp. (rush).

Other biosilica preserved during the separation process are diatom skeletons. Diatoms are microscopic Algae which live in lakes, ponds, ditches, damp soil, or any damp area. The silicified skeletons of

TABLE D-3

GRASSES ASSOCIATED WITH THE PANICOID-CLASS PHYTOLITHS
(after Beetle and May 1971; Porter 1964)

TRIBE	GENERA	COMMON NAME
Paniceae	Panicum Cenchrus Digitaria Echinochloa Setaria	Panic Sandbur Crabgrass Cockspur Bristlegrass
Andropogoneae	Andropogon Sorghastrum Sorghum	Bluestem Indiangrass Sorghum
Maydeae	Zea	Corn

these Algae are often observed in the soil samples analyzed from archeological sites. Because the separation process retains only the very small diatom skeletons, those observed on the slides cannot be considered representative of the total population at the site. Since they are indicators of moist soil conditions, counts are made and noted during this phytolith analysis.

METHODS

Several techniques have been used by researchers in sample preparation (Carbone 1977; MacDonald 1974; Rovner 1971; Twiss et al. 1969). The technique for sample preparation reported herein is as follows. Soil samples to be examined are first ground with a mortar and pestle. Twenty grams are weighed and dissolved in a beaker containing distilled water and 5 ml of 30-percent solution of hydrogen peroxide to destroy any organic materials present. After settling for 24 hours, the sample is agitated with 5 ml of "Calgon" to disperse soil particles. When the sand has settled to the bottom of the beaker, the clay and silt portion is decanted through a U.S.A. Standard Testing Sieve 270 (53 micron) and saved. The clay particles are separated by centrifuging the sample with distilled water. After centrifuging for 10 minutes at 750 rpm, the clay portion is poured off, retaining the silts. This procedures is repeated until the silt sample is free of clay. The silt portion is then dried.

In order to separate the phytoliths from 1 g of dried silt, a mixture of bromoform and bromobenzene having a specific gravity of 2.3 is added to the silt and the mixture is centrifuged at 1,500 rpm for 15 minutes. The phytoliths and other light materials are decanted, filtered, washed several times with acetone, and then mounted permanently on slides with Canada balsam for examination.

Three transects on each specimen slide were examined at 450 magnification. This constitutes approximately seven percent of the slide. The phytolith types observed were identified and counted. The number of diatoms was also noted. The results of this study are present in Table D-4.

INTERPRETATIONS

Thirty soil samples collected at the Sun River site (24CA74), Montana, were examined for phytoliths. One sample was collected on the surface of the site. Thirteen of the samples were from a soil profile located in Test Trench 3 East. The profile extended from 0-260 cm below the present ground surface. Three features (A, E, and F), located several decameters west of the profile, were also examined. The remaining 13 samples were collected from buried cultural levels adjacent to the soil profile.

Sample 3

Sample 3 was collected from the surface of 24CA74. The provenience is unknown. All four classes of phytoliths were present as well as a large number of diatom skeletons. Festucoid-class grasses are the dominant morphologically distinct phytolith observed. The majority of modern grasses identified at the site are Festucoid-class grasses.

In comparing the frequency of phytolith and diatom skeletons from this sample with the 0- to 23-cm level in the profile, it appears that the surface sample was collected from an area which was extremely damp, thus providing an environment favorable to diatom and grass production. Phytoliths from Sample 9 indicate a mixed grass environment.

Sample 7

Sample 7 was collected from the 0- to 23-cm level in the soil profile. The soil is silt and very fine sands. The phytolith evidence is too slight to make any predictions concerning past vegetation.

TABLE D-4

PHYTOLITH ANALYSIS RESULTS

SAMPLE NUMBER	PROVENIENCE	LEVEL NUMBER	FEATURE NUMBER	FESTUCOID		CHLORIDOID		PANICOID		ELONGATE		DIATOMS
				NO.	%	NO.	%	NO.	%	NO.	%	NO.
3	Surface	--	--	20	32	2	3	1	2	39	63	62
7	T3E N Wall Soil 5	0-23 cm	--	1	50	--	--	--	--	1	50	--
15	T3E N Wall Soil 5	23-30 cm	--	--	--	--	--	--	--	--	--	--
2	T3E N Wall Soil 5	30-41 cm	--	--	--	--	--	--	--	3	100	--
5	T3E N Wall Soil 5	41-49 cm	--	1	33	--	--	--	--	2	66	--
14	T3E N Wall Soil 5	49-66 cm	--	--	--	--	--	--	--	3	100	--
10	T3E N Wall Soil 5	66-73 cm	--	--	--	--	--	--	--	--	--	--
12	T3E N Wall Soil 5	73-85 cm	--	--	--	--	--	--	--	--	--	--
13	T3E N Wall Soil 5	85-130 cm	--	--	--	--	--	--	--	4	100	--
11	T3E N Wall Soil 5	130-150 cm	--	--	--	--	--	--	--	--	--	--

TABLE D-4. PHYTOLITH ANALYSIS RESULTS (continued)

SAMPLE NUMBER	PROVENIENCE	LEVEL NUMBER	FEATURE NUMBER	FESTUCOID		CHLORIDOID		PANICOID		ELONGATE		DIATOMS
				NO.	%	NO.	%	NO.	%	NO.	%	NO.
4	T3E N Wall Soil 5	150-184 cm	--	--	--	--	--	--	--	1	100	--
8	T3E N Wall Soil 5	184-200 cm	--	--	--	--	--	--	--	3	100	1
9	T3E N Wall Soil 5	200-244 cm	--	--	--	--	--	--	--	--	--	--
6	T3E N Wall Soil 5	244-260 cm	--	--	--	--	--	--	--	--	--	--
23	S1/2 of the Feature	23-30 cm	A	--	--	--	--	--	--	--	--	--
27	44N 418W SW Unit Bottom	--	E	--	--	--	--	--	--	6	100	--
20	26N 324W 105S 143W	--	F	--	--	--	--	--	--	--	--	--
29	43N 266W 10-20 cm S/ 5-15 cm W	6 cm Level IV	H-Ash	--	--	--	--	--	--	13	100	--
30	43N 266W	Level IV	H-Fill	--	--	--	--	--	--	--	--	--
28	43N 266W 60-80 cm S/ 50-70 cm W	2 cm Level IV	--	--	--	--	--	--	--	1	100	--

TABLE D-4. PHYTOLITH ANALYSIS RESULTS (continued)

SAMPLE NUMBER	PROVENIENCE	LEVEL NUMBER	FEATURE NUMBER	FESTUCOID		CHLORIDOID		PANICOID		ELONGATE		DIATOMS
				NO.	%	NO.	%	NO.	%	NO.	%	NO.
22	44N 266W SW corner of unit	Level IV	--	--	--	--	--	--	--	1	100	--
18	43N 264W	0-11 cm Level IV	--	1	25	--	--	--	--	3	75	2
16	45N 266W	17-21 cm Level IV	--	--	--	--	--	--	--	--	--	--
25	44N 268W	Level V	G	--	--	--	--	--	--	--	--	--
26	43N 268W	Level V	G	--	--	--	--	--	--	1	100	--
24	44N 267W	28-31 cm Level VI	I	--	--	--	--	--	--	--	--	--
19	45N 267W 10-20 cm S/ 80-100 cm W	31-33 cm	J-Ash	2	4	--	--	1	2	54	94	--
31	45N 267/268W	35-40 cm Level VI	J-Fill	--	--	--	--	--	--	19	100	--
21	45N 268W	39 cm Level VI	J	1	8	--	--	--	--	11	92	--
17	45N 266W	37-39 cm Level VI	--	--	--	--	--	--	--	3	100	--

Sample 15

Sample 15 was collected from the 23- to 30-cm level in the soil profile. The soil is silt and very fine sands. No phytoliths were observed in the sample.

Sample 2

Sample 2 was collected from the 30- to 41-cm level in the soil profile. The soil is silt and very fine sands. Three badly eroded Elongate phytoliths were observed. The phytolith evidence is too slight to make any predictions concerning past vegetation.

Sample 27

Sample 27 was collected from the southwest unit bottom of surface Feature E, which is located in 44N 418W. Feature A has a date of 3987±194 (3570±80) BP. Six badly eroded Elongate phytoliths were observed. The phytolith evidence is too slight to make any predictions regarding the past enviroment or possible cultural activities.

Sample 20

Sample 20 was collected from surface Feature F, which is located at 105S 143W in Unit 26N 324W. The feature has been dated to 3790±162 (3420±100) BP. No phytoliths were observed in the sample.

The following samples were collected from the Oxbow Levels IV-VI at the site. The Oxbow Level IV was encountered at 1.8 m below the surface. This is the same level as Sample 8 in the soil profile. Below surface depths in the following samples start with Oxbow Level IV.

Samples 29 and 30

Samples 29 and 30 were collected from Feature H which is located in 43N 266W. Feature H has not been dated.

Sample 29, which contained Elongate phytoliths, was collected from the ash in Feature H from Level IV. These phytoliths are not morphologically distinct, so little can be said about the vegetation associated with the feature. The frequency of phytoliths in this sample is high enough to postulate that some cultural activity relating to plants probably took place here.

Sample 30 was collected from the fill out of Feature H. No phytoliths were observed in the fill level from Feature H.

Sample 28

Sample 28 was from Level IV but was not associated with a feature. The sample was collected in Unit 43N 266W at 2 cm below surface. Only one badly eroded Elongate phytolith was observed. The phytolith evidence is too slight to make any predictions concerning past vegetation. The probability of cultural activity associated with grasses is low.

Sample 22

Sample 22 was collected from the southwest corner of Unit 44N 266W in Level IV. The area is adjacent to Feature H. One Elongate phytolith was observed. The phytolith evidence is too slight to make any predictions regarding the past environment or possible cultural activities.

Sample 18

Sample 18 was collected from Level IV (0-11 cm) in Unit 43N 264W. One Festucoid-class phytolith, three Elongate phytoliths and two diatom skeletons were observed in the sample. The only other buried diatom evidence was from Sample 8 (the corresponding level) in the soil profile. The phytolith evidence is too slight to make any predictions regarding past vegetation or cultural activities.

Sample 16

Sample 16 was collected at 17-21 cm below surface in Level IV in Unit 45N 266W. The sample was not from a feature. No phytoliths were observed.

Samples 25 and 26

Samples 25 and 26 were collected in units 44N 268W and 43N 268W, respectively. The samples were from Feature G in Level V, which has dates of 5252±167 (4560±70) BP and 5017±200 (4370±110) BP. The phytolith evidence is too slight to make any predictions concerning past vegetation or possible cultural activities.

Sample 24

Sample 24 is from Feature I located in Unit 44N 267W. The feature was in Level VI at 28-31 cm below surface. Feature I has been dated to 6498±287 (5670±190) BP. No phytoliths were observed in the sample.

Samples 19, 31, and 21

Samples 19, 31, and 21 were collected from Feature J, which is located in Units 45N 267W and 268W at Level VI. Feature J has been dated to 5350±193 (4640±120) BP.

The Feature J ash level (Sample 19) is at 31-33 cm below surface and contains Festucoid, Panicoid, and numerous Elongate phytoliths. Some cultural activity involving grasses may be postulated on the basis of these results.

The Feature J fill (Sample 31) was from 35-40 cm below surface and also contains Elongate phytoliths. Sample 21 was collected at 39 cm below surface and has Festucoid- and Elongate-class phytoliths.

Sample 17

Sample 17 was collected in Unit 45N 266W at 37-39 cm below surface in Level VI. The sample was from the occupation surface west of Feature J. Only three Elongate phytoliths were observed. The phytolith evidence is too slight to make any predictions concerning past vegetation, but the paucity of phytoliths in this sample may help to support the supposition made regarding cultural activities associated with Feature J.

The phytolith results from the samples collected in the soil profile at 24CA74 provide no information on past environments at the site. Features A, E, and F also contribute little information.

Phytolith evidence is relatively strong in the ash level from Feature H in Level IV and from the three samples collected in Feature J located in Level VI. The ash level from Feature J has the highest frequency of phytoliths of any of the buried samples.

The occupation surfaces in Levels IV and VI and the corresponding soil levels in the profile contain a negligible amount of phytoliths. Only within Features H and J does the phytolith count become significant. Phytolith evidence from the Hudson-Meng site, Nebraska, indicates that fecal material (probably buffalo chips) which contains an extremely high phytolith count was used for fuel (Lewis 1978b). This does not appear to be the situation at 24CA74. The frequency of phytoliths is too low and Feature I, located just south of Feature J, had no observed phytoliths. The plant remains in the two features may have resulted from numerous activities such as food preparation, basket making, or even the remains of grass pad used as bedding (Lewis 1979b).

SUMMARY

Thirty soil samples from the Sun River site (24CA74), Montana, were examined for phytolith remains. The samples were from the surface, from a soil profile, and from various cultural levels and features. Overall phytolith evidence of past vegetation was poor. Soil samples from seven features were prepared. No phytoliths were observed in three of the features (A, F, and I). Features E and G had a very low frequency of phytoliths. The ash levels from Features H and J contained a significant number of phytoliths as did the fill from Feature J. Soil samples collected from the occupation surface and corresponding soil levels in the profile contain little or no phytoliths. It is therefore proposed that cultural activities necessitating the utilization of grasses was associated with Features H and J.

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APPENDIX E

24CA74 -- FLOTATION ANALYSIS

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24CA74 -- FLOTATION ANALYSIS

Twenty-one flotation samples from 24CA74 were processed to facilitate the recovery of small macro archeological remains. Although lithics and bone were collected during this procedure, the primary objectives were the separation and identification of archeologically significant botanical remains. Of these 21 samples, 12 were collected as feature related soil and 9 were collected from various other site localities. In many cases there were only slight differences in the proveniences.

Flotation Technique

After the sample volume was measured, the sample was carefully poured into a water-filled, 20-l plastic bucket. The sample was gently hand agitated to allow the organic remains to surface. Then, the water was slowly poured into a window screen which had been lined with 0.8-mm nylon netting. The bucket was then refilled with water, the sample again agitated, and the water poured off onto the netting. This process was repeated until little or no debris floated -- usually about four or five times. In many cases, 30 ml of trisodium phosphate (TSP) was added to the water and the sample was allowed to soak for two or three minutes before continuing the process. This action was taken when it seemed probable that some organic remains were trapped in the clay heavy soil.

The portion of the sample which did not float was water screened through the window screen. The remains from this and those which had been collected in the nylon netting were air dried.

In approximately half of the samples, rock-hard clay chunks were present even after the water screening. In these cases all observable cultural remains were separated out and the sample was processed a second time. Prior to repeating the procedure, the clay chunks were soaked in a very strong solution of TSP (45 ml to a liter of water). This was allowed to soak for up to 20 minutes.

Identification

Both the heavy and the light fractions from all of the samples were examined under a binocular microscope at a magnification of 10x. All seeds, lithics, bones and complete snails were separated from the remains. Relative amounts of charcoal were noted for each sample; the exact quantification being very impractical due to the large amount of very minute pieces.

Results

The results of the flotation analysis are summarized in Table E-1. A total of 11 seeds, 1,235 lithics, and 830 bone fragments were recovered. A few assorted insect parts and small snail shells were also noticed, all of which were in excellent condition and are believed to be modern. Small fragments of fire-altered rock were observed in a few samples (9a, 10a, and 14).

Interpretations and Conclusions

The botanical remains, particularly seed recovery, were extremely disappointing. The 11 seeds which were recovered are those of the Chenopodiaceae or Amaranthaceae families (Goosefoot and Pigweed families). Seeds of the families are often recovered in an archeological context and have numerous ethnographic uses. They are also commonly found as contaminates in flotation samples. It is feared that the latter pertains to these 11 seeds. They are in excellent condition and exhibit no signs of heat alteration. Although it is possible that uncharred seeds are of cultural origin, these all lock to be in far too good condition to be much more than a few years old. The total absence of probable culturally utilized noncharcoal macro plant remains is most likely due to poor preservation. It is not necessarily a reflection of aboriginal plant use patterns.

Charcoal made up a large percentage of some sample remains. This usually amounted to very little charcoal; most of the pieces were very minute. The charcoal which could be identified is most likely that of a nonsage hardwood shrub.

As with the charcoal, most of the bone fragments are very small. The size and fragmentary nature of the bone renders a large percent of it unidentifiable, and sometimes made heat alternation determination difficult. A count of these fragments and their weight is provided for comparative purposes.

A count and the weight of the lithics is also provided. In general, the lithics consisted of extremely small interior flakes, most of which were quartzite.

TABLE E-1

SUMMARY OF FLOTATION ANALYSIS RESULTS FROM SITE 24CA74

	UNIT	FEATURE	PROVENIENCE HORIZONTAL	PROVENIENCE VERTICAL	SAMPLE SIZE IN LITERS	CHARCOAL*	LITHICS COUNT	LITHICS GRAMS	BONE CHARRED/NOT COUNT	BONE CHARRED/NOT GRAMS	COMMENTS
10	43N 264W		10- 90 cm S 80-100 cm W	Level IV 0-11 cm B.S.	3.75	M	361	11.0	8/ 42	1.5/1.2	
7	43N 266W		60- 80 cm S 50- 70 cm W near Feature H	Level IV 2 cm below NE surface	.50	M	86	4.6	1/	<.1/	
8	43N 266W		40- 60 cm S 35- 45 cm W near Feature H	Level IV	.75	M	310	6.5	2/	.1/	
9	44N 266W		SW corner near Feature H	Level IV 5-8 cm B.S.	.75	T	251	3.1	1/	<.1/	
11	44N 267W			Level IV 0-10 cm B.S.	1.75	T	10	.1	1/	.1/	
12	44N 268W			Level IV 0-10 cm B.S.	1.75	T			/	/	
13	44N 269W			Level IV 0-10 cm B.S.	1.50	T			/	/	
21	45N 266W		90 cm S 0- 10 cm W	Level VI 37-39 cm B.S.	1.00	M	8	.1	9/ 5	.1/ .1	
14	45N 266W			Level IV 17-21 cm B.S.	1.25	M	38	.6	2/ 29	.1/ .3	
1	19N 350W	A	SE Quad		1.75	A			/ 2	/ .1	
2	20N 350W	A	SE Quad		1.25	A			/ 6	/ .1	2 Cheno-Ams

*Charcoal scale:

T = trace; less than 25 percent of floated remains are charcoal
M = moderate; between 25 and 75 percent of floated remains are charcoal
A = abundant; more than 75 percent of floated remains are charcoal

TABLE E-1. SUMMARY OF FLOTATION ANALYSIS RESULTS (continued)

	UNIT	FEATURE	PROVENIENCE HORIZONTAL	PROVENIENCE VERTICAL	SAMPLE SIZE IN LITERS	CHARCOAL*	LITHICS COUNT	LITHICS GRAMS	BONE CHARRED/NOT COUNT	BONE CHARRED/NOT GRAMS	SEEDS
3	44N 418W	E	SW Quad	bottom	.75	A			/	/	
4	44N 418W	E	SW Quad	0-14 cm B.S.	1.00	A			1/	<.1/	
15	44N 268W	G		Level V	2.50	A	1	<.1	31/ 20	.8/ .5	
16	43N 268W	G		Level V	.50	A			55/ 8	3.4/ .2	
5	26N 324W	F			.75	A			/	/	9 Cheno-Ams
6	43N 266W	H		Level IV	1.75	T	1	<.1	/ 1	/<.1	
17	44N 267W	I		Level VI 26-31 cm B.S.	2.25	A	91	2.9	47/ 74	3.4/2.2	
20	45N 267W 268W	J		Level VI 35-40 cm B.S.	8.25	M	66	2.8	352/	22.0/	
18	45N 267W	J	50- 70 cm S 20- 30 cm W	Level VI 31-33 cm B.S.	.75	M	5	.5	64/ 19	3.5/1.4	
19	45N 267W	J	10- 20 cm S 80-100 cm W	Level VI 31-33 cm B.S.	1.50	M	7	.4	48/ 3	1.5/ .5	
TOTAL					36.00		1,235	32.6	620/210	36.5/6.6	

*Charcoal scale:

T = trace; less than 25 percent of floated remains are charcoal
M = moderate; between 25 and 75 percent of floated remains are charcoal
A = abundant; more than 75 percent of floated remains are charcoal

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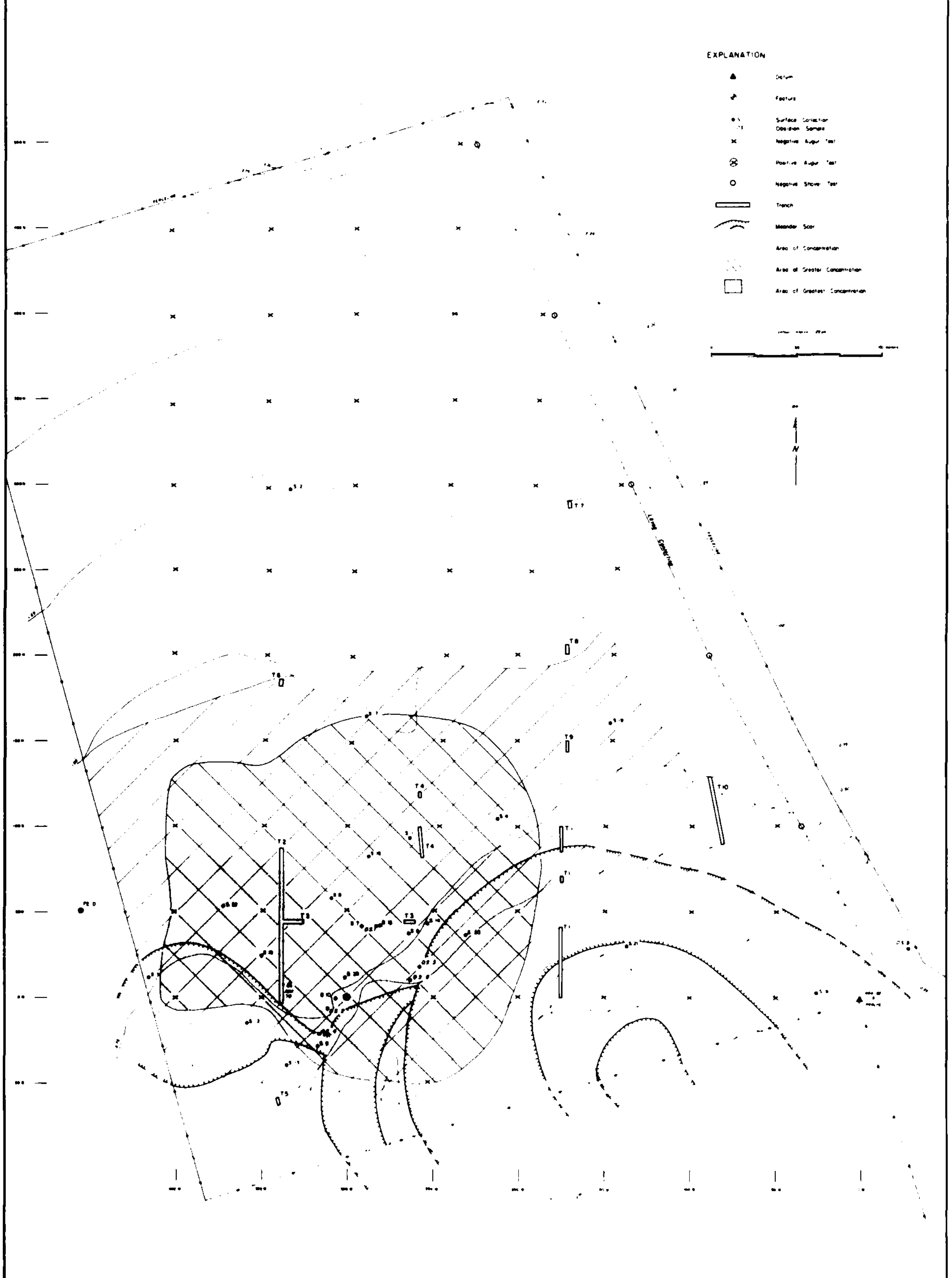

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