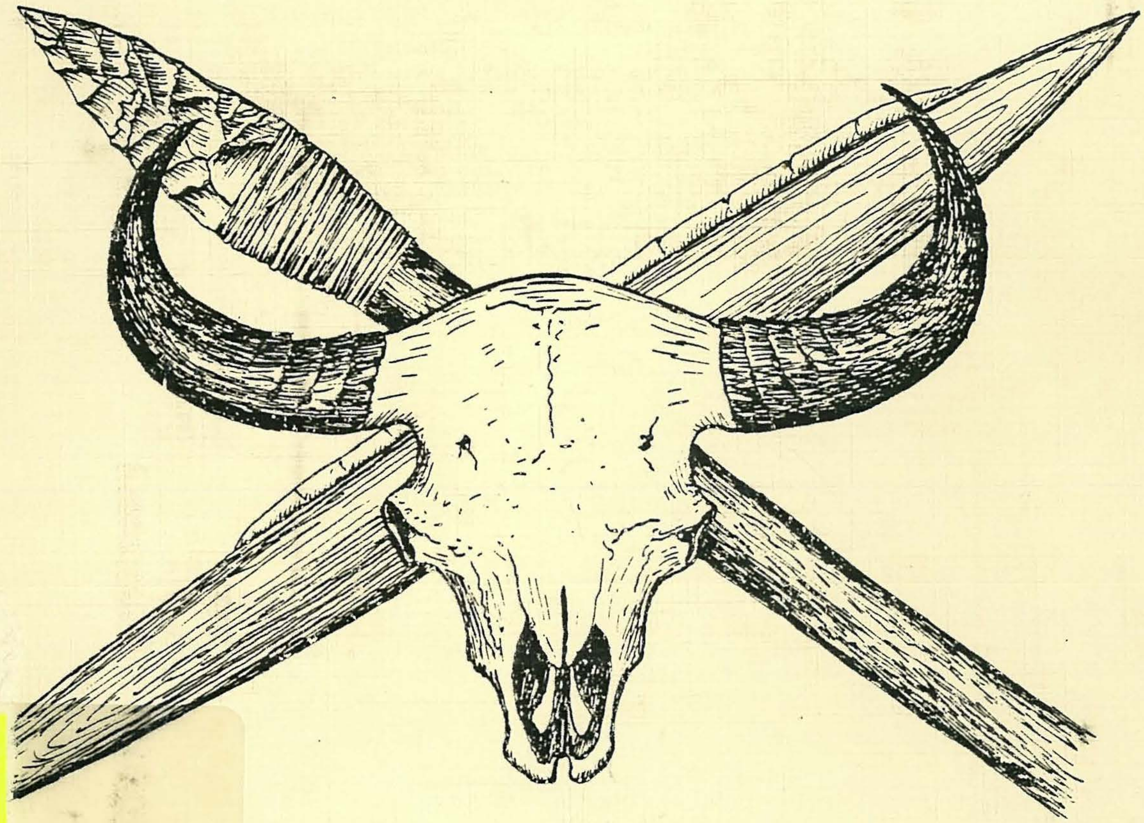
DRY CREEK

Archeology and Paleoecology of a Late Pleistocene Alaskan Hunting Camp



by
ger Powers, R.Dale Guthrie, and John F.Hoffecker

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1983

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Charles Holmes discovered the site and gave considerable time and effort in developing the research potential of the Dry Creek Site.

We are especially indebted to the University of Alaska for providing the initial support to begin test excavations at the Dry Creek site.

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TABLE OF CONTENTS

APPENDIX D

LIST OF FIGURES

Page

CHAPTER FIVE

LIST OF TABLES

CHAPTER ONE

INTRODUCTION

by

R. Dale Guthrie and W. Roger Powers

INTRODUCTION

Research Philosophy:

Multidisciplinary Approach

There seems to be at least two ways in which sites are currently dug. One is to obtain the artifactual material in order to produce a point in time and space with typological identity so that a cumulative pattern may emerge of the "phylogenetic" distribution and chronology of peoples and their traditions. Studies of palynology, paleontology, geology, all become ancillary subdisciplines directed toward this end.

Another way, is to look at an archeological site as an important and possibly unique occasion from which to focus on that point in human pre-history and all of the natural forces which were affecting and molding it. It is an opportunity for natural historians from several disciplines to live together in the field and to share laboratories, arguing over the various meanings of Quaternary events, using the site almost as an informal symposium for inter-disciplinary discussion. That is, it is an occasion to pursue the interrelationship between an environment and a people with the underlying assumption that there are causal connections. Approaching it from this angle, the presence of Chloridae phytoliths in the hearths and their rarity in the rest of the sediments, indicating the use of buffalo chips for fuel (Lewis, 1978) may be as important to our general understanding as whether or not the occupants of a site used Cody knives. Likewise, information about sediments in the site dating from when there is no archeological evidence at all may sometimes tell us as much about humans as the artifact-laden levels. People are beginning to argue that there are long segments of time during which there is no evidence of human occupancy in areas occupied by humans both before and after (Reher, 1974). These absences may be the result of environmental restrictions.

The bothersome thing about the "natural history" approach of looking at the ecological setting of an archeological site, past and present, as opposed to the "prehistory" approach is that no one person can be trained to have, or even gain through a lifetime of experience, the necessary skills and angles of perception to gather the information. As difficult as it is to coordinate specialists with varying interests and disperse the responsibility for a watermark site, it seems obvious that an interdisciplinary approach is by far the most productive. By this we do not mean that a site should be dug and the specimens sent to respective specialists for identification, but rather, that there should be a cooperative focus by various Quaternary researchers using, in addition to their rote expertise, a creative eye for new questions as well as means to resolve them. During a dig it begins to become apparent that in contrast to the archeologist with a support staff, sites can be excavated by a number of Quaternary researchers all interested in Quaternary biota, climate, and people, each knowledgeable about the other's specialty and interested in the common focus.

Such a synthesis at the Dry Creek site admittedly began after excavations were initiated, but furnished the fuel for many hours of discussion between the authors and their colleagues. Some approaches to collecting and analyzing the data went unbelievably well, others we would now do quite differently. The sediments were unexpectedly devoid of small mammals and invertebrates. The ground squirrel burrows offered great potential but the expected fossil nests never occurred within the site. Also the sediments contained a poor pollen record and pollen cores in nearby lakes were not sufficiently old.

In retrospect we could probably have benefited from a person interested in Quaternary soils. Also, the geoarcheological and bioarcheological studies were disjunct, the former having been conducted during the early part of the project with the latter following during the main thrust of the excavations and analyses. The interdisciplinary character of the research could have been greatly strengthened had these phases of the research run concurrently. Despite our disappointments and misjudgements, the site has been the origin of much new information and many new ideas.

Research Hypotheses

The Dry Creek site, like most Early Man sites, was an accidental discovery, but one which was to be the first occurrence in the northern part of North America of a multicomponent site containing many thousands of lithic artifacts and identifiable large mammal remains which span a good part of the eleventh millennium B.P. Because of its discovery, it was possible to develop a research strategy that can predict the occurrence of similar sites in a comparable topography. This twofold quality, its importance for understanding the lifeways of early hunters at the site itself, and opening the door to the discovery of other early sites, underscores the fundamental importance of Dry Creek for northern archeology.

The site was excavated over three summers by several Quaternary researchers with multidisciplinary approaches in geology, archeology, and paleobiology. As tests were conducted and excavations expanded the importance of the site began to emerge and it became quickly obvious that Dry Creek possessed several features which, in combination, made it ideal for further investigations. First of all, the site was deeply stratified, at least by Alaskan standards, and the radiocarbon date from near the base of the section, in what was later to be called Component II, indicated a probable terminal Pleistocene age. Secondly, the site was multicomponent, with two occupation horizons near the base of the section containing preserved fauna, and a third nearer the top. In addition, the archeological remains occurred in clusters and they contained variable compositions of artifacts.

These features of the site allowed us to pose several hypotheses which could be tested by further excavation.

1. The two stratigraphically separate early components could provide us with new information on temporally separated lithic and faunal assemblages.
2. The clustering of artifacts would allow us to isolate and define sets of tools, waste materials and associated fauna within each of the early components.
3. Identification of age, sex, species and seasonality of the fauna would allow us to reconstruct some aspects of the paleoecology of the site, the Nenana Valley specifically, and the northern Alaska Range foothills in general.
4. The associated fauna and artifact clusters could allow us to reconstruct, in part, the procurement and processing techniques of the game species.
5. The preservation of bone raised the possibility that the

articulation of microblades with bi- or unilaterally grooved bone/antler points would provide information on the presumed existence of the composite inset techique and that the manufacture and maintenance of these points could be described.

6. Given a comparable quality of information from both of the early components, we could examine some aspects of subsistence activity and possibly study the problem of either stability or change in the patterns of site use.

7. A familiarity with the surrounding area and its seasonal climatic variations would permit us to study how these affected large mammal distributions. Combined with information from the archeological site, this would allow us to reconstruct the reasons for the site's particular location and what kinds of activities would then have likely occurred there.

Research strategies, the kinds of paleoecological data sought, and our ideas about what we were seeing underwent a series of changes as more and more data came in. These ideas continued to change back at the University, where careful analysis revealed many things which were not obvious in the field.

Though other analyses will be conducted with the Dry Creek material over the years and our ideas and interpretations will no doubt continue to change and evolve, the data from the site does provide important new information pertinent to some of the major questions in the study of Early Man in North America.

General Conclusions:

1) Settlement Pattern. The Dry Creek site was occupied several times as a temporary hunting camp or "spike camp" by early peoples. The site is located on a prominence too exposed for long-term winter camping comfort but it is ideal as an observation point. The artifacts indicate extensive weapon repair and manufacture and some large mammal processing. Judging from these observations one can conclude that the Dry Creek site was primarily a hunting camp, and not a main habitation. Most of the moraine-top Denali Complex sites in the Tangle Lakes area (West, 1981) and ridge prominences (such as the Campus Site), seem to fall into this general category of hunting and processing stations.

Dry Creek was evidently a site where people camped briefly when out looking for game, repairing and manufacturing new weapon tips while they watched. Meat and hides already obtained were probably rough processed and dried for transport to the main camp.

This pattern of spike camps could indicate an orbital exploitation strategy in which small groups on hunting forays radiated out away from a central, more permanent campsite. Such an orbital pattern of resource use would exploit a large area and thus allow a critical group size of 25-100 people to be maintained without the necessity of constant movement due to overhunting.

Although they are poorly preserved, the bones found at the site do corroborate Paleoindian and Paleolithic evidence of a reliance on large mammals for food. Mountain sheep (*Ovis*), wapiti (*Cervus*), and bison (*Bison*) were used at various times at the Dry Creek site.

Reconstruction of the ecology of range use by large ungulates suggests a fall-winter concentration in the area because the wind from the pass keeps the rangeland free of snow and greatly increases the ungulates' access to critical winter forage.

Rather than positing nomadic groups moving over the landscape cropping game as they went, this orbital model suggests a more believable hunting strategy in which new ground at the periphery of the "wheel" would be explored by a mobile-hunting focus as game concentrations varied within a large patrolled area.

Such central base camps undoubtedly occurred in quite different areas than the spike camp sites, which are the major sites known thus far. The former are probably in areas not necessarily conducive to hunting efficiency, but next to open water in winter and away from strong down-valley winds. Field surveys in search of base camp sites may need a quite different search image than that associated with the spike campsites.

2) Hunting of Extinct Fauna. In Alaska, a substantial body of data about Pleistocene fauna and their paleoecology had accumulated over the years, but little was known about the rates and patterns of their extinctions and redistributions. One could say that there was a complex Pleistocene fauna and a Holocene fauna, that they were remarkably dissimilar and represented adaptations to very different environments. From the archeological perspective, we knew next to nothing about the species hunted by early Alaskan peoples simply because lithic assemblages had not yet occurred with faunal assemblages. Hence, ideas about early hunting activities were, at worst, speculations, and at best, logical constructions.

Judging from the few fossils at Dry Creek and from other radiocarbon dates on the Alaskan megafauna, the lower levels of the Dry Creek site date to a time when many extinctions had just occurred. Mammoths, for example, have not been dated into the lower 11,000's B.P. in Siberia or Alaska. Our surveys of Quaternary deposits in the vicinity of Dry Creek found mammoth remains dating between 12,340 ± 205 B.P. (GX-6284) and 12,240±180 B.P. (I-10,532)(Ten Brink and Waythomas, 1980). These data fit into a large body of information relating to the demise of the mammoth steppe throughout northern Europe, Asia, and North America. Although horses, mammoths, camels, saiga, lions and others may have already become extinct in Alaska at the time when the lower two levels of Dry Creek were occupied, other grazers such as wapiti and bison had not. Neither wapiti nor bison are native to Alaska today.

Thus, the lower Dry Creek components document the remnants of a grassland environment which was once the dominant Pleistocene habitat in Alaska. The Dry Creek people were still hunting relict Pleistocene fauna (the grazing ungulates) and may not have shifted to the more mesic-nivian adapted, caribou and moose. Thus, the Dry Creek site dates to an important time and is located in an area of North America important to Quaternary paleoecological interests, especially those concerned with the pattern of large mammal extinctions which occurred during the glacial/post-glacial transition. But just as interesting and important is the question of Clovis technology, its origins, spread and its adaptation to a doomed fauna.

3) Clovis Origins. One of the arguments for the Clovis projectile point not being derived from an Alaskan precursor has been the presumed use in Alaska of inset microblades for projectile points. There is a hiatus between the technologies involved in the manufacture of microblade insets and Clovis points. Microblades, and the characteristic wedge-shape cores do not occur in Clovis sites.

Component I at Dry Creek, dated at around 11,100 B.P. lacks no microblades but does contain broken, and complete triangular bifaces (Chapter Four). These are basally thinned and potentially could have been related to the ancestral line which produced the Clovis tradition. Also within Component II, dating around 10,600 B.P., there are several clusters of artifacts (Chapter Five), which instead of microblades, contain broken bifaces possibly similar to Hell Gap points of the Great Plains. These dichotomous clusters in Component II suggest that either there were two different groups occupying the area at the same time, or that the people who produced the characteristic Denali Complex had another activity which depended on biface projectile points in addition to their composite antler-microblade points.

Either of these different interpretations would argue for a strong biface tradition in the north which could have given rise to Clovis points at the time of the southward colonization in North America prior to 11,500 B.P.

4) Dry Creek and the Diuktai Culture. The Dry Creek stone workers strongly emphasized the manufacture of microblades, wedge-shaped cores and a specialized burin technique, all of which are well represented in northeast Siberian sites of an earlier age. These techniques are

probably derived from a technology which has been called the Diuktai Culture (Mochanov, 1977). While there is reason to be cautious about the dates from the older Diuktai sites (Abramova, 1979) there seems little doubt that this tradition, characterized by both microblade and bifacial technologies, became widespread in northeastern Siberia and spread to Alaska during the terminal Pleistocene (West, 1981) and is represented in part at Dry Creek by Component II. Whether or not the bifacial point technology mentioned above is derived from the Diuktai Culture or from some area within America is a problem that cannot presently be solved. The types of bifaces at Dry Creek that we have called projectile points are unknown in Diuktai sites although some specimens at Dry Creek, that we feel confident were used as knives, have been called points at Ushki Lake (Dikov, 1977). While the Diuktai Culture contains bifacial pieces which could represent the technological base for bifacial projectile points at Dry Creek, this aspect of the technology would appear to have its origins in either eastern Beringia or elsewhere in North America. Hence, there is an interface between Siberian and North American lithic techniques which we can see at Dry Creek and other slightly younger Alaskan sites and it seems reasonable that if local antecedant developments gave rise to this situation we should see evidence of it in the archeological record as more new sites are discovered.

CHAPTER TWO

THE DRY CREEK SITE

by

W. Roger Powers

THE DRY CREEK SITE AND ITS REGIONAL SETTING

Location

The Dry Creek site (HEA-005) lies in the Nenana River Valley of central Alaska and is located about 180 km southwest of Fairbanks near the town of Healy (Fig. 2.1). The site proper is situated on a prominent bluff which lies on the north side of the bed of Dry Creek and is about .5 km upstream from the Parks Highway bridge over Dry Creek (Fig. 2.2 and 2.3).

The prominent southeast facing bluff on which the site is situated was formed by the downcutting of Dry Creek through a glacial outwash plain of Healy Age (Illinoisian/early Wisconsinan (Wahrhaftig, 1958)). This incision formed the Healy terrace along Dry Creek which is composed of glaciofluvial sediments and is mantled by a continuous aeolian formation of sands and loesses.

Regional Setting

The Nenana River valley transects two major physiographic provinces — the Pacific Mountain System and the Intermontane Plateau (Wahrhaftig, 1965). The former comprises the imposing mountainous massif generally called the Alaska Range. Technically, the mountains visible from the Dry Creek site (Fig. 2.4) are referred to as the Outer Range while the Inner Range ("Alaska Range") proper lies further to the south. The Intermontane Plateau in this region is a zone of foothills about 50 km wide, which stretches north from the Outer Range until it merges with the Tanana-Kuskokwim lowland, a vast interior region composed of piedmont alluvial fans which begin about 100 km north of the Dry Creek site and continue northward until they interdigitate with

Figure 2.1. Location map of central Alaska and the study area.

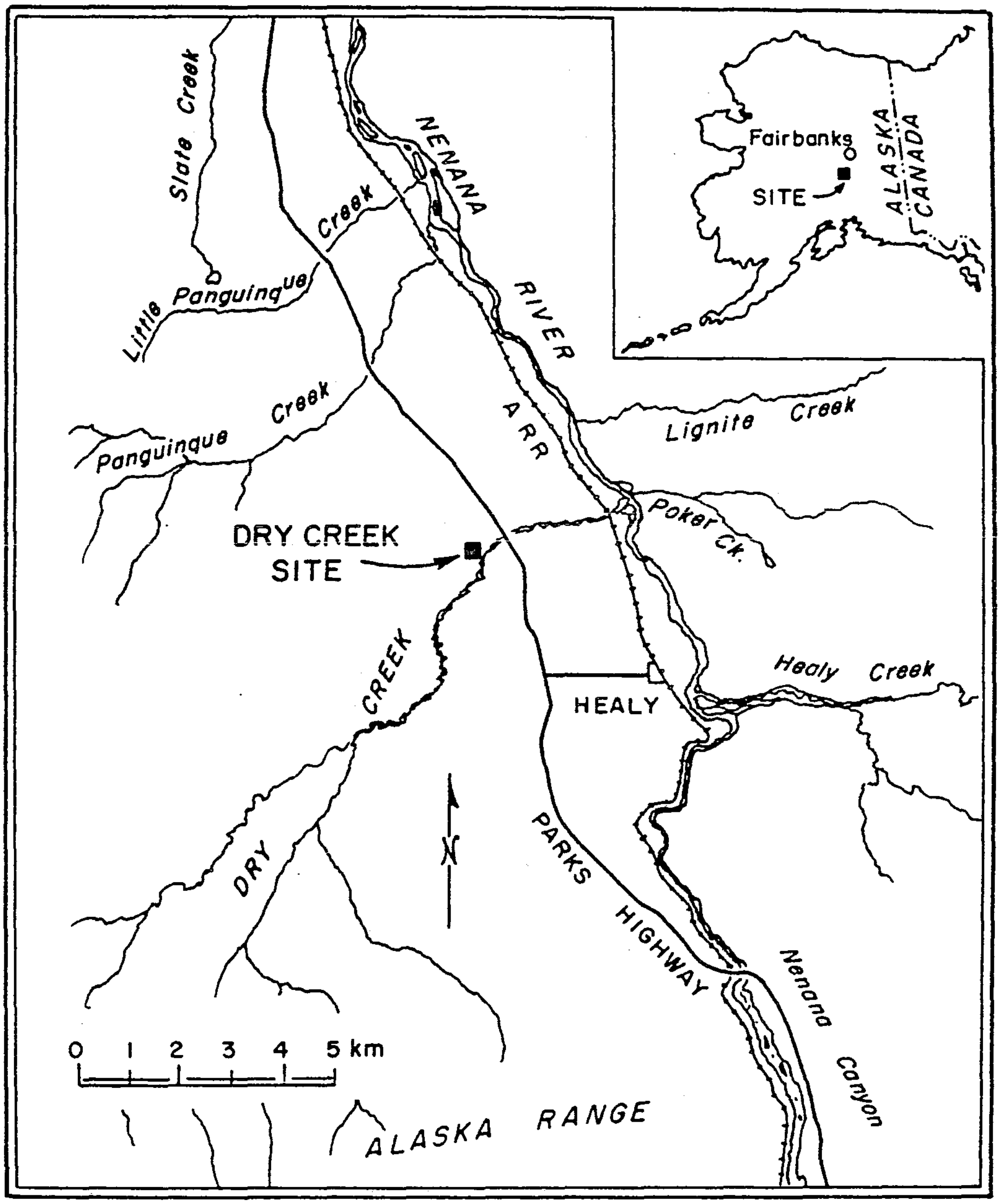
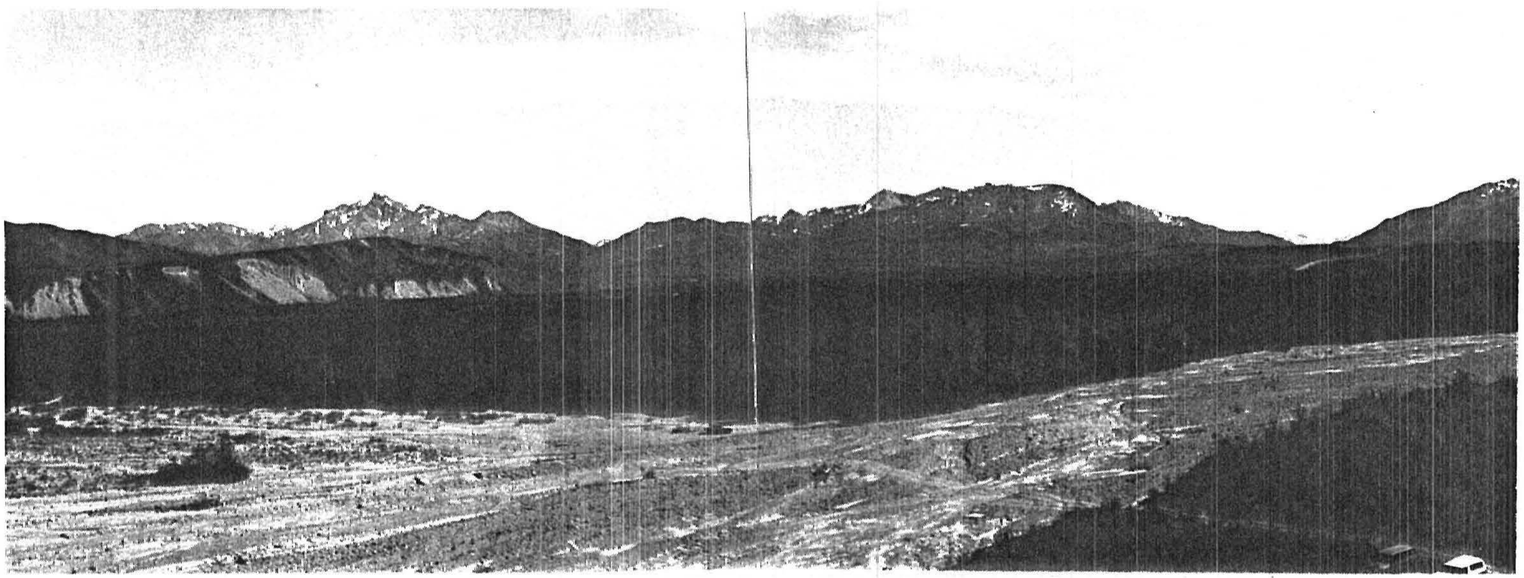

Slate Creek
NENANA
RIVER
Creek
Little Panguingue
Fairbanks
SITE
ALASKA
CANADA
Panguingue Creek
ARR
Lignite Creek
DRY CREEK
SITE
Poker Ck.
Healy Creek
HEALY
CREEK
DRY
N
PARKS HIGHWAY
Nenana Canyon
0 1 2 3 4 5 km
ALASKA RANGE

Figure 2.2. View of Dry Creek. Parks highway is in low center and the Dry Creek bluff is at center of picture. The view is upstream to the southwest. Outer Range is in the distance.

Figure 2.3. The Dry Creek site. The view is downstream to the northeast showing topography of the Nenana Valley.

Figure 2.4. View of Dry Creek and the Riley Creek terrace surface with the Outer Range in the background.



Tanana River floodplain deposits.

The Nenana River which originates in the Nenana Glacier on the south side of the Alaska Range, cuts north across this range and emerges from the mountains at Healy. From this point it flows through the foothill zone and emerges onto the Tanana-Kuskokwim lowlands, which it crosses, and empties into the Tanana River at the village of Nenana.

The valley of the Nenana River between the Outer Range and the lowlands possesses a somewhat subdued topography relative to the majesty of the surrounding mountains and is dominated by suites of terraces standing as erosional remnants of the ancient floodplains of the Nenana River and its tributaries. Downcutting by the Nenana and its tributaries has dissected and eroded these terraces so that the topographically lower portion of the valley is dominated by a step-like appearance as these terraces progressively drop to the modern floodplain of the Nenana. This erosional activity has produced a topography composed of broad, sweeping, relatively even terrace surfaces which end abruptly in steep bluffs (terrace risers), as much as 60 m in height, which separate the different terrace surfaces. Further incision has occurred through the action of tributary streams, such as Dry Creek, which have cut valleys through the terraces. As a result of these various erosional activities, the terrace systems are heavily dissected and present a very striking contrast between broad, even areas and precipitous terrace edges and stream valleys (Fig. 2.2 and 2.3).

While absolute elevations are seldom great, relative topographic relief is quite imposing. The Nenana Valley is 394 m above M.S.L. at Healy which is situated at the base of the Outer Range. This range in turn rises to 1356 m at Sugar Loaf Mountain and 1742 m at Mount Healy. Thus, in the immediate Dry Creek area there is about 1350 m of relief.

Above the terrace systems, the topography of the valley margins is less striking and is characterized by higher, more evenly rounded hills. Several prominent mountains, termed "domes" in this area, rise to 1200-1300 m and provide some scenic relief to a rather monotonous landscape. The upper reaches of the Nenana's eastern tributary streams originate in these hills and in a few localities e.g., Lignite Creek, some spectacular badlands topography is present.

At the present time, the Dry Creek site lies roughly on an ecotone between the alpine, open, herbaceous tundra and the lowland forests, and the major vegetation communities of the Nenana valley and neighboring hinterlands are simply an intricate interplay of these two ecosystems. In the lower elevations of the valley (below 600 m) the open, poorly drained terrace surfaces are dominated by shrub and herbaceous communities with scattered stands of black spruce (muskeg) and isolated copses of deciduous trees. Mixed deciduous and coniferous associations (balsam, poplar, aspen, willow, alder and spruce) are commonly found along stream valley margins and sometimes on the south facing slopes of the hills and stream valleys. North facing slopes are generally covered with a dense black spruce forest and sphagnum moss undercover. South facing slopes with a well drained substrate typically bear aspen, poplar and willow stands with an herbaceous ground cover. Terrace edges can be quite grassy but more generally have a dense mixed deciduous and coniferous tree cover.

Above 600 m as a rule, tundra associations (meadows and bogs) are dominant and grade from shrub and cotton grass bogs at lower elevations to the drier heaths on the higher mountain slopes.

At the present time, the only large mammals which occupy the lowland forests are moose and black bear while mountain sheep, caribou and brown bear can be found on the higher mountain slopes.

History of Archeological Investigations at Dry Creek

1973

In May, 1973, Charles Holmes located displaced artifacts at the base of the loess mantle and on the debris slope at the Dry Creek bluff. Further investigations revealed that the artifacts were eroding from a cultural horizon lying about 1.3 m below the present surface. A charcoal sample which lay at the same depth as the artifacts was collected from a presumed hearth by Thomas D. Hamilton. During the summer of 1973, Robert Stuckenrath of the Smithsonian Institution determined the age of this sample to be 10,690±250 B.P. It appeared that a site with a deeply buried microblade technology had been dated to the terminal Pleistocene.

The surface of the Dry Creek site is a relatively flat terrace covered with a dense stand of black and white spruce and a considerable amount of deadfall. An herbaceous plant cover established near the bluff edge, and comprised mainly of grasses, extends sporadically into the woods (Fig. 2.5). The debris slope below the site supports scattered clumps of aspen and willow and a sparse herbaceous cover including some xeric components such as *Artemisia*. A hundred meters upstream the terrace riser is stable and wooded, but, as the site lies at the outside of a meander loop of Dry Creek which is undercutting the entire terrace edge, this slope is actively eroding. At the time of discovery, the edge of the loess mantle blanketing the terrace was suffering from heavy wind erosion and was undergoing considerable destruction from slumping.

Initially cultural remains were encountered along the eroded loess bluff for a distance of about 50 m. However, the center of density of the flakes and tool parts lay at the highest point on the terrace surface (Fig. 2.7). It was for this reason that test excavations were begun here. Three test pits were excavated at this time along the bluff edge and these further confirmed the presence of *in situ* cultural material in the loess (cf. Fig. 2.8).

With this information at hand a five year program of archeological and paleoecological (geology, paleontology, paleobotany, palynology) studies was initiated at the Dry Creek site.

1974

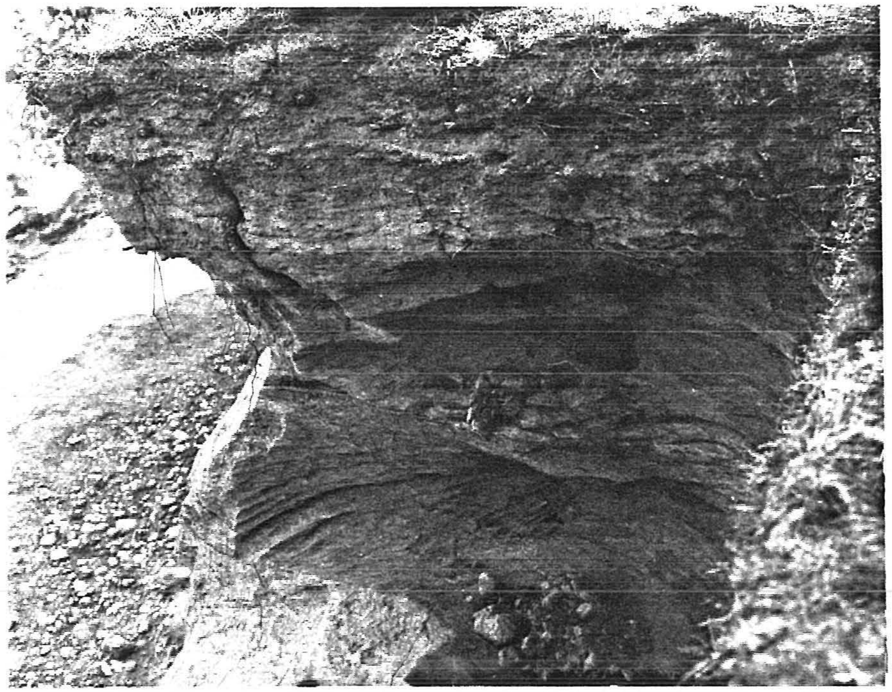
After the initial test excavations, conducted in the late summer of 1973, plans were made for a full scale testing program which reached fruition in May and June of 1974 with a National Science Foundation institutional grant from the University of Alaska. It was during this time that the site emerged as one worthy of extensive study.

The site was mapped, a grid and provenience datum was established about 25 m west of the bluff edge and a metric Union Grid was laid out over the area in which excavation was anticipated to occur. The north-south axis (Y-Y') was oriented parallel to the bluff edge so that

Figure 2.5. Spruce woods on the Dry Creek site prior to clearing for excavation.

Figure 2.6. Wind destruction of exposed 1973 test pit at the edge of the bluff.

Figure 2.7. View of the central site area prior to the 1976 excavations.



the east-west axis (X-X') would intersect the stratigraphic section at approximately 90 degrees. This was done to avoid odd angles in the excavation units along the bluff edge. As a result, project north (PN) is 20 degrees from true north (Fig. 2.8).

A 2 x 15 m test trench excavated at approximately 90 degrees to the bluff edge was linked to planimetric excavations at the bluff edge (Fig. 2.9). The results of these test excavations are summarized as follows:

1) The north wall of the test trench was mapped and the geological units within the section were defined and related to the regional geology (Thorson and Hamilton, 1977). Additional radiocarbon samples revealed that the loess section spanned the last 11,000 years B.P. These dates also provided control for the stratigraphic units of loesses, sands, and paleosols all of which record changing environmental conditions during the terminal phase of the Pleistocene and throughout the entire Holocene (cf. Fig. 2.9).

2) Three (and possibly four) cultural components were found in the Dry Creek loess mantle. The components are definable on geological grounds and even in those rare cases where the lower two components come vertically close, there is still a clear stratigraphic separation (Powers and Hamilton, 1978). This phase of the excavation produced 2827 artifacts. The oldest of the components (I) contained flakes, flake cores, retouched flakes, a triangular biface, possible burins, a chopper, and end scrapers. No microblades, microblade cores, or any byproducts of microblade production were recovered. Component II

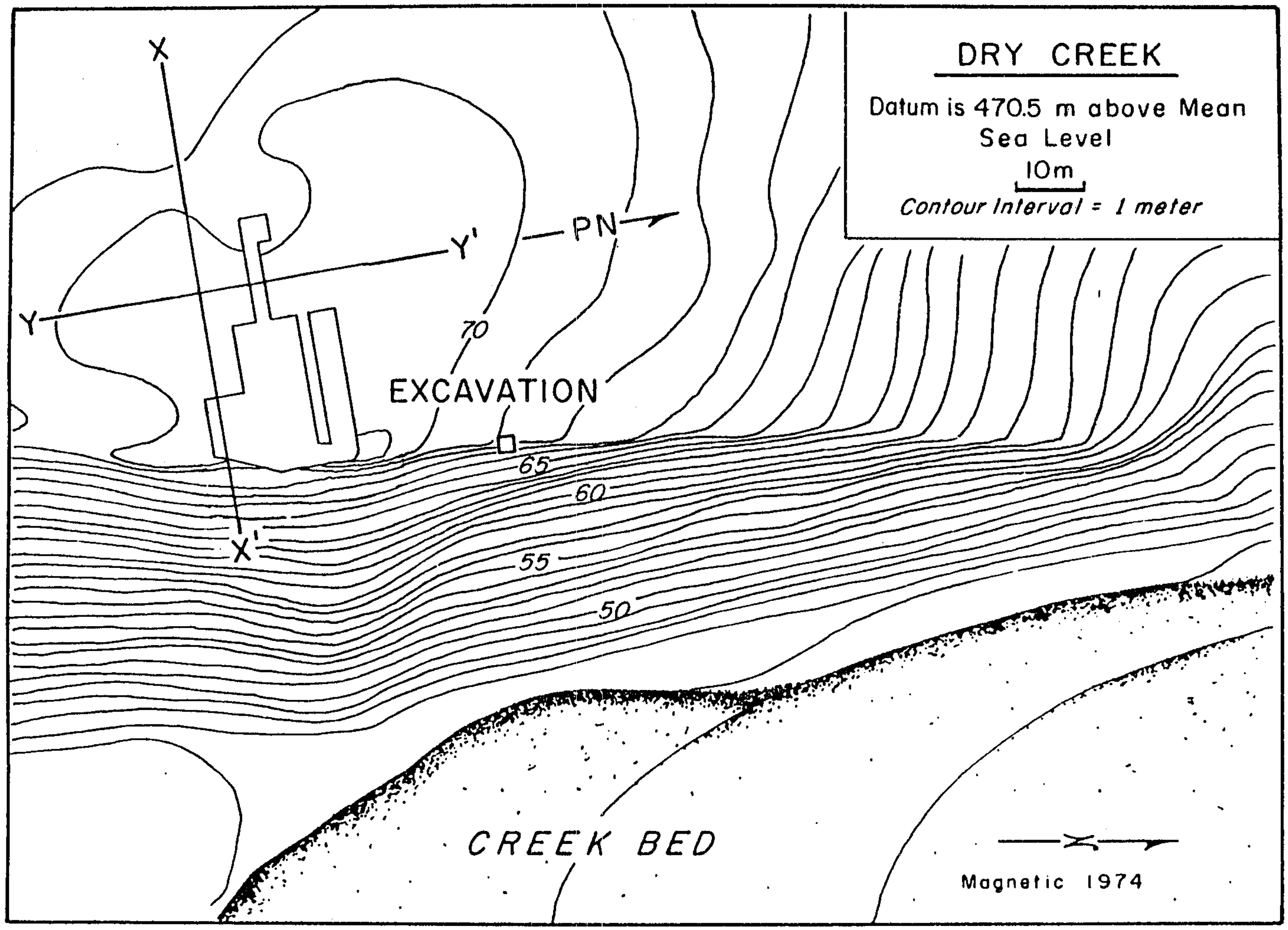
overlies Component I and it is from this horizon that the radiocarbon date of 10,690 ± 250 B.P. was secured. This component produced microblades, wedge-shaped microcores, burins, and a variety of bifacially flaked pieces most of which appear to have been knives. In addition there are large choppers, biface blanks, anvil stones, hammer stones, unworked stones, and pebbles. Component III was noted in the 1974 excavations. It is comprised of 573 waste flakes, 1 blade-like flake, 3 blades, and a biface fragment. It appeared to be similar to Component II although the undiagnostic character of the material prohibited further refinement or identification. The uppermost horizon, Component IV, produced two side notched point bases and flakes.

3) Fragments of dentition were found in a poorly preserved state. However, they were sufficient to allow preliminary identification by R. Dale Guthrie at the University of Alaska in 1974, who was not yet a part of the project. The majority of the remains were of *Bison* sp. It was also thought that one fragmentary specimen of a hyposodont molar might be from a horse (*Equus* sp.) and some large, oval stains occasionally seen in the excavation might be the remains of mammoth tooth plates (*Mammuthus* sp.). Unfortunately, further study failed to confirm the presence of either *Equus* or *Mammuthus*.

4) Tools and flakes were clustered in definable areas of high concentration with intervening areas of low artifact frequency. While only one obvious hearth was located, there was evidence of burning in areas of high artifact concentration.

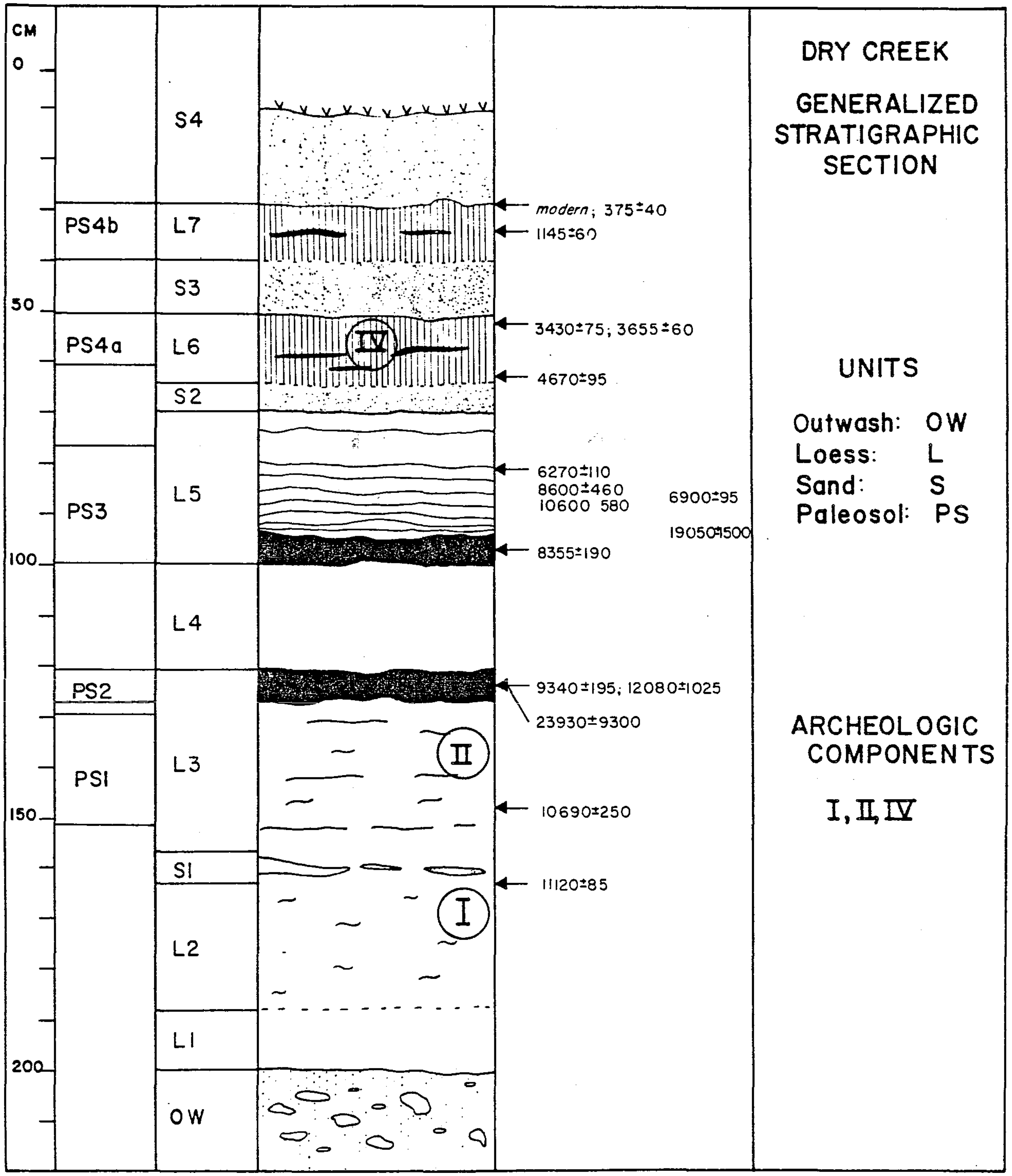
As a result of this information i.e., the stratification, a

Figure 2.8. Topographic map of the Dry Creek site showing grid axes and completed excavation area.



DRY CREEK
Datum is 470.5 m above Mean Sea Level
10m
Contour Interval = 1 meter
X
X'
Y
Y'
PN
70
EXCAVATION
65
60
55
50
CREEK BED
Magnetic 1974

Figure 2.9. Generalized stratigraphic section of the Dry Creek site.



DRY CREEK
GENERALIZED STRATIGRAPHIC SECTION
CM
0
50
100
150
200
PS4b
PS4a
PS3
PS2
PSI
S4
L7
S3
L6
S2
L5
L4
L3
SI
L2
LI
OW
IV
II
I
modern; 375±40
1145±60
3430±75; 3655±60
4670±95
6270±110
8600±460
10600 580
6900±95
19050±1500
8355±190
9340±195; 12080±1025
23930±9300
10690±250
11120±85
UNITS
Outwash: OW
Loess: L
Sand: S
Paleosol: PS
ARCHEOLOGIC COMPONENTS
I, II, IV

temporal interval spanning the terminal Pleistocene and the Holocene, distinct archeological units, extinct fauna, and horizontal concentrations of cultural material, more extensive excavations at the Dry Creek site were planned.

A problem was encountered during this phase of the work which would affect all future excavation strategies. Within a closed trench, the thawing loess could not dry out. By necessity, the work was performed in a very mucky environment which compelled the crew to use winter clothing. Also, the walls would not stand and shoring became a constant problem. In spite of our best efforts, portions of the walls collapsed after the excavation was completed.

Expedience required that broad open areas should be excavated concurrently so that both sunlight and wind could reach to the thawing loess. This approach proved to be very successful and the excavations of 1976 and 1977 suffered very little from collapsing walls.

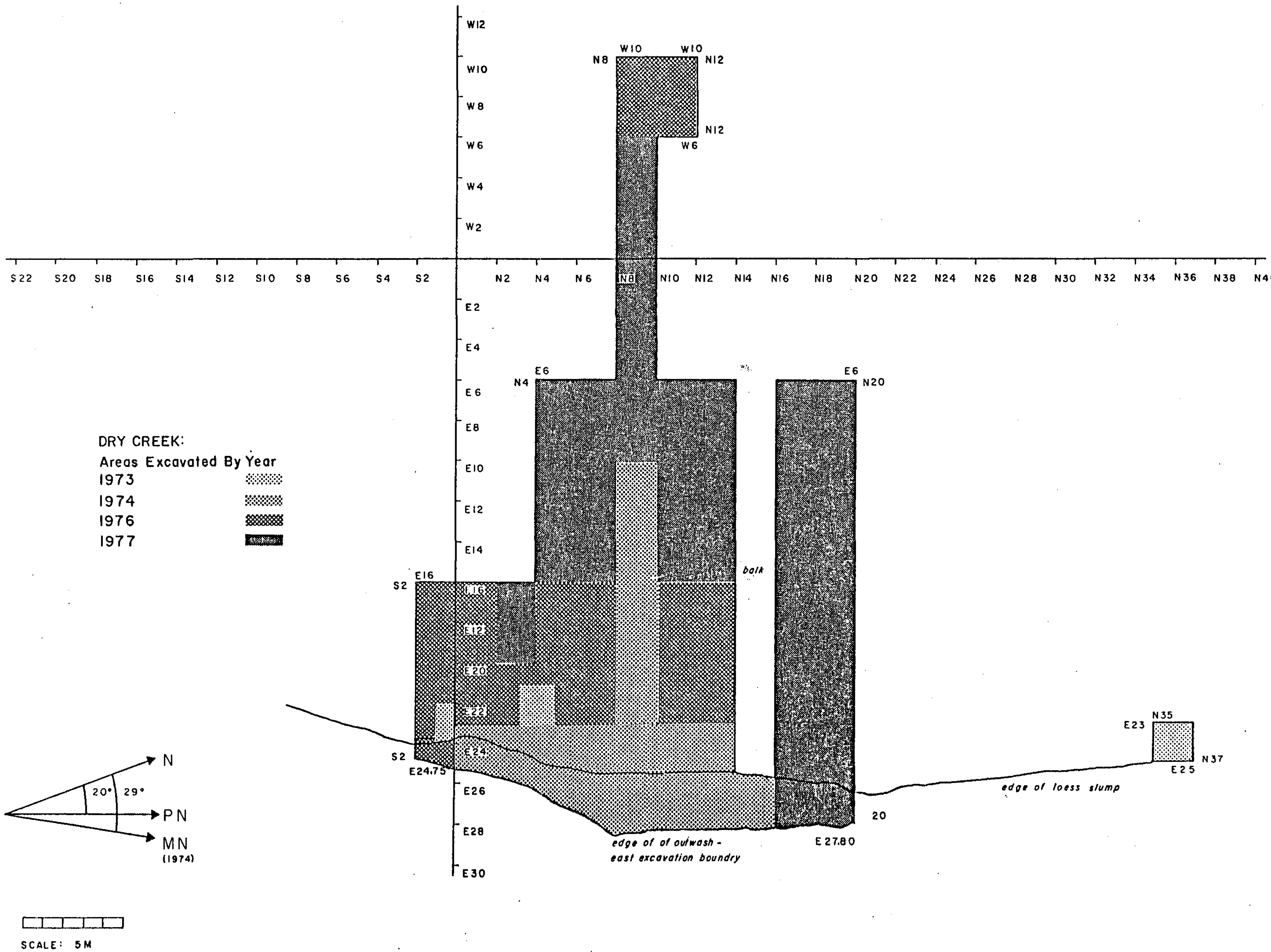
1976

The first broad scale excavations were conducted during the summer of 1976 with support from the National Science Foundation, the National Geographic Society, and the Division of Parks of the State of Alaska. Students in an archeological field school worked the site through June and July and the excavation continued through August and September with volunteer labor. Geological studies were continued by Thomas D. Hamilton of the U.S.G.S. and James McCalpin, then of the University of Alaska.

During this season the excavation was expanded considerably (Fig. 2.10). Two 4 x 7 m units (Areas A and B) were opened between the bluff edge and grid line E16 and between grid lines S2 and N8. A 2 m baulk was left between these two areas, the eastern half of which was removed near the end of the season. Further extensions conformed to the configuration of the bluff and kept the excavation orderly. A third 4 x 10 m unit (Area C) was opened between the bluff edge and grid line E16 and between grid lines N10 and N14. As we still had little control over the extent of the site, and as random test pits were impractical in the frozen loess, we opened another 4 x 4 m unit (Area D) between grid lines W6 and W10 and N8 and N12.

An additional 60 m of stratigraphic profiles were taken, sediment and pollen samples were removed for analysis, and several radiocarbon samples were collected providing our first dates from Components I and IV: Component I -- 11,120 ± 85 and Component IV -- 4670 ± 95 to 3430 ± 75 B.P. (Fig. 2.9). The excavation produced 12,951 cataloged specimens. While the same categories of artifacts were recovered from the components, it was clear that the vast majority were being found in Component II. Component I still contained flakes, side scrapers, end scrapers, and another triangular point or blank, but no microblade technology. Component II produced more microcores, microblades, microcore parts, burins, spalls, scrapers, and a variety of bifacial forms. Component IV yielded two more side notched points, some end scrapers, and more flakes. No evidence of Component III could be detected. This prompted a thorough re-examination of the stratigraphic position of this component. It was realized that, in fact, this component was really the uppermost part of Component II. This called for a new numeration of the components and it was decided that Component II should encompass Component III. Hence, we were left with an odd

Figure 2.10. Grid system of the Dry Creek site showing excavation areas.


DRY CREEK:
Areas Excavated By Year
1973
1974
1976
1977
W12
W10
W8
W6
W4
W2
S22 S20 S18 S16 S14 S12 S10 S8 S6 S4 S2
N2 N4 N6 N8 N10 N12 N14 N16 N18 N20 N22 N24 N26 N28 N30 N32 N34 N36 N38 N40
E2
E4
E6
E8
E10
E12
E14
E16
E18
E20
E22
E24
E26
E28
E30
N8
W10
W10
N12
N12
W6
N4
E6
E6
N20
balk
S2
E16
S2
E24.75
E27.80
20
E23
N35
N37
E25
edge of of outwash - east excavation boundry
edge of loess slump
N
PN
MN
(1974)
20°
29°
SCALE: 5M

system of numeration for the archeological components i.e.,I, II and IV. It was thought that this system would create less confusion than renumbering Component IV to III since the uppermost component, IV, had already been referred to in the literature (Thorson and Hamilton, 1977; Powers and Hamilton, 1978). However, it should be noted that the system of numeration in which Component IV is called III has been used elsewhere (Smith, 1977).

The artifacts of all components were still occurring in concentrations or activity areas and these were usually related directly to a burned area. Also, lithic raw materials were differentially distributed in the artifact concentrations.

All identifiable fragments of bone from the 1976 excavation are mandibular tooth fragments of *Bison*. Based on tooth morphology, our specimens are *Bison priscus*, the large Eurasian steppe bison.

Analysis of pollen samples taken during this season revealed poor pollen preservation in the highly oxidized loesses of Components I and II. Of those grains identified fern spores are predominate. Some disturbance plants were noted and arboreal pollen (*Betula*, *Alnus* and *Picea*) was very weakly represented.

While conducting sedimentological analyses at the U.S.G.S. labs in Menlo Park, California, James McCalpin discovered the presence of opaline phytoliths in the loess from the site. While little has been done with this potentially potent paleoecological tool in Alaska, it was realized that with the development of a phytolith key for northern vegetation, this may well develop into another source of ecological information. McCalpin did notice that the phytoliths from loesses 2 and 3 (Components I and II) differed morphologically from those in the upper forest soils (Paleosols 4a and b)(Component IV). Further analysis by our lab technician, Mary Calmes, revealed phytoliths from festucoid grasses. Thus, opaline phytoliths could possibly help to distinguish predominately herbaceous from sylvan landscapes and could conceivably offer further refinements.

The 1976 excavation failed to augment the sample of diagnostic artifacts in the oldest component and this became a major concern. Was this really a non-microblade horizon or was there a possible sampling error? It had always seemed probable that if Component I lacked a microblade technology, its antiquity could be much greater than that indicated by our single radiocarbon date. Muller-Beck (1967) had postulated the presence of a non-blade Mousteroid technology as a Clovis ancestor in North America and such a technology would be succeeded by an Aurignacoid blade technology. This general situation appeared to be present at Dry Creek.

1977

The final excavation season at Dry Creek covered June and July of 1977 with full support from the National Geographic Society and the National Park Service as part of the Early Man in Alaska program. The major objectives of this season were to excavate as large an area as possible, supplement the sample from Component I, and to collect more radiocarbon samples from this horizon. As a result of these expanded excavations, the samples from Component II were also increased substantially.

Even larger areas were open during the summer of 1977 employing the same, planimetric excavation strategy (Figs. 2.10-11). Areas B and C

Figure 2.11. View of the Dry Creek bluff during the 1977 excavation.

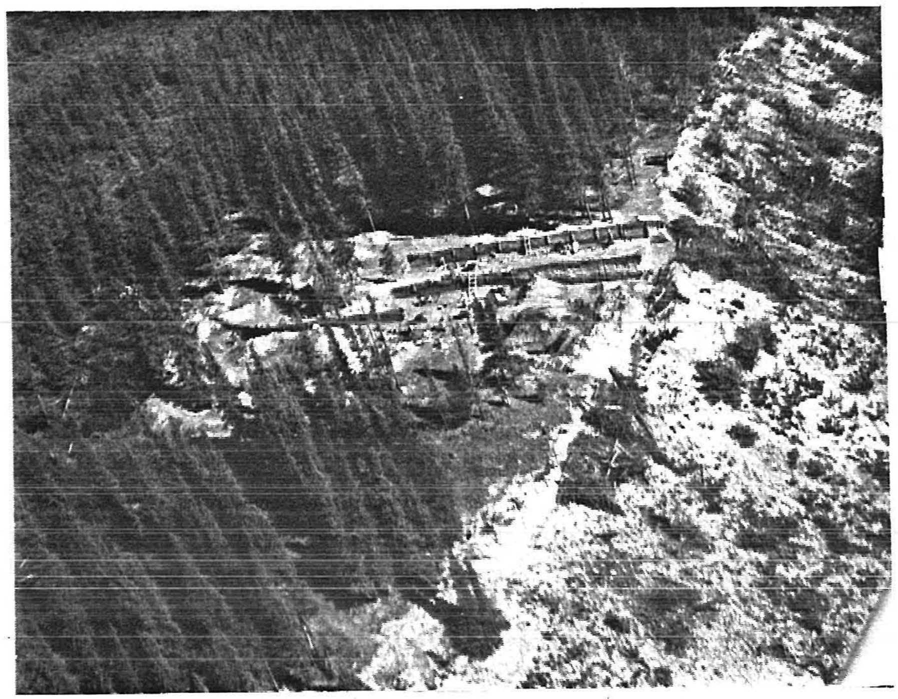
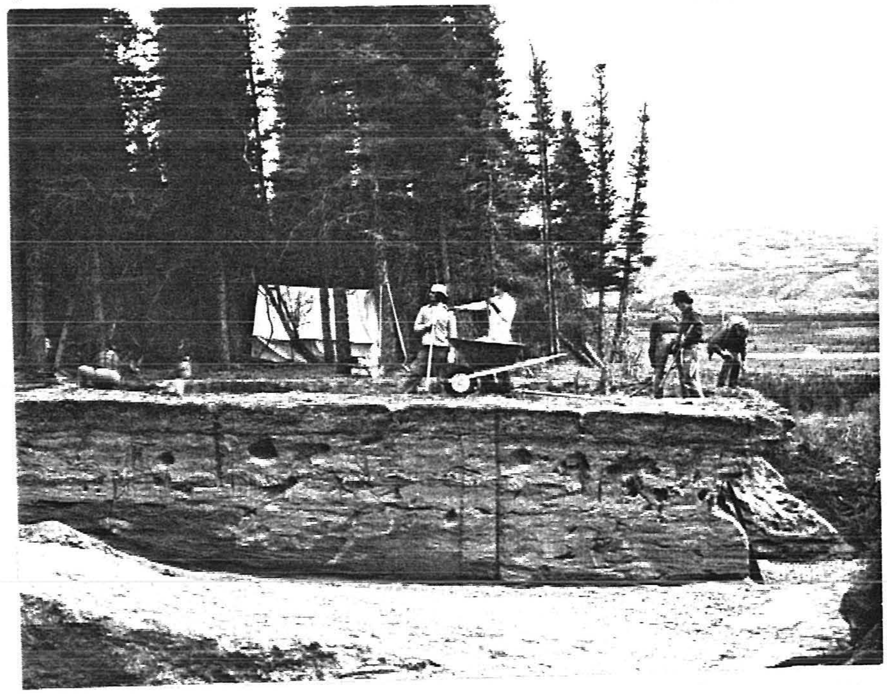


Figure 2.12. View of the 1977 excavation showing an excavated portion of area C.

Figure 2.13. View of the 1977 excavation showing the expansion of areas B and C.



of 1976 were extended to grid line E6 (Figs. 2.10 and 12) and the 1974 test trench was extended to connect Area D with the main excavation. Another 4 x 20 m unit (Area E) was also excavated at this time (Fig. 2.14).

During this season an additional 172 square meters were excavated to the surface of the Healy outwash bringing the total Dry Creek excavation to 347 square meters. An additional 160 linear meters of stratigraphic profiles were taken and another 19,033 cataloged specimens were recovered which increased the total sample size for all components at Dry Creek to 34,811. This figure does not include specimens collected from the surface and those for which provenience is incomplete or ambiguous.

The following diagram illustrates the numerical breakdown of the Dry Creek assemblage by year and component:

	1974	1976	1977	Total
C IV	145	907	1,320	2,372
C II	2,370	10,749	15,762	28,881
C I	312	1,295	1,951	3,558
Total	2,827	12,951	19,033	34,811

We found that the relative percentages of artifact categories from component to component did not change significantly, and that the actual composition of the components remained generally consistent with only a few new classes and types appearing in the 1977 season. The 1977 excavations produced more faunal remains of bison and in addition, mountain sheep and elk. It should be noted that for all genera at Dry Creek (*Bison*, *Ovis*, and *Cervus*), measurements on dentition indicate significantly larger animals than are known in extant species of these genera. Furthermore, only mountain sheep are presently in the area.

The presence of bird gastroliths (gizzard stones) was noted for the first time during the 1977 season. These occurred in small clusters in the site and were seen as another possible clue to understanding the paleoecology of the site, especially the seasonal nature of the occupations.

At the end of the 1977 excavation season the entire area was backfilled with the use of a bulldozer (Fig. 2.15). Today the disturbed area is being recolonized by herbaceous vegetation dominated by grasses and a few small willows and aspens.

Summary

Now that this phase of full-scale excavations has been completed, it is possible to briefly summarize the salient features of the site.

First of all, the oldest cultural horizon appears to date to about 11,000 B.P. and there is still no evidence that a microblade technology was part of the tool kit. Of the total inventory from this component, 90% of the finds are waste flakes, 7.4% are pebbles, rocks and rock fragments, 1.1% are bone and tooth fragments and only 2.2% are chipped stone tools. The latter category is composed of retouched flakes, utilized flakes, small bifaces, biface fragments, side scrapers,

Figure 2.14. View of excavation area E during the 1977 excavation. The majority of the area is on Component II (Loess 3, Paleosol 1).

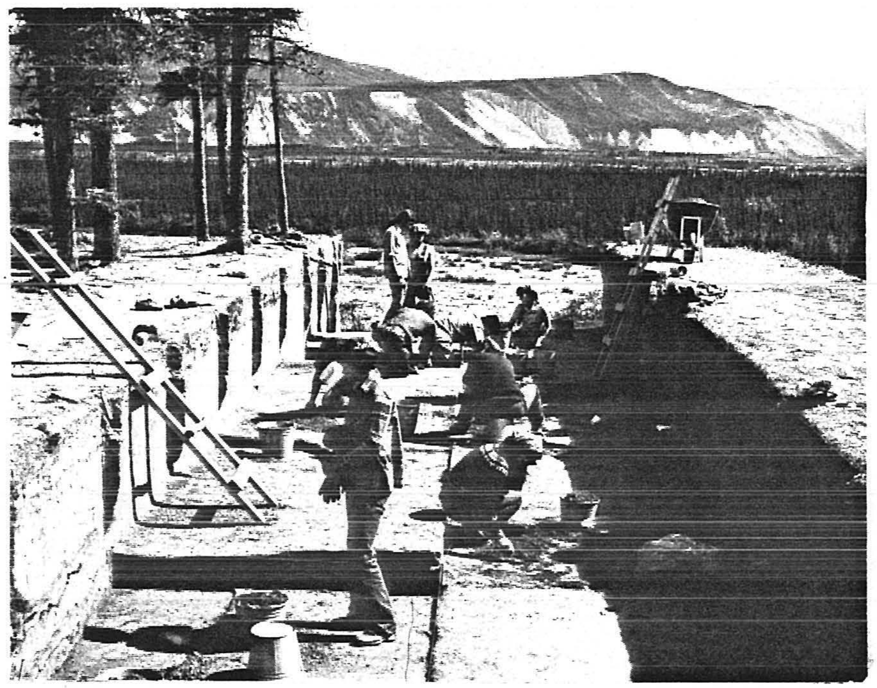


Figure 2.15. Backfilling the 1977 excavation.

end scrapers, scraper fragments, choppers, cores, core fragments, split pebbles and cobbles.

Component II dates to the mid-eleventh millennium B.P. and accounts for 84% of the entire site assemblage (N=28,881). Again, a very high percentage (95.1%) is unmodified waste (flakes and blade-like flakes) with the remainder of the inventory constituting pebbles, rocks and rock fragments (7.4%), bone and tooth fragments (1.1%), and chipped stone tools (2.2%).

A notable aspect of this component is the microblade technology and the numerous by-products of core manufacture (core tablets and rejuvenation flakes). Next, there is a series of bifacial tools composed of acuminate bifaces (elliptical, lanceolate, ovate, and deltoid), oval bifaces and rectangular bifaces and bifacial preforms. A series of bifaces stand out which have the appearance of projectile points and have been called such elsewhere in Alaska. These are roughly spatulate or slightly stemmed pieces with a very narrow straight base, expanding lateral edges and a short, broad tip; the greatest width is just below the tip, and the lateral edges are ground. Only one edge of the tip shows use wear. Also, the tips are slightly asymmetric. It would appear that these pieces have been used as knives. The remainder of the Component II artifacts is made up of side scrapers, retouched and utilized flakes, burins and burin spalls, flake cores and fragments, hammerstones, anvil stones, and flaked, split and battered pebbles and cobbles.

In Component IV, almost 99% of the inventory is waste material (flakes). Actual tools include a few end scrapers, a boulder spall tool, and five projectile points which have weakly formed side notches.

While the association of artifacts in high numbers with the remains of extinct fauna in separate stratigraphic units makes Dry Creek unique in Alaska, at least for the present, the horizontal distribution of these remains in concentrations adds a new dimension to the importance of the site. This situation permits us to examine the assemblage in terms of activity areas within the site, since, as indicated above, the artifacts classes cluster, to a high degree, within separate areas. Also, these areas are often situated around or near a burned area.

The importance of this horizontal patterning slowly became apparent during the 1974 excavations, even though the majority of this work was confined to a trench. Also, during the course of this work, particularly at the end of the season, some areas of the site were bulk sampled, i.e. flakes and microblades were collected within 25 cm square units and bagged accordingly. During our present analysis, it became necessary to renumber and re-sort these samples in order to integrate them and maintain consistency with the remainder of the collection.

During the excavations of 1976 and 1977, point provenience was recorded for the vast majority of the collection. Under certain circumstances, flake concentrations (flakes in physical contact with each other) were bulk sampled with the dimensions and positions of the clusters being recorded. This allowed us to structure our analysis of the spatial distribution of the artifacts as follows:

1) mapping the exact horizontal arrangement of all artifactual and paleoecological data,

2) mapping the density of these data by arbitrary upper and lower limiting amounts of data per one meter square units,

3) developing articulation matrices (the spatial distribution of artifact parts which fit together).

These maps then allowed us to delineate both the spatial distribution and the artifactual content of the clusters (activity areas) and to examine the variability within and between the clusters. We could also plot the position of different types of flakes (biface reduction flakes, sharpening flakes, core rejuvenation flakes, and spalls, etc.) in order to relate these kinds of activities to the site as a whole.

CHAPTER THREE

THE GEOLOGY OF THE DRY CREEK SITE

by

W. Roger Powers

THE GEOLOGY OF THE DRY CREEK SITE

Introduction: Regional Geology

The Pleistocene geology of the Nenana Valley has been studied in detail by Wahrhaftig (1958) and the regional geology of the Dry Creek site and its relationship to the broader geological framework of the Nenana Valley has been discussed thoroughly (Thorson and Hamilton, 1977). Further field investigations concentrating on the surficial Pleistocene geology of the Nenana region have been conducted by the North Alaska Range Early Man Project with Norman Ten Brink in charge of geological investigations. As a final report on these studies is still in progress, our understanding of the geological history of the Nenana Valley must rest on previous research.

Four major glacial episodes have been defined in the Nenana Valley and three of these were responsible for the formation of the major terrace systems previously described. The Browne Glaciation is the oldest and may be of Early Pleistocene or possibly Late Pliocene age. No outwash terraces have been linked to this glaciation in the Nenana Valley. The next youngest glacial episode is the Dry Creek Glaciation and it is probably of Middle Pleistocene age. The terrace surfaces attributable to this glaciation are localized in the Nenana Valley where they constitute the highest outwash terrace systems presently known. Following the Dry Creek episode, a major ice advance deposited morainal material about 1 km south of the Dry Creek site. This event, termed the Healy Glaciation also deposited extensive glacial outwash sheets which now constitute the Healy terrace. It is at the edge of this terrace that the Dry Creek site is situated on the north side of Dry Creek.

Outwash of this glaciation forms the substrate underlying the aeolian deposits at the site. The Riley Creek Glaciation is the last major glacial episode and comprises several advances (Riley Creek I and II and the Carlo Readvance) which built outwash plains represented today by several terrace surfaces which lie below the Healy terrace throughout the valley. The age of the Riley Creek Glaciation is considered to be Late Wisconsinan and it was during the waning phases of this event that the occupation of the Dry Creek site began.

Geology of the Dry Creek Site

As mentioned above, the geology of the Dry Creek site has been studied in detail and published elsewhere (Thorson and Hamilton, 1977). This description of the site geology is based entirely on this excellent work and supplemented only by field notes and by the laboratory report by James McCalpin who continued field investigations in 1976. Subsequent observations were made by the site investigators and Norman Ten Brink in 1977.

With few exceptions, the stratigraphy of the Dry Creek site remained constant throughout the history of research. Because of this, the published report by Thorson and Hamilton (1977) still stands as the definitive study of the site geology.

As previously mentioned, the cultural remains at Dry Creek were contained in an aeolian mantle overlying outwash deposits of the Healy Glaciation. This mantle is composed of sands and loesses which maintain a general thickness of 2 m. At the present time the site lies within the zone of discontinuous permafrost and the aeolian deposits at Dry Creek remain thoroughly frozen except for summer months when they thaw to a depth of about .50 m from the surface and 1.0 m in from the face of the bluff.

The geological studies published by Thorson and Hamilton (1977) were based on natural bluff exposures, the stratigraphy of four test pits and a 15 x 2 m exploratory trench which was excavated perpendicular to the bluff edge (cf. Chapter Two). The most detailed stratigraphic profile was taken on the north wall of this trench along grid line N10 between E10 and E26 (Thorson and Hamilton, 1977: Fig. 5). This profile formed the basis for the interpretation of the stratigraphy and the model by which future stratigraphic sections would be compared and monitored.

The stratigraphy of the Dry Creek site is represented by the vertical accumulation of aeolian loesses (7 units) and sands (4 units) which was interrupted by five episodes of soil development (Paleosols 1 through 4b). The following general description of the lithological units provides more detailed information. It is taken verbatim from Thorson and Hamilton (1977: Table 1).

Sand 4	Sand with minor silt and clay; light-yellowish-brown (10 YR 6/4)[b], very poorly sorted angular to subangular grains; peaty texture, with partially decomposed wood near base. Living spruce trees rooted at sharp lower contact.
Loess 7	Sandy silt with clay; poorly sorted angular grains, commonly with clay and oxide coatings; well developed reddish-brown (5YR 5/4) buried soil (Paleosol 4b) with charcoal fragments. Gradational lower contact.
Sand 3	Silty sand with minor clay; yellowish-brown (10YR 5/6), poorly sorted angular to subangular grains; thickness variable. Sharp lower contact.

Loess 6	Sandy silt with minor clay; yellowish-brown (10 YR 5/4), poorly sorted angular grains, commonly with clay and oxide coatings; contains archeologic Component IV; well-developed reddish-brown (5YR 5/4) buried soil (Paleosol 4a) with charcoal lenses and root casts. Gradual lower contact.
Sand 2	Sand with minor silt; brownish-yellow (10YR 6/6), very poorly sorted angular to subangular grains. Sharp lower contact.
Loess 5	Sandy silt with minor clay, mottled strong brown (7.5YR 5/6) to light olive-gray (5Y 6/2); poorly sorted angular grains, strongly folded and faulted, slightly to strongly deformed by creep and solifluction; altering dark organic, light olive-gray (5YR 6/2), and yellowish-brown (10YR 5/6) horizons (Paleosol 3). Sharp lower contact.
Loess 4	Sandy silt, mottled strong brown (7.5YR 5/6) to light olive-gray (5YR 6/2); poorly sorted angular grains; contains archeologic Component III. Gradational lower contact.
Loess 3	Sandy silt with minor clay, mottled strong brown (7.5YR 5/6) to light olive-gray (5Y 6/2); poorly sorted angular grains; contains archeologic Component II and decomposed bone fragments; nearly continuous dark organic horizons at top of unit (Paleosol 2), discontinuous dark organic horizons occur throughout unit (Paleosol 1). Sharp lower contact.
Sand 1	Medium sand; yellowish-brown (10YR 5/4), discontinuous sand lenses, with very well-sorted subrounded to subangular grains; weakly developed pitted texture on large quartz grains. Sharp lower contact.
Loess 2	Sandy silt with minor clay, mottled yellowish-brown (10YR 5/6) to light olive-gray (5Y 6/2); poorly sorted angular grains which coarsen upward; burrow casts common; contains archeologic Component I. Gradual lower contact.
Loess 1	Silt with minor fine sand; olive (5Y 5/3), very poorly sorted angular grains; upper 10 cm coarsens upward; occasionally contains pebbles intruded from below. Sharp lower contact.
Outwash	Cobbles, pebbles, and sand with minor silt; poorly sorted rounded to subrounded clasts of schist and other metamorphic and plutonic rocks; clasts wind polished at upper contact, and frost cracked, stained, and carbonate encrusted to 30-40 cm depth.

[a]All units are composed primarily of quartz, muscovite, and rock fragments, hence mineralogy is not described individually for each unit.

[b]Munsell colors on field-moist material.

As can be seen from the foregoing description, the schematic profile (Fig. 2.8) the stratigraphic profiles and photographs (Figs. 3.1 - 3.6), the oldest aeolian deposit at the site is Loess 1. As this unit coarsens upward, the boundary with Loess 2 is gradual. Loess 1 was probably derived from the floodplain of the Nenana River. Loesses 2 and 3 are especially important as they contain archeological Components I and II respectively. These loess units were derived from the floodplain of Dry Creek. Sand 1, although discontinuous, separates Loesses 1 and 2 throughout most of the site and constitutes a clear stratigraphic break between Components I and II. It is thought to have been a sand sheet moving over the site when especially strong, active surface winds derived coarser grained material from the front of the bluff.

Deposition was sporadically interrupted during the accumulation of Loess 3 by the formation of Paleosol units 1 and 2. Paleosol 1 occurs within Loess 3 as a series of discontinuous soil stringers (dark, organic A horizons). They are more scattered and less predictable near the bluff edge but become more continuous and better developed away from the bluff and along the northern periphery of the site. This soil complex is thought to represent a series of immature tundra soils (Cryepts) by Thorson and Hamilton (1977). The artifacts from Component II were found within and between these soil stringers.

Paleosol 2, which formed at the top of Loess 3, is thicker and nearly continuous throughout the excavation area. It is very often a single soil unit (dark, organic A horizon) but locally bifurcates or even separates into a series of discontinuous soil stringers. Like Paleosol 1, Thorson and Hamilton (1977) interpret this unit to be an immature tundra soil (Cryept). It is entirely sterile of cultural

Figure 3.1. North-south stratigraphic profile along grid line E20 between S2 and N8. This section is parallel to the bluff edge.

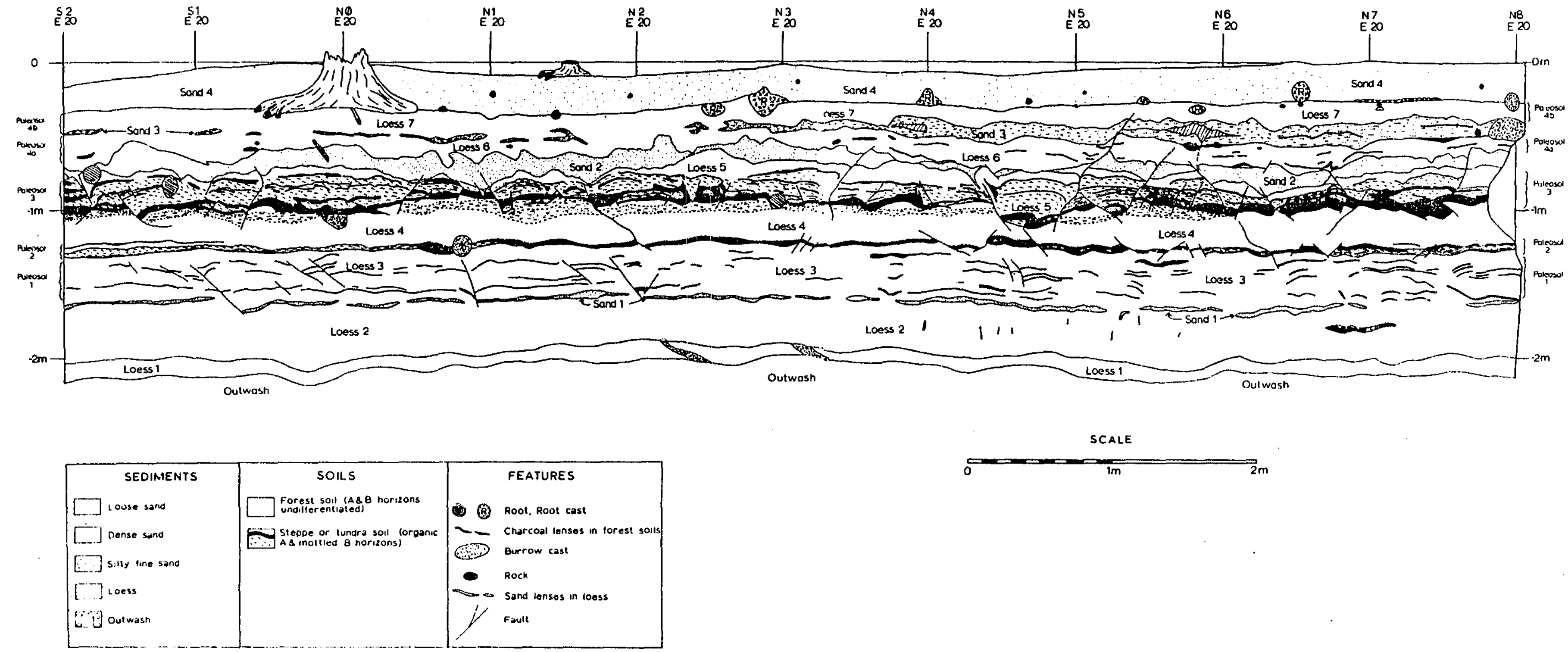

S2 E20
S1 E20
NØ E20
N1 E20
N2 E20
N3 E20
N4 E20
N5 E20
N6 E20
N7 E20
N8 E20
0
0m
-1m
-2m
Paleosol 4b
Paleosol 4a
Paleosol 3
Paleosol 2
Paleosol 1
Sand 4
Sand 3
Loess 7
Loess 6
Sand 2
Loess 5
Loess 4
Loess 3
Sand 1
Loess 2
Loess 1
Outwash
SCALE
0
1m
2m
SEDIMENTS
Loose sand
Dense sand
Silty fine sand
Loess
Outwash
SOILS
Forest soil (A&B horizons undifferentiated)
Steppe or tundra soil (organic A & mottled B horizons)
FEATURES
Root, Root cast
Charcoal lenses in forest soils
Burrow cast
Rock
Sand lenses in loess
Fault

Figure 3.2. North-south stratigraphic profile along grid line E16 between N10 and N14. The section is parallel to the bluff edge. See Figure 3.3 for a photograph of this section.

Figure 3.3. Photograph of the stratigraphy along grid line E16 between N10 and N14. This section is parallel to the bluff edge. Figure 3.2 is the stratigraphic profile of this section. The vertical lines are .50 m apart. The horizontal line is 1 m below sub-datum.

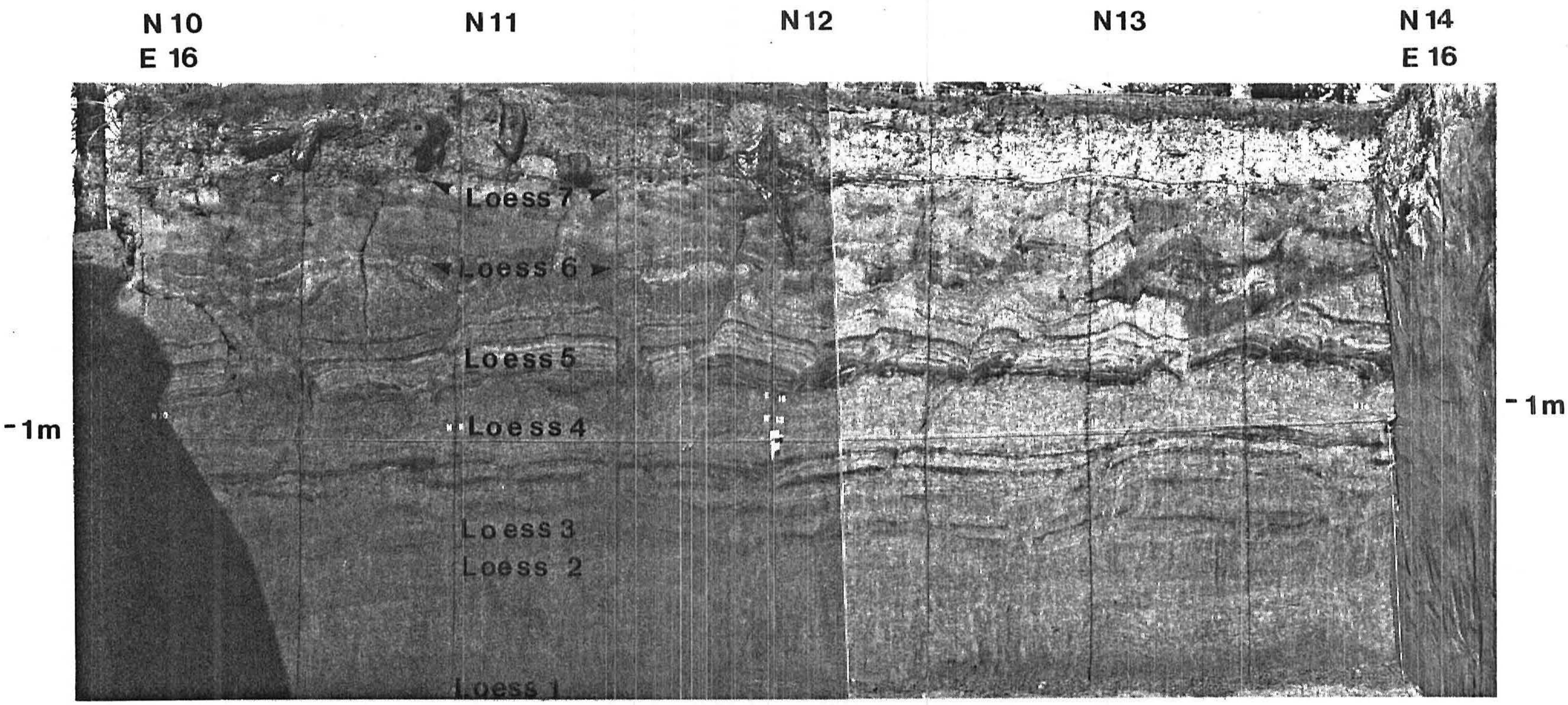
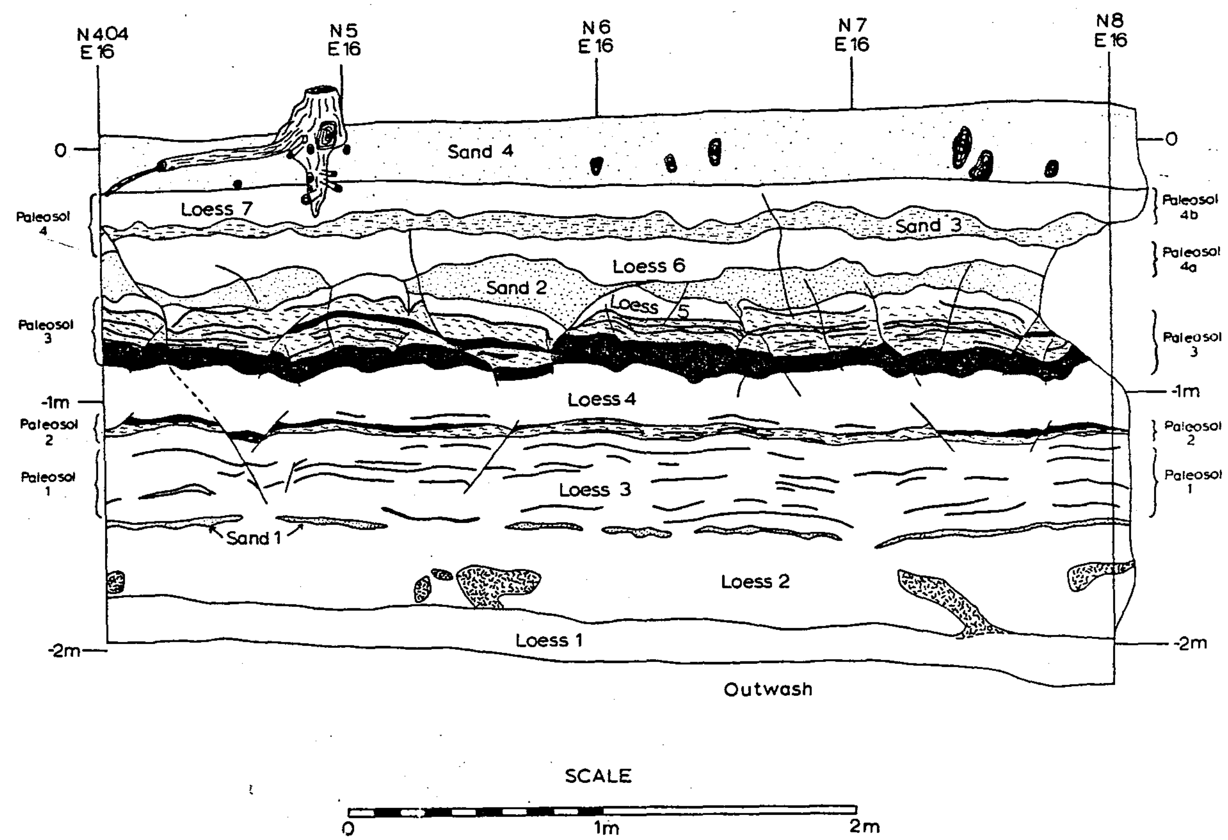

N 10
E 16
N 11
N 12
N 13
N 14
E 16
Loess 7
Loess 6
Loess 5
Loess 4
Loess 3
Loess 2
Loess 1
-1m
-1m

Figure 3.4. North-south stratigraphic profile along grid line E16 between N4.04 and N8. The irregular wall at the left hand side of the picture is the collapsed south wall of the 1974 test trench.



SEDIMENTS	SOILS	FEATURES
Loose sand	Forest soil (A & B horizons undifferentiated)	Root, Root cast
Dense sand	Steppe or tundra soil (organic A & mottled B horizons)	Charcoal lenses in forest soils
Silty fine sand		Burrow cast
Loess		Rock
Outwash		Sand lenses in loess
		Fault

Figure 3.5. Photograph of the stratigraphy along grid line E16 between N4.04 and N8. The vertical lines are .50 m apart. The horizontal line is 1 m below sub-datum.

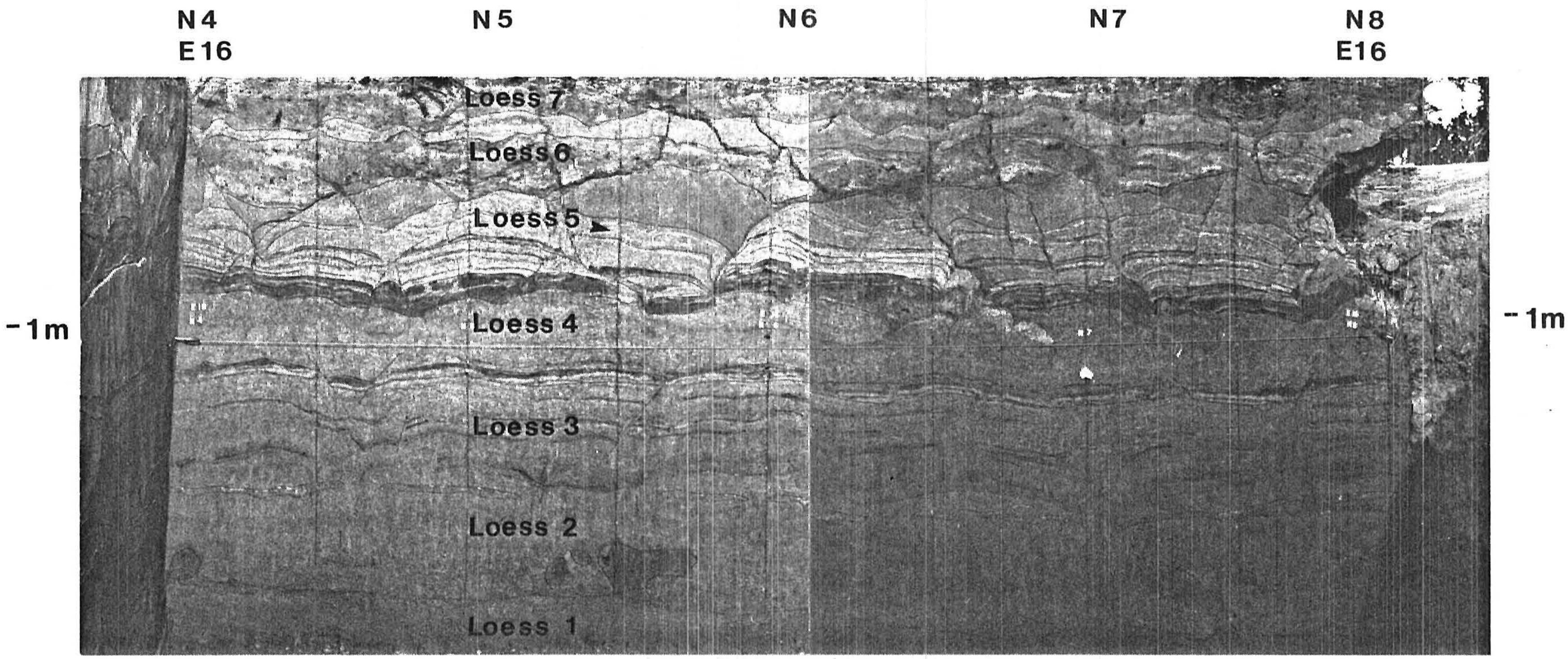
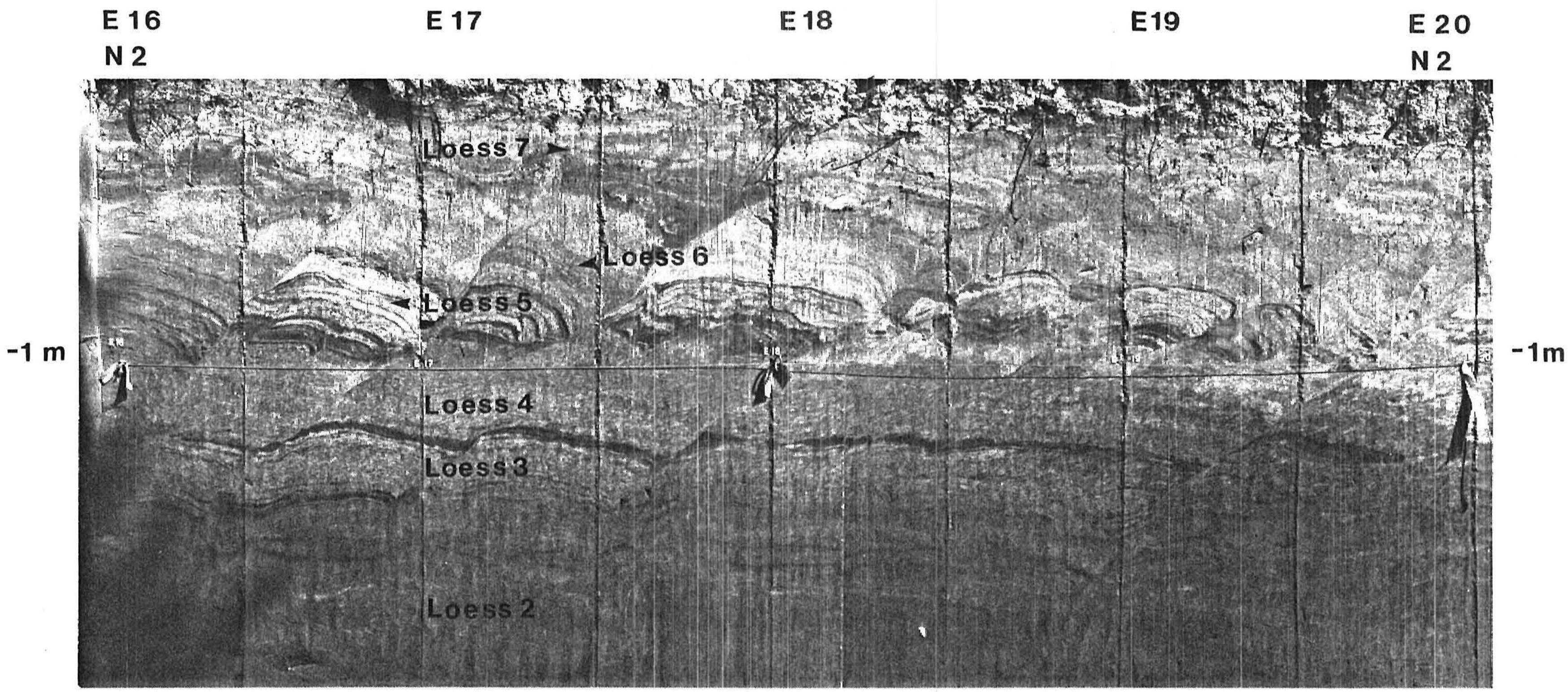

N4
E16
N5
N6
N7
N8
E16
-1m
-1m
Loess 7
Loess 6
Loess 5
Loess 4
Loess 3
Loess 2
Loess 1

Figure 3.6. Photograph of the stratigraphy along grid line N2 between E16 and E20. This section is perpendicular to the bluff edge. The vertical lines are .50 m apart and the horizontal line is 1 m below sub-datum.


E 16
N 2
E 17
E 18
E19
E 20
N 2
-1 m
-1m
Loess 7
Loess 6
Loess 5
Loess 4
Loess 3
Loess 2

material.

Loess 4 represents renewed accumulation following the formation of Paleosol 2. The source area for this loess appears to be the Nenana River floodplain. This unit is better sorted and shows little thickness or textural variation over the excavation area.

There has been some confusion over the presence of artifacts in this loess unit. It appeared during the 1974 excavation period that a localized accumulation of flakes, microblades, and a few tools were associated with this unit. While depth measurements indicated the possible presence of a Component III, subsequent examination showed that in this area of the 1974 trench, the top of Loess 3 was higher than in most areas, and Paleosol 2 was often little more than a series of discontinuous soil stringers. These facts, plus structural deformation, (see below) created a situation where such a mistake was highly probable.

Loess 4 is followed by the accumulation of Loess 5 and the development of a thick set of soil units -- Paleosol 3. Like Loess 4, this unit is also better sorted and is fairly consistent with respect to texture and thickness. Its source area is also thought to be the floodplain of the Nenana River (Thorson and Hamilton, 1977). Loess 5 was continually interrupted by the formation of a series of soil units (Paleosol 3). The lowest soil is the most strongly developed and over much of the site at least eight more organic horizons are present. These soils are more continuous and are represented by prominent, dark organic A horizons which are separated by light-gray and yellowish-brown zones. This series of soils, like Paleosols 1 and 2 is interpreted by Thorson and Hamilton (1977) as being immature tundra soils (Cryepts). This entire unit is continuous throughout the main excavation area. The only disturbance which has affected development has been structural (see below).

During excavation a few scattered flakes and one microblade core were found in this unit. Rather than a wedge-shaped microblade core such as those recovered from Component II, this specimen is similar to a Tuktu core (cf. Campbell, 1961). Even in this comparison, we hasten to add that it is abberant. It is not entirely clear if these scattered remains are <u>in situ</u>. It is possible that they have moved upward along one of the many cracks which run through this unit as a result of structural deformation. Again, since the situation is unclear, we have chosen to exclude these few remains from consideration.

Loess 5 is covered by Sand 2. It is very coarse grained, poorly sorted, and becomes thinner and finer grained away from the bluff. It is thought to be derived from the Dry Creek floodplain and the exposed slope in front of the site when strong, gusting winds were sweeping the area.

Loess 6 overlies Sand 2 and like Loesses 4 and 5 is better sorted and exhibits little thickness or textural variation. Again, the source area is thought to be the Nenana River floodplain.

Paleosol 4a occupies nearly the upper two thirds of this loess unit. This soil differs considerably from the lower paleosol units. According to Thorson and Hamilton (1977), this paleosol is a Subarctic Brown Forest Soil (Ochrepts and Orthods) which is commonly found developing under the modern taiga of interior Alaska. This soil is thick, continuous and contains a prominent reddish-brown oxidized B horizon. Charred root casts indicate both the development of forests during this episode and periodic burning. Local drainage conditions on the site area were variable. The B horizon of this soil exhibits oxidation near the bluff edge (better drainage) but, at roughly 15 m from the bluff edge, it changes to a composite profile more similar to Low-Humic Gley Soils (poorer drainage) (Thorson and Hamilton, 1977). Archeological Component IV occurs within this soil unit. It is an assemblage which differs considerably from the underlying components and probably represents the appearance of the Northern Archaic in the Nenana Valley.

Sand 3 overlies Loess 6 and in contrast to Sands 2 and 4, is comparatively finer grained and exhibits better sorting. The floodplain of Dry Creek may have been further from the site, or the exposed outwash surface of the bluff was more protected. This unit pinches out along the bluff edge and results in the vertical coalesence of Loesses 6 and 7 and hence Paleosols 4a and 4b.

Loess 7 overlies Sand 3 throughout most of the site. Again, this is a better sorted loess bed and shows little thickness or textural change. It is also thought by Thorson and Hamilton (1977) to have derived from the floodplain of the Nenana River. This entire loess unit is occupied by Paleosol 4b which is nearly identical to Paleosol 4a. As mentioned above, this soil merges with Paleosol 4a near the bluff edge. Forest development and periodic burning are also suggested for this soil. It appears to have been better drained then Paleosol 4a as it does not exhibit the transition to a gleyed condition away from the bluff (Thorson and Hamilton, 1977).

The entire sequence is capped by Sand 4 which is presently building up along the bluff edge. This unit thins away from the bluff and is presently burying the trunks of the existing trees. It is derived from the exposed bluff edge which is presently being undercut by Dry Creek (Thorson and Hamilton, 1977).

An examination of the stratigraphic profiles from Dry Creek reveals a section that has undergone striking deformation. The numerous cracks which run through the section are thought to be normal faults resulting in displacements of up to 50 cm. They run about 30 degrees near the bluff but become progressively more vertical away from the bluff edge. The strike of most of these faults is parallel to the bluff edge and many of these small fault blocks appear to have rotated counterclockwise as the entire mantle was expanding toward the bluff. This has resulted in the lateral stretching and minor vertical deformation of the lower part of the section (Loesses 1 through 4). However, the loess mantle underwent a major episode of stretching and faulting roughly concurrent with the deposition of Sand 3 (near the top of the section). It has been suggested that this may be the result of a strong local earthquake (Thorson and Hamilton, 1977).

Evidence of solifluction disturbance is noticeable in the bluff edge, particularly in Paleosol 3. The movement appears to have been in a northeasterly direction along the edge of the terrace. Solifluction also affected Paleosol 3 within the excavation area where this unit slopes toward the bluff edge (Thorson and Hamilton, 1977).

Because of the deformation by faulting which affected all of the archeological components in the Dry Creek site (Component I the least and Component IV the most), extreme care was necessary in determining the stratigraphic unit in which one was working and in monitoring the fault systems both vertically and horizontally. As a result, there could be little doubt about the stratigraphic position of most finds, and as the mapping of the finds in Components I and II illustrates (Chapter Four), the horizontal displacement of artifacts in these components was minimal.

Dating

Like other aspects of the geology of the Dry Creek site, the radiocarbon dates have been presented in detail and discussed by Thorson and Hamilton (1977) and the geochronology of the Dry Creek site has also been treated briefly by Powers and Hamilton (1978).

Of the seventeen dates from the site (Table 3.1), all but three are believed to represent the correct chronological succession of the site (cf. Fig. 2.9). The questionable samples have exceedingly high counting errors and are anomalously old considering the present general understanding of the Late Pleistocene geological history of the Nenana Valley. Those samples which are considered incorrect are 23,930 ± 9300 (SI-1938), 12,080 ± 1025 (SI-1936) and 19,050 ± 1500 (SI-1544). Sample SI-1935A (10,600 ± 580) from the top of Paleosol 3 (Loess 5) should also be treated with suspicion as it is clearly not in line with the other dates from this unit. However, the incongruity is not of the magnitude represented by the samples mentioned above. One other sample, SI-2328 (7985 ± 105) was taken from the 4m x 4m test pit excavated at the western extremity of the site in 1976. The stratigraphy here is so badly deformed by convolutions that little correlation can be made with the main excavation area.

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*Eighteen samples were dated by Dr. Robert Stuckenrath of the Smithsonian Institution. All samples except SI-1933b (375 ± 40 -- Paleosol 4b: peat and roots) were identified as charcoal.

Table 3.1

Radiocarbon dates from the Dry Creek site[a]

Lab No.[b]	C^{14} yrs B.P.	Stratigraphic and Archeological units	
SI-1933A	Modern	Paleosol 4b	
SI-1933B	375 ± 40	Paleosol 4b	
SI-2333	1145 ± 60	Paleosol 4b	
SI-2332	3430 ± 75	Paleosol 4a	Component IV
SI-1934	3655 ± 60	Paleosol 4a	Component IV
SI-1937	4670 ± 95	Paleosol 4a	Component IV
SI-2331	6270 ± 110	Paleosol 3	
SI-1935C	6900 ± 95	Paleosol 3	
SI-1935B	8355 ± 190	Paleosol 3	
SI-2115	8600 ± 460	Paleosol 3	
SI-1935A	10,600 ± 580	Paleosol 3	
SI-1544	19,050 ± 1500	Paleosol 3	
SI-2329	9340 ± 195	Paleosol 2	
SI-2328	7985 ± 105	Paleosol 2? (test pit)	
SI-1936	12,080 ± 1025	Paleosol 2	
SI-1938	23,930 ± 9300	Paleosol 2	
SI-1561	10,690 ± 250	Paleosol 1	Component II
SI-2880	11,120 ± 85	Loess 2	Component I

[a]Modified after Thorson and Hamilton, 1977: Table 4
[b]Smithsonian Institution

The anomalous dates are difficult to explain. Thorson and Hamilton (1977) have discussed the possibility that during episodes of paleosol development, airborn coal, lignite, or ash from burning seams of the same, may have been deposited at the site as part of the normal loess fallout. They also point out that the samples identified as charcoal actually yielded low amounts of residual carbon after nitration pretreatment indicating that the original samples apparently contained high percentages of humic material. It is further noted that:

> If windblown particles of dead carbon had been transported to the site at a nearly constant rate, then those samples that yielded the smallest insoluable residue of charcoal after pre-treatment would show the greatest age anomalies. The largest samples, with smallest counting errors, should yield the most nearly accurate dates (Thorson and Hamilton, 1977:167).

Research should be conducted to determine the presence or absence of airborn coal or lignite in the Nenana Valley since, in all likelihood, more of these seams are presently exposed than ever before due to modern mining activity and the burning of fossil fuels at the nearby Golden Valley Electrical Association coal fired power plant at Healy. This would, at least, give us a point of departure for dealing with this potential problem in the future.

It should also be noted that wind direction is a critical factor and to derive airborn coal dust from the presently exposed coal seams would require wind direction from the north and east, neither of which are common occurrences in the area today. The effective winds (in this case katabatic) are predominantly from the south. However, the Healy area is topographically complex with several tributary valleys joining the Nenana and this results in localized up and down valley drafts which could conceivably waft the dust over the whole region.

Until a further attempt is made to solve this perplexing matter, we should consider it a very likely, albeit speculative possibility, that airborn coal dust has contaminated some of the Dry Creek radiocarbon dates, specifically those we have excluded from the site chronology.

Of the samples remaining, 11,120 ± 85 B.P. (SI-2880) provides a reasonable date for the upper part of Loess 2 and hence an upward limiting date for Component I. The date of 10,690 ± 250 B.P. (SI-1561) from a hearth in Component II, provides an age for the middle of Loess 3 (Paleosol 1). This is followed by the date of 9340 ± 195 B.P. (SI-2329) from Paleosol 2 and applies to the top of Loess 3. Dates 8355 ± 290 B.P. (SI-1935B) and 6270 ± 110 B.P. (SI-2331) nicely bracket Loess 5 (Paleosol 3) with the date of 6900 ± 95 (SI-1935C) constituting an average date for this unit. Two other dates from the top of Loess 5 of 8600 ± 460 B.P. (SI-2115) and 10,600 ± 580 B.P. (SI-1935A) show increased counting errors and are anomalous. Loess 6 (Paleosol 4a) which contains Component IV is bracketed by 4670 ± 95 B.P. (SI-1937) for the bottom and 3655 ± 60 B.P. (SI-1934) and 3430 ± 75 B.P. (SI-2332) for the top. Loess 7 (Paleosol 4B) has three samples taken from near the top of this unit which have provided dates of 1145 ± 60 B.P. (SI-2333), 375 ± 40 B.P. (SI-1933B) and Modern (SI-1933A).

The only major weaknesses in the geochronology of the Dry Creek site are the number of single dates for the lower components and the possibility of contamination. In an attempt to overcome these obstacles, we have used only those dates with the lowest counting errors which, as fortune would have it, provide a consistent vertical series. The age of Component II is not excessive and is roughly synchronous with other early microblade sites in the Alaskan Interior. Also, the nature of the fauna discovered in Components I and II increases our confidence that the Dry Creek loess cap has been correctly dated.

In addition to providing dates on the archeological occupations at the Dry Creek site, the chronology provides estimates on major climatic changes in this part of the Nenana Valley. During the early history of the deposition at Dry Creek (Loess 1, 2, Sand 1 and Loess 3) aeolian sediments accumulated in what was probably an open herbaceous landscape concurrent with the major glacial-alluvial activity of the Riley Creek II Glaciation or the Carlo Readvance of the Riley Creek glacier. Our ideas relating to the nature of this environment are treated in greater detail in Chapter Six. However, this major glacial activity probably ended by 8500 B.P. and the subsequent vegetation history of the site area up to about 5000 B.P. can be characterized by a slow deterioration of the dryer herbaceous cover, the development of tundra associations, poorer drainage conditions, a rising permafrost table in response to a more insulating vegetation cover and finally the appearance of the Modern Boreal Forest shortly after 5000 B.P. which has continued to the present day (Thorson and Hamilton, 1977).

CHAPTER FOUR

LITHIC TECHNOLOGY OF THE DRY CREEK SITE

by

W. Roger Powers

LITHIC TECHNOLOGY OF THE DRY CREEK SITE

Introduction

The Dry Creek stone workers selected a wide range of raw materials for the production of their tools: most commonly used were rhyolite (light, dark and banded), degraded quartzite (often referred to as just quartzite in the report), gray chert and chalcedony (including jasper). Of these, the rhyolites and quartzite are locally available, the former occurring east of the Nenana River and the latter in the bed load of Dry Creek, past and present. The cryptocrystalline rocks, gray chert and chalcedony, probably occur locally, considering their abundance, but the exact source is not presently known. Brown chert is available in the gravel bed of Dry Creek and is derived from the Tertiary gravels upstream. Less commonly encountered are pumice, diabase, sandstone, slate, argillite, schist and quartz all of which are available locally in the Tertiary age Nenana gravels and the Pleistocene outwash and alluvial gravels of the Nenana River and its tributaries (e.g., Dry Creek). Several fine-grained and cryptocrystalline rocks were used, but uncommonly, and either occur sporadically in the local gravels or have distant source areas. These include green, black, and ferruginous cherts. Obsidian and devitrified volcanic glass are not presently known in the immediate area. There is a possibility that the obsidian may be derived from the Indian Mountain area on the Koyukuk River about 330 km by air to the northwest of Dry Creek (Holmes, personal communication).

The Dry Creek stone workers were careful to reserve the fine-grained and cryptocrystalline rocks for tools in the finer end of the technology, i.e., small bifaces, microblade cores, and small scrapers. There was a definite tendency to use these raw materials to the fullest extent. This could mean that most or all of these rocks were relatively rare in the immediate hinterlands or fairly difficult to come by. The coarser stones, especially the quartzites and dark rhyolites with phenocrysts, were used extensively for making opportunistic implements.

The total site assemblage is comprised of 34,811 cataloged specimens. Component I accounts for 3558 specimens, Component II for 28,881 and Component IV for 2372. It is the 32,439 specimens from the two early components that are discussed in this chapter.

The lithic remains in the two early components at Dry Creek are of chipped and battered stone tools which account for only 8.3% of the assemblage. The remainder of the artifacts (91.7%) are flakes or waste material resulting from stone tool manufacture. It is the tools themselves which are discussed in this chapter and the emphasis is on technology and function. The spatial patterning of both tools and flakes plus an analysis of the flakes are discussed in Chapter Five.

Certain judgments about the relative importance of artifact categories have been necessary. Hence, in describing certain artifact classes, particularly those which have controllable variability, measurements and attributes are provided individually. In other cases, where variability is more diffuse, measurements are provided as ranges and means, and descriptions are formalized.

Observations on the functions of some artifact types from the Dry Creek site are based on morphology and technology e.g., shape, manufacturing technique and evidence of repair. In addition, microscopic examination of use wear and striations was conducted by Dr. T.A. Del Bene and presented in detail in his doctoral dissertation at the University of Connecticut (Del Bene, 1981). The results of his research which have been incorporated into the discussion of the lithic technology at Dry Creek, are based on both the dissertation and lab notes.

Measurements for all classes are given in millimeters in a linear sequence such as 102 x 67 x 14 mm, where the first is length, the second width, and the last thickness. This is true of all classes except wedge-shaped cores where the sequence is length, width, and height. The length refers to the distance from the fluted surface to the back of the core, the width is the distance between the two sides or faces of the core, and the height, the distance from the base to the top of the working platform.

Component I: Artifacts

Of the total assemblage of 3517 artifacts from Component I, only 43, or roughly 1%, can be classified as shaped tools. The remaining 99% of this assemblage is composed of flakes. Within Component I (Loess 2), most of the tools and flakes occurred within discrete clusters. The analysis of the spatial distribution of the finds and the contents of the clusters is presented and discussed in Chapter Five.

The tools from Component I are classified as bifacial tools (8), scrapers (18), and miscellaneous artifacts (17).

Bifacial Tools

The bifacial tools can be further subdivided as follows: projectile point (1), point bases (2), biface base (1), biface tip (1), and bifacial knives (3).

Projectile point (1)

This specimen is the single complete example of a point from Component I (Fig. 4.1A). It is a small, black chert isosceles triangular biface measuring 31 x 16 x 4 mm. The edges are slightly excurvate and the base is straight except for a small spur at one corner. There is no evidence of use wear or edge grinding although there are faint hints of hafting wear on the base. All edges are straight, finished and the tip is well formed and very sharp. Its flatness and symmetry renders the piece perfectly suitable for penetration.

Point bases (2)

Two basal fragments of probable points were also found in Component I. On morphological and technological grounds they appear to be bases of points very similar to that just described above. They are both of gray chert and were finished with fine pressure retouch. The larger specimen (Fig. 4.1B) has a straight base and straight ascending edges while the smaller piece (Fig. 4.1C) is more irregular, has constricting edges and a small spur at one corner of the base. In this regard, it is similar to the complete specimen of a point from this component. There is no evidence of use wear, edge grinding, or hafting wear. The measurements are: 8 x 23 x 3 mm (Fig. 4.1B) and 7 x 19 x 3 mm (Fig. 4.1C).

Biface base (1)

This piece (Fig. 4.1D) is the basal fragment of a brown chert biface either broken during manufacture or discarded unfinished.

Figure 4.1. Bifacial artifacts from Component I.

A Projectile point

B-C Projectile point bases

D Biface base

E Bifacial Tip

scale = 10 cm

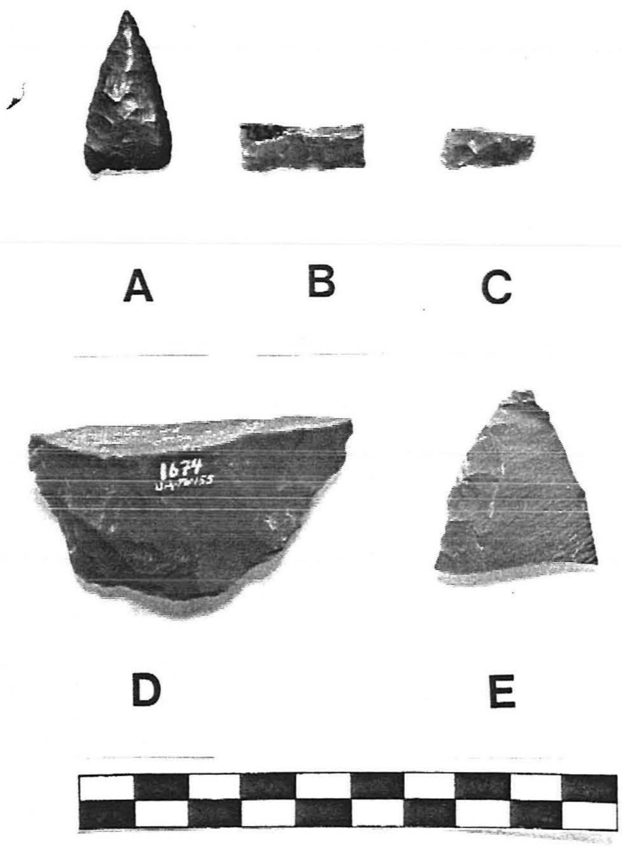
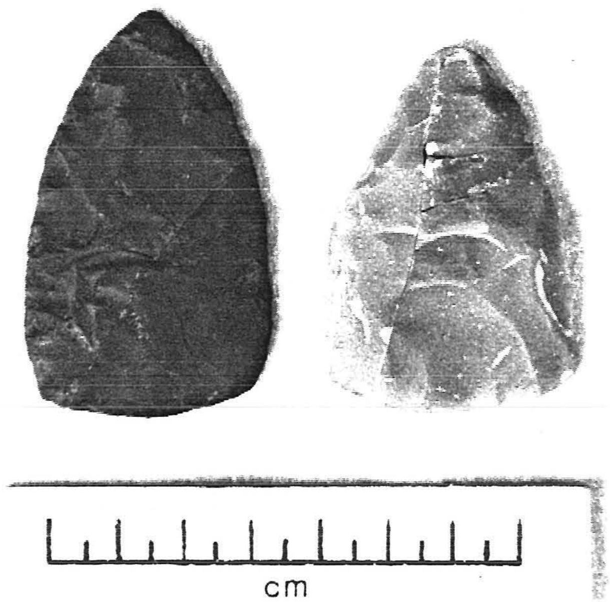

A
B
C
D
E
1674

Figure 4.2. Bifacial knives from Component I.

scale = 7 cm


cm

Attempted fabrication essentially ruined one of its edges. It measures 31 x 60 x 20 mm.

Biface tip (1)

This flake of ferruginous chert (Fig. 4.1E) has a triangular form and a lenticular cross section. There is unifacial retouch along one edge and bifacial retouch along the other. The bifacial edge and the tip are unfinished. This situation may be related to a snap which broke the base away from the piece. The fragment measures 32+ x 30+ x 5+ mm.

Bifacial knives (3)

Two of these knives were found in fragments which fit together to form complete tools. They have triangular outlines with slightly excurvate edges and convex bases. The cross sections are lenticular.

Of these, one (Fig. 4.2: right side) measures 55 x 38 x 9 mm and was made on a flake of devitrified volcanic glass. It was broken during manufacture into three pieces: one entire edge, a portion of the tip and the main body of the knife. The three fragments of the knife lay directly in the flaking debris resulting from its manufacture. The knife was broken when the worker applied excessive pressure while attempting to remove a knob at one edge. Crushing and deep hinge fractures along the edge indicate that several attempts were made to remove the obstacle. This knife was in the pressure flaking stage of bifacial reduction and only some thinning along the edges and the tip remained before completion.

The other complete knife measures 64 x 36 x 8 mm (Fig. 4.2). It was made on a flake of ferruginous chert and was probably complete and in the process of use when it was broken. All final retouch had occurred along the edges and there is isolated evidence of use wear. No clear evidence of hafting could be detected but it seems possible that the specimen broke in a haft when either a blow or excessive pressure was applied, and a diagonal fracture developed which ran from high on one edge to the opposite corner of the base.

The third specimen possesses the same formal features but it is a very crudely triangular rhyolite flake on which bifacial thinning and shaping was attempted. The flaking apparently miscarried and the piece was abandoned. It measures 45 x 32 x 10 mm.

Scrapers

The Dry Creek Component I scrapers are classified as follows: transverse scrapers (3), side scrapers (2), end scrapers (11), double end scraper (1) and end scraper/burin (1).

Transverse scrapers (3)

These specimens are characterized by a unifacially flaked edge which is transverse to the long axis of a piece of dacite. On one specimen (Fig. 4.3A), this edge is straight and traverses the distal end of a flake which retains cortex on the dorsal surface. The working edge lies at an angle of 70° to the ventral surface and appears to have been applied to a scrape or cut resistant material. It also appears to have been hand held. This specimen measures 110 x 61 x 10 mm.

The second transverse scraper (Fig. 4.3B) was made on a rectangular water worn slab. It has a rectangular cross-section and the unifacial working edge, formed by steep flaking, runs across one end of the slab. It lies at an angle of 70°-90° to the ventral surface of the tool. The edge is straight and fairly crude. Some additional finer retouch was applied, but most of the smaller flaking is edge damage which sporadically extends onto the ventral surface. It appears to have been hand held and used to pound on a resistant material. This piece measures 179 x 107 x 33 mm.

The third piece in this group (Fig. 4.3C) was made on a section of a longitudinally split oblong cobble. The dorsal surface is comprised mainly of the facet of a previous flake removal which is bordered by cobble cortex. The unifacially flaked working edge is slightly convex. It is transverse to the long axis of the flake and lies at about 70° to the ventral surface. There is no evidence of use wear. It measures 157 x 73 x 27 mm.

Side scrapers (2)

One of these specimens is an asymmetric, opposing convergent side scraper made on a thick flake of ferruginous chert (Fig. 4.4A). The axis of the scraper departs about 20° from the axis of the flake. One finely retouched, slightly convex scraping edge is found on the dorsal surface and runs along the entire length to the butt of the flake. A second scraping edge converges on the first from the opposite side and face of the flake. This second edge conforms to a break in the flake which renders it highly convex. The converging edges form an unrefined tip. No use wear can be detected on either edge and it may have been discarded before use. It measures 73 x 49 x 14 mm.

Figure 4.3. Transverse scrapers and quadrilateral uniface from Component I.

A–C Transverse scrapers

D Quadrilateral uniface

scale = 10 cm


A
B
C
D

The second side scraper was made on a bifacial thinning flake of rhyolite (Fig. 4.4B) and has a straight, steeply retouched scraping or cutting edge. Retouch was also applied to one end of the flake forming a narrow convex bifacial edge. It measures 62 x 41 x 10 mm.

End scrapers (9)

End scrapers from Component I at Dry Creek (Fig. 4.5) were manufactured on flakes of dacite (3), green chert (2), gray chert (1), rhyolite (1), and chalcedony (2). Four of the scrapers were made on blade-like flakes which preserve one or two arises on the dorsal surface. On these specimens the scraper edges are on the distal ends of the flakes and (on four examples) the edges are transverse to the axes of the flakes. Two other specimens were made on simple flakes and the scraper edges occupy the same distal and transverse positions. Two specimens display end scraper edges on the left side of the flakes. In each case, this edge lies at a 90° angle to the axis of the flake.

Fine pressure retouch was used to form the convex scraper edges on all specimens. In each case, the length of the retouching facets depends on the variable thickness of the distal ends of the flakes.

On the basis of the scraper edge/ventral surface angle exactly at the edge of the specimen, the end scrapers can be subdivided into two categories -- steep and flat. Steep end scrapers (Fig. 4.5A-G) have edges ranging from 70°-80° to the ventral surfaces of the flakes. Flat end scrapers (Fig. 4.5H-K) have scraper edge/ventral surface angles which vary from 40°-60°. Four of the steep-end scrapers bear traces of minor, sporadic retouch along the lateral edges and one has a

Figure 4.4. Side scrapers and unshaped flake tools from Component I.

A–B Side scrapers

C–D Unshaped flake tools

scale = 10 cm

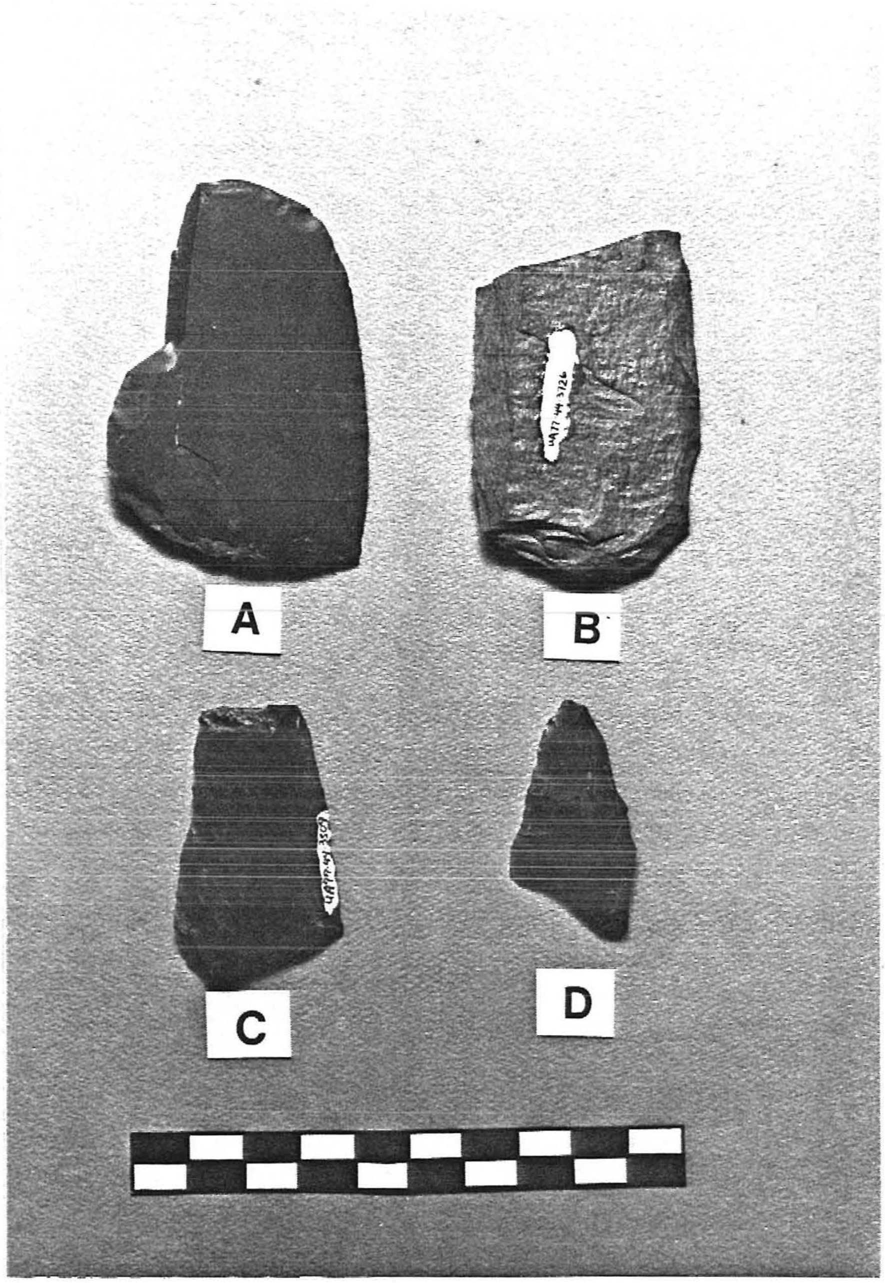
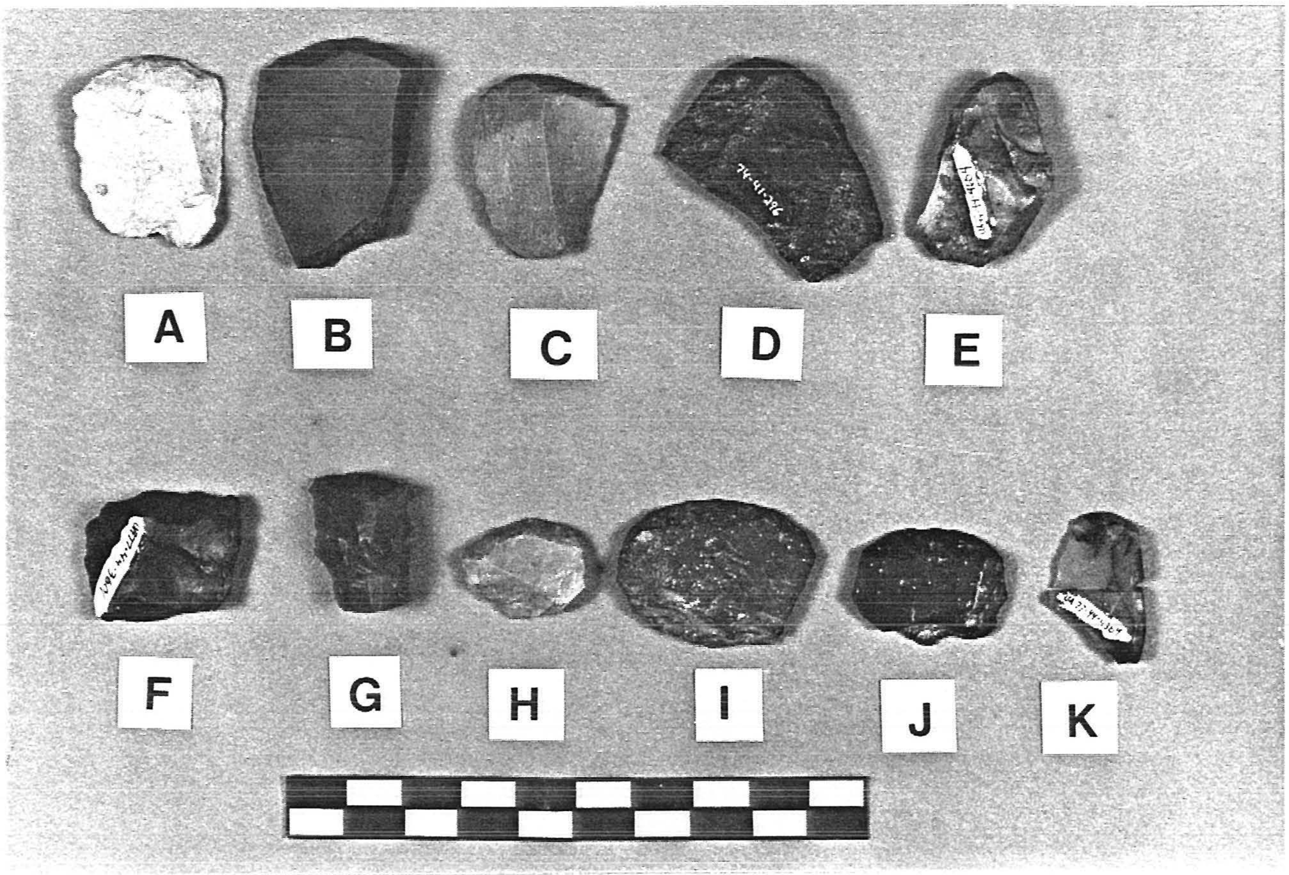

A
B
C
D

Figure 4.5. End scrapers from Component I.

A–E,G Steep end scrapers

H–J Flat end scrapers

scale = 10 cm


A
B
C
D
E
F
G
H
I
J
K

well-shaped, convex scraping edge on the left margin and minor retouch at the proximal end. Two of the flat end scrapers are retouched on both lateral edges. One lacks additional working.

All specimens classified as end scrapers lack polishing on the working edges. Rather, each displays fine to microscopic crushing which could best be explained by a cutting action which was directed against a fairly resistant material such as bone. This is an important distinction since this artifact type is consistently classified as a scraper, with that function implied, and, while experimental evidence exists to support that assumption (Semenov, 1964), it appears that in some instances the end scraper can function as a knife (Aigner, 1970, 1978).

Microscopic examination also indicates that all but one of the specimens were probably hafted. This is revealed by wear on the crests of flake facets beginning just behind or below the scraper edge and continuing to the proximal end of the flake.

The last specimen is the detached working edge of a flat end scraper which was broken during either use or manufacture. It is chalcedony and measures 7 x 16 x 2 mm.

Double end scraper (1)

This single specimen (Fig. 4.5F) is bifacially retouched. It has two opposing scraper edges and additional retouching along both lateral edges. Enough of the ventral surface of the flake remains to distinguish proximal and distal extremities. The proximal scraping edge lies at a 90° angle to the ventral surface. Like some other end scrapers it was probably used as a cutting implement which was applied to cut resistant material.

The distal scraping edge may have never been used and an attempt to prepare it miscarried. This edge lies at 75° to the ventral surface. The distal end of the scraper bears hafting wear. This scraper was made on a flake of black chert and measures 22 x 26 x 9 mm.

End scraper/burin (1)

This is a combination tool (Fig. 4.5K) made on a thin flake of moss agate. It was broken during use. The short convex scraper edge lies at the distal end of the flake at a 70° angle to the ventral surface of the flake. Three burin blows were struck at the distal end although only one succeeded. A return blow was struck in the opposite direction. The use wear on the burin is on the ventral edge and at the origin of the return blow. Both lateral edges of the flake are formed by breaks which bear extremely fine retouch or utilization chipping. It appears that the breaks were also used as burins.

Again, the scraper edge was used as a cutter on a resistant material but no wear from hafting could be discovered. After the piece was broken, the snapped edges were further utilized as burins. The specimen measures 26 x 18 x 3 mm.

Miscellaneous Artifacts

The miscellaneous artifacts from Dry Creek have been classified as follows: quadrilateral uniface (1), unshaped flake tools (6), split cobble tools (3), cobble cores (4) and anvil stones (2). As such, they do not constitute a typological entity, but rather, a convenient grouping of unrelated forms.

Quadrilateral uniface (1)

This object (Fig. 4.3D) is a rectangular unifacial tool with each of the four edges processed by steep percussion flaking resulting in a strongly plano-convex cross section. It was made on a very thick flake of degraded quartzite. The working edges lie at angles of 40°-90° on the ventral surface. The tool appears to have been hand held and used to hack, chop, or pound a resistant material as evidenced by edge damage sporadically extending onto the ventral surface. The measurements are 105 x 87 x 43 mm.

Unshaped flake tools (6)

These small tools (two of which are shown in Fig. 4.4C and D) are commonly called retouched flakes. They were made on flakes of gray chert (1), ferruginous chert (1), black chert (1), devitrified volcanic glass (1), chalcedony (1), and rhyolite (1). They range in size from 32 x 19 x 4 mm to 48 x 30 x 10 mm with a mean of 41.6 x 25.5 x 7 mm.

Two of these tools have fine retouch on one end of the flake and have been used as scrapers. The remaining four have unifacial edge retouch (1 on both edges and 3 on a single edge) and would have served well as small flake knives.

Split cobble tools (3)

These heavy implements were all manufactured on pieces of split cobbles. They have a general oval to rectangular outline and a plano-convex cross section. Each is slightly different. One rhyolite implement (Fig. 4.6A) was flaked on the dorsal surface at one end which formed an irregular edge. Sporadic retouch was then applied and it carried onto the ventral surface. At the opposite end, heavy flaking formed an irregular edge which was then retouched regularly and extensively, but only on the dorsal surface. It measures 145 x 101 x 32 mm.

The second specimen, a quartzite tool (Fig. 4.6B) bears irregular, light retouch along the edge of the ventral surface. The dorsal surface is unworked. It measures 124 x 72 x 48 mm.

The last specimen in this group is quartzite (Fig. 4.6C) and has flaking, which culminates in a point, concentrated at one end of the implement on the ventral surface. It measures 119 x 72 x 71 mm.

Functionally, the tools are probably identical and were used in heavy scraping or planing activity. Evidently, the desired feature being sought was the relatively long, flat ventral surface.

Cobble cores (4)

These objects are elongate river cobbles with roughly rectangular to sub-oval cross sections. Three of these cores are of degraded quartzite and one is of rhyolite. They range in size from 122 x 64 x 33 mm to 178 x 121 x 96 mm.

On three of the pieces, one end was removed to establish a striking platform from which blows were directed down the thinner edges (parallel to the long axis) of the cobble (Fig. 4.6D). The fourth core (Fig. 4.7) illustrates the method of platform preparation. Thick sections of the

Figure 4.6. Split cobble tools and cobble core from Component I.

A–C Split cobble tools

D Cobble core

scale = 10 cm


A
B
C
D

Figure 4.7. Cobble core with articulated flake from Component I. Flake slightly exploded for effect.

scale = 10 cm

cobble were struck off as if splitting a loaf of bread. The articulated flake in the illustration is slightly exploded to enhance presentation.

Anvil stones (2)

Both of these artifacts are flat rhyolite boulders with evidence of heavy battering and denting on one surface. They measure 158 x 125 x 60 and 199 x 122 x 56 mm respectively.

Split boulder (1)

This specimen is a rounded river boulder of conglomerate measuring 205 x 155 x 150 mm. It was split in two, and one half bears unifacial flaking at one end on the dorsal surface. It is quite heavy and may have been used to weigh something down. On the other hand, it may have been brought to the site to be used as an anvil stone.

Component II: Artifacts

Component II is comprised of 28,881 lithic artifacts. Of these 2124 (7.3%) are worked and the remaining 26,757 specimens are flakes (including 3 blade-like flakes) which account for 92.7% of the lithic assemblage. However, as discussed in Chapter Five, many of the larger flakes were probably used as butchering tools.

Within the category of worked pieces, 1963 (92.4%) specimens are the result of microblade production and burin utilization and are classified as follows: wedge-shaped cores (21), aberrant microblade cores (8), microcore preforms (3), miscarried microcore preforms (21), core tablets (45), miscellaneous wedge-shaped core parts (24), microblades (1772), burins (29), core-burins (8), and burin spalls (35).

The remaining group of 161 worked pieces (7.6%) is comprised of bifacially worked tools (44), heavy percussion flaked implements (47), scrapers (21, including 2 spokeshaves), subprismatic cores (4), flake tools (21), blade-like flake tools (18), hammerstones (3), and anvil stones (3).

Wedge-shaped Cores, By-products and Microblades

The wedge-shaped microblade core has been given a great deal of attention in the northern archeological literature (cf. e.g., Aigner, 1970; Anderson, 1970a and b; Dikov, 1977; Kobayashi, 1970; Medvedev, Mikhniuk and Lezhenko, 1974; Mochanov, 1977; Morlan, 1965) as its distribution spans northeast Asia and northwest North America during the terminal Pleistocene and early Holocene. Since the initial discovery of this distinctive form of stone artifact over 40 years ago in Alaska and Mongolia (Nelson, 1935, 1937), it has provided a rich field for subsequent research on cultural relationships between the Old and the New Worlds (Morlan, 1965, 1970). Furthermore, extensive typological and technological studies of these microcores makes them a relatively well known item with which to work (Kobayashi, 1970; Morlan, 1970, 1978; Yoshizaki, 1961). The distinctive attributes, manufacturing sequences, and by-products of these cores are now well understood, at least technologically, but there is room for refinement, especially in our understanding of the exact methods of blade detachment and the purposes to which the microblades were put.

In the treatment of the wedge-shaped core technology presented here, these speculative matters will be discussed and differences as well as similarities with established concepts of wedge-shaped core technology will be addressed.

At the Dry Creek site, Component II, a total of 1958 specimens are the result of wedge-shaped microcore technology. These include the microcores themselves (21), the microblades detached from them (1772), miscarried cores (8), preforms for microblade cores (3), attenuated preforms ("core-scrapers") (21), core tablets (45) which are a by-product of both core manufacture and maintenance, and miscellaneous core parts (24).

In addition to these easily recognized groups of artifacts, perhaps thousands of bifacial thinning flakes and many hundreds or even a few thousand platform preparation flakes should be visualized when one attempts to appraise the amount of stone working involved in the production, use, and maintenance of wedge-shaped cores.

Wedge-shaped microblade cores (21)

A summary of metric and non-metric observations is presented in Table 4.1. Of the 21 finished, utilized and/or discarded microblade cores 17 were made on chunks of cryptocrystalline rocks in which brown to red chalcedony (11) predominates. Other stones utilized are gray chert (4), rhyolite (5), and black chert (1). Four of the cores were made on flakes. Where chunks of stone served, bifacial reduction was employed to shape the core. Where flakes were used, unifacial beveling with minor bifacial thinning was employed, usually to reduce the thick dorsal surface of the flake. It is clear that in selecting a piece of stone, whether chunk or flake, the worker looked for at least one thick edge on which to establish the platform. If the opposite edge was thin, so much the better, and only minor adjustments were necessary. However, if this edge was thick, bifacial or unifacial working was employed. The cores are small and range from 15 to 46 mm in length, 10 to 18 mm in thickness and 18 to 31 mm in height. The mean values for these measurements are 30 x 14 x 25 mm.

The number of microblade flutes can range from 3 to 8 with a mean of 5.6 flutes. The mean flute width for individual cores ranges from 2.4 to 4.8 mm with the mean width for all cores being 3.4 mm.

Judging from both the completed and discarded attempts at preforms, the stone worker established a platform on the shaped piece of stone. This was accomplished by beveling the edge and attempting to keep it as even as possible so that when finished, the prepared platform lay at about an 80°-90° angle to the sides of the core. Notwithstanding, blanks and some core tablets (cf. Fig. 4.18) show that the initially prepared platform can be quite concave resulting in a high hook or spur at the rear of the platform. The edge opposite the platform may be convex. It may also arch slightly in one direction. One side of this arch will ultimately be the terminus for microblades leaving a core base which arches backward and upward until it intersects the prepared platform at the end opposite the area of microblade removal. This arch may be interrupted by an area of unworked stone or cortex which leaves the core with a distinctively shaped base and back which is unmodified.

This situation is also found on preforms which have a rough rectangular outline when viewed from the side. In this instance there is a distinctively retouched base which may be relatively straight, and an unmodified or cortical back.

Table 4.1 Summary of metric and non-metric observations on wedge-shaped cores.

Catalog Number	Fig.	Material	Core Measurements Original	Core Measurements Discarded	Intact	Prepared Platform Part. Removal	Prepared Platform Complete Removal	Removal Blows	Striking Platform Length	Striking Platform Width	Microblade Flutes N	Microblade Flutes Mean Width	Back	Base Straight	Base Arched	Base Bevel Right	Base Bevel Left
76-3765	4.12E	Gray Chert		29x12x23			X	2	14	12	4	2.4	Cortex	X		X	
77-2089	4.11G& 4.12G	Gray Chert		26x18x18			X		26	8	5	2.5	Cortex		X		X
76-1787	4.11H& 4.12H	Gray Chert		20x13x22			X		20	13	7	3.5	Fluted		X	X	
76-5058	4.11F& 4.12F	Gray Chert		17x15x22			X		16	10	8	3.6	Retouched		X	X	
77-637	4.13A	Rhyolite	46x16x30				X	1	15	10	5	3.5	Unmodified	X	X		X
76-3225	4.13A	Rhyolite	51x14x?	21x14x26		X	X	8	11	14	5	3.8	Unmodified	X		X	X
76-273	4.10A& 4.11C	Rhyolite		28x12x31	X						7	3.6	Unmodified		X	X	
73-24	4.10C	Rhyolite		31x14x29		X			12	13	6	3.2	Retouched		X	X	
77-2777	4.10E	Rhyolite		23x17x27			X		7	13	6	5.3	Retouched	X		X	
76-474	4.10D	Chalcedony		32x14x25		X			11	12	5	3.6	Unmodified	X	X		X
76-587	4.11D& 4.12D	Chalcedony		34x15x24		X			12	13	5	4.8	Retouched		X		X
76-764	4.12A	Chalcedony		23x13x21		X			6	13	6	3.0	Retouched		X	X	
76-241	4.12D	Chalcedony		25x14x23	X	X					4	3.4	Broken	-	-	-	-
76-278a	4.13B	Chalcedony		35x18x23			X	2	17	15	6	3.0	Retouched		X	X	
76-278b	4.13E	Chalcedony	46x15x?	33x13x28			X	4	32	13	5	3.3	Unmodified	X			X
76-4058	4.11E& 4.10B	Chalcedony		46x15x25		X			9	14	5	3.8	Unmodified		X		X
76-731	4.10G	Chalcedony		23x10x26		X			13	9	6	3.7	Retouched		X	X	X
76-757	4.10H	Chalcedony		26x12x23		X			3	9	5	3.2	Retouched		X	X	X
76-4518	4.13C	Chalcedony	37x15x30	30x14x25		X		2	17	13	6	3.0	Retouched		X	X	
76-4097	4.10F	Black Chert		32x10x25		X		1	11	7	3	3.0	Retouched		X	X	X
76-588	4.11C	Chalcedony		28x18x29		X		1	9	13	8	3.0	Unmodified		X	X	X
				$\bar{x}$ 30x14x25	2	12	8		14	11	5.6	3.4		6	15	8	6

The condition of the back of the core was probably irrelevant; only half exhibit any degree of retouching. Conversely, the bases were universally treated. The purpose of shaping the base was to straighten it by bifacial retouch where feasible and by unifacial beveling, particularly on flakes, where the dorsal surface was especially bulbous. It seems that straightness, rather than symmetry, was the critical consideration in shaping the base for securing it into a clamp or vice. On one example, a large bifacial thinning platform remains on the base. It did not impede the use of the core.

The bases of the cores all show considerable crushing and some exhibit wear or polish on the back. Apart from this there is little apparent wear on the cores. This wear must be the result of the technique used to secure the core, at least initially. The variability of core form, especially the shape of the backs and bases, leads one to conceive of a securing method which met the formal requirements of technology, but likewise allowed for flexibility.

If the microblades were detached with a shoulder punch, then the critical control problem is forward rocking in the vice. The type of clamp discussed by Crabtree (1967) should leave traces on the lateral surfaces especially if the core was not set in a support device. Since the Dry Creek cores do exhibit basal damage, they must have been set in something similar to a triangular incision in a piece of bone, which would provide stability and resistance to rocking.

This brings us to a discussion of platform modification during the microblade removal sequence which bears directly on the question of clamping techniques.

Figure 4.8. Schematic microcore production sequences: Sytems 1 and 2

A Microcore perform production

B Microcore manufacturing System 1

C Microcore manufacturing System 2

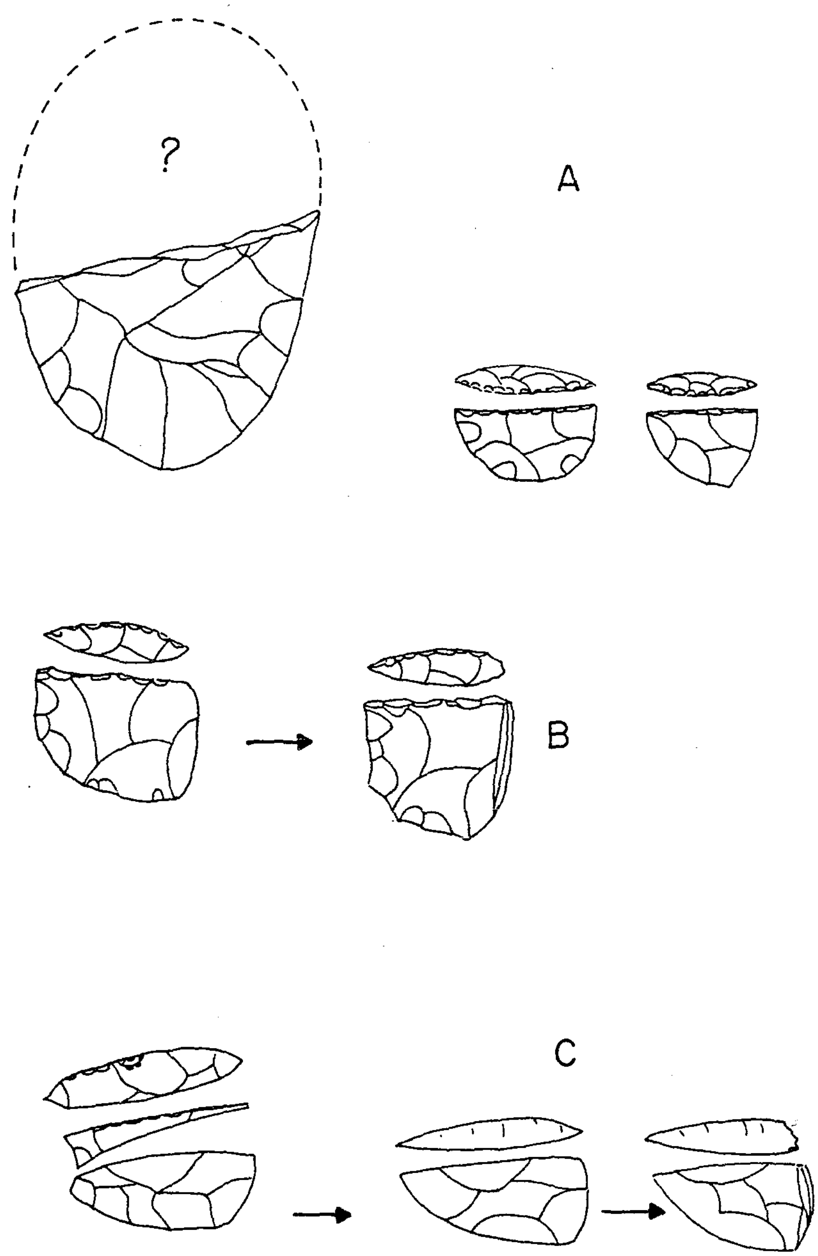

?
A
B
C

Figure 4.9 Schematic microcore production sequence: System 2b.

A-B Microcore manufacturing System 2b

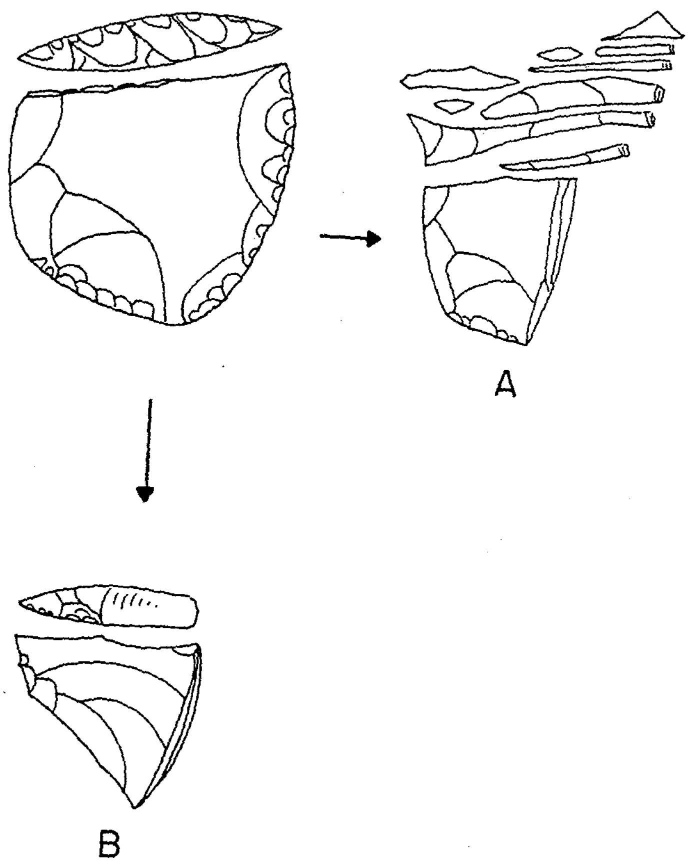

A
B

Figure 4.10. Wedge-shaped microblade cores from Component II.

A System 1 microblade core

B–G System 2b microblade cores


A
B
C
D
E
F
G

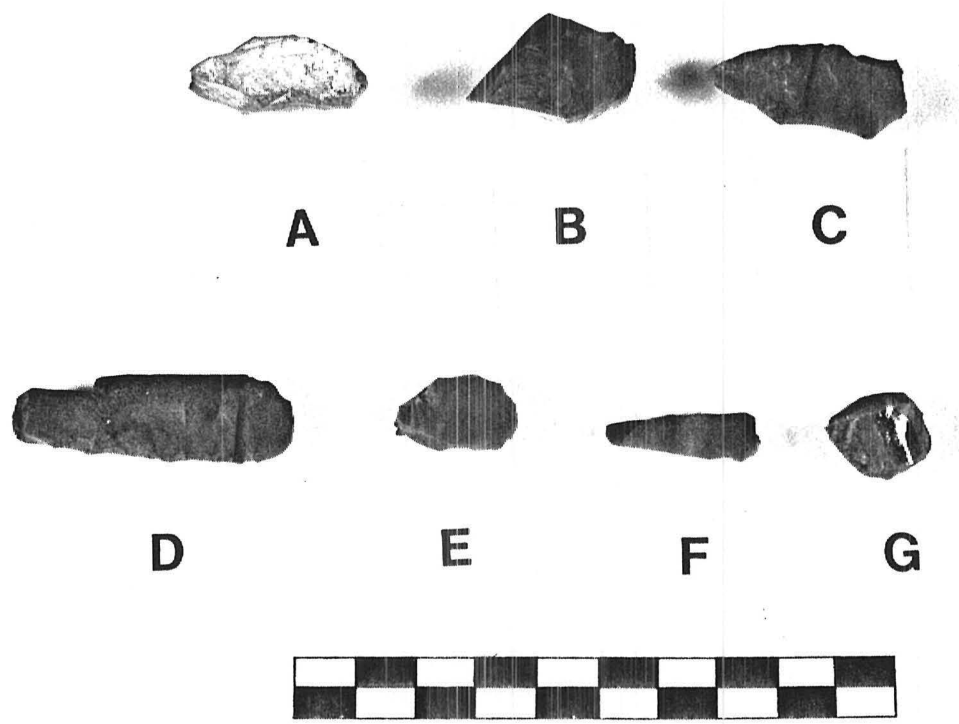
Figure 4.11. Wedge-shaped microblade cores from Component II.

A System 1 microblade cores

B–E System 2b microblade cores

F–G System 2a microblade cores

scale = 10 cm



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G

Once the preform was ready for microblade removal (Fig. 4.8A), the stone worker utilized three different options, separately or in combination, in dealing with the initially prepared platform (Figs. 4.8-9).

The least common option at the Dry Creek site is what could be called System 1 (Figs. 4.8B, 4.10A, 4.11A-B). On two examples, blades were detached directly from the initially prepared platform. The core was discarded after an episode of microblade removal.

A second option, called System 2a was used on eight cores to remove the entire retouched platform with a burin blow aimed directly at the front of the core (cf. core tablet). Following this, a sequence of microblades was detached (Figs. 4.8C, 4.11F-H, 4.12F-H, 4.13A).

The most common method of establishing a platform for microblade removal, System 2b, was to detach only a portion of the retouched platform (Fig. 4.9). Twelve Dry Creek cores were treated in this fashion. This resulted in a stepped platform since the burin blow did not carry the full length of the core. Otherwise, the technique is the same as System 2a. In these instances the actual working platforms are from 3 to 32 mm long and 7 to 15 mm wide. The mean length is 14 mm and the mean width is 11 mm (Figs. 4.10B-H, 4.11C-E, 4.12A-E).

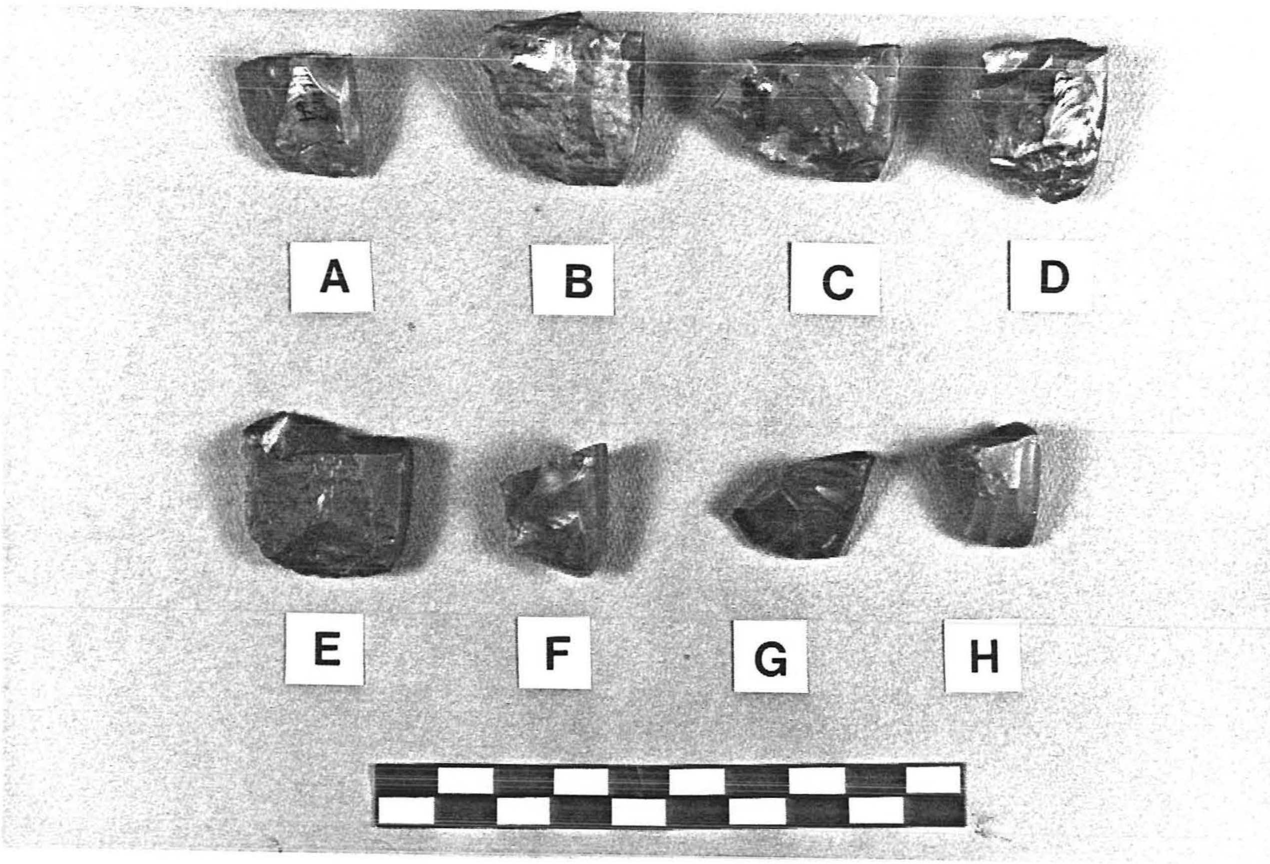
It would be very tempting to view these variations in platform treatment as grounds for establishing morphological types of wedge-shaped cores or even manufacturing techniques. Fortunately there are two reconstructed cores from the Dry Creek site which exhibit both forms of System 2 platform treatment (Fig. 4.13). One of these (Fig. 4.13E) had a partially retouched platform which was detached after a suite of microblades was removed. Following this, the platform was totally removed and more microblades were detached. The second of these

Fig. 4.12. Wedge-shaped microblade cores from Component II.

A-E System 2b microblade cores

F-H System 2a microblade cores

scale = 10 cm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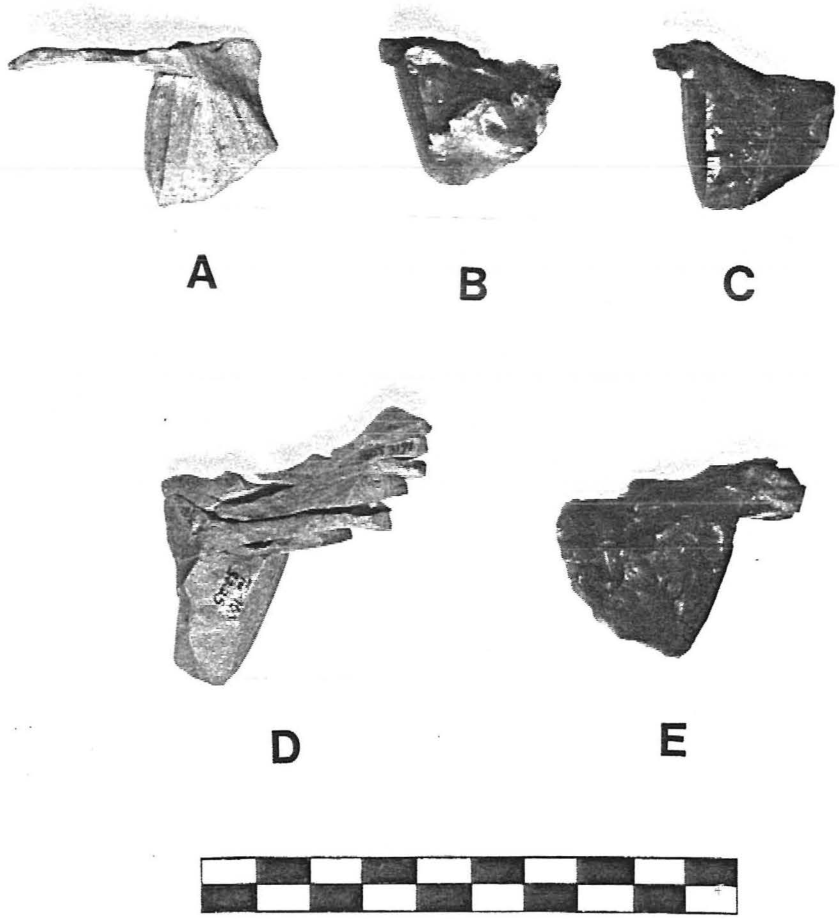
H

Figure 4.13. Microblade cores with re-articulated core tablets from Component II.

scale = 10 cm


A
B
C
D
E

reconstructed cores (Fig. 4.13D) underwent eight episodes of platform removal. The first tablet removal created the working platform. The second through the sixth platform removals were likewise partial, but the seventh removed the entire core platform. The eighth, and last, was again partial. More microblades were detached after the last episode than from any previous attempts at platform rejuvenation.

In both examples, the stone worker combined both System 2 methods for the removal of the retouched platform clearly illustrating that total and partial platform removals form a technological continuum.

Another feature of core platforms (Fig. 4.11) is heavy crushing along one edge. This transpires as the platform is being beveled prior to partial platform removal. Once the platform is removed, a remnant of the beveling (retouching and crushing) remains at the rear of the platform area. After the core tablets have been struck off, additional fine chipping and crushing is applied to an otherwise smooth platform. This type of modification can take the form of a low concavity at the edge of the platform, and, in most instances, this feature appears on the right hand side of the core. However, it can occur sporadically on the left. As this chipping and crushing is far removed from the fluting arch, it must be related to the device used to hold the core.

It seems improbable that the core was held directly in the hand. The size alone would make this impractical and, if this was the method employed, the careful shaping of the core base would have been superfluous.

Based on the various non-metric attributes of these cores, especially basal shaping and platform treatment (edge crushing or dulling), two methods of securing the core seem more feasible.

In one method, the core base could be fitted to a slot and then a lateral clamp (bone or wood) could be lashed at the top. One of the lateral pieces would have to have been bent over the top of the core to prevent forward rocking. In such a clamp, microblades could be detached by either indirect percussion or applied pressure although direct percussion may have been employed (Del Bene, 1981). There are numerous examples of fairly deep negative bulbs on nearly all of the cores.

A second method has been suggested by Del Bene (1981) as a result of his analysis of the cores and microblades. He argues that the core could have been grasped in a holding device with the base of the core in a slotted anvil. The holding device was then wrapped with cordage to keep the core from slipping and rocking. Such a method appears quite feasible and makes the lateral crushing of the platform and the treatment of the base easier to understand. The common occurrence of a hinged (partially removed) platform then could be explained by the core tablet terminating at the haft. In the two examples of total platform rejuvenation, the core was either removed from the haft or the break was fortuitous.

The use of such a technique would allow the stone worker the option of either holding the haft in the hand or wedging it under a foot.

Aberrant microblade cores (8)

Attempts to remove microblades from variously shaped chunks of chalcedony were fairly common at the Dry Creek site. Platform preparation and microblade removal resulted in a series of rather aberrant looking cores (Fig. 4.14), so idiosyncratic that individual description would be necessary to describe the variability. In each case, a burin blow was used to establish a platform and some microblades were detached. Some of these pieces have shaping along the bottom or rear edges and others display some crushing along one edge of the platform areas. Most display some classic wedge-shaped core attributes but no single specimen has them all. It would be difficult to ascertain the orginal size of these chunks or to gauge the amount of blade detachment. These cores were probably short-lived and the microblades removed (judging from the flutes on the cores) were quite irregular both with respect to length and width. Also, the cores seldom display a continuous fluting arch. In the majority of cases, deep irregular bulbs at the proximal ends of the flutes suggest blade detachment by direct percussion.

These specimens range from a maximum length, width and height of 73 x 49 x 21 mm to a minimum of 29 x 17 x 13 mm. The mean values for these dimensions are 43 x 31 x 15 mm.

Core preforms (3)

Three objects (Fig. 4.15) illustrate a method of preparing a wedge-shaped microblade core preform which employs bifacial reduction to form an asymmetric preform with one strongly convex edge and one straight or slightly beveled edge. The straight edge is further modified by unidirectional retouch directed across it at a right angle to the faces. This process produces a straight to slightly concave flat truncation along this side of the biface. It is this truncation which eventually is removed, either in part or entirely, by burin blows as the platform of the core is prepared for microblade detachment.

Figure 4.14. Aberrant microblade cores from Component II.

scale = 10 cm

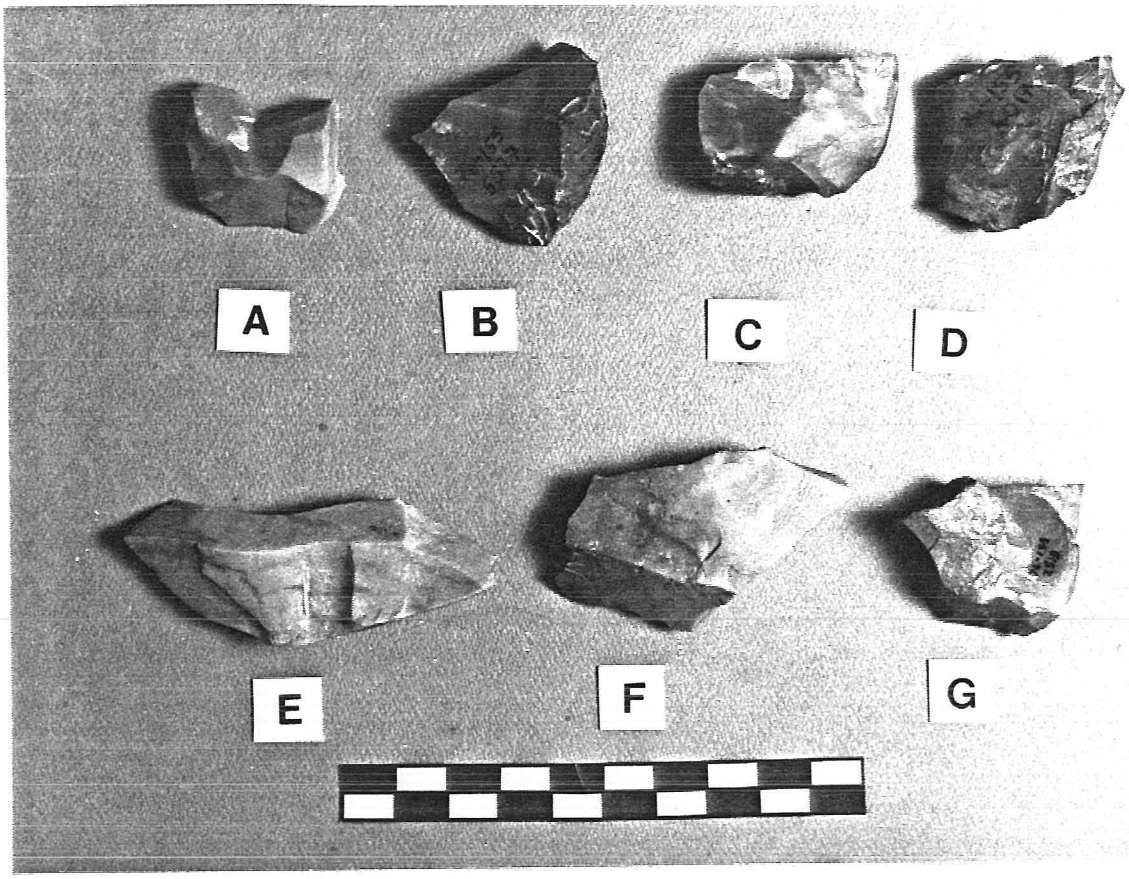

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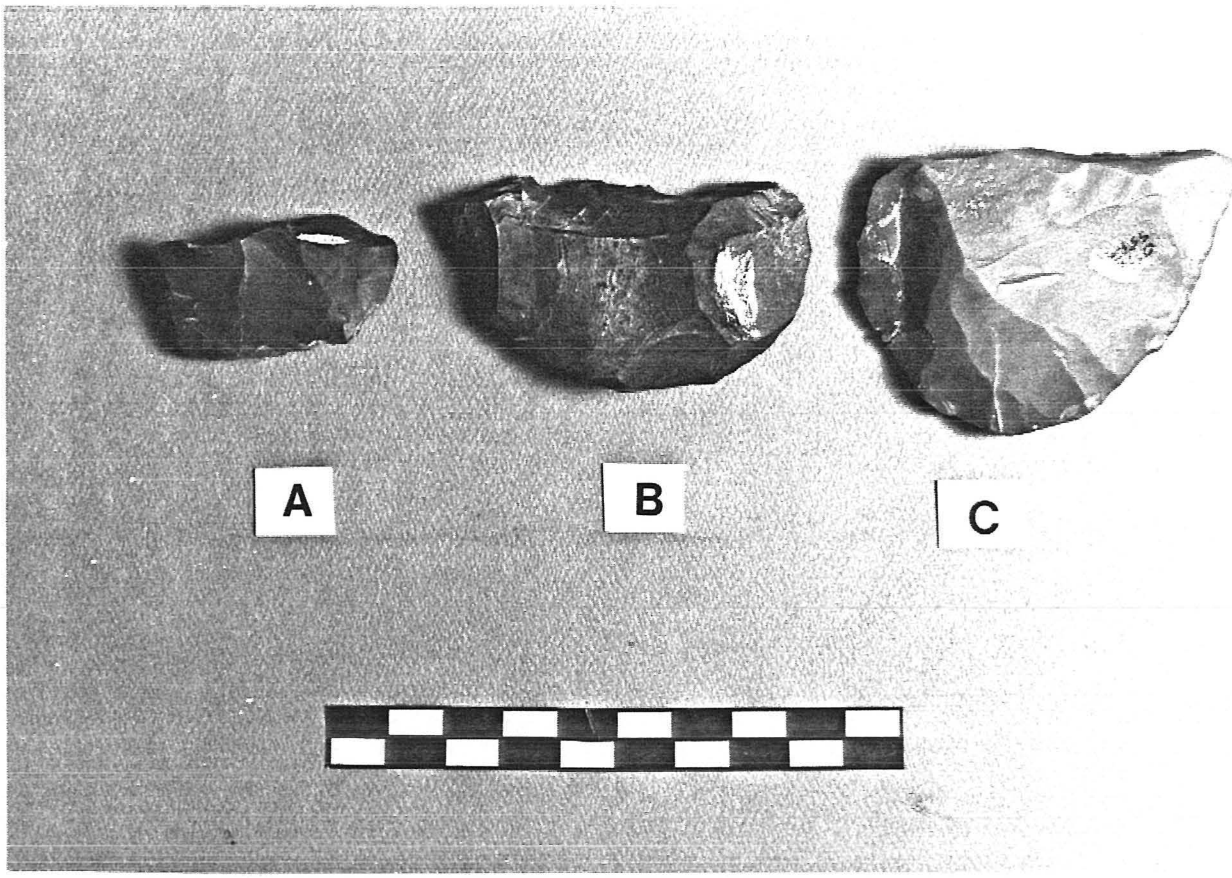
Figure 4.15. Microblade core preforms from Component II.

scale = 10 cm


A
B
C

These cores were manufactured from gray chert (1), black chert (1) and chalcedony (1). Measurements range from 44 x 22 x 17 mm to 63 x 62 x 22 mm with a mean of 54.6 x 41 x 19.6 mm.

Miscarried microcore preforms (21)

This group of artifacts is quite ambiguous. In a couple of cases, chunks of chalcedony were used to attempt microblade removal. The endeavor was aborted after bifacial thinning and platform development failed. Nonetheless, they all bear retouching or damage at some point along the edge of the "platform." However, it does not extend onto the "platform", but only down a lateral surface or face (Fig. 4.16).

These specimens were probably attempts at microblade cores (5 were fire treated) but when the effort appeared hopeless, they were transferred, apparently to heavy duty scraping or possibly to use as burins. This action was consistent with the frugal use of high quality raw materials at Dry Creek.

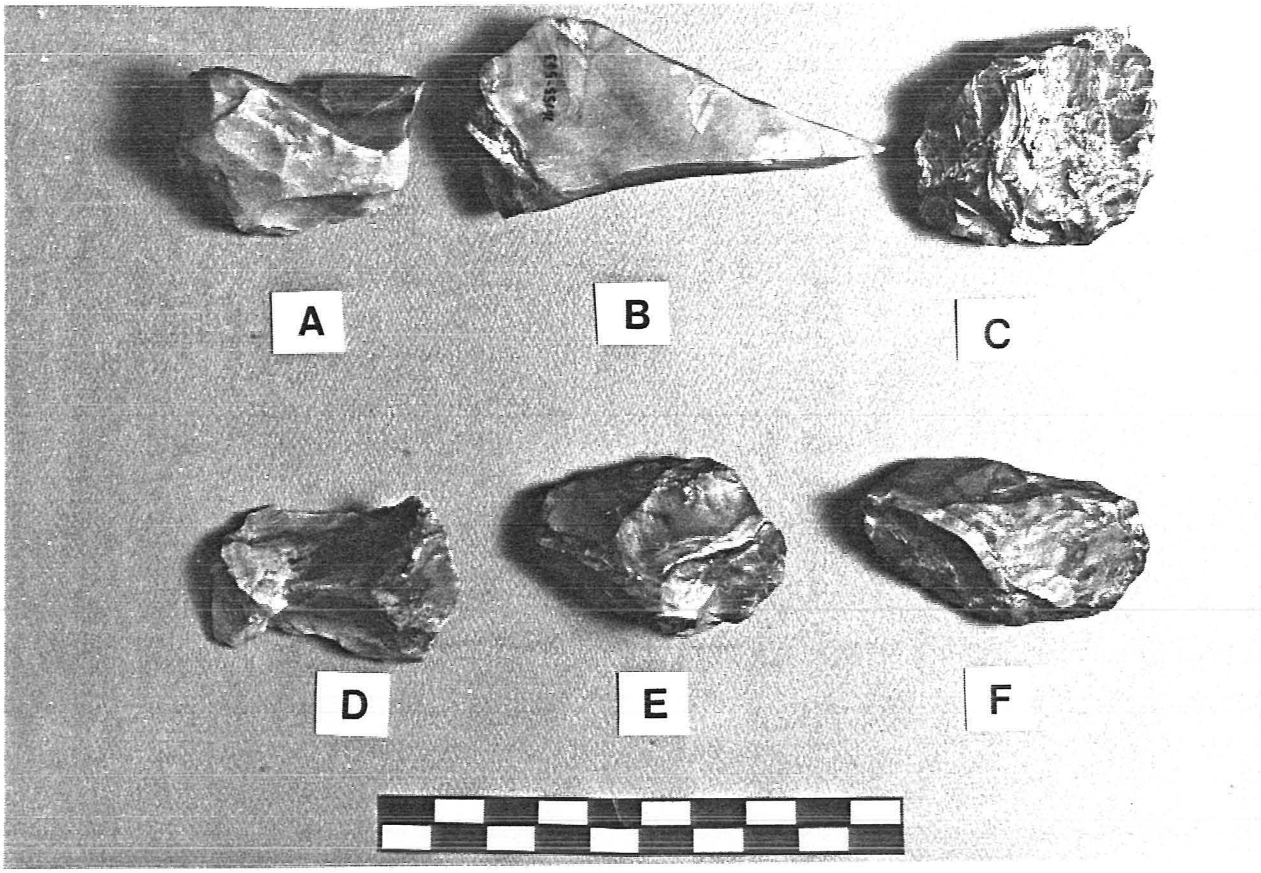
The maximum size range for these tools is 80 x 45 x 27 mm and the minimum is 33 x 11 x 12 mm. The mean dimensions are 49 x 34 x 19 mm.

Core tablets (45)

Core tablets are a by-product of microblade technology. Technically, they are spalls produced by a burin blow directed at the top of the fluted end of the wedge-shaped microblade core. Such a blow truncates the plane of the core at a right angle and shears away all or part of the retouched platform. In some cases, this was done to remove impurities which impeded microblade detachment while in others, the purpose was platform rejuvenation. All of the tablets have some degree

Figure 4.16. Miscarried microblade core preforms from Component II.

scale = 10 cm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of retouch on the dorsal surface, but in many cases the entire dorsal surface is heavily truncated by fine lateral pressure retouch. The tablets also display scrubbing and roughening across the edge where microblades were detached.

Almost all of the examples represent well executed symmetrical removals, but 7 of these specimens are the result of blows which miscarried and took away only one side of the platform and a portion of the lateral surface of the core.

Forty-five of the core tablets are considered waste material, while 2 were transformed into transverse burins (cf. burins). Of the 45 waste tablets, 13 could be fitted to their respective cores (cf. wedge-shaped cores). The core tablets fall into the following raw material groups: light rhyolite (13), gray chert (18), obsidian (4), chalcedony (1), brown chert (7), black chert (1), and a heavily fired opal-like rock (1).

Morphologically, the core-tablets fall into two groups. Specimens in the first group (37) (Fig. 4.17) have a generally rectangular outline with the exception that the proximal end is usually slightly convex and bears remnant microblade flutes. Also, the distal end can be quite irregular as a result of termination in a steep hinge fracture. Cross sections are normally rectangular since the lateral edges lie at 90° angles to the ventral and dorsal surfaces. These are the result of the partial removal of the core's platform. This type of platform removal results in a deep hinge fracture near the back of the core. The remaining portion of the platform is higher than that from which microblades are being removed. The size ranges for these pieces are 17

Figure 4.17. Microblade core tablets from Component II.
Top view showing prepared platform remnant
scale = 10 cm

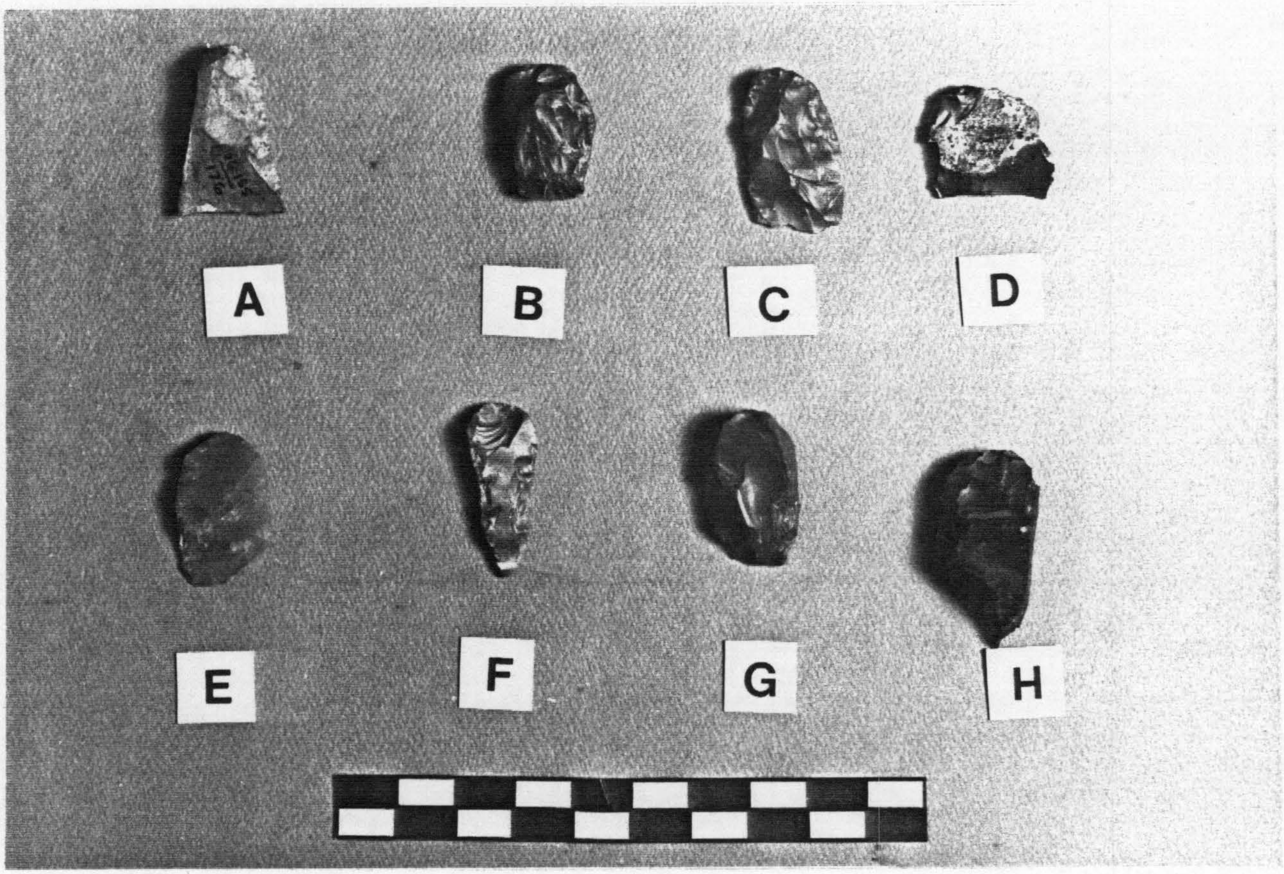
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Figure 4.18. Microblade core tablets from Component II.

A-E lateral view of core tablets

B Three re-articualted core tablets

scale = 10 cm

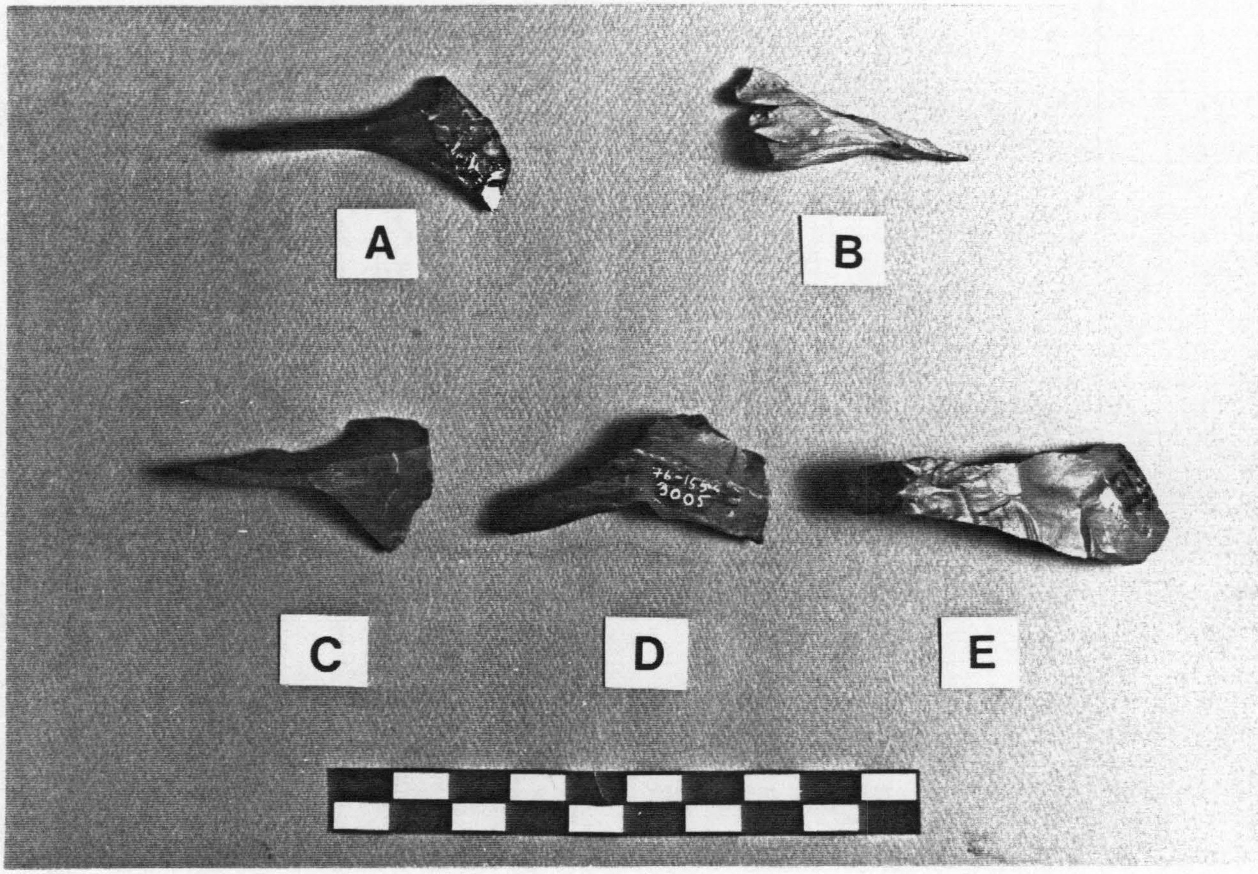
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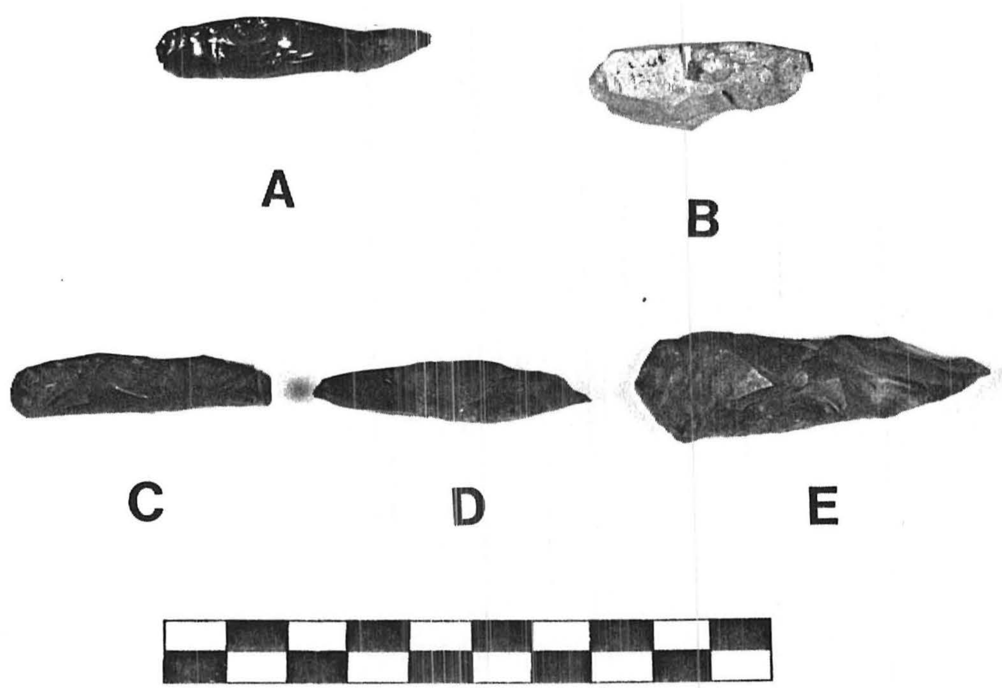
Figure 4.19. Microblade core tablets from Component II.

Top view of the tablets shown in figure 4.18.

scale = 10 cm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to 50 mm in length, 7 to 23 mm in width, and 3 to 16 mm in thickness. The mean values for these dimensions are 34 x 13 x 7 mm.

The second type of core tablet (8) (Figs. 4.18-19) resulted from the total removal of the prepared platform; in effect, the entire top of the core. In so doing, the blow sheared downward and the upper portion of the rear of the core was cut away. The size ranges are as follows: length, 33 to 46 mm; width, 10 to 18 mm; and thickness, 7 to 28 mm. The mean values for these dimensions are 44 x 13 x 17 mm.

Miscellaneous wedge-shaped core parts (24)

This group includes pieces of wedge-shaped cores resulting from "industrial accidents." They all fall well within the normal size ranges of the cores. Artifacts in this group include 4 sheared fluted surfaces (3 chalcedony, 1 gray chert), 2 sheared bases (1 chalcedony and 1 gray chert) and 18 unidentifiable pieces from the corpus of the core (7 gray chert, 11 chalcedony).

Microblades (1772)

The entire purpose of the elaborate preparation and maintenance procedures employed in wedge-shaped microblade core technology was the production of microblades of which 1,823 were recovered from Component II at Dry Creek. The sample, for analytical purposes is 1,772 or 97.2% of the total sample. These were found in microblade clusters (see Chapter Five), while the remainder (51 or 2.8%) occurred either as surface finds, have poor provenience, or were isolated finds outside the defined limits of the microblade clusters.

In some instances, microblade raw material types could not be matched to a core. This information is summarized in Table 4.2.

Table 4.2 Raw material frequences for microblades, core tablets and microcores.

Raw Material	Microblades No.	Microblades %	Core Tablets No.	Core Tablets %	Microcores No.	Microcores %
Chalcedony	465	26.2	1	2	11	52
Gray chert	732	41.3	18	41	4	19
Rhyolite	362	20.4	13	29	5	25
Quartzite	64	3.5	--	--	--	--
Brown chert	32	2.0	7	15	--	--
Black chert	25	1.4	1	2	1	4
Obsidian	88	5.0	4	9	--	--
Green chert	4	.2	--	--	--	--
Opal	---	----	1	2	--	--
	1772	100	45	100	21	100

Considering the importance of chalcedony in both microblade and microcore production, very few core tablets of this material were recovered. Gray chert and rhyolite compare favorably across the categories but there are no cores or core tablets for quartzite (64 microblades). A considerable number of brown chert microcore platform rejuvenation pieces compares curiously with low microblade recovery and an absence of microcoresof this material type. The same is true of obsidian. One core tablet of opal was recovered, but no microblades or microcores of this material were discovered. The four green chert microblades may have come from a brown or gray chert microcore with greenish inclusions. Another possibility presents itself and focuses our attention on a methodological problem: these specimens may be burin spalls struck from one of the green chert burins. In terms of technology, burin spalls and microblades can be difficult to separate.

This outline indicates that in spite of the numerous examples of single core production and microblade detachment episodes recorded at the site, part of the record is still missing either as a result of sampling procedures, or loss due to bluff erosion. Also, the cores may have been taken elsewhere.

Only 10.4% (184) of the microblades were complete. The remaining occurred as segments with proximal segments accounting for 45% (796), medial segments 30.3% (539) and distal segments 14.3% (253) (Fig. 4.20).

A breakdown by raw materials is summarized in Table 4.3.

Table 4.3 Raw material frequencies for microblades and microblade segments.

Raw material	Complete	Proximal	Medial	Distal	Total
Chalcedony	88	207	92	78	465
Gray chert	66	334	236	96	732
Rhyolite	19	169	134	40	362
Quartzite	2	21	29	12	64
Brown chert	4	11	12	5	32
Black chert	--	9	13	3	25
Obsidian	4	42	22	19	88
Green chert	1	2	1	--	4
	184	796	539	253	1772

Figure 4.20. Microblades from Component II.

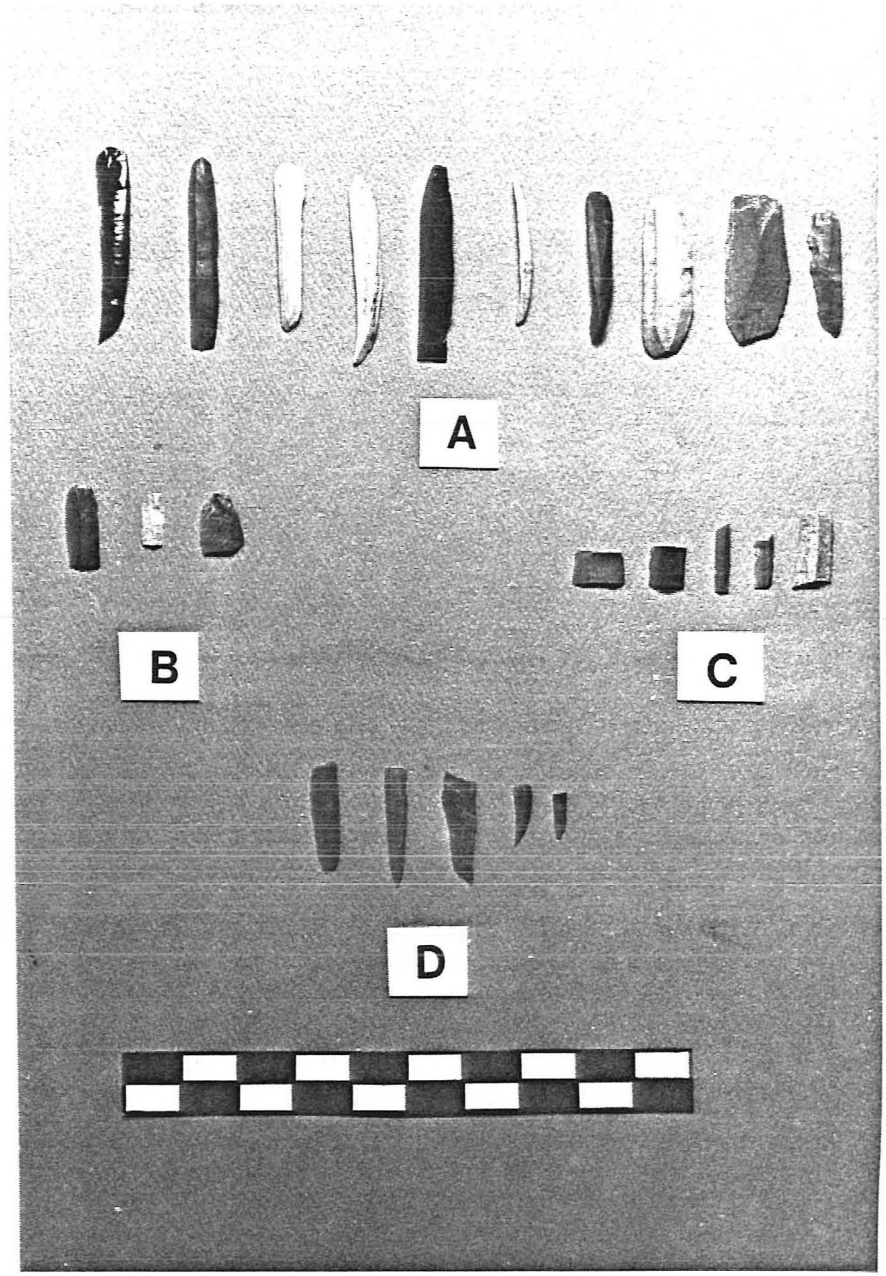
A Complete

B Proximal

C Medial

D Distal

scale = 10 cm


A
B
C
D

It is impossible to distinguish the process of segmentation since those segments which were purposely executed by the stone workers and those which were broken while being detached from the cores cannot be typologically separated. The high frequency of incomplete microblade flutes on the cores is ample evidence that premature microblade termination constantly plagued the ancient stone worker. This is an important matter since it is assumed that the segments, especially medials and possibly proximals, were the desired end-product of the entire manufacturing sequence. These, it is assumed, were employed as inset blades and set into narrow grooves or slits incised into the edge of bone or antler projectile points or knives (see below and Appendix B).

The complete microblade is essentially useless for inset purposes since it is almost always curved. Apparently the reason for intentional segmentation was the removal of the curvature to create the straightest possible cutting edge. Such edges, in all likelihood, would be found on the medial segments and one would expect the medial segments to have the lowest representation in a microblade count.

An examination of the frequencies of microblade segments shows that the lowest frequencies are of complete and distal segments. Low frequencies of complete microblades are expected since complete blades were broken purposely, or accidentally, during production. Proximals and distals should be about equal, but at Dry Creek, there are three times as many proximals as distals. In fact, a lower number of distals may be the result of the microblades snapping during detachment leaving the distal portion on the core. Obviously, this process would automatically increase the frequency of proximal segments. Most of these proximals must have been usable for segmentation, and considering that the stone workers could snap as many as four or more medials from each complete microblade and at least half that many from proximal segments, the actual number of medial segments should be from two to four times the number recovered. While the actual number of medial segments is high (30.3% N = 539) one would expect that far more were produced, possibly 1000-2000. Viewed from this perspective, the number of medial segments suddenly appears low when compared to production levels, and should if this segment was the most functional.

When considering metric variability, it should be noted that some northern archeologists consider maximum microblade width to be the crucial variable (cf. e.g., West, 1967; Cook, 1968). Following this procedure, width measurements can be briefly summarized. There is some variability in mean width values between the different raw materials, e.g., the widest complete microblades are rhyolite and obsidian, whereas microblades from the remaining lithic groups are narrower (Table 4.4).

Table 4.4 Mean width measurements (mm) for complete microblades and microblade segments.

Material	Complete	Proximal	Medial	Distal
Chalcedony	3.6	4.0	3.9	3.0
Gray chert	4.1	4.2	3.6	3.6
Rhyolite	4.9	4.4	3.8	4.3
Quartzite	3.8	4.4	3.4	3.5
Brown chert	3.8	4.0	3.1	5.1
Black chert	--	5.3	6.0	3.3
Obsidian	4.6	3.9	3.4	3.5
Green chert	2.7	3.4	--	--

The mean width for all microblades from Dry Creek is 3.8 mm which compares well with the mean width of the microblade flutes on the micro-cores where the mean width is 3.6 mm.

The only lithic groups which really stand apart are black and green chert, but in both instances the samples are very small. The remaining specimens are quite uniform in width.

Only 11% (193) of all microblades bear any evidence of retouching. For the most part, this occurs as irregular nicking of the fragile edges. Thirty-two (16.6%) complete specimens, 81 (42%) proximals, 56 (29%) medials, and 24 (12.4%) distals exhibit this treatment. The causes of this nicking may not be cultural since excavation and measurement could be responsible. Some of this treatment may result from utilization, but only one medial segment of an obsidian microblade bears extensive unifacial retouching along both edges of its dorsal surface.

It is necessary, at this point, to return to the problem of microblade function. As stated earlier, the presumed use of the microblade was to obtain segments with straight edges which could be set into laterally grooved bone or antler points. This idea is also suggested by Anderson (1970b) for the Akmak microblades and by West (1967) for microblades from the Donnelly Ridge site and the Teklanika River sites.

However, there is not universal agreement. Cook (1968) has presented data to support the argument that Campus type cores (i.e., wedge-shaped cores with stepped platforms) were not cores but burins and that the microblades were actually waste material. He supports this idea by ascribing the crushing and flaking on the lateral margins of the platforms to the core or tool being used as a burin. Furthermore, he feels that the low incidence of retouching on microblades indicates that low numbers were utilized.

It has been argued in this report that platform edge damage results from securing the core for microblade detachment. It is agreed that some objects from Dry Creek which look like microcores were used as burins (cf. "core-burins" in this report) but not all microcores were used in that manner. Lack of retouching on microblades should not be used to infer lack of utilization.

One of the troublesome issues in dealing with this sort of controversy is the Alaskan data base: no interior Alaskan site has produced a grooved bone/antler point. There is evidence indicating that the composite inset technique was employed in manufacturing weapon tips at Trail Creek Cave No. 2 (Larsen, 1968), but here, the age is much too young to be pertinent to our discussion.

The Siberian data is direct, but distant. In the third cultural horizon (14,450 ± 150 B.P. [LE-628]) at the site of Kokorevo I on the Middle Yenisei River, Abramova (1967: Fig. 4) reports and illustrates a fragment of an antler spear point with one lateral groove and microblade segments intact. The antler point is flattened with an oval cross section and has a sharpened tip. The base is missing. The specimen is 110 mm long and its greatest width is 16 mm. At 15 mm from the tip, a groove begins and continues to the broken base. The groove is from 1 to 2 mm wide and up to 3 mm deep. At 33 mm from the tip there is a tiny fragment of a microblade and 2 more small fragments next to it which were apparently broken during use. The actual continuous flint edge begins at 51 mm from the tip and is composed of 6 sections of microblades which range in length from 6 mm to 97 mm. They are 4 mm wide, have a triangular cross section, and bear no traces of secondary working.

A similar find was reported from Afontova Gora III by Sosnovskii where a point with 3 intact unretouched microblade fragments was found (Abramova, 1967). An additional discovery was reported by Gromov from

Afontova Gora II where a bone point with 2 unretouched microblades in the groove was recovered (Abramova, 1967).

In addition to these direct examples of the inset technique, both unilaterally and bilaterally grooved bone/antler points lacking microblades occur at Kokorevo I and Kokorevo II (Abramova, 1967) and, in fact, are a common occurrence in the Late Paleolithic of South Siberia (Chard, 1974).

The bone/antler inset technique occurs within lithic complexes which feature wedge-shaped microblade cores, microblades, large side scrapers, end scrapers, and transverse burins, a tool complex which is essentially identical to the early Alaskan microblade complexes. There are differences, especially in the presence and absence of bifacial technology which will be discussed later, but the overall similarities are sufficient to assume that a cultural-historical continuum existed in Siberia and northwestern North America at the end of the Pleistocene, and that microblades were manufactured for the purpose of obtaining insets for composite tools and possibly other functions as well.

Burins

Burins from Component II at Dry Creek are represented by 29 specimens. While many burins possess the same non-metric, technological attributes (platform preparation sequence) as a microcore, particularly those made on flakes, they can be distinguished functionally. Those specimens classified as burins bear both macroscopic and microscopic wear patterns. Normally, the edges of the burin facets show fine chipping, crushing, or microscopic damage. It is interesting that little use wear can be isolated at the junction of platform and facets although burin blow damage may well obscure such evidence.

Along with microcores on flakes, the burins form one end of a technological continiuum with "core/burins" lying at midpoint on a imaginary curve, and bifacial microcores occupying the opposite extreme. While the extremes (burins and microcores) are obvious, microcores on flakes are problematic and can only be separated from burins by the absence of edge damage.

The Dry Creek burins can be divided into four groups: burins on snaps ("single blow burins") (10), dihedral burins (ordinary burins) (3), angle burins (2), and transverse burins (13).

Burins on snaps (10)

These pieces were formed by a burin blow or blows struck on a snap or hinge fracture of a flake or other suitable piece (Fig. 4.21). In fact, of those illustrated, three (Fig. 4.21C, D, F) were made on core tablets, utilizing the distal hinge fracture as a striking platform.

The remaining examples (Fig. 4.21A,B,E) were made on flakes with the burin facets confined to one edge and running parallel to the axis of the flake. One of these has a well retouched scraper edge lying opposite the burin facets. It also displays use wear on the base of the flake (Fig. 4.21A). Gray chert, brown chert and black chert served as raw materials for these specimens and measurements range from 13 x 10 x 3 mm to 40 x 39 x 7 mm with a mean value of 27.3 x 18.5 x 5.2 mm.

Dihedral or ordinary burins (3)

Of these three burins (Fig. 4.22A-C), two were made on flakes of gray chert. One of these (Fig. 4.22B) appears to have been made on a

Figure 4.21. Burins on snaps from Component II.

scale = 10 cm

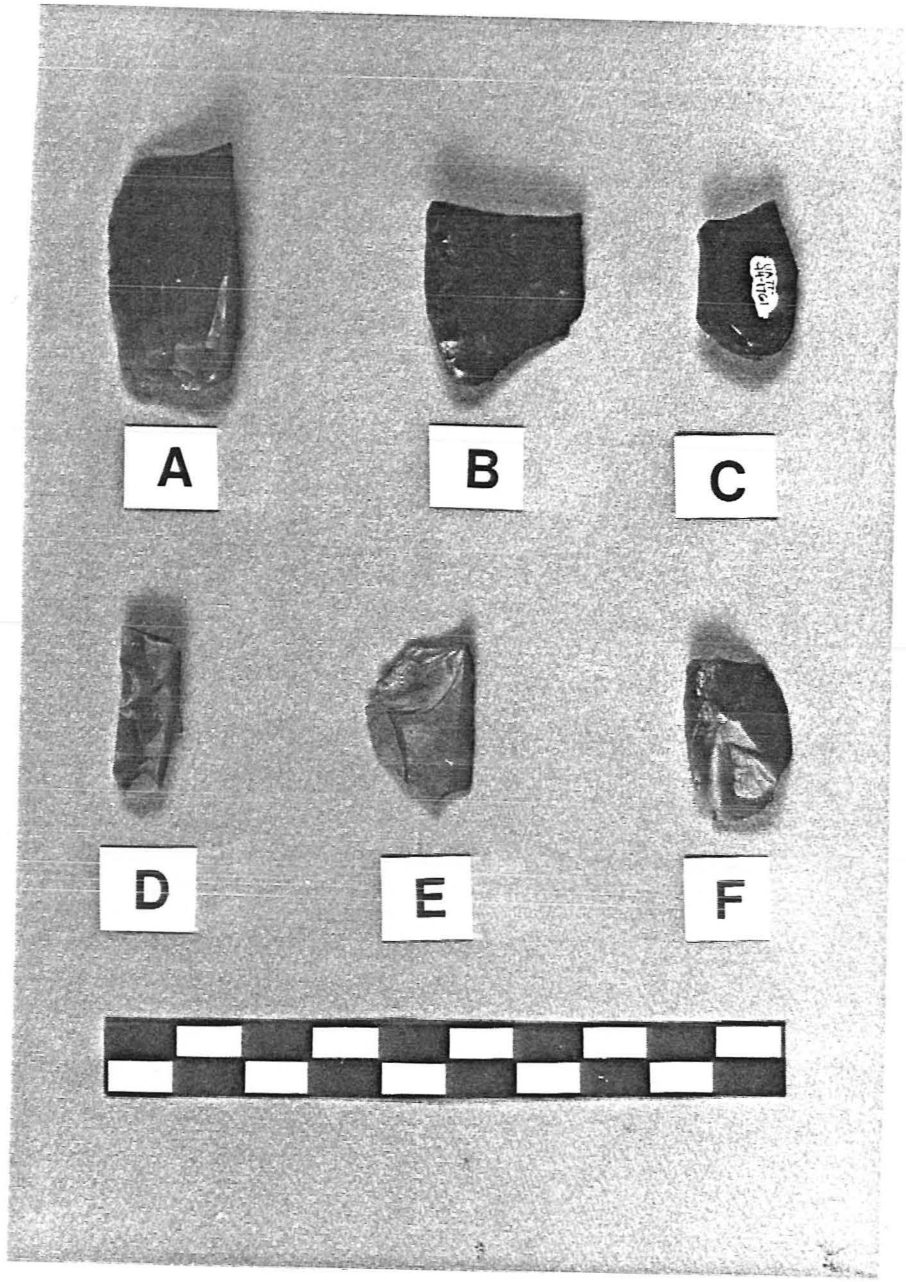
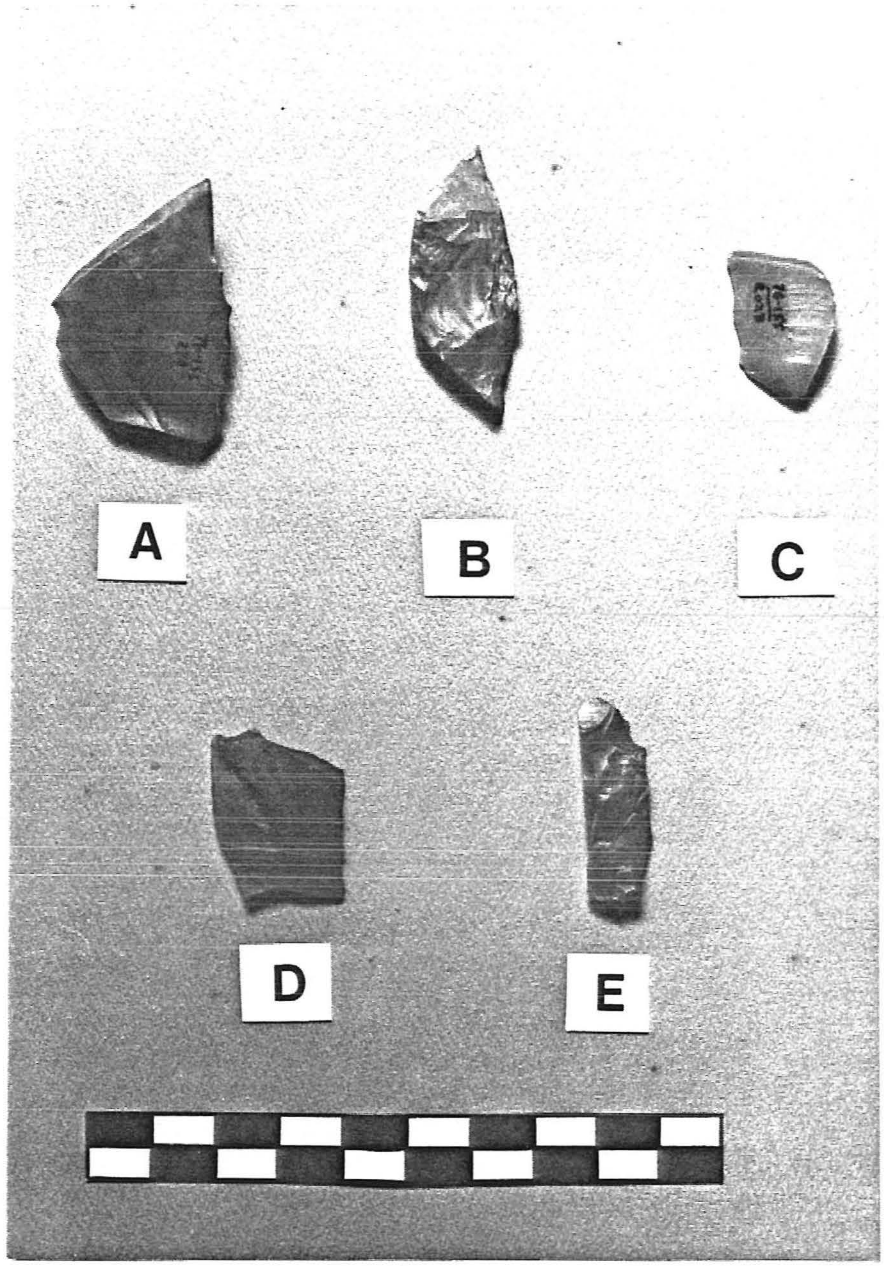

A
B
C
D
E
F

Figure 4.22. Burins from Component II

A-C Dihedral burins

D-E Angle burins

scale = 10 cm



bifacial thinning flake. Brown chert served for the remaining specimen. Dihedral burins are distinguished by a burin facet which functions as a platform for spall removals. The platform and the spall facets forms an intersection at the corner of the flake.

On one specimen, (Fig. 4.22A) the same technique of platform preparation was utilized as one would find on a microcore: initial lateral preparation, removal of preparation by burin blow (tablet removal), and detachment of burin spall from the platform. At the opposite end of the fluted surface there is a notch which was possibly intended to control the length of the spalls. This specimen may be a core, although damage along the edge of the fluted surface indicates use as a burin, or possibly a scraper on hard, resistent material.

A second flake (bifacial thinning flake) has a dihedral burin at both ends (Fig. 4.22B) and damage is visable along all edges.

The measurements range from 22 x 12 x 4 mm to 42 x 28 x 9 mm with a mean of 35 x 19.6 x 7 mm.

Angle burins (2)

The first specimen in this group is a multiple angle burin with spall facets running down both lateral edges from a transverse truncation at one end of the piece (Fig. 4.22D). The opposite end bears a small notch at the lower right corner and spalls were also struck along this edge utilizing the notch as a platform. One spall struck down the left edge traversed the lower left corner of the flake and terminated at the notch. All dorsal edges display damage. The second angle burin (Fig. 4.22E) was made on a core tablet. The burin blow was struck on a notch formed at the distal end of the tablet. It bears use wear at one locality. Both were manufactured on gray chert flakes and measure 27 x 21 x 4 mm and 33 x 10 x 5 mm respectively.

Transverse burins (15)

Transverse burins were made on flakes (13) and core tablets (2). Their distinguishing characteristic is a facet(s) resulting from a blow struck from the side and running transverse to the axis of the piece. In all of our examples (Fig. 4.23), the facet(s) traverses the distal end of the flake or spall. The striking platform for the burin blow can be a straight truncation (9), snapped edge (2), convex truncation (1), or an actual notch (3). Five have single facets and the remainder have two or more.

The raw materials used for manufacture are gray chert (5), brown chert (6), jasper (1), brown chalcedony (1), rhyolite (1) and moss agate (1). Measurements range from 18 x 14 x 4 mm to 32 x 31 x 11 mm with a mean of 23.4 x 23.8 x 5.8 mm.

Core-burins (8)

These specimens are very difficult to classify (Fig. 4.24). Technologically, they were prepared in the same manufacturing sequence as a microblade core. A platform was prepared by either retouching one or two edges of a flake specimens (3) or a burin blow was struck on the edge (4 specimens). From these platforms burin blows were struck. The resulting artifact resembles a small, chunky, wedge-shaped core. A

Figure 4.23. Transverse burins from Component II.

scale = 10 cm

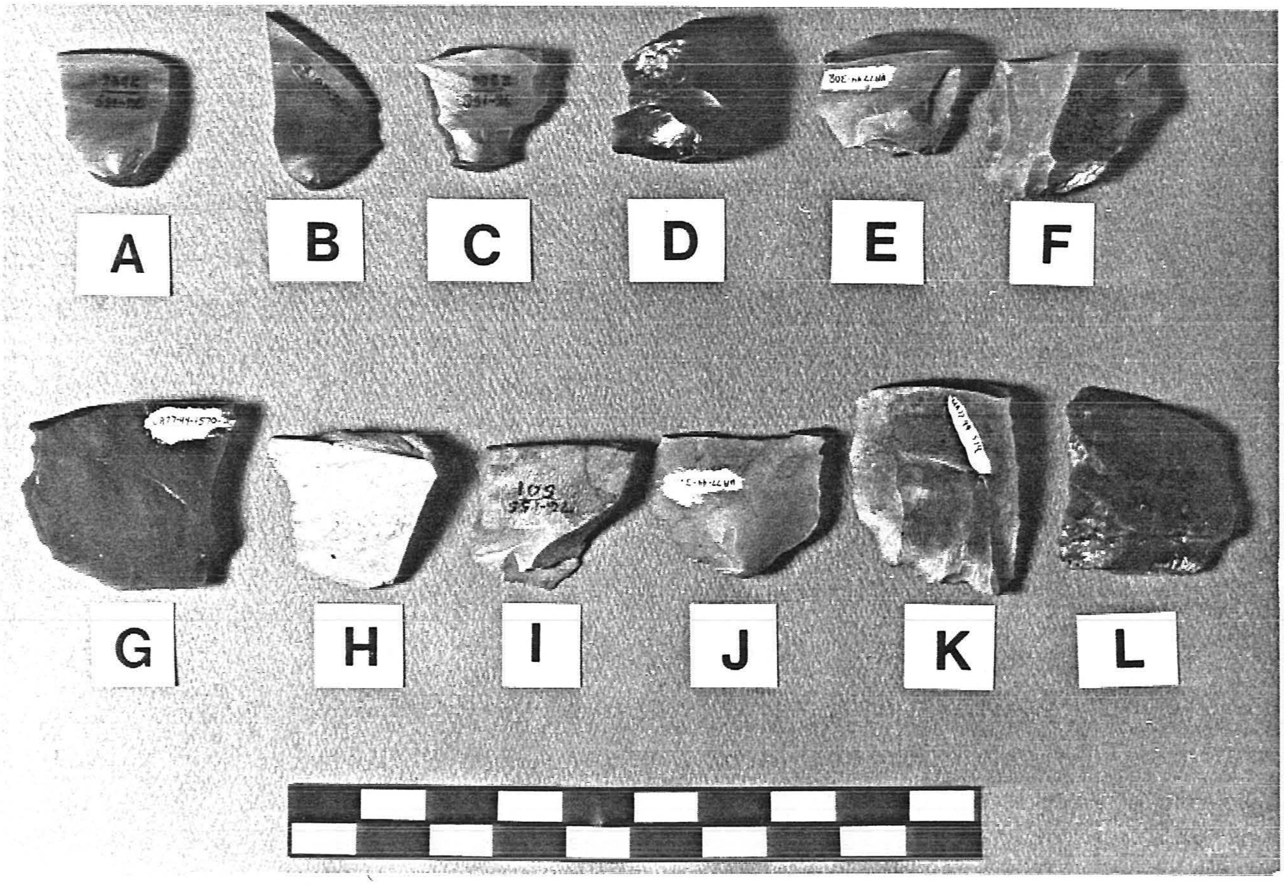

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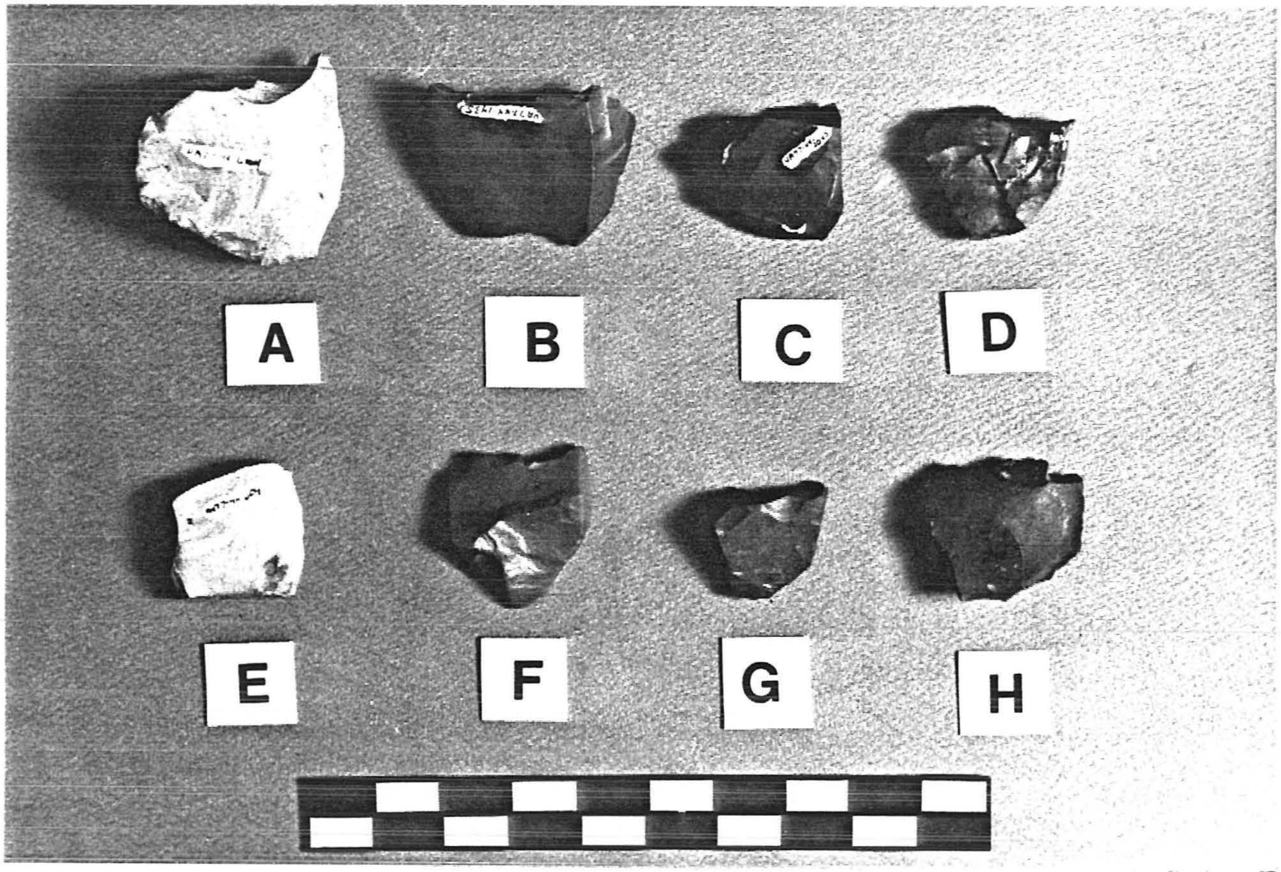
Figure 4.24. "Core-burins" from Component II.

scale = 10 cm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distinguishing characteristic of these specimens is minor crushing and use wear along one edge of the burin facet(s) possibly indicating that these specimens were used as end scrapers. They were made on thick flakes of chalcedony (3), green chert (1), gray chert (1), brown chert (1) and rhyolite (2). Measurements range from 20 x 17 x 5 mm to 32 x 29 x 14 mm with a mean of 24.5 x 24 x 7 mm.

Burin Spalls (35)

These distinctive spalls are distinguished from microblades by their generally smaller size and triangular to rectangular cross sections. However, burin spalls lacking evidence of use as a burin edge can technologically grade directly into microblades. There are probably many more true spalls in the collection but only those which could be definitely identified have been classified. Information on the spalls is summarized as follows in Table 4.5.

Table 4.5 Raw material frequencies for burin spalls.

Material	Complete	Proximal	Medial	Distal	Total
Rhyolite	1	--	--	1	2
Obsidian	1	--	--	--	1
Brown chert	7	2	--	--	9
Chalcedony	10	1	--	1	12
Gray chert	5	--	--	6	11
Totals	24	3	0	8	35

Of the 35 burin spalls, 22 have utilized edges and are broken down by raw material in Table 4.6.

Table 4.6 Raw material frequencies for burin spalls with utilized edges.

Material	Complete	Proximal	Medial	Distal	Total
Obsidian	1	--	--	--	1
Chalcedony	10	1	--	--	11
Gray chert	5	--	--	5	10
Totals	16	1	0	5	22

The spalls are very uniform in size regardless of raw materials (Fig. 4.25). The range for complete spalls is 15 x 2 x 1 mm to 34 x 8 x 5 mm. The mean size is 24 x 3 x 2 mm.

The proximal sections of the spalls range from 14 x 2 x 1 mm to 16 x 4 x 3 mm. The mean is 15 x 3 x 2 mm.

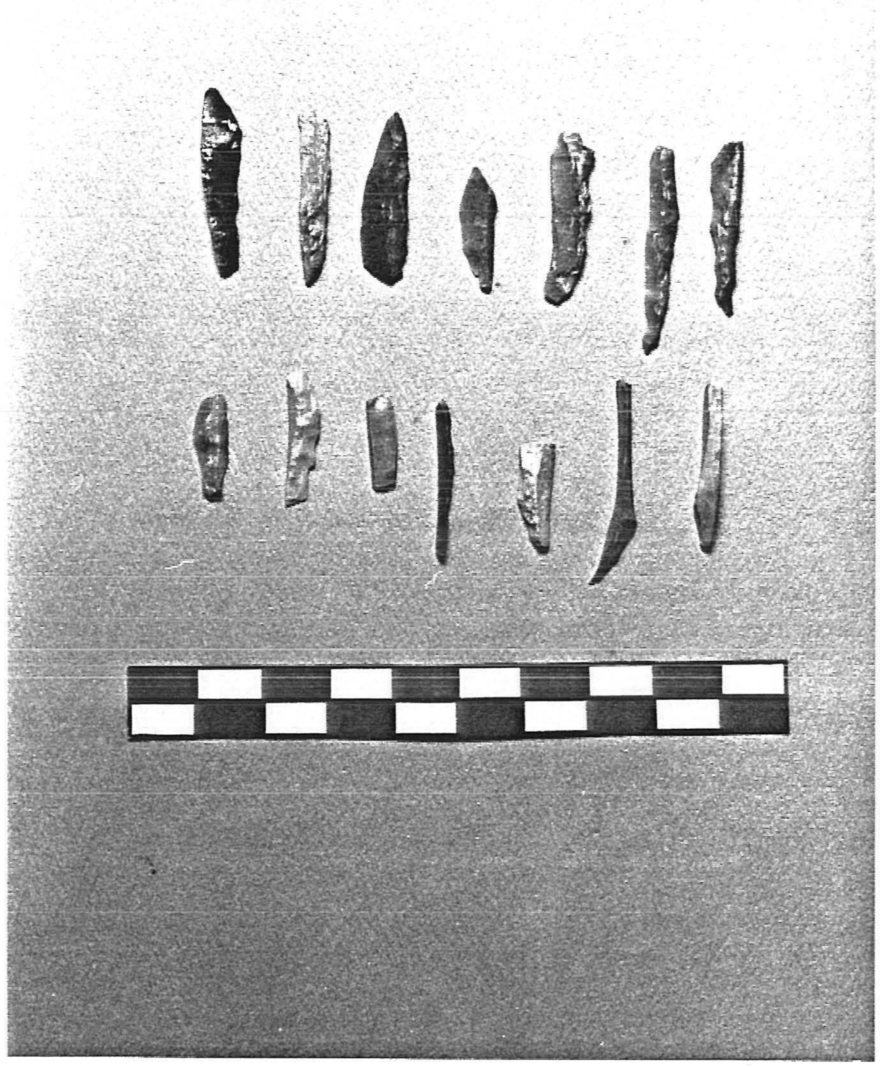
The distal spall fragments range from 6 x 2 x 1 mm to 20 x 6 x 3 mm with mean value for the dimensions being 14 x 4 x 2 mm.

Projectile Points

There is one complete specimen of a projectile point from Component II and six projectile point bases. The six bases represent a uniform group although the finished shape of these specimens is unknown. The basal portion of the complete specimen is unlike the six basal fragments.

Figure 4.25. Burin spalls from Component II.

scale = 10 cm



Projectile point (1)

In an earlier draft of this report, this specimen had been assigned to Component I. This very unfortunate situation was discovered quite late in final manuscript preparation. The mistake was due either to incorrect bagging in the field or to a cataloging error.

This single complete specimen of a point (Fig. 4.26) has a lanceolate outline. The point was produced by the bifacial reduction of a gray chert flake. The edges are excurvate, slightly serrated, and are ground on the lower one quarter of the point. The unifacially retouched base is asymmetrically concave and the spurs at both corners of the base are highly polished. The tip is sharp but well pointed. It measures 34 x 13 x 3 mm. During analysis, Del Bene noted that this point may never have been used, unless the blunted tip represents an impact fracture. Unfortunately, the evidence is equivocal.

This point appears to be fluted on one face although careful examination of the facet outlines demonstrates that it was actually formed by the termination of lateral thinning flakes which have truncated a previous basal thinning facet. While the outline of the point, shape at the base, and apparent fluting would fit into a continuum of fluted points in Alaska and further south, we would caution against implying a historical link between this specimen and Clovis points. At Dry Creek, it is an isolated and technologically marginal artifact.

Projectile point bases (6)

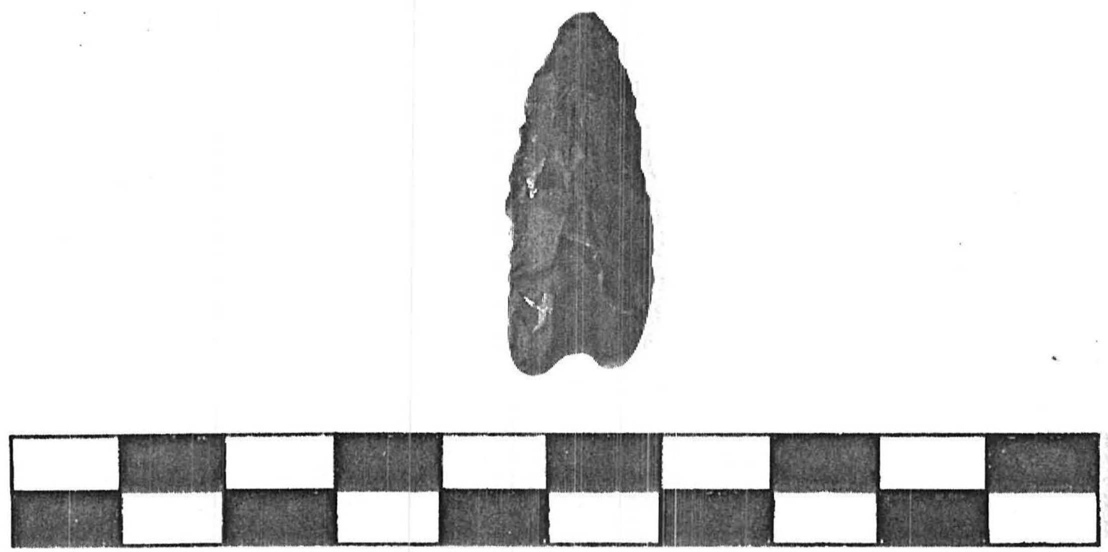
Six basal portions of projectile points have been isolated at Dry Creek. Raw materials for these bases are dark rhyolite (1), chalcedony (1), degraded quartzite (2), pumice (1), and light rhyolite (1). It is unfortunate that complete specimens could not be located since it is impossible to determine exactly to which type of points they should be assigned. There are only a few attributes available, but these should serve to narrow the range of possibility, and to provide a tentative suggestion as to which early projectile point types the Dry Creek specimens are most typologically similar. The specimens range in size from 19+ x 17+ x 6+ mm to 45+ x 27+ x 8+ mm.

These basal fragments are from some type of stemmed or lancelolate point. They have been prepared with fine bifacial retouch and have symmetrical lenticular cross sections. The edges are straight and expanding and the bases are straight on four examples and slightly convex on two bases. Stem angles range from 13° to 43° with a mean angle of 27°. The edges are ground from the break to the base and the bases themselves are ground on five of the specimens. Only one lacks grinding and there is evidence that resharpening was attempted. Hafting wear is exhibited on all specimens except the one lacking grinding.

All of the point bases appear to have been broken in the haft. The length of the specimen is probably a good indicator of the depth of hafting (Fig. 4.27A,B,D,E,F,G). Two of the bases display simple hinge fractures. One of these (Fig. 4.27B) shows use wear on one edge of the fracture indicating that this piece saw future service as a scraper or burin. The other four bases display more complex fracturing and on two of these it can be attributed to impact damage. One of these pieces(Fig. 4.27D) had an edge sheared away in addition to snapping. Another (Fig. 4.27E) was sheared twice and displays several burin-like fractures at the broken end. The uppermost sheared fragment was not

Figure 4.26. Projectile point from Component II.

scale = 10 cm



recovered. The remaining bases display complex fracturing which presumably resulted from impact.

This category of artifacts displays a uniform set of attributes, albeit incomplete, which provide the only basis for attempting comparisons with point types which may be related historically.

The basal fragments possess no attributes which would make comparison with fluted point complexes fruitful. While the age of Component II at Dry Creek is broadly synchronous with fluted point complexes on the plains, the point bases find their closest similarities to certain point styles which fall under the term Plano. More specifically, they appear to be very similar to the basal extremities of Hell Gap points. In particular, the morphology of the base, the thickness of the stem, and minimum width of the stem compare favorably with Hell Gap points from the Casper site (Frison, 1974: Table 1.4). Even the longer examples of the basal segments of the points are very similar in length (Frison, 1974: Figs. 1.35-1.43). In comparing stem angles it is obvious that three of the Dry Creek specimens fall within the range of Colby site Hell Gap points. However, three Dry Creek specimens exceed the range (30°-40°).

The Dry Creek specimens show similarity to Haskett points from the upper Snake River Plains of Idaho (Butler, 1978). Although, the stem angles of the Dry Creek specimens appear to overlap slightly at the upper range of Haskett points, the minimum basal width of Haskett point is narrower than the Dry Creek specimens.

One further observation should be noted. The flaking technique displayed on the Dry Creek specimens differs markedly from both Haskett

Figure 4.27. Projectile point bases from Component II.

scale = 10 cm

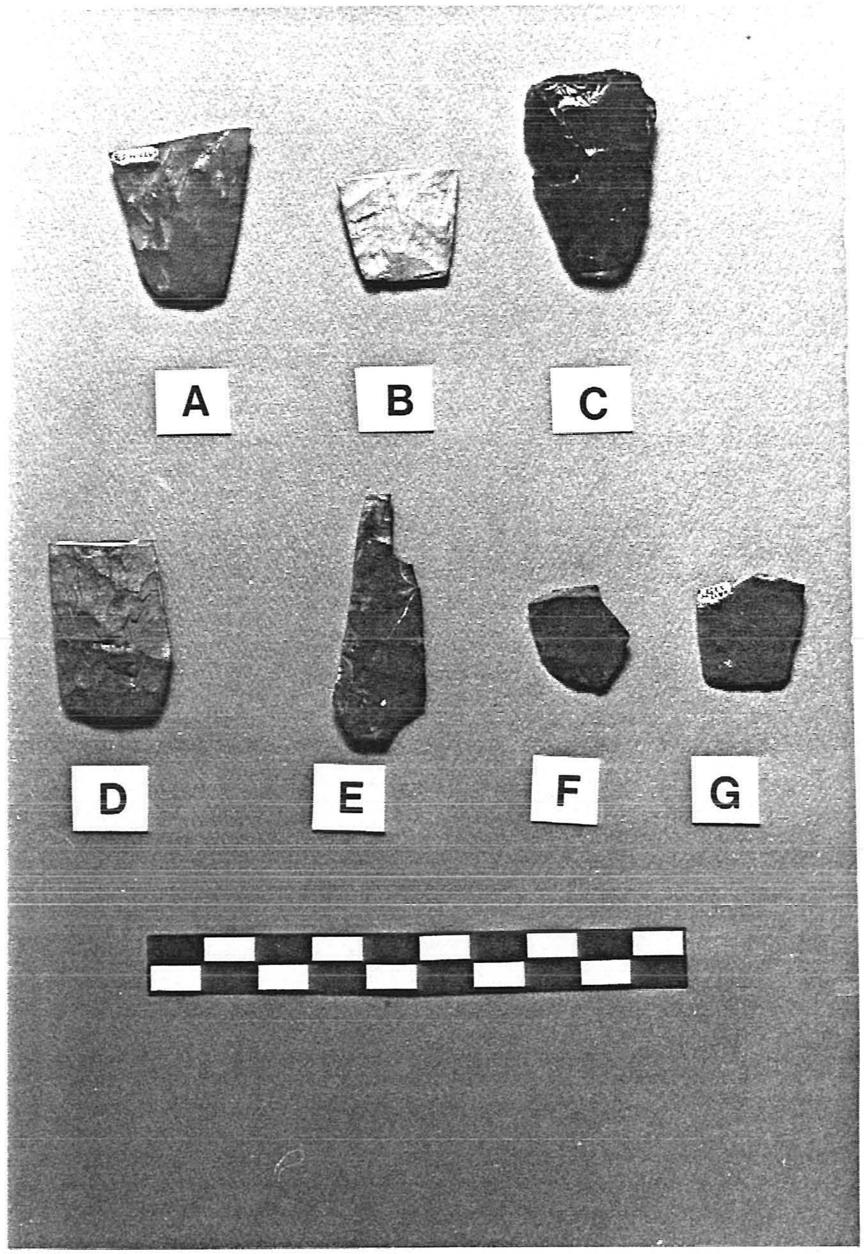

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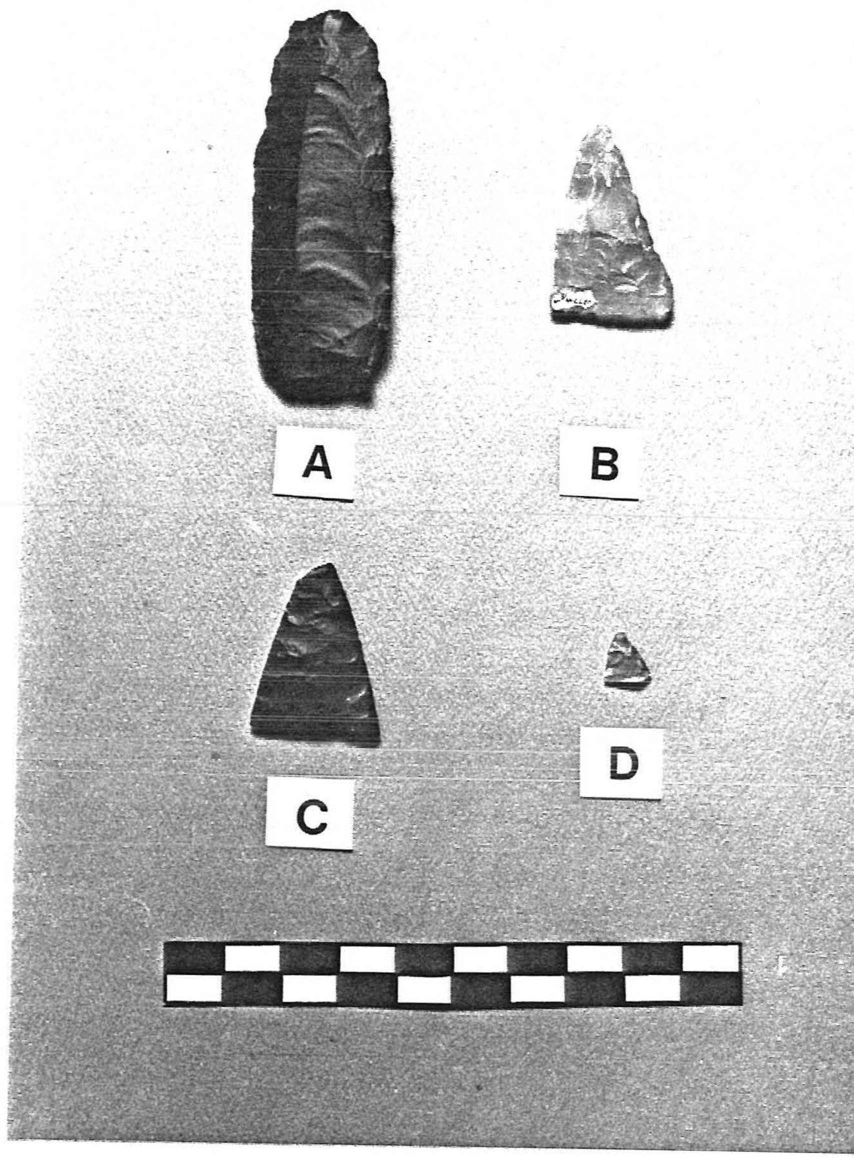
Figure 4.28. Knives and point tips from Component II.

A Oblong knife

B Asymmetric traingular knife

C-D Projectile point tips

scale = 10 cm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and Hell Gap points. This is probably a stylistic rather than functional attribute.

In summary, the Dry Creek specimens are probably bases of projectile points with expanding stems. They are broadly similar to Plano points and of these, they appear closest to Hell Gap points. However, without the tips, certainty is impossible.

Projectile point tips (2)

Two small, bifacial, triangular segments with lenticular cross sections are probably tips of projectile points (Fig. 4.28C-D). They are flatter and have tip angles which are narrower than those observed on knive categories. One is chalcedony and one is chert. They measure 9 x 8 x 2 mm and 30 x 23 x 3 mm.

Knives

Twenty-six specimens from Component II at Dry Creek are defined as knives on the basis of wear patterns on the tips and morphological asymmetry. Originally, some of these pieces may have been projectile points which became broken or damaged. Many of the tools in this category have been reworked and/or repaired, possibly from pieces of damaged points.

They can be subdivided on the basis of morphology into seven groups: spatulate or weakly stemmed, elliptical, oblong, asymmetric triangular, oval, ovate and lanceolate. In addition to these, there are five bases, three tips and three midsections which can be assigned to the knife category. Also, there are three bifaces (one discoid and two deltoid) for which a function is not apparent, and five miscellaneous bifaces.

Oblong knife (1)

This single specimen of a black chert biface is at the pressure retouch stage (Fig. 4.27A). It has an oblong or crudely retangular outline with slightly excurvate edges and a rounded tip. The base retains the hinge fractures of the flake on which the tool was made. It has a symmetrical lenticular cross section. The ventral surface displays a longitudinal flake facet which looks like a flute. However, it is simply a previous flake facet which was truncated by later trimming. The edges are ground from the base to about mid point but there is no obvious sign of hafting. Isolated portions of the edges above the grinding indicate use on a cut yielding material. This piece measures 65 x 25 x 9 mm.

Asymmetric triangular knife (1)

This little biface was made on a flake of translucent chalcedony and displays an asymmetric triangular outline with a lenticular cross section (Fig. 4.28B). There is a slight twist running from the base to the tip. One edge and the base are straight while the opposite is slightly excurvate. No use or hafting wear is evident. A series of hinge fractures near the tip, and impurities in the stone along one edge, made further thinning impractical. It seems that this piece was discarded. Its dimensions are 33 x 21 x 5 mm.

Small spatulate or slightly stemmed knives (8)

This category is represented by one complete piece, three which are essentially complete, two bases, one mid-section and one tip. All are bifacial and appear to have been made on flakes. Dark rhyolite (1), light rhyolite (5), gray chert (1), and obsidian (1) served as the raw materials. They have a spatulate outline and a narrow base which expands to a point of maximum width which is closer to the tip than the base. This expanding base has the appearance of a weak stem on one specimen (Fig. 4.29A). The tips have been thinned while the basal areas retain a thicker cross section. The cross sections are symmetrical and lenticular although thickness measurements indicate different degrees of thinning. Complete or nearly complete specimens have a size range of 46 x 24 x 8 mm to 54 x 26 x 9 mm with a mean of 50 x 25 x 9 mm. Minimum width at the base is 7 mm. Base angles range from 28° to 47° with a mean of 39°.

The one complete specimen (Fig. 4.29D) displays fairly fresh edges. It was probably abandoned after an unsuccessful attempt at removing a knob on the dorsal surface near the base. This impediment would surely have been a problem if hafting had been attempted.

Two of these knives are missing the basal extremity, and display extremely worn and ground edges extending from the base to the point of maximum width. One of these (Fig. 4.29A) has use wear on both edges of the tip whereas the other (Fig. 4.29B) has wear only on one edge. Its opposite edge is very fresh due to resharpening. Both of these knives bear heavy hafting wear. The missing basal extremities may have resulted from snapping in the haft.

The base of the remaining nearly complete specimen was probably snapped off in the haft (Fig. 4.29C), and appears to have been in a phase of resharpening. Both edges of the base are ground, but the edges of the tip are very fresh. However, during resharpening, nearly the whole ventral surface of the tip was sheared away and while there was an

Figure 4.29. Small spatulate knives from Component II

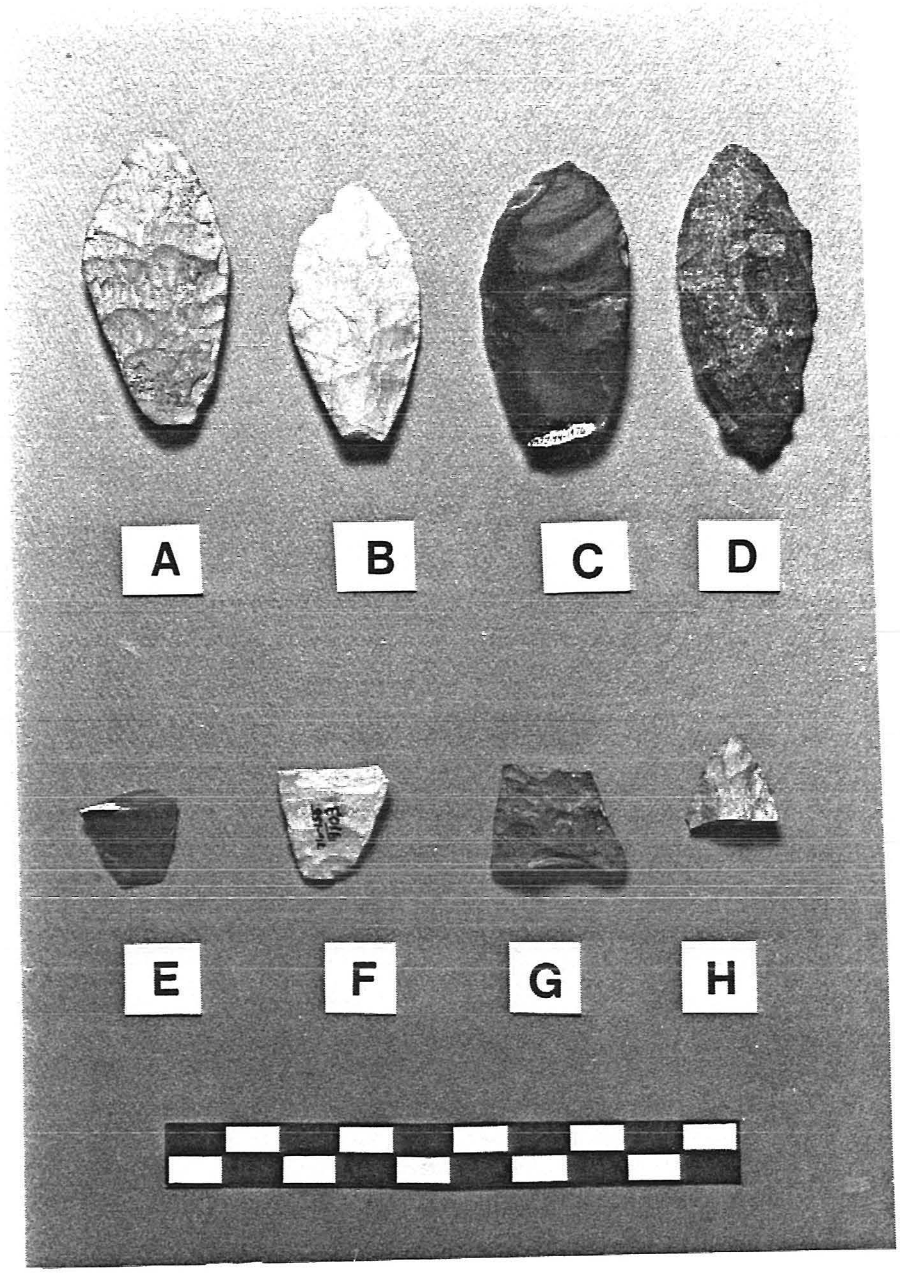
A-D Small spatulate knives

E,F Small spatulate knife bases

G Small spatulate knife midsections

H Small spatulate knife tip

scale = 10 cm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attempt to recover the edge, this accident probably rendered the piece useless.

It appears that these knives were applied to substances of varying hardness. Two of the knives (Fig. 4.29A-B) were used on a cut-yielding material, while the third knife (Fig. 4.29C), judging from crushing on the edges, was used on a cut-resistant substance.

Three bases have been assigned to this group on the basis of morphology. Two are complete and indicate that the bases of these knives were narrow, straight, sharp and unground. The third specimen is missing the basal extremity. All three have both edge grinding and hafting wear. Two of the basal sections (Fig. 4.29E-F) saw further use as burins or scrapers on some cut resistant material, an action which formed heavily crushed shallow concavities along one edge of the snapped end. These pieces were made from obsidian, light rhyolite and gray chert and have a dimensional range of 16+ x 17+ x 5+ mm to 37+ x 25+ x 7+ mm. Minimum width at the base is 6-7 mm. Base angles range from 35° to 43° with a mean of 39°.

The dark rhyolite mid-section (Fig. 4.29G) is heavily ground on both edges and shows hafting wear. Its base was broken by a clean snap but a more complex hinge fracture removed the tip. It measures 18+ x 23+ x 7+ mm.

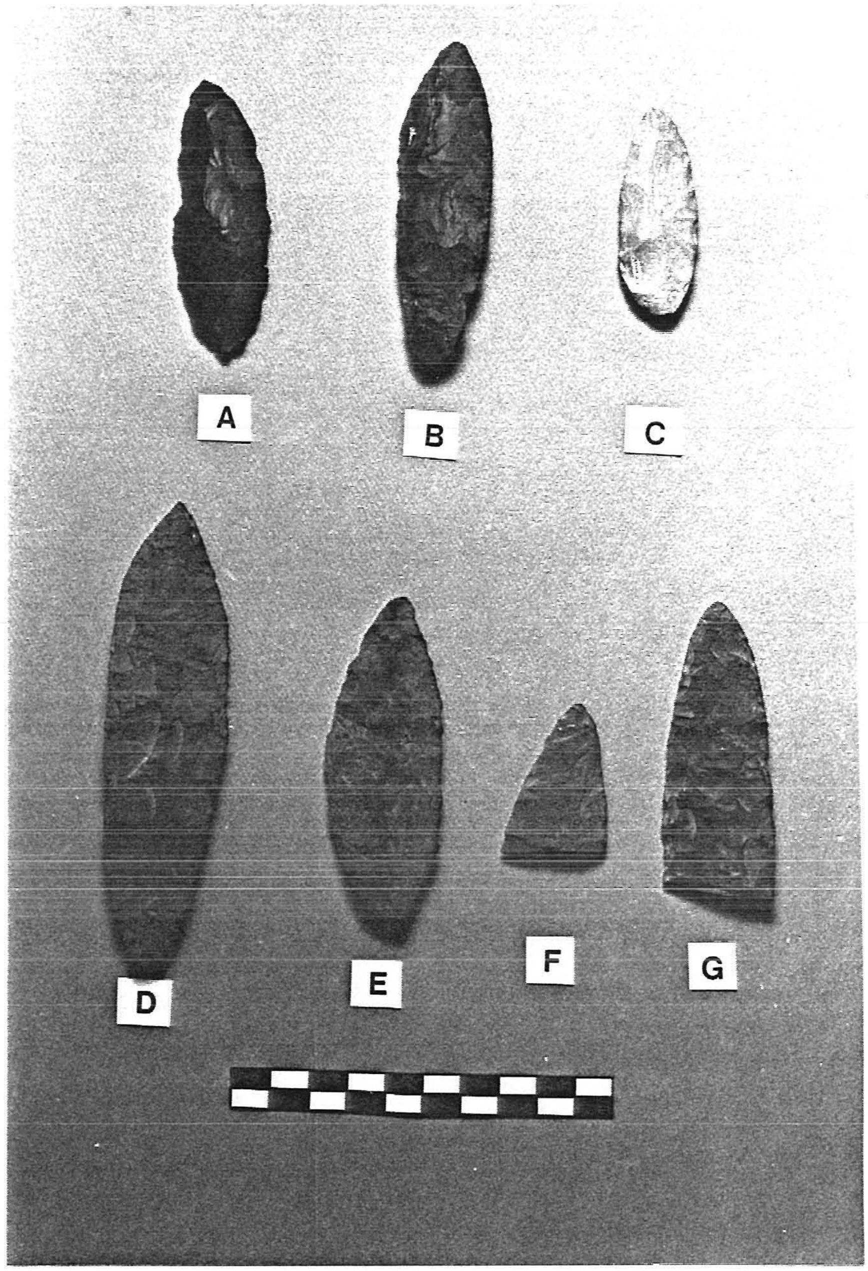
The light rhyolite tip (Fig. 4.29H) shows heavy dulling and use polish on both edges and appears to have been resharpened at least once. It measures 16+ x 16+ x 6+ mm.

Figure 4.30. Elliptical knives from Component II.

A–E Elliptical knives

F–G Elliptical knife tips

scale = 10 cm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G

Elliptical knives (7)

Five complete specimens and two tips comprise this group (Fig. 4.30). Of the five complete specimens, one was made from a piece of light rhyolite, two from black chert, one from quartzite and one from pumice. Measurements range from 55 x 21 x 8 mm to 119 x 32 x 13 mm with a mean of 83 x 27 x 11 mm.

These knives have elliptical or bipointed outlines and are fairly symmetrical with slightly rounded bases. The cross sections are symmetrically lenticular except for one specimen which is plano-convex. The tip areas have been thinned leaving the greatest thickness either at midpoint or close to the base.

One of these knives has edge grinding, hafting wear and heavy edge wear near the tip (Fig. 4.30C). One specimen (Fig. 4.30A) was probably discarded after flaking destroyed one edge. Another knife (Fig. 4.30B) bears no trace of edge grinding or hafting wear but does have minor edge modification from application to cut-resistant material. It may have been handheld. This is also the case with the last two complete specimens (Fig. 4.30D- E). Some edge damage is evident but the coarseness of the raw material makes this difficult to determine. One of these (Fig. 4.30E) was broken although the two pieces were found together.

The knife tips made of quartzite were both applied to cut-resistant materials and one (Fig. 4.30G) which retains edge grinding up to the snap, appears to have snapped in the haft. They measure 43+ x 27+ x 8+ mm and 76+ x 29+ x 19+ mm.

Oval knives (5)

This category contains large bifaces which have been manufactured on thick flakes of brown chert (1), argillite (1), light rhyolite (1) and dark rhyolite (2).

They measure from 95 x 39 x 12 mm to 128 x 69 x 37 mm with a mean of 113 x 57 x 22 mm. They have elongate oval outlines and lenticular cross sections. All of the specimens are unfinished as they retain patches of cortex. Three have thick, flat butts, and another has an irregular edge. One of these bifaces bears evidence of use along some portions of its edges while other portions were resharpened. Two oval bifaces, which look like preforms of some sort, also display heavily-used edges. One (Fig. 4.31B), bears widespread use wear on both the edges and faces which may have resulted from rotating the piece in a haft. It was probably used on a cut-yielding substance. The other, (Fig. 4.31E) displays no evidence of hafting, but shows edge damage or dulling from use on a cut-resistant material.

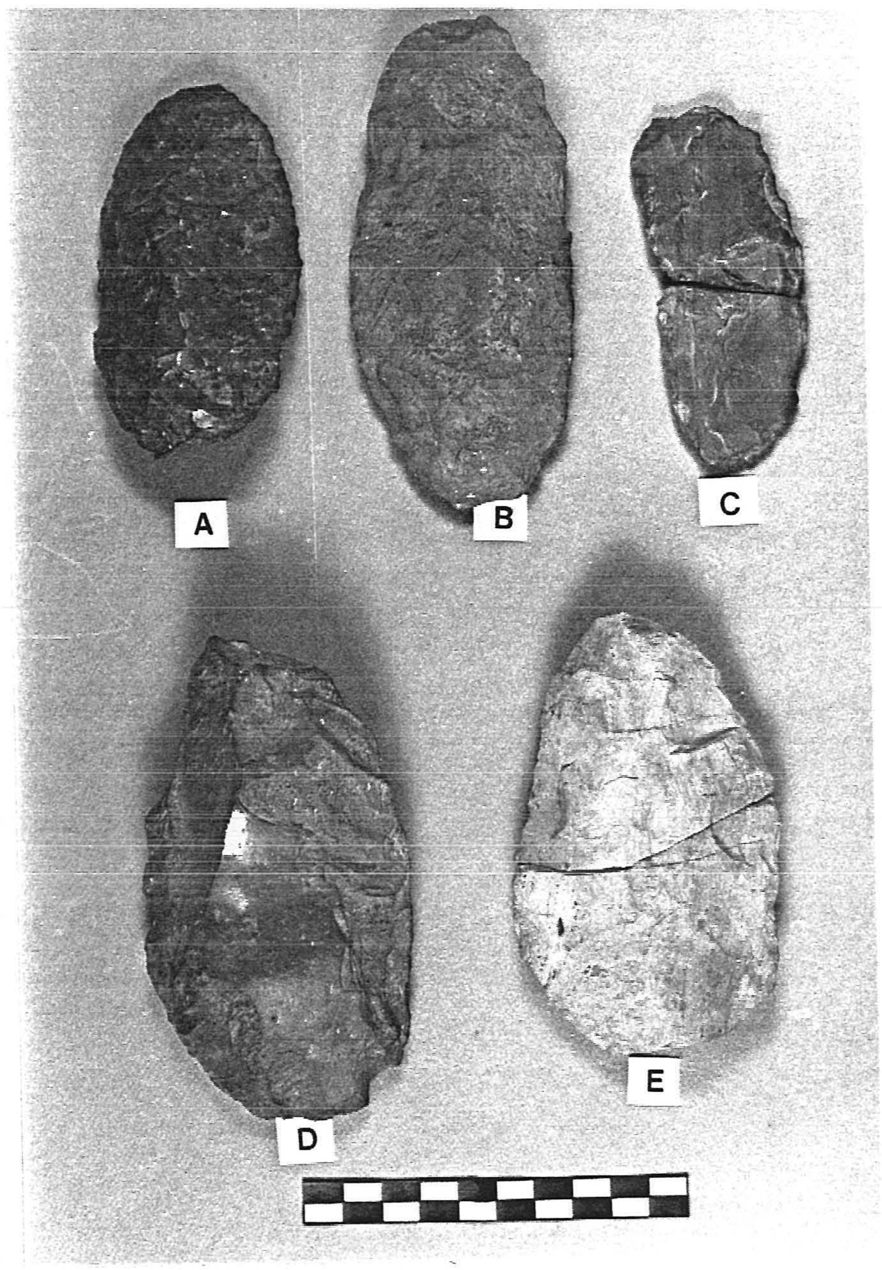
One interesting piece (Fig. 4.31C) was broken and its two pieces were recovered from different parts of the site. Prior to breaking, it appears to have been handheld and used to cut both yielding and resistant materials. After the break occurred, an attempt was made to further reduce one half of the piece but the effort was fruitless.

The remaining specimen is in a bifacial reduction stage (Fig. 4.31D). Even this piece shows isolated instances of use wear which probably resulted from working a relatively yielding substance.

The evidence indicates that these larger bifaces were used as cutting implements at the stage of production in which they were found. This observation is not intended to deny the possibility that further

Figure 4.31. Oval knives from Component II.

scale = 10 cm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bifacial reduction may have been intended in order to produce more refined tools.

Ovate knives (3)

Knives assigned to this category were manufactured on bifacially reduced flakes of gray chert (1), dark rhyolite (1), and diabase (1). Their dimensions range from 79 x 43 x 16 mm to 99+ x 54 x 19 mm with a mean of 89 x 52 x 18 mm (Fig. 4.32).

These knives have an ovate outline. The bases are strongly convex and the edges are excurvate and converge to form a tip. The cross sections of each varies from lenticular to plano-convex.

Two of the specimens display signs of use. On both, the edge of the convex base is even and finished. Grinding is apparent on this edge and wear, which probably indicates hafting, is widespread on both of the faces over the lower one-third of the tool. The converging edges of the tip are sinuous and while showing use wear polish, also display clear signs of resharpening. Damage to the edges is quite minimal and the use wear present resulted from contact with a resistant material. One of these knives (Fig. 4.32A) is missing the tip and the other (Fig. 4.32C) still retains a striking platform on one edge of the tip.

The third specimen in this category does not appear to have been hafted. A striking platform lies on one edge of the tip and a thick platform can be seen on one side of the base. One edge was badly damaged during flaking and then abandoned. The opposite edge is unfinished but does have isolated areas of use wear resulting from working a resistant material.

Figure 4.32. Ovate knives from Component II.

scale = 10 cm

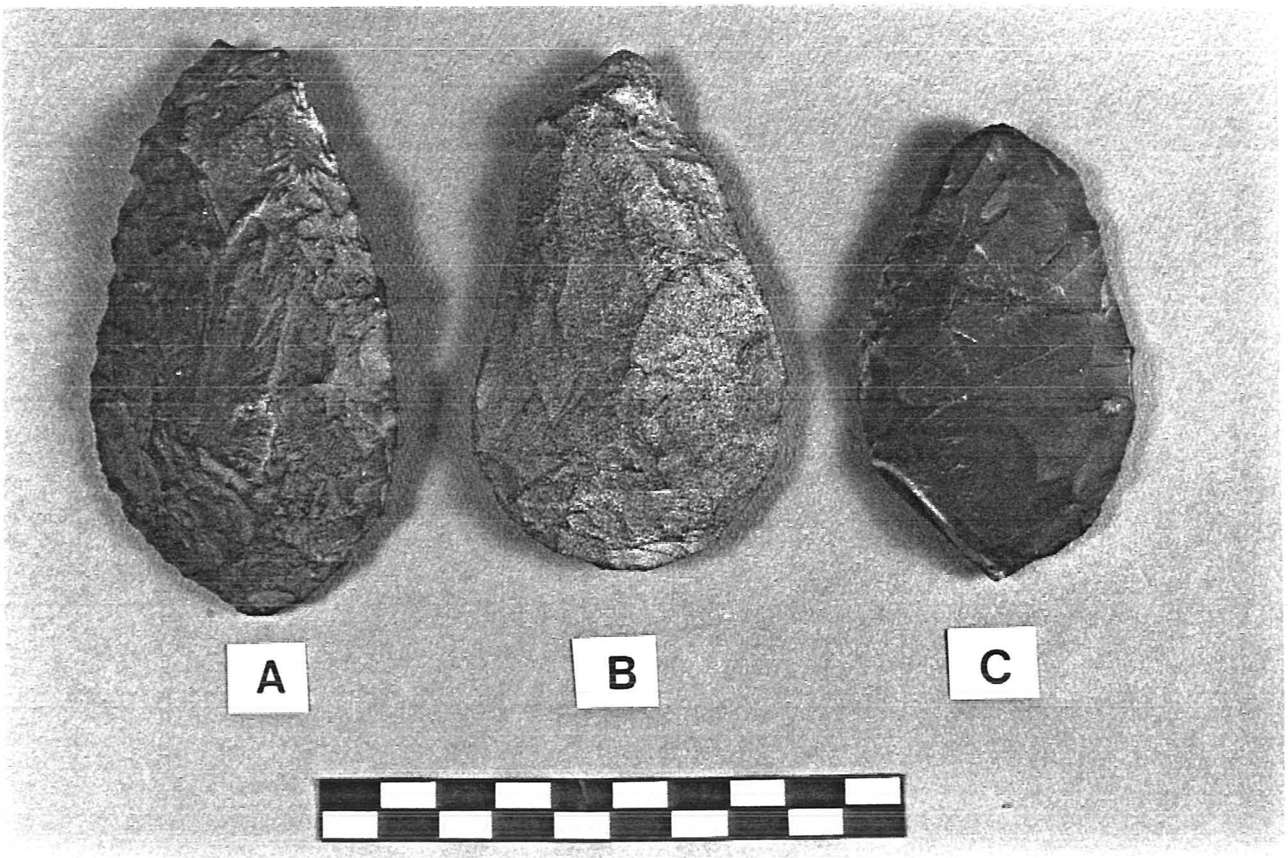
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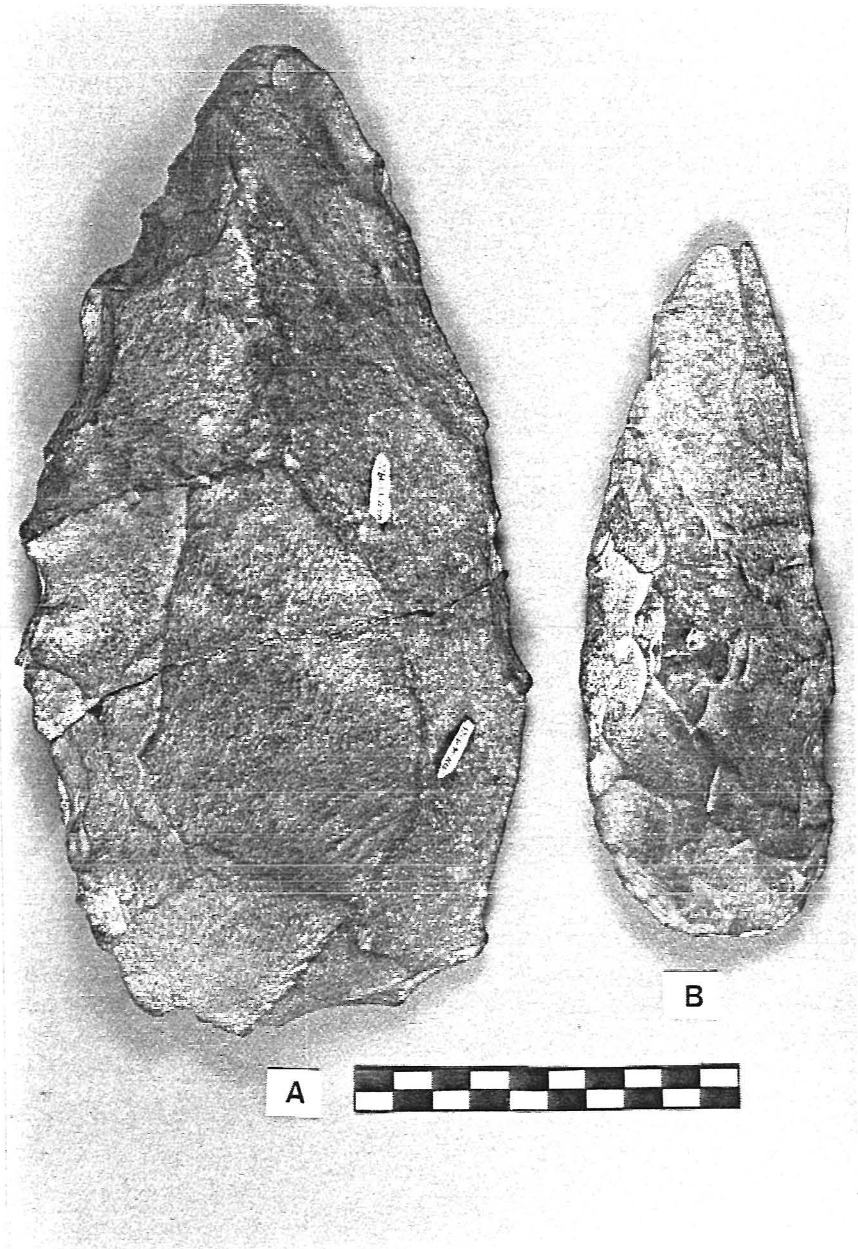
Figure 4.33. Lanceolate bifaces from Component II.

scale = 10 cm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Lanceolate bifaces (2)

These specimens are large, relatively crude bifaces which have evidence of use on their edges (Fig. 4.33). They have broad convex bases and excurvate edges which taper to a tip. The cross sections are variable on both specimens but are generally lenticular.

The first is an elongate biface which displays a convex base. The edges converge to form the tip (Fig. 4.33B). One edge is convex and the other is fairly straight. This gives the tool an asymmetric outline.

A large cortex flake of degraded quartzite underwent bifacial reduction to form this tool. The implement still retains part of the cortex on the dorsal face and a portion of the fracture on the ventral face near the tip. An attempt to flatten a thick bulb of percussion at the base was partially successful.

There are no signs of hafting but possible use wear can be seen on both edges although the coarseness of the material makes this determination very difficult.

The measurements of this biface are 176 x 66 x 28 mm.

The second biface in this category which was found in two pieces is a larger version of the previous specimen (Fig. 4.33A). It was manufactured on an enormous flake of degraded quartzite, by bifacial percussion flaking. One edge is fairly straight but the other edge and the base are irregular and sinuous. The tip was only partially formed and is fairly thick. Isolated use wear is evident on the tip, the lower part of the edges, and the base. The tool could have been used for working through the joints of an animal, or it could have functioned as a digging implement. It appears to have been held in the hand and was

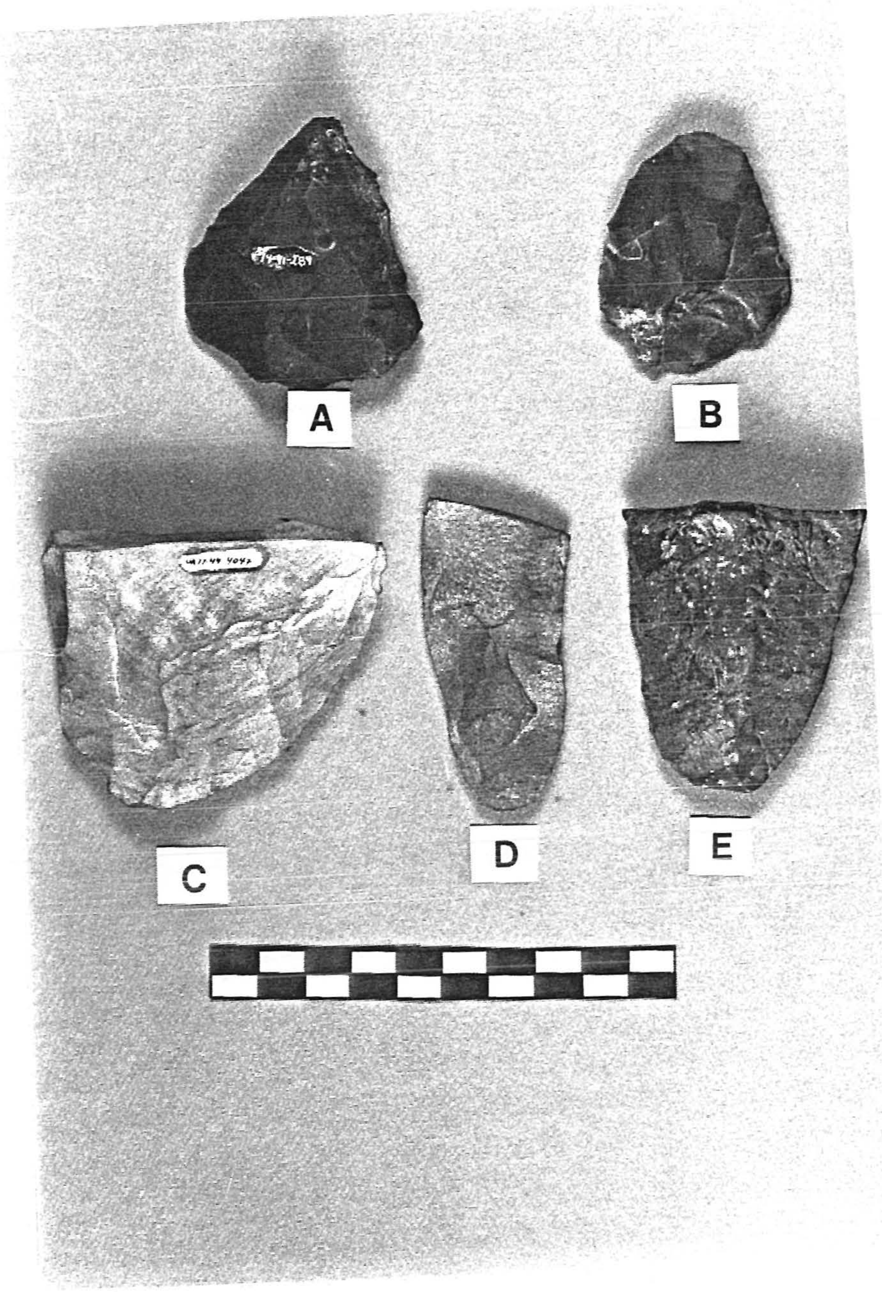
Figure 4.34. Bifaces from Component II.

A Deltoid biface

B Discoidal biface

C-E Base fragments of bifaces

scale = 10 cm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broken in two during early stages of use. It measures 257 x 119 x 41 mm.

Deltoid biface (1)

This piece was an attempt at bifacially reducing a flake of argillite and it was not very successful (Fig. 4.34A). The flaking process produced a small biface which remained incomplete and was probably discarded. No traces of use wear could be detected. It measures 58 x 53 x 25 mm.

Discoidal biface (1)

In this case an attempt was made to bifacially reduce a flake of gray chert. Impurities in the stone prevented further refinement. However, isolated areas of the edge show evidence of utilization on a hard, resistent material. No evidence of hafting can be detected; presumably, it was handheld. It measures 51 x 42 x 16 mm (Fig. 4.33B).

Base fragments of bifaces (3)

These basal fragments may have been part of ovate or oval bifaces (Fig. 4.34C-E). Only one appears to have been finished (Fig. 4.34E). They were made of pumice, dark rhyolite, and argillite. The finished piece was made on a thick flake of dark rhyolite and retains a patch of cortex on the dorsal surface at the base. The edges are straight and well trimmed. There is some edge abrasion and the crests of facial flake facets show polishing from the haft. It measures 61 x 52 x 26 mm.

Another of these specimens (Fig. 4.34C) is a fragment of either an ovate or an oval biface which was abandoned in a bifacial reduction stage. It was made on a flake of argillite and does show edge wear and possible evidence of hafting. It measures 61 x 72 x 20 mm.

The remaining basal fragment was made on a flake of pumice and shows no evidence of utilization or hafting. It was probably the base of a lanceolate knife (Fig. 4.34D). It measures 68 x 32 x 9 mm.

Biface tips (5)

These tips are of degraded quartzite (Fig. 4.35A-E). Three are biface fragments which were probably finished and subsequently broken in the haft. They have straight edges with varying degrees of use wear and two of the tips have hafting wear on the faces. Some minor resharpening can be seen on all of the specimens.

The fourth tip (Fig. 4.35A) has a sinuous edge formed by bifacial flaking and no final trimming is evident. But, it was used and shows cut yielding wear along both edges. It also displays hafting wear on both faces. It was also probably broken in the haft. The last tip snapped along a vein of impurity in the stone. It displays some minor use wear and was probably broken early in its career (Fig. 4.35E). The size ranges are from 55 x 46 x 10 mm to 107 x 57 x 25 mm with a mean of 70 x 51 x 14 mm.

Biface mid-section (1)

This light rhyolite biface mid-section was snapped at both ends (Fig. 4.35F). One edge is heavily worn through use on a cut yielding material while the opposite edge is fresh and appears to have been in

Figure 4.35. Biface fragments from Component II.

A-E Biface tips

F Biface mid-section

scale = 10 cm

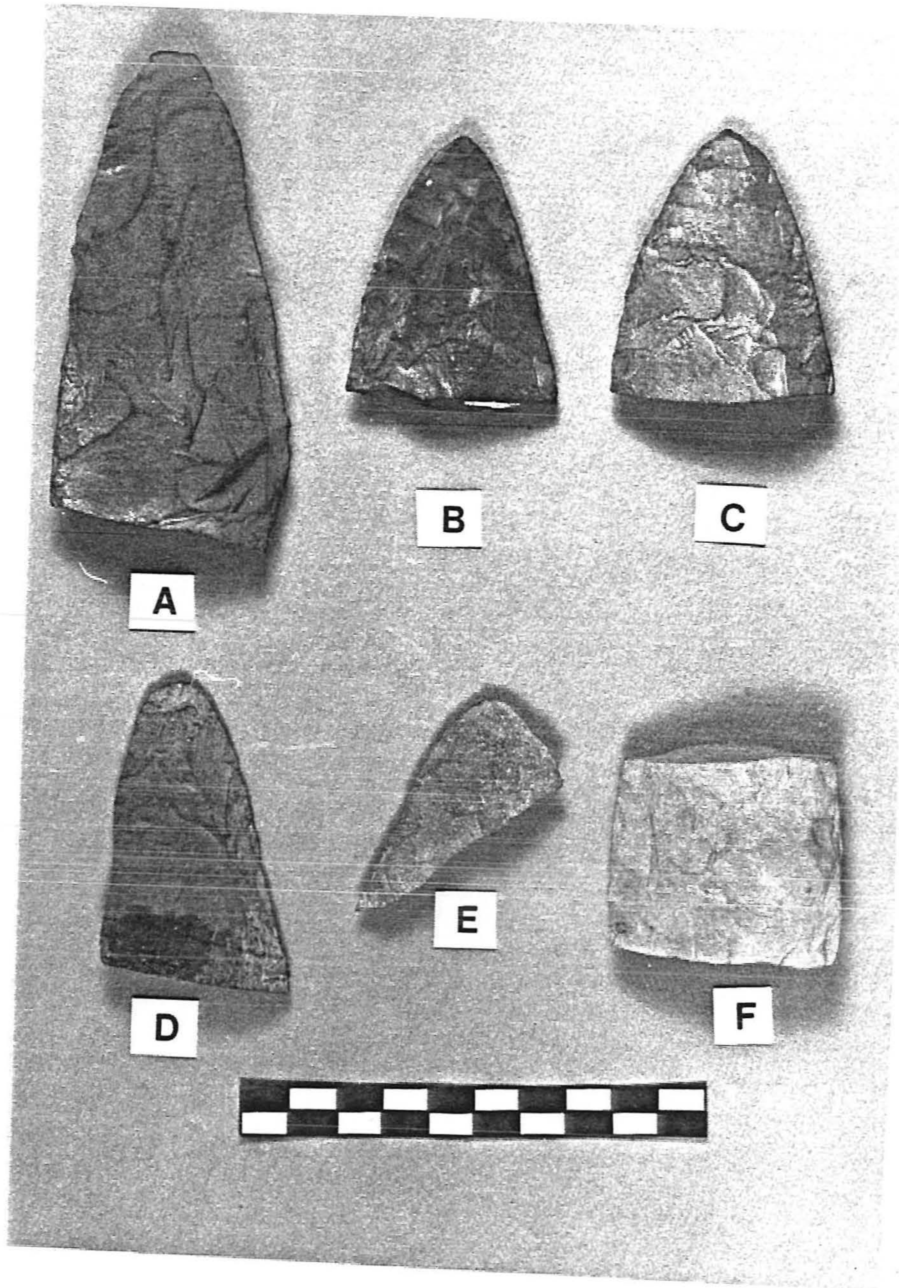

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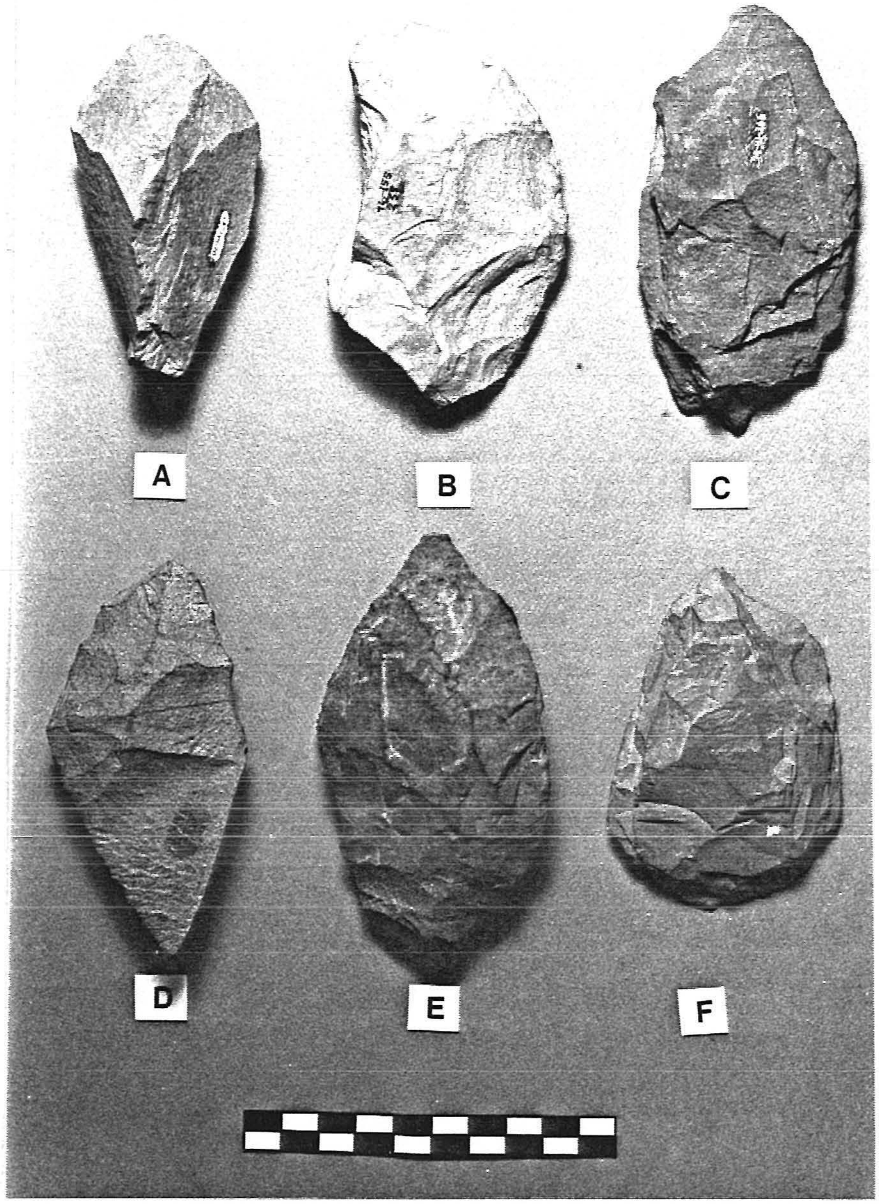
Figure 4.36. Miscellaneous bifaces from Component II.

scale = 10 cm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the process of resharpening. Hafting wear is present on both faces. Its measurements are 49 x 50 x 16 mm.

Miscellaneous bifaces (5)

This category includes objects which display some degree of bifacial flaking but which do not fall in established formal categories (Fig. 4.36). Three of these (Fig. 4.36B,D,E) (dark rhyolite [1], banded rhyolite [1], and degraded quartzite [1]) have edges formed by bifacial percussion flaking. While these edges are crude and sinuous, they do display abundant evidence of nicking and abrasion and have undergone substantial utilization as cutting implements. The material being processed was fairly resistant and durable. Heavy wear on the crests of facial flake facets can be found over most of the surfaces of these tools and this is interpreted as having resulted from rotation in a haft. In these examples, the haft probably was designed to cover one edge of the tool leaving the opposite edge free for use.

Another piece (Fig. 4.36C) resulted from an attempt at bifacially reducing a degraded quartzite flake. Most of the flaking was directed at the dorsal surface and resulted in so many deep hinge fractures that the effort was abandoned.

The last item in this group (Fig. 4.36A) is a thick piece of light rhyolite which still has a patch of cortex along one edge. One end has been flaked to produce a thick, short, broad angled (slightly pointed) cutting edge. The edge is fresh and bears no serious damage or dulling. The tool recalls a modern splitting wedge. Measurements for this category range from 90 x 50 x 15 mm to 113 x 68 x 36 mm with a mean of 102 x 58 x 24 mm.

Heavy Percussion Flaked Implements

These large, percussion flaked tools are very crude both with respect to appearance and technique of manufacture. Thirty-seven of these tools were made on water-rounded river cobbles and 10 were made on flakes struck from cobbles. The cobbles used for tool manufacture are of degraded quartzite (16), rhyolite (16), sandstone (12) and a poor quality brown chert (3), all of which are available in the debris apron in front of the site and in the bed load of Dry Creek.

These tools could have been made on the spot and discarded quickly since the working edges undoubtedly dulled rapidly during use. Availability of raw material and ease of manufacture resulted in a relatively large number of these implements in the site, most of which were found in a tight concentration together with the debris resulting from their manufacture (see Chapter Five). This suggests a very specific activity conducted in a limited area.

These implements are divided into the following catagories: cobbles with lateral working edges, cobbles with working edges on the end and side, miscellaneous cobble artifacts, and miscellaneous large flake artifacts.

Cobbles with a lateral working edge (7)

These tools have a crescentic outline and a cuneate cross section. One thick edge retains the cobble cortex and the opposite side has been shaped by bifacial percussion step flaking to form a thick, convex working edge. Four of these tools were made on cobbles and two on flakes. The flake tools maintain the same attributes as the cobble tools. Their efficacy as cutting implements is very doubtful. The edges are heavily crushed indicating either use as cleavers or wedges on a resistent material (bone or joints?).

These implements range in length from 126 x 52 x 30 mm to 164 x 121 x 77 mm. Mean values are 149 x 95 x 61 mm.

Cobbles with working edges on the end and side (29)

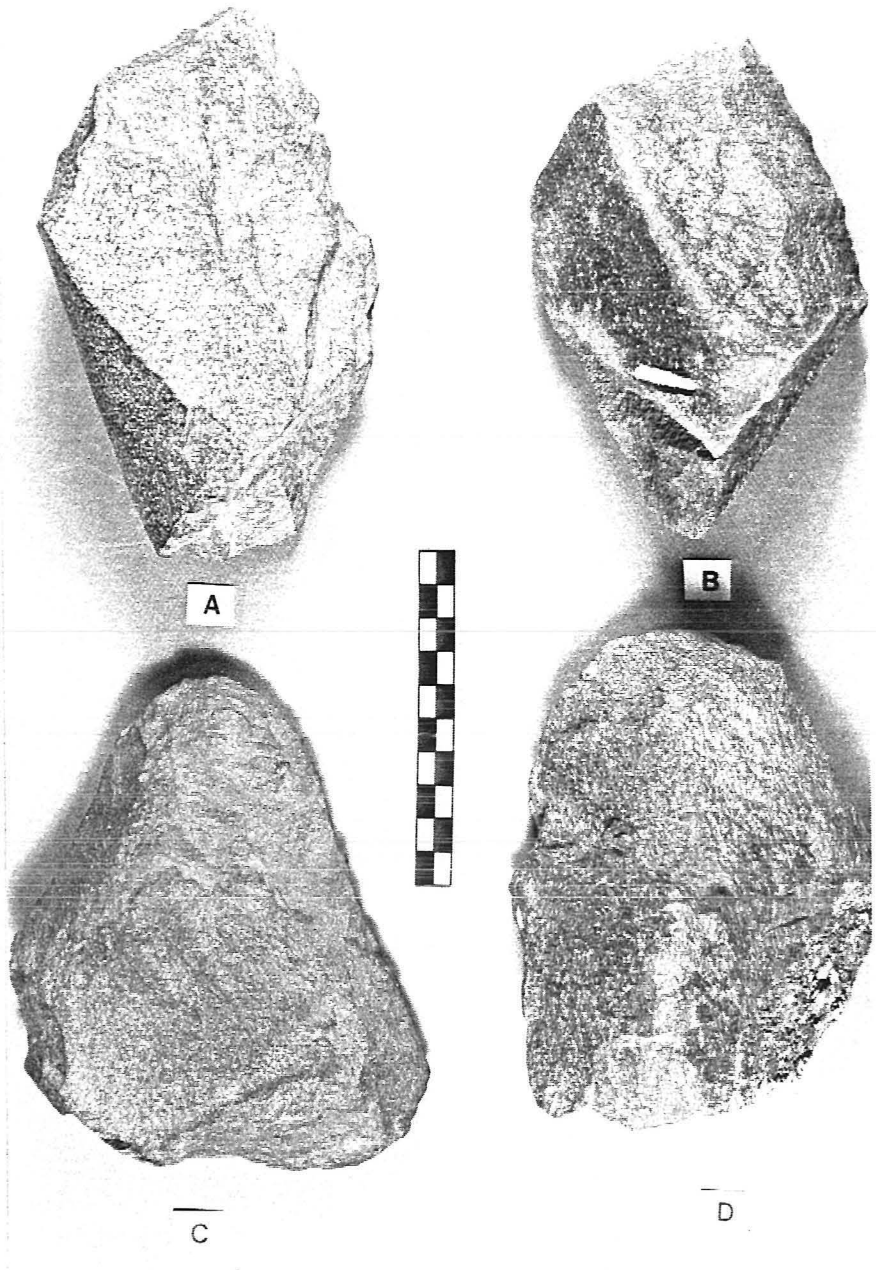
These tools have two working edges: one on the side and another on the end. Twenty-five were made directly on cobbles and four were made on large flakes actually representing longitudinally split cobbles. The outlines are generally ovate but sometimes tend toward discoidal. The cross sections range from plano-convex to cuneate. All were made by heavy percussion flaking and retain a substantial amount of cortex on both the dorsal and ventral surfaces. Also, on 22 of the tools, the side opposite the lateral edge has been left intact, retaining cortex and the original curvature of the cobble. This may have been done intentionally to provide a broad area to absorb shock in the palm of the hand while the tool was being used. The working edges have been worked bifacially but to differing degrees. In most cases, substantial bifacial reduction on the ventral surfaces was necessary to flatten the bottom of the tool. This feature was definitely desired and surely had special functional significance. The lateral edges are quite uniform and display very steep, almost vertical, step flaking. Some are simply thinner examples of the above and edge angles are reduced as a consequence. In many instances these edges are extremely dull from use, but others were damaged from flaking which miscarried.

The ends of the tools have been treated in two separate ways: 18 have convex edges (Fig. 4.37C-D) while 11 (Fig. 4.37A-B) have a pointed

Figure 4.37. Heavy percussion flaked implements from Component II.

A-D Cobbles with working edges on the end and side.

scale = 10 cm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end resulting from the convergence of two lateral edges.

Those tools with convex edges also vary somewhat. Five (Fig. 4.37D) have thick, broad, convex noses which give the tool the appearance of an enormous end scraper. The remaining 13 also have broad, convex noses, but substantial bifacial reduction has resulted in a much flatter, spatula-like working edge. Considerable dorsal keels have resulted from the formation of the working edges on these examples.

These implements probably were used in heavy butchering work, e.g., dismemberment, and our field experimentation has shown that tools such as these, manufactured from the same raw materials accomplished the task of separating joints better than any other stone tool. Since the raw materials are so coarse, we were unable to detect use wear on these tools. Also, several tools exhibit percussion damage on the end opposite the convex edge which suggests that they were used as gigantic wedges. These also would make an ideal tool for working through joints.

These tools range in size as follows: 122 x 82 x 41 to 175 x 140 x 75 mm. Mean values for these dimensions are 150 x 102 x 59 mm.

The 11 remaining tools in this category, as mentioned above, have pointed rather than convex ends (Fig. 4.37A-B). Except for this feature they are morphologically identical. They also differ in the degree of flattening of the end of the implement. On these tools the converging edges form a fairly thick point. Percussion flaking is heaviest on the dorsal surface, but some flaking is present on the ventral surface and this served to flatten this area of the tool. Like the preceeding category, coarseness of the raw material creates problems in interpreting both use wear and function. Functionally, they are probably similar to the tools with convex ends and the development of a point on the end of the tool is most likely the result of situational requirements. Like the preceeding category, they would be well suited for separating joints.

The size ranges for length, width and thickness are 135 x 71 x 44 mm to 210 x 120 x 90 mm. Mean values for the same dimensions are 162 x 98 x 71 mm.

Miscellaneous large bifacial tools

This group of implements is represented by miscellaneous cobble tools (5) and large flake tools (7).

Miscellaneous cobble tools (5)

These artifacts were manufactured on cobbles of sandstone (3), quartzite (1), and rhyolite (1). The degree of heavy crushing on the flaked end and battering on the opposite end indicate application of the working edge to a very resistent material. The size range of these objects is 125 x 146 x 76 mm to 146 x 98 x 80 mm.

The third item in this category is unique in the site (Fig. 4.38). A flat, water-rounded river cobble of sandstone which probably had an original cresentic outline, was percussion flaked bifacially to form a broad, deep concavity giving the tool the appearance of an enormous spoke-shave. The working edge is dull, worn and even crushed from what was probably a pounding action. It measures 191 x 86 x 27 mm.

Miscellaneous large flake tools (7)

Large flakes of rhyolite (4), pumic (1), quartzite (1) and low grade brown chert (1) illustrate differing degrees of alteration and edge damage.

Figure 4.38. Miscellaneous cobble tool from Component II.

scale = 10 cm


76-155 4018.

Two display some retouch along the most acute edge while the opposite edge is much thicker and suitable for holding in the hand. A single specimen displays a thin sharp edge with some nicking, and an opposing edge which was dulled or backed by bifacial retouch. These tools would have made excellent knives. These three tools range in size from 97 x 61 x 15 mm to 122 x 74 x 40 mm.

Two other specimens are large, thick bifacial thinning flakes that have fairly sinuous edges which are crushed from pounding and bashing a hard substance. These measure from 120 x 82 x 32 mm to 123 x 100 x 34 mm.

The last piece in this group has a broad, unifacially prepared concave working edge at one end of the flake. This edge is dull and partially crushed and was probably used in heavy butchering activity. It measures 16 x 83 x 42 mm.

Scrapers

This class of implements displays unifacial working edges and some degree of formal shaping. While unifaciality is a definite criteria, some degree of bifaciality does occur for obvious technological reasons i.e., straightening the curvature of a flake, reducing bulbs of percussion or other impediments to the thinning and shaping process.

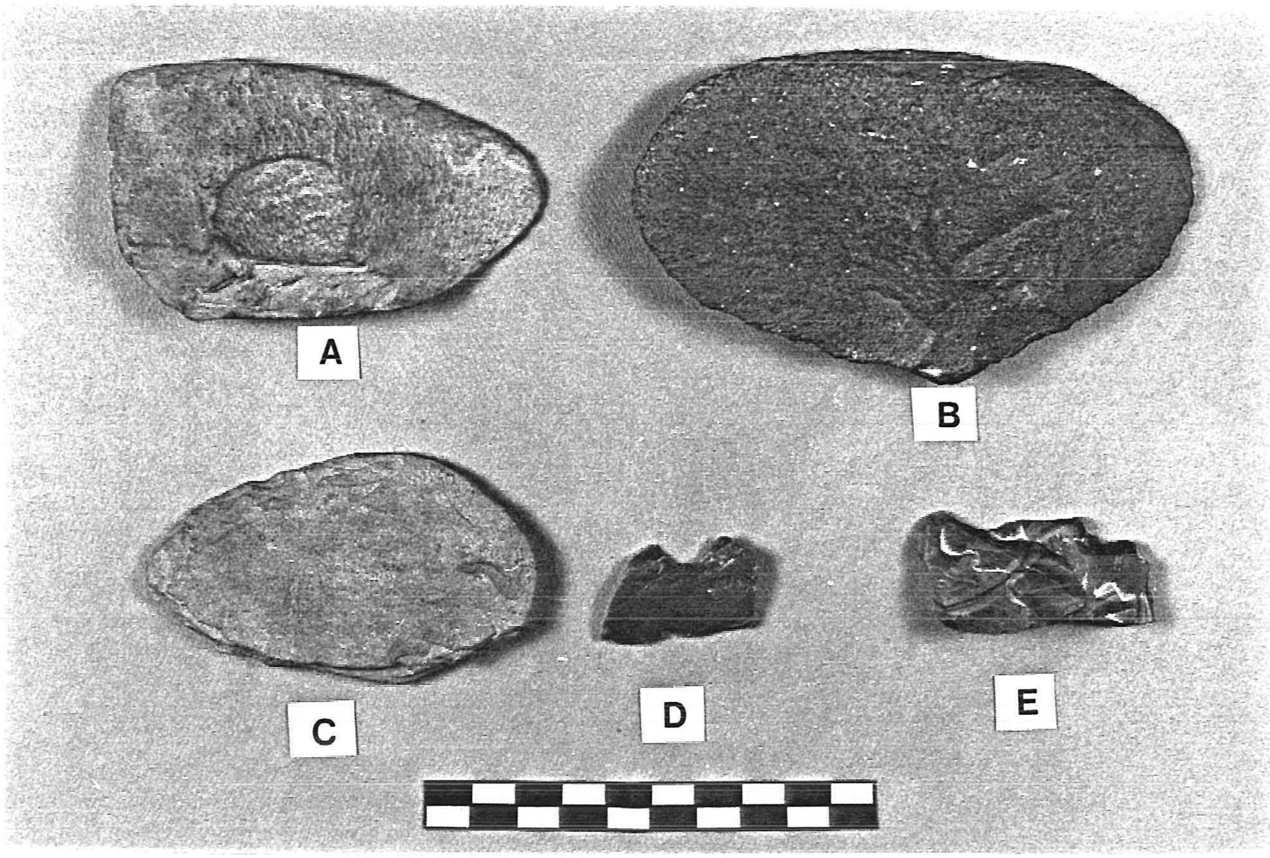
All of the scrapers were made on flakes of various dimensions and thicknesses and can be separated into the following categories: transverse scrapers (3), spokeshaves (2), side scrapers (10), and convergent side scrapers (6).

Figure 4.39. Scrapers from Component II.

A-C Transverse scrapers

D-E Spokeshaves

scale = 10 cm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Transverse Scrapers (3)

These scrapers are characterized by a straight or convex working edge which is transverse to the axis of the flake. The working edge lies at the opposite end of the flake from the bulb of percussion (Fig. 4.39A-C).

Raw materials for this category are light rhyolite (2), dark rhyolite (1). Size ranges vary from 52 x 87 x 9 mm to 75 x 124 x 19 mm. Mean dimensions are 62 x 101 x 16 mm. Scraper edge angles vary from 12° to 20° with a mean of 14°.

Of the scraper edges, one bears no obvious evidence of use or hafting (Fig. 4.39B), although, it may have been resharpened. A second (Fig. 4.39A) shows use wear polishing and micronicking probably indicating use on substances of differing degrees of hardness. This piece also was used in a haft which held the side opposite the working edge and covered about 2/3 of the tool. The third scraper of this group likewise shares differential use on both scrape yielding and scrape resistant substances but no evidence of hafting.

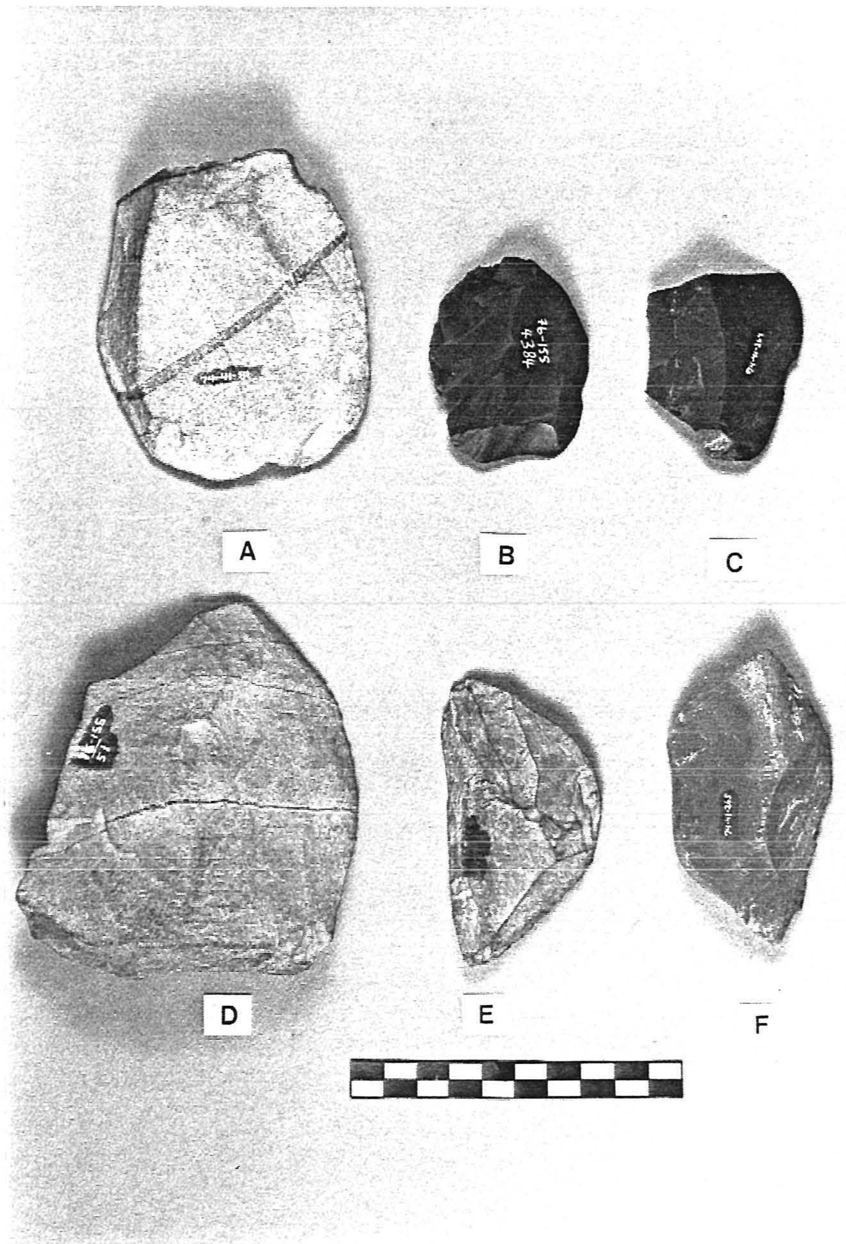
Spokeshaves (2)

Both of these spokeshaves were made on flakes (Fig. 4.39D-E). One has a deep unifacial concavity in one edge and minor degrees of fine chipping along the opposite edge. It measures 39 x 22 x 7 mm and is of gray chert.

The second spokeshave is chalcedony and bears an unifacial concavity. Adjacent to the concavity is a finely retouched nose. At the opposite end of the flake there is another such nose with a vertical, crushed edge along one side. It measures 53 x 26 x 14 mm.

Figure 4.40. Single side scrapers from Component II.

scale = 10 cm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On both specimens, the deepest part of the concavity is nearly vertical as a result of heavy crushing in this area. It is assumed that they were employed to shape shafts for tools.

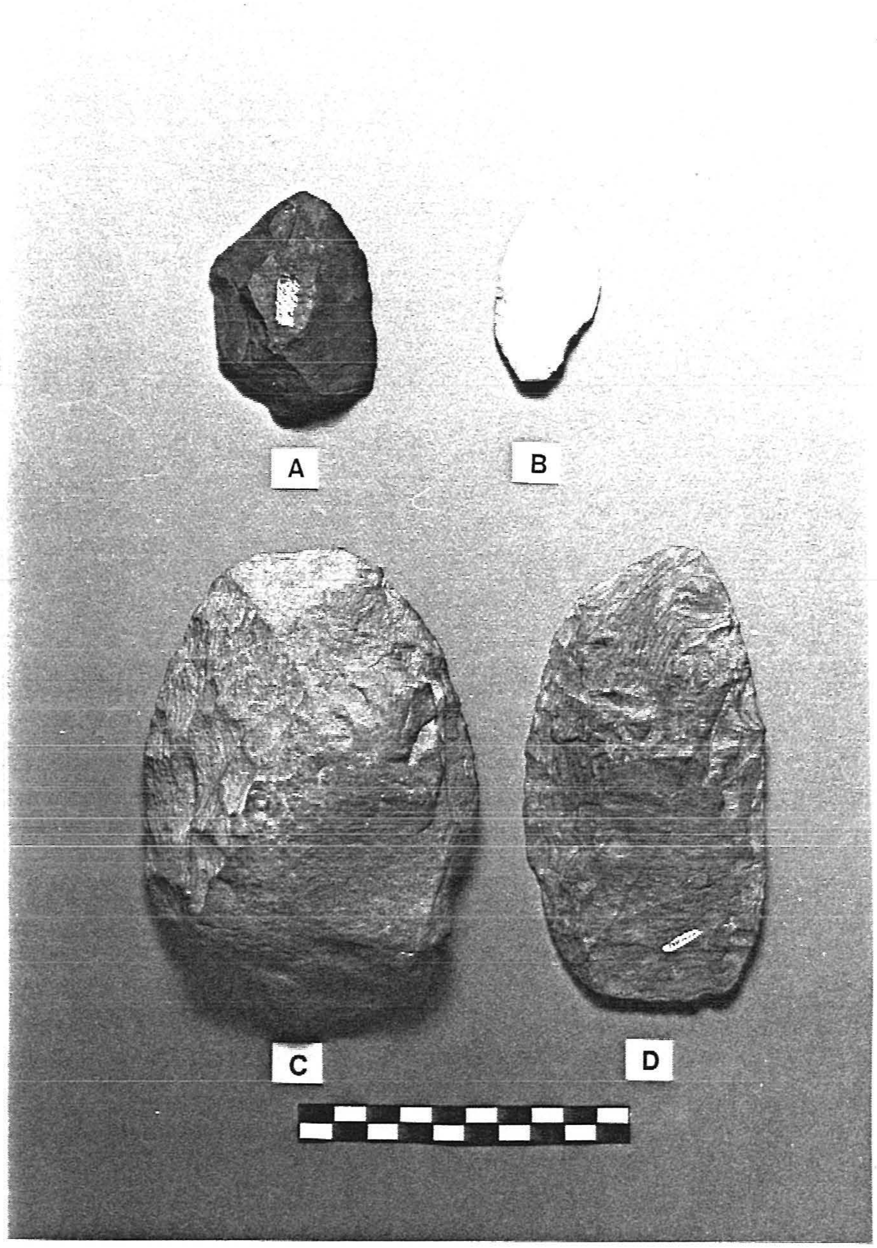
Side Scrapers (10)

In this category, the scraper edge lies parallel to the axis of the flake. All but one of these has the scraper edge on the dorsal surface of the flake. Six of these (Fig. 4.40) are single side scrapers and they all have convex working edges. Raw materials for these scrapers are diabase (2), black chert (2), gray chert (1) and quartzite (1). Measurements range from 56 x 41 x 8 to 118 x 102 x 31 mm with a mean of 88 x 62 x 181 mm. Edge angles vary from 10°-20° with a mean of 21°. Four are double side scrapers i.e., they have two opposing scraper edges, but they are situated on alternate faces (Fig. 4.41). In this subgroup, three have convex working edges, one has one convex and one straight edge, and one has two straight edges. Raw materials for these are black chert (1), light rhyolite (1), banded rhyolite (1), and quartzite. Measurements are 50 x 32 x 7 mm to 140 x 100 x 42 mm. With a mean of 99 x 63 x 19. Scraper edge angles vary from 5° to 70° with a mean of 26°.

Among the single side scrapers, three have edges dulled from use on a fairly yielding material and may have been held in the hand. The remaining three may also have been handheld since no hafting wear can be detected. Two of these exhibit edge damage which must have resulted from working a scrape resistant substance, whereas, the remaining specimens appear to have been used partially for cutting and scraping.

Figure 4.41. Double side scrapers from Component II.

scale = 10 cm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Most of the nick marks occur on the dorsal surface but some isolated marks can be found on the ventral face.

The double side scrapers show similar variability. One (Fig. 4.41B) has isolated wear interrupted by resharpening, two (Fig. 4.41A,C) appear to have both cut and scraped, and one shows heavy dulling of both edges from working scrape yielding material. None of the scrapers display any evidence of hafting.

Convergent side scrapers (6)

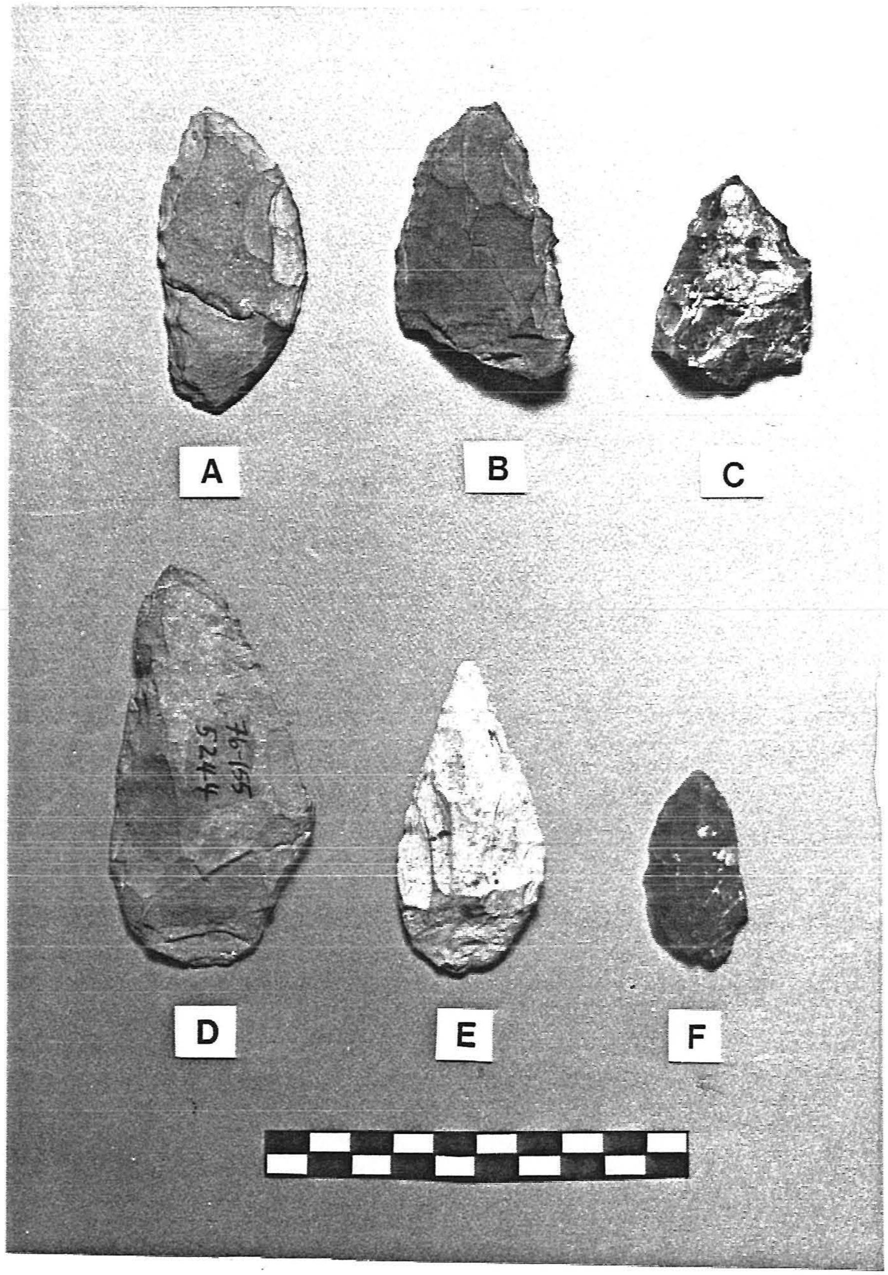
These scrapers have two scraper edges, which converge to form a tip (Fig. 4.42). On two examples, the steep flaking used to form the edges created a keel on the dorsal surface (Fig. 4.42E-F). The other four specimens are broad and lack keels. Each scraper has both a relatively straight and a convex edge. Large flakes of chalcedony (2), quartzite (2), light rhyolite (1), and dark rhyolite (1) were used to make these scrapers. Size ranges run from 46 x 24 x 8 mm to 74 x 48 x 27 mm with a mean of 65 x 36 x 12 mm. Edge angles range from 30° to 60° with a mean of 48°.

In five instances, these scrapers were manufactured on the edges of the dorsal surface of flakes. The remaining specimen has convergent edges but they lie on alternate faces. Four of the flakes display edges which are parallel to the long axis of the flake with the bulb of percussion at the base of the tool. The other two scrapers were simply made on pieces of flakes lacking the bulbar end.

One of these scrapers (Fig. 4.42C) bears no evidence of use wear; it was probably discarded after flaking miscarried and destroyed one edge.

Figure 4.42. Convergent side scrapers from Component II.

scale = 10 cm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The remaining five pieces display varying degrees of use wear and one shows evidence of resharpening. None of the scrapers show any clear hafting wear and may have been held in the hand.

One specimen (Fig. 4.42A) has clear hafting wear on both faces. It was secured so that both edges were exposed and it appears to have been broken in the haft.

The evidence of utilization is variable on these items and would appear to indicate that both cutting and scraping affected the edges. While classified as convergent side scrapers on morphological and technological grounds, these tools were probably used, at least in part, as knives.

Other Core Technology

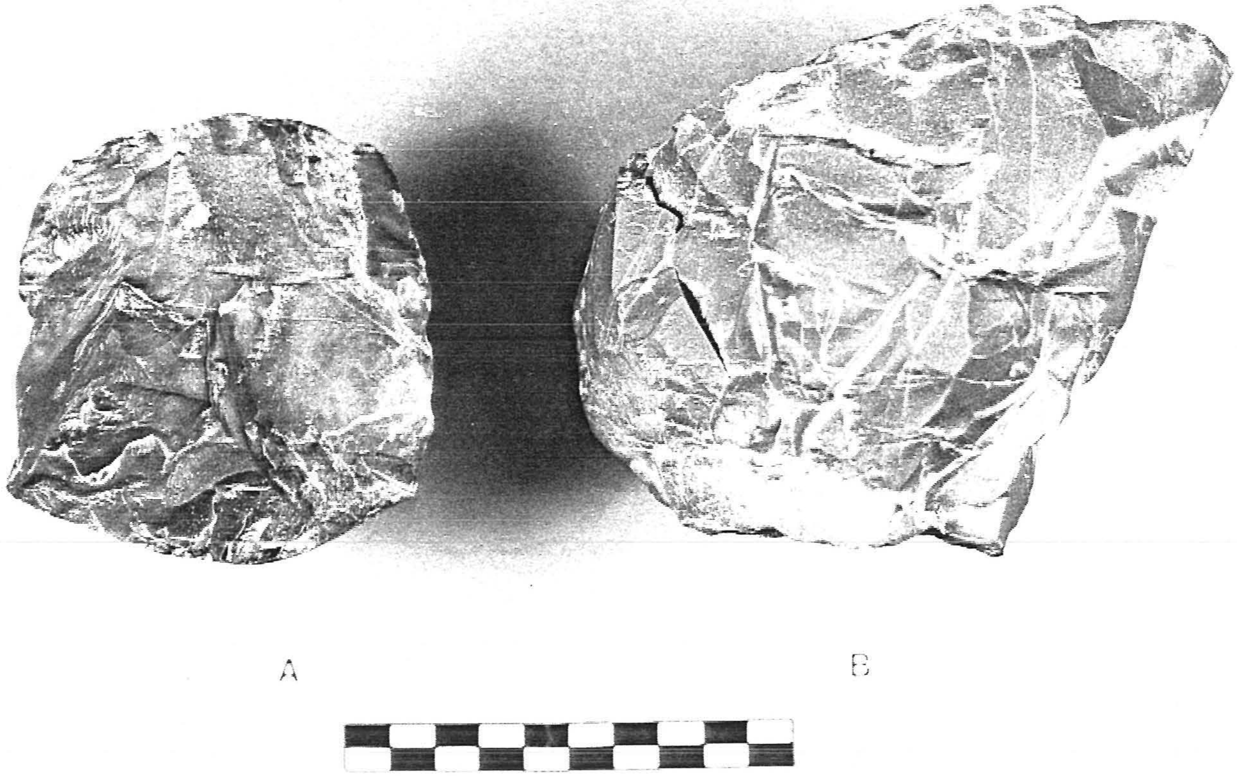
Subprismatic cores (4)

Subprismatic cores were manufactured on water rounded cobbles of gray chert (2), diabase (1), and degraded quartzite (1) which were probably taken from local gravel deposits.

Their measurements range from 87 x 93 x 65 mm to 137 x 106 x 140 mm with a mean of 121 x 100 x 87 mm. They are crudely prismatic and are characterized by the removal of flakes from one side of the core. In one example (Fig. 4.43B), about 3/4 of the perimeter of the core was used for flake removal. The opposite side, or back of the core, preserves areas of cortex. A few flakes were struck from this side, and from the end opposite the platform. On two of the cores (Fig. 4.43), one frontal blow removed the entire top and massive flakes were then removed without further modification of the striking platform. The remaining two

Figure 4.43. Chert subprismatic cores from Component II.

scale = 10 cm



A B

Figure 4.44. Diabase subprismatic core with re-articulated flake from Component II. Front view.

scale = 10 cm

Figure 4.45. Diabase subprismatic core with re-articulated flake.
Side view (right) with platform at the top.
scale = 10 cm

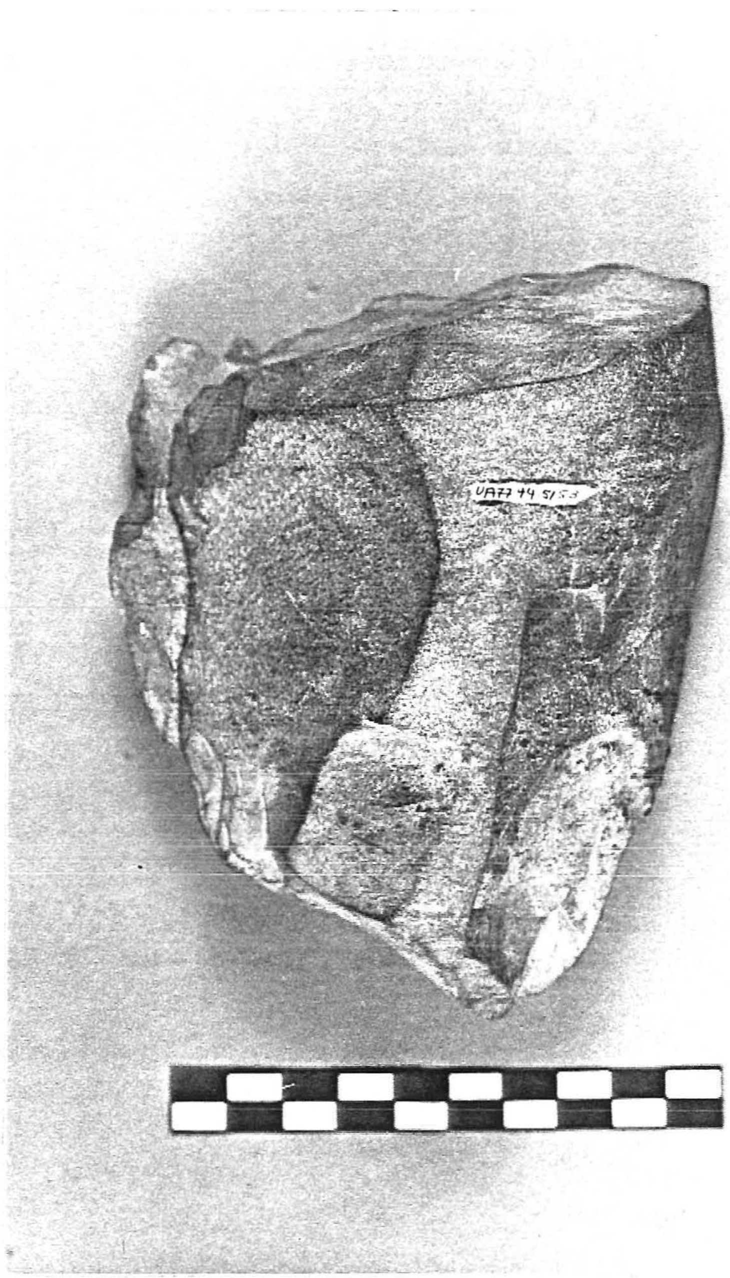

VA77 44 51

Figure 4.46. Diabase subprismatic core with re-articulated flake.
View of beveled platform.
scale = 10 cm

specimens have platforms with substantial preparation and one of these (Fig. 4.44, 4.45, 4.46) displays edge preparation along one side of the face from which the flakes were removed. This core also displays an exceptionally well-developed platform. A flake struck from this core (Figs. 4.44-46) has been reattached. The proximal end of the flake displays heavy faceting. This is a remnant of the preparation on the striking platform of the core. Technologically and morphologically, this specimen is a levallois flake; it was detached from a core type which Soviet investigators working in Siberia classify as epi-levallois, and this type of core-flake technology is a common occurence in sites dating to the Late Paleolithic in Siberia (Powers 1973).

Blade-like flakes (3)

No blade cores from which such blades/flakes could have been struck were found at Dry Creek. The existence of a separate macroblade technology is possible, but accidentally produced blade-like flakes are likewise a reasonable expectation. Larger or more complete samples are required to settle this particular conundrum. Three unworked blade-like flakes were found of which three are quartzite and one is pumice (Fig. 4.47C,E,F). They range in size from 63 x 10 x 04 mm to 85 x 31 x 8 mm. The mean measurements are 75 x 23 x 6 mm.

Blade-like fake tools (18)

Eighteen blade-like flakes have retouched or utilized edges and are summarized in Table 4.7.

Figure 4.47. Blade-like flakes from Component II.

A-B,D Blade-like flake tools

C,E-F Unmodified blade-like flakes

scale = 10 cm

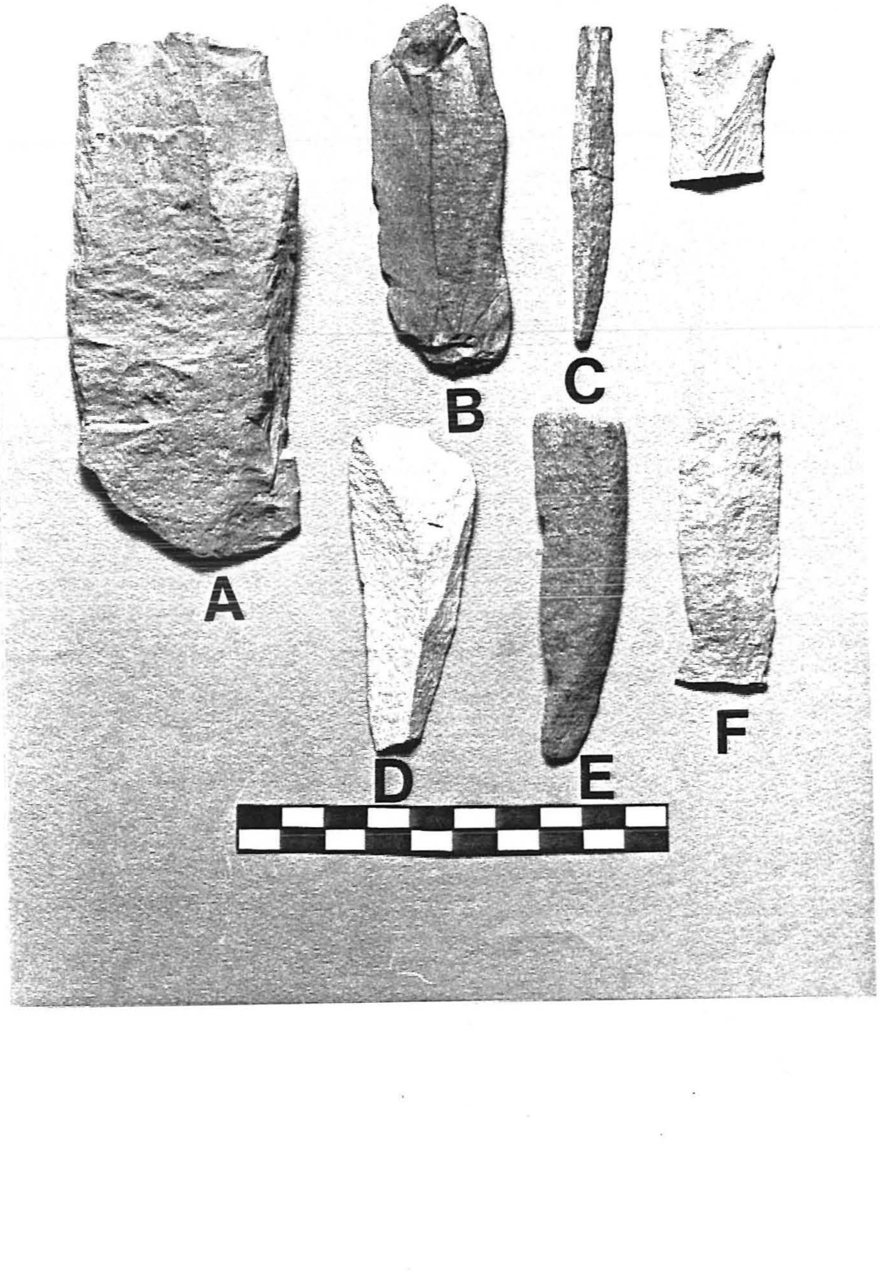

A
B
C
D
E
F

Figure 4.48. Flake and blade-like flake tools from Component II.

A Unshaped flake tool

B-L Blade-like flake tools

scale = 10 cm

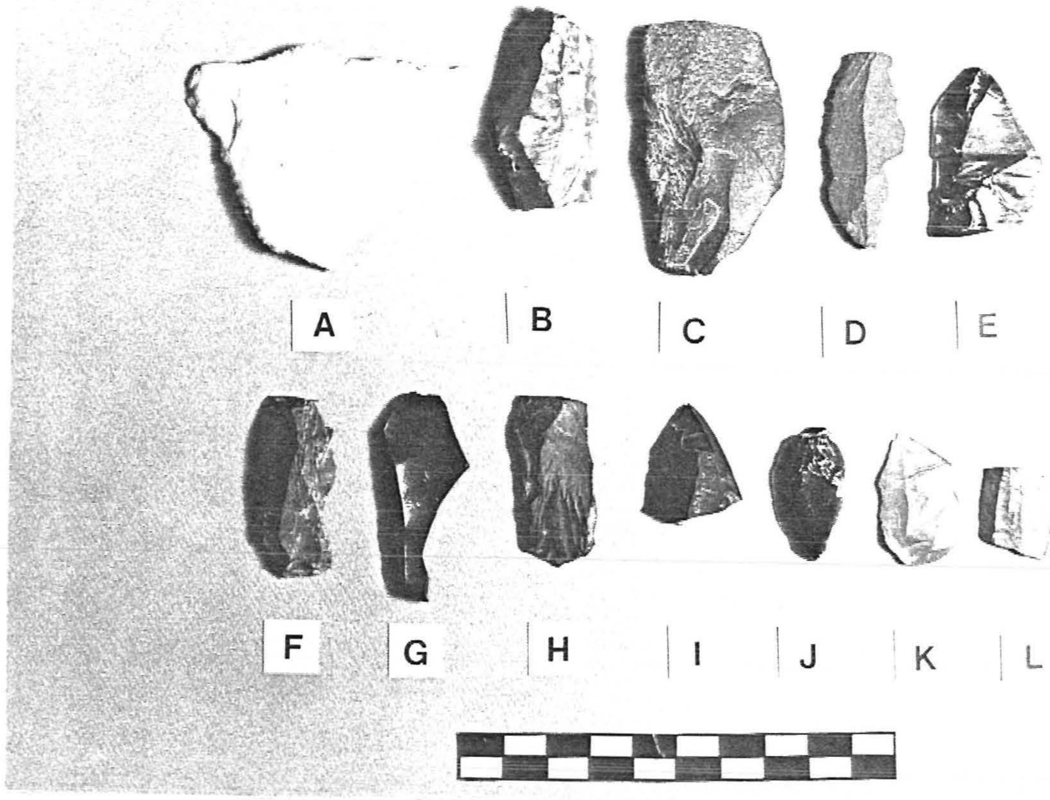

A
B
C
D
E
F
G
H
I
J
K
L

Table 4.7 Raw material frequencies for flake and blade-like flake tools.

Material	Complete	Proximal	Medial	Distal	Totals
Gray chert	4	1	--	--	5
Rhyolite	1	--	--	1	2
Pumice	1	--	--	--	1
Black chert	1	1	--	--	2
Obsidian	3	--	--	--	3
Brown chert	--	2	3	--	5
	10	4	3	1	18

One complete rhyolite specimen is quite large and measures 120 x 54 x 18 mm. The remaining nine complete pieces are more uniform in size and range from 42 x 13 x 5 mm to 60 x 33 x 7 mm. The mean size for these specimens is 47 x 22 x 6 mm (Figs. 4.47A,B,D and 4.48B-L).

The proximal portions vary from 12 x 12 x 2 mm to 71 x 29 x 10 mm. Their mean size is 40 x 19 x 5 mm.

The medial portions range from 21 x 7 x 4 mm to 68 x 27 x 6 mm. The mean is 41 x 19 x 5 mm. The single distal fragment measures 40 x 16 x 4 mm.

All but one, as indicated above, have fine retouch and edge damage. They probably functioned as small knives and appear to have been very resistant to edge damage.

The last item (Fig. 4.47A), the largest, is a complete rhyolite piece with no evidence of flaking. However, one edge and the base are heavily polished, and there are weakly developed striations running at a 90° angle to the working edge. This tool appears to have been unhafted and used as both a scraper (the end) and a knife (the side) on a fairly soft, yielding material, possibly hide.

Unshaped Flake Tools (21)

These small flake implements have been given no formal shaping other than fine retouching along the edges. Twenty of these pieces have unifacial working and one has bifacial edge retouch. The raw materials employed are rhyolite (4), quartzite (4), brown chert (2), gray chert (3), black chert (2), obsidian (2) and chalcedony (1). The sizes range from a maximum of 63 x 57 x 13 mm to a minimum of 14 x 7 x 2 mm.

These small, fairly fragile tools were probably employed as light duty scrapers or knives (Fig. 4.48A).

Miscellany

Hammerstones (3)

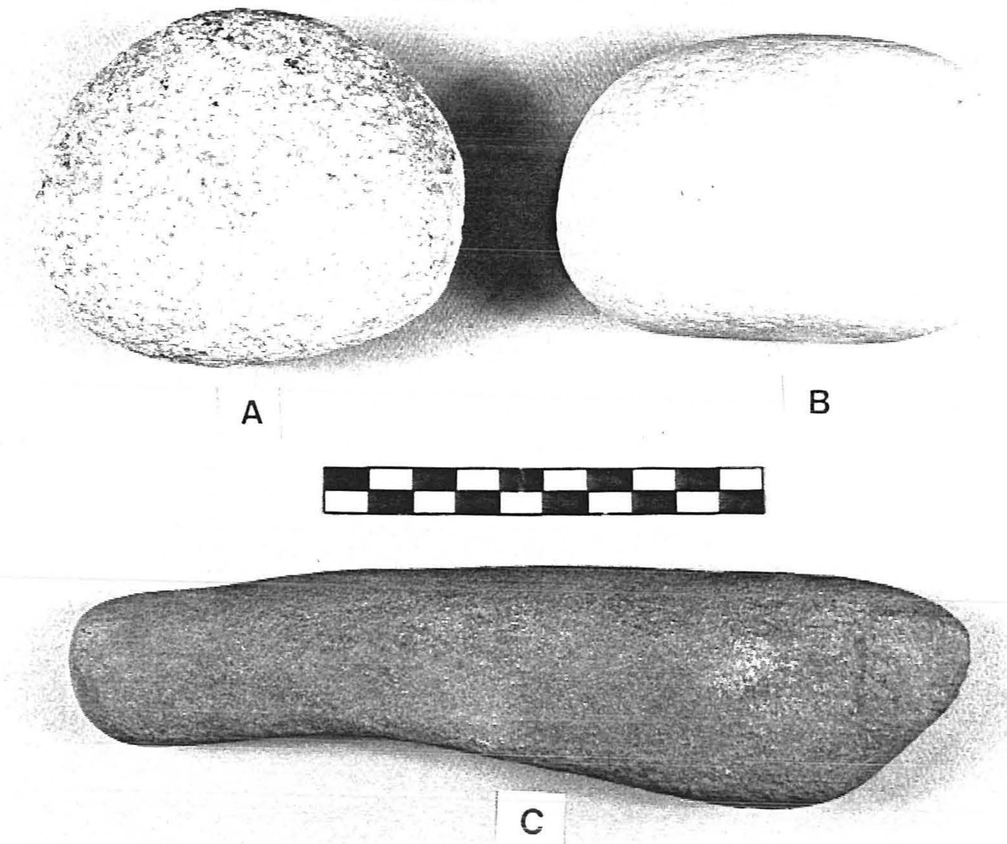
These tools are rounded river cobbles with heavy battering and crushing on both ends as a result of direct percussion (Fig. 4.49). Two are coarse grained quartzite and measure 101 x 68 x 60 mm and 94 x 78 x 51 mm. The third is rhyolite. It is long and narrow and may have been used for either pressure retouch or light percussion flaking as a hard blow would surely have broken it. It measures 202 x 53 x 30 mm.

Anvil stones (3)

These stones are generally oval and have flattened cross sections. They display heavy battering on one face which probably resulted from

Figure 4.49. Hammerstones from Component II.

scale = 10 cm


A
B
C

stones being smashed against them. This battering could have also resulted from stones being placed on the anvil and struck with a hammer stone (Fig. 4.50). Two are quartzite and measure 240 x 170 x 126 mm and 440 x 249 x 175 mm. The last is rhyolite and measures 167 x 123 x 77 mm.

Summary

Excavations at Dry Creek have demonstrated the existence of human groups in the Nenana Valley 10-11,000 years ago and that these groups were hunting, in part, remnants of the steppe adapted grazing fauna that had existed in Alaska in the Late Pleistocene. These hunters left a residue of their activity at Dry Creek in the form of two temporally separate sets of occupations. Component I dates to the late 12th millenium and is confined to Loess 2. Component II which dates to the mid 11th millenium lies in Loess 3, Paleosol 2 and is separted from the underlying component by Sand 1.

It is difficult to tell how many times the site was visited during Component I time as there are far fewer cultural remains than in Component II, but during this latter occupation the site was heavily used and probably on many different occasions.

These occupations are typified by tool kits which were probably directed at two major activities regardless of component or cluster: 1) the production or maintenance of hunting equipment and, 2) the procurement and processing of game. These activities were carried out with artifacts that fall into two general categories: 1) large,

Figure 4.50. Anvil stone from Component II.

scale = 10 cm

crudely fabricated, opportunistic implements made from locally available low grade raw materials, and 2) small, light-weight tools produced from medium to high quality materials which were either brought to the site from the hinterlands or derived from trade networks.

The heavy, crude implements are shared by both components and were probably used in butchering activities, and more specifically, in the dismemberment of carcasses.

The small, light-weight tools from Component I are difficult to characterize because there are so few of them and many appear fresh or unused. However, this same category of tools from Component II represent something quite different as evidenced by extensive maintenance activity (reworking and resharpening).

Many of the small bifaces are highly curated and, we think, represent weapon tips as well as cutting tools. Possible, many of the cutting tools first served as weapon tips, but as they sustained damage and were reworked and reduced to the point that they were ineffective, they were transformed into knives. All of the remaining categories of small tools (burins, scrapers etc.) likewise show evidence of multiple purposes.

During Component II time microblade production was a major activity at the site. We assume that the purpose of this activity was the production, or at least maintenance, of composite points. One of the attractions of composite points is the portability of the points themselves, and the tools necessary for its production. The microblade core can be viewed as a perfect adaptation to mobility. It is small, light weight and produces the maximum amount of sharp linear edge per unit of stone. A technology such as this, plus the other small tools from the site would have made excellent light-weight tool kits for small groups of people pursuing a highly mobile hunting strategy (see also Del Bene, 1981).

While there are general similarities in the activities conducted at the site, Components I and II differ markedly in technological emphasis.

The technological emphasis of Component I was in the production of bifaces (both projectile points and knives), side scrapers, transverse scrapers, burins, cobble tools, and unshaped flake tools. This set of artifacts, or what we can see of it, constitutes the tool kit. The absence of microblade cores, core tablets, and microblades is notable. This situation may be the result of a sampling error at the site, or regional level, and differences in site specific tasks or seasonal activities beyond the site could account for the absence of a microblade technology at this time level in the Dry Creek site. However, for the time being, verification of these hypothetical sampling problems is beyond reach as there are no adequately sampled sites of this age in the area with which to compare this particular stratigraphic situation.

Microblade technology is reported from the Chindadn complex at Healy Lake which is probably penecontemporaneous with Component I at Dry Creek. However, this site should be assessed cautiously as the entire sequence lies in a compressed loess section with ample possibility for internal mixing and attendant sampling problems. Besides Healy Lake and Dry Creek, the Moose Creek site in the Nenana Valley (Hoffecker, 1982) is the only other locality that has produced data that relates to this early lithic horizon. It occupies a similar topographic position as Dry Creek. The artifacts are also contained in an aeolian section. Component I at this site is associated with a set of paleosol stringers

(Unit 6) and an underlying silt (Unit 7) which in turn rests on a till or outwash deposit of a pre-Wisconsinian glaciation of undetermined age. There is a set of radiocarbon dates run on soil organics from the paleosol stringers (Unit 6) which range from 8160 ± 260 to 11,730 ± 250. These are viewed as upper limiting dates for Component I. The artifacts are vertically distributed through about 30 cm of silt down to the surface of the glacial deposits. To date fragments of six bifaces have been recovered from this component, two of which appear to be bases of lanceolate points. One possible microblade fragment is also reported (Hoffecker, 1982). An expansion of the excavations at this site should provide badly needed information on the possible existence of a pre-microblade lithic horizon in Alaska.

Component I at Dry Creek is a small, but distinctive assemblage and as such, representes one aspect of the earliest lithic horizon in Alaska. While specific typological similarities are lacking for the projectile points, the general appearance of this component is close to established Paleoindian tool kits much further to the south on the plains of interior North America. It is entirely possible, albeit speculative, that Component I at Dry Creek may be a northern variant of the Paleoindian plains adaptation of the eleventh millenium.

The artifacts recovered from Component II occurred in tight, relatively well-defined horizontal concentrations or clusters (cf. Chapter Five). Here, however, it is necessary only to note that there are two basic types of clusters: (1) those with microblades and (2) those lacking microblades.

The microblade clusters contain, of course, the microblades plus the by-products of the entire production sequence (cores, preforms, core tablets and broken parts of cores) and numerous bifacial knives and flake tools. Also, occurring in these concentrations are burins and burin spalls.

This complex of artifacts can be assigned to the Denali Complex (West, 1967) which is a widely distributed early complex in parts of interior Alaska. Beyond the interior, the Denali Complex becomes part of a broader lithic continuum which includes the Ugashik Narrows Phase in the Alaska Peninsula (Dumond, 1977) and the Akmak Complex from Onion Protage on the Kobuk River in northwestern Alaska (Anderson, 1970a). These early dated complexes appear to be related to the Diuktai Cultural Tradition of central Siberia (Mochanov, 1977). As a result, this spatially discontinuous series of lithic complexes, distributed in the circum-Beringian region during the Late Pleistocene, has been called the Siberian-American Paleo-arctic Tradition by Dumond (1977) and the Beringian Tradition by West (1981).

The non-microblade clusters are quite a different matter. Not only do they lack microblades but the by-products of the microblade production sequence are absent. Instead, the non-microblade clusters contain crude bifacial implements, flake tools including shaped scrapers and the bases of projectile points of general Plano appearance. These points are not found in microblade clusters.

This situation creates an interpretative dilemma presently impossible to resolve, but with options that are fairly straightforward: (1) all clusters are part of the same culture and can be explained by differences which are activity specific (composite point manufacture/repair and butchering), (2) the differences are due to seasonal technological variability (different weapon systems for different game species and butchering), or (3) two separate clutures are present in the area at the same time conducting the same activities.

These options, or hypotheses, are testable given that certain conditions are met: namely, that more sites from this time period are excavated with these problems in mind and that the sites have good faunal preservation so that the seasonal shifts in subsistence activity can be better documented.

CHAPTER 5

HUMAN ACTIVITY AT THE DRY CREEK SITE: A SYNTHESIS OF THE ARTIFACTUAL, SPATIAL, AND ENVIRONMENTAL DATA

by

J. F. Hoffecker

Introduction to the Research Strategy

In this chapter, an attempt will be made to reconstruct some of the activities of the Dry Creek Site occupants. The approach used was an indirect one: the artifacts and their spatial arrangements were recognized as the most direct evidence of human activities, but specific hypotheses were generated from the contextual data. These contextual data include the geography, topography, stratigraphy, and paleobiology of the site and are discussed in detail elsewhere in this monograph. Their value as a source of hypotheses about site activities lies in the fact that their analysis and interpretation does not suffer from the high degree of ambiguity which continues to plague the study of artifact function. Ultimately, of course, these ambiguities cannot be avoided; the results and conclusions retain a significant amount of uncertainty. By beginning with the contextual data, however, the investigation seemed likely to possess a more reliable foundation and structure.

In more specific terms, the research stratgey consisted of three phases of an alternating inductive-deductive approach. In the first phase of the investigation, hypotheses about site activities were developed from the contextual or environmental information mentioned above. On the basis of the overall geographical setting, topographic position, associated faunal remains, and inferred season of occupation, the site was interpreted as a temporary hunting camp. The activities likely to be performed at such a site were thought to be watching for game, weapons manufacture and maintenance, and, possibly, some food processing. These hypotheses were then translated into a set of specific models of the residual archeological debris expected from the performance of the activities. It was assumed that particular types of complex activities would involve characteristic sets of non-randomly associated artifacts (a "tool-kit" and its waste products).

The second phase involved an initial examination of the artifact assemblages (Component I and Component II). At this point the question was: what are the general characteristics of the remains and how can this information be used to guide the formulation of site-activity hypotheses? Two important conclusions emerged from this initial study. First of all, it was observed that the artifacts were spatially organized into distinct, relatively dense clusters. This provided the study with a unit of analysis which has been used elsewhere by other archeologists (Morlan, 1974; Price, 1978; Cohen and Keely, 1980; and others). It was clear that these artifact clusters were non-random spatial aggregrations; they were assumed to be behaviorally significant. Secondly, it was noted that unretouched flakes and blades predominated heavily. This suggested that any hypothesis about site activities should be tested in such a way as to maximize this abundant source of data, and not rely chiefly on the information provided by the few tools and tool fragments present.

In the third phase the tool kit models were compared with the characteristics of the artifact clusters. It was not assumed that each cluster would represent only one activity, or only one tool kit and associated waste. It was found that each of the clusters was generally consistent with one or more of the predictive models. It was more difficult, however, to refute all of the possible alternative models, and the result must be regarded as tentative. It is possible that activities other than those predicted on the basis of the contextual information are represented by the artifactual remains. On the other hand, it seems most likely that the predicted activities were performed at the site.

In the remainder of this chapter, the research strategy outlined above will be described in detail, the results examined and future research discussed. Detailed descriptions and analyses of the individual artifact clusters are presented separately in Appendix A.

Hypotheses Concerning Site Activities: Tool Kit Models

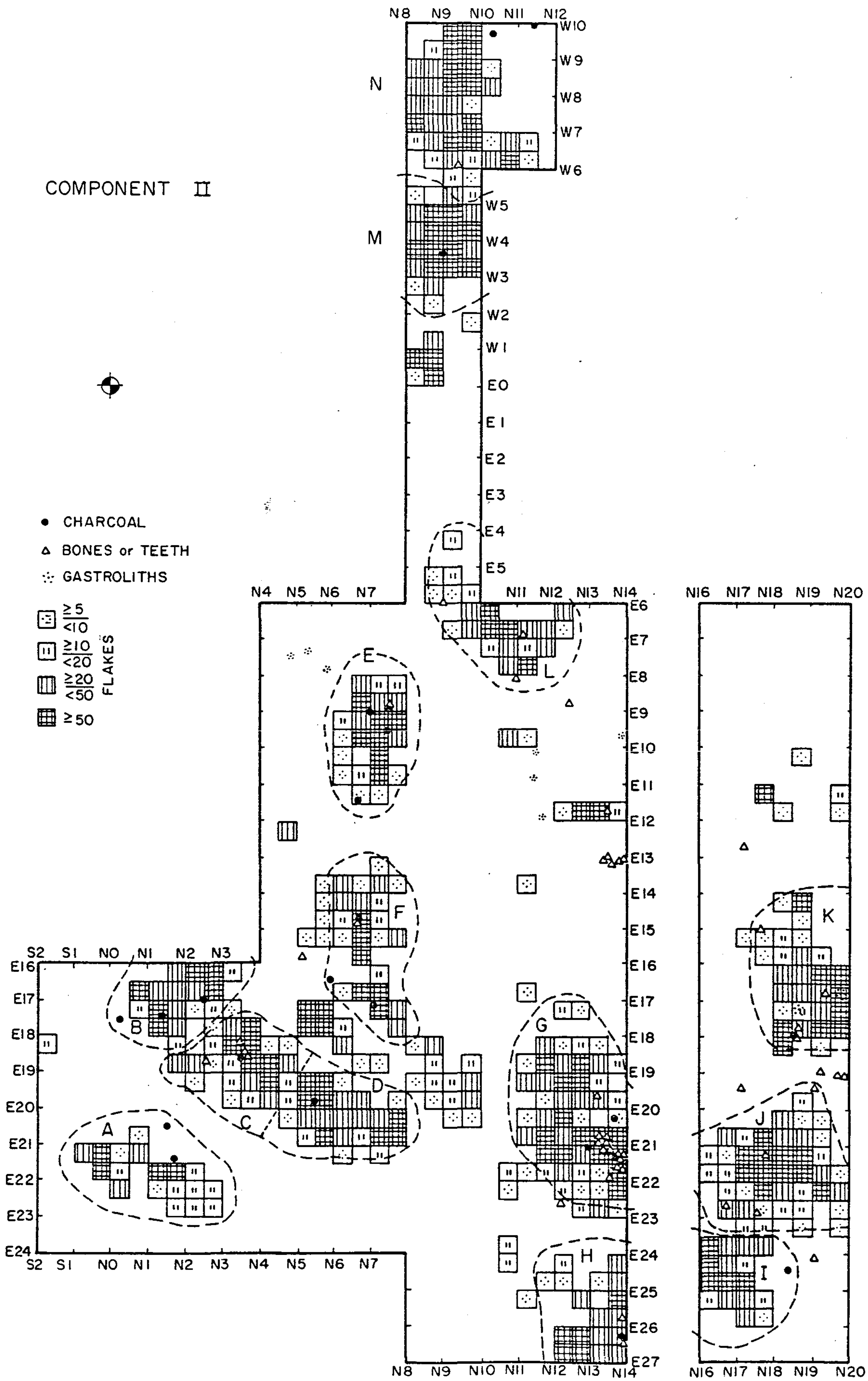
Hypotheses about activities performed at the site were generated, as noted above, not from the artifacts, but rather from a broad range of contextual data. Its geographic and topographic position and associated paleobiological remains suggested a temporary hunting lookout and possible campsite, probably occupied during the autumn. Although the analysis of these data is presented in full detail elsewhere in this monograph, I will briefly review the principal points below. I will then discuss the translation of these hypotheses into specific "tool kit models" of the type expected from a hunting lookout and campsite.

The first consideration was the overall geographic context of the site, which is situated in the upper foothills of the north-central Alaska Range, approximately five kilometers north of the mountain front, in the Nenana Valley. Guthrie (Chapter Six) has suggested that this area was a likely concentration point of Pleistocene mammals in the late summer and autumn because of the delayed maturation of plant communities at higher altitudes. He has further suggested that this portion of the Nenana Valley would have provided an attractive winter range for grazers, because local katabatic winds create disclimax conditions and limit snow cover even today. Ager (1975) has, in fact, proposed that valleys like the Nenana offered the last grassland refugia communities to grazer populations in the 12,000 - 10,000 years BP period, when most of the Alaskan interior was being colonized by shrub-tundra vegetation. It might be expected, therefore, that prehistoric hunters would have been drawn to this area between late summer and winter, particularly at the close of the Pleistocene, to exploit large mammal concentrations. In late prehistoric times, Athabaskan Indians are known to have hunted sheep here during the autumn (Plaskett, 1977).

The second consideration was the topographic position of the site, which is located on a prominent southeast-facing bluff, the edge of which has been created by stream incision of a glaciofluvial outwash terrace (Thorson and Hamilton, 1977). This bluff, which rises approximately thirty meters above the present-day floodplain of Dry Creek, affords an unobstructed view of the landscape between the creek and range front. This location is highly suitable for observing large game, although it is perhaps less attractive for prolonged occupation, given the energy required to transport water up to the site. Moreover, the prevailing wind direction is from the southeast (where the Nenana Gorge is situated), frequently placing the site down-wind of the area it overlooks. Although the bluff edge has undoubtedly been subject to some post-Pleistocene retreat due to water and wind erosion, it appears to have been relatively close to its present position during the time of occupation (Thorson and Hamilton 1977:174).

Additional contextual data recovered from the artifact levels of the site were also useful in developing hypotheses about the activities of its occupants. The large mammal remains are significant, not only by their presence, but in the species represented as well. Although it is difficult to interpret the meaning of the wapiti specimens, Guthrie (Chapter Six) believes that the presence of bison and sheep strongly suggest a fall-winter occupation. Further possible support for this argument was provided by the morphology of the ptarmigan gastroliths in Component II. These are skewed towards the angular end of the spectrum, indicating deposition between summer and early winter (Guthrie, Chapter Six). It should be noted, however, that gastroliths were recovered from non-archeological layers also, and may or may not be associated with human habitation. Finally, the position of the charcoal remains, relative to the artifact clusters, was thought to be potentially significant. People normally seat themselves on the windward side of a hearth in order to avoid smoke, a pattern observed by Binford (1978) in his recent ethnoarcheological study of the Nunamiut. Although a leeward seating arrangement might be preferred in the early or middle summer to discourage mosquitoes, the evidence for a fall-winter occupation increases the likelihood that the hearths, if contemporaneous, were built downwind of the activity areas. Charcoal remains were found north and west of artifact clusters A,E,F,G,H,I, and N, and parts of B and D in Component II (see Figure 5.1), and artifact clusters X and Z in Component I (see Figure 5.2). Charcoal was also recovered in other positions relative to some of these clusters, and it is of course, unclear how much, if any of it, is actually associated with the deposition of the artifacts. Nevertheless, a southeasterly wind direction, which as noted previously, is common at the site today, would present optimal hunting conditions.

Figure 5.1. Distribution of artifacts and features in Component II. Boundaries of individual artifact clusters are indicated by dotted lines.

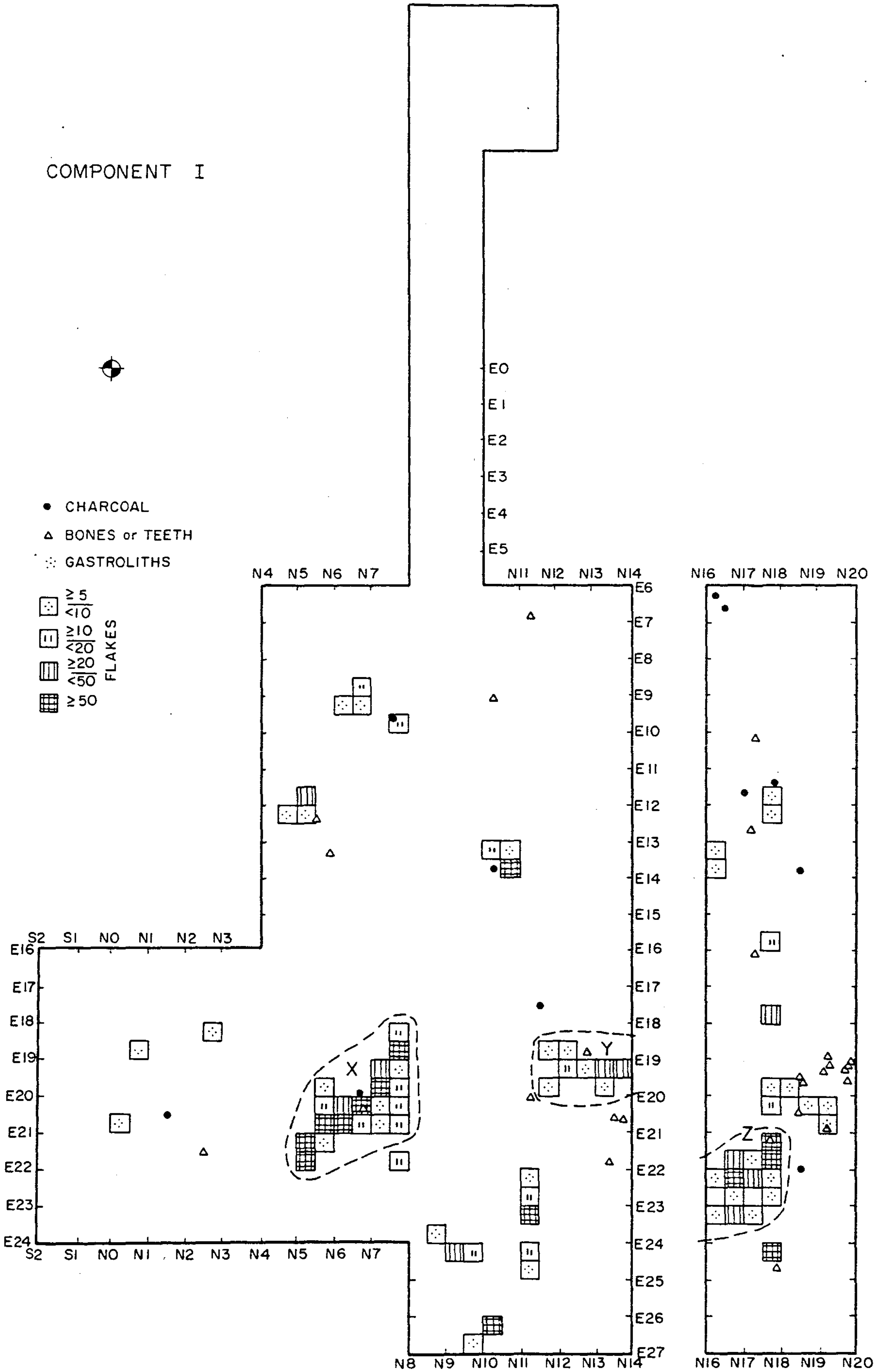


COMPONENT II
CHARCOAL
BONES or TEETH
GASTROLITHS
≥5 <10
≥10 <20
≥20 <50
≥50
FLAKES
A
B
C
D
E
F
G
H
I
J
K
L
M
N
N8 N9 N10 N11 N12
W10 W9 W8 W7 W6 W5 W4 W3 W2 W1 E0 E1 E2 E3 E4 E5 E6 E7 E8 E9 E10 E11 E12 E13 E14 E15 E16 E17 E18 E19 E20 E21 E22 E23 E24 E25 E26 E27
N4 N5 N6 N7
N16 N17 N18 N19 N20
S2 S1 N0 N1 N2 N3

Consideration of these points, some of which are undoubtedly deserving of more weight than others, thus provided an interpretive framework for the study of the artifacts. I approached the analysis of the artifact clusters with the question: to what extent are they consistent with this hypothesized fall-winter big game hunting look-out model? The stone tools and waste do not presently yield information on seasonality, but they do constitute a data base for testing hypotheses about activities performed at the site. Before such hypotheses can be tested, however, they must be stated in the form of specific predictions concerning the lithic remains. For this task I employed the concept of the tool kit, which is familiar to archeologists and not uncommon in the literature (Binford and Binford, 1966; Hammatt, 1970; Isaac, 1977; Price, 1978; and others).

In constructing tool kit models, I assumed that the lithic debris at the site would be likely to represent, not a random assortment of activities, but a set of specific tasks related to the use of the site. These tasks would logically involve a characteristic set of tool forms and associated waste material. Furthermore, it seemed probable to me that, prior to any substantial post-depositional disturbance (a subject discussed in the following section), some degree of spatial association would exist among the artifacts of a given tool kit. Two types of tool kit models were developed. The first reflects an activity which might be expected to be common at overlook sites: the production and maintenance of hunting weapons. A general acquaintance with the artifact assemblages, which contain both microblades and projectile points, suggested that at least two types of weapons might have been produced and/or repaired at the site. The presence of the faunal

Figure 5.2. Distribution of artifacts and features in Component I. Boundaries of individual artifact clusters are indicated by dotted lines.



COMPONENT I
CHARCOAL
BONES or TEETH
GASTROLITHS
≥5 <10
≥10 <20
≥20 <50
≥50
FLAKES
X
Y
Z
E0
E1
E2
E3
E4
E5
E6
E7
E8
E9
E10
E11
E12
E13
E14
E15
E16
E17
E18
E19
E20
E21
E22
E23
E24
E25
E26
E27
S2
S1
N0
N1
N2
N3
N4
N5
N6
N7
N8
N9
N10
N11
N12
N13
N14
N16
N17
N18
N19
N20

remains suggested that some butchering or meat processing activities might have also occurred at Dry Creek.

Upper Paleolithic sites in Siberia indicate that large game was regularly hunted with antler or bone spear points which were laterally grooved (on one or both sides) to accomodate a line of microblades (Abramova, 1967; Powers, 1973; Chard, 1974; and others). At Kokorevo I on the Yenisei, one such point with inset blades intact was found imbedded in a _Bison priscus_ scapula (Chard, 1974:32). Holocene sites in both Siberia and Alaska also illustrate the uses of microblades (Bandi, 1969; Dumond, 1977; and others). From this information and Guthrie's experimental work on inset spears (Appendix B), it seems likely that a tool kit for their production will minimally include:

1. microblade cores (of good quality raw material to insure adequate flaking control) for blade production,
2. burins or other steep-edged tools for antler and bone working (see Wilmsen 1974:91-92) for some comments on the suitability of edge angles of 50° - 75° for working hard materials), and
3. bone and/or antler.

In addition to these items, I would expect, on the basis of experimental studies conducted by other researchers, the presence of certain characteristic forms of edge damage and waste material. The latter will be discussed in the methods section.

The presence of points and point fragments in the assemblages suggested that stone-tipped projectiles were being manufactured and/or repaired at the site as well. It seemed to me that a tool kit for the production of these weapons would probably include the same elements as the inset point tool kit, minus the microblade technology. As in the case of the latter, characteristic forms of edge damage and waste material would be evident.

Butchering tool kits have been described from the North American Plains (Hammatt, 1970; Frison, 1978), and the early Holocene Carlo Creek site in the upper Nenana Valley, which has been interpreted as a kill site on the basis of the faunal material, reflects a similar set of artifacts (Bowers, 1978). From this information and experimental butchering operations performed by many researchers (Frison, 1974; Jones, 1980; and others), including members of the Dry Creek excavation crew in 1977, it is apparent that one or more of the following stone tools would be suitable for various stages in the processing of a large mammal carcass:

1. heavy cutting tools (with medium edge angles) for severing joints,
2. light cutting tools and/or utilized flakes (with steep edge angles) for cutting muscle and fat (see Wilmsen [1974:91-92] for comments on the use of edge angles of 35° - 45° for effective butchering operations), and
3. bifacial knives for skinning (see Walker [1978:712] for a discussion on the preferability of bifacial edges for skinning).

It is also possible to use bone tools, a common occurrence on the Plains, according to Frison (1978). The data from waste flake and edge-wear analysis are probably applicable to some extent. Much caution must be used, however, in testing a butchering tool kit model. It is clear from experimental and ethnoarcheological studies that a variety of implements can be used to perform similar functions in meat processing. Moreover, the tools tend to be highly generalized compared to microblade inset or projectile point weapons, and are suitable for activities unrelated to butchering. In short, it is difficult to refute alternative hypotheses in the case of assemblages containing these tool forms and associated wear patterns and waste material.

I am aware that this approach to human behavior is an overly rigid one. It seems to me highly unlikely that the complex character of such behavior would neatly conform to the predictions of specific tool kit models, regardless of the accuracy of the site activity hypotheses on which they are based. I would, instead, expect a substantial amount of background "noise", generated by idiosyncratic behavior and post-depositional human disturbance. The tool kit models outlined here are conscious simplifications, and are not expected to account for all the data.

The Artifact Assemblages: Overall Composition and Spatial Patterning

Once the site activity hypotheses had been formulated, I turned my attention to the artifacts. At this stage of the analysis, I attempted to identify those general characteristics of the assemblages which would be helpful in designing ways of testing the hypotheses. Two points seemed to deserve consideration: the high proportion of small unretouched flakes, interpreted as waste debris, and the tendency of artifacts to occur in dense spatial concentrations.

A typological analysis of the retouched forms in both artifact assemblages has been presented in the previous chapter. It is not necessary to review this material here, only to note the predominance of unretouched flakes and blades (roughly 95%). This is a common, though by no means universal, pattern in archeological sites. Nevertheless, I felt that it was important to place as much emphasis as possible on the characteristics of the unretouched flake and blade component. Although many of the larger flakes may have been utilized (a few examples of edge wear in the form of crushing and nicking were observed), and many of the microblades were presumably functional, the bulk of the smaller flakes (less than roughly 20 mm in length/width) seem likely to represent waste material. This waste material is most likely to represent accumulated stone flaking debris deposited during the production or maintenance of tools. As Frison (1968:154) has noted in many cases, the waste flakes may constitute a more reliable record of stone-working activities than the tools. The latter may be made at another locaton and brought to the site, or they may be manufactured or resharpened at the site and discarded elsewhere. The waste flakes, however, being of no apparent utilitarian value, seem likely to remain as occupation residue without substantial human disturbance. This last consideration is also significant; it is probable that, barring processes of disturbance, the spatial patterning of the waste flakes will be behaviorally meaningful.

In order to detect such spatial patterning, horizontal flake distribution maps for Components I and II were constructed (Figures 5.1 and 5.2). Flake provenience was plotted by one quarter meter square; more precise locations did not seem necessary for the purposes of my analysis. Blades, cores, tools, and rocks were added, and all items were color-coded for raw material. Fragments of bone, teeth, gastroliths, and charcoal were also plotted. The picture which emerged was clear and dramatic. The flakes and microblades (and to a large extent the tools as well), resolved into a number of dense concentrations. These concentrations or clusters varied in size (from approximately 100 to over 2000 flakes) and raw material composition. In some cases, two or more clusters were adjacent (i.e., C and D), but differences in raw materials (not reproduced in the text figures) made for easy separation.

Horizontal clustering of artifacts and/or other occupational debris is also a common phenomenon in archeological sites. Procedures for its recognition vary, and deserve further comment. At some sites, significant deviations from random spatial patterning cannot be determined reliably by a visual inspection of the distribution maps, and investigators have employed a variety of quantitative techniques to accomplish this (Hesse, 1973; Whallon, 1973a). Many of these techniques were originally developed by plant ecologists. Where the data are in the form of grid counts, dimensional analysis of variance (Whallon, 1973b), variance mean ratio (Dacey, 1973), and simple phi-coefficient and chi-square tests (Freeman, 1978:66-67) are applicable. Where point provenience data are available, nearest neighbor analysis (Clark and Evans, 1954; Whallon, 1974) may be used. At other sites, spatial clumping is readily observable (Leroi-Gourhan and Brezillon, 1966; Wheat, 1972; and others), and in these situations, quantitative procedures are unnecessary (Morlan, 1974:92). Spatial patterning at Dry Creek is clearly not random, and falls into the latter category. This is consistent with the expectations of an open air site where limited specialized activities are hypothesized (Freeman, 1978:68).

Having determined, on the basis of visual inspection, the existence of a series of artifact clusters, it remains to consider the possibility that these aggregations are a product of post-depositional disturbance. As the site is situated on a relatively level bluff top, erosional processes seem unlikely to have caused much movement of artifacts.

However, the sediments have been exposed to tectonic micro-faulting, frost disturbance, and rodent burrowing (Thorson and Hamilton, 1977:162). It is apparent from the stratigraphic profiles that the micro-faulting has created both vertical and horizontal displacement of items. The vertical movement has, in fact, prevented the accurate assignment of micro-stratigraphic provenience to each cluster for relative dating purposes. The lateral movement would not appear to have exceeded a few centimeters and, while producing a certain amount of horizontal "blurring", should not have caused a significant degree of distortion in the spatial relationships among artifacts or in the content of the clusters.

My study proceeded, therefore, under the assumption that the artifact clusters (delineated in Figure 5.1 and 5.2) were behaviorally meaningful. These artifact clusters, rather than individual grid units or whole components, became the units of analysis for testing the tool kit models. The approach differs from others which have attempted to identify tool kits on the basis of spatial associations among specific types of artifacts, chiefly retouched pieces (Binford and Binford, 1966; Freeman, 1978; Price, 1978; and others). Here, retouched pieces, comprising a small percentage of the assemblages, were initially ignored. Clusters, assumed to represent the residue of one ore more tool kits, were defined on the basis of dense concentrations of unretouched flakes, most of which probably constitute waste. I believe that this approach, where suitable, has the advantage of reducing the probability of post-depositional human disturbance to a minimum.

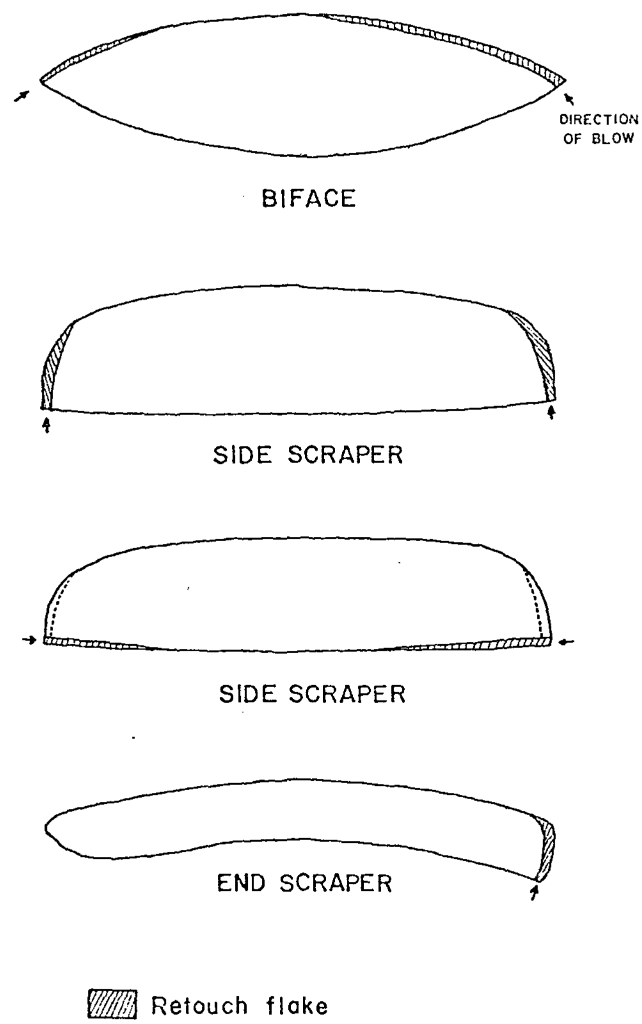
Methods of Analysis

Some of the methodological procedures employed in this study have already been discussed. In the second section, I described how generalized, predictive tool kit models were constructed, drawing on various sources of information. In the section on the overall composition and spatial patterning of the artifacts, I described the design of the artifact distribution maps, and explained the emphasis on waste flakes. In this section, I will discuss the specific set of procedures used to test the tool kit models: how unretouched flakes from the clusters were sampled and measured, and how flake morphology was utilized. While retouched pieces associated with the cluster were given less weight, they were, depending on their degree of fit with the flake debris, accorded some attention. I will, therefore, also discuss the use of edge angles and wear patterns on these artifacts to further test the tool kit models.

The unit of analysis in this study was, as I have noted earlier, the artifact cluster. Once these clusters had been isolated on the spatial distribution maps, a complete list of all items in each cluster (rocks, waste flakes, tools, and tool fragments) was compiled. Raw material composition was determined and, while subject to some error due to occasional misidentifications during cataloging, should be essentially accurate. While all tools and tool fragments (and the larger rocks and rock fragments) were examined, it was necessary to employ sampling procedures in the study of the flakes. All flakes equal to or larger than 6 cm were arbitrarily classified as "large flakes" and included in the analysis of the tools and cores. From the remainder, a systematic sample, varying according to cluster size but generally averaging about 150, was drawn from each list. Only whole flakes, roughly half of each sample, were measured. Length was measured as the largest axis perpendicular to the striking platform. Width was measured as the greatest distance perpendicular to the length axis, and thickness was obtained by measuring the greatest distance orthogonal to the plane created by the length-width axis.

Information on the morphology and edge-wear of the waste flakes, in addition to raw material type and size, was also collected. As Frison (1968) has noted, flakes removed during the resharpening of various stone tool types often exhibit a characteristic shape and edge-wear pattern. The presence or absence of specific types of waste flakes in each cluster should reflect some of the activities which were or were not performed there. Some of these characteristic morphologies are illustrated in Figure 5.3. It can be seen from these diagrams that, for example, the shape of a bifacial retouch flake will tend to differ markedly from that of a side scraper retouch flake. The bifacial retouch flake will also be distinctive with respect to the position of the striking platform and type of macroscopic edge-wear (Frison, 1968:149-150). Expanding on Frison's work, I attempted to match retouch flakes from other types of tools in the Dry Creek collection. For example, many moderately large (> 2 cm long) flakes of coarse-grained material like degraded quartzite, seemed likely to have been derived from implements such as the heavy percussion tools associated with clusters like M (see Appendix A). Not being a lithic specialist, however, and having relatively small samples of retouch flakes clearly assignable to a tool type, I did not quantify my observations on retouch flake

Figure 5.3. Examples of different types of retouch flakes (redrawn from Frison, 1968: Figure 1).


DIRECTION
OF BLOW
BIFACE
SIDE SCRAPER
SIDE SCRAPER
END SCRAPER
Retouch flake

morphology, and have simply noted instances where readily identifiable specimens are present.

To some extent, the tools, cores, and tool and core fragments associated with the flake clusters were also included in this study. All tools within or in close proximity to a cluster (< .5 m) have been listed in conjunction with that cluster (see appendix). Beyond this initial compilation, however, spatial association with a given cluster was not accorded much significance. In a number of cases it was clear from the analysis of the waste flakes that certain tools were neither manufactured nor retouched at or near their associated flake cluster. Often the complete or near complete absence of waste flakes of the same raw material provided this information. It cannot, of course, be proven that these tools were not used, at least briefly, at the time and/or place where their associated flake clusters were deposited.

Conversely, it does not necessarily follow that those associated tools and cores which are consistent with the characteristics of the waste flakes were manufactured and/or used at that cluster. They have been examined in order to determine whether they conform to both the predictions of the tool kit models and the associated waste flakes. Besides raw material, three sources of data were used in the analysis of the tools: a) typological classification (following Powers, Chapter Four), b) macroscopic edge wear, and c) microscopic edge-wear (analysis performed by Terry A. Del Bene, then a graduate student at the University of Connecticut).

In some cases, the typological classification appeared to be sufficient for the functional categories demanded by the tool kit models. For example, it seemed unlikely that wedge-shaped microblade cores or square-based projectile points had been manufactured for other purposes. It was recognized, however, that these items could have been subsequently used for different tasks. Microblade cores might be used as burins, and projectile points as knives. In other cases, the typological classification was inconsistent with the observed patterns of edge wear (e.g., side scrapers exhibiting traces of cutting action - see Chapter Four). Such cases are noted. As a rule, more significance was attached to the edge-wear patterns.

Studies of edge-wear patterns on stone tools have multiplied in recent years, providing a growing body of literature (Semenov, 1964; Hayden, 1979; Keeley, 1980; and others). Lacking the training in this specialization and recognizing the continued complexities and uncertainties in this area of research, I did not attempt to identify edge-wear patterns beyond the most obvious macroscopic types. For example, much of the macroscopically visible wear on the tools is in the form of step-flaking or "scalar retouch" (Frison, 1968). A study conducted by Hester, Gilbrow, and Albee (1973), on steep-edged tools exhibiting this type of wear, attributed these patterns to hard surface working, specifically wood. Keeley (1980) found that scalar retouch was related to several types of hard surface working, including bone and antler. It seems likely that, in the case of the Dry Creek tools, this heavy wear is mostly the product of bone and antler work, as Thorson and Hamilton (1977:169) have suggested that trees and shrubs were locally rare or absent during late glacial time.

The analysis of microscopic wear was left entirely to Del Bene. In those cases where his observations were used in this study (not all tools examined were associated with clusters and not all tools associated with clusters were examined), this fact is noted.

Using the procedures described above, the basic tool kit models outlined above were expanded and tested with the data collected from each artifact cluster. It should be emphasized again that the characteristics of the flaking debris were of central importance; the worked pieces were accorded only limited weight. The presence of a microblade core in a given cluster, for example, was not regarded as especially significant, but the presence of several hundred microblades and microblade fragments (and core parts) in the same cluster was regarded as significant. The tools and cores associated spatially with each cluster were examined to see if they were consistent, firstly, with the characteristics of the waste flakes in that cluster and, secondly, with any of the tool kit models being tested.

Results and Discussion

A relatively detailed description of the artifact clusters is presented in Appendix A, with an analysis of how closely each conforms to the predictions of the three tool kit models presented earlier. In this final section of the chapter, I will confine myself to a brief summary of these findings, and a general discussion of activities at the Dry Creek site. I will then attempt to evaluate the results, raising the question of whether or not alternative hypotheses about site activities can be effectively refuted.

The tool kit model for microblade inset spear production includes, as previously described, microblade cores, steep-edged tools possibly including burins, and bone and/or antler. Although bone has been very poorly preserved at the site and antler remains are altogether unknown, the lithic elements of this tool kit are present in Clusters A, B, C, G, and N in Component II. The recovery of numerous microblades, microblade fragments, and core parts further suggests that actual blade production occurred in these clusters. The heavy scalar retouch on the burins and other steep-edged tools like core-scrapers is consistent with the hypothesis that they were used on bone or antler. This tool kit model appears to account for the bulk of the lithic remains in Clusters A, B and C. In Clusters G and N, there are significant quantities of material, in addition to the elements of the inset spear tool kit model, which require further explanation.

The hypotheses that stone-tipped projectiles were being manufactured and/or repaired at the site was suggested, as will be recalled, by the points and point fragments themselves. The tool kit model for this activity also includes steep-edged tools for shaft work and bone and/or antler. The steep-edged tools should exhibit scalar retouch, and evidence of bifacial stone working in the size and shape of the waste flakes. The elements of this tool kit are present in Clusters E, J, and K in Component II, all of which contain projectile point fragments. They are not present, however, in Clusters X and Y in Component I, both of which contain point fragments. Nor does this tool kit model fully account for the lithic remains in Clusters J and K, and possibly even E.

The butchering tool kit model, which may include heavy and light cutting tools, simple utilized flakes, and possibly bifacial knives, seems to account best for the artifactual remains in Clusters D, H, I, J, L, and M in Component II, and Cluster Z in Component I. Some meat processing may have occurred in Clusters F, G, and perhaps even N, and this activity cannot be excluded from Clusters X and Y. These clusters are generally characterized by raw materials of variable quality and large flakes which occasionally exhibit macroscopic wear in the form of edge-crushing and nicking. They are frequently associated with sharp-edged "scraper" tools, and bifacial knives and/or heavy bifacial tools. Scalar retouch is often visible on the heavy implements and on what appear to be resharpening flakes struck from these tools, and could be the product of bone splitting for marrow extraction. Some of these clusters (M, I, and Z), are associated with steep-edged tools bearing scalar retouch. These tools may be intrusive, may reflect other activities performed at these locations, or may even reflect the manufacture of bone tools for the butchering process.

As in the case of the weapons production clusters, two distinct patterns may be represented among the butchering tool kits. The first, exemplified by M, I, and possibly X is characterized by better quality raw materials, smaller flake size, and several delicately worked associated tools. The second, exemplified by L, M, and Z is characterized by coarse-grained raw materials, very large flakes, and a number of crudely worked associated tools. The former is similar to many butchering tool kits on the plains, where much of the hide and muscle cutting was apparently performed with worked implements, the edges of which were continuously resharpened (Frison, 1974 and 1978). The latter suggests that mass production of simple flakes of poor quality stone which might have been used briefly, then discarded.

Thus, despite the presence of a certain amount of background noise, the artifact clusters at Dry Creek appear to be generally consistent with the predictive tool kit models formulated on the basis of environmental data. This lends support to the original hypothesis that the site was used in hunting of big game animals. The "primary site function" (Binford, 1978), judging by the topographic position, was probably an observation post. Many of the clusters exhibit a close fit with the simple models of tool kits for the production and maintenance of hunting weapons, an activity logically associated with this occupation. Others appear to be consistent with butchering tool kit models. It seems unlikely that many, if any, large animals were actually killed at the site, but rather that portions of the carcass were returned to the overlook. Considering the difficulties of transporting whole carcasses, particularly of bison and wapiti, back to the bluff top, I think that it is reasonable to assume that animals were probably skinned and dismembered at the site of the kill. The butchering tool kits may, therefore, represent the later stages of meat processing. If the site was occupied over a period of several days, it would be the logical place to store and protect the meat accumulated from each kill. Its exposed position also provides a suitable location for drying meat and hides. While these activities were being performed, the game watch could continue. The small size of most clusters (5-6 square meters) seems to be consistent with the hypothesis (discussed elsewhere in this volume) that only a small number of people (perhaps a few adult males) used the site at any one time. This last statement must be regarded as extremely tentative, however, as the actual relationship between the dimensions of the cluster and both the number of individuals present and their length of occupation remains undeterminable.

Up to this point, I have discussed the variability in the artifacts only in terms of different activities. The apparent functional redundancy in the two types of weapon and butchering tool kits suggests, however, that cultural differences could account for some of the variability. In the case of the butchering tool kits, an equally plausible and simpler explanation may lie in the relative availability of good quality raw materials. Moreover, both types of butchering kits appear to be present in each component. It is more difficult to explain the presence of two types of weapon technologies. The same raw materials were used for both (chiefly light rhyolite, chalcedony, and chert), and the microblade tool kit is absent in Component I, suggesting possible temporal differences. Since the microblade and point technology in Component II is not necessarily contemporaneous, it is conceivable that the point technology precedes it altogether. This hypothesis must be tested in the field. It is discussed in detail elsewhere in this volume (see Powers, Chapter 4).

Having demonstrated that the artifact clusters at Dry Creek are generally consistent with the predictions of the tool kit models, it seems advisable to attempt an evaluation of these results. How reliable are the conclusions which I have drawn, if tentatively, about human activity at the site? A more rigorous approach would demand that alternative explanatory models be tested and rejected as well. Is it possible that other types of activities could also account for the remains? I think that some of the activities which might be associated with a base camp such as hide working or plant processing can probably be eliminated. This is because of the generally rare occurrence of edge polish (both macroscopic and microscopic) on the artifacts, an expected pattern of wear on tools used for these functions (Keeley, 1980 and others). Exceptions include one tool in Cluster F and another in Cluster E, and some microscopic polish on the tips of several microblades in Cluster G, observed by Del Bene. Moreover, there is an overall lack of tools like gravers, spokeshaves, and borers which are thought to reflect the wider range of activities often associated with this type of site (Wilmsen, 1974; Frison, 1978). Nor is there any evidence for dwelling structures in the form of post-molds or tent rings, although this might be accounted for by post-depositional disturbance.

The most difficult problem here is the elimination of alternative functions for the more generalized tools and their associated debris (e.g., heavy bifaces, utilized flakes). Given the ambiguities of lithic analysis and the wide range of conceivable uses for such artifacts, a certain amount of uncertainty seems inevitable. The problem is less acute in the case of the specialized technology related to hunting weapons, although it remains to be demonstrated that the microblades were intended for inset spears and that the points were actually manufactured or repaired at the site. The results obtained from testing the butchering tool kit model are probably the least reliable. (Better preservation of faunal material at the site would have been helpful.) The generalized tools and associated waste in clusters consistent with this model are much less specific to their interpreted function. Many of these artifacts might have been used to manufacture bone, antler, or wood tools unrelated to big game hunting.

The ambiguity of the results is less disturbing, perhaps, if I reverse the order of the approach taken in this study and adopt a different perspective. Instead of starting with the environmental data, formulating site activity hypotheses and then testing them in the form of predictive tool kit models, I could begin with the artifact clusters. For each artifact cluster, a range of various possible functions would be defined. The range would be broadest for those clusters containing less specialized tools and associated waste, and include bone, antler, and wood working, butchering, and although unlikely, even plant processing and hide scraping. This range of possibilities would the be evaluated in the context of the environmental data. Given the geographic and topographic position of the site, its probable season of occupation and associated faunal remains, which activities are most likely to have been performed at the site? I believe that the best answer at present remains those activities closely related to the hunting and processing of big game animals. The occurrence of other types of activities cannot be excluded, but seems less likely.

Future research on the Dry Creek artifacts, features, and spatial patterning by trained lithic specialists will almost certainly provide a firmer basis for reconstructing human activities at the site. Such research would, I hope, reduce the ambiguities inherent in the procedures used here to test the tool kit models. More precise methods of classifying and quantifying the waste flakes would be especially helpful. Ongoing studies conducted by Tim Smith, a graduate student at SUNY-Binghamton, which include the analysis of lithic reduction sequences, may be very useful in this regard.

CHAPTER SIX

PALEOECOLOGY OF THE SITE AND ITS IMPLICATIONS FOR EARLY HUNTERS

by

R. Dale Guthrie

PALEOECOLOGY OF THE DRY CREEK SITE AND ITS IMPLICATIONS FOR EARLY HUNTERS

Paleoecological Significance of the Site

At about 11,500 BP plus or minus a few tens of human generations, monumental changes occurred throughout North America. Jet stream patterns had shifted, climatic fronts had moved, and the large ice sheets were rapidly retreating. Entire plant biomes began to undergo restructuring and redistribution. Large grazing ungulates and many other animal species underwent a time of rapid extinctions; among surviving species some experienced withering declines while still others increased and flourished. Among the latter were humans. The mid 11,000's and early 10,000's BP saw the explosion of "Llano" or early Paleoindian peoples in North America, and South America as well.

Quaternary researchers disagree about many aspects of this critical time between 11,500 - 10,500 BP. The exact nature of climatic changes are controversial, as are the megafaunal extinctions and their causes. The origins of Paleoindian peoples and their effects on the plant and animal communities, and the causes underlying their population distribution, and prey shifts during this time are even more controversial.

There are a number of New World archeological sites dating from this period but few contain substantial artifactual and paleoecological information. More well-dated sites are necessary to allow us to reconstruct what occurred during that critical millennium. Alaska may play a unique role in disclosing the story as it was an important focus of faunal interchange, including the Paleoindian peoples themselves.

The Dry Creek site is the first multicomponent deeply stratified site in Alaska which dates from this critical millenium and contains megafaunal remains in association with tens of thousands of lithic artifacts. Though the bones and teeth are poorly preserved and are not in the profusion found at mass kill sites, they provide us with the information that:

1. The two oldest components of the site mark the heart of the faunal changes associated with a shift from steppe to woodland. Though some extinctions probably have occurred within the preceeding centuries, the megafaunal community in that area was still composed of grazers.
2. Holocene dwarfing of the megafauna at the site was not well underway or had not yet begun. That is, the sheep, bison, and wapiti in the site are as large as the Pleistocene forms.
3. The mammalian fossils were poorly preserved, and only weathered enamel was identified to genera (by species, based on context only). However, from Component I, I could identify several specimens of _Ovis_ and _Cervus_ and from Component II several of _Ovis_ and _Bison_.
4. While the lithic assemblage is different between the two lower cultural layers in numerous tool patterns and suggestive of a cultural or activity shift, the fauna still seems to suggest a similar pattern of ecological exploitation.
5. Though very incomplete, the Dry Creek occupation patterns, taken together with other information, contribute additional perspectives on early northern hunting strategies and community organization.

6. Although much the same kinds of large mammals were hunted, hunting patterns and perhaps group organization seem to be different than those which produced the mass kills on the Great Plains. The Dry Creek site was neither a kill site nor does it seem to have been a home base camp site. It was probably a temporary seasonal hunting "spike" camp or processing station, where kills were brought to process the meat and hides for transport elsewhere. Other game could be spotted from the site while the Dry Creek people were engaged in repair or replacement of their hunting and processing equipment.

Although the Dry Creek site by itself does not settle many questions now in dispute about the Pleistocene-Holocene transition, it does add important information and clarity to the paleoecology of that most eventful period, and at the same time raises more questions and poses more puzzles.

Paleoecology of the Fossil Ungulates at the Dry Creek Site

We know that the Dry Creek site people hunted at least bison (*Bison*), wapiti (*Cervus*), and mountain sheep (*Ovis*). The fossil preservation at the site is poor and there are many bone fragments in addition to the few which are identifiable, so it is quite possible that there were other species taken as well. The presence of the above species does allow us to explore the chronology of habitat occupation and hunting strategy. In this respect the Dry Creek site is almost unique among early northern archeological sites studied thus far.

In this chapter I will examine the ecology of the living counterparts of the species found at the site for clues to similarities and differences in the paleoecology 10,000-11,000 years ago. There are potential hazards to using such indirect and circumstantial evidence inherent in making neo- and paleo- comparisons. However, I am familiar with the nature of at least some of the risks involved and hope that an informed and judicious use of such analogies can enrich our reconstruction of the lives and environment of these hunting peoples. In the case of the animals found in the site at Dry Creek, we can show that, in fact, the fossil ungulates were not living lives identical to their modern counterparts, and these differences allow us to show how the environment at the Dry Creek site was different from the environment in which these species live today.

Before discussing the paleobiology of each species there are two general points which should be made. The first pertains to the special ecological adaptations of present-day northern ungulate species to their seasonally harsh environment; those same adaptations were undoubtedly also characteristic of Pleistocene ungulates in the far north. The second point concerns the character of the environment itself. Ungulates in the far north experience a seasonal boom-bust economy. This seasonality involves divergent swings in food availability and quality, predation exposure and physical characteristics of the environment such as snow depth and terrain access. There are a number of ways northern ungulates adapt to these seasonal shifts. They are not territorial, thus migration and mobility are a central part of their behavior. This nomadism is not random but tends to follow seasonally favorable habitats.

Winter forage is extremely low in quality. Pastureland is made inaccessible by deep snow, and in wind cleared areas available for grazing, nutrients are leached through exposure. Northern ungulates do not simply stop growing in winter, they actually decline in weight and physiological condition. Curiously enough, this decline is not only environmentally induced by lack of food but is also intrinsic. Unlike domestic animals or some southern species, they do not have the ability to grow during this winter dormancy period. Raised on a high plane of winter dietary supplement, they still continue to decline (e.g. Norden, Cowan and Wood, 1968). Winter adaptations are all geared toward a "get-by" survival strategy.

However, summer strategies are the opposite. Klein (1965, 1970) has shown that arctic herbaceous plants and many woody species eaten by northern ungulates are of exceptionally high nutritional quality. Thus, in contrast to their winter dormancy these same northern ungulates have special growth abilities which allow them to grow and rear young during the brief seasonal flush of high quality herbage. This rapid growth potential is also true of some northern small mammals, such as ground squirrels (Levenson, 1979).

In addition to numerous physiological specializations, northern ungulates have behavioral characteristics which also encourage full utilization of the summer greenery. These species follow the early growth stages of plants over the countryside as the phenological wave sweeps across different latitudes, land contours, and altitudes. The early plant growth is highest in nitrogen and phosphorus and lowest in anti-grazing compounds, fiber, and phytoliths. Different landscapes thus tend to attract these ungulates in a seasonally specific manner and these seasonal uses are usually repeated from year to year in traditional patterns of use. That is, northern ungulates can be expected to occur on particular landscapes with a fairly high fidelity for a given season. This phenomenon will play a critical role in the interpretation of the seasonal use of the Dry Creek site.

Although we have a fairly firm grasp of the environmental demands of these past ungulates (by analogy to the modern species which are moderately well understood), we know very little detail about the past environment in terms of plant species or plant community composition which formed the rangeland. To settle the larger questions about the Pleistocene mammoth steppe we have to know a lot more than we do now, but we can say something about the ungulate use of the Nenana Valley at the close of the Wisconsinan glaciation. Without knowing the past plant species, but knowing the present patterns of ungulate use in that area and in similar areas, we can reconstruct a conceptual model of ungulate seasonal exploitation in part of the year. Because we now know that bison, wapiti, and sheep were there, we have some critical information range did exist at that time to support large grazers. Given this one fact and some rather unique features of the area, we can reconstruct with some confidence the pattern of the most intensive seasonal use of the range and how this use was partitioned among the grazers. This, in turn, can tell us something about the strategies of the human hunters.

Somewhere between 14,000 and 11,000 years ago (Ager, 1975) we know that mesic woody plants began to replace the xeric herbaceous vegetation of the glacial communities. Exactly how and why it happened we are not certain, but it is quite probable that these windy outwash areas from the mountain passes were the last holdouts of the mammoth steppe and the ungulates living there were confined (seasonally at least) to the wind-cleared grasslands. The Dry Creek ungulates may then be looked upon as an intermediate stage in the unraveling of the mammoth steppe fauna.

Judging from the diverse mammoth fauna which lived nearby in the Fairbanks area during the last glacial period (Guthrie, 1968), the major Late Pleistocene megafaunal extinctions had already occurred when the Dry Creek peoples were living at the lowest levels of the site (Components I and II). Yet, the <u>regional</u> extinctions of wapiti (<u>Cervus</u>) and bison (<u>Bison</u>) had not yet occurred. These two species are not native to Alaska today, though some small herds have been reintroduced from the south and now live in marginal habitats.

Thus the Dry Creek fauna occurs at a fascinating time for a paleoecologist. The species-wide extinctions have occurred, but the ecological changes of the Pleistocene-Holocene transition are not yet complete. The postglacial dwarfing of bison and sheep has not commenced, at least in a noticebly dramatic form, and the range contractions southward are probably just in process. Thus I have taken the approach that the fauna from the Dry Creek site, though poorly preserved, deserves detailed paleoecological attention and I have tried to squeeze as much information as possible from the identifiable material. I have tried to place the paleoecological work in a setting of the larger questions in order to maximize its contribution to the problem of early people in the New World and their changing environments.

To do this requires a thorough examination of the biology of the living ungulate counterparts, an examination of the biology of species which are not represented in the site, and a look at some general phenomena of Holocene dwarfing (and hence Pleistocene gigantism) and the problem of Late Pleistocene megafaunal extinctions.

Now I would like to discuss the paleoecological implications of the presence of sheep, bison, and wapiti singly and then look at the combined pattern they present. Dall sheep will be discussed first. They are the best base from which to work as they exist in most mountainous areas of Alaska today, and still occur near the Dry Creek site within easily huntable distances.

Dall Sheep, _Ovis dalli_

Though our knowledge of Dall sheep biology is far from complete we do know about many aspects of their ecology. My graduate students and I have worked with extant wild sheep in the Healy-McKinley Park area (immediately adjacent to the Dry Creek site) for a number of years and I have a captive flock of sheep taken from this same area, as part of an ongoing study of their ecology, growth, and behavior. In addition to my professional experience with Dall sheep, I have also hunted them almost every autumn for the last 20 years.

The bones and teeth at the site were treated _in situ_ with an acetate-acetone mixture, then removed with the silt matrix. With few exceptions the material was fragmentary and poorly preserved. Many gray "smears" of bone were not collected from the site as they were almost totally decomposed. These diffuse smears sometimes had a few particles of the bone remaining. Those which contained any solid forms of the bone pattern were collected. The osteological material was taken to the laboratory for further preparation before they could be analyzed. Most remained unidentifiable. Several pieces of bone showed the silvery white and black coloration characteristic of fire-charring.

The teeth consisted only of the more durable enamel (Fig. 6.1); the cementum and dentine were missing. Also only one side of the teeth (lingual or labial) was usually present though in some the entire enamel casing was preserved.

Fourteen different specimens of sheep teeth were identified, some consisted of a few fragments and others the entire alveolar row. The large specimens identifiable to specific teeth are listed in Table 6.1. It is noteworthy that all but one were uppers. These occur in both the earlier levels (Components I and II).

The sheep are contextually referred to the species Ovis dalli with some confidence because of other zoogeographic information about these sheep. They occupied the unglaciated Alaskan-Yukon Territory refugium during the Wisconsinan glaciation and continue to exist in that same area. As the Dry Creek site is in the middle of that region it is unlikely that the sheep could be anything else than Ovis dalli in the general time period of 11-10,000 BP.

The Dry Creek sheep are near modern sheep in tooth shape, except they are somewhat larger. This is a general pattern over much of the range of American sheep; the glacial forms were larger than their modern counterparts. At this point in the discussion, it is most important to note that the sheep at the Dry Creek site were morphologically more akin to glacial than to postglacial forms. The degree of tooth wear indicates that they were in the early years of maturity somewhere between three and six years of age.

The first sheep into North America (sometime in mid-Rancholabrean)

Figure 6.1. Dall sheep, *Ovis dalli* from Dry Creek.

A number of enamel fragments were tentatively identified as sheep. However, five specimens could be attributed to sheep with certainty. Most of the specimens are upper dentition, with the one exception of UA 76-155-3868.


UA77-44-2740
0 2 4 6 8 10
cm


UA77-155-3868
0 2 4 6 8 10
cm


UA77-44-1300
0 2 4 6 8 10
cm


UA77-44-4399
0 2 4 6 8 10
cm


UA77-44-4347
0 2 4 6 10

TABLE 6.1 Sheep (*Ovis dalli*) teeth

Number	Tooth	Length	Estimated age
UA 77-44-2740	Right M^2	22.7 mm	Juvenile
UA 77-44-4347	Right M^2	21.2 mm	Post-juvenile adult
UA 77-44-4399	Right M^2	Inc.	Middle aged
UA 77-44-1300	Right M^3	Inc.	Older adult innerface of tooth broken away looking at the labial side of the outer portion of the tooth row.
	M^2	Inc.	
	M^1	Inc.	
	P^4	Inc.	
UA 76-155-3868	Right M_3	Inc.	Juvenile to young adult
	M_2		

were large, long-legged, foothill-adapted forms. In Central Eurasia, sheep (Ovis) occupy the rolling foothills and mountain plateaus, and the goats (Capra) occupy the steep terrain. As a result their body construction is quite different. Goats are stocky with short, stout limbs. The prelimb sets back further into the body. Sheep are more lanky with the long forelimbs set forward as in gazelles, for rapid running, rather than for climbing (Geist, 1971). These early sheep in the New World were thus quite large and lanky and are even given a specific status (Ovis catclawensis) by some. Geist proposed, however, that on entering Beringia and the New World the Capra niche was unfilled and so sheep underwent an evolutionary shift more toward the Capra body form and habitat preference. This seems to be well supported by the paleontological data.

Sheep were much more widespread throughout the Pleistocene in Beringia than at present. Fossils have been found in areas now unoccupied by sheep. Presumably the lowered treeline and the increased herbaceous cover allowed them to expand to precipitous areas which furnished adequate escape terrain, but are now wooded. Of course, the more foothill-adapted sheep colonists would have facilitated this dispersal before they became more alpine adapted, probably the result of a rising treeline during past periods of treeline shifts. It appears that this alpine Capra adaptation in the New World occurred earlier in Alaska than further south, as Wisconsinan-aged sheep in Wyoming and further south still exhibit the long-legged foothill adaptation.

The factors affecting mountain sheep local distribution in the north have been known for some time and have been reviewed by Summerfield (1974). The major factor is escape terrain, that is, suitable topography which also provides access to the food to which sheep are adapted. They rely neither on out-running their predators on a straight chase (like Antilocapra, the pronghorn antelope) nor on climbing into inaccessible rocky cliffs (like Oreamnos, the Rocky Mountain goat) but rather they rely on escaping predators in an uphill chase. Thus, American mountain sheep can never venture far from relatively steep slopes for long, without being vulnerable to predation.

Because of the rugged character of the mountain slopes, where sheep can escape predators, the vegetation is not abundant. In these alpine areas plants are usually thinly scattered and low growing. Mountain sheep are well adapted to grazing close to the ground, using rapid bites (over 4500 bites per hour [Horejsi, 1976]). Mountain sheep are among the most selective feeders ever studied, specializing in the young leaves and fruiting parts of the plants which are the most digestable and nutritious. The summer range must have enough chronological diversity in plant phenology to cover several months of the year, allowing sheep sufficient time to grow and nurse lambs. Most mountainous uplands seem to fulfill this summer range requirement, it is the winter range which is usually the limiting bottleneck in sheep distribution.

Winter range not only has to have plant species which provide summer nutrients, the plant species must also retain some of their energy and nutritive quality above ground, and have gone relatively ungrazed during the summer. These plants must be located on escape terrain and, most importantly, must not be covered by crusted or deep snow. This latter factor is often critical because sheep do not have the ability to dig through deep snow for food, or at least it is energetically expensive for them to do so (Petocz, 1973).

In most mountain systems there are few areas which meet all of these criteria for winter range. They are usually on exposed mountain range fronts or in windy pass areas where valleys widen from the mountains into the foothills or other major valleys.

There is another possible factor contributing to sheep distribution which is mentioned by Whitten (1975) but seldom mentioned by others and that is the presence of salt licks. New growth herbaceous material is high in potassium but low in sodium. The potassium causes the animal to excrete more sodium thus causing sodium deficiencies. As a consequence, many animals turn to salt licks during spring to replenish their sodium. Sheep normally concentrate at these natural licks in the spring just after returning from lambing range sometime in June. These mineral licks are traditional and sheep return to them with considerable fidelity (Heimer, 1973). Wherever one finds sheep, there are usually mineral licks within their home range. How limiting salt licks are to sheep distribution is not known.

Sheep movements can be divided into those which are intrinsic and seem to be independent of direct environmental control, and those which are environmentally related and extrinsically controlled. The latter includes changes in temperature, predator harassment, snow cover, and most importantly, changes in plant phenology. Sheep follow variations in plant quality over the landscape. Movements to rutting and/or winter ranges seem to be more intrinsically controlled (Geist, 1971; Whitten, 1975).

Sheep then have several different traditional ranges which they use for different times of the year and for different reasons. The number and kind have been shown to differ between populations and relate to several variables. What is important for our purposes, as seen from the perspective of early human hunters, is only that these ranges are predictable and that winter ranges tend to be in special environmental situations. I propose that the mountain pass area of the Nenana River, which is now a major Dall sheep winter range would have also been winter range in the past. Furthermore, it is this behavior of traditionality which makes sheep (an otherwise difficult prey species) vulnerable to human hunting.

There are several things which we must know to make an evaluation of how and when Dall sheep could have been hunted by the Dry Creek peoples: when are Dall sheep concentrated and accessible from the campsite; at what altitude and areas do they occur seasonally; and when do they move to winter range?

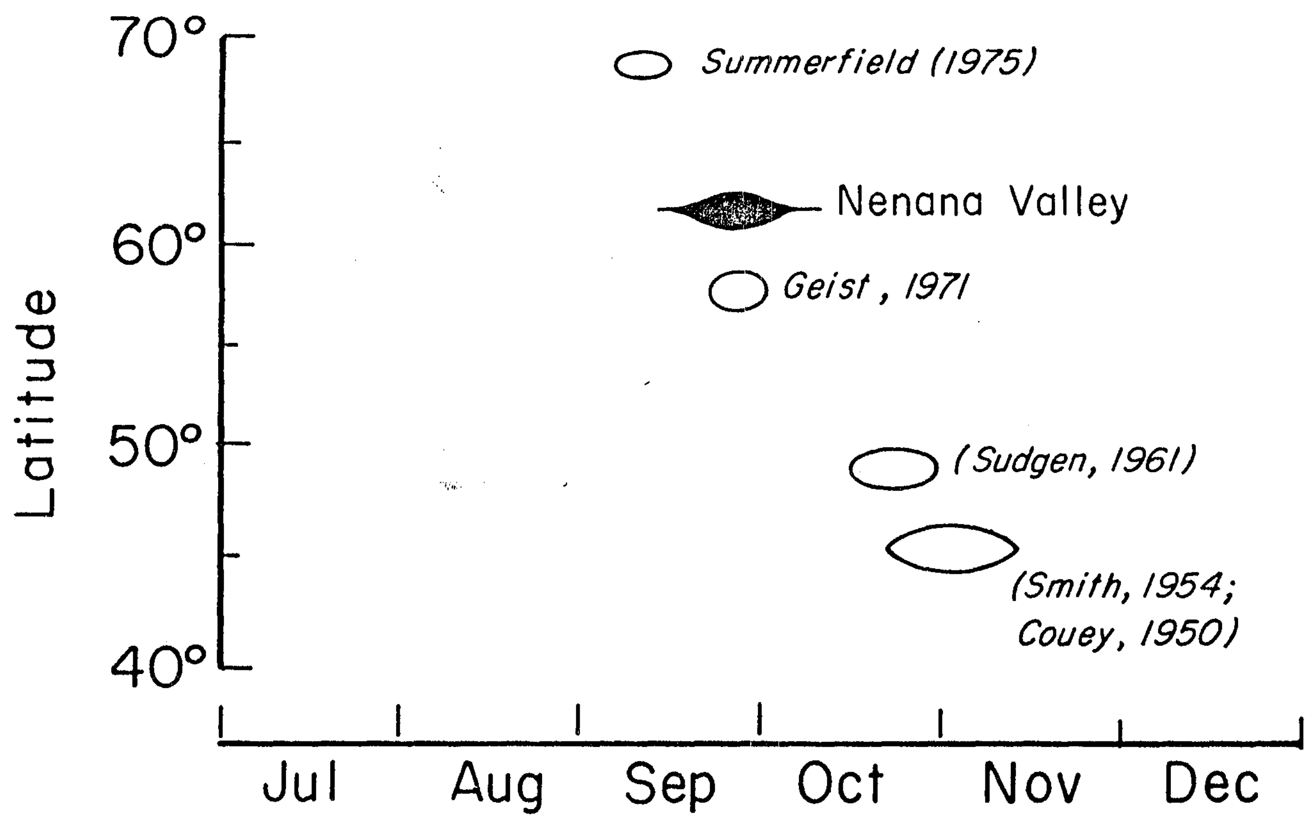
Summerfield (1974) reviewed the time of movement to winter range in different populations and subspecies of North American mountain sheep. I have presented his results in Fig. 6.2 and added the sheep from the Nenana Valley (my observations on the east side of the Nenana River and Whitten's [1975] on the west side). There is a clinal gradient from northern latitudes to southern ones. It may have been somewhat different 10,000 years ago than it is today, but it is doubtful that the difference would have been in the order of several weeks. Pleistocene sheep would have moved onto winter range at least before the rutting season (late November to early December).

As we noted in the section on climate, the katabatic winds generated in the Nenana Valley are greater than virtually any other area in the interior of Alaska. As a result, the snow cover in the area is very light. This is true in the high mountainous borders as well as the valley bottoms. Sheep move into the area in late September or early October and do not leave until May. Some rams usually linger until early June, on the west side of the valley. Sheep use the spur ridges which are snow bare or the interconnecting basins which have only a light snow covering. The sheep remain high except for rare movements to adjacent highlands where they must cross low lying areas. On the east side of the Nenana River the sheep move down onto the high terrace edges which are also snow free. The number of sheep wintering in the area has had a long variable history (Murie, 1944; Murphy, 1974) but today is in the range of 200-300 animals on the west side of the valley and about 100 animals on the east side.

There is some very limited movement across the frozen Nenana River in the gorge between the populations on the east and west side, otherwise they are separate. Several biologists have studied the populations on the west side. These sheep which winter nearest the Dry Creek site spend their summers and autumns in Denali National Park, thus, are unhunted and form a natural age group distribution. Murie (1944) studied a number of basic biological parameters in his classic study of the wolf and sheep. Murphy (1974) updated and re-evaluated Murie's original population data and history of the Park sheep movements and diet in a thorough way, and his work is most germane to our interests.

The Alaska Range is divided into two tectonic arcs set against one another. The higher southern arc is the Main or Inner Range and the

Fig. 6.2. A graphic comparison of the time North American mountain sheep move onto winter range. There appears to be a latitudinal gradient. The recent sheep near the Dry Creek site move into the Nenana Valley onto winter range in late September and early October.


70°
60°
50°
40°
Latitude
Summerfield (1975)
Nenana Valley
Geist, 1971
(Sudgen, 1961)
(Smith, 1954;
Couey, 1950)
Jul
Aug
Sep
Oct
Nov
Dec

lower, northern-most arc is called the Outer Range. The sheep winter on the north face of the Outer Range, where despite the constant shadows during the short, subarctic winter days when the sun barely appears above the horizon, forage is available. The herbage is exposed by wind in numerous places along this Outer Range and nowhere is this more marked than in the Nenana Valley.

The biology of these Nenana Valley sheep can be summarized graphically in a seasonal chart (Fig. 6.3), illustrating altitude, food, range use, time of movement, etc. This data comes mostly from Whitten (1975) some are my own observations and other elements are taken from other Dall sheep studies (Summerfield, 1974; Hoefs, 1974).

We can reconstruct the optimum time of the year that Dall sheep could have been hunted by a knowledge of their behavior and seasonal uses of the landscape. These are presented in Figure 6.4.

During the late spring or early summer, sheep frequently converge in large numbers from many kilometers to mineral licks (Heimer, 1973). In so doing they use well-worn traditional trails. They return to the lick repeatedly despite being flushed away. These lick areas would have been unusually good hunting locations, especially for pre-firearm hunters. By June (the earliest time that licks are used by large numbers of sheep) there are few sheep remaining in the Nenana River areas accessible from the Dry Creek hunting site. It is likely that people using the Dry Creek camp site hunted sheep only in winter (that is, from late September to late April). They may have hunted sheep at other times but probably not while camped at the Dry Creek site.

It is 2 km from the Dry Creek site to suitable escape terrain, which is today relatively snow-free as a result of winter winds. These

Figure 6.3. An encapsulation of the annual cycle of living Dall sheep (*Ovis dalli*). The timing of the above events vary somewhat from area to area, as does the diet, but these are the usual patterns. There are regular seasonal shifts in altitude and diet. Mineral licks are likely to be visited in late June after lambing. Rut peaks in early December, although rut activity commences well before that time. As discussed in the text, these seasonal changes make sheep especially vulnerable to human hunters at specific times and places.

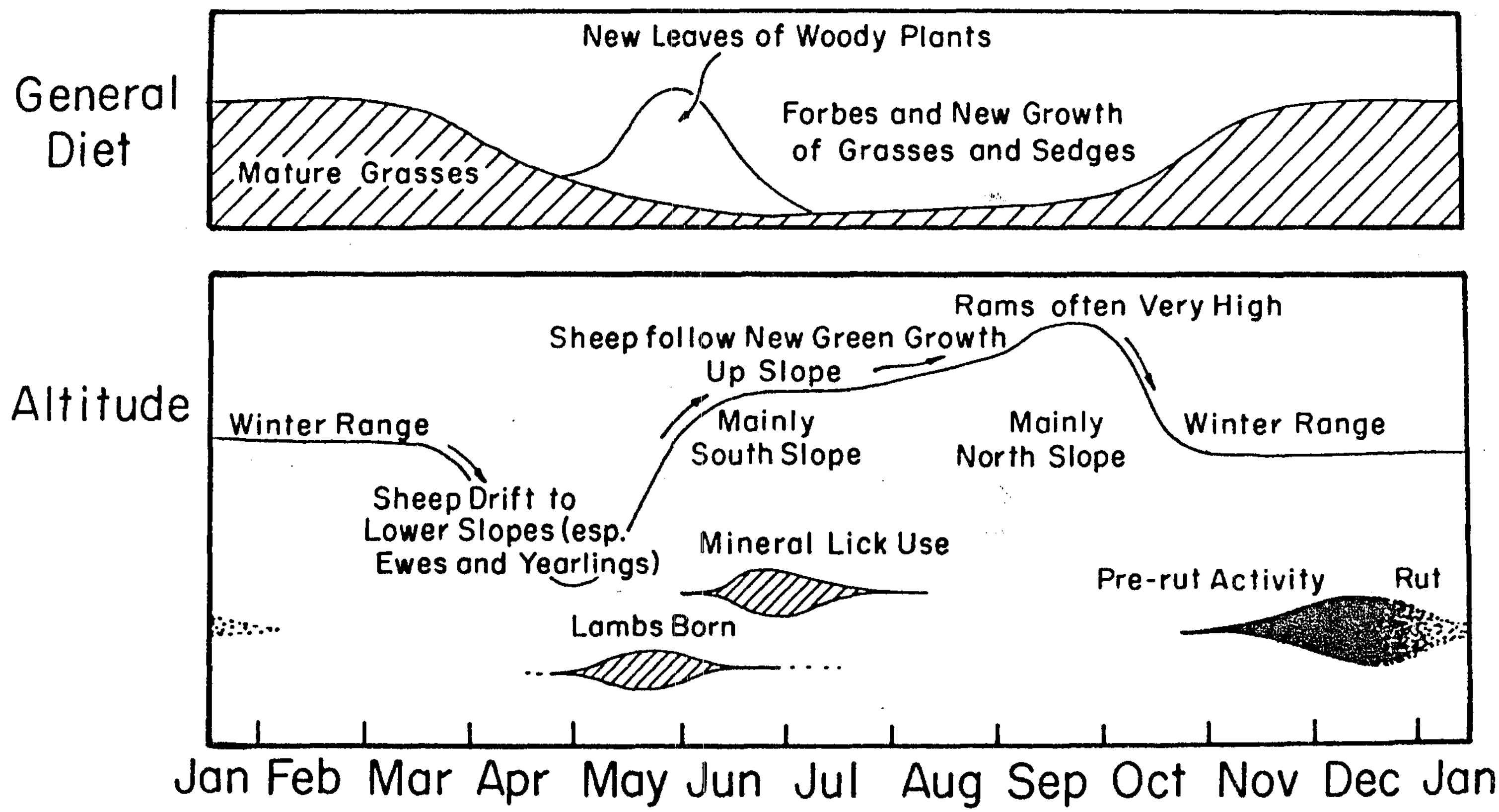
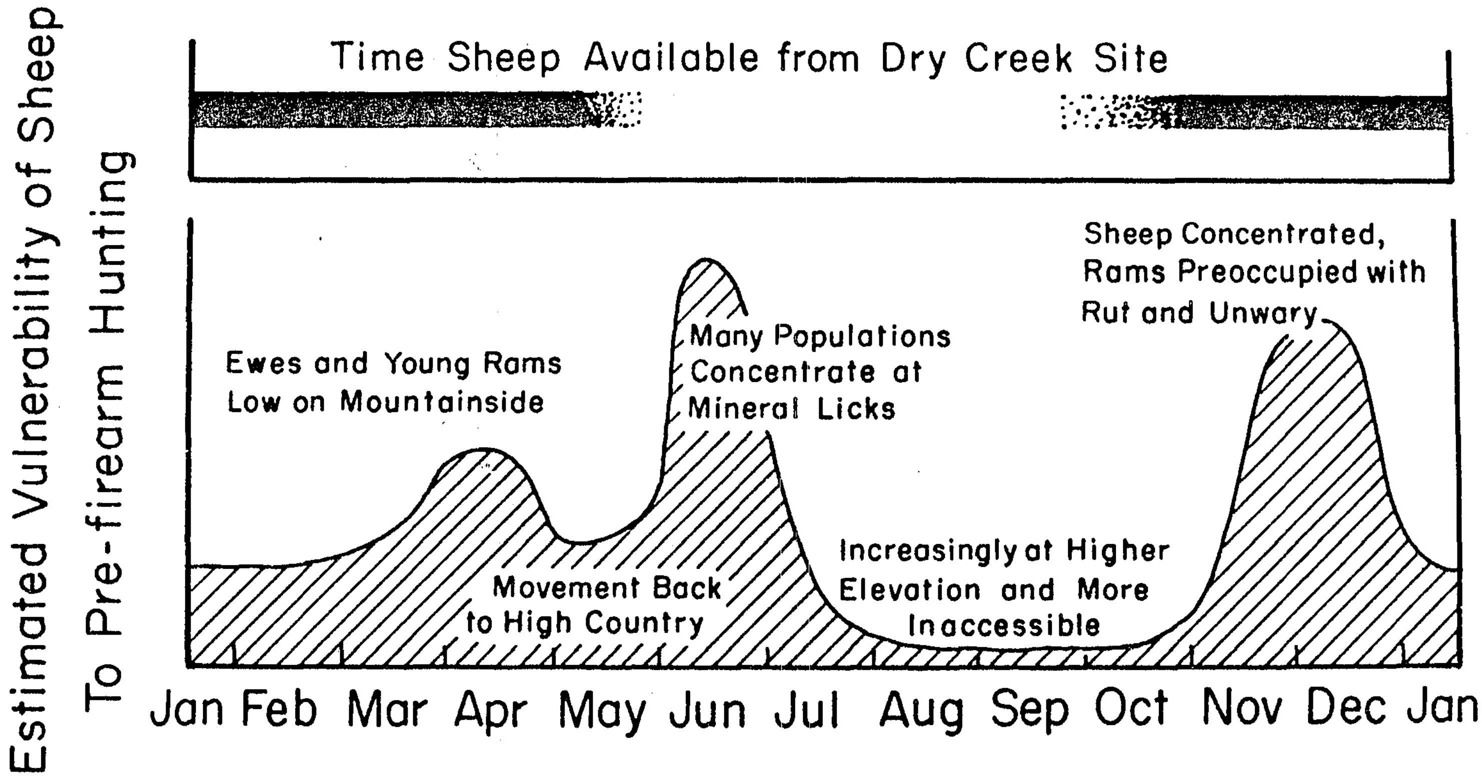

General Diet
New Leaves of Woody Plants
Forbes and New Growth of Grasses and Sedges
Mature Grasses
Altitude
Rams often Very High
Sheep follow New Green Growth Up Slope
Winter Range
Mainly South Slope
Mainly North Slope
Winter Range
Sheep Drift to Lower Slopes (esp. Ewes and Yearlings)
Mineral Lick Use
Pre-rut Activity
Rut
Lambs Born
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan

Figure 6.4. An illustration of sheep vulnerability to pre-firearm hunters, with an indication of the time of the year that sheep now use the area adjacent to the Dry Creek site. During the early winter sheep are concentrated in the period of rut. Rutting areas, which sheep use from one year to the next with high fidelity, could be seasonally used by human hunters.


Time Sheep Available from Dry Creek Site
Estimated Vulnerability of Sheep To Pre-firearm Hunting
Ewes and Young Rams Low on Mountainside
Movement Back to High Country
Many Populations Concentrate at Mineral Licks
Increasingly at Higher Elevation and More Inaccessible
Sheep Concentrated, Rams Preoccupied with Rut and Unwary
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan

areas were probably winter ranges during the Late Pleistocene just as they are today. To reach sheep-summering areas one has to go considerably farther and climb high, steep, rocky terrain. It is unlikely that the Dry Creek peoples would have done so, at least from that camp, particularly when one realizes that the skull bones of a large sheep (maxillae with teeth) were found at the site.

Sheep on winter range spend most of the few daylight hours feeding with heads down. They are frequently dispersed over the ridges and hillsides presenting more varied opportunities for stalking or driving in predictable directions. During the first part of the winter, rams are in the rut and quite preoccupied with the ewes. This would probably be the most opportune time of year to use a decoy strategy. On the whole, the winter range confines the sheep to a small part of the countryside, allowing humans to study natural movements and escape routes. Sheep tend to use the same trails, shortcuts through passes, and detours around rock outcrops. They become vulnerable to surprise or snaring. When feeding in a given area they can be driven along predictable routes and can, of course, be confined to these routes by the use of drive fences, thus allowing other hunters to lie in ambush concealed next to the escape route or to place snares connected to drags prior to the drive. Corrals at the end of a fence funnel are another possibility (Frison, 1978).

Although the collections from Dry Creek are meager, one can see that at least three adult sheep were killed, all in the early adult age range. Animals in this age range normally suggest a hunt by stealth or decoy on unwary, naive animals as opposed to the trail ambush system. Old males tend to lead the line of sheep moving up a trail (Geist, 1971) and would be killed first. Although this does not always happen if sheep are moving rapidly away from danger for example, a sheep dog pursuing them. At Jaguar Cave in Idaho both wild mountain sheep and dogs occur in the same horizon of 11,000 years BP (Sadek-Koores, 1966), about the same age as the Dry Creek site. Whether the Dry Creek site peoples had dogs is unknown.

A late prehistoric site (about 300-400 BP) in the Nenana Canyon also contained Dall sheep material (Plaskett, 1977). These sheep were identified as autumn kills by the growth stage of the dental cement. Despite the much closer proximity to sheep range (the Nenana River Gorge site is at the base of Mt. Healy, where many sheep now over-winter) there are skull and tooth remains and yet no evidence of sheep upper limb bones (scapula, pelvis, humerus, femur). The deboning of the meat was a common practice of early hunters to lighten the load for transport to camp (Frison, 1974). The Carlo Creek site, also in the Nenana Canyon south of the Dry Creek site (Bowers, 1980) dated at 8500 BP, contains sheep, caribou, and ground squirrel. Bowers also concludes that it is probably an autumn processing-butchering station. Information from the prehistoric use of the Nenana River Gorge site corroborates our model of the chronological uses of the Dry Creek site for sheep hunting in fall to early winter with sheep heads being carried back to camp for the valuable raw material of the horn sheath and perhaps the choicest food items of tongue, brains, and orbital fat (see Speiss, 1979).

Like most other ungulates, there is a spatial sexual separation in sheep during most seasons except the rut. However ewes and rams can be in the same general area during parts of the year. The greatest concentrations occur during June when the maternal bands flock together with their lambs and during October and November on rutting range. Unlike bison, where old males are difficult to drive, rams do frequently occur in modest sized flocks (of around 10) and are drivable.

Sheep grow quite fat in the late fall, up to 20% body weight, (Hoefs, 1974). Sheep fat is highly polysaturated, more so than most ungulates, and the rendered lard becomes quite solid when cooled. It is thus excellent for making pemican and for the treatment of leather for winter garments. The small amount of carbohydrates in the diet of northern peoples makes fat an extremely important commodity. I will return to this point later.

There are several interesting questions raised by the presence of sheep in the site: How important were sheep in the Dry Creek hunters' diet? At what intensity would they have had to hunt sheep for them to be a major part of the diet? A sample of sheep with a bias skewed towards adult rams would average about 100 kg apiece. Of this 100 kg, a maximum of 50 kg would have been usable for food (this includes lean meat, fat, liver, kidneys, some marrow, pancreas, etc.). Boning-out over two dozen large, mature rams, has shown that this figure is liberal. Large rams boned-out provide only 30-35 kg of muscle. Wheat (1972) in a thorough review of the literature on historical observations arrived at the figure of about 5 kg as the average fresh meat consumption per day of plains hunters. Using his estimate, one sheep would then furnish enough food for 10 man/days (the 5 kg estimate was an average for all people in the camp). To be liberal we could say that this figure includes some meat loss to storage and scavengers.

The number of people occupying the Dry Creek campsite at any one time is unknown. Estimates on the Great Plains groups from about the same time period run between 100-200 with a theoretical fraction of 20% grown males in the population to carry out the hunting forays. Northern hunting groups may not have been that large. A hypothetical group of 24 would have somewhere between 4 to 8 grown men. A population that size eating only sheep would require 16-17 sheep a week or a staggering figure of 72 sheep a month. If they were to live solely on sheep for the winter (October to April) a total of over 1400 sheep would have been required. This figure should be modified downward somewhat especially if a substantial part of the fat were used for food or if they lived, seasonally, on a suboptimal caloric diet.

A sheep population can tolerate varying degrees of harvest depending on a number of factors. Let us say that, considering both a balance of favorable and unfavorable production years and some density-dependent increases in production with hunting, an average sheep population can sustain 20% annual adult harvest at its maximum sustained yield. The huntable sheep population from the Dry Creek site is now less than 300 and, even if one increased it by five times to 1500 for Pleistocene numbers, which is probably far too liberal, only 300 sheep could be taken on the average (less than 3 months food resource for a group of 24 people). This figure does not include dogs which could have been present. Nor does it include wounded sheep which escaped and died later and were not found. I have performed this exercise to emphasize: (1) The difficulties (or virtual impossibilities) in relying solely on mountain sheep for a long period of time. (2) The difficulties for hunters in ever establishing stores by depending solely on these medium sized animals. (3) The varied benefits of hunting bison-mammoth sized prey characteristic of the Paleolithic-Paleoindian specializations. (4) People who hunted deer-sheep sized animals did so mainly as a protein supplement. (5) The large role women traditionally played in gathering and in small mammal trapping and hunting. (6) The significance of carbohydrates in reducing hunting intensity.

The northern peoples have been hunting specialists because there are virtually no plants which can contribute to large carbohydrate stores. The tubers and fruits in the north are small and sparsely scattered. Likewise, part of the seed dispersal strategy of most northern plants is to produce small seeds. The vegetative parts of northern plants are at best only edible in their early growth stage. All of this means that Paleolithic diet in the north was mainly animal tissue with some seasonal plant garnish. One can readily understand the adaptations to the use of coastal invertebrates and anadromous fish after the demise of the mammoth fauna.

Steppe Bison, *Bison priscus*

The taxonomic status of Alaskan Pleistocene bison is in dispute, but they are closely related to the ubiquitous European, Asiatic, Beringian *B. priscus* and, for contextual reasons, these fossils will be tentatively assigned to that species.

Bison do not seem to have played as large a role in the Eurasian Paleolithic hunter's diet as in North America. Although bison are common in camp refuse in the Eurasian Paleolithic, most concentrations seem to be of horse, reindeer, red deer, or mammoth. It is possible that bison were simply never as abundant as they were in the New World, at least in the large herds, or were more thinly dispersed though fairly ubiquitous. The exception may be the area of the Caucasus. There are several archeological sites in the Caucasus which look similar to the bison-drive sites on the American Great Plains (Vereshchagin, 1967). One can safely say that there are more Bison found among the post-11,000 BP Paleoindian sites in North America than any other large mammal species. The popularity of bison as a prey species was undoubtedly due to its large numbers, the quantity of meat it provided, and perhaps its behavioral susceptability to mass-kill hunting techniques. Whatever the reason, there are numerous bison kill sites scattered across North America, concentrated in a belt from west Texas up through Alberta (Guthrie, 1980). They cover a time period of somewhere around 11,000 BP to the decline of the bison herds in the late 1800's. There are several common features that most of these bison kill sites share:

(1) They are mainly autumn sites (Ewers, 1955; Frison, 1974). Peak bison hunting prior to the horse seems to have been in late summer, fall and early winter. Seasonality of the kill is determined mainly by the age of young animals.

(2) Much of the bison meat was preserved for stores to be eaten at a later date, unlike the strategies of many modern hunting societies (Lee and DeVore, 1968). This is determined mainly by the butchering techniques and quantity of meat removed from the site.

(3) More female bison were taken than males. It has been suggested (Frison, 1974) that this is due to the herding behavior of females; whereas, males are in small groups and thus not easily driven toward hunting ambushes.

(4) Some special topographic features of the landscape were used to concentrate and prevent escape while hunters dispatched animals. This was either an impoundment, arroyo, embankment, sand dune, or something

similar. The geology of the site usually provides this kind of information.

(5) Camp was not moved to the kill-site, rather the meat was taken to camp along with certain bones and parts of bones, some of which were used to carry the meat. The reconstructed butchering techniques reveals an absence of these elements at the site. Often the yearlings are missing and it is thought that they too were taken whole to camp.

(6) At least in the autumn, and probably winter, human hunting groups tended to be moderately large (not simply a nuclear family group). This has been surmised from the large number of people required to perform a major drive-kill, the number of tools present, and the disassembly line technique of butchering (removed limbs were taken to specific areas and the bones disposed of in stacks).

(7) Though they were large mammal hunting specialists, other supplemental game species were widely used by these early hunters. Early camp sites reveal a diverse assortment of fauna. Among modern hunting societies the women often provide the greater portion of calories to the diet in the form of small game and plants in season (Lee and DeVore, 1968).

(8) Frison (1974:110) concludes "Some means of distribution of exotic materials for stone-flaking purposes existed during the Paleoindian period on the Plains."

It is curious that the Dry Creek site, several thousands of kilometers from the Great Plains, in what is now a quite different environment, should be so similar to that of the Paleoindian bison hunters from Montana to the Llano Estacado. With the exception of the Asiatic microblade technology and the permafrost they could be almost identical in fauna and similar in lithic technology. There is ample reason to suspect that the overall ecological texture of Beringia during the Late Wisconsinan glacial period shared features with that of the early Holocene American Great Plains.

With the recession of the Wisconsinan ice sheets the Beringian bison moved into the Great Plains, probably bringing the bison hunters with them. Sometime before that, however, bison had begun to decrease in size from the ubiquitous B. priscus which occupied the Far North from western Europe across Beringia, at least during the Illinoian-Wisconsinan (Riss-Würm) interval. Throughout its range bison began to decrease in size during the Late Wisconsinan. In Alaska and northern Canada it became known as Bison occidentalis (B. bison occidentalis) which colonized the northern plains, but probably continued to decline in size to become B. bison (B. bison athabascae). During the early expansion of the Great Plains in the Late Wisconsinan a large bison known as Bison antiquus figginsi also continued to decline in size to B. antiquus antiquus. Hence, Bison occidentalis met B. antiquus. They were exposed to one another on the open plains with no artificial barriers and, being closely related, they probably interbred (Wilson, 1975). The body size and character of the horn core in the resulting plains bison (B. bison bison) underwent further size reduction, but for the most part retained the style of horn shape of B. occidentalis from the north. That is, the horns were directed posteriorly with respect to the skull and the tips were posteriorly twisted and pointed. The more southern form had horn cores extending at right angles from the skull, with little or no posterior twist.

Unfortunately no bison horn cores are present in the Dry Creek site, but B. priscus fossils with horn cores are known from other areas in Alaska.

The identifiable bison remains in the Dry Creek site are all teeth. Bison (and all of the Bovinae -- Bos, Bubulus, Syncerus) have very hypsodont teeth, more complex than most bovids. This high-crowned characteristic is an adaptation to grass and grasslike plants, which use silicious phytoliths as an antiherbivore defense. As a result of this increased rate of wear, high crowned molars evolved in Bison and most other grazers. Many grazers do not use much grass in summer (our discussion of sheep diets) and many ungulates with brachyodont or low-crowned teeth consume a lot of grasses or sedges when these plants are young and have not yet produced their anti-herbivore defenses. Extant bison consume some forbes and leaves of woody plants in the summer but eat mainly short grasses or the regrowth of grazed tall grasses. In fact they are one of the least selective ruminant grazers studied (Peden, Van Dyne, Rice and Hausen, 1974). Their winter diet, like that of most other grazers, consists almost entirely of grass-like plants. Unlike moose, bison do not have the capacity to rely chiefly on woody twigs in winter. Judging from the rate of enamel wear in the browsers, the lignin, hemi-cellulose, and cellulose is quite coarse and fiberous but not very abrasive. The rate of bison-tooth wear can probably serve as an index to the proportion of leaves of mature grass and grasslike plants in the diet.

Unfortunately bison herds in the wild were reduced and confined before any studies were done on their seasonal movements. McHugh (1972) reviews the migration-nomadism controversy. If we can use the fragmented modern bison populations and can draw analogies from other plains grazers such as wildebeest (Connochaetes), we can say that bison followed the moisture-nutrient gradient around the countryside probably with some traditional year-to-year regularity. Unlike the situation we observed in sheep, which live amidst considerable topographic relief, bison tend to be foothill or plains dwellers. They do, however occasionally graze high into the mountains (McHugh, 1972). But even for bison the lowland vegetation is not phenologically or nutritionally homogeneous in a fine-grained pattern. Local variations in rainfall, past fire history, differences in the past grazing intensity, and proximity to open water, create subtle variations in vegetational communities over the plains.

Bison sexes are separate for most of the year. Cows and calves are in larger bands and the bulls in small groups. They come together in the mid-summer for rut (rut lasts, in most modern herds, from late June through September, peaking in late July or early August).

With this brief review of bison life history, we can now look at the significance of bison in the Dry Creek site. There is evidence of bison persisting in small fragmented populations in Alaska and northern Canada through historical times (Guthrie, in preparation). Adequate wintering areas seem to be the limiting bottleneck. The deep, dry powder snows of the interior make access to winter grasses difficult. Where snow-free areas exist, grasses of sufficient quality may not. The most likely wintering ranges are out-wash areas of major mountain passes. The bison which have been restocked in Alaska are in these special areas and winter on native grasses. Their numbers are small and the Alaska Department of Fish and Game manages them on a carrying capacity basis. The upper Nenana Valley could perhaps overwinter a small herd of bison today. Several bison actually were introduced there in the 1960's, but were subsequently killed by a train, while grazing on the railroad tracks in a narrow pass. Several horses have also overwintered on the revegetated strip-mine areas on the east side of the Nenana River where grass is exposed by winter winds from the pass.

The terraces, foothills, and valley bottoms of the upper Nenana River were probably bison winter range for reasons which have already been discussed. As we know very little about the actual snow cover in the interior of Alaska during the Wisconsinan glacial event other than that it was light (Guthrie, 1968), it is difficult to determine the extent of winter range. The wind and precipitation shadow effect near the mountains in the area of the Nenana River must have produced stretches of snow-free winter pastures. As the mean snow cover began to deepen near the end of the Wisconsinan, these valley outwash fans would have been among the last remaining winter ranges to consistently overwinter bison.

There are numerous columnar tooth sliver fragments throughout the lower levels of the site which have the same thickness and character as bison teeth. One quite weathered cluster of extremely long enamel fragments in the original 1974 test trench was tentatively identified by me as *Equus* sp. (Thorson and Hamilton, 1977). Subsequent study has shown that the unworn M_3 of bison can also produce enamel fragments of that length. Though several subsequently excavated specimens are definitely identifiable as bison only a few are complete enough

Figure 6.5. Steppe bison, *Bison priscus* from Dry Creek

The best preserved large mammal specimen was a complete left lower tooth row (enamel only) of *Bison* (UA77-44-120). Only two other specimens were sufficiently well preserved to be measurable (UA77-44-1422 and UA74-22-181). All of the *Bison* and *Cervus* teeth were identified as lowers and all but one of the *Ovis* as uppers, suggesting that the sheep skulls were being brought back to camp, perhaps for their horns as tool material. The heavy bison and wapiti skulls were perhaps left behind at the kill and only the lower jaw brought back, perhaps for the mandibular marrow. The lower jaw also makes a suitable hand hold with which to carry the tongue, cheek muscle and neck meat back to camp.


UA77-44-120
0 2 4 6 8 10
cm


UA77-44-1422
0 2 4 6 8 10
cm


UA-74-22-181
0 2 4 6 8 10
cm

TABLE 6.2

Bison (*Bison priscus*) teeth

Number	Tooth	Length	Estimated Age
UA77-44-120	(Left)M_3	52 mm	Juvenile, hardly worn
	M_2	36 mm	
	M_1	28 mm	
	P_4	25.5 mm	
	P_3	23.5 mm	
UA77-44-1422	(Right)M_3	46 mm	Very old
	M_2	33 mm	
UA74-22-180	(Right)M_3 fragment	Inc.	Peak growth
UA74-22-181	(Right)M_3	46.5 mm	Quite young
	M_2	Inc.	
UA77-44-121	Unerrupted crown	Inc.	Immature

to determine individual age and take reliable measurements (Table 6.2). All consist of lower dentition and all occur stratigraphically in Component II.

The fact that these bison teeth are all mandibular teeth (no uppers were found [Fig. 6.4]), might suggest that no skulls were brought back to camp, only lower jaws.

Using Reher's (1974) indices of Bison antiquus individual age, the stage of tooth eruption of one specimen was in the middle of its fourth year of life. Another was between nine and ten, as determined by metaconid height. One of the best indicators of sex is depth of the lower jaw, but the jaws were not preserved at the site. The teeth are robust compared to modern bison and are larger. In M_1 comparisons among bison from a number of archaeological sites in the Great Plains (see Reher [1974]) the Dry Creek bison fall outside the size range of historic and prehistoric Bison bison and well up into the larger size range of the earlier bison with an M_1 length of about 29 mm and a width of about 18.5 mm.

Unlike many other northern grazing genera (such as mammoth, Mammuthus, or collared lemming, Dicrostonyx), Pleistocene bison have not undergone any rapid dental changes. The first identifiable fossil bison have teeth very similar to living bison. There is one exception which Skinner and Kaisen (1947) have pointed to as an indication of fossil vs. present bison. It is the expansion in the living bison of the metaconid of P_4, posteriorly so that it results in a shortening of the depth of the linqual fold and produces a fossette on moderately worn teeth. The development of a metastylid also contributes to the width of the mesoconid in living bison. The teeth from the Dry Creek site are primitive in regard to these characters. This information is consistent with the carbon dates for the site.

Though the information about bison is fragmentary it seems certain that the peoples camped at Dry Creek were hunting and eating bison. Because of the reconstructed seasonal grazing range characteristics we can conclude that bison were probably in this area mainly in fall or winter. The fact that long bone fragments and jaws are present indicates that the animals were probably not killed a great distance from the site, as the bones would have added considerably to the pack weight, and are usually left behind at bison kills (Wheat, 1972). Whatever hunting techniques were being used, they were sufficient to take adult bison. Judging from the lithic assemblage, the bison were probably dispatched with bifacially tipped javelins or by spears with composite bone and microblade heads. Normally the bone point tradition is not found in mid-continent North America. It does, however, occur at Blackwater Draw and other scattered areas throughout North America. A bison scapula from Kokorevo I in Siberia has embedded in it a composite point minus the inset microblades (Abramova, 1967).

An intensive autumn and early winter hunting effort aimed at larger animals like bison would make sense. The same limitations on fat availablility in the fall would have pertained to bison as well as to sheep. Also the bison concentrations in autumn are a practical time to set aside stores. Active nomadism of the entire camp during winter, when plant and microfaunal resources are more limited, would have meant a total reliance on the unpredictable large mammals. A more sedentary winter existence would have allowed the hunters to take advantage of the fall and early winter game concentrations and kill beyond their immediate needs. Frozen, dried, or smoked meat would not have to be transported. Camp could be made near running water (probably not a minor convenience in a pre-ceramic era). Fires could be maintained; starting fires in the arctic winter is different than at warmer temperatures. Warm, heavy skins for sleeping could be seasonally accumulated for comfort. Heavier sturdy skin tents could also be built in conjunction with establishing a base camp. A permanent fall and winter camp would have allowed mobile hunting parties to forage great distances, accumulating and adding to stores.

Traditionally, moose-hunting Athabascans have been sedentary in the summer (fish camps) when it is difficult to travel cross-country over impenetrable tussock muskeg and through gnats and mosquito swarms. Athabascans traveled in winter using snowshoe and dogsled over the frozen landscape (Vanstone, 1974).

Autumn or early winter hunting intensity is indicated by the human megafaunal kill sites on the Plains of North America (Frison, 1974) and the prevalence of winter Paleolithic campsites in Eurasia (Klein, 1973). Both argue for an almost universal seasonal hunting strategy of northern early peoples which is also exemplified by the traditional inland Eskimo and Athabascan caribou hunters.

Not only would the Dry Creek camp site have been in the path of autumn movements of large mammals along the front of the Alaska Range, as well as the major terrace systems and the river flats, it also would have been on the winter range of several large grazing mammals.

Wheat (1972) calculated (by using dietary and ethnographic data) that one bison would furnish food for about 60 man/days. This would mean that a group of 100 people living on bison meat alone would have had to have 400 bison to last them from early October through May. A group of 24 people would have had to have about 100 bison for the same time period.

Traditionally meat was preserved on the Great Plains by drying it in thin strips into jerky. Often, this was then pounded into a white flakey powder and mixed with fat (and usually some berries) as pemican. The plains tribes then wrapped these into standardized, fat-sealed containers of untanned bison skin (rawhide) which were known as parfleche among the plainsmen. These containers were inaccessible to small vermin, and preserved their contents for long periods of time. It is likely that the hunting peoples of the Late Pleistocene in the north also had similar ways of storing and preserving meat. A small fire under the drying racks to smoke meat strips adds preservability and flavor. I have made smoked jerky from wapiti, caribou, and moose for a number of years and find that it is excellent trail food. The weight is reduced by about 70% from that of lean fresh meat depending on how dry it is prepared. The processing of dried meat as pemican is not only a more convenient package but it is quite concentrated in nutrients and calories.

The advantages of dried muscle as opposed to cooked meat is that the heat labile nutrients are retained. The pemican is also a convenient vehicle by which fat can be eaten. Fat is more difficult to digest and less palatable when eaten alone.

One thing which should be emphasized is that this process of cutting the meat into thin strips (around .5 cm), drying-smoking them, breaking and pounding each into small pieces, dicing the fat into small chunks (less than .5 cm) and constructing a container is a timeconsuming task. Several dozen big game animals represent many hours of preparation after the animals are hunted, killed, skinned, butchered, boned, and packed to camp.

The great reliance on meat in the north meant that if larger game like bison were not available, very great quantities of medium and small sized animals had to be harvested. There were however other large species available during the period 10,500-11,500 BP, and one of these was wapiti.

Wapiti, *Cervus canadensis*

While the fossil *Cervus* teeth found in the site cannot be definitely assigned to a species by any inherent morphological characters, they are probably (*C. canadensis*).

The habitat of wapiti is more difficult to delineate than bison and sheep. They can occur in the grassy heath meadows, like the Scottish red deer, in the woodlands of the Appalacians, the plains of Illinois and Kansas, or high in the Rocky mountains. Lewis and Clark (1893) reported that "they are common to every part of this country."

From Murie's (1951) classic study one can conclude: (1) Wapiti follow the high-quality early plant growth stages which usually means movements into the mountains in spring and summer (when sufficient topographic relief is present). (2) They characteristically move out onto the wind-swept prairies, or plains, whenever snow in mountains or woodlands becomes limiting. (3) Like mountain sheep, they are animals of habit and tradition, making similar seasonal movements and using similar ranges from year to year. (4) Also, as in sheep, body and antler size are general indications of range quality. (5) They are very social with sexes living separately through the year, except for the autumn.

On high quality range where sheep numbers are below carrying capacity, it has been found that wapiti eat much the same plant species as sheep: forbs in summer and grasses in winter. If both sheep and wapiti are on the same range there is direct competition; but because of different range-use patterns, this overlap does not occur often.

The cervids, or deer group, have radiated as browsers in a deciduous woodland setting, specializing on young seral plant growth at the parkland edge. *Rangifer* and *Cervus* have moved away from this original focus, the former becoming a specialist on lichen for winter diet and the latter has become more of a grazer in winter. Both have moved away from the woodland cover in parts of their range and have become relatively social, occurring in herds of large size in an un-deer-like fashion.

In the northern Rocky Mountains the rut begins in late August and runs until mid October (Murie, 1951). The period of calving is from May 15 to June 15. Wapiti, like both mountain sheep and bison give birth to a single calf and virtually never have twins. The males drop their antlers in February and commence to regrow them in April. In a number of ways, the life histories of sheep, bison, and wapiti are quite similar. They mature at somewhat similar rates, eat much the same foods, have similar mortality curves, have roughly similar social organizations, have only one young per year, and the males are elaborately adorned with social paraphenalia. They have evolved towards similar aspects of the open grassland environment from different evolutionary lines and experienced somewhat the same general selection pressures.

Wapiti were a common element of the mammoth steppe which extended across Eurasia to Alaska (Guthrie, 1966, 1968) and were generally well represented in Rancholabrean faunas throughout the Holarctic. Many of the C^{14} dates from Beringia however cluster in the very late glacial or Holocene suggesting a possible increase in numbers with the decline of the mammoth steppe. Straus (1977) concludes that it is the most abundant megafaunal component throughout the Paleolithic sites of Northern Spain. This is true for many northern European sites as well. *Cervus* is the most frequent species at Star-Carr (Clark, 1954), a famous Mesolithic site in England. It is also present in several early sites in North America and in Northern Asia. It never seems to have been a major early dietary item in the New World, at least it is uncommon in Paleoindian archaeological sites (Frison, 1978).

We know very little of the early techniques used to hunt wapiti. As major predictable migrations occur when wapiti are in large herds, rock fences with snares (anchored to drags) across the openings could have been used in the same manner that the Kutchin hunted caribou (Roseneau, 1977). We do know that *Cervus* was driven into impoundments in Medieval Europe. The construction of elaborate hunting facilities in the Nenana Valley would have meant a more traditional committment to those hunting grounds. Other hunting techniques may have been used, of course. At Star-Carr there are a number of *Cervus* skull caps with antlers attached from young *Cervus* bulls. These have 2 holes for the attachment of a chin strap so that they can be worn on the head.

Whether these were used in allowing the hunter to approach a herd or used in some ceremonial rite is unknown.

The large wapiti antlers would have provided a valuable raw material for tools. Antler is less dense and easier to work than the diaphyses of long bones and yet it is strong and durable. It is porous and when wetted works quite easily (see Appendix B).

There are a number of specimens from the site of enamel fragments which could be Cervus, but only two specimens are definitely identifiable as such (Table 6.3), both are lower dentitions and both come from Component I (Fig. 6.6).

Although sex is not known, these appear to be large teeth consistent with the findings from other wapiti fossils in Alaska and the Yukon Territory (Guthrie, 1966). These fossil Beringian wapiti were the largest group in the past and present range of Cervus. One can only conclude that they were on a high quality range.

Reconstruction of the Late Glacial Megafaunal Community of Interior Alaska and its Paleoecology

Because the Dry Creek megafauna are transitional between the full glacial and Holocene community, it would be worthwhile to first reconstruct the general features of these periods before analyzing and interpreting the Dry Creek fauna.

Although the palynological evidence is equivocal (Cwynar and Ritchie, 1980), the vertebrate fossils indicate a dry steppe environment during full glacials (Guthrie, 1968). There is very little direct evidence as to exactly what that steppe was like. Indirectly, however,

Figure 6.6. Wapiti or elk, _Cervus canadensis_.

Two specimens were identified as _Cervus_, both are left lower dentitions from two different animals.


UA76-388-3891
0 2 4 6 8 10
cm


UA76-155-3888
0 2 4 6 8 10
cm

TABLE 6.3

Wapiti (*Cervus canadensis*) teeth

Number	Tooth	Length	Estimated Age
UA76-20-110	(Left)M_2	Inc.	Only medium tooth wear
	M_3	Inc.	
UA76-155-3891	(Left)M_3	Inc.	Very worn (+16)
	M_2	30.5 mm	
	M_1	22.5 mm	
	P_4	Inc.	

one can argue that the specialized adaptations seen in the morphology of bison, horses, asses, sheep, and mammoth indicate a dependence on grass, at least for winter forage. The great diversity within the faunal grazing community also points to a steppe flora of considerable spatial and growth-form diversity. I have referred to this general biotic province which extended from England to the Yukon Territory, Canada as the mammoth steppe (Guthrie, 1980, 1982).

We know from the studies of ungulate grazing communities elsewhere that competition is avoided or reduced by niche specialization (Bell, 1969). Some species even increase the volume of forage available for other species (e.g. equids removing grass tops which improves access to mid-stem leaves for bovids). Also when there is direct competition grazers have often evolved a spatial separation. For example sheep have undergone adaptations to climbing in order to escape predators on steep alpine slopes (Geist, 1971), while saiga antelope (about the same size as sheep and with similar dietary preferences) use the flat lowlands and depend on speed to outdistance their predators.

Jarman (1974) and Bell (1969) have shown that in a grazing community there is a species gradient in the ability to use fiber in the diet. Some species select for portions of the plant which are lower in antiherbivory devices (fiber, phytoliths, resins, alkaloids, etc.) while others are less selective, specializing in the abundant parts of plants which are high in fiber. Jarman and Bell were able to show that this use of fibrous plants relates to body size. The smaller ungulates require a larger percentage of digestable protein in their forage (lower quantity of fiber) than do larger bodied species. Sheep and saiga-sized animals require relatively high concentrations of protein, hence are extremely selective. They graze by selecting the best (least defended) plant parts (Whitten, 1975). Elephants at the other extreme, consume vast quantities of low quality forage (Laws, Parker and Johnson, 1975).

With these general principles in mind there is much we can say about the ecology of the grazing ungulates which occupied the mammoth steppe even though we do not yet have a firm grasp of the exact character of the vegetation.

In an earlier paper (Guthrie, 1968) I showed that bison increase in numbers relative to equids toward the Tanana Uplands. Sheep bones are virtually unknown from the lowlands and when found usually show signs of stream transport from the uplands. One must be cautious about reading these distributions as indicative of year-around occupation, however, because of the seasonality of range use. But we do know from numerous wildlife management studies that most adult mortality occurs during late winter or early spring or, in the case of more temperate climates, during the dry season (Laws, _et_ _al_, 1975). Thus, in Alaska, natural fossil ungulate assemblages may be general indicators of winter range (in combination with depositional biases). The upshot of all this is that ungulate winter use of the Tanana Valley during full glacial conditions can be reconstructed through a combination of fossil distributions, ecology of relict forms, current models of grazing ungulate habitat partitioning, and information about the dental morphology.

Modern Ungulate Community

Much ecological information now exists about the ungulates living in central Alaska today. For background in the discussions which will follow, I would like to give a simple review of the salient features of ungulate ecology in the north. The species are in general order of abundance: Caribou (*Rangifer tarandus*), moose (*Alces alces*), and Dall sheep (*Ovis dalli*). Caribou are usually found in the rolling tundra covered foothills, though they often frequent the thinly vegetated lowlands and higher alpine areas. Caribou bulls generally tend to be high in the mountains in the summer months. Moose are generally a lowland animal, however, willow fingers reaching into alpine areas are favored habitats and like caribou, bulls will frequently be found at higher altitudes in summer than will cows. Sheep are exclusively alpine dwellers, though they will come down rather low at times if suitable escape terrain is available. Rams tend to graze higher in the summer than ewes.

There is considerable overlap in the summer diets of moose, sheep, and caribou. For example, young willow leaves play an important role in all of their diets. In winter however, there is virtually no dietary overlap. Caribou crater through the snow for lichens and a few herbs. Moose shift to woody twigs above the snow. Sheep inhabit alpine areas of low snow cover and concentrate mainly on the green bases of grasses and a few other herbs.

The climax spruce forest is inhabited regularly by no large mammals and few small mammals, mainly red squirrels (*Tamiasciurus*), flying squirrels (*Glaucomys*), and red-back voles (*Cleithrionomys*).

Snow is one of the major limiting factors for ungulate populations in the north. It increases the amount of energy required for moose to move among the lowland high shrub patches, makes the subnivian plants less accessible to caribou and decreases access to the sheep's winter alpine ranges.

Ungulate Winter Range in the Nenana Valley

The archeological record of Late Paleolithic and Paleoindian peoples usually reveals a hunting economy centered on large mammals. As the peoples at the Dry Creek site were evidently also big game hunters, the concentrations and distributions of large mammals should be a central focus of the paleoecological reconstruction. I wish to propose that the Nenana Valley, which is an important winter range for ungulates today, was also prime winter range during the time of occupation of Components I and II of the Dry Creek site.

The chief bottleneck for northern ungulates is the winter (Klein, 1970). While most wild northern ungulates are not stressed by cold temperatures, winter food quality is quite low and when access is restricted by snow it usually results in rapid depletion of fat reserves, debilitation, or exposure to predation. Winter ranges thus become critical in northern ungulate biology. These are usually quite restricted and ungulates use them in a traditional fashion (Summerfield, 1974).

The windswept slopes around Healy are traditional wintering ranges of two different large herds of Dall sheep (*Ovis dalli*) from either side of the canyon. This area was also an important winter range of the Delta caribou herd. When the deep snow accumulates in the upper drainages of several adjacent rivers and tributaries, moose also concentrate in the Nenana Valley in late winter.

Several local residents of Healy turn their horses loose during the winter to graze on the revegetated excavations from open pit coal mining. There is also a maverick pack horse which has gone feral in the area and can't be caught. The horse has escaped pursuers and survived for several years. A rancher, Beryl Mercer, has also kept bison in the area.

There are two factors which make the Nenana Valley good ungulate winter range. The first is reduced snow cover; the second is vegetation characteristics produced directly and indirectly by the wind. Wind is most destructive to the climax spruce forests. Not only does it blow down the shallowly rooted northern conifers and abrade the wintergreen needles with tumbling ice crystals, it magnifies the effects of fire by causing hotter burns and carrying the burn over wider areas. The dry wind also makes for greater plant susceptability to burning.

Thus most vegetation around the Nenana Valley is in the early stages of fire succession or aridity subclimax. There are many grass meadows and willow thickets. These are the plants now used by many ungulates for winter range.

During the last glacial and early post-glacial we know from other lines of evidence (see Pewe [1975] for a review) that woody plants were uncommon in interior Alaska. Given a more herbaceous plant community at that time in the Nenana Valley it would have been an even more favorable wintering area for ungulates. This assumes the same type of katabatic air flow. If anything, the winds would not have been diminished by increased mountain glaciation but actually increased. Sand dune activity and thick loess deposition further to the north (Pewe, 1975) indicate even greater windspeed through katabatic flow during glacials.

Unfortunately, until now most Quaternary geological investigations in interior Alaska have been devoted to the Tanana Uplands with their famous glacial aged thick loess, rich in vertebrate fauna. As yet there have been no deeply stratified sites of Wisconsinan age with fauna and flora studied in detail from the north Alaska Range, so we know relatively little about the vegetation and animal communities there during the full Wisconsinan glacial, say 15,000 BP. However, the species of the mammoth-fauna so common around Fairbanks have also been found along the north front of the Alaska Range. Our archeological surveys produced a mammoth lower jaw in the Teklanika (a nearby drainage running parallel to the Nenana River) and Joseph Usibelli, owner of the coal mine at Healy, said several mammoth and bison bones had been unearthed in the process of removing the overburden sediments from the open-pit coal mine.

It is possible, however, that the periglacial conditions produced a harsh environment for ungulates, though modern periglacial analogues suggest conditions even more conducive to ungulate rangeland than further out in the plains (Geist, 1978). But, of course, there may be no appropriate modern analogues to the Pleistocene periglacial environments (Guthrie, 1982).

It may be possible that the Dry Creek fauna represented a relict of the mammoth steppe which we know occurred further away from the glacial front throughout most of unglaciated Alaska, Beringia, and Northern Eurasia. It would have been relict, because by 10,00-11,000 years BP the shrublands and woodlands were probably well along in gaining dominance over the mammoth steppe (Ager, 1975). These relict habitats probably existed only in scattered refugia with special windy conditions.

Megafaunal Analysis and Site Chronology

Wilson (1975) has illustrated the utility of bison size in dating archeological sites in the northern High Plains. Because the sequence of size reduction in Alaskan bison is not documented to such a fine degree as in the northern Great Plains, the same size-date equivalents cannot be as precise in Alaska. In addition, bison numbers were probably declining in the Far North at the beginning of the postglacial, so that exact parallels between there and the expanding herds of the Great Plains may never be available.

Be this as it may, the Holocene bison in Alaska do undergo a rapid size reduction. Harington (1978) has several large male skulls from the mid-lower range of *B. priscus* at about 12,500 BP from the Yukon Territory, Canada. At the other end of the scale an older male bison skull collected by Dr. Frederick Hadleigh-West from near Anchorage, Alaska was dated at 500 BP (Guthrie, unpublished). The latter is well within the size range of *Bison bison*, though near the high end.

On the basis of climatic expectation alone one might expect that the bison in the Dry Creek site would be generally smaller than the Wisconsinan *B. priscus* mean. We know from pollen evidence (e.g., Ager, 1975) that the climatic change resulting in woodlands along the Yukon drainage was well underway by 10,000-11,000 years BP. Thus, the currently accepted paleobotanical view is a rapid reinvasion of the mammoth steppe by shrubs by 14,000 BP and conifer woodlands by

10,000-11,000 BP. Given 10,000-11,000 BP carbon date of the Dry Creek site, such large bison were unexpected. We can safely say that whatever changes resulted in the size reduction of bison in the Holocene, they had not yet appreciably affected the bison populations living in (or visiting) the Nenana Valley. In fact, the Dry Creek bison is not only as large as the Wisconsinan _B_. _priscus_ from Fairbanks but appreciably larger than the mean. Exactly what this means paleoecologically is not clear, but it definitely has some major implications for our ideas about Pleistocene gigantism.

The relationship of this large bison to an independent evaluation of the site chronology is also unclear. Superficially, it would suggest an earlier date than the C^{14} date indicates; however, Wilson (1975) has shown that while bison in the Great Plains began to undergo size reduction by 10,000-11,000 BP there were still moderately large bison in the Hawkin Site dated at 6270 $\pm$ 170 and 6270 $\pm$ 140 years BP. The major reductions in bison size on the Great Plains thus seem to have taken place after 6000 BP (Wilson concludes that this may be caused by the arid altithermal). However, there is no reason to suppose that the size reductions in the Alaskan and Siberian bison corresponded exactly to this same chronology but they do seem to have been roughly comparable.

Nutritional Considerations at the Dry Creek Site

It is important to consider the nutritional dimension to the story of early peoples in the north because ultimately that is going to be the central factor in their population biology, seasonal strategies, and general success or failure. The sparseness of carbohydrate resources in the north cannot be overemphasized. There are a few wild greens; legume tubers are the size of one's finger tip and most berries are quite small (in fact, there are little or no ericaceous pollen in mid to late Wisconsinan-aged sediments in Alaska indicating that no berries were available at that time). These plant resources are not available in all areas, and when they are it is for a very brief season. This leaves animal tissue as the major food source. There are few invertebrates of edible size away from the seacoast. There is, as yet, no good evidence that Paleoindians used fish to any great extent. Early peoples were dependent mainly on birds and mammals. Birds can be difficult to catch and do not provide much meat unless dozens are killed. The volume of small mammals required to meet nutritional needs is also very great. Thus, the selection in the Far North quickly narrows down to large mammals as the main Paleoindian food resource.

Viscera, heart, lungs, liver, spleen, etc. are high in calories and vitamins, but do not keep well. Muscle is the best storable protein source. Body fat and marrow also store moderately well when properly treated.

Muscle, however, is not very calorie rich. As I already mentioned, researchers have proposed from ethnographic studies that the average person required around 10 lbs. (5 kg) of red meat per day if meat was the only food available (Wheat, 1972; Agenbroad, 1978).

To check this calorically, I went to the nutrition literature and found that from every 5.65 kilo-calorie per gram of protein (on the average) .45 is lost in feces and 1.20 is lost in urine. This leaves 4.0 kcal/gm metabolizable energy, or physiological fuel value (Pike and Brown, 1967). Raw meat from game animals normally averages about 26 gm of protein per 100 gm of meat. This results in 136 kcal gross energy per 100 gm meat or 104 available calories. The calculation ignores the digestable intracellular fat content of the meat which varies depending on condition of the animal. Speiss (1979) calculated 800-1000 kcal/kg or 450 kcal/lb., which agrees with these calculations.

The mean daily caloric requirements are difficult to calculate without some knowledge of average human weights, age, sex structure, and activity budgets (Pike and Brown, 1967). As a rough estimate in all human subgroups very active males may require over 4000 kcal, but only use between 2-3000 per day in more relaxed conditions. Women use less than men because of lower metabolic rates, averaging 15-20% less than males. A moderately active 120 lb. woman requires about 2000 kcal per day. Children require slightly less. Using an average equivalent of 3000 kcal per person would mean only 3 kg of meat per person and about 4 kg for a hardworking male. Fat has more than twice the available energy as protein (9.0 vs. 4.0 kcal/gm). A daily supplement of only 50 gm of fat per day would decrease the daily calories required from lean meat by 450 calories.

Thus without the carbohydrate supplements in the north, people require considerable volume of protein and fat. The calculations here are somewhat below those for the Great Plains, but are not greatly different. These amounts of meat seem incredibly great to those of us on modern, carbohydrate rich diets, living rather sedentary life-styles.

The concentration of large game hunting activity in the autumn or early winter in both the Late Paleolithic of Eurasia (Klein, 1973) and the New World (Frison, 1978) has been explained by the need for winter food stores and this is undoubtably correct. But there was probably another major reason. Even when winter hunting was profitable, fall would have been the only season that fat was available in any quantity. Killing animals at this time of year maximizes available calories. Speiss (1979) calculates, for example, that an adult caribou yields 76 man-days of food in September but only 15 man-days of food in December; the difference is mainly one of fat content.

In addition to being calorically rich, fat makes for both efficient stores and compact trail food. But probably most of all, its rich sweet salty flavor breaks the monotony of lean roasted meat. Wild meat is not marbled, like grocery-store domestic cuts, and unless cooked quite rare becomes dry because of this lack of interfasicle fat. When drying meat for storage one must first remove the fat, thus jerky eaten alone is dry like bark. Esthetically and energetically dry meat is best when combined with fat as pemican. Fat also greatly increases the heat from woody twigs when added to a fire. But burning one's food is generally an uneconomic proposition in terrestrial habitats (sea mammals produce so much fat it is sometimes used for fuel by Eskimos). Fat is a long-burning source of light, the only one available in dark houses or tents during the subarctic winter. Fat is necessary for water and snowproofing garments and for retaining leather suppleness.

Northern wild ungulates killed at any time except fall are generally without appreciable body fat. Thus these autumn harvests of large mammals take on considerable importance because the fat must last until the next summer. The available small mammals (such as hares) and birds (ptarmigan. grouse) are equally lean during winter. So fat was undoubtably a commodity of high worth. Rather than postpone harvest through the winter these early hunters would have maximized available calories by killing heavily during the fall when fat was obtainable. This probably explains the general concentration in fall and early winter harvests in both the Old World and the New. They were after the fat. But this principle may also tell us why these earlier peoples created a relatively well-used hunting camp or processing station on Dry Creek.

The Development of Big Game Hunting in North America

Though not a rich, well-preserved bone assemblage, the material in the Dry Creek site provides some critical clues to the nature of big-game hunting techniques and their development in the New World.

Despite the availability of hundreds of productive Paleolithic archeological sites in Eurasia, there is no well-defined evidence of hunting technique. The most obvious interpretation of the faunal diversity in the Eurasian sites is that the hunters were skillfully opportunistic, using a variety of methods on a variety of game species. The species represented in site middens are heterogeneous between sites and often within sites.

This opportunistic type of hunting persisted for many tens of thousands of years over a vast continental area, most of the Eastern Hemisphere. The peoples of the early Holocene in North America however, became specialists at one major kind of hunting technique, the drive.

Drive sites are uncommon in Eurasia. The cliffs of Solutré are a notable exception. Here the land lay uniquely suited to herding horses over a precipitous cliff (remains of over 100,000 horses are present). But indications are that drives were a small part of the hunting repertoire; there seem to have been few drive specialists such as in the American Great Plains during the Holocene.

From studies of the osteological assemblage associated with the bison drive sites (Wheat 1972; Kehoe, 1973; Frison, 1974), the kinds of bone least likely to be taken back to the encampment have been shown to be mandibles and skulls. Yet teeth are among the more common skeletal elements in Eurasian sites and the Dry Creek site. In fact, like the Eurasian Paleolithic sites, the assemblage at Dry Creek has all the earmarks of the employment of a more opportunistic, heterogeneous hunting strategy. At least three different species of large ungulates are present, each species lived in different environments and terrain and used different escape behavior; each demanded a different kind of hunting strategy.

Another characteristic of the bison remains found in the drive sites is the preponderence of females. Judging from the large size of the Dry Creek site specimens it is possible that they were males. Ethnographic studies of bison use indicate that females were more easily herded and driven and that in fact the hides and meat of females were more highly prized (Kehoe, 1973). My experience in hunting other ungulates confirms this. The meat and hides of females and young are preferable to that of bulls for almost every use.

The massive concentrations of bone associated with drive sites have not been found in Alaska. When bone accumulations have been discovered they have not been in contexts which would indicate a drive kill-site (the caribou fences from a much later time are an exception).

Another indirect piece of evidence which suggests that the northern hunters were using more opportunistic strategies is the location of archeological sites along lookout prominences. Most sites of the Denali Complex (West, 1975) in the Nelchina Basin dating from about the same time as the Dry Creek site and later are along the tops of serpentine moraines. This is also true of a number of other sites along the north face of the Brooks Range. The Healy Lake site and the Campus site are both up off the valley floor affording a good view to someone searching for game. Until the Dry Creek site was analyzed it could be argued that these were sentinel stations from which the "decoy" could sight the herd and prepare to drive the animals into the trap.

The Dry Creek site, however, allows us to see that these early people were taking a variety of game and probably looking for any likely huntable animals, from these spike camps.

Thus, a pattern begins to emerge from the spectrum of sites across Eurasia, into Alaska, and on into the Great Plains. There was a shift from the generalist-opportunist hunters to the more specialized hunting industry of first mammoth hunting, and then bison hunting. The reason behind this shift probably lies in the nature of the large mammal community. The Eurasian faunas were heterogenously mixed cervids, equids, rhinos, bovids, and proboscidians. Much the same is also true of the late Pleistocene faunas of the Alaskan and Asian mammoth steppes (Guthrie, 1982).

In the Great Plains, however, at least after 12,000 BP, the faunal elements were mammoth and bison. After 11,000 BP the major biomass component of the large mammals seems to have been mainly bison. This was not the case in the more mountainous areas; Paleoindians were still hunting a wide variety of game species (for example Jaguar Cave, Idaho with _Equus_, _Ovis_, _Bison_, _Cervus_ [Kurtén and Anderson, 1972]). In the open plains however, people were becoming bison specialists. Frison (1978) refers to it as the "buffalo procurement complex" and Kehoe (1973) calls it the "bison industry."

At first these bison specialists seem to have used the older opportunistic strategy of the northern hunters but went a step further and herded bison over natural precipices or, more often, into narrow ravines where many could be speared before getting away. Still, these were probably opportunities of circumstance rather than laid-out plans (Wheat, 1972). The final stage of this trend was an impoundment area where all bison herded into the enclosure could be systematically dispatched (Kehoe, 1973). With the coming of this technique and the Iberian horse, bison became similar to "open range" stock which could be harvested at appropriate times of the year.

From this perspective we can begin to see these Paleolithic colonizers in a different light. The Great Plains mammoth and bison hunters were specialists. The Dry Creek peoples and their Eurasian counterparts probably were not. Although these differences are surely a matter of degree, they do indicate a notable difference and provide an important ingredient in a reconstruction of how these early people must have lived. Combined with several other bits of information, they can provide some clues about the environment as well.

The fact that all sites in the 10,000-11,000 years BP range or earlier thus far excavated in Alaska show neither long-term sustained nor intense use (other than a profusion of flakes which can be generated in a short period of time), is consistent with the exploitation pattern at Dry Creek where a variety of animals were being taken. People were taking every game animal they could get, not in organized, planned drives on single game species, but as individual groups of hunters using a variety of hunting and possibly trapping methods.

This kind of exploitation will not support a population in the same area indefinitely. Even seasonal use in this fashion eventually reduces the food productivity of an area. Most of the early sites in Alaska suggest this pattern of use. There is intense use for a season or maybe even sporadically over several years then a sterile horizon before any other signs of use and often no more artifactual evidence in the rest of the strata.

The Orb Model of Hunting Camp Settlement

The character of the Dry Creek site has led us to conclude that it was a "spike camp", a secondary, short-term encampment, used primarily to spot game (its position on an exposed prominence); to prepare game for retransport (the presence of knives and worn large flakes); and to manufacture and repair hunting tools (the presence of the complete microblade manufacture sequences and broken bifaces). The "permanent camp" aspect of the tool assemblage is poorly represented, worn end scrapers and leather working tools are rare. These are not elaborate habitation areas with indications of long-term use, nor are there house pits or tent-ring stones, center postholes or the like, although the camp is positioned on an exposed windy prominence.

Interestingly, many of the early sites in Siberia are characterized by these same features: heterogeneous fauna, few end scrapers, a predominance of points and knife-like tools, and locations on river terrace or moraine prominences overlooking areas where big game frequently travel (Mochanov, 1977).

I would like to argue that these frequent Siberian camps along with those of the Denali Complex, the Campus Site, and most other northern sites in the 12-8000 BP range are part of a land-use system which involved a moderately stable base camp and numerous outlier spike camps. Hunters used these spike camps in a radiating pattern away from the main hub, the more permanent base, like the web of an orb spider.

The conceptual model would allow a more thorough use of a thinly distributed, only moderately predictable, big-game resource. There is a critical size for a hunting group, well above that of the nuclear family (around 100, or relatively less, is the generally agreed upon range). A small nomadic band of a family group would be extremely inefficient year-around hunters. The entire camp and equipment (it takes no mean amount of gear for anybody to live in the north) would travel slowly and noisily. Game would soon be flushed out of their general area. If these few hunters ran into a long period of poor hunting, they would be doomed with no back-up reserve buffer. It is most difficult to imagine that people could survive in the north as truly nomadic hunters, always faced with the unknown or poorly known terrain.

A central camp exerting light hunting pressure scattered throughout a wide area of known conditions has a better fit with the data. A stationary base camp would allow larger stores to be accumulated for winter or lean times. Maintenance energy (preparation of garments, cooking facilities, etc.) would not be stressed by constant travel. Camps could be chosen for optimal locations of water availability, dust and wind protection, fuel access, substrate for tents or dugouts and other things which would be compromised if camp sites had to be chosen for direct mobile hunting purposes as well. The individuals who were less able to travel, but had nonetheless important contributions, could remain sedentary: pregnant women, small children and women with small children, the aged, and the sick or injured.

This base camp would allow very mobile bands (I suspect mostly adult males) to travel throughout a great distance, continually adding to the meat stores with big game already processed in a preliminary fashion for retransport. In this way a familiarity with a large region and traditional patterns of game use could be achieved. This hunting pattern would, in general, result in a system moderately buffered against the vicissitudes of big game hunting existence in the Far North. If game resources become depleted the information would already exist as to which direction the main camp could be moved, thanks to the familiarity the widely ranging hunting bands would have with the expanse of their territory. The mention of territory raises another issue which is intergroup aggression. The base camp "orb" hunting territory would allow the moderately rapid availability of the most people for the defense against invaders. A simple family band would be relatively defenseless in comparison.

The permanence of the base camp may however have only been seasonal. Athabascans and Eskimos have traditionally had different camp sites winter and summer. One might imagine that, like Eskimos, winter would be the harsh season where people would band together in the larger kinship units with food stores and continued organized hunting pressure over a larger region.

The circumstantial arguments for a stable base camp during winter are, to me, persuasive. The large amount of equipment required for winter living in the north (skin blankets, extra robes and clothing, various specialized tools and a stock of raw materials) would be relatively immobilizing without dog teams and sleds for travel. But the most important reason to be sedentary is the quantity of food stores necessary to provide a buffer against the boom-bust conditions in the north. The ethnological literature about caribou-dependent northern tribes discusses the hundreds of animals taken seasonally for stores. Enough dried meat to last for a lean two months would alone weigh about 120 kilograms per person (2 kg per person for 60 days) or more than could be carried. Also condiments like tubers and berries gathered in the summer could not be kept if one were mobile. Also most groups in the north at the time of European contact depended heavily on concentrated marine resources (sea mammals on the coast and salmon in the interior) few were exclusively big game hunters as the Dry Creek peoples may have been.

However it would be difficult to lay up meat to last all winter; I imagine stores were only meant to last for long, hungry times and that hunting would have to have been continued throughout the winter. I believe that most of the early sites in the north were fall or winter spike camps of people residing away from the main camp with only the rudiments of necessities. Most of the tool manufacture or use is for traditional tools, weapons and butchering tools. The few scrapers are probably to do preliminary work on the hides in order to dry them for transport. A green hide, with the subcutaneous muscles and fascia not removed, weighs several times that of a fleshed dried hide. Also if the hide is dried without fleshing, the latter becomes very difficult.

The spike camps could serve as cache areas to store raw materials later used in tool and weapon manufacture and repair. Also, the select bones which were to be used for implements, or even horn could be cached there. There is a large stone "cache" at the Dry Creek site though it is unclear why these particular stones were piled up.

It is likely that some preliminary meat preparation occurred at the site. Given the amount of meat required to maintain a hunting group, large quantities would have had to be carried back to camp. As meat is over 70% water, it can be dehydrated by drying (even in winter) for easier transport back to the base camp, by cutting it into thin strips and hanging it in an exposed spot.

It is interesting to note that although the Dry Creek site was probably used by several different groups of people, at quite different times, hunting different species of animals, they seem to have been hunting in roughly the same manner. That is, they were camping on the bluff, using it as an observation prominence, making weapons or repairing them, retrieving their game back to the bluff and processing it. Yet they left no sign of any substantial dwelling or general "household" activities. If I am interpreting the spike camp aspect of the site correctly, it would seem to be a part of larger pattern of land use which persisted in the north for a long time.

This orb pattern would make a great deal of ecological sense. Thinly scattered resources could be tapped over a wide area. It also inherently creates a partitioning system of land use between groups; expansion could only be done in the direction of new occupation or in abandoned areas. Out-group relations could be relatively stable for exogamous marital exchanges (biologically necessary in groups of only modest to small size) and trade goods (non-local, exotic lithic material is present in virtually all northern early archeological sites including the Dry Creek site).

Because of the large area probably required to support the central base camp, the record of these central camps would be rare; at present there exists no good search model for their location. According to the model, the spike camp (processing station) sites should however be common. Intensive surveying done on good lookout prominences or game crossing areas generally does uncover these latter kinds of sites. They are, however, usually not deeply stratified due to the erosional character of the prominence or terrace lip and, for somewhat the same reason, have seldom preserved the non-lithic material. The deep deposits at Dry Creek, with their spatial separation of artifact clusters, clear separation of vertical components and preservation of large mammals combined with the lithic manufacturing sequences, provides some new information with which to view the paleoecology of other sites of similar age in Beringia which lack this information.

Traditionally, it has been assumed that these sites are products of mobile nuclear or extended families, because, in general, there are none of the signs of a large stable encampment. The orb model, however, provides an alternative explanation and, I think, a more effective way to live in the north as big game hunters.

Dry Creek Bioliths - Gastro and Phyto

It was not until early in the last excavation season (1977) that one of the field school excavators brought in a hand full of small pebbles which were recognized as bird gizzard stones. This was discussed with the rest of the crew and the following days they began to be found by many people. Undoubtedly they were present earlier, but had not been a part of the crew's artifact "search image." All this was despite careful skim trowling. Our experience suggests that they are present in many archeological sites, but are overlooked. Gastroliths have been identified from other archeological sites (Bottema, 1975), but she concluded that the variation was too great to be diagnostic. However, the roundness and polish indices can be used as a good seasonality indicator in the far north. In some cases even species or more general bird groups can be identified, when accompanied with some knowledge of the environmental conditions. Contrary to Bottema's experience in parts of Europe where large sand grains and gravel are common in archeological deposits, the loess silt and small sand-size ranges of interior Alaska make gastroliths extremely important as seasonal indicators of site use.

Many bird groups use a gizzard to masticate food before it passes into the stomach. The food can be ground against the horny walls of the gizzard, or seeds can be used as a grinding compound, but usually the birds pick fine hard stones as grit. In the far north these are seldom replaced during mid-winter, even when opportunities are provided - though birds will actively seek out windswept slopes in early spring to renew the grit. Extant ptarmigan killed near Healy in early February, with continuous access to new winter grit on the windblown gravels, all had rounded and polished gastroliths. During the fall, well before the first snow, there is a concentration of grouse along river bars and road shoulders gathering new angular grit (usually quartz) which lasts them through the winter. These angular stones first begin to round and as wear continues, sometime after the first of the year, they acquire a high-gloss polish. Spring and early summer birds have mixed gizzard contents of rounded, polished and angular, unpolished stones.

In a more thorough discussion of the analysis techniques and the theory of identification (Hoskins, Guthrie, and Hoffman, 1970), fossil gastrolith samples from the Fairbanks loess and a cluster taken from a peat sample were shown to be from winter-kill birds.

From what we can reconstruct of the upper Nenana valley 10-11,000 years BP, the valley was not good habitat for waterfowl (another important game bird with gastroliths); it was most likely good grouse habitat.

There are a number of northern grouse. Of these, the sage grouse (*Centrocercus urophasianus*) does not have gastroliths. The blue grouse (*Dendragapus obscurus*) and spruce grouse (*Canachites canadensis*) are normally found in coniferous woodlands. The ruffed grouse (*Bonasa umbellus*) is a deciduous woodland species. That leaves three species of ptarmigan (*Lagopus*) and the sharp-tailed grouse (*Pedioecetes phasianellus*). At this time we have not been able to locate sharp-tail specimens (during the study grouse were in the low period of their 10 year cycle in interior Alaska).

Rock (*Lagopus mutus*) and white-tail (*Lagopus leucurus*) ptarmigan are characteristically found in treeless tundra. Willow ptarmigan (*Lagopus lagopus*) are usually in the shrub zones; sharp-tailed grouse occur on the open grasslands, but more frequently in brushy stands in the grassland.

The mean size of the gizzard stones in the Dry Creek site is 2.14 mm for both the total mean and the mean of the different clusters. The distribution is unimodal (Figs. 6.7 and 6.8). There could have been some sampling biases in the recovery of the gastroliths. Only the clusters were recognized from skim troweling. Wet-screen washing of back-dirt in fine mesh screens showed many gastroliths and fine fragments of worked stone missed by trowlers. Biases would likely be on the small end of the distributional tail, which would tend to lower the observed mean. When or if other portions of the site are excavated or sites nearby are worked, wet-screen techniques should be used in gastrolith sampling.

We can assume, for the time being, that the mean gastrolith size is 2.14 mm, or smaller, for the Dry Creek clusters. This is not a diagnostic figure, but it suggests birds in the ptarmigan range. Preliminary small samples from late winter birds showed very little size differences among Alaskan Range ptarmigan species (Hoskins _et al_, 1970). Weeden (pers. comm.), however, gathered much larger samples and showed willow ptarmigan to have significantly larger grit (60% of their grit were 3 mm and larger as opposed to around 10% for rock and white-tail ptarmigan). There were no observed differences in the grit size distribution between rock and white-tail ptarmigan, except that white-tail gizzards contained slightly more grit.

Judging from the reconstructed physical and vegetative environment, either rock or white-tail would be expected to be the most abundant grouse.

Figure 6.7. Distribution of mean of means of the various clusters of gastroliths found at the Dry Creek site.

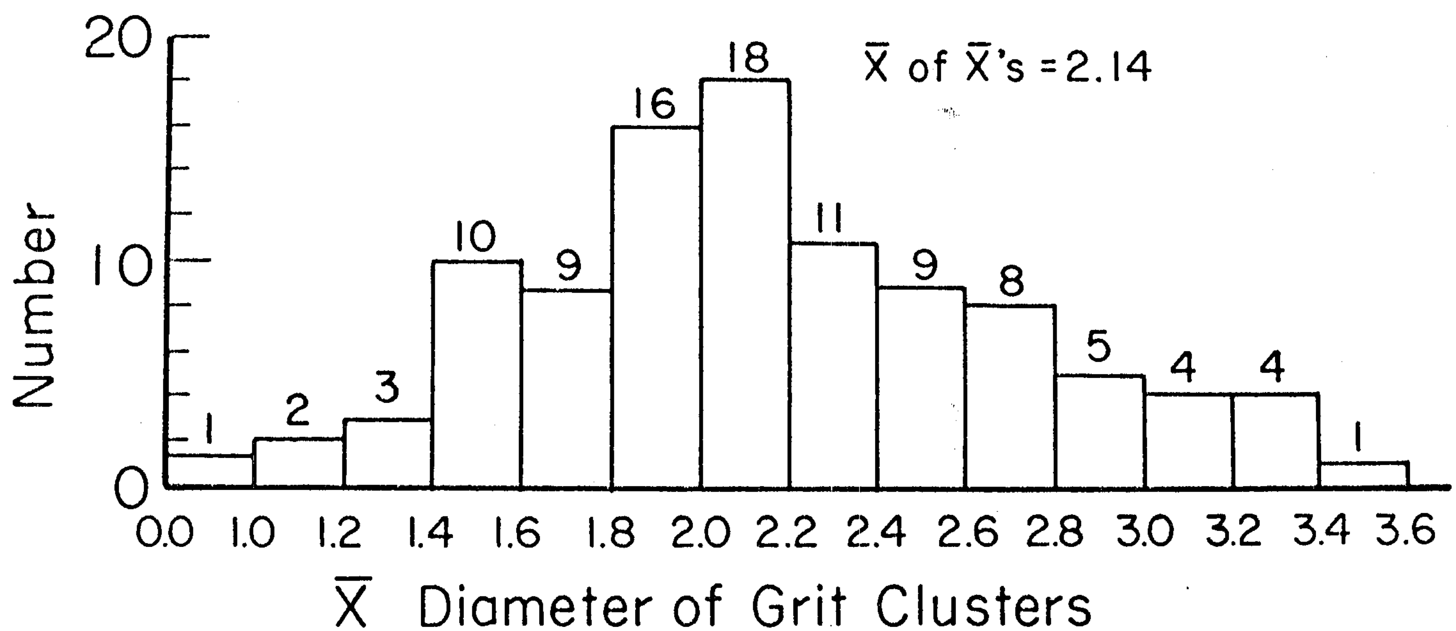
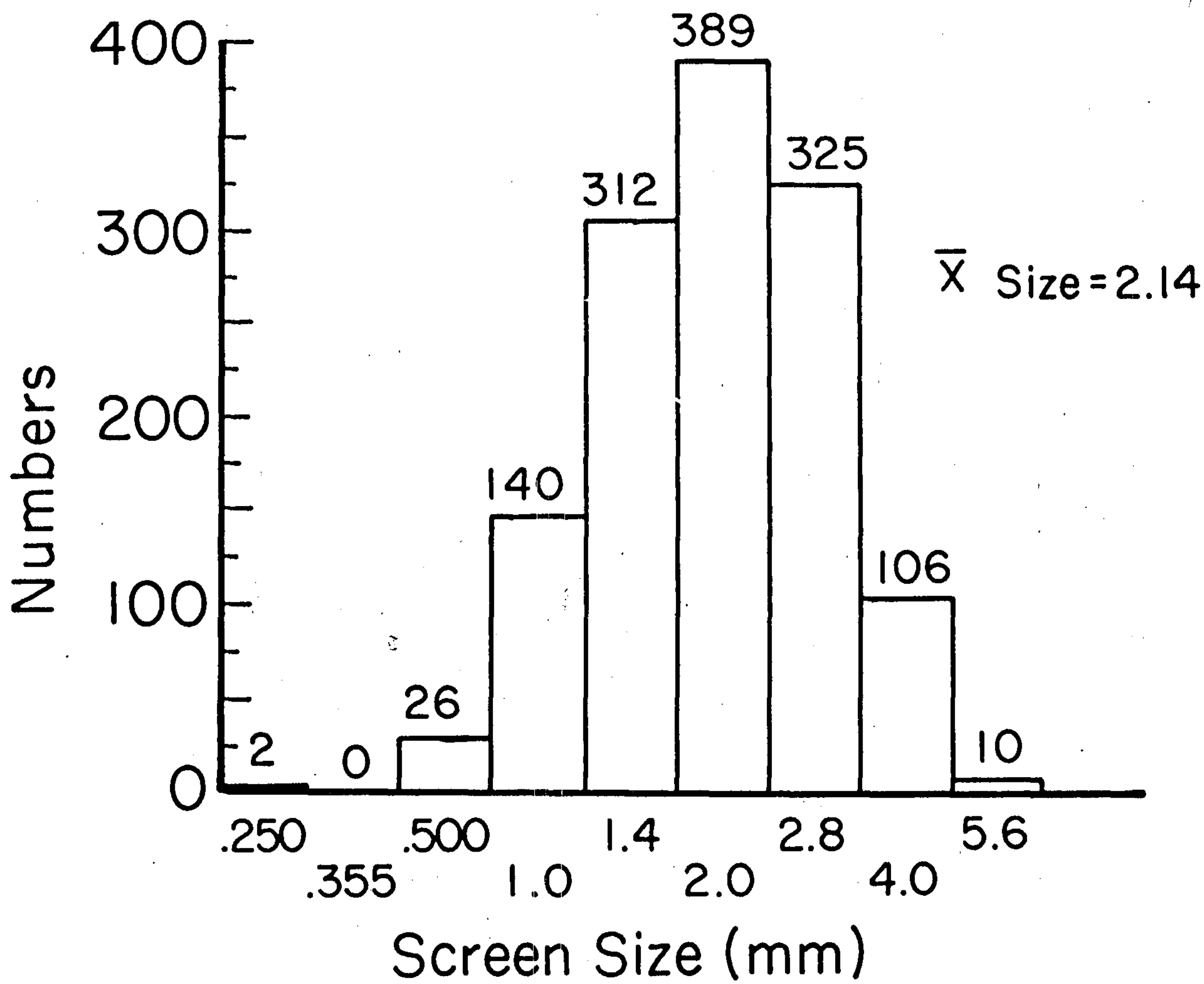

20
10
0
Number
1
2
3
10
9
16
18
11
9
8
5
4
4
1
X̄ of X̄'s = 2.14
0.0 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6
X̄ Diameter of Grit Clusters

Figure 6.8. Comparisons of the gastroliths collected at the Dry Creek site by diameter, using sorting screens.

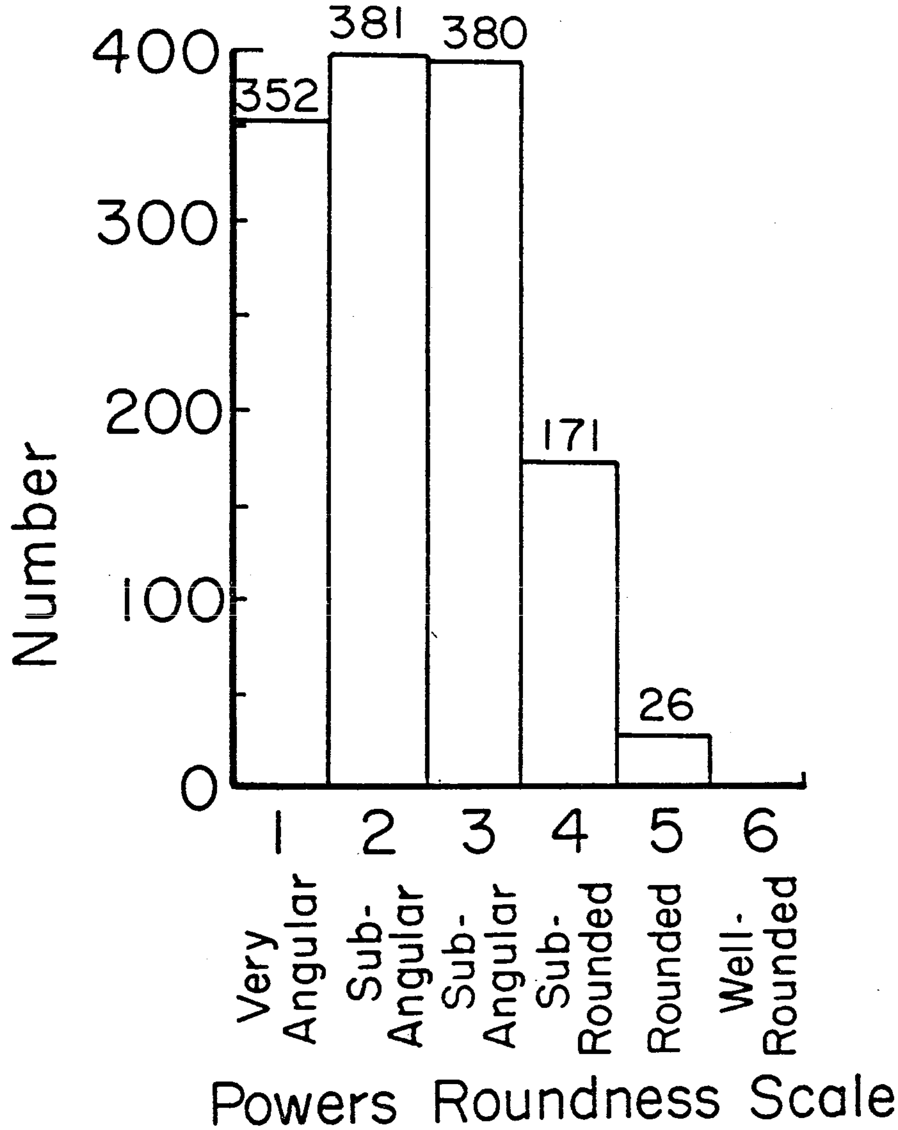


400
300
200
100
0
Numbers
2
0
26
140
312
389
325
106
10
$\overline{X}$ Size=2.14
.250
.355
.500
1.0
1.4
2.0
2.8
4.0
5.6
Screen Size (mm)

The Powers roundedness scale (Powers, 1953) reveals a skewed distribution toward angularity (Fig. 6.9). Most of the stones show only slight signs of rounding and there is no polish characteristic of grit from early spring birds. These, then, could represent birds from summer, fall, or early winter. During much of mid-summer ptarmigan are dispersed and very secretive while the brood is being hatched and it is virtually impossible to locate them, let alone catch them. Once the birds are fledged and are of moderate size (usually late July to early August) the family broods coalesce into large flocks. Probably because these flocks are composed chiefly of young birds, they are not very wary of humans, and they are most vulnerable to hunting during this time period. It is even common to kill them with thrown stones. They turn white in the fall, but sometimes the synchronization of plumage change is poor and the white birds stand out against the drab brown autumn vegetation. Alternately, the early snows may reveal brown birds exposed on the open hillsides. So, despite the fact that grouse, or ptarmigan gastrolith angularity at an archeological site could mean summer, fall, or early winter hunting, it is more likely an indication of fall or early winter use (September). Snares can be set in among the low shrubs with great success when ptarmigan are abundant. This is the traditional Interior Eskimo method. Ptarmigan move to and from summer and winter ranges in great numbers (Weeden, 1964), and major valley systems in the Alaska Range are often concentration areas during migrations.

Unfortunately for archeological interests, most silt sediments in the interior of Alaska contain gastroliths, for every time a bird dies these highly preservable parts remain. Thus in the noncultural sediments at Dry Creek there are also gastroliths. Gastroliths in these

Figure 6.9. Distribution of roundedness of the gastroliths found at the Dry Creek site. Most cluster at the angular end of the spectrum suggesting that the birds which were killed, or were brought to the bluff, died in the late summer or autumn.



Number
400
300
200
100
0
352
381
380
171
26
1
2
3
4
5
6
Very Angular
Sub-Angular
Sub-Angular
Sub-Rounded
Rounded
Well-Rounded
Powers Roundness Scale

sediments show the same wear stages as those from the archeological Components I and II. Careful plotting of the gastrolith distribution at the site showed a concentration within the general stratigraphic units which contained the living areas and hearths, but they were not concentrated specifically with the living areas nor the hearths. Thus the question of grouse-ptarmigan use at the site will have to await further detailed studies. During the time of year ptarmigan are most vulnerable to being caught by humans, they are most vulnerable to other predators. Raptors, foxes, etc. might well have brought them to this same high rise to eat them as did humans. So, like a cave deposit where faunal elements in an archeological assemblage must be distinguished from the natural paleontological background, gastroliths can only be judged an artifact by careful study of their distributions, concentrations and associations. Fine wet-screening of these early northern sites in the future will be of utmost importance.

The role of ptarmigan in the diet, if any, was probably one of adding variety and garnish rather than as a caloric staple. Ptarmigan do not accumulate fat like waterfowl, but are lean throughout the year. There is an average of approximately .25 kg of meat per bird (including liver, heart, etc.). Assuming a 3 kg lean-meat requirement per person per day, approximately 12 ptarmigan are required per day per person, or 1200 per 100 people or 400 for 24. Ptarmigan do not occur in those numbers in any one area to sustain harvests at that level for more than a few days. This also assumes a superbly efficient hunting technique. Even today with a modern shotgun it is difficult to live on ptarmigan particularly when the birds are in the low of their 10 year cycle.

The sediments of the site are rich in opaline phytoliths. These silicous crystals are secreted by the plant and tend to have a characteristic shape for each plant group. They preserve well and will probably be an important tool for Quaternary research, once identification guides become better developed and some of the dynamics of their preservation and deposition are better understood.

Presumably phytoliths are part of the plants' antiherbivory defenses, and are best developed in the grass leaves, which tend not to have elaborate chemical antiherbivory substances nor much fibrous lignin. It is the phytoliths which seem to be responsible for the increased tooth wear of mammalian grazers, ultimately resulting in the characteristic high-crowned complex molars of these species.

Originally a student had wished to study the Dry Creek site's phytoliths as a thesis topic, but decided on another thesis instead. As there were no other people in Alaska working on phytoliths we decided to run only preliminary analyses and save the in-depth analyses for the future. In order to do justice to a phytolith analysis, a thorough key to their shape and distribution in northern plants would have to be constructed.

Both James McAlpin, the geologist on the site in 1976, and Mary Calmes, a botanist technician, extracted phytoliths from the sediments. Ms. Calmes took her samples from the darkened areas interpreted as hearths. Both people found abundant phytoliths. Many could be identified as festucoid grasses.

Either the Dry Creek peoples were burning the dung of large mammal grazers where the phytoliths are concentrated or the grasses grew in abundance on the hearth areas after the people had abandoned the site, or both. One of the phytolith shapes which occurred in at least two hearths was a microscopic sized "Clovis point." It was dart shaped with a thinned, concave base. This shape was not found in any of the published guides to phytolith identification.

General Paleoecological Conclusions

There are several obvious conclusions that one can draw from the large mammals present at the Dry Creek site. I will first outline, then discuss each of these.

1. During the general time range of 10,500-11,500 BP large mammal grazers still dominated the megafaunal community.

2. Though our Dry Creek faunal sample is from two points in time, it is consistent with other data, which indicate that blanket megafaunal extinctions had probably occurred, but that regional extinctions had not.

3. At the time that the lower levels of Dry Creek were occupied the local megafauna still exhibited a Pleistocene body size.

4. From what we can surmise about the present ecology of the area combined with the information from the site, Dry Creek appears to be an autumn-winter hunting camp.

5. Though it was not itself a kill-site, the overlook at Dry Creek affords an excellent opportunity to spot all three large mammal grazers (sheep, bison, and wapiti).

6. The scattered bone fragments and teeth within the site that is located in an area of opportune hunting, the exposed location of the site, the general lack of indications of permanent firepits, dwelling

dugouts, and tent perimeter stones all suggest that Dry Creek was not a central base camp but a hunting spike camp and processing station.

7. The diversity of large mammal species suggests an opportunistic hunting strategy which selected for a wide range of age and, perhaps, sex classes of megafauna.

8. The Dry Creek site once lay within the Great Bison Belt.

1. During the general time range of 10,500-11,500 B.P. large mammal grazers still dominated the megafaunal community. At the beginning of the Holocene there was a major shift from a grazer dominance: mammoth (*Mammuthus*), bison (*Bison*), and horse (*Equus*), etc., to a dominance of cervids: moose (*Alces*), and caribou (*Rangifer*). (Hunters in Alaska now take moose and caribou from the area of the site.) The exact chronology of this shift to cervids is still unclear and undoubtably had some real variations. The point at issue, is whether the Dry Creek area and the Nenana Valley was a relict of the northern mammoth steppe or represented a general pattern through Beringia. Unfortunately, at the time of this writing, there are not other early dated, stratified, multi-component sites containing megafauna in Beringia with which to make comparisons. The valley-pass outwash nature of the Nenana River Valley would prolong the steppic character of the vegetation. If the Nenana Valley did retain a relict habitat for large grazers during the postglacial it was probably limited or intermittent.

2. Though our Dry Creek sample is from two points in time, it is consistent with other data, which indicate that blanket megafaunal extinctions had probably already occurred but that the regional extinctions had not. The reduction of species of megafaunal grazers in

the north seems to have been a general phenomenon. The extinction of a number of species was accompanied by the retraction of the distributional range of several others southward. The Dry Creek site is very important from this angle as it seems to be situated chronologically in the middle of these two events - adding important information about their timing and sequence of these events.

3. At the time the lower levels of Dry Creek were occupied, the local megafauna still exhibited a Pleistocene body size. That is, they had not yet begun to undergo the almost universal postglacial megafaunal "dwarfing."

4. From what we can surmise about the current ecology of the area combined with information from the site, Dry Creek appears to be an autumn-winter hunting camp. The venturi funneling of the winds through the Nenana gorge of the Outer Range creates snow-free autumn and winter pastures. The dehydration effect, wind disturbance of the soil, abrasion of woody plants by wind-blown ice and snow crystals, all create a more grassy landscape than in any area in the entire region. The combination of the presence of grass and its availability due to lack of snow cover creates a situation more conducive to winter grazing by large mammals than in any nearby area. Sheep populations now only use this area during fall and winter. It is not a particularly good spring range and because of its altitude and position in the shaded side of the Alaska Range, green-up is 2-3 weeks later than in many other parts of interior Alaska.

5. Though it was not itself a kill-site, the overlook at Dry Creek afforded an excellent opportunity to spot all three large mammal grazers (sheep, bison, and wapiti). From the high point at the site one

can see the mountains, foothills, broad terraces, and valley floor, covering a diversity of large mammal habitat. There is every reason to believe it was not a kill-site. For one thing, sheep-escape terrain is too far away. There are no natural entrapment areas, steep overhanging cliff faces, etc. which would indicate that the site was a drive kill-site camp. It is obviously a lookout area to which game was brought from somewhere within the purview of the site.

6. The scattered bone fragments and teeth within the site that is located in an area of opportune hunting, the extremely exposed location of the site, and the general lack of permanent fire pits, dwelling dugouts, and tent perimeter stones, all suggest that this was not a central base camp but a hunting spike camp and processing station. From this camp, meat could be roughly processed for easier transport to a more distant base camp and at the same time one could continue to search for more game. The presence of faunal remains at the Dry Creek site and its general character creates an entirely different view of early hunting strategies.

7. The diversity of large mammal species at the site suggests an opportunistic hunting strategy which selected for a wide range of age and, perhaps, sex classes of megafauna. This opportunistic technique seems to be more Pleistocene-like than the Paleoindian sites later than 11,000 BP on the Great Plains, which generally have remains of females and young of mainly one species of large mammal, predominating.

8. The Dry Creek site in Interior Alaska lay, ecologically, within the "Great Bison Belt." If one plots the distribution of fossil bison sites, or the areas of highest bison density in historic times, they

fall along a belt from Mexico through Northern Canada in the rain-shadow of the Rocky Mountains. It is also along this same belt that Paleo-indian kill-sites are the most common. For a short time period around 11,000 to 12,000 BP, the bison-dominated large mammal community in Beringia connected with the bison-dominated communities of the Great Plains forming a long, roughly continuous belt of bison habitat which ran the length of North America (Guthrie, 1980). The fauna at Dry Creek is essentially a Great Plains fauna of sheep, wapiti, and bison. In other areas in the Alaskan interior there were ground squirrels, groose, badgers, ferrets, and horses. The Great Bison Belt at or shortly after 13,000 BP thus tied the waning arctic mammoth steppe to the waxing grasslands of the Great Plains. The Dry Creek peoples appear to be connected, at least ecologically, to the early plains hunters to the south. The colonization of North America by the Beringian people was facilitated by the continuity of the "plains" habitat, to which they had already adapted in the North. They followed it from Alaska - along the grasslands which lay between the two receeding continental ice sheets - on through to the expanding grasslands of the High Plains and further south.

CHAPTER SEVEN

DRY CREEK AND ITS PLACE IN THE EARLY ARCHEOLOGY OF THE NORTH

by

W. Roger Powers and R. Dale Guthrie

DRY CREEK AND ITS PLACE IN EARLY ARCHEOLOGY OF THE NORTH

Specific Conclusions

Like finding another Clovis site in the Great Plains, Dry Creek is another Denali Complex site in interior Alaska. It produced no significantly new lithic 'types', nor did the site produce any radical chronological revision of these lithic types. Rather, the main importance of the Dry Creek site is within these already established time boundaries and typologies. It begins to address the next level of issues and raises an entirely new set of questions about early Beringians and their activities.

New information and insights gained from the excavation and analysis of the site are considerable; a few key items can be summarized as follows:

1. The site clearly documents, for the first time, discrete typological and temporal variations within an Alaskan site of this time range. The earliest component I (c.11,100 B.P.) does not exhibit blade and core technologies, rather the projectile point being used was a basilly-thinned, triangular, stone point. The later Component II (c. 10,600 B.P.) has two types of lithic clusters. One kind contains microblades and microcores. The other has no microblade technology. These latter, instead, have lanceolate stone points with expanding bases.
2. The complete sequence of microblade production from refined preform to microcore, through microblade extraction, on to the final completed use of the core is all documented within lithic clusters. This sequence helps us gain some insights

and raises new questions as to how the site was used and how weapons were manufactured.

3. The hearths, distribution of lithic clusters, the remains of large mammals, and the location of the site when compared with other Alaskan sites of similar age, allow us to propose a new model of large mammal resource exploitation.
4. The presence of identifiable remains of large mammals conclusively associated with well-dated artifacts in the 11,000 year B.P. range in Alaska thus far is unique. It allows us to see what large mamals were being hunted and eaten, that is, it allows us access to broader paleoecological interpretations.
5. The comparatively good data (we always hope for better) from the Dry Creek site allowed us to see the site in context of the overall use of the Nenana Valley by early peoples, answering questions as to why the site was located along the terrace edge in that particular location. From this vista one can see the area of the pass kept free from deep snow by the ubiquitous winter winds. Because of the wind, large mammal herbivores would have had winter access to grazing land, a rare occurrence in interior Alaska.
6. Combining the archeological and paleoecological information from Northern Eurasia, Beringia, and the Great Plains one can envision the Dry Creek peoples as a connecting link between the hunting traditions of two continents. Thus the Pleistocene grassland belt of Eurasia was buckled to the great bison belt of North America.

Implications for Further Research

These new data and reconstructions raise a new set of questions. The foremost of these questions is probably the issue of how to interpret the typological differences between Components I and II, particularly with regard to the major differences in projectile point design. Thus, most of this current section will stress the implications of that issue.

The concurrent use of two weapon systems - composite microblade inset and bifacial lithic projectile points - between 10,000 and 11,000 BP in Siberia and parts of Beringia contrasts with the emphasis on the bifacial fluted point and related forms which are the hallmark of early Paleoindian assemblages. Apart from these, the remainder of the assemblages show a considerable amount of technological and formal similarity over tremendous distances. Dry Creek possesses both of these weapon systems, with bifacial stone projectile points occurring alone in Component I, and then with the microblade inset technique in Component II; however, in the latter instance, the two systems occur in spatially distinct clusters. Hence, Dry Creek displays both temporal variability and a degree of continuity with the classic Siberian-Beringian microblade technologies to the west. Formal similarities with American bifacial point technologies can be demonstrated, although geographic continuity is more difficult. The site then appears to be intermediate. This is in part due to its geographical location and position within an ecological continuum running from the north Eurasian and Beringian mammoth steppe to the evolving plains of interior America during the late Pleistocene and early Holocene. However, there are cultural-historical factors which have surely affected the development of the early Dry Creek technologies.

Before attempting broader comparisons and discussing the implications for the earliest components of the Dry Creek site, we should briefly summarize the economic and technological activities presented in the foregoing analyses and point out the problems this information creates in seeking these comparisons.

Component I

The earliest presence of human culture at Dry Creek is represented by a relatively small assemblage of lithic remains comprised of bifacial knives and projectile points, side scrapers, transverse scrapers, end scrapers, burins, flake tools, and cobble cores and tools. The spatial analyses indicate that the primary activity carried out at the bluff at that time was meat processing and a minor amount of weapons maintenance. This contrasts somewhat with the richer and more complex remains of Component II.

At the time of the formation of Component II, a greater range of activity may have been conducted at the site. This resulted in the spatially separate patterns of activity which fall into two main categories: microblade and non-microblade clusters. The microblade clusters contain large numbers of microblades, microcores and attendant production and maintenance parts, plus distinctive bifacial knives, core scrapers, core-burins, blade-like flake and flake tools, burins, and burin spalls. In contrast to this set of associated implements, we find in the non-microblade clusters, possible burin use, crude bifacial implements, shaped scrapers and projectile point bases. As sets of implements, the two types of clusters are quite distinctive.

With respect to economic activity, we know that both *Cervus* and *Ovis* were hunted by the people who left Component I and that *Bison* and *Ovis* were procured during Component II times, though we doubt if these differences have any major significance due to the limited number of animals in our sample. Although occurring in spatially-distinct clusters, both microblades and bifacial points are associated with *Bison* remains, hence we assume that both were involved in some way with the procurement or processing of this species. We must bear in mind, however, that the nature of this association is tenuous, since we cannot be certain as to why any particular faunal remain is where it is in the site. The nature of the data simply does not allow that level of refinement. The facts we can work with are that 1) *Bison* remains occur within spatially separate clusters, and 2) these clusters are composed of different sets of lithic remains, characterized by two methods of producing weapons systems.

The Component II *Ovis* remains are not associated with any particular cluster. Little should be made of an apparent temporal difference in the fauna between the two components or the two types of clusters in Component II. Poor preservation has surely affected the faunal representation within both components.

It can be suggested, however, that the earliest occupants at Dry Creek were engaged in the same economic activity - hunting large herbivores - and that this activity cross cuts both components and the two types of clusters within Component II.

With respect to these types of activity, it appears that the earliest levels of Dry Creek represent very similar site usage and extrasite activity, at least based on the data now available, and that these activities represent only a part of the total subsistence cycle of the populations which were utilizing the Nenana Valley 10,000-12,000 years ago. This fact will clearly affect the validity of any comparisons with other sites of comparable antiquity, especially since the information presently available from such sites cannot be evaluated in terms of seasonality of activity areas. It is simply impossible to develop a common comparative standard in the absence of this information.

There are several possible interpretations of the technological variability displayed at Dry Creek. It could be argued that the remains from Component I can be accounted for by resorting to inherent difficulties in the sample size and that the variations of clusters in Component II represent differences in seasonal or other ecologically related activity. This position has been implied by previous summary treatments of the material (Thorson and Hamilton 1977; Powers and Hamilton 1978) where both early components were simply lumped into one classification and its relationships traced to other early Alaskan sites as well as to the Late Palaeolithic Period of Siberia, specifically the Diuktai Culture.

While being fully mindful of the possibility that such problems as sampling error and lack of better faunal preservation may well be affecting our interpretations, it is also necessary, in view of more detailed analyses of the material, to treat Components I and II separately and to recognize that the internal differences within Component II require special treatment.

It should be noted that spatial clustering can result in the isolation of artifact sets which may represent a special activity within a technological continuum, or may be totally unrelated to other clusters lying nearby. Therefore, the definition of complexes or other classification in northern sites should be done cautiously, especially where less than ideal stratigraphic or spatial contexts are present.

Although we cannot offer any final solution that accounts for the differences displayed in the early components, we can suggest two alternate interpretations.

Within the Nenana Valley, Components I and II at Dry Creek are presently the best understood early occupations and still form the basis of the temporal and cultural framework for understanding the prehistory of the region. Component I can be interpreted to represent a pre-microblade horizon in the Nenana Valley. Additional support for this position has been derived from test excavations at the newly discovered Moose Creek site on the east side of the Nenana Valley (Hoffecker, 1978; 1982). Here, preliminary data suggest that a technology characterized by bifacial tool production (projectile points and knives) and an associated flake industry from in the 8000-12,000 B.P. range. The dated paleosols lie at the top of the artifact bearing horizon. At the present time it appears that this material is similar to the lowest cultural horizon at Dry Creek. Unfortunately, no faunal remains have been encountered to date. A similar typological and stratigraphic situation possibly exists at the Usibelli site on Healy

Creek but no radiocarbon dates or fauna are yet available (Hoffecker, 1980).

Within the context of central Alaska Prehistory, the phase of culture history manifested by Dry Creek Component I, and Moose Creek, and possibly Usibelli, may be present at the lowest levels of Healy Lake in the upper Tanana Valley. Here, the Chindadn Complex at the Village Site dates between 11,000 and 10,000 B.P. (Cook and McKennan 1970; Hamilton 1973). There are some superficial similarities between the projectile points at Dry Creek and Chindadn points but the techniques of manufacturing are distinctive for the two areas. It is possible that a microblade technology occurs in the Chindadn Complex, which sets it apart from Dry Creek Component I in the Nenana Valley (although not from Component II if these clusters are considered as part of the same cultural entity). In addition, as mentioned earlier in this work, the Healy Lake material occurs in a compressed loess section where ample opportunity for mixing exists. West (1981) has thoroughly reviewed numerous sites in Alaska which are similar typologically to the Dry Creek Site, and some of these contain traingular stone points similar to those in Component I at Dry Creek (West, personal communication).

In addition to the central Alaskan sites which may bear some relationship to Dry Creek, mention should be made of the fractured bison calcanei and horse scapula at the Trail Creek Caves on the Seward Peninsula which have been dated to between 13,000 and 15,000 B.P. (Larsen, 1968). The oldest tool found here is a generalized bifacial point from the lowest level of Cave 2 and which could be as old as the fractured bones. These finds would precede the earliest occupations of the Nenana Valley. It is possible that a technology somewhat similar to the bottom of Dry Creek may have been present in western Alaska which would have been roughly synchronous with or slightly older than the Nenana sites.

In addition to the above sites, human activity has been revealed at the Blue Fish caves in the northern Yukon. The occupation here is proposed to have spanned about 6,000 years from 10,000 to 16,000 B.P. While the earlier part of the record is more cryptic and has produced only altered bone and micro-chips (the artifactual nature of these is still open to discussion), a later occupation contains lithic artifacts (burin spall, flakes, and, possibly, a microblade) which is probably consistent with microblade technology elsewhere in the Far Northwest (Cinq-Mars, 1979).

Seeking broader cultural/historical relationship with the Siberian Late Paleolithic yields little that can shed light on the origins of the oldest Nenana Valley occupation (Component I). Whereas bifacial point (not necessarily projectile point) technology is well documented in the Siberian Diuktai Culture (Mochanov, 1977) and in scattered occurrences across south Siberia during very late Pleistocene/Early Holocene times (Medvedev, 1968; Powers, 1973), for the most part they are awash in a sea of microblade technology. While the vast majority of these sites display considerable similarity with the microblade cluster assemblages in Component II at Dry Creek, they bear little resemblance to Component I. There are, however, a few exceptions, the most notable of which is Kukhtui III located about 1.5 km from the coast of the Sea of Okhotsk. Here, underlying a Neolithic level dated to 4700 ± 100 (LE-995) is a collection of lithic artifacts which, while classified as Diuktai, contains no microblade technology (Mochanov, 1977). The artifacts here include discoidal cores, flake knives, broken spear points made on large blades, bifacial oval knives, a fragment of a bifacial knife or spear point, a blank for a bifacial knife or spear point, a blank for a bifacial knife, a bifacial spear point, and a wedge. The one complete specimen referred to as a bifacial spear point is very similar to the triangular points from Component I at Dry Creek. The remaining portions of both assemblages are similar in composition and typology. This site is the only northeast-Siberian example that we presently know of that may represent an industry emphasizing a refined bifacial technology and lacking a microblade (wedge-shaped core) technology and which could possibly relate to the origins of non-microblade late Pleistocene industries in northern North America. Unfortunately, no date is available for the Kukhtui material nor are there any faunal remains.

As there is little data with which to compare Component I at Dry Creek in Alaska or Siberia, it remains to point out another possible area of relationship - the American Plains. This idea was broached only briefly in Chapter 4 where it was suggested that the tool kit in Component I is broadly comparable to Palaeoindian tool kits from the plains of interior North America. Specific resemblances cannot be drawn with any of the established projectile point types of this region and any other similarities between flake tool or end-scraper types may be viewed as fortuitous. The points of similarity lie in the emphasis on a lithic technology comprised mainly of stone projectile points and knives with a variety of flake tools and a generalized core/flake or large blade technique. This set of tools contrasts strongly with those possessing a wedge-shaped core/microblade technology with attendant distinctive burin forms. The Component I tool kit is broadly concurrent with the Clovis Culture to the south but is probably not old enough to provide a technological base from which to derive this technology. However, it may represent the terminal phase of a tradition with greater time depth and geographical extent which did give rise to Clovis Culture although just when, where, and in exactly what sequence is presently unknown.

Fluted points are present in Alaska (Clark, 1978; Dumond, 1977). The verifiable specimens are all located north of the Alaska Range and of these the majority are north of the Yukon River (Clark, 1978). Dixon (1976) has argued that these points are younger in Alaska than in the south and that the point of origin for fluted points must lie outside of Alaska, presumably in Canada or the continental United States. However, Clark (1978) is of the opinion that some of these fluted point occurrences in Alaska could be as old as 9,000-11,000 B.P. Morlan (1977) argues that the Alaskan data are too scarce to justify assigning a later age for fluted points than those found further to the south. Morlan (1977) further hypothesizes that fluted points will be found to be older in Beringia and that they spread south as part of a cultural response to the collapse of the northern steppe biome at the end of the Pleistocene. While this is speculative, it does provide a model to direct further research on the problem and one which is, more or less, in agreement with the interpretation of the data presented herein.

Although the data are at best sketchy, it may be that there were at least two concurrent early geographical variants of point styles at about 11,000 B.P. in Alaska. One was centered more to the northern interior of Alaska and beyond, with Clovis points proper, and a second was distributed across the southern interior and characterized by the more generalized, triangular point styles of Dry Creek. Also, both of these point variants could share a common ancestry in Alaska. Haynes (1978) in briefly reviewing the evidence from the lower components at Dry Creek, suggests that two concurrent traditions may have existed in Beringia and that the one lacking microblades may have given rise to Clovis.

Based on the Dry Creek evidence and those scattered data pertaining to fluted points (Clovis) in Alaska, it is possible that Clovis did develop in the north, possibly even in Alaska, from a technological base similar to that found in Component I. It is further possible that these events predate the appearance of microblade technology in Alaska.

Further work at the new Moose Creek site near Dry Creek may help clarify the situation. The site may prove to truly predate both microblade technology in the north and Clovis in the south. In the latter case, the temporal extension is near enough to provide a clear source for Clovis, but again it may be a later part of the tradition which might have been the developmental base for fluted point technology.

Clearly, by the time of Component I at Dry Creek, Clovis was well established on the American Plains, but both of these cultural developments represent steppe adaptations geared at hunting large Pleistocene-grazing mammals. At this time, the two points on a geographic spectrum - Alaska and the Great Plains - could be seen as representing two parts of a north-south technological gradient adapted to a vast sheet of grasslands which stretched from the Alaskan interior to northern Mexico and perhaps beyond; a zone which included the older, northern mammoth steppe, through intermediate transition zones in the newly deglaciated Canadian regions and the evolving steppes of interior North America - The Great Bison Belt (Guthrie - Chapter 6). The impetus for this movement - a drift to the south of formative or developed Clovis - could be seen in the terminal Pleistocene deterioration of the mammoth steppe biome (Morlan, 1977; Guthrie - Chapter 6) and the development of a new, rich grassland ecosystem along the eastern margin of the Rocky Mountains.

Component II

Component II at Dry Creek comprises the next major occupation in the Nenana Valley.

For the most part, Component II constitutes a Denali Complex assemblage (West, 1967) which is widespread in the neighboring parts of the Alaska Range. While the age of this complex has been controversial, West (1981) has presented evidence, including the 10,690 ± date for Component II at Dry Creek, that the Beringian Tradition in Alaska (which includes the Denali complex), is at least 8,500-11,000 years old. In view of the information now available, West's estimation should be considered essentially correct.

At the present time, there are no other sites in this region which contain the same degree of internal complexity as Dry Creek. It should be noted that Component I at the Carlo Creek site may date roughly to the time of Component II at Dry Creek although available radiocarbon determinations obscure the situation (Bowers, 1978). That site does contain evidence of both small (*Citellus* sp.) and large (*Rangifer* sp., *Ovis dalli*) game procurement. In addition the lithic remains are thought to represent butchering activity. Technologically, it is difficult to determine any relationship with Dry Creek although one may very well be possible. Carlo Creek is especially important as it lies well back in the Alaska Range along the Nenana River and thus affords a view of both local montane and riverine activity. Two dates, 8,400 ± 200 (WSU-1700) and 8,690 ± 330 (GX-5132) probably best represent the temporal interval of this site. Another date of 10,040 ± 435 (GX-5131) has a large counting error and may be anamolous although it does bring this occupation closer in line with Component II at Dry Creek.

Small test pits at Little Panguingue Creek just north of Dry Creek in 1976, 1977, and 1979 revealed dense and highly localized accumulations of microblade technology in the sod layer which lay at the top of a 2.0 m loess section of the Healy Terrace. To date no radiocarbon dates are available; however, the assemblage is very close to Component II (microblade clusters) at Dry Creek. Microblade technology, again very similar to Dry Creek, was discovered in test pits at Panguingue Creek in 1976, although no chronometric age determinations are possible. Apart from the sites mentioned above, no other remains have been dated to this time period although the Teklanika River sites (West, 1967) are typologically consistent with Component II at Dry Creek.

The cultural materials from the different clusters at Dry Creek, on typological grounds, correspond perfectly with the established categories of artifacts in the Denali Complex (West, 1967).

However,the spatial separation of projectile points from artifact clusters typical of the Denali Complex creates a special problem of interpretation.

Bifacial projectile points have not been considered a diagnostic feature of the Denali Complex or related assemblages in Alaska. Those industries most closely related to the Denali Complex are the Akmak Complex (Anderson, 1970a) in northwestern Alaska (9,857 ± 155) and the Ugashik Narrows Phase on the Alaska Peninsula (ca. 9,000 B.P.) (Henn, 1975; Dumond, 1977). Like Component II at Dry Creek, these industries combine wedgeshaped core/microblade and bifacial (knife) technology. Likewise, other early Alaskan lithic assemblages such as the Gallagher Flint Station (Dixon, 1975) dated to 10,540 ± 150 and Anangula in the Aleutians (Aigner, 1970) dated to about 8,400 B.P., are both characterized as core/blade technologies.

Those industries characterized by the co-dominance of both wedge-shaped core and bifacial technology (Denali, Akmak, Ugashik) are considered to be derivatives of the Siberian Late Palaeolithic (Abramova, 1973; West, 1967; 1981). Some authors have pointed specifically to the Diuktai Culture which was widespread in northeastern Siberia at the end of the Pleistocene (Mochanov, 1973; Dumond, 1977; Powers, 1978; Powers and Hamilton, 1978; Haynes, 1978; West, 1981). There is a great degree of similarity between Component II at Dry Creek and the Diuktai Culture (20,000-10,000 B.P.). The cultural remains from Diuktai Cave (in the core area of this culture) on the Aldan River of central Yakutia (Mochanov, 1978) with dates ranging from 12,100 ± 120 (LE-907) to more than 13,110 ± 110 (LE-908) displays considerable continuity with levels V-VI at Ushki Lake on the Kamchatka Peninsula with a date of 10,360 ± 350 (MO-345) (Dikov, 1978). Mochanov (1978) states that bifacial knives and spear points were present in Diuktai assemblages. It must be reemphasized however, that these points coexist with a microblade technology. The complete Diuktai points are few in number and all characterized as triangular or bipointed. One specimen resembles a lanceolate point with a straight, slightly constricted base (Mochanov, 1977; Fig. 2:1) but it is very small and is more similar to later Neolithic (Siberian) point forms than to lanceolate points in North America. These generalized Diuktai bifacial forms could be seen as prototypical for the bifacial projectile points at Dry Creek. The notion that there may have been a continuity in bifacial projectile points from Siberia to Alaska seems reasonable.

Thus, both the Diuktai and Dry Creek hunters employed the microblade inset technique and bifacial projectile points for game procurement.

It was mentioned in Chapter Three that relationships for the Dry Creek projectile points could be sought in North America. The attributes of these basal fragments compare best with point types such as Casper Site Hell Gap points, or Haskett points from eastern Idaho (Frison, 1974; Butler, 1978). This again raises the issue of direct relationships with the interior Plains of North America. The age of the Hell Gap points at the Casper site is roughly concurrent with the age of Component II at Dry Creek so that similar point styles were being employed in both areas at about the same time associated with similar fauna, and maybe used in a similar way. Does this represent a convergence of technology from a common technological base or cultural-historic connections resulting from the spread of new projectile point techniques through a still common environment?

Thus, we are left with two alternative approaches to explain the spatial and temporal differences within the Dry Creek site. The first approach would portray the lithic variants as simply representations of different activities of basically the same stock of people. According to this view people would likely use several different kinds of projectile points for several different purposes. The second approach is to be typologically conservative and portray the earlier occupants at Dry Creek as employing exclusively triangular stone points (or at least de-emphasizing inset points). From this view, the occurrence of microblades postdated (or, at least, experienced a major shift in increased emphasis) the arrival of the earlier stone projectile point. These are numerous permutations of possible scenarios between these extremes.

This question was never presented so clearly before the excavation of the Dry Creek site. At present, the answer does not appear to inherently lie within the data from Dry Creek, or other known sites, but can only come from future sites. Until we have better sites, carefully dug, a clear unambigous answer cannot be given. We can state, however, that the technological separations at Dry Creek do show that these early people did not always rely on microblade inset points and a core-blade technology. The sole characterization of their sites on that basis would be misleading.

At this time our energies should be directed at discovering sites which are in well stratified and datable contexts with good faunal preservation and which display spatial patterning of activity. These searches should be regional in scope, e.g., a single riverine system or limestone ridges which have habitable caves or rock shelters. These study regions should transect various ecological zones. This should permit investigators to deal with such questions as settlement patterns and seasonal activity to define the total technological inventory of a past cultural system. Then, slowly, valley by valley, we may begin to understand just how the New World was populated and when. For this approach to be successful, it will have to be applied on a broad front, including our Soviet colleagues working in Siberia. Far better cooperation and communication is necessary between the Old and the New Worlds before the archeology of these regions can become one.

APPENDIX A

A DESCRIPTION AND ANALYSIS OF ARTIFACT CLUSTERS IN COMPONENTS I AND II AT THE DRY CREEK SITE

by

J. F. Hoffecker

Artifact Clusters in Component II

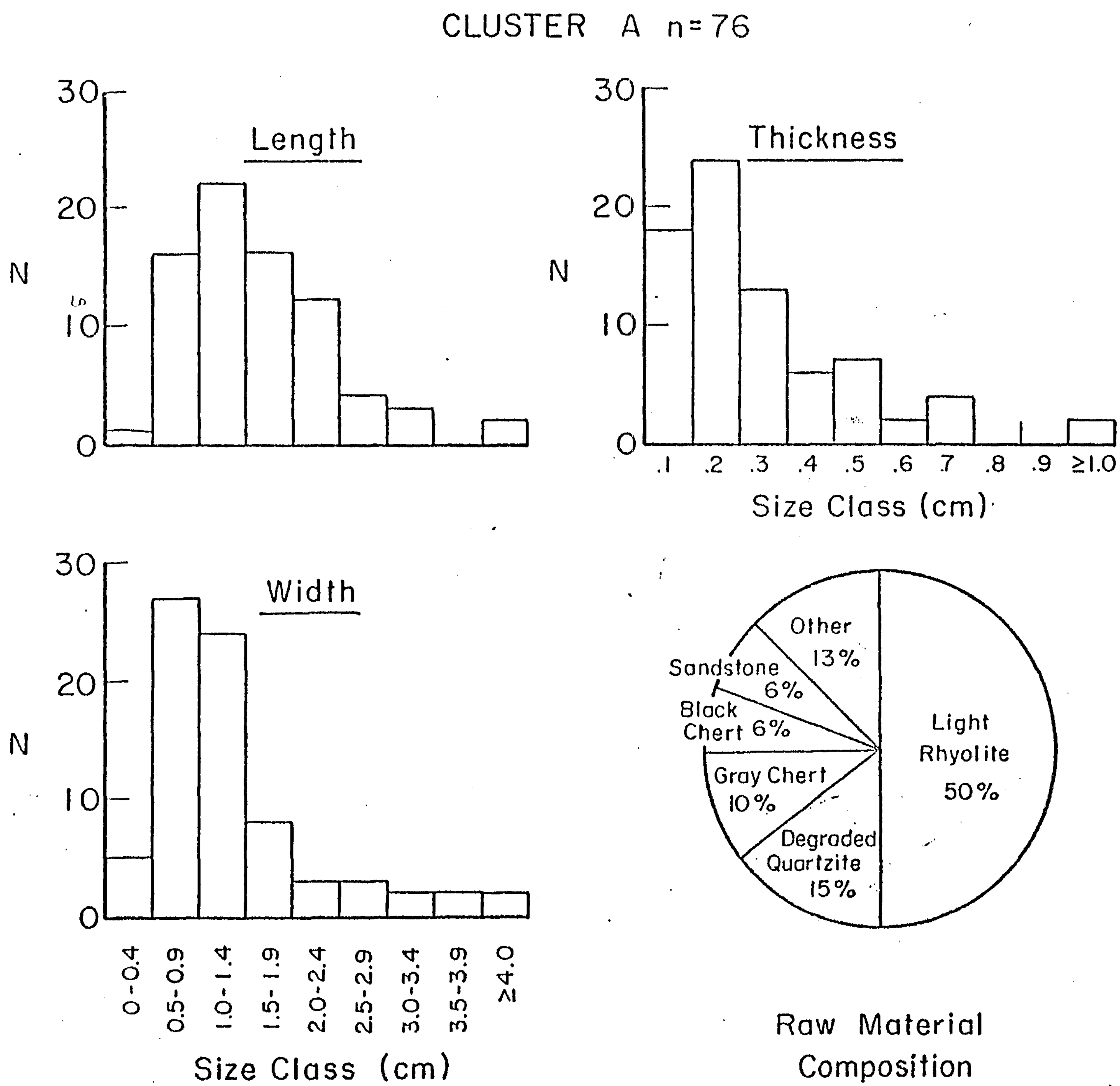
Cluster A

This cluster is composed of less than 350 artifacts. Light rhyolite and chert predominate among the raw materials, although some degraded quartzite and sandstone are present. A single light rhyolite microblade core was reconstructed, and a total of five complete microblades and 105 microblade fragments of the same material were recovered. Two microblade fragments of obsidian and gray chert are also present. The cluster contains only one tool, a gray chert burin, and there are a few, if any, utilized flakes.

The flake dimension profiles are skewed towards the smaller end of the spectrum, the modal length and width categories being 1.0-1.4 cm. and .5-.9 cm. respectively. Among these are a number of light rhyolite flakes exhibiting heavy wear in the form of scalar retouch along the edge created by the intersection of the platform and dorsal surface. The angle of this edge typically approaches 90° on these flakes. No faunal remains were preserved in this cluster.

Cluster A is the smallest in Component II. There is little evidence here for butchering activities in the form of sharp-edged flakes of adequate size, cutting or chopping tools, or the types of waste flakes which might be expected from their production and use. Nor is there evidence for skin-working activities in the form of edge-polished implements. The artifacts present are consistent, however, with the expectations of a tool kit for manufacturing microblade-inset spears and its associated waste. The reconstructed core suggests that blade production was occurring here, although the

Figure A.1. Cluster A: Flake size and raw material composition.


CLUSTER A n=76
Length
Thickness
Width
N
30
20
10
0
.1 .2 .3 .4 .5 .6 .7 .8 .9 ≥1.0
Size Class (cm)
0-0.4 0.5-0.9 1.0-1.4 1.5-1.9 2.0-2.4 2.5-2.9 3.0-3.4 3.5-3.9 ≥4.0
Size Class (cm)
Other 13%
Sandstone 6%
Black Chert 6%
Gray Chert 10%
Degraded Quartzite 15%
Light Rhyolite 50%
Raw Material Composition

obsidian and chert blade fragments are probably intrusive, perhaps from neighboring Cluster B. Both the burin and the steep-edged, heavily-worn waste flakes suggest bone or antler working, which may also indicate that fore-shafts were being produced and/or modified here. The absence of faunal remains, which are poorly preserved at the site generally, may not be significant.

Cluster A: Cores, Tools, and Large Flakes:

Catalogue No.	Description	Material	Dimensions
76-3225	Microblade Core	Light Rhyolite	2.1 x 1.3 x 2.5cm
76-3269	Burin	Gray Chert	2.7 x 2.1 x .4
76-3219	Large Flake	Brown Chert	6.9 x 6.0 x .8

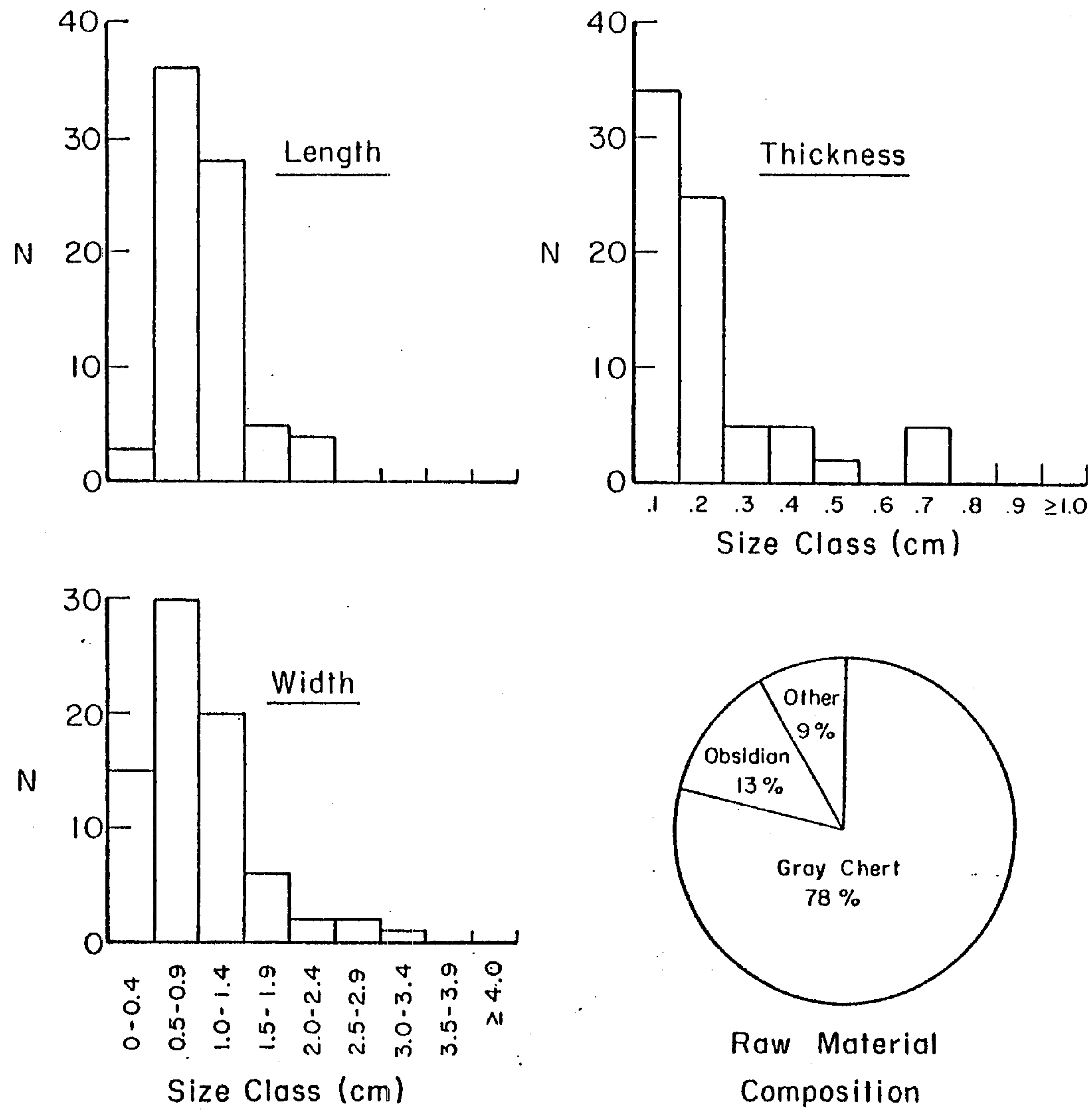
Cluster B

Cluster B is composed of over 800 flakes and 199 microblades and microblade fragments. Gray chert and obsidian account for most of the raw material. There are two gray chert microblade cores and numerous core tablets (platform rejuvenation flakes) present, and, although obsidian cores are absent, there are core tablets and microblades of this material. Several chalcedony microblade fragments were also recovered. Tools include four burins, a core-scraper, and four core-scraper fragments.

The core-scrapers all bear heavy wear in the form of scalar retouch, as do some of the waste flakes. Edge angles on these tools range from 45° to 90°. Flake size in this cluster is unusually small, the modal size class for length and width being 0.5-0.9 cm. Faunal remains are not present.

Figure A.2. Cluster B: Flake size and raw material composition.

CLUSTER B n=76



After excavations were completed in 1977, it became clear that a substantial portion of this cluster remained unexcavated (see Figure 5.1). Nevertheless, the sample appears to be sufficient for some observations and interpretations about activities performed here. As in the case of Cluster A, the artifactual remains can be adequately accounted for by the model for spear production and/or maintenance. Evidence for activities other than microblade manufacture and bone or antler working is lacking.

Cluster B: Cores and Tools:

Catalogue No.	Description	Material	Dimensions
76-3765	Microblade Core	Gray Chert	2.9 x 2.1 x 2.3 cm
77-2089	Microblade Core	Gray Chert	2.6 x 1.8 x 1.8
77-1433	Burin	Jasper	2.1 x 2.2 x .8
77-1435	Burin	Green Chert	3.1 x 2.4 x 1.0
77-2042	Burin	Gray Chert	2.0 x 1.7 x .8
77-2045	Burin	Green Chert	2.2 x .9 x 1.9
77-3429	Core-scraper	Green Chert	4.7 x 4.7 x 1.9
77-2040	Core-scraper Frag.	Gray Chert	4.3 x 4.0 x 1.1
76-3475	Core-scraper Frag.	Gray Chert	3.2 x 2.0 x .9
77-2057	Core-scraper Frag.	Gray Chert	4.3 x 2.5 x 1.2
76-3447	Core-scraper Frag.	Gray Chert	3.6 x 2.2 x 1.1
77-1773	Utilized Flake	Black Chert	2.9 x 2.3 x .5

Cluster C

Cluster C contains over 700 flakes, as well as 146 microblades and microblade fragments. The three most important raw materials are chalcedony, degraded quartzite, and light rhyloite. There are three, light, rhyolite, microblade cores and four, aberrant, chalcedony cores from which one or two blades have been struck. Most of the microblades are rhyolite; there are only 18 chalcedony blades and blade fragments. Eight burins were found, as well as one denticulate tool, and a degraded quartzite biface fragment.

Heavy wear in the form of scalar retouch is visible on two of the rhyolite and all of the chalcedony cores. The burins also bear signs of substantial use, the denticulate of moderate use. The flake dimension profiles reflect a general tendency towards small size. Scalar retouch is present on some of the chalcedony and rhyolite waste flakes, which manifest edge angles between 45° and 90°. There are over 100 small degraded quartzite flakes, some of which reflect the characteristics of bifacial edge trimming flakes. Two flakes, one of degraded quartzite and the other of gray chert, exhibit traces of heavy utilization (crushed edges). Faunal remains were found in association with the artifacts, and tooth fragments were identifiable as belonging to *Bison priscus*.

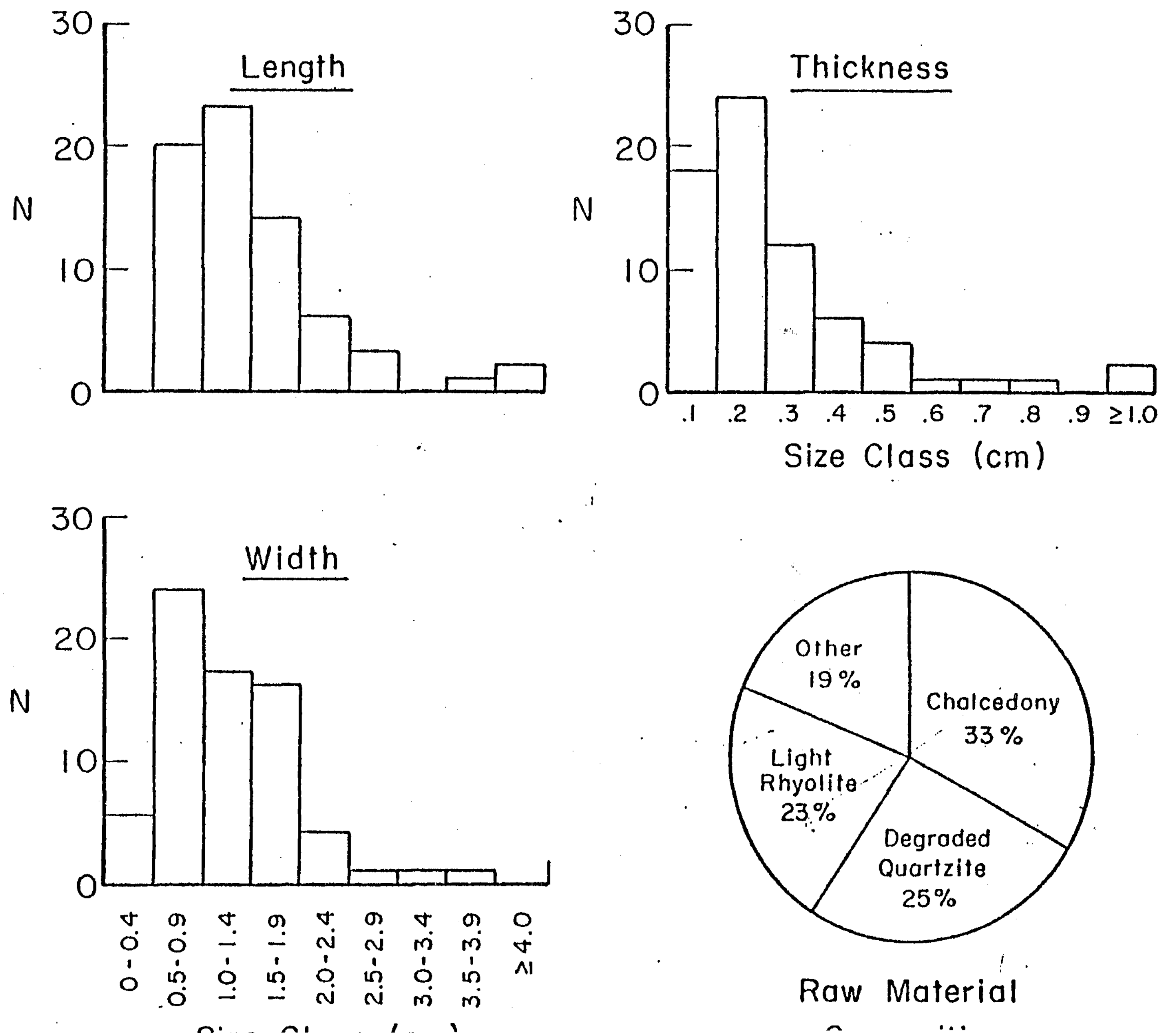
All the elements of spear manufacture are present in Cluster C, but evidence of other activity is apparent also. The biface fragment and possible the utilized flakes may indicate that some meat processing was occurring here. Although the biface fragment is located on the northwestern periphery of the cluster, the degraded quartzite waste flakes suggest that such a tool was being used here. Most of the tools, judging by their steep edge angles and scalar retouch wear, and many of the remaining waste flakes, judging by their small size, suggest, however, that bone or antler working, in addition to microblade production, was the most common activity performed here. The faunal remains could reflect some butchering work, but could also conceivably constitute traces of raw materials used in weapon production.

Cluster D

Cluster D is large, composed of over 1,900 flakes. Raw materials of poor quality predominate, chiefly degraded quartzite and diabase. Some obsidian, brown chert, and rhyolite were used for more

Figure A.3. Cluster C: Flake size and raw material composition.

CLUSTER C n=69



Cluster C: Cores and Tools:

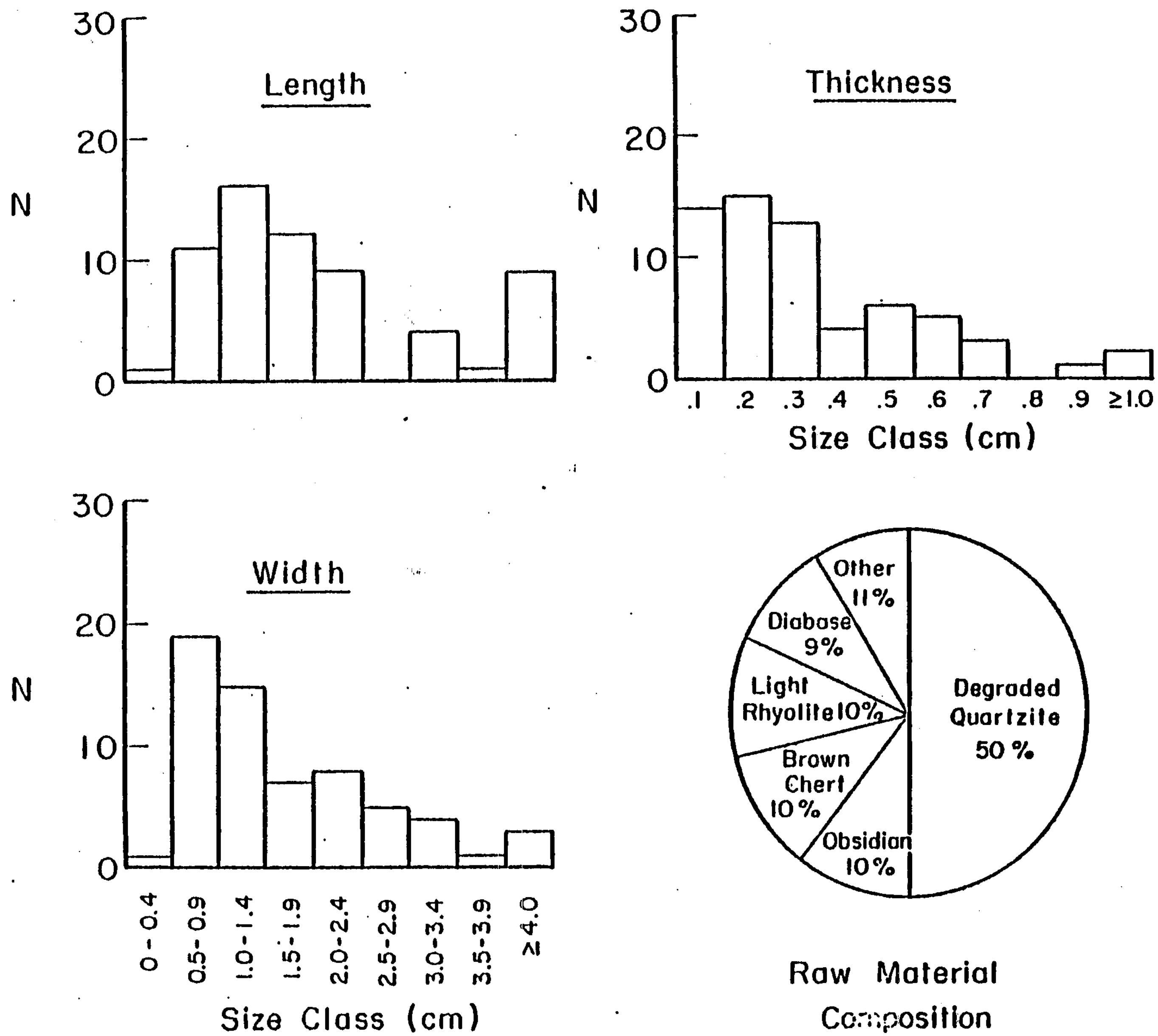
Catalogue No.	Description	Material	Dimensions
77-637	Microblade core	Light Rhyolite	1.5 x 1.1 x 2.4 cm
77-364	Microblade core	Light Rhyolite	3.6 x 1.7 x 2.6
77-669	Microblade core	Light Rhyolite	3.2 x 1.6 x 2.8
77-638	Transverse Burin	Light Rhyolite	2.5 x 2.4 x .6
76-667	Burin	Light Rhyolite	2.6 x 1.8 x 1.3
76-5480	Burin	Chalcedony	2.2 x 2.6 x .7
77-574	Burin	Light Rhyolite	3.2 x 2.4 x .6
76-5496	Burin	Light Rhyolite	2.7 x 2.0 x .8
77-308	Burin	Light Rhyolite	1.8 x 2.4 x 1.1
77-308	Burin	Light Rhyolite	2.2 x 3.6 x .5
77-604	Burin	Light Rhyolite	2.1 x 2.0 x .7
76-1362	Aberrant Core	Chalcedony	3.7 x 1.7 x 3.0
76-2513	Aberrant Core	Chalcedony	3.7 x 1.4 x 3.3
76-5527	Aberrant Core	Chalcedony	3.9 x 2.1 x 3.2
76-5534	Aberrant Core	Chalcedony	3.0 x 1.3 x 2.7
77-362	Core-scraper Frag.	Chalcedony	3.2 x 3.0 x 1.5
76-5533	Core-scraper	Chalcedony	5.6 x 3.3 x 1.5
76-5098	Core-scraper Frag.	Chalcedony	4.1 x 2.2 x 1.0
77-441	Core-scraper Frag.	Chalcedony	3.2 x 2.6 x 1.4
76-4364	Biface Frag.	Degraded Quartzite	6.8 x 3.9 x 1.0
77-365	Denticulate	Chalcedony	3.8 x 2.6 x 1.2
77-369	Utilized Flake	Gray Chert	2.2 x 3.3 x .4
77-800	Utilized Flake	Degraded Quartzite	4.7 x 1.9 x .6
76-5125	Blake-like Flake Frag.	Degraded Quartzite	6.2 x 3.1 x .8

finely-worked items. Microblades, microblade cores, and core parts are entirely absent from this cluster. A single obsidian bifacial fragment was found on the southern periphery. A light rhyolite knife of similar size and shape was recovered approximately one meter beyond the northeastern periphery. On the northwestern periphery there is a large sandstone cobble from which several flakes have been struck on one corner.

The obsidian knife fragment exhibits heavy wear in the form of crushed edges. The edges of the light rhyolite knife, according to Del Bene, bear evidence of hafting and use on soft material. The edge angles on these tools are low; the sandstone cobble worked edge is approximately 45°. In terms of size, the flakes lie in the medium

Figure A.4. Cluster D: Flake size and raw material composition.

CLUSTER D n=63



Raw Material Composition

Cluster D: Tools:

Catalogue No.	Description	Material	Dimensions
76-1361	Bifacial Knife Frag.	Obsidian	3.7 x 2.5 x .7 cm
74-199	Bifacial Knife	Light Rhyolite	5.1 x 2.6 x .9
76-5298	Chopping Tool	Sandstone	17.0 x14.3 x 4.6

range for the site as a whole, as illustrated by the dimension profiles. Some of the larger flakes possess signs of moderate damage along their sharp edges, while other flakes (of degraded quartzite and diabase) bear the faceted platforms and dorsal scars characteristic of bifacial sharpening flakes. Some of these are large and manifest scalar retouch. Faunal remains are not present.

Cluster D thus offers a significant contrast to the three clusters discussed previously. Evidence for microblade production and bone and antler working is lacking. On the other hand, the utilized flakes, bifacial implements, and heavy cobble tool are consistent with the requirements of a butchering tool kit. The bifacial trimming flakes of degraded quartzite and diabase suggest that other tools, subsequently removed, were used here. The absence of faunal remains may be due to post-depositional disturbance. It is conceivable, however, that the Bison remains located in Cluster C., slightly over a meter beyond the southern priphery, are actually associated wtih Cluster D. This could account for the bifacial tool fragment and degraded quartzite waste flakes in the former.

Cluster E

This cluster is composed of over 1,000 flakes. Although there is a substantial amount of degraded quartzite present, much of the raw material is of moderately good quality (rhyolite and a medium gray chert), and there is a sizable proportion of high quality chalcedony. Worked implements include a delicately flaked chalcedony projectile point tip, a small triangular chalcedony biface, and a large dark rhyolite bifacial tool. Microblades, microblade cores, and burins are completely absent.

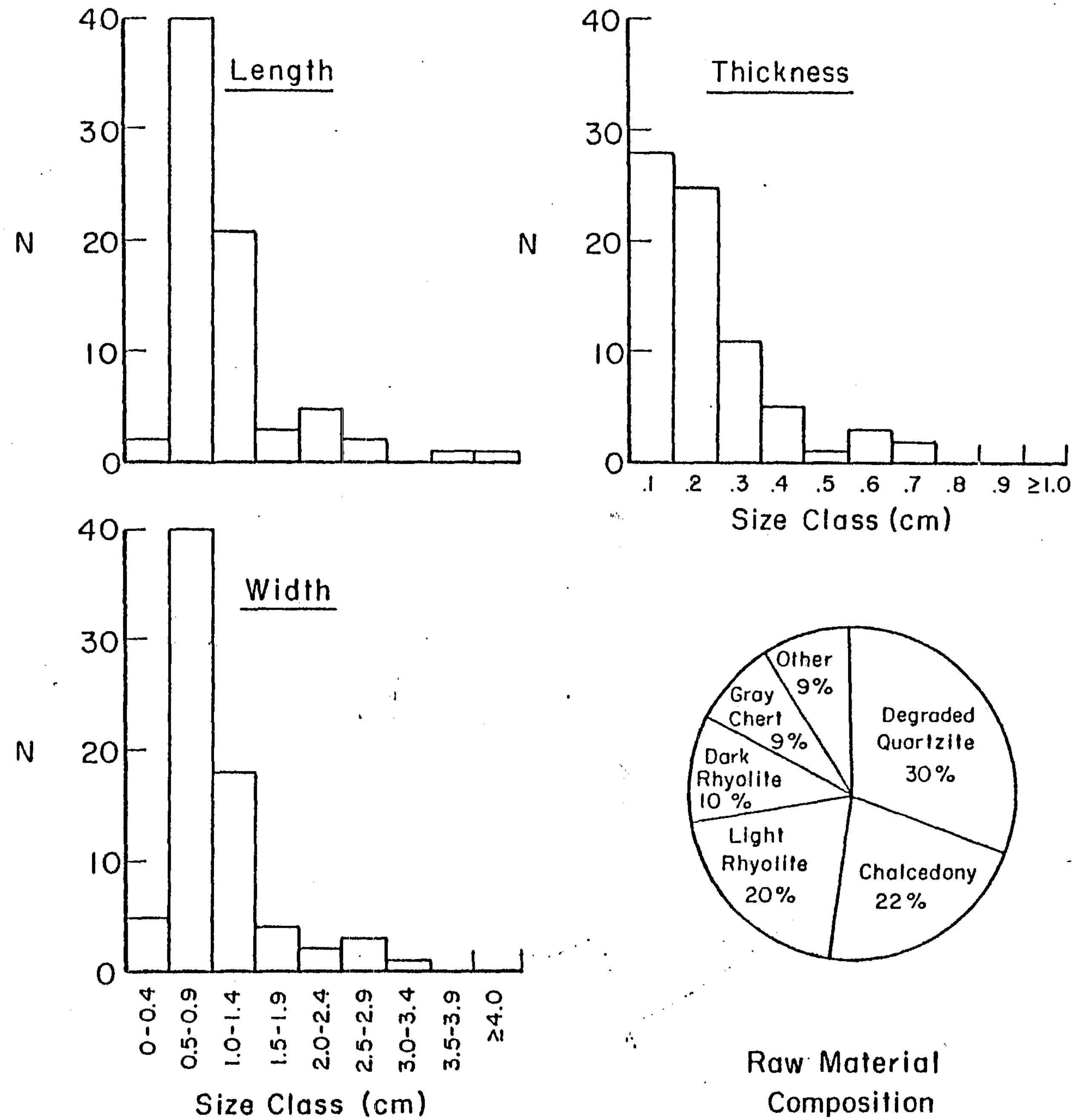
The large biface exhibits heavy use wear in the form of scalar retouch along one side. The flake dimension profiles are strongly skewed towards the smaller end of the size spectrum, the modal length and width categories being .5 - .9 cm. The waste flakes appear to fall into two groups: very small flakes (<1.0 cm.), frequently of chalcedony and some of which possess the characteristics of bifacial sharpening flakes, and slightly larger flakes (>1.0 cm.), often of degraded quartzite, displaying heavy scalar retouch. The latter include two gray chert flakes which bear extremely heavy scalar retouch along portions characterized by steep edge angles. There are several large flakes of coarse-grained material which lack discernible wear. Faunal remains are present, but unidentifiable.

Cluster E is problematic, being consistent with none of the tool kit models discussed. The size of the flakes and the evidence of bone and antler working in the form of edge wear recall the clusters which I have interpreted as residues of microblade spear production. The absence of microblades and burins, and the evidence of bifacial working do not. Perhaps the explanation which best accounts for these data is that stone point projectiles were being manufactured and/or repaired here, involving work on bifacial points and bone or antler foreshafts.

Figure A.5. Cluster E: Flake size and raw material composition

The significance of the large flakes is unclear.

CLUSTER E n = 75



Cluster E: Tools and Large Flakes:

Catalogue No.	Description	Material	Dimensions
77-	Point	Grey Chert	3.4 x 1.3 x .3 cm
77-1879	Triangular Biface	Chalcedony	3.3 x 2.1 x .6
77-2840	Point Tip	Chalcedony	.9 x .8 x .2
77-2219	Biface	Dark Rhyolite	17.6 x 7.2 x 4.8
77-1880	Large Flake	Degraded Quartzite	13.6 x 6.3 x 2.5
77-2555	Large Flake	Dark Rhyolite	7.1 x 3.7 x 1.5
77-5007	Large Flake	Degraded Quartzite	7.3 x 4.7 x 1.3
77-2439	Large Flake	Degraded Quartzite	7.2 x 5.2 x 2.3

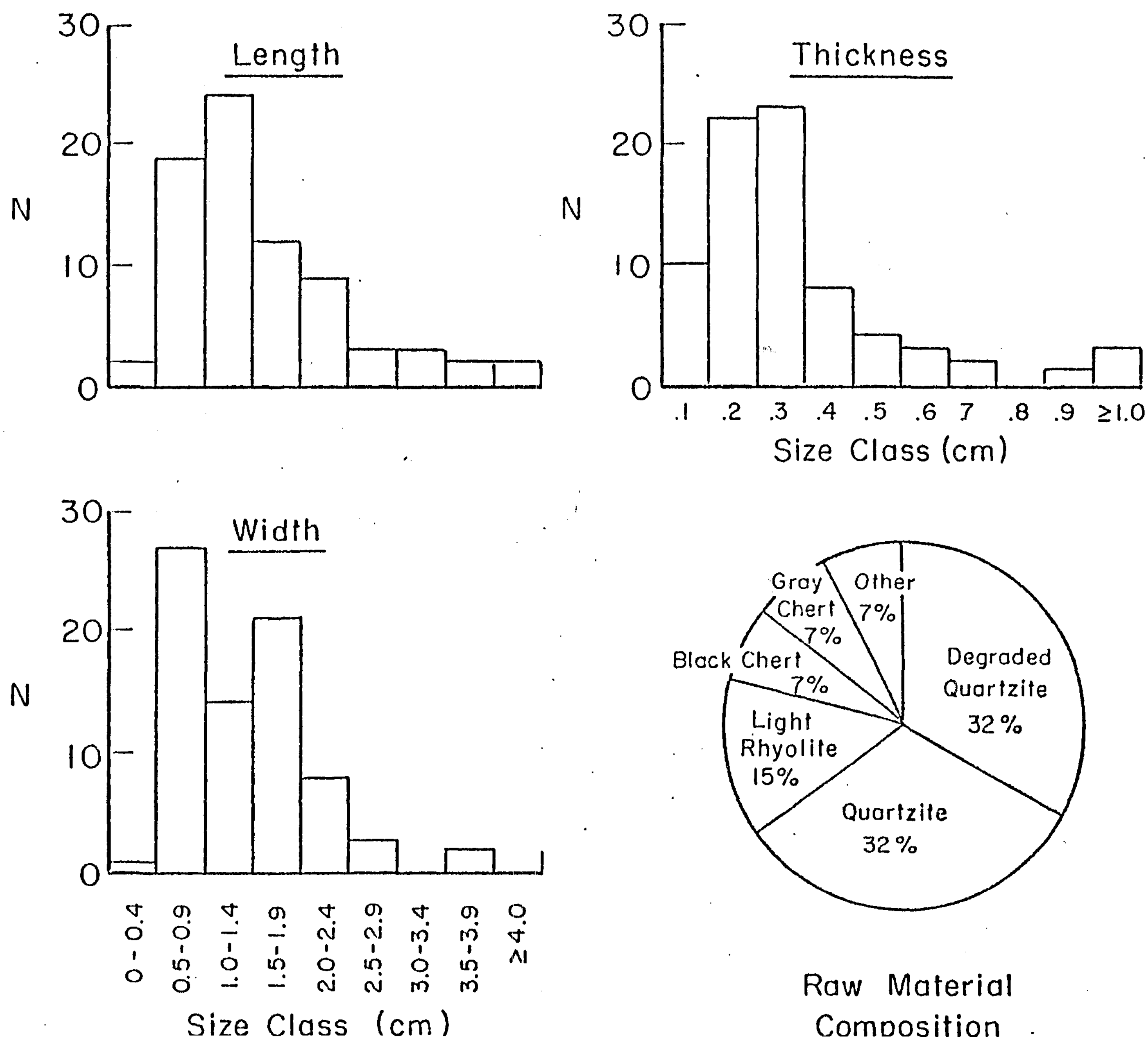
Cluster F

Cluster F contains more than 680 flakes. Raw materials of poor quality predominate (degraded quartzite and quartzite), but light rhyolite and chert are also present. Microblades, burins, and any other evidence of their production are absent, except for one possible burin spall. Four small, finely worked bifacial knives and two knife fragments were recovered, and there are two larger bifacial tools of cruder manufacture as well. Rhyolite and chert were used in the production of the knives; diabase and degraded quartzite for the larger tools. Four scraping tools were found, and on the southern periphery there are six chalcedony core-scrapers. In addition, there is a chalcedony scraping tool, and one utilized flake.

The scraping tools all possess sharp edge angles (less than 45°), and three of these manifest moderate damage in the form of edge-crushing. Five of the steep-edged core-scrapers bear heavy scalar retouch. The chalcedony scraping tool exhibits edge polish. Several of the bifaces and scrapers bear evidence of hafting in the form of grinding along certain edges. The flakes are generally small and many exhibit the characteristics of bifacial and scraping tool sharpening flakes. Some of the larger flakes of coarse-grained material bear scalar retouch. Faunal remains are present but unidentifiable.

Figure A.6. Cluster F: Flake size and raw material composition.

CLUSTER F n=76



Cluster F: Tools and Large Flakes:

Catalogue No.	Description	Material	Dimensions
77-213	Knife	Light Rhyolite	5.5 x 2.1 x .8cm
77-210	Knife	Light Rhyolite	4.6 x 2.4 x .8
77-2959	Knife	Dark Rhyolite	5.4 x 2.5 x .9
77-1976	Knife	Gray Chert	5.0 x 2.6 x .9
77-3179	Knife Frag.	Light Rhyolite	1.6 x 1.6 x .6
77-1847	Knife Frag.	Gray Chert	1.6 x 1.7 x .5
77-269	Biface	Degraded Quartzite	18.2 x 6.5 x 2.5
77-215	Biface	Diabase	8.8 x 5.4 x 1.8
74-81	Scraper	Degraded Quartzite	9.9 x 815 x 2.5
74-82	Scraper	Degraded Quartzite	6.0 x 9.3 x 1.9
77-2659	Scraper	Light Rhyolite	5.2 x 8.7 x .9
76-5244	Scraper	Light Rhyolite	9.5 x 4.8 x .8
77-2386	Scraper	Chalcedony	5.0 x 3.8 x 1.1
76-5606	Core-scraper	Chalcedony	5.9 x 3.2 x 1.8
77-2384	Core-scraper	Chalcedony	4.4 x 4.3 x 1.1
77-2387	Core-scraper	Chalcedony	4.8 x 3.5 x 1.8
77-2388	Core-scraper	Chalcedony	4.9 x 3.4 x 2.3
77-209	Core-scraper	Chalcedony	4.6 x 4.0 x 1.5
77-2385	Core-scraper	Chalcedony	4.3 x 3.3 x 1.3
76-5248	Large Flake	Degraded Quartzite	7.4 x 4.7 x .7

This cluster is difficult to interpret. Some of the tools were apparently not manufactured or heavily used here such as the chalcedony implements and the diabase biface, as waste flakes of these materials are lacking. Butchering activities could account for the knives, the sharp-edged "scraping tools", and the utilized flake. If some work on bone or antler hafts was being performed, this could account for the core-scraper tools and the signs of scalar retouch. The evidence for skin-working in the form of the edge-polished tool is rare at this site. This polish could conceivably be the product of bone or antler working as well (Keeley, 1980: 42-59).

Cluster G

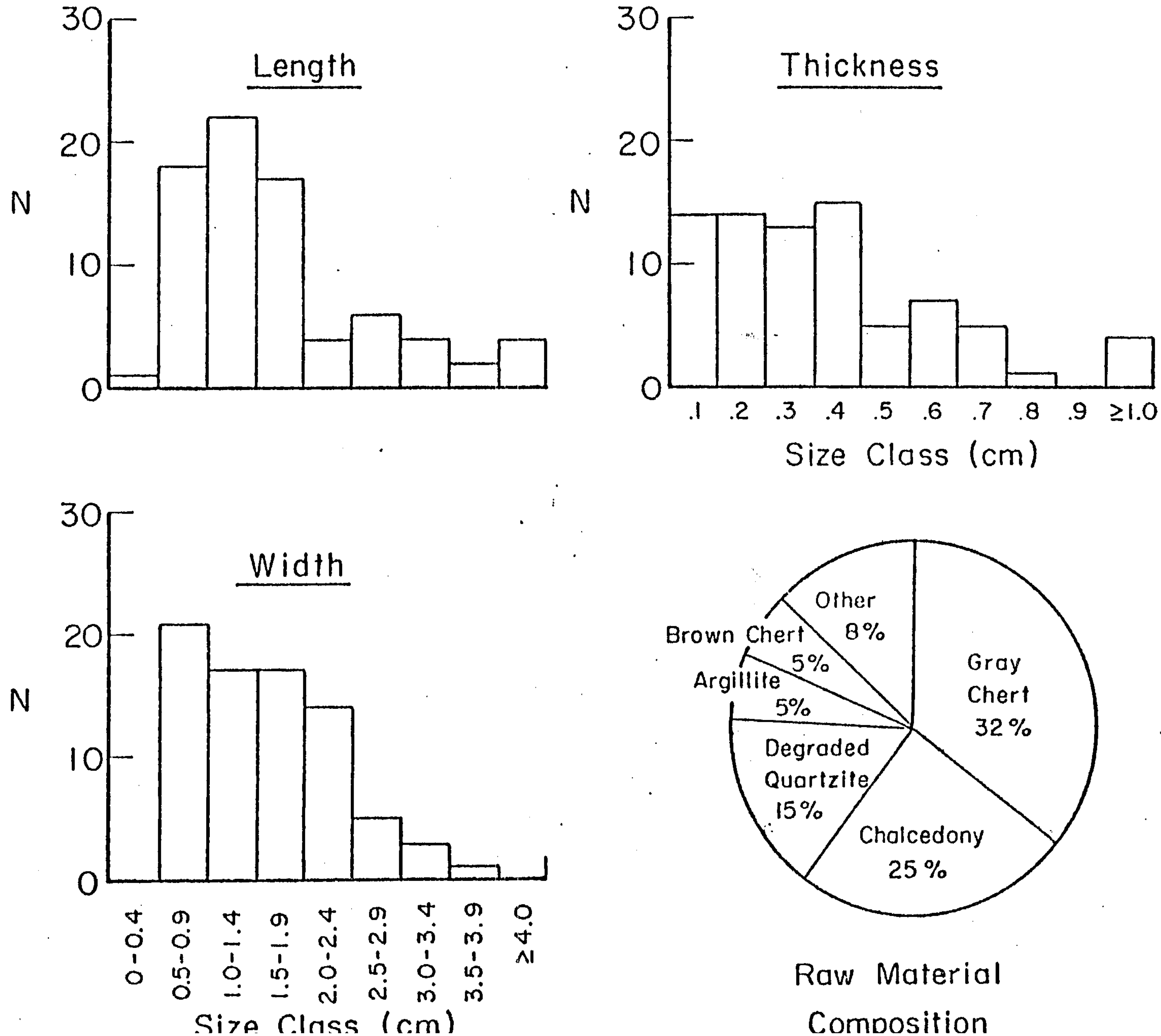
This cluster is composed of approximately 2,800 flakes. The most important raw materials are gray chert and chalcedony, although a significant quantity of degraded quartzite was also used. There are no less than 13 microblade cores and over 760 microblades and microblade fragments. Cluster G also contains five burins and 22 core-scrapers. In addition to this, there are two denticulate tools, and two large crude biface fragments of argillite, as well as two smaller chert bifaces and a battered cobble. Two fragments of small bifacial knives, two utilized flakes, and one retouched flake are also present.

The utilized flakes bear signs of use in the form of edge crushing, and one of the denticulates is heavily worn (scalar retouch) around the notch. According to Del Bene, edge wear patterns on the retouched flake suggest that it was used to scrape yielding material, and polish on the tips of several pointed microblades suggest the scraping or cutting of soft material. The flake-dimension profiles indicate an unusual degree of thickness, relative to the length and width which reflect a generally small size. Many of these thick flakes exhibit heavy scalar retouch, as do the core-scrapers. Some bifacial trimming flakes can be distinguished. There is a large amount of faunal material present, but none of it is identifiable.

Despite the fact that its northernmost portion lies unexcavated, Cluster G is the largest at the site, both in terms of quantity of remains and spatial extent. It may, therefore, reflect a more complex history of activity than most of the other clusters. The numerous cores, core parts, and blades indicate that a considerable amount of microblade production was occurring here, and the steep-edged core-scrapers, burins, and denticulates are also consistent with the tool kit hypothesized for microblade-inset spear production. Other elements of the cluster suggest additional activities, such as meat processing (knives, large bifaces, utilized flakes, and cobble), and skin-working (edge-polished microblade tips).

Figure A.7. Cluster G: Flake size and raw material composition

CLUSTER G n=78



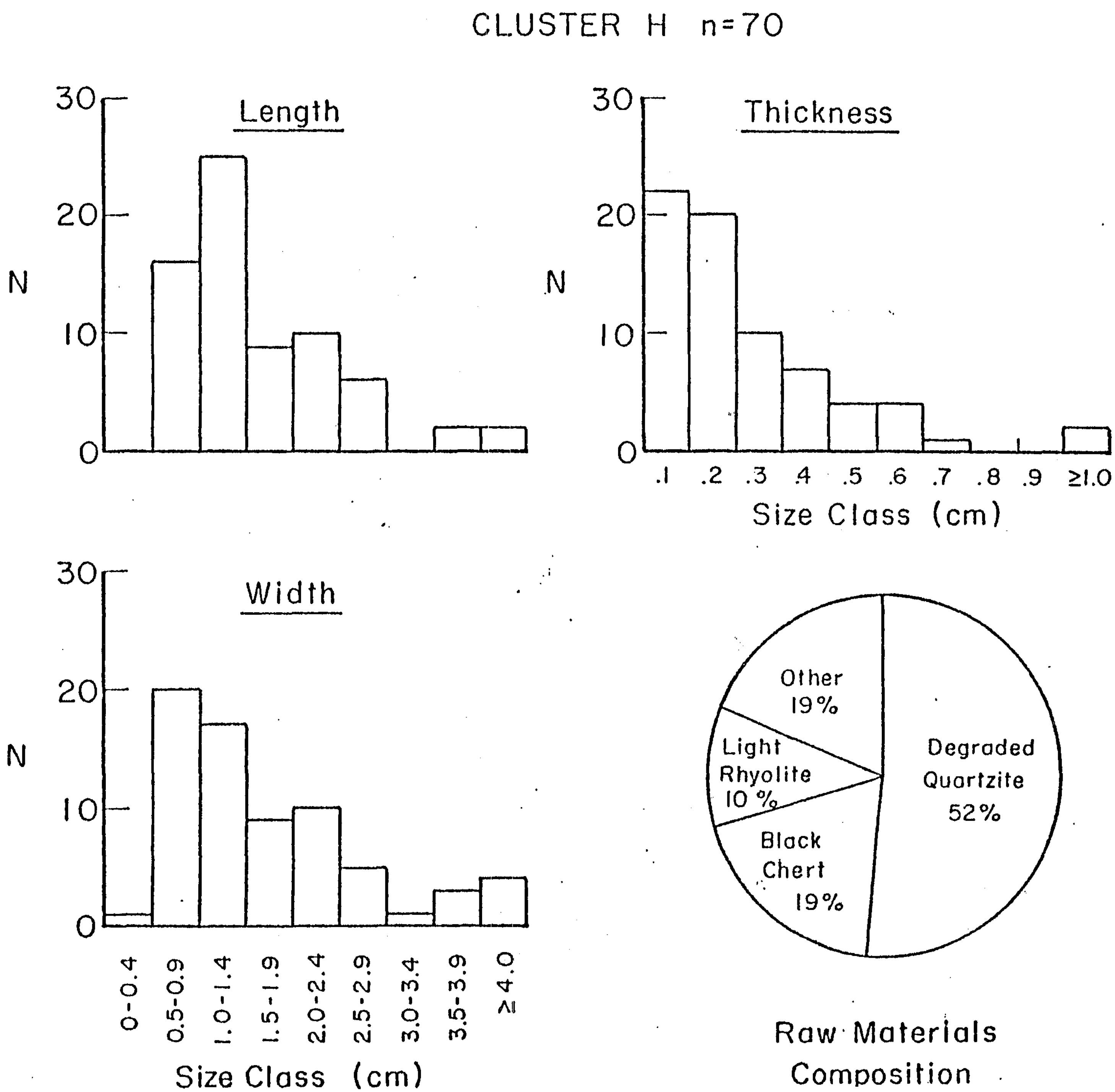
Cluster G: Cores, Tools, and Large Flakes:

Catalogue No.	Description	Material	Dimensions
76-273	Microblade Core	Light Rhyolite	2.8 x 1.3 x 3.1cm
76-588	Microblade Core	Chalcedony	2.9 x 1.7 x 2.9
76-474	Microblade Core	Jasper	3.3 x 1.4 x 2.5
76-4058	Microblade Core	Brown Chert	4.6 x 1.5 x 2.4
76-4097	Microblade Core	Black Chert	3.2 x 1.0 x 2.5
76-278	Microblade Core	Chalcedony	3.3 x 1.4 x 2.7
76-4518	Microblade Core	Chalcedony	3.0 x 1.4 x 2.3
76-241	Microblade Core	Chalcedony	2.5 x 1.4 x 2.3
76-764	Microblade Core	Chalcedony	2.3 x 1.3 x 2.1
76-731	Microblade Core	Chalcedony	2.4 x 1.0 x 2.6
76-757	Microblade Core	Chalcedony	2.6 x 1.2 x 2.3
76-587	Microblade Core	Chalcedony	3.4 x 1.5 x 2.4
76-278	Microblade Core	Chalcedony	3.5 x 1.8 x 2.3
76-832	Burin	Chalcedony	2.4 x 2.2 x .5
76-4135	Burin	Chalcedony	2.1 x 2.0 x .9
76-274	Burin	Light Rhyolite	4.1 x 2.8 x .9
76-501	Burin	Light Rhyolite	2.5 x 2.1 x .6
76-230	Burin	Gray Chert	2.5 x 1.2 x .7
76-775	Denticulate	Chalcedony	5.2 x 2.9 x 1.4
76-148	Denticulate	Gray Chert	3.6 x 2.2 x .6
	Core Scrapers (22)	Chalcedony	4.9 x 3.4 x 1.9
76-4103	Knife Frag.	Light Rhyolite	2.2 x 2.0 x .5
76-4475	Knife Frag.	Light Rhyolite	1.9 x 2.3 x .7
76-4400	Biface	Black Chert	6.5 x 4.1 x 1.6
76-4047	Biface	Gray Chert	5.1 x 4.2 x 1.6
76-259	Biface Frag.	Argillite	10.3 x 6.6 x 2.1
76-90	Biface Frag.	Argillite	7.7 x 3.4 x 1.8
76-4384	Utilized Flake	Black Chert	5.8 x 5.5 x 1.0
76-656	Retouched Flake	Light Rhyolite	5.8 x 5.8 x .6
76-4067	Retouched Flake	Gray Chert	4.6 x 2.4 x .7
76-762	Large Flake	Degraded Quartzite	9.2 x 4.7 x 2.5
76-4049	Large Flake	Sandstone	6.6 x 8.8 x 1.7
76-997	Large Flake	Degraded quartzite	8.9 x 8.8 x 1.7
76-624	Utilized Cobble	Sandstone	19.2 x10.0 x 2.7

Cluster H

This cluster contains over 860 flakes. Degraded quartzite was the chief raw material used here, although some chert and rhyolite of good quality was also used. There are no microblade cores or core parts, but one gray chert microblade fragment was recovered. Burins and burin spalls are also absent. The tools are simple and crude, consisting of three bifaces and four utilized flakes. There is a very large diabase artifact which may be classified as a core and/or chopper, and two large

Figure A.8. Cluster H: Flake size and raw material composition


CLUSTER H n=70
Length
Thickness
Width
N
30
20
10
0
.1 .2 .3 .4 .5 .6 .7 .8 .9 ≥1.0
Size Class (cm)
0-0.4
0.5-0.9
1.0-1.4
1.5-1.9
2.0-2.4
2.5-2.9
3.0-3.4
3.5-3.9
≥4.0
Size Class (cm)
Other 19%
Light Rhyolite 10 %
Black Chert 19%
Degraded Quartzite 52%
Raw Materials Composition

Cluster H: Cores, Tools, and Large Flakes:

Catalogue No.	Description	Material	Dimensions
46-4035	Biface	Dark Rhyolite	9.9 x 5.3 x 1.9 cm
74-258	Biface	Degraded Quartzite	14.5 x 7.6 x 4.7
74-266	Biface	Degraded Quartzite	11.2 x 5.8 x 2.2
74-289	Core-scraper	Black Chert	5.8 x 5.3 x 2.5
74-264	Utilized Flake	Black Chert	5.8 x 4.7 x 1.0
74-267	Utilized Flake	Black Chert	6.7 x 4.9 x 1.8
76-4039	Utilized Flake	Black Chert	6.0 x 3.4 x .6
74-265	Utilized Flake	Gray Chert	7.1 x 6.2 x 1.1
76-4092	Core	Diabase	17.5 x14.4 x 6.4
76-24	Large Flake	Diabase	4.8 x 8.3 x 2.2
76-51	Large Flake	Diabase	10.4 x 9.9 x 3.9
76-26	Large Flake	Sandstone	3.8 x 7.4 x 1.4
76-4036	Large Flake	Quartzite	8.5 x 4.4 x 2.3

flakes of the same material . One core-scraper of black chert is present.

The steep-edged core-scraper bears scalar retouch. The flakes are within the small size range for the site. The utilized flakes exhibit considerable nicking along their sharp edges (35° - 45°), while some of the waste flakes possess scalar retouch. Other waste flakes have faceted platforms, suggesting bifacial resharpening. A number of small retouch flakes of light rhyolite and gray chert were recovered, although tools of these materials are not present. Faunal remains are present but unidentifiable.

The data retrieved from Cluster H, which is partially unexcavated (see Figure 5.1), are probably best accounted for in terms of butchering activities; the bifaces and large flakes are suitable for this work. Some bone and antler work may have been occurring as well, but there is no reason to believe, beyond the spatial association, that this was related to meat processing, as suggested in Cluster F. The microblade is presumably intrusive, perhaps from Cluster G.

Cluster I

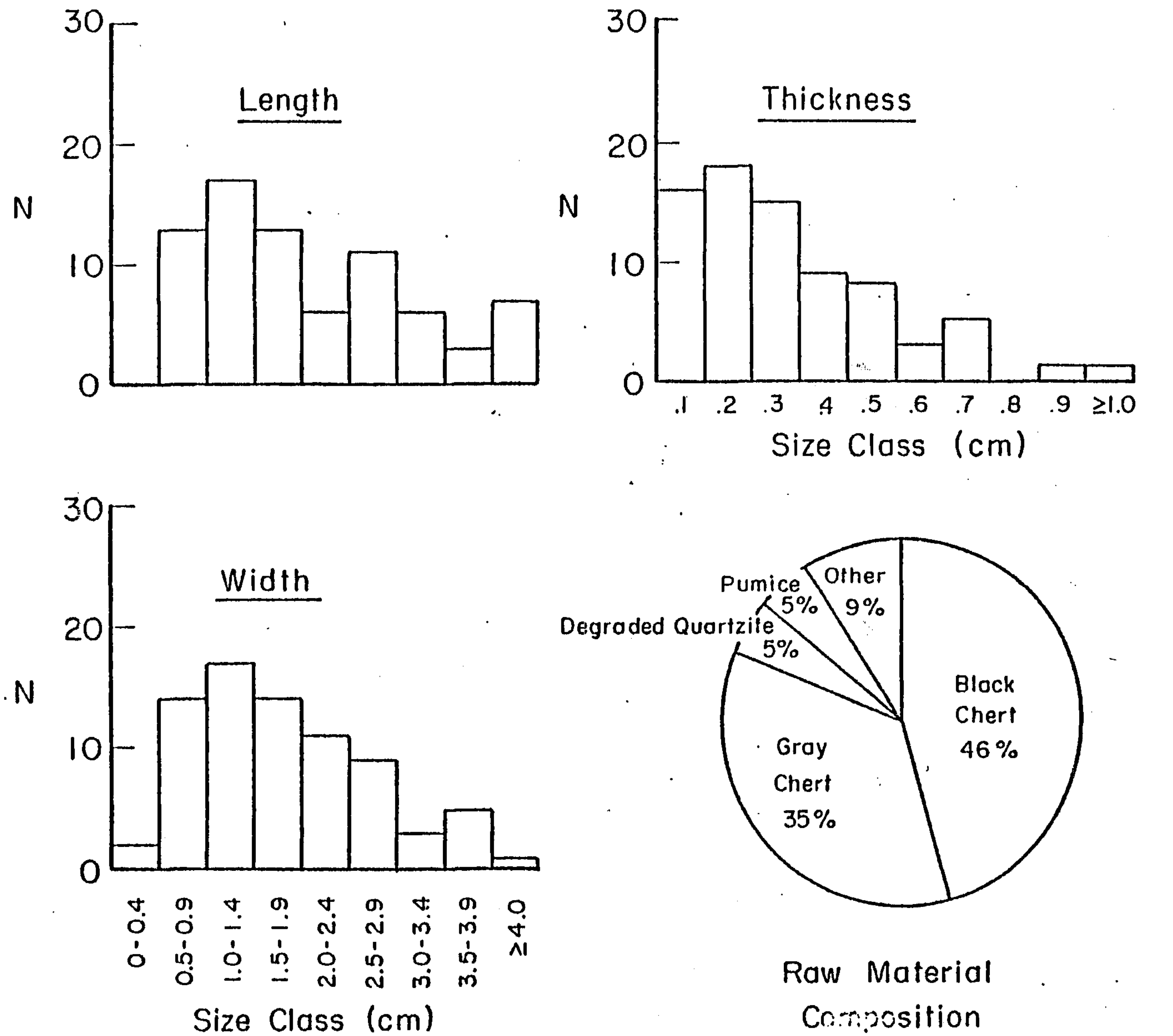
Approximately 880 flakes were recovered from this cluster. A good deal of chert was used here, much of it of medium quality, and, presumably, local origin. No microblades, microblade cores, or burins are present. The tools consist of one crude biface, two biface fragments, a core-scraper, and a unifacially retouched tool classified as a scraper. In addition to this, there are a number of large flakes and one obsidian utilized flake. A finely worked black chert knife lies on the border shared by this cluster and Cluster J.

The core-scraper is typically steep-edged (75° - 90°), while the scraper has a low edge angle (35° - 45°). The former exhibits moderate scalar retouch and, according to Del Bene, the obsidian flake (35° - 45° edge angle) was used to scrape a hard surface. The chert knife lacks any clear traces of use or hafting. The flakes lie in the medium range for the site as a whole with respect to size. It is difficult to discern obvious morpholigical characteristics in the waste flakes in order to attribute them to specific tool forms. No faunal remains are present.

Cluster I, which is partially unexcavated (see Figure 4-1), is generally consistent with the butchering tool kit model. Flake size is comparable to Cluster D, and appropriate cutting implements are present. (The black chert knife has been tentatively included with this cluster because of the relative lack of black chert waste flakes in Cluster J). As in the case of Clusters F and H, evidence for bone and antler working exists in conjunction with this type of tool kit. The absence of faunal remains could be due to post-depositional disturbance, or, alternatively, some of the faunal remains in neighboring Cluster J may have been associated with this cluster.

Figure A.9. Cluster I: Flake size and raw material composition

CLUSTER I n=76



Cluster I: Cores, Tools, and Large Flakes:

Catalogue No.	Description	Material	Dimensions
77-745	Biface	Light Rhyolite	9.0 x 5.0 x 3.6cm
77-746	Biface Frag.	Pumice	2.8 x 3.2 x .9
77-449	Biface Frag.	Dark Rhyolite	6.1 x 5.2 x 2.6
77-1591	Biface Frag.	Black Chert	8.6 x 2.5 x 1.2
77-454	Scraper	Degraded Quartzite	6.8 x 4.2 x 1.0
77-525	Core-scraper	Gray Chert	6.5 x 4.0 x 2.7
77-524	Utilized Flake	Obsidian	4.9 x 2.1 x .5
77-1684	Core	Gray Chert	10.3 x 9.3 x 7.5
77-744	Large Flake	Degraded Quartzite	6.2 x 9.5 x 2.0
77-1959	Large Flake	Degraded Quartzite	7.5 x 8.0 x 2.8
77-741	Large Flake	Gray Chert	6.1 x 6.1 x 1.2
77-1708	Large Flake	Gray Chert	7.7 x 5.4 x 2.1
77-523	Large Flake	Degraded Quartzite	6.2 x 4.3 x .8
77-1683	Large Flake	Gray Chert	10.6 x 5.7 x 3.5

Cluster J

This is a large cluster with approximately 2,200 flakes. Raw material types of poor quality predominate: degraded quartzite, a local chert, and even some volcanic pumice. Some phyolite was used also, however. Microblades, microblade cores, and burins are absent. Tools include three medium-sized bifaces and one fragment. Evidence of projectile point technology is represented by a thin, parallel-sided biface tip, and a possible point base. Two unifacially retouched pieces have been classified as scrapers, and a small retouched flake is also present.

The bifaces all possess sharp edge angles (35° - 45°), and two of them exhibit a moderate amount of edge crushing. Del Bene believes that the point tip was used to cut resistant material. The "scrapers" also have sharp edge angles and display heavy wear in the form of crushing and nicking. Both of these tools bear evidence of hafting in the form of edge grinding. Flake size is generally small, as illustrated by the dimension profiles. The waste flakes include large forms with scalar retouch and smaller delicate forms which appear to be the product of pressure-flaking. Faunal remains were recovered and tooth fragments were identified as Bison priscus. A group of fossil gastroliths are also associated with this cluster.

Cluster J is another problematic one. Like Cluster G, its size and composition suggest a complex history of activity. The elements of a butchering tool kit are present, including large flakes, bifaces, and the "scrapers" which seem to be suitable cutting implements. On the other hand, the overall size of the flakes, the evidence of careful pressure-flaking, and the possible point fragments suggest that the production of stone-tipped projectiles may have occurred here also, as at cluster E.

Cluster J: Tools and Large Flakes:

Catalogue No.	Description	Material	Dimensions
77-1593	Biface	Dark Rhyolite	9.9 x 5.1 x 3.0cm
77-1902	Biface	Gray Chert	7.9 x 4.8 x 1.6
77-931	Biface	Degraded Quartzite	12.0 x 7.0 x 2.7
77-930	Biface Frag.	Degraded Quartzite	5.9 x 4.6 x 1.2
77-929	Biface Frag.	Degraded Quartzite	7.7 x 2.9 x .9
77-2009	Point Base (?)	Degraded Quartzite	9.1 x 1.8 x .8
77-2013	Scraper	Siltstone	9.1 x 6.2 x 1.5
77-1505	Scraper	Degraded Quartzite	7.2 x 3.4 x .6
77-2248	Retouched Flake	Black Chert	4.0 x 1.9 x .4
77-2010	Large Flake	Gray Chert	8.8 x 4.7 x 3.0
77-999	Large Flake	Gray Chert	11.6 x 6.4 x 3.2

Cluster K

Over 1,660 flakes were recovered from Cluster K. Raw materials of fairly good quality predominate, including light rhyolite and chert. Microblades and microblade cores are lacking. However, four square-based point fragments are present, three of light rhyolite and one of chalcedony. In addition to these, there is a small, parallel-sided chert biface, classified as a knife, a simple burin-on-a-snap, a retouched flake, and a utilized flake. Just beyond the western periphery of the cluster lie a dark rhyolite biface and a brown chert biface fragment.

Two of the point fragments are broken in such a way as to suggest possible impact fracture. The chert knife has a rounded tip and full length unifacial flute. According to Del Bene, edge wear on this tool indicates that it may have been hafted and used to cut soft material. The utilized flake possesses a steep edge (90°), which exhibits some crushing and some polish. The retouched flake manifests a narrower edge angle (about 45°), but no visible wear. The flake dimension profiles are skewed towards the small end of the spectrum. Waste flakes belong both to the small, possibly pressure-flaked variety, and to those with thick striking platforms perpendicular to the length axis and heavy scalar retouch along the dorsal-proximal edge. Some faunal remains were found in association, but were unidentifiable, and fossil gastroliths were also recovered.

The data from Cluster K may reflect several types of activity. The small size and shape of many of the waste flakes and the point bases suggest that stone-tipped projectiles may have been manufactured and/or repaired here. Many of these waste flakes are of light rhyolite, as are three of the point fragments. The utilized flake and the scalar retouch on some of the larger waste flakes suggest that some bone and antler work could have occurred in conjunction with this. There is also some evidence that softer materials were being worked, perhaps meat and/or hide.

Figure A.10. Cluster J: Flake size and raw material composition

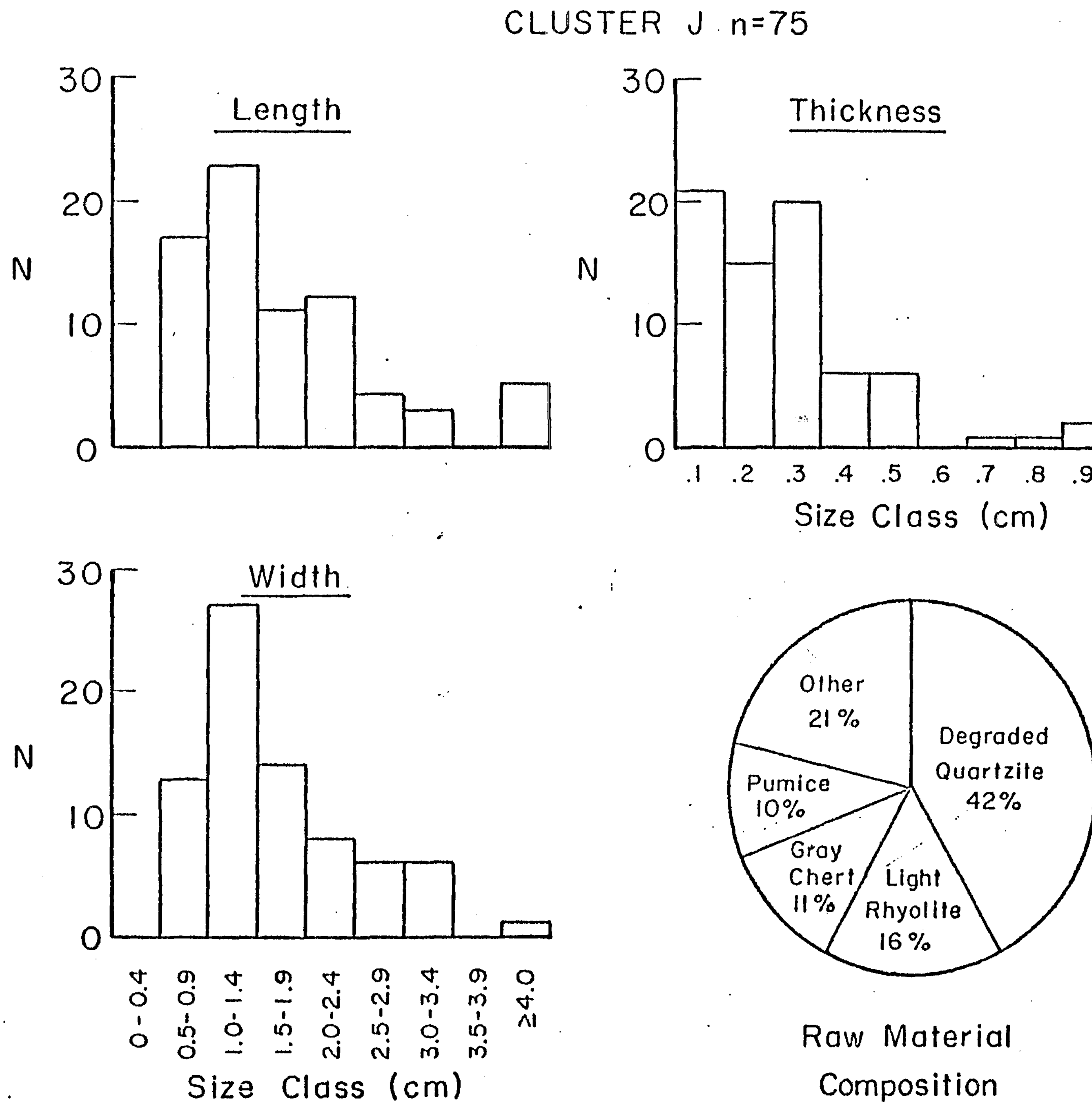
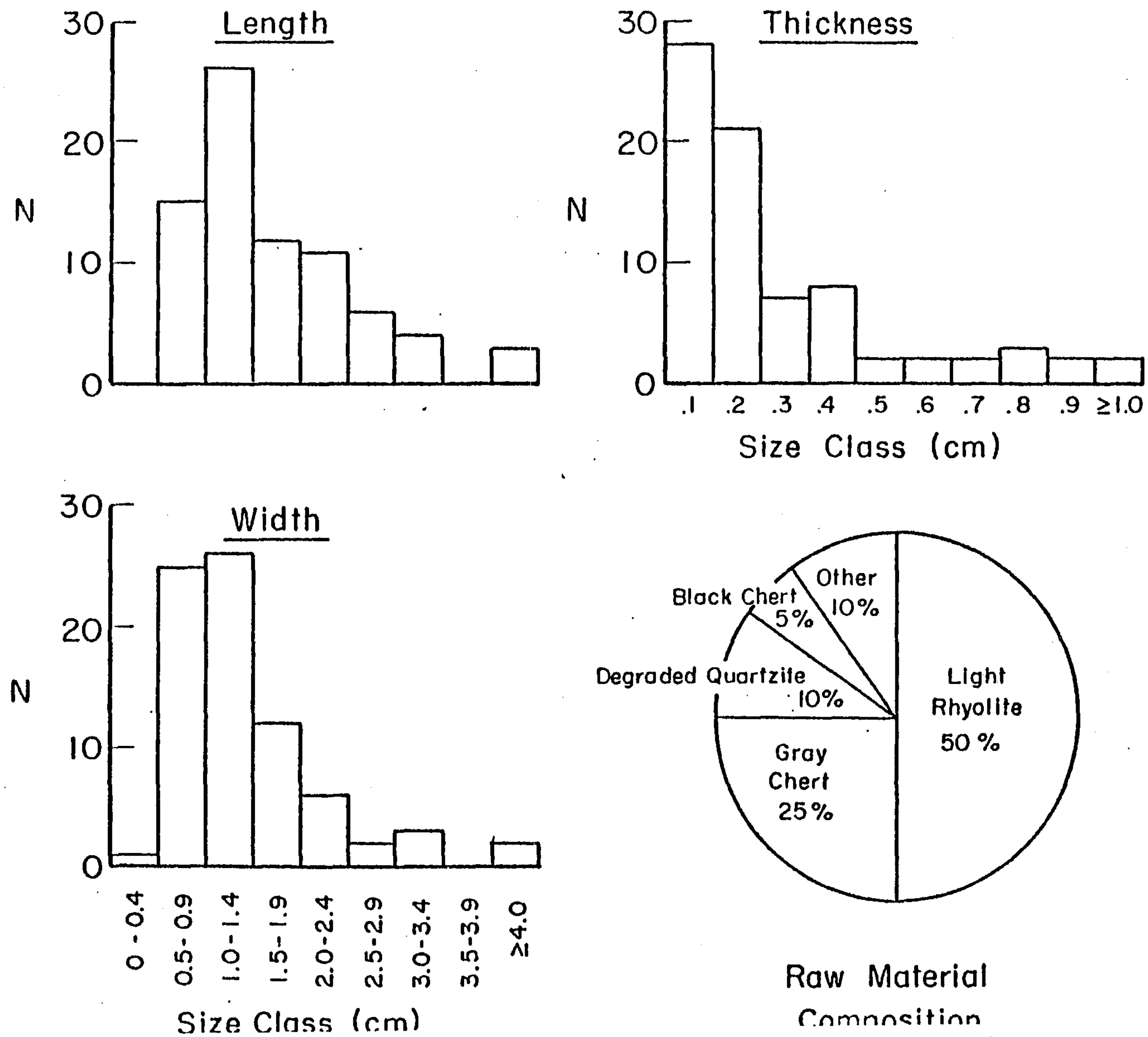

CLUSTER J n=75
Length
Thickness
Width
N
30
20
10
0
.1 .2 .3 .4 .5 .6 .7 .8 .9 ≥1.0
Size Class (cm)
0-0.4
0.5-0.9
1.0-1.4
1.5-1.9
2.0-2.4
2.5-2.9
3.0-3.4
3.5-3.9
≥4.0
Size Class (cm)
Other 21%
Degraded Quartzite 42%
Pumice 10%
Gray Chert 11%
Light Rhyolite 16%
Raw Material Composition

Figure A.11. Cluster K: Flake size and raw material composition

CLUSTER K n=77



Cluster K: Tools:

Catalogue No.	Description	Material	Dimensions
77-1375	Point Frag.	Light Rhyolite	2.1 x 2.3 x .8 cm
77-2318	Point Frag.	Light Rhyolite	4.8 x 1.7 x .9
77-3325	Point Frag.	Light Rhyolite	3.4 x 2.3 x .8
77-1578	Point Frag.	Chalcedony	3.3 x 2.7 x .8
77-939	Knife	Black Chert	6.5 x 2.5 x .9
77-1570	Burin	Gray Chert	2.8 x 3.1 x 1.0
77-3317	Utilized Flake	Gray Chert	4.3 x 2.5 x .9
77-1361	Retouched Flake	Light Rhyolite	5.5 x 3.2 x .8
77-1999	Biface	Dark Rhyolite	12.7 x 6.8 x 3.1
77-479	Biface Frag.	Brown Chert	5.8 x 7.3 x 2.1
77-3804	Core Tool	Sandstone	12.5 x 9.8 x 6.8

Cluster L

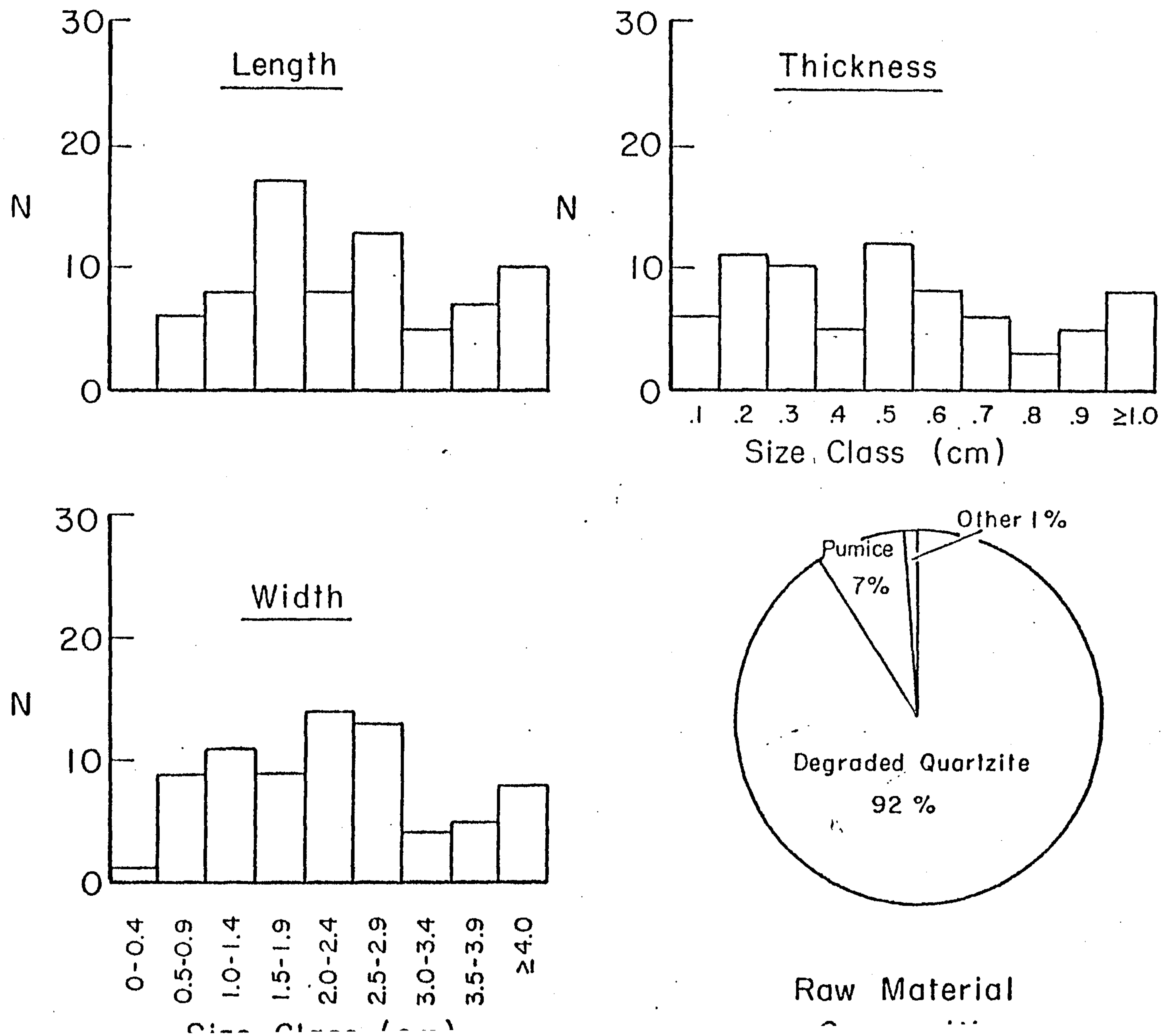
Over 760 flakes were recovered from this cluster. Degraded quartzite was virtually the only raw material used; a few pumice flakes were also found. No microblades, microblade cores, or burins are present, and the tools are confined to large crude bifacial implements. Two of these are true bifaces (one is broken), but the remaining four are relatively amorphous pieces which may be cores. There are two medium, somewhat more finely-worked biface fragments, one of which is made of light rhyolite.

It is difficult to distinguish edge-wear patterns on such coarse-grained, irregularly worked material, and the only damage visible is on the proximal end of some of the flakes. There is no sign of retouch. The flakes are unusually large and thick, and do not exhibit any of the characteristics of resharpening flakes. Faunal remains are present, but unidentifiable.

Cluster L is probably best explained in terms of butchering activities. Evidence for activities such as weapons production or hide working is lacking. The damage on the proximal ends of some of the

Figure A.12. Cluster L: Flake size and raw material composition

CLUSTER L n=74



Cluster L: Tools and Large Flakes:

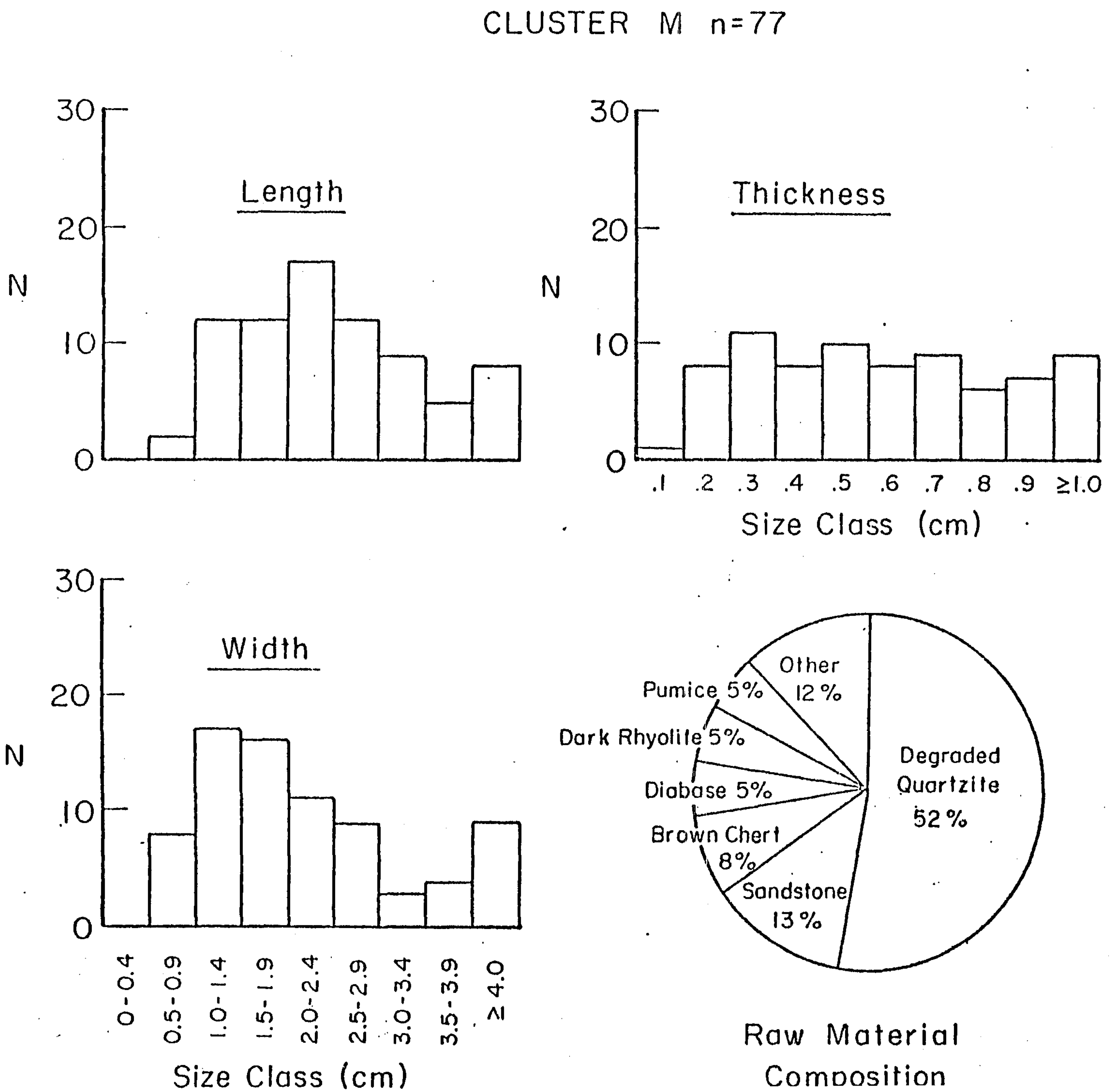
Catalogue No.	Description	Material	Dimensions
77-4920	Biface	Degraded Quartzite	25.0 x 12.3 x 3.9cm
77-5104	Biface	Degraded Quartzite	15.0 x 10.5 x 3.7
77-5129	Biface	Degraded Quartzite	14.8 x 8.9 x 4.9
77-4026	Biface Frag.	Degraded Quartzite	10.1 x 4.9 x 2.5
77-5127	Biface Frag.	Light Rhyolite	4.7 x 5.0 x 1.6
77-5124	Percussion Tool	Degraded Quartzite	16.0 x 10.5 x 7.5
77-5129	Percussion Tool	Degraded Quartzite	14.7 x 9.5 x 7.3
77-5129	Percussion Tool	Degraded Quartzite	17.0 x 10.3 x 7.1
77-5129	Percussion Tool	Sandstone	14.2 x 11.1 x 6.8
77-4820	Hammerstone	Degraded Quartzite	20.2 x 5.2 x 2.8
77-5126	Large Flake	Degraded Quartzite	8.7 x 7.4 x 1.8
77-5125	Large Flake	Degraded Quartzite	3.9 x 7.4 x 1.7
77-4326	Large Flake	Degraded Quartzite	6.6 x 5.2 x 2.1
77-4260	Large Flake	Degraded Quartzite	7.3 x 6.8 x 1.2
77-4999	Large Flake	Degraded Quartzite	4.8 x 9.2 x 2.2
77-4266	Large Flake	Degraded Quartzite	7.8 x 4.2 x 1.4
77-4321	Large Flake	Degraded Quartzite	8.0 x 4.1 x 1.4
77-4306	Large Flake	Degraded Quartzite	5.1 x 7.3 x 1.5
77-4900	Large Flake	Degraded Quartzite	4.2 x 6.7 x 1.1
77-5115	Large Flake	Degraded Quartzite	8.0 x 3.0 x 1.0
77-4317	Large Flake	Degraded Quartzite	4.8 x 9.7 x .8
77-4323	Large Flake	Degraded Quartzite	7.2 x 6.4 x 1.6
77-3018	Large Flake	Sandstone	6.7 x 2.9 x 1.0
77-3381	Large Flake	Dark Rhyolite	4.4 x 8.3 x 2.0

flakes can probably be accounted for by the impact necessary for detachment. The simple elements of a butchering tool kit are present, including both light and heavy cutting implements.

Cluster M

Cluster M is a large one, containing over 2,050 flakes. Coarse-grained materials predominate, especially degraded quartzite, sandstone, and a poor quality brown chert, presumably of local origin. Microblades and burins are absent, although one light rhyolite microblade core lies within the cluster. The tools include 29 large crude percussion implements, and two large-flake tools classified as scrapers.

Figure A.13. Cluster M: Flake size and raw material composition



CLUSTER M n=77
Length
Thickness
Width
N
30
20
10
0
.1 .2 .3 .4 .5 .6 .7 .8 .9 ≥1.0
Size Class (cm)
0-0.4 0.5-0.9 1.0-1.4 1.5-1.9 2.0-2.4 2.5-2.9 3.0-3.4 3.5-3.9 ≥4.0
Size Class (cm)
Other 12%
Pumice 5%
Dark Rhyolite 5%
Diabase 5%
Brown Chert 8%
Sandstone 13%
Degraded Quartzite 52%
Raw Material Composition

Cluster M: Cores, Tools, and Large Flakes:

Catalogue No.	Description	Material	Dimensions
77-5131(a)	Core	Degraded Quartzite	13.0 x 7.2 x 10.8
77-5131(b)	Core/Biface	Degraded Quartzite	15.2 x 9.4 x 7.2
77-5131(c)	Percussion Tool	Sandstone	15.5 x 10.0 x 7.0
77-5131(d)	Percussion Tool	Degraded Quartzite	13.9 x 9.9 x 3.3
77-5131(3)	Percussion Tool	Siltstone	12.8 x 5.4 x 3.0
77-5131(f)	Percussion Tool	Degraded Quartzite	13.0 x 10.5 x 7.1
77-5130(a)	Percussion Tool	Degraded Qaurtzite	16.6 x 9.3 x 7.0
77-5130(b)	Percussion Tool	Sandstone	2.7 x 9.3 x 6.7
77-5130(c)	Percussion Tool	Degraded Quartzite	16.9 x 7.8 x 7.2
77-5130(d)	Percussion Tool	Degraded Quartzite	18.7 x 10.4 x 7.4
77-5130(e)	Percussion Tool	Degraded Quartzite	17.6 x 7.6 x 4.3
77-5132(a)	Percussion Tool	Degraded Quartzite	13.9 x 11.1 x 6.5
77-5132(b)	Percussion Tool	Sandstone	15.5 x 10.4 x 5.1
77-5132(c)	Percussion Tool	Degraded Quartzite	16.5 x 10.6 x 5.9
77-5132(d)	Percussion Tool	Sandstone	13.9 x 10.4 x 8.4
77-5132(e)	Percussion Tool	Degraded Quartzite	15.5 x 9.3 x 6.5
77-5132(f)	Percussion Tool	Brown Chert	15.7 x 10.5 x 5.8
77-5135(a)	Percussion Tool	Degraded Quartzite	11.4 x 12.1 x 7.7
77-5135(b)	Scraper	Degraded Quartzite	14.4 x 10.0 x 4.1
77-5135(c)	Scraper	Degraded Quartzite	10.5 x 9.4 x 2.5
77-5135(d)	Percussion Tool	Siltstone	16.0 x 10.2 x 5.0
77-5135(e)	Percussion Tool	Degraded Quartzite	15.6 x 9.4 x 5.5
77-5135	Percussion Tool	Degraded Qaurtzite	15.0 x 10.5 x 5.5
77-5153	Core	Diabase	13.5 x 11.0 x 17.4
77-5141	Percussion Tool	Brown Chert	13.8 x 7.9 x 3.8
77-5152	Percussion Tool	Degraded Quartzite	12.2 x 9.6 x 3.0
77-3309	Percussion Tool	Degraded Quartzite	16.5 x 12.2 x 7.8
77-5199	Percussion Tool	Dark Rhyolite	20.3 x 8.5 x 8.2
77-5137	Percussion Tool	Degraded Quartzite	17.5 x 9.2 x 6.1
77-5151	Large Flake	Degraded Quartzite	6.0 x 6.4 x 2.0
77-3771	Large Flake	Brown Chert	3.7 x 7.3 x 1.9
77-3782	Large Flake	Sandstone	8.4 x 4.5 x 1.9
77-5151	Large Flake	Degraded Quartzite	7.9 x 5.5 x 1.8
77-3292	Large Flake	Sandstone	6.9 x 5.3 x 1.2
77-2330	Large Flake	Quartzite	7.2 x 5.7 x 1.8
77-5144	Large Flake	Sandstone	5.2 x 9.5 x 1.3
77-5136	Large Flake	Degraded Quartzite	4.8 x 10.0 x 1.8
77-5138	Large Flake	Degraded Quartzite	5.5 x 10.0 x 2.5
77-3768	Large Flake	Degraded Quartzite	6.7 x 4.6 x 1.1
77-5136	Large Flake	Dark Rhyolite	5.4 x 8.6 x 2.4
77-5136	Large Flake	Degraded Quartzite	10.7 x 5.5 x 2.4
77-5130	Large Flake	Dark Rhyolite	12.4 x 6.6 x 1.7
77-2031	Large Flake	Dark Rhyolite	10.1 x 6.7 x 1.7
77-5136	Large Flake	Quartzite	7.5 x 7.1 x 1.1
77-5136	Large Flake	Diabase	5.6 x 7.6 x 1.6
77-2356	Large Flake	Light Rhyolite	3.9 x 7.1 x 1.4
77-2031	Large Flake	Dark Rhyolite	4.6 x 6.6 x 1.0
77-2337	Large Flake	Sandstone	5.9 x 6.9 x 1.1
77-3307	Large Flake	Sandstone	7.4 x 3.7 x 1.1
77-3296	Large Flake	Degraded Quartzite	3.8 x 9.9 x 1.6
77-2032	Large Falke	Sandstone	7.8 x 6.5 x 1.0
77-4774	Large Flake	Sandstone	8.1 x 4.6 x 1.2
77-4872	Large Flake	Degraded Quartzite	7.0 x 5.3 x 1.6
77-3311	Large Flake	Dark Rhyolite	8.0 x 7.2 x 2.1

Neither the heavy percussion tools nor the flake scrapers, the latter possessing sharp edge angles of 35° - 45°, exhibit detectable wear. Many of the large flakes, however, which are unusually large and thick, do bear heavy scalar retouch on their proximal ends. Faunal remains were recovered from the western periphery of the cluster, but were unidentifiable.

This cluster, a large portion of which may remain unexcavated (see Figure 5-1), is consistent with the butchering tool kit model, and lacks substantial evidence for other types of activities. The light rhyolite microblade core is probably intrusive, perhaps from Cluster N, which contains microblades of that material. The scalar retouch on some of the flakes seems most likely to be the product of the heavy blows which must have been necessary to detach them from the percussion tools or cores. The possibility that some bone or antler work was occurring here cannot be excluded, however.

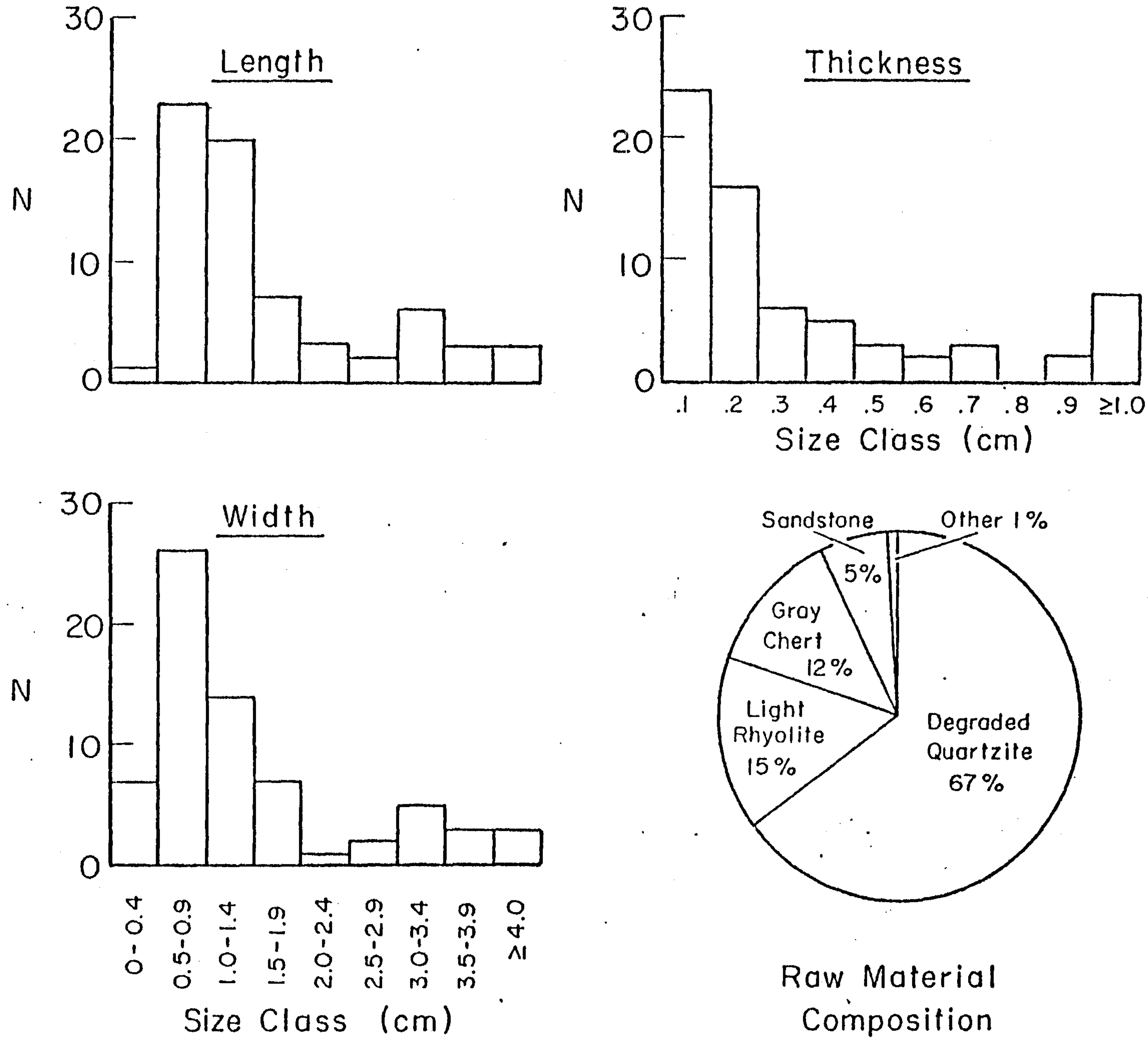
Cluster N

Cluster N lies on the western margin of the excavation where the complex stratigraphy of the site is highly compressed. Assignment of artifacts to their proper vertical provenience relative to other clusters was difficult, and this problem was further compounded by high frozen ground levels during excavation. Many of the artifacts may in fact belong to Paleosol 2 and constitute part of a separate, younger component. In this analysis, these materials have been lumped together, because of the difficulties of isolating the potentially younger artifacts.

Over 1,190 flakes were recovered, and the raw material composition

Figure A.14. Cluster N: Flake size and raw material composition

CLUSTER N n=68



Cluster N: Cores, Tools, and Large Flakes:

Catalogue No.	Description	Material	Dimensions
76-5058	Microblade Core	Gray Chert	1.7 x 1.5 x 2.2 cm
76-1787	Microblade Core	Gray Chert	2.0 x 1.3 x 2.2
77-2777	Microblade Core*	Light Rhyolite	2.3 x 1.7 x 2.8
76-2346	Burin	Gray Chert	2.0 x 1.7 x .6
76-2366	Burin	Gray Chert	1.8 x 2.0 x .4
76-2023	Burin	Gray Chert	2.2 x 1.9 x .4
76-2017	Burin	Chalcedony	2.7 x 1.4 x .4
76-2030	Burin	Gray Chert	4.2 x 1.2 x .8
76-2081	Burin	Gray Chert	3.5 x 1.9 x .5
76-2016	Burin	Light Rhyolite	2.2 x 1.6 x .5
76-2125	Burin	Black Chert	2.7 x 2.3 x .5
76-1785	Burin	Gray Chert	2.3 x 2.0 x .6
76-1725	Large Flake	Degraded Quartzite	8.1 x 8.5 x .8
76-1831	Large Flake	Dark Rhyolite	10.3 x 4.3 x 2.2
76-1950	Large Flake	Dark Rhyolite	8.1 x 5.4 x 2.2
76-5035	Large Flake	Sandstone	10.4 x 8.8 x 1.8

(* located in Cluster M)

includes both poor quality local rock (degraded quartzite and sandstone) and good quality imported rock (light rhyolite and gray chert). Two gray chert microblade cores are present, associated with a total of 385 microblades and microblade fragments, mostly of gray chert. The microcores are unusual in their large width, relative to their length. Nine burins were also recovered, along with several burin spalls. Bifacial tools are absent.

Although flake size is generally small, there are a number of larger crude flakes of coarse-grained material. These lack discernible signs of wear. It is difficult to characterize most of the waste flakes, except to note that they do not suggest bifacial work. Faunal remains were found on the eastern periphery of the cluster, but were unidentifiable.

Cluster N presents some problems of interpretation. The expected elements of the microblade-inset spear tool kit are here, including cores, core parts, microblades, and burins. The scatter of large degraded quartzite and sandstone flakes is more suggestive of some butchering activity, but heavier cutting implements are lacking. It is conceivable, considering the atypical morphology of the microblade cores and their possible stratigraphic provenience, that the microblade production and related work occurred at a later period. The large flakes, although distributed throughout the cluster, could be intrusive from Cluster M.

Artifact Clusters in Component I

Cluster X

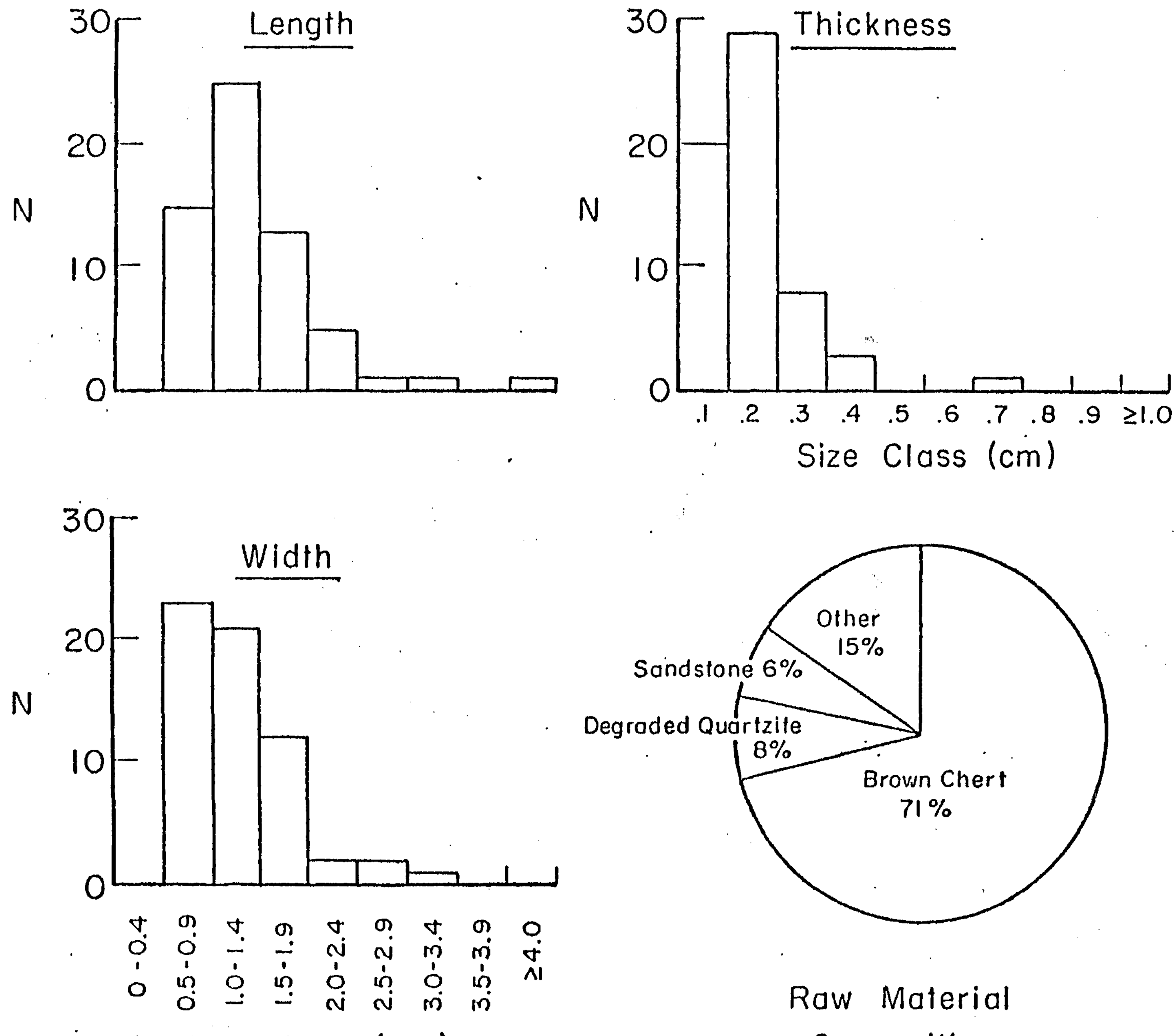
Cluster X consists of over 1,160 flakes. The predominant raw material is a moderately good quality brown chert; some degraded quartzite and sandstone are also present. Worked implements include a brown chert bifacial knife, the tip of a wide unifacial brown chert knife, a gray chert rectangular point base, and a crude biface fragment of poor quality chert. Within two meters of the periphery of this cluster, a brown chert retouched flake was recovered.

None of the tools reflect clear indications of wear, and according to Del Bene, the point base exhibits no edge-grinding and thus no suggestion of hafting. Flake size is small, being influenced by the large number of small brown chert waste flakes. Most of the flakes do not display the characteristics of bifacial resharpening flakes. Faunal remains are present but unidentifiable.

This cluster is extremely difficult to interpret. It is not consistent with any of the tool kit models used in this analysis, nor is it consistent with the expected residues of other activities such as

Figure A.15. Cluster X: Flake size and raw material composition

CLUSTER X n=61



Cluster X. Tools and Large Flakes:

Catalogue No.	Description	Material	Dimensions
76-4382	Knife Frag.	Brown Chert	3.6 x 3.0 x .5
76-5311	Point Base	Gray Chert	.8 x 1.8 x .3
76-1674	Biface Frag.	Gray Chert	3.1 x 6.0 x 2.0
76-5320	Large Flake	Degraded Quartzite	8.1 x 3.4 x .6
76-5327	Biface*	Brown Chert	6.2 x 3.3 x .8

hide working or plant preparation. The lack of gray chert waste flakes suggests that the point base was not made or modified here; it may be intrusive. The bifaces could have been used for meat processing, although there are few of the medium and large flakes present which are associated with other clusters thought to represent this type of activity.

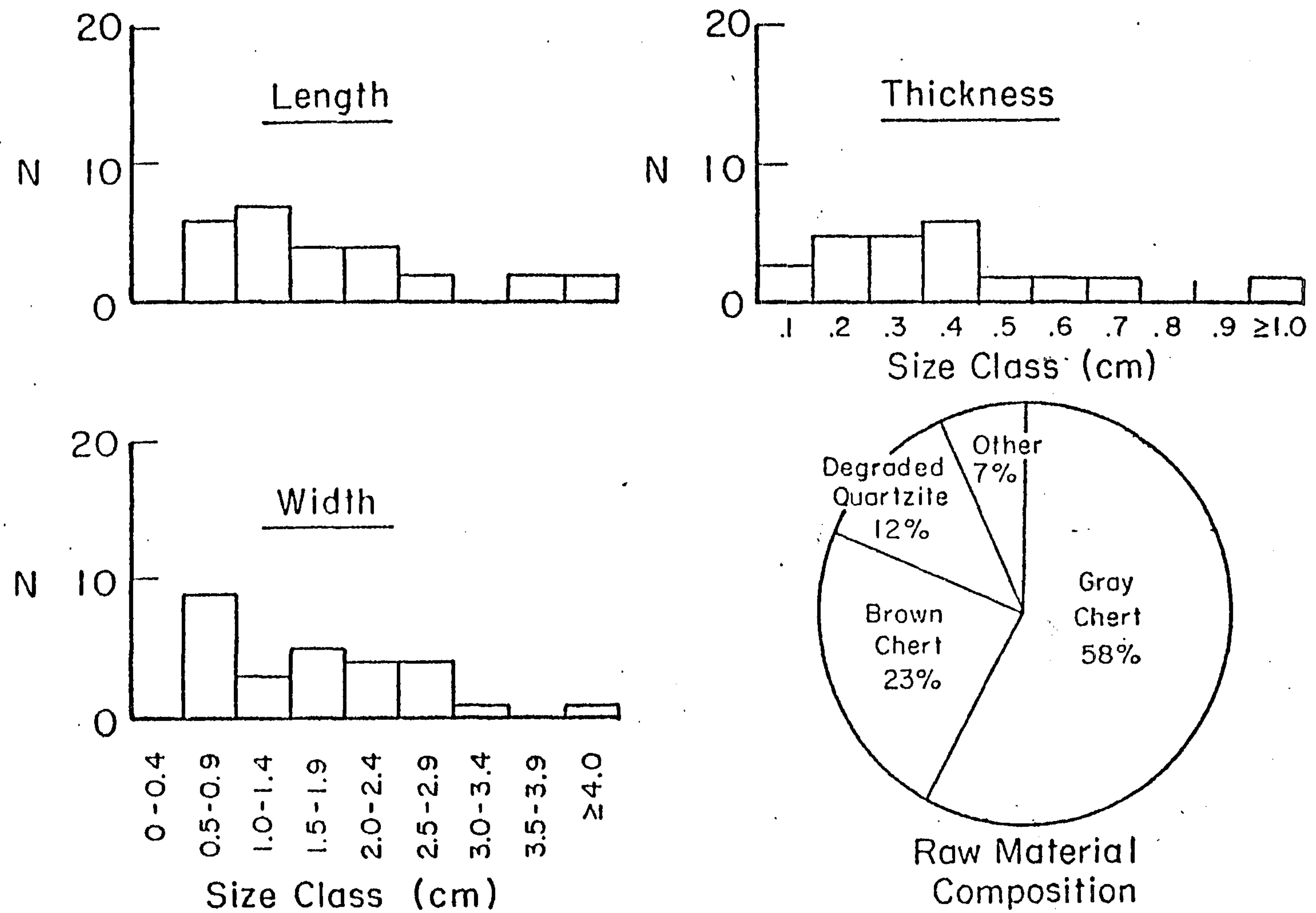
Cluster Y

This cluster is small, being composed of little more than 110 flakes. The raw materials used here appear to have been of local origin, and include gray and brown chert of poor quality and degraded quartzite. Tools include a small end scraper, a large chopping tool manufactured on a flat cobble of dark rhyolite, a split cobble scraping tool, and a utilized flake A rectangular point base of good quality chert is also present.

The end scraper possesses a steep edge angle (75°), and according to Del Bene, exhibits the type of wear patterning characteristic of scraping hard surfaces. The narrow edge of the utilized flake (35° angle) bears mild damage. The chopping tool possess a steeper edge (75° angle), which displays heavy scalar retouch wear. Del Bene observes that the edges of the point base show no sign of grinding. Flake size is in the medium/large range for the site. Many of the waste flakes

Figure A.16. Cluster Y: Flake size and raw material composition

CLUSTER Y n=27



retain portions of cortex and some manifest scalar retouch on their proximal ends. Faunal remains are present and teeth fragments have been identified as belonging to Cervus.

Cluster Y is another problematic one. The waste flakes suggest that one or more tools used here are no longer present--tools which may have been employed for working hard materials like bone or antler. The wear on the end scraper also suggests this type of activity. There is little evidence of bifacial working; the significance of the point base is unclear. It seems possible, however, that some meat processing activity took place here.

Cluster Y: Tools and Large Flakes:

Catalogue No.	Description	Material	Dimensions
76-4563	Point Base	Gray Chert	.8 x 2.4 x .3 cm
76-4270	End Scraper	Tan Chert	2.1 x 1.7 x .6
76-4632	Utilized Flake	Black Chert	4.2 x 2.3 x .8
76-4516	Chopping Tool	Dark Rhyolite	17.5 x10.9 x 3.1
76-4273	Scraping Tool	Degraded Quartzite	10.7 x 6.3 x 1.9
76-4210	Large Flake	Degraded Quartzite	7.4 x 5.3 x 1.7

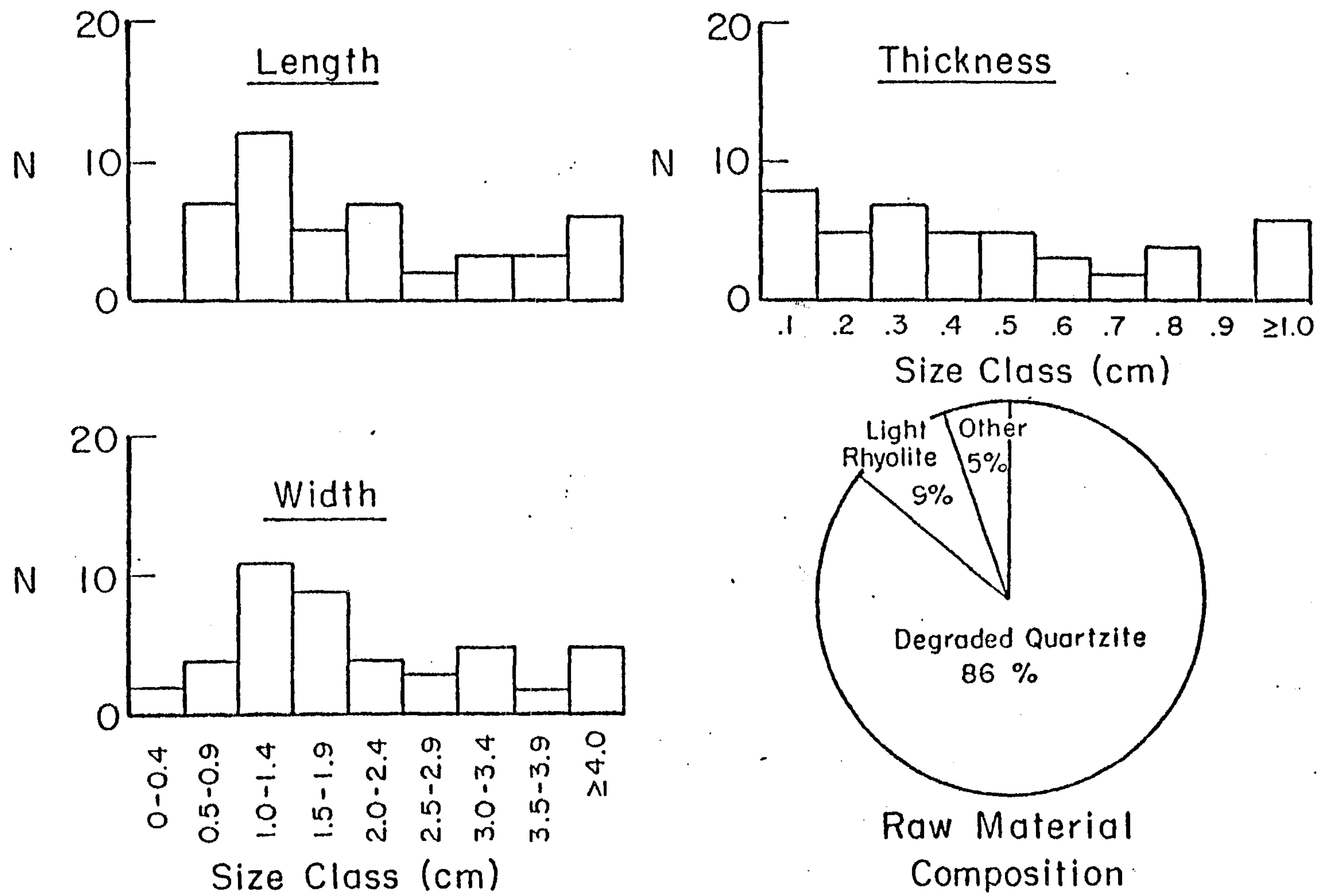
Cluster Z

Cluster Z is composed of over 500 flakes. Most of these are of degraded quartzite; some light rhyolite was used. The tools are limited to a medium-sized scraper of crude manufacture and two broken cobbles, one of which has been worked into a chopping tool. Another broken cobble has been classified as a core.

The worked cobble possesses a steep edge (80° angle) and bears heavy scalar retouch. The other cobble does not manifest significant wear. One of the flakes also possesses a steep-edge angle (approaching 90°) and bears scalar retouch. The side scraper displays a medium edge

Figure A.17. Cluster Z: Flake size and raw material composition

CLUSTER Z n=45



angle (45° - 60°) and no macroscopically visible wear. The flakes are generally large, and most do not exhibit the characteristics of resharpening flakes. Faunal remains are present, and teeth fragments within one meter of the northwestern periphery of the cluster were identified as belonging to Ovis dalli.

This cluster is probably best accounted for in terms of butchering activities. The tools and flakes comprise the necessary equipment. Although some bone working may have occurred, there is no substantial evidence for weapons production or other activities here.

Cluster Z: Tools and Large Flakes:

Catalogue No.	Description	Material	Dimensions
77-2732	Core	Degraded Quartzite	12.4 x 11.8 x 6.4cm
77-3726	Scraper	Degraded Quartzite	6.2 x 4.1 x 1.0
77-2728	Percussion Tool	Degraded Quartzite	15.4 x 7.0 x 4.1
77-2701	Percussion Tool	Degraded Quartzite	18.0 x 8.2 x 6.4
77-3743	Large Flakes(17)	Degraded Quartzite	($\bar{x}$) 7.3 x 5.6 x 1.6

APPENDIX B

COMPOSITE BONE-STONE TOOL REPRODUCTION AND TESTING

by

R. Dale Guthrie

COMPOSITE BONE-STONE TOOL REPRODUCTION AND TESTING

Introduction

In order to better understand the processes used to manufacture some of the tools found at the site, antler and some original microblades found on the slope colluvium of the Dry Creek Site, without stratigraphic provenience, were used to construct a representative composite weapon tip. Duplication of a composite projectile point was thought to be a worthwhile endeavor as reproduction of tool manufacturing techniques has traditionally involved mainly biface stone implements. In deference to researchers with extensive experience in these areas, I have not discussed details of stone tool production of the microblades, but have concentrated on their hafting methods and use. Suffice to say that a large fund of information exists about stone implement production, especially biface points, scrapers, etc. There is less information about microblade production and very little about bone/antler working (e.g. Semenov, 1964; Bonnichsen, 1979). As I have had some experience in bone and ivory carving and a paleontologists' background in osteology, it seemed appropriate to investigate the osseous component of tool production.

To me, the most intriguing tools associated with early man in Beringia are the inset microblades and osseous spear points. The craftsmanship of these thin microblades is outstanding. Microblade production compared to normal knapping is a little like comparing watchmaking to blacksmithing. A hundred microblades may be taken from a small core not much larger than a peach-pit. They must not be much larger than a pencil lead in thickness and have only slight variation, as they must all fit friction tight in a groove of the same width. Composite points were made from a splinter of antler, shaped into a point, and grooved to hold a row of these minute stone blades.

Although microblades are the most frequent early-man artifact from Alaska and Northeastern Canada during the late Pleistocene and early Holocene, there has yet to be a single find of these stones mounted in antler or bone. So the argument of their hafting is circumstantial, yet it is, I think, none-the-less a strong argument. It is in summary:

Hafting

1. This same microblade design has been found mounted in thin-grooved reindeer antler splinters in Siberia (Abravmova, 1967). Asia is the area of their origin and the two lithic traditions of Diuktai and Denali collectively called by West (1981) the Berigian Tradition seem to grade inseparably across Beringia.
2. The finished grooved antler splinters have been found in Alaska in Trail Creek Caves (Larsen, 1968) on the Seward Peninsula.
3. The tradition of small stones inset into antler or bone seems to be almost continuous in the north coast of Alaska from these late Pleistocene origins to the present, although microblades change to retouched small microliths.

Function--Projectile Points instead of Knives

1. The major evidence for their use comes from a reindeer antler composite point imbedded in a scapula of steppe bison, Bison priscus, in southern Siberia (Abramova, 1967).
2. Because of the fragile nature of the composite piece, it would have

been unusually sensitive to torsional stress like that met with in using a knife for butchering. Torsional stress is one of the most limiting factors of knife design by early peoples (Spiess, 1979).

Only the very best cryptocrystalline stone can be used to make the tiny, razor-sharp microblades. Many of these slender, sharp-edged flakes were produced from a single small stone. High quality stone which is easily worked and produces a sharp edge, (e.g. obsidian) is typically rare in Beringia and microblade insets are a very efficient use of this rare material. Microblades average 1 to 2 mm thick and less than a centimeter wide. They vary in length, but presumably only the middle section was inset in projectile points and the distal and proximal portions were either used directly or discarded. Judging from the Asian counterparts, these middle segments of the stone microblades were inset end-to-end on the lateral edge (or edges) of a piece of antler thinned to form a blade and sharpened to a point.

Most of the sites of Beringian Tradition throughout the north have a varying array of stone types. The finest quality end of the spectrum is invariably used to manufacture microblades and the poorer quality stone is used for tools of less demanding purposes. This same pattern is true of the Dry Creek site. It would appear as if fine quality of stone was a limiting factor in point design in the north. Composite projectile points were undoubtably the most efficient use of these minute amounts of stone which could be worked to a fine cutting edge. The design and production of microblades required stone of the highest quality. Poorer stone would not behave in the same manner. The two Alaskan sites of this age which deviate somewhat from the Paleo-Arctic tradition are the two sites which have poor quality stone: Anangula (Laughlin, 1967) and Gallagher Flint Station (Dixon, 1975) the former has a shaley chert and the latter a siltstone.

Microblade edges inset in a bone (or antler) spear point greatly increase the cutting damage in the viscera of the animal, and because a spear must kill by causing internal hemorrhage, stone cutting edges make the spear point a much more effective weapon. A simple sharpened bone tip is effective in puncturing a lung, or occasionally rupturing a major artery or vein if the blood vessel is hit directly. A sharp edge moving through the viscera causes much greater damage, severing blood vessels left unharmed by the passage of the sharpened tip. If the sharp-edged tool stays in the body as the animal runs away in flight the blade would continue to cut, causing even greater damage. The desired effect by the hunter is to have the animal collapse in the shortest possible time - i.e., the shortest distance. That seems to be the major role of the microblades.

The Reproduced Composite Point

As in any reconstruction of human craft techniques over 10,000 years old, we will probably never know exactly how they went about it, but some information does exist which allows us to piece together a tentative possibility. It is only within that context that this reconstruction took place.

Having the monograph on Star Carr by Clark (1954) before me with its well-illustrated antler groove and splinter technique and the paper by Abramova (1967) ("O Vkladyshevykh orvdiiakh V Paleolita Yenisei,"), I proceeded to make an antler stone-blade spear point. Also I photographed and examined dozens of antler projectile points and antler-stone projectile points from prehistoric archeological sites from across the Arctic.

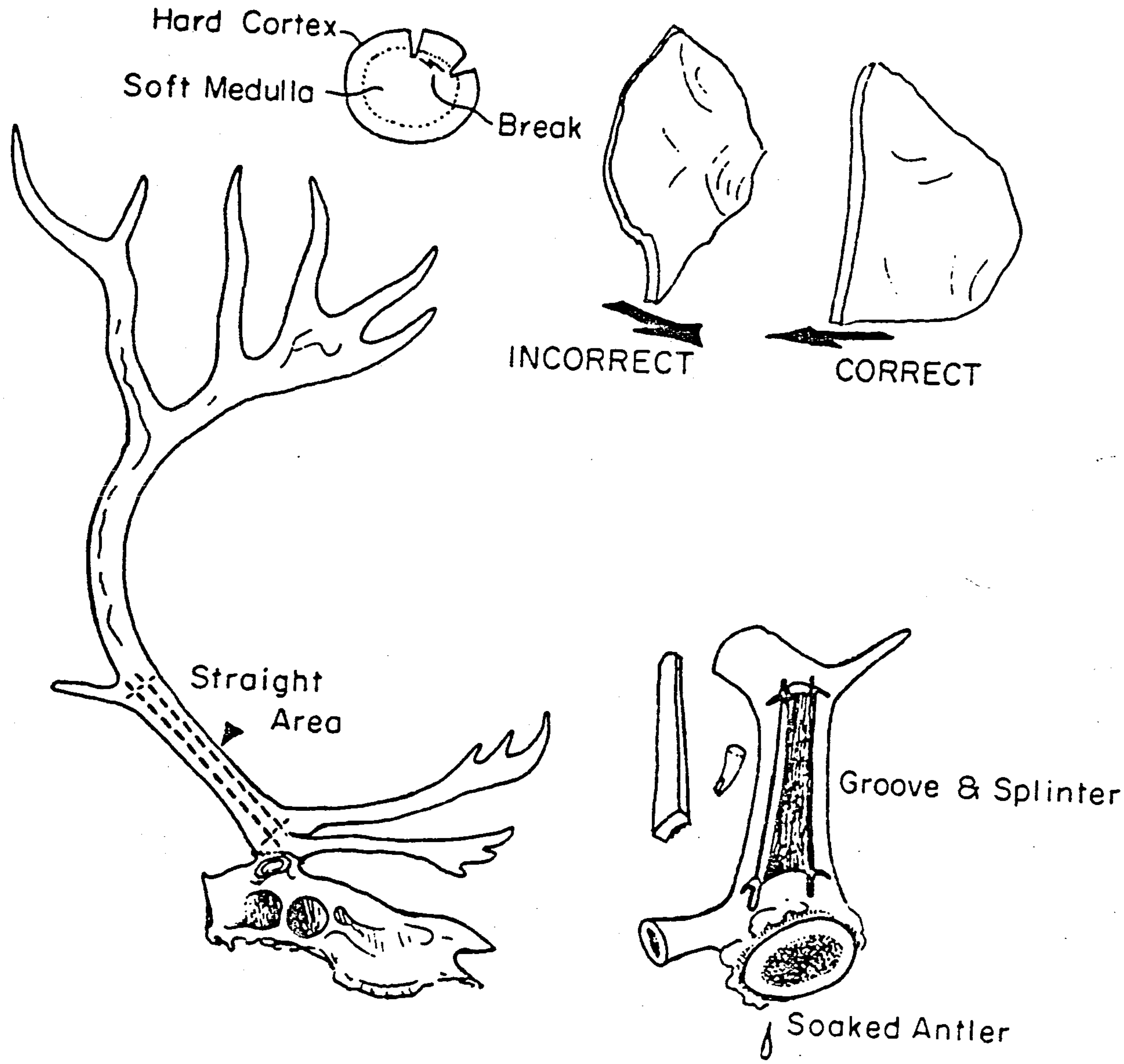
I began with a caribou antler from a large 8-year-old bull taken from the Nelchina herd - among the largest bodied and antlered caribou herds in Alaska. I sawed the antler from the skull to make it easier to work on, though I have often broken antlers or antlers and calvarium from skulls with sharp rocks of 2-3 kg while backpack hunting. Caribou skulls are relatively fragile and easy to break apart (unlike mountain sheep, bison and muskoxen skulls). Although this was a very large antler (4 kg), there was only one section straight enough to provide a blank from which to make the projectile point, other blanks would have had to be straightened. This straight section was between the burr and the tiny posterior tine (Fig. B.1.). All sides of this section were useable, but no straight lengths were found which exceeded 25 cm and most were nearer 20 cm. This is the long section Corbin (1975) refers to in the production of <u>main beam cores</u>.

I chose a line on the medial surface, marked off a long rectangle, and commenced to scrape the groove. I used bottle glass to reproduce the simple scraping burins illustrated by Clark (1954) and also present at the Dry Creek site. The grooving process was quite slow on the dry antler and the burin chipped easily when much force was applied, so I soaked the antler in water overnight to soften it (Corbin, 1975).

Scraping laterally with the face of the glass broke the burin whether the antler was wet or dry. The motion had to be "backed" with the forward burin edge doing the scraping (Fig. B.1.). The antler seemed considerably softer when wet and progress was faster. However,

Figure B.1. Possible mode of bone point construction.

During the reproduction of the antler point, I became aware that there is one segment of the antler beam which is usually quite straight. While others are segments of arcs (lower left), the antler is essentially a tube (upper left), from which a burin can be used like a milling lug instead of a scraper (upper right), to groove and splinter from a soaked antler, (lower right).


Hard Cortex
Soft Medulla
Break
INCORRECT
CORRECT
Straight Area
Groove & Splinter
Soaked Antler

it is a slow process which worked best with moderately light strokes repeated thousands of times. The entire grooving process on the wet antler took about 3 hours total. The cross-end grooves could be made first. I began with the long grooves. It also helps to wet the grooves occasionally, even after soaking. All the Upper Paleolithic antlers from Les Eyzies, France show only longitudinal grooves, the antler beam was then broken entire at the ends of the grooved section (personal observation).

Burins like the ones at the site could easily be used without hafting, though they may have been hafted. Great pressure on the burin edge resulted in breakage and the greater pressure allowed by handles would have had to remain unused. The advantage of handles is that they add comfort to jobs requiring many hours of work.

The grooves must penetrate the dense antler cortex to the spongy medullary tissue around the perimeter of all four sides of the blank before the splinter can be easily broken loose. Penetration of the spongy medullary portion was recognized when dark reddish-maroon color of the blood still remaining in the interior of the antler appeared (the caribou had been killed in early September, just after the velvet was shed).

The splintering technique involves wedging the grooves apart to crack the cortex splinter from the medulla. In the Star Carr site there were small antler-tine wedges about 4-5 cm. I made one of these by grooving around an antler tine and snapping it off. A flat wedge was ground into the tip and it was inserted in a groove. After pounding downward (centrally) the wedge was hit with an angling stroke. This created a fine crack after several efforts, into which the wedge was inserted. After 3 more hits, the splinter broke loose. I shaped the splinter by grinding it on stone. This stone shaping was effective but after shaping several points it became obvious that many hours were involved, and I then resorted to a power sander. Even so, the material was quite dense and even with the power sander the work was slow.

After completion of the points I noticed the fine linear facets on the prehistoric points from Eskimo archeological sites (and Magdalenian bone points). These were undoubtably from scraping not grinding so I again wet an antler splinter and began shaving it to shape with the sharp edge of bottle glass. It was much more effecient and gave better control of the ultimate contour of the product. I found this technique worked very well on green wood which was probably the medium in which the technique originally began and later was transferred to wet antler.

I tried to approximate the size and form of the point illustrated by Abramova (1967). On the lateral edges I left a flat surface of about 2 mm. The point was then given a final sanding. The edges were scored with a groove about 1 mm wide and 1 mm deep. Complete preparation of the point before attempting the final microblade grooves allowed me to pinch the burin between thumb and forefinger on the antler splinter edge and thus control alignment of the groove (Fig. B.2.). At this stage I suspect the Paleoindian craftsman resoaked the point and used an unusually fine burin, perhaps one of the microblades (maybe the proximal stubs), to deepen the groove. I found that the narrow trapezoidal microblades worked better than the more fragile triangular microblades as a burin to set the groove. For the final stages I used a needle file and "Dremel tool" to control width - by an untrained hand.

The depth of the grooves was around 3 mm at the base tapering to flush with the edge at the distal end. On inspecting numerous microblades from the Dry Creek site it became obvious why many were left unused. Most were too narrow or too wide or a hinge fracture had occurred half way down the blade, leaving a lump.

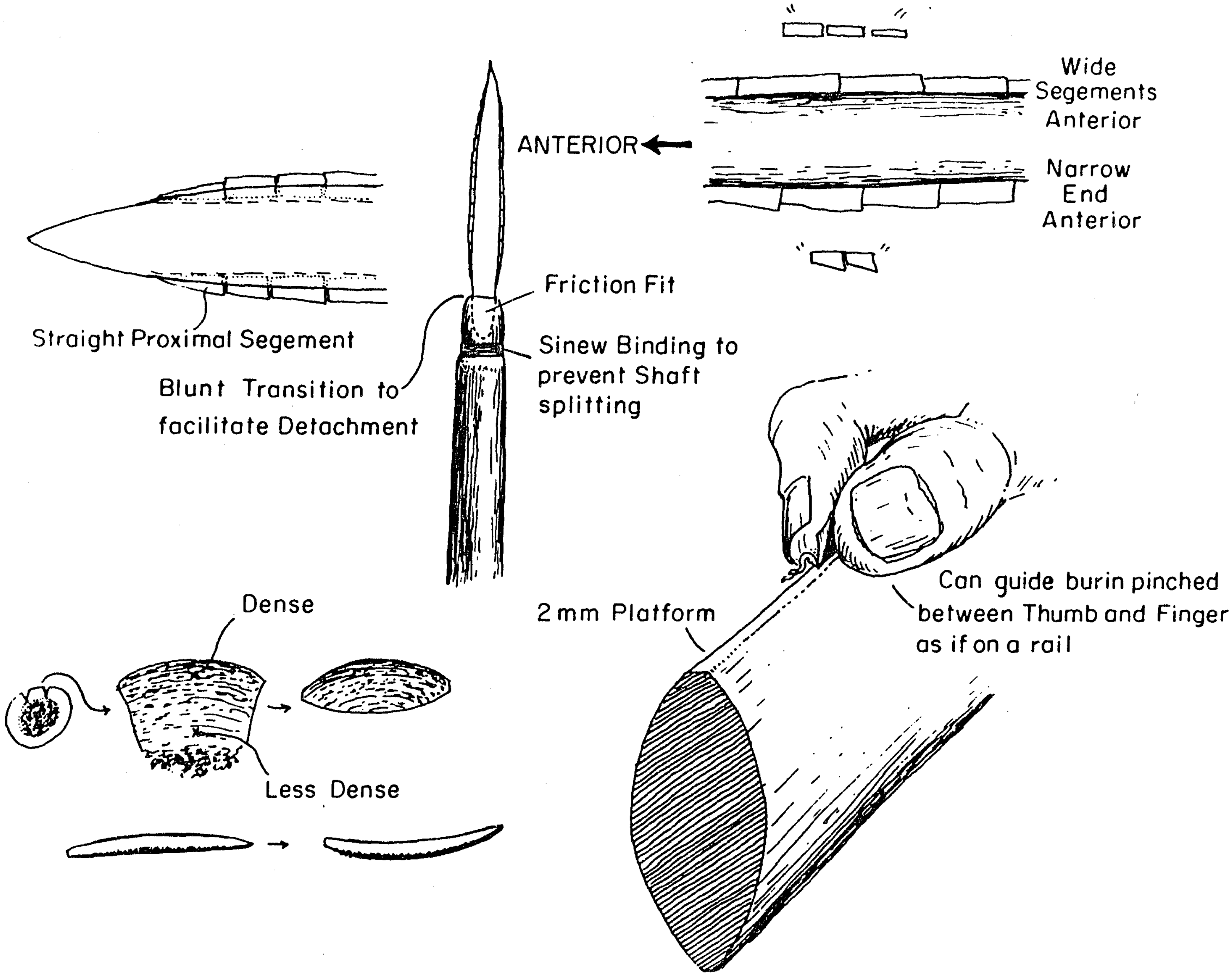
I broke the blades I needed to use into segments by placing thumbnails back to back and bending the blade toward them. Most broke cleanly at right angles. A slight scoring might have helped get a straighter break.

The blades I found most useful approximated isosceles triangles in cross-section, only a few of the trapezoidal blades could fit exactly into the groove. These latter seem to represent blades removed to allow more triangular blades to be struck (Fig. B.3.) and, if used, were perhaps for purposes other than projectile point edges. The isosceles cross section fits into the groove on its side, and therefore has a left and right side. Once a run of segments has begun, the entire row must continue with the isosceles base either all to the right or all to the left. Otherwise, an alternation will disrupt the running edge (Fig. B.3.).

The slight microblade curvature tends to hold the blades in the groove, but they cannot be pounded on the fragile edge. There was no manner in which the blades varying in thickness could all be recessed to an exact tight fit into the same groove. The triangular cross-sectioned blades compensate for this deficiency to a considerable extent; the parallel-sided trapezoidal blades do not. It is also probable that some glue or resin-like substance was used which hardened to give the blades a tight fit. Some inset microliths in the Old World do have a black

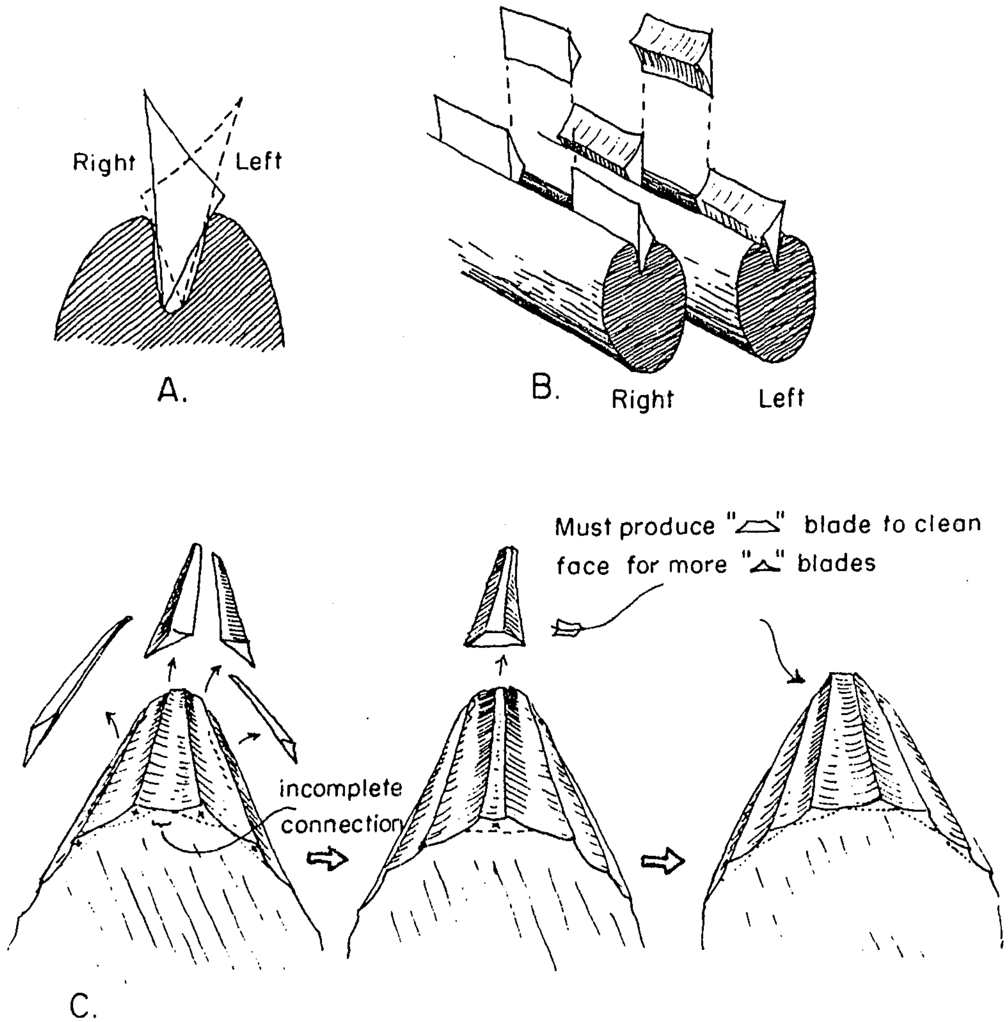
Figure B.2. Possible mode of microblade inset.

Some of the microblades found at the Dry Creek Site were probably part of antler-stone composite projectile points. One such point was reconstructed, being modeled after points found at other sites. In the process of its manufacture, several principles emerged; the manner in which the groove could have been routed (lower right), the reason for antler warping due to density differentials (lower left), the manner in which irregular microblade widths can be used (upper right) and the way in which the microblade row may begin and how it can be affixed to the shaft (upper left).



Wide Segements Anterior
ANTERIOR
Narrow End Anterior
Friction Fit
Straight Proximal Segement
Sinew Binding to prevent Shaft splitting
Blunt Transition to facilitate Detachment
Dense
2 mm Platform
Can guide burin pinched between Thumb and Finger as if on a rail
Less Dense

Figure B.3. Functional morphology of the microblade inset segments. In the process of insetting microblades into the grooved antler splinter, it became obvious that the microblades which were triangular in cross-section were easier to seat than the trapezoidal ones. The trapezoidal microblades probably were either used for other purposes or produced in the process of punching the triangular blades (lower illustrations). The upper two illustrations portray the observation that once a row has begun, it must "run" either all right or all left in symmetry, otherwise, the composite edge would be irregular, and hence reduce penetration, and result in microblade damage.



Right
Left
A.
B.
Right
Left
Must produce "⏢" blade to clean
face for more "∧" blades
incomplete
connection
C.

pitch-like substance associated with them (Leroi-Gourhan, 1967). What the Diuktai-Denali (Beringian Tradition) people used is unknown. The protein in egg albumen or in blood would probably be suitable. I used a minute bead of diluted Elmer's glue (which is based on the milk protein, casein).

Like a stone mason fitting flagstone, it helps to have an ample variety of material on hand from which to select pieces compatable in width and thickness. It is thus likely that many microblades were struck at once and several points made from different ranges of blade thickness and widths -- at least that is an obvious way to circumvent the problems associated with the inherent variation in microblade production. In fact the complete series of preparation flakes, platform retouch flakes, microcore, and microblade fragments from the same blank, all found togehter at the Dry Creek site strongly suggests that this was the strategy used.

Antler is a tolerant medium with which to work: size and shape can be easily controlled and the antler point is astonishingly strong yet resilient, almost comparable to soft metal. The collagen matrix allows it to flex; at the same time the inorganic structure gives it rigidity. Stone points are hard and hold a good edge, but are brittle and easily fractured. The antler point is almost indestructable, but the inset blades seem to be moderately fragile.

Details of the mounting and use of these composite points is not at all clear. It may have been convenient to carry several antler points. Multiple detachable points seem to be common among some spear-lance using groups. Only one shaft has to be carried and can be retrieved and quickly rearmed with a new point after each hit. From bowhunting, I am familiar with the phenomenon of using less valuable shafts to take high risk shots and reserving quality shafts for the important occasion. This may have been the practice among Paleoindians as well.

It is possible that the razor-sharp microblade-antler points were carried in sheaths, like the whaler's harpoon-head, to protect both the tool and the carrier. Upon sighting game the hunters could quickly arm their spears. Although, if European Paleolithic points and Eskimo caribou spears are any indicator, the projectile points were probably permanently affixed, and the hunters probably carried several light spears to use with a spear thrower.

It might be worthwhile for those unfamiliar with antler composition to mention a few characteristics of the material. Although antlers are solid, the cortex is the main supporting structure; the medullary portion is a pithy, spongy bone. The cortex forms a dense shell from which quality tools can be made. The microstructure of this shell is a layered arrangement, almost like plywood.

Antlers, unlike bone, can undergo large amounts of plastic deformation without fracture. Currey's (1979) calculations on the Work of Fracture (J/m^2) between red deer antler and a cow femur showed measurements of 6,186 and 1,710 respectively. Deer antlers have been selected to catch the opponent's violent twist and thrust by being impact resistant and able to absorb energy in a plastic flow. Bone, on the other hand, functions in long bones as a lever and as such needs to be rather stiff. The two differ considerably in mineral content, elasticity, and density (Currey, 1979). Antler thus has unique properties which make it optimal for projectile points, point straightners, and similar tools. I have sectioned antlers of several deer and found caribou/reindeer (Rangifer) to have a much thicker cortex than other deer. The thick Antler cortex exhibits the necessary tool qualities of a projectile point, and explains why Rangifer antlers were used predominatly, when available, by Magdalenians, and Eskimos. Antlers of other species, like red deer (Cervus), were resorted to only when there were no Rangifer available (Clark, 1954). The antler cortex of my specimen averages around 8-9 mm in the antler base to about 4 mm near the distal end of the beam. This provides material with a wide range of thickness and contour for tool manufacture. I have begun to test the finished point on carcasses of slaughtered animals and on my own live domestic animals ready for slaughter. The composite point is amazingly effective and penetrates easily. The microblades cause little trauma to the tissue, allowing for free and rapid internal hemorrhaging and hence rapid debilitation and death. There seems to be little emotional trauma, that is, less fright or startle at the time of impact - much less than a bullet wound.

Some Ideas about Composite Point Manufacture

In the process of making and using my antler point with inset microblades, several ideas emerged as to the earlier manufacture and use of such points. These ideas are listed below; a more detailed discussion follows:

1. There is an inherent, unavoidable variability in microblade production, such that few blades are of the exact width of any groove which would contain them. The wedge on the triangular microblades cross-section compensate for this variability.

2. Microblades which are trapezoidal in cross-section are virtually unuseable as insets because they lack the above triangular feature.

3. The use of some glue-like substance helps to seat the microblade and wedge it more securely in the groove.

4. Some variability in protrusion of microblades from the groove is also unavoidable, but this is of little importance if the protrusion is always greater proximally, near the antler point base.

5. Even when some blades are chipped, the entire point with the chipped blades can be used at least several times without repair. The antler splinter is extremely durable and could have additionally been reset with new microblades a number of times.

6. The production or repair of multiple microblade projectile points at the Dry Creek site occurred on at least four occasions.

7. The inset microblade antler point is the most efficient use of high quality stone in terms of length of cutting edge or number of points.

8. The use of antler points produced from readily available material that was moderately easy to work and extremely durable was, however, accompanied by chronic warping due to the medio-lateral density gradient in the antler cortex.

9. Microblades are vulnerable to chipping and dulling, such that it would be necessary to carry either extra points or repair blades in a protective container or wrapping.

10. The antler point can be sharpened to an extremely sharp tip facilitating penetration, however, neither antler, ivory, nor bone have a very suitable cutting edge.

11. The combination of a sharp antler point with small inset microblades penetrated deeply into a large mammal's chest cavity with little effort, and the razor-sharp blades acted as efficient cutting edges, creating rapid hemorrhaging.

12. Because it does not have the hafting paraphenalia connecting short stone biface point to shaft, the streamlined structure of this elongate composite point was a considerable reduction in tissue drag, thus increasing penetration (these experiments will be reported in detail in another publication).

Even a quite skilled stone craftsman could not produce microblades which would all fit tightly into a groove of a predetermined width. A variance of only .5 mm when the mean is 1.5 mm is tremendous. Rather than trying to produce microblades for inset to an exact fit, blades would ideally be made in the shape of an isosceles triangle in cross-section (Fig. B.3.). The wedge available on the triangular blades allow them to be pushed into a narrow groove until securely seated to a natural fit (Fig. B.3.). This fact became readily apparent when I began trying to fit microblades to the grooved antler.

It is now obvious why complete trapezoidal microblades are so commonly found at camps or knapping stations - they are mainly rejects or were used for other purposes. Examination of trapezoidal blades in the Dry Creek artifacts showed that a few of them were broken into medial sections, apparently intended for use in some form or other. They might be ideal as delicate graver-burins in working the grooves for the triangular microblades. Careful analytic and experimental work needs to be done in this area.

A straight proximal microblade section can be used for both anterior and posterior ends of the row of inset segments. The antler is brittle enough to take a sharp point and clamp the microblades in place, but at the same time is resilient and very difficult to break. The inset blades are considerably less durable, but as few are damaged in use some attrition can be tolerated without general repair. At some stage of use however the broken blades would have to be replaced. This could probably occur several times over the life of the antler point. The composite point is the optimal wedding of razor-sharp edges with a resilient spine.

The reconstruction of the blank of a wedge-shaped core and others, (see Powers, Fig. 3.13D this volume), allowed us to determine that microblade production was started and exhausted at one specific spot - and probably at one occasion, as the core preparation flakes and microblade flakes were all found in a small cluster. I will argue that this implies the production or repair of <u>multiple</u> projectile points at one time. Loose microblades are fragile and probably did not keep well in a pouch. They continually dull and chip with contact, thus it is more likely that they were either used at the time they were produced or kept in a special matrix of batting.

The density of a core was calculated by weighing out the amount of water displaced in a beaker. Clay was inserted into the area of the missing microblades and displacement was remeasured. The density of the stone, the volume of microblades removed, and the average microblade weight allowed me to calculate the number of microblades from the stone (150). Assuming the microblades were 2.6 cm long on the average, a total of <u>400 linear cm</u> of cutting surface was produced from this small stone. Assuming that only 25% may have been used for projectile point edges (rejecting some poor complete blades and the proximal and distal tips) this leaves 100 cm of projectile point cutting edge.

Using this stone as a microblade core as opposed to a medium to small biface stone-projectile point, means that 20-30 times more cutting edge can be produced, but this figure does not totally portray the increased efficiency. When a stone biface is broken it can seldom be reworked and reused more than once, but the microblade composite point may last through several cycles of use with the replacement of some segments. There is a fairly high attrition of stone bifaces as the American Paleoindian kill sites show (Frison, 1974). In fact Frison (1976) goes so far as to state that experimental evidence shows that Clovis points "rarely survive more than one use." Composite bone points are much more durable to total shattering, but undoubtedly required a greater initial time investment and more upkeep or maintenance at the advantage of an extremely frugal use of quality stone materials. The other possible uses found for the microblade segments not incorporated into the inset projectile points adds a further volume to the efficiency of the microblade technique.

Although only the antler cortex was used to make the antler point, it became apparent that the cortex varies in density, the outside or lateral surface being the most compact. This is seen in the lighter color on the outside and the darker color on the inside. Although the antler was from an animal which had been killed 2 1/2 years old, and had remained outside exposed to sun and rain, it was still moderately fresh looking. The medulla smelled of putrid blood and dripped red when soaked in water. Although straight at first, the point began to warp and continued to do so. It can be straightened and that habit will be maintained for hours or even days, but gradually the point resumes its bent form. I assume this bending is due to differential density and varying moisture content. This warping tendency must have been a chronic problem in the antler-based industries of the upper Paleolithic.

I would like to propose that this warping tendency of antler points is the major reason behind the tool variously called "baton-de-commandment," "lochstab," "shaft-straightner," or "shaft-wrench." The caribou or reindeer antler segment with a hole in it provides an excellent lever which can be used to periodically straighten the antler points. Thus it is not a tool to be used only rarely but a permanent tool to be used frequently and kept on one's person when out hunting or at least in the hunting camp.

The tip of the antler projectile point can be resharpened anytime. I used a piece of sandstone to achieve quite a sharp point and edge after the blades had been inserted. A bone point by itself however is not a very efficient cutting tool although it penetrates well. Animals killed with single bone points are probably killed by multiple wounds when lungs or heart are eventually punctured; however, the stone cutting edge of the composite point lacerates blood vessels and would cause rapid internal hemorraging over a large target area.

The ease of penetration by the composite point is highlighted by experiments with hafted Hell Gap biface projectile points (Frison, 1974). In contrast to antler or bone points, Frison's biface point had limited penetration. Because the long antler-stone inset point is its own foreshaft there is no tissue drag from the hafting paraphernalia - the shaft or foreshaft "override" onto the projectile point, and sinew-glue binding. Thus, once the tip penetrates the animal, the lateral edge moves along in the same narrow opening. Mounting the antler point in a socket cut into the spear shaft allowed almost as much freedom of use as a permanent attachment, yet was detached with the concussion of the shaft shoulder hitting the animal after the point had fully penetrated.

The simple lozenge-shaped thick-bodied bifaces found in the Dry Creek site were probably knives and were possibly hafted with wood or stone handles. The skining knife in Nelson (1899:112, XLV11-2) is very similar in form and size to the small "knife" biface at the Dry Creek site. It was possibly hafted in the same manner, with a handle attached by rawhide thong.

The work of several other researchers with microcores has suggested the necessity of a vise structure. The vise reconstructed here is an exercise in trying to logically approach the problem, consistent with the shape of the microblade core. It is admittedly among several different ways the core could have been held in a vise. It is probable that no dense hardwood was available to the Dry Creek people for a vise - if in fact any large wood was available. But the antler splinters which they were accustomed to depending on for projectile points could also have been used for a vise. By binding two together in the midsection and spreading the ends apart a pincer-effect is produced at the other end. This is accentuated if there is some obstacle separating the two splinters at the binding - a sort of hinge-pin. The two butts of the vise members can be propped apart by an insert piece held in two notches.

By placing the rough spongy medullary side of the antler splinters medially toward one another the jaws of the vise can mold to the sides of the core.

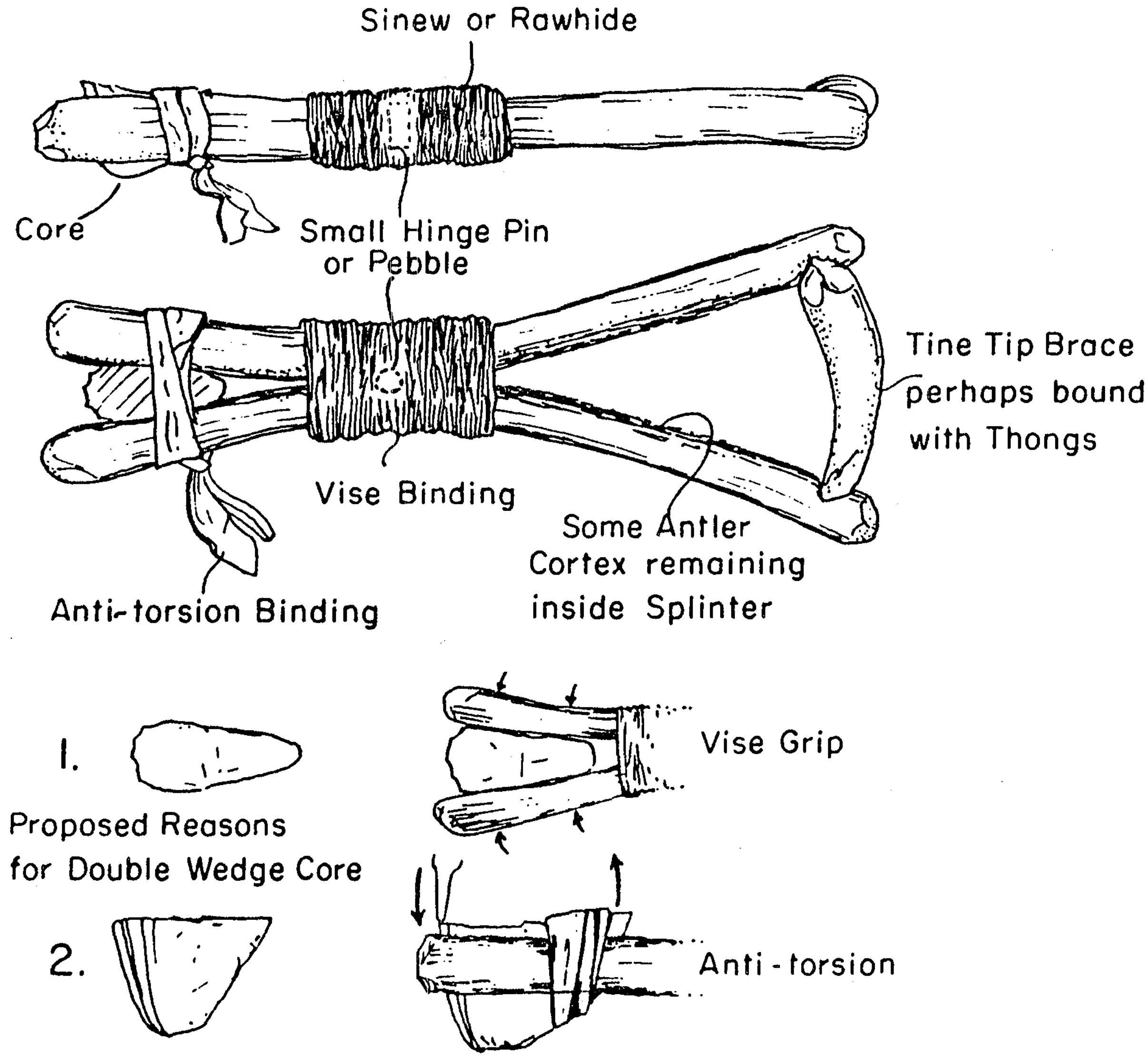
The characteristic double wedge shape of the cores becomes more understandable in such a device (Fig. B.4).

The wedge shape, when viewed from the platform (dorsal) surface forms a better fit with the angling jaws of the vice. The sides of the cores never show flaking for microblades, but do show some wear, like that which would be produced by the jaws of a vise.

Also the wedge shape produced when viewed from the side (laterally) is understandable. The vise can only exert lateral pressure, so the core is susceptable to rotary twisting when pressure is applied to the edge of the platform in the process of producing a flake. This can be easily remedied by tying a thong (a green hide or sinew lace which would shrink when dry) around the body of the vise at the level of the posterior or proximal portion of the mounted core. For greater anti-torsion the dorsal or platform side of the core should have a projection posteriorly to push against the binding. This is the shape that gives these cores their characteristic form. The posterior ventral part of the core needs nothing as the rotary direction is dorsal not ventral on the posterior end.

Rather than having an antler vise which has a permanently routed friction-fit receptacle (which could be used on no other core - as all cores are different shapes and sizes), the two-member antler or hardwood splinter could be kept and re-used on many different cores. It is adjustable for a wide range of sizes by its resiliency and these ranges can be further increased by changing hinge pin, brace or both.

Figure B.4. Proposed reasons for double wedge core morphology. The curious "double wedge" shape of the microblade core may be explained by the construction of the vice which could have held it. A simple antler leaf-spring would have been not only suitable, but portable and adjustable for core size and shape. Such a vice is shown in the illustration.


Sinew or Rawhide
Core
Small Hinge Pin
or Pebble
Tine Tip Brace
perhaps bound
with Thongs
Vise Binding
Some Antler
Cortex remaining
inside Splinter
Anti-torsion Binding
1.
Proposed Reasons
for Double Wedge Core
2.
Vise Grip
Anti - torsion

The posterior narrow wedge of the core shows percussion abuse - probably when the core preparation tablets were removed by striking the opposite end while the posterior narrow portion of the wedge was braced against a solid structure. The ventral wedge end also shows use, probably from when the microblades were produced.

The core, held firmly in the vise, could be set into a grooved antler or stone (Powers, Chapter 4) and the microblades could then be carefully punched or stuck from a rigidly held core.

A Model for Calculating Numbers of Projectile Points

Having approximated the amount of linear-cutting surface from a wedge-shaped core and having translated that into the approximate number of points which could be constructed, combined with the number of cores at the site, one could guess at the amount of big game killing which took place from the site. We can easily construct a stochastic model covering different estimate ranges of hunting activity. Some feeling of point durability can be derived from my preliminary experience with the reconstructed point. So let us construct a model assuming the following estimates to be roughly correct:

1. There are about thirty major microcores at the site (an estimate which includes the unexcavated portions of the site).

2. An animal is hit at least 50% of the throws and that an average of two hits are used to bring an animal down.

3. The average lifetime of a single point (prorating its recycled microblades) occurs somewhere in the range from 10 to 40 throws.

4. Of the calculated about 400 cm of double edged microblades produced from each core only about 25% was useable for point

construction. Thus 90-100 cm of edged antler points are assumed to be available from an average core.

5. The average inset microblade is about 1 1/2 cm or that there are about 75 useable segments for projectile points per average core.

6. The entire length of the projectile point cutting edge was somewhere in the vicinity of 6-12 cm, and was either double or single edged.

Minimal and maximal ranges of the potential number of points derived from one core vary by several fold (Table B.1). Given that microblades are a design to conserve on stone, one might expect the most conservative use of length of microblade row on only one edge, but these would probably be less effective than longer double rows. Obviously some compromises were made. Microblade grooves on most archeological specimens of bone points are, in fact, short and only on one side. Early hunters might even have varied this in their assortment of points - some situations requiring less of a hunter's edge.

Although these calculations are rough approximations they do show that somewhere over ten and under a hundred (Table B.2) big game animals were probably taken per core by the peoples who were using the microblade inset method. With this in mind, one can easily see why good quality stone was a highly valued commodity. The peoples (or hunting activities) using the much rarer small biface stone points found within the site are not included in these calculations. The estimated equivalent of 30 large cores at the site (there were more cores than this but some cores were quite small) would have thus produced from 300 to 3,000 big game animals (Table B.3).

Also the number of person/days can be calculated from an average of 150 kg of useable food per animal and comparing that with some potential ranges of daily requirements and potential animals killed from the site. The calculations range between 9,000 and 150,000 person/days (Table B.3). For ten people, say, there would be enough food for an estimated time range between 2.4 years and 41.2 years. For 50 people the range of food supply would be between 0.5 years and 8.0 years. Remember that the various calculations tend to exaggerate the total range with the addition of each range of new variables. So these are likely liberal brackets. No accommodations were made in these calculations for meat spoilage nor loss to scavengers nor for dog food, if dogs were present - because there is no way of even guessing the magnitude of these factors. All of these factors would obviously lower the estimated number of people supported by big game hunting.

The obvious conclusion is that, if these calculations are even within a rough "ball-park" range, big game hunting at this site could not have supported many people for a very long period of time.

Table B.1. Number of projectile points obtained per core.

	Bracket Estimates			
Approximate length of cutting edge per point (in cm)	6	8	9	12
Approximate no. of microblades used per point	4	5	6	8
No. of points per core: 1 side	16	13	11	8
No. of points per core: both sides	8	6	6	4

The greatest number of points per core is thus estimated at 16 and the smallest at 4.

Table B.2. Approximate number of big game animals acquired per core.

Range of Number of Points Available per Core		16	12	8	4
Average no. of throws per composite point (recycled microblades prorated) divided by 4 (assuming 4 throws per animal killed)	2.5	40	30	20	10
	5.0	80	60	40	20
	7.0	100	80	50	30

The greatest number of big game animals taken with the points produced from each core is thus estimated at about 100 and the smallest about 10. As there are an estimated 30 cores at the site, this produces a total estimated range of 3000 to 300 animals taken from the site. Assuming an average animal to produce 150 kg of usable meat, the range of available kilograms of meat can be estimated to range between 450,000 and 45,000.

Table B.3. Estimate of range of people-days supported at the Dry Creek site. Range of people-days supported by varying amounts of animals killed at the site assuming an average of 150 kg food per animal (a blend of sheep, wapiti and bison), estimated from a two-dimensional range of variables.

	Potential Range of Kilograms of Meat Taken With Tools from the Site		
Range of Requirements	45,000	150,000	450,000
3 kg/person/day	15,000	50,000	150,000
4 kg/person/day	11,200	37,500	112,000
5 kg/person/day	9,000	30,000	90,000

APPENDIX C

COMPONENT IV AT THE DRY CREEK SITE

by

W. Roger Powers

COMPONENT IV AT THE DRY CREEK SITE

Introduction

Component IV is the only cultural horizon for the later part of the Holocene epoch at the Dry Creek site. Artifacts assigned to this component were recovered from Loess 6, Paleosol 4a which averages 100 mm in thickness (Figs. 2.9; 3.1-6). This buried soil unit appears to have developed during the establishment of the taiga over the Alaskan interior during the mid-Holocene. (Thorsen and Hamilton, 1977).

Paleosol 4 is thick and continuous with well-developed oxidized horizons. The presence of a discontinuous B horizon indicates that different parts of the site were better drained than others. Near the bluff edge the Palesol is well oxidized, indicating good drainage. Further into the site it becomes similar to Low Humic Gley soils typical of poor drainage conditions. In general, Paleosol 4a is a Subarctic Brown Forest soil similar to those found currently developing beneath the interior forests (Thorson and Hamilton, 1977).

Charcoal occurs either as scattered flecks or burned roots scattered throughout this soil horizon, but is not encountered in high concentrations in areas of intense cultural activity. Charcoal used for carbon 14 dating probably represents the residium of several forest fires which swept the area during the development of the soil. The samples were collected from the wall of the 1974 test trench and cannot be related directly to the activity areas discussed below. These dates therefore represent only upper and lower limiting dates for Component IV. There are three radio-carbon dates for Paleosol 4a. Two dates apply to the top of this soil: 3430 ± 75 and 3655 ± 60. The remaining date of 4670 ± 95 is derived from the base of the Paleosol (cf. Chapter 3, Table 1 in this volume).

Unfortunately the faunal remains from Component IV are unidentifiable. All specimens were badly broken and smashed, probably to extract bone grease. However, the spatial distribution of many of these fragments coincides with areas of intense flaking activity.

The cultural assemblage from this occupation is composed of 2,372 cataloged specimens which include tools, flakes, bone fragments, pebbles and rocks. For purposes of analysis, a sample of 2,131 pieces (or 90% of the total assemblage) was used. This sample is composed of 16 tools and 2,115 flakes. The flakes occur in either of two clusters, A and B (Fig.) while, with few exceptions, the tools are scattered beyond the perimeters of the clusters.

Raw materials for tool manufacture during this ocupation were rhyolites, quartzite, degraded quartzites, obsidian, cherts, and siltstones.

Component IV: Artifacts

The tools in Component IV can be subdivided into the following categories: bifaces (4), biface base (1), end scrapers (8), retouched flakes (2) and boulder spall knife (1).

Bifaces (4)

Four complete bifaces were found in this component which can best be characterized as weakly stemmed or slightly side-notched. The pattern of edge treatment just above the base really falls into neither category. These specimens have probably undergone several episodes of reworking before they were discarded which may account for this ambigious hafting technique. No freshly-manufactured specimens were found with which to compare these pieces.

The tips are basically asymmetric triangles with excurvate edges. This form is the result of repair or resharpening episodes. The cross sections are lenticular. The bases of the bifaces were formed by chipping in broad concavities. This technique left slight ears at the corners of the basal extremeties. The base itself is concave on three specimens and straight on one. There are varying degrees of grinding or polishing on some portion of all specimens.

All of these pieces were manufactured by bifacial reduction on flakes of rhyolite (2), degraded quartzite (1) and obsidian (1).

Of the rhyolite bifaces, the largest (Fig. C.1A) displays marginal retouch on the ventral surface and facial flattening on the dorsal surface. In addition to very minor edge polish near the tip, there is polish on the facial facets near the base. This is probably the result of hafting. Retouching along one edge miscarried during a resharpening episode leaving a marked concavity. This may have been the reason it was discarded. This piece measures 67 x 34 x 5 mm.

The second rhyolite biface has an extremely sharp tip (Fig. C.1B). It is more stemmed than notched. It shows minor polish along both edges below the shoulders and across the base. There may be some minor hafting wear. There were several resharpening episodes which resulted in a highly asymmetric tip. Reworking of this piece appears to have been interrupted by the inability to remove a knob at the center of one face. It measures 45 x 30 x 6 mm.

Figure C.1. Artifacts from Component IV at the Dry Creek site.

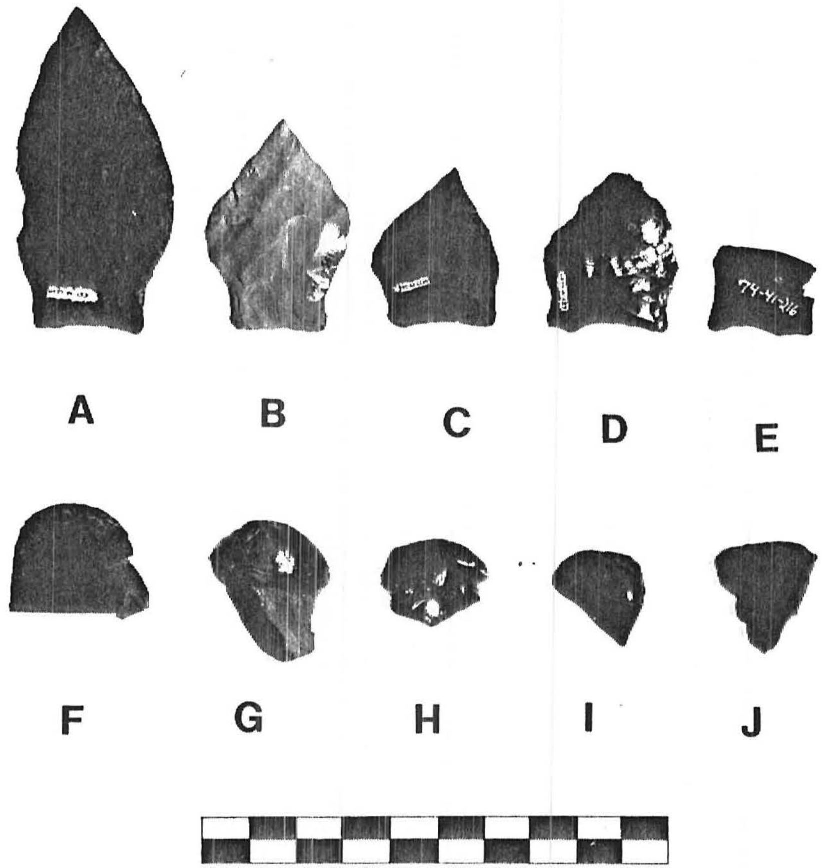
A-D Bifaces

E Biface base

F Flat end scraper

G-J Steep end scraper

scale = 10 cm


A
B
C
D
E
F
G
H
I
J

The degraded quartzite biface is likewise asymmetric (Fig. C.1C). It also has a very sharp tip and retains heavy polish across the base. Its edges are fresh as a result of a resharpening episode. There is also wear on the facial facets near the base. The piece measures 33 x 27 x 6 mm.

The obsidian biface (Fig. C.1D) is the most heavily-used tool in this category. The artifact was discarded, either because repair failed or the tool was used so heavily that resharpening would have reduced it to an unusable size. The tip is very blunt, and the edges are dull, thick and heavily crushed. Likewise, the facial facets are heavily worn and polished from extensive use. The edges along the lower part of the piece display heavy grinding which is also evident across the base. The artifact measures 35 x 29 x 6 mm.

Biface base (1)

This specimen is the basal remnant of a tool manufactured on a rhyolite flake by bifacial reduction. The edges and base are polished. No polish on the facial facets could be detected. A break, which removed the tip, is a simple hinge fracture. Along one edge is a series of longitudinal fractures (facets) beginning at the snap and extending about one-third of the way to the base. They appear to be purposeful burin blows. The intersection of the hinge fracture and the longitudinal facets shows fine crushing indicating use as a burin. One of the hinge fracture edges is also crushed indicating use as a scraper on a hard material. The artifact measures 19+ x 23+ x 5+ mm.

The Component IV bifaces may have been intended for use as projectile points when first made, but, judging from their asymmetricity and edge wear, they were probably functioning as cutting tools when they were lost or discarded.

End scrapers (8)

Of these scrapers, 7 are in situ and 1 was recovered from a block of Paleosol 4a which had slumped into the 1974 trench.

All of these specimens are on flakes and were manufactured by unifacial retouching. They display at least one well-formed, convex working-edge.

As in Component I, the end scrapers can be sub-divided into two categories: 1) steep end scrapers (5) and, 2) flat end scrapers (3).

Steep end scrapers have at least one working edge which lies at a 60° to 90° angle to the ventral surface of the flake. Three were made on sub-cortical flakes of obsidian and two were made on cortical flakes of the same material. Four of the steep end scrapers have single, steeply flaked, convex working-edges (Fig. C.1G-J). One specimen is a double end scraper with working-edges of the same morphology which lie on the end and one side of the piece (Fig. C.1J). This scraper also displays crushing along the edge opposite the lateral working-edge.

All the specimens show crushing along the working-edges and lateral margins. One (Fig. C.1G) displays polishing on the dorsal facets at the end opposite working-edge which possibly indicates hafting.

The flat end scrapers were made on flakes of obsidian (2) and degraded quartzite (1). The working edges on these scrapers lie at a 30° to 60° angle to the ventral surface of the flake. Two have symmetrical, convex working-edges (Fig. C.1F). One is asymmetric and has a narrow retouched working-edge at one corner of the flake. There is also crushing along one side on an unretouched facet indicating that this edge likewise functioned as a scraper. The facets on the dorsal face show polishing. Length measurements range from 15 to 38 mm with a mean of 26 mm. Widths range from 20 to 27 mm with a mean of 23 mm. Thicknesses range from 6 to 13 mm with a mean of 9 mm.

Retouched flakes (2)

One flake of degraded quartzite and one flake of rhyolite were retouched slightly along two edges to form small scrapers or knives. It measures 21 x 23 x 5 mm.

Boulder spall tool (1)

This piece is the only example of a large implement from Component IV. Bifacial edge flaking was used to develop both a symmetrical outline and cross section on a slab of degraded quartzite. Flaking was carried out along the entire perimeter although it was more concentrated on one face. The opposite face had approximately one third of its surface sheared away. Edge flaking on this face was much less intense. The tool resulting from this activity is roughly ovate in outline and has a rhomboidal cross section.

The edges of this tool display considerable wear and crushing possibly as a result of use as a butchering tool. It measures 207 x 118 x 32 mm.

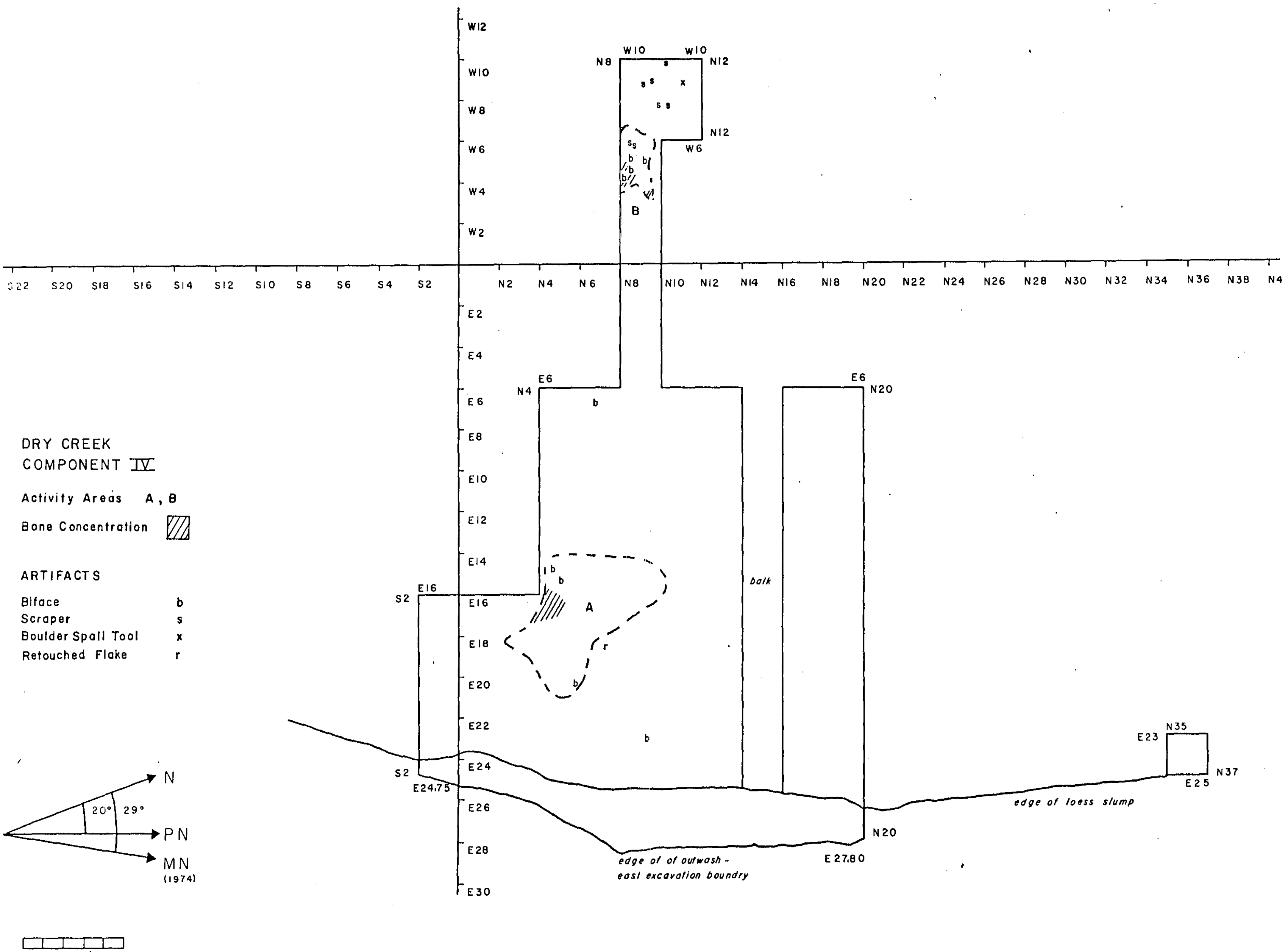
Activity Areas

Analysis of flaking events and raw material distribution for Component IV has been conducted by Tim Smith (1981). This analysis is still in progress as part of his doctoral dissertation research. However, the data at hand are more than sufficient to demonstrate the main activities conducted at the site during this occupation.

The definition of activity areas was accomplished by mapping the distributions of thirteen raw material types which had been reduced to differing degrees in this component. The combined perimeters of the individual raw material clusters revealed two areas of intense flaking activity. The first, and largest, of these (Cluster A) lies near the southern margin of the excavation (Fig.) and the other (Cluster B) is located near the western extremity of the excavated area.

In order to associate the assorted flakes with specific flaking episodes, it was necessary to further refine the types of raw materials. Of the five rock types mentioned previously, the rhyolites and degraded quartzites were further subdivided into five and four subgroups respectively. Of the rhyolites, five different types can be distinquished: tan-greenish (64) flakes), reddish (162 flakes), heat-affected (153 flakes), greenish phenocrysted (92 flakes), grey-grainy (14 flakes). There are four types of degraded quartzite: rugose (283 flakes), "matte" (238 flakes), smooth (231 flakes) and phenocrysted (89 flakes). The remaining categories contain the following number of flakes each: obsidian (104), chert (93), siltstone (6) and granite 912). Oddly enough, a piece of granite was smashed in Cluster A and many of the "flakes" could be fit back together. The purpose of this activity is unknown.

Figure C.2. Map of Component IV at the Dry Creek site showing activity areas.



DRY CREEK
COMPONENT IV
Activity Areas A, B
Bone Concentration
ARTIFACTS
Biface b
Scraper s
Boulder Spall Tool x
Retouched Flake r
N
PN
MN
(1974)
20°
29°
W12
W10
W8
W6
W4
W2
E2
E4
E6
E8
E10
E12
E14
E16
E18
E20
E22
E24
E26
E28
E30
S22 S20 S18 S16 S14 S12 S10 S8 S6 S4 S2
N2 N4 N6 N8 N10 N12 N14 N16 N18 N20 N22 N24 N26 N28 N30 N32 N34 N36 N38 N40
A
B
balk
S2 E16
S2 E24.75
N4 E6
E6 N20
N20 E27.80
N35 E23
N37 E25
edge of loess slump
edge of of outwash - east excavation boundry

Of the sample of 2130 specimens, 1974 flakes and 2 tools fall within Cluster A. Cluster B is composed of 141 flakes and 10 tools. In addition, two tools, both bifaces of smooth degraded quartzite, fall outside the clusters. One (Fig. C.2) is situated about midway between the clusters, and the other (Fig. C.2) lies to the east of Cluster A.

Three tools were found within the clusters for which there is no flaking debris within the site. The first is a biface of a light tan rhyolite which is in Cluster A. The second is a boulder spall tool of quartzite which is located in Cluster B, and the third is a retouched flake of light tan rhyolite which also falls in Cluster B.

A summary of the raw materials, tools and flakes found in the clusters and tools which fall outside the clusters can be found in Tables C.1 and C.2.

Table C.1 Summary of raw materials, tools and flakes for Cluster A, Component IV at the Dry Creek site

CLUSTER A

Raw Materials	Tools N = 2	Flakes N=1794
Rhyolites		
Tan-Greenish and Heat-Affected	No tools found	669
Reddish	No tools found	162
Greenish-phenocrysted	No tools found	92
Degraded quartzites		
Rugose	One retouched flake	283
Matte	No tools found	283
Smooth	No tools in cluster	231
Phenocrysted	One biface	89
Obsidian	No tools in cluster	104
Cherts	No tools found	93
Siltstone	No tools found	13

Table C.2 Summary of raw materials, tools and flakes for Cluster B, Component IV, at the Dry Creek site

CLUSTER B

Raw Materials	Tools N = 10	Flakes N = 141
Rhyolites		
Tan-Greenish and Heat-Affected	No tools found	124
Gray Grainy	No tools found	14
Tan Rhyolite	One retouched flake	0
Obsidian	One biface; 7 side scrapers	3
Quartzite	One boulder spall tool	0

Several conclusions can be drawn from this presentation:

1) The clusters are composed almost entirely of small, bifacial reduction flakes and their greatest concentration is in Cluster A.

2) The clusters share only three raw material sub-types: tan-greenish and heat-affected rhyolite, and obsidian. Tools of either type of rhyolite were not located inside or outside of the clusters. The obsidian flakes (3) in Cluster B are unrelated to the obsidian tools in that cluster. Almost all of the obsidian flakes occurred in Cluster A although no tools of that material were discovered in association.

3) The flake distributions of the remaining material types are mutually exclusive.

4) The bifaces are scattered within the site; two fall in Cluster A, one is in Cluster B and two are situated outside of the clusters. Of the five bifaces, three were made at the site and one of these was found in Cluster A. The obsidian biface in Cluster B may have been manufactured in Cluster A although it could have been made elsewhere.

5) The scrapers are all situated in Cluster B. The obsidian end scrapers may have been made in Cluster A; however, this is uncertain.

6) There are tools in the site which apparently were manufactured elsewhere: one biface in Cluster A; and both the boulder spall tool and the retouched flake in Cluster B.

7) The majority of the flakes in the site (1,405) resulted from bifacial reduction activity for which no tools were found.

It is difficult to establish the contemporaneity of the clusters since the flakes of one cluster could not be cojoined to tools in the other cluster. However, the distributions of the obsidian flakes and tools may indicate tool production in one cluster and tool use in the other cluster. Also, the co-occurrence of the tan-greenish and heat-affected rhyolites could indicate utilization of these specific rock types on the site at the same time. Unfortunately, the activities represented by the tools distributions in Component IV could just as well have resulted from separate and/or temporally different occupations.

It should be emphasized that the scrapers constitute the only clear concentration of tools in association with a flaking cluster (B) and this strongly suggests that this was a specialized activity area where the use of those tools was required.

Paleoecology and Regional Relationships

We still have an incomplete picture of the vegetation shifts and realignments in the Nenana Valley during the Holocene. At the present time, there is a clear steppe quality to the vegetation communities of the floodplains and the lower slopes of the valley and one which has probably been preserved throughout the Holocene. In addition, the taiga occurs in several forms. It is established as gallery forests along terrace edges and water courses and forms continuous cover on most moderate south-facing slopes. It becomes continuous only below 300 m. In the immediate area of Dry Creek there are broad expanses of scrub, heath and bog communities that today form important feeding areas for moose and black bears. The mountain slopes are dryer and support an herbaceous cover important for both sheep and caribou.

We know from the Carlo Creek site (Bowers, 1980) that caribou were present by 8500 B.P. and sheep have utilized the area since Pleistocene times (Dry Creek and Carlo Creek). The modern, large ungulates (moose, caribou, and sheep) have probably existed in the area throughout the Holocene although we lack direct fossil evidence in this particular area.

The association of Component IV with Paleosol 4a and the radiocarbon dates for this horizon (ca. 3000-5000 B.P.) indicates that this set of tools and waste were left at the site during the development of the Holocene forest in the Nenana Valley, or at least during the development of the gallery forest along the northwest side of Dry Creek. Based on such contextual reasoning, it can be argued that the tool kit in Component IV was employed in the procurement of essentially modern species of large or small game.

Technologically, the single distinctive tool set at Dry Creek at this time are the side-notched points. They occur at other ecologically different localities in the nearby Alaska Range and Tanana Valley.

In the area closest to Dry Creek, asymmetric notched points were found at the Ratekin site deep in the Alaska Range (Skarland and Keim, 1958). This material is undated and has undergone mixing with older and younger artifacts. While there are no faunal remains at the site, topography and altitude could be used to argue seasonal caribou hunting as at least one of the major activities conducted at this locality.

A better sample of notched points, again mostly asymmetric was found at the XMH-35 site near Tangle Lakes which date somewhere in the range of 4500 B.P. (Mobley, 1982). Faunal remains are unfortunately absent from this site also, but regional setting is also conducive to caribou hunting.

Notched points are an important tool catagory in several phases at the Healy Lake site (Cook and McKennan, 1970). They occur in the Tuktu Phase and continue through the Denali and Historic Athapaskan Phases along with lanceolate bifaces, microblades, and burins. The position of Healy Lake, adjacent to the Tanana Hills, certainly made this locality ideal for exploiting both upland and lowland resources.

Fortunately, a complex comparable to Component IV at Dry Creek and in association with faunal remains has recently been discovered and studied at the XBD-106 site on Rainbow Lake near the Tanana River between the Little Delta River and Delta Creek (Bacon and Holmes, 1980). Here a typical taiga fauna composed of caribou, moose, black bear, and beaver occur with side notched points, possible microblades and end scrapers. Although there is no date for this site, the association of side-notched points with typical modern fauna is significant and places a more concrete basis for our understanding of the cultural ecology of the Tanana Valley.

Perhaps one of the most important discoveries of recent years for the Late Holocene archeology of the Alaskan Interior was made by Holmes and Bacon (1982) at the XMH-297 site on the Delta River north of the Alaska Range. A small collection of artifacts (Component 5) has been recovered from Block B, Loess 6. This component is composed of flakes, one chi-tho and two hammerstones. In addition, Loess 6 yielded the proximal end of a bison tibia which, unfortunately, was not directly associated with archeological materials. However, the bison specimen is bracketed by an overlying date of 2280 ± 145 and an underlying date of

3980 ± 150. Based on this information, it appears that bison in the Tanana Valley were in the later Holocene. Bison remains have been radiocarbon dated to 500 B.P. near Anchorage (Guthrie Chapter 6).

On the basis of this evidence, we should modify our view of the Holocene northern hunter as an exploiter only a modern northern fauna. This new evidence, while not categorically placing cultural remains in association with bison during the Late Holocene, does establish that bison existed in certain localities in Alaska where limited and probably relict steppe environments existed, e.g. the Delta River Valley. The Nenana River Valley in the vicinity of Dry Creek is another area where these relict xeric plant communities occur today.

In the broader view, it is probably more correct to view the later Holocene hunters of the North Alaska Range foothills and the Tanana Valley as possessing a broad spectrum subsistence base geared to the mosaic plant-animal patterns still typical for the area today. The subsistence based included, besides the possibility for fishing and bird resources coupled with small mammals, the procurement of large mammals of both taiga and tundra. In addition, it appears that the steppe grazing niche remained in existence and was occupied by herds of bison and possibly wapiti long after Component IV times at Dry Creek.

The Northern Archaic Tradition

Beyond the Tanana Valley and the central Alaska Range, the broader typological affinities of Component IV at Dry Creek relate to the widespread occurrence of notched points in Alaska which date as early as 11,000 B.P. (Gal and Hall, 1982) and as late as 1250 B.P. (Anderson, 1978). These notched point complexes are usually linked to the Northern

Archaic Tradition (c.f. Anderson, 1978; Dumond, 1978) although the temporal boundaries and cultural content of this tradition can vary considerably.

If one attempts to develop a composite understanding of the Northern Archaic by incorporating its many attributes from the differing formulations in the literature a very complicated cultural-historical entity emerges which displays differing ecological adaptations, artifact variability, and both a considerable temporal and spatial spread. Its sites are found in the taiga (Anderson, 1968b; Dummond, 1978) and on the tundra (Gal and Hall, 1982; Davis, Link, Schoenberg and Shields, 1981). While notched points are important throughout, stemmed or even lanceolate points can also form a significant part of the assemblages (Anderson, 1978). Any one of these combinations of point styles can co-occur with microblades or microblades may be completely absent (Anderson, 1968a and b). The microblades may have been detached from tabular Tuktu cores (Anderson, 1978; Campbell, 1961) or from wedge-shaped Denali cores (Cook and McKennan, 1970). This particular situation depends on whether or not the Tuktu Complex and the later phases at Healy Lake are included in the Northern Archaic Tradition.

Anderson (1968a and b) first used the term Northern Archaic with regard to a set of cultural strata at Onion Portage which were positioned between and contrasted with the preceding Paleo-Arctic and succeeding Arctic Small Tool assemblages. The earlier part of this tradition, the Palisades II Complex, was characterized by notched points, coarse stones, crude workmanship, and a lack of microblades. However, the close affinity of Palisades II projectile point styles with those of the Tuktu Complex (Campbell, 1961) was recognized although the lanceolate points and microblades of the latter set it apart. The later phases of the Northern Archaic at Onion Portage witnessed the appearance of more projectile point variability including corner notching and lanceolate forms.

More recently, Anderson (1978) has refined his thinking on the problem of the Northern Archaic and we see added to the earlier Palisades II Complex an implied relationship with Tuktu Complex. This Palisades/Tuktu Phase dates between 6500 and 6000 B.P. The succeeding Portage Complex displays a shift from side- or corner-notched points to lanceolate or pentagonal forms. Following a Denbigh Flint occupation, we see both the elements of the Northern Archaic and Arctic Small Tool Tradition in the Choris levels which date to between roughly 2000 and 3000 B.P. Again, after an interval of various occupations, the Northern Archaic reappears as the Itkillik Complex dated to roughly 1250 B.P.

As such, the Northern Archaic has great time depth and internal typological complexity, and is ethnogenically linked to the Athapaskans.

Ecologically, the Northern Archaic is viewed as an adaptation to a forest way of life with an emphasis on caribou hunting, primarily, and fishing, secondarily. The fishing aspect of the economy is based on the presence of notched pebble sinkers in the Northern Archaic levels at Onion Portage (Anderson, 1968a).

Dummond (1977, p.47) relates a number of Alaskan sites to the Northern Archaic which are typified by "somewhat asymmetrical projectile points with deep, wide, side-notches, and bases that are commonly rather convex; large unifacially chipped knives; and chipped endscrapers." Again, in later times, we see more projectile point variability with corner notching and lanceolate forms. Other assemblages such as the

Tuktu Complex and the Denali Complex at Healy Lake which contain microblades are also included in this discussion. However, Dummond (1977) notes the absence of notched pebble sinkers in the archeological record of the Northern Archaic for Ugashik and Upper Naknek drainages.

With respect to the origins of the northern Archaic, Dummond (1977) traces its affinities to peoples moving from the south into the northern regions as forests were spreading about 6000-7000 B.P. The occurrence of notched and lanceolate points with microblade technologies is explained by the mixing of different peoples in contact situations.

On the other hand, Cook (1969) and Henn (1978) have both argued that the continuity of microblade technologies into later Holocene cultures, especially in the eastern interior and on the Alaska Peninsula respectively, is sound evidence for continuity in populations themselves.

The position of Dry Creek Component IV in the later Holocene prehistory of the interior is fairly straightforward.

The small complex of tools in Component IV is fully consistent with the definition of the Northern Archaic proposed by Dummond (1977). It likewise compares well with the early part of the Northern Archaic as manifested in the Palisades II complex as defined by Anderson (1968a and b) although the carbon 14 date at Dry Creek overlaps only with the later part of Palisades II as it is dated at Onion Portage. The notable features of Component IV shared with both of these formulations are side notched points, larger, more crudely worked implements, and an absence of microblades. While these similarities can be noted we should also note the striking contrast between Component IV at Dry Creek and those complexes which contain, in addition to side notched points, lanceolate forms and microblade industries. As already pointed out, none of these typological complexities are present in Component IV at Dry Creek. Also where Component IV is compared with Component II we are struck by the fact that they share not a single artifact type except retouched flakes. Our view of the situation from the Nenana Valley at the present time is that the early microblade and biface techologies of Component II and the artifacts from Component IV are as different as night and day. There are simply no grounds for developing the idea of continuity between Component II and IV.

Based on the evidence from the Dry Creek site, the proposition that an entirely different population had occupied the Nenana Valley during the Mid-Holocene would appear completely justified. However, evidence from other areas of Alaska summarized above points to the fact that Dry Creek is more the exception rather than the rule. Since side-notched points similar to those in Component IV do occur with microblades elsewhere, their absence at Dry Creek should be viewed cautiously. The Component IV occupation does not appear to have been as intense as the occupation in Component II. However, it is possible that the major area of settlement was in a different, unexcavated parte of the site. Likewise, a late microblade technology could have been part of the tool kit used by the later Holocene inhabitants of the Nenana Valley and they simply did not bring it to the part of the site which we excavated, if they brought it to the site at all.

Summary

It can safely be said that the Northern Archaic Tradition is represented at the Dry Creek site by Component IV, and that it occurred somewhere betweeen 3,000 and 5,000 B.P.

We see two definable activity areas where tool manufacture and repair were conducted and where bone was smashed to bits. Side-notched points were located both within and outside the areas. Only one of these pieces appears functional as a weapon tip. The remainder were probably repaired or reworked into knives.

We cannot establish that the two areas were used at the same time. While it is possible that they were, it is just as likely that they resulted from two separate occupations. In either case, the occupations appear to have been brief.

In the absence of identifiable faunal remains, no specific aspect of the subsistence economy can be clarified. We can only suggest that large or small mammal procurement was conducted from the site. We have also suggested that besides modern large ungulates, bison may still have been available in the Nenana Valley during the late occupation of the Dry Creek site.

Finally, the artifacts from Component IV stand in striking contrast to those of Component II. There is no apparent continuity between the two components. However, evidence from elsewhere in Alaska suggests that we may be missing part of the picture at Dry Creek with respect to the absence of microblades as well as other types of bifaces commonly found with notched point assemblages.

Clearly, we have only scratched the surface of Northern Archaic archeology in the Nenana Valley and until the pattern we see at Dry Creek is confirmed it would be wise not to press the data too far.

APPENDIX D

THE 1977 SURVEY FOR PLEISTOCENE AGE ARCHEOLOGICAL SITES

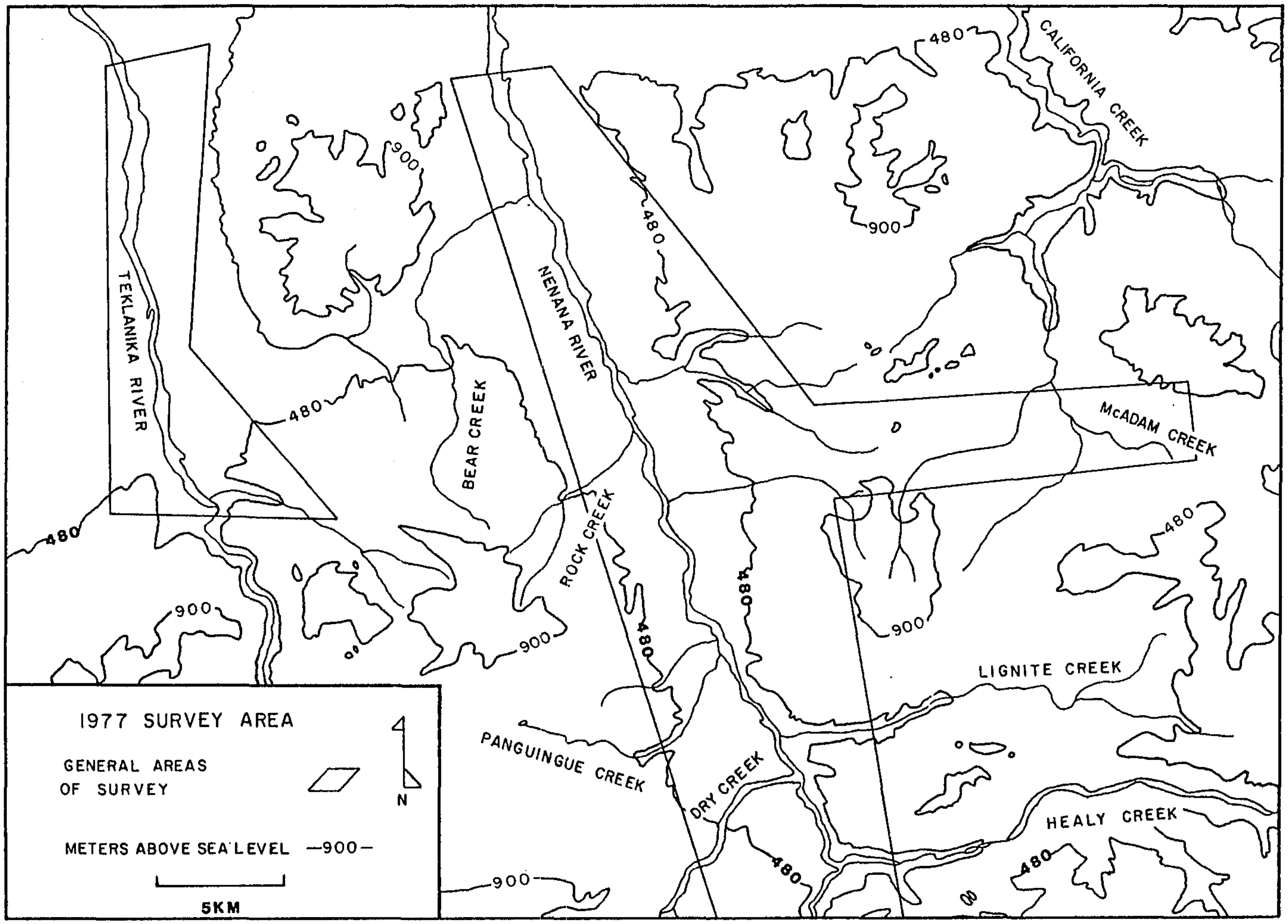
by

W. Roger Powers

Introduction

During the summer of 1977, a survey for Pleistocene age archeological sites was conducted in the north central foothills of the Alaska Range. Research was concentrated in two valleys, the Nenana and the Teklanika (see Fig. D.1). It was believed that the area chosen possessed a high potential for the discovery of archeological remains in this time period for several reasons. Firstly, the northern foothills of the range have historically comprised a concentration zone for large mammals, especially in the late summer and fall. A number of prehistoric occupation sites are known in the region, including the Dry Creek site, which dates to the terminal Pleistocene (i.e., ca. 11,000 years B.P.), and these sites are believed to be related to late summer-fall large mammal exploitation in the area. Secondly, the foothills possess numerous attractive topographic situations for site location, many of which occur in conjunction with a good stratigraphic context which facilitates preservation and dating of the remains. In order to maximize the results of the survey, a research design or survey strategy (discussed below) was developed specifically for the Nenana and Teklanika valleys with these considerations in mind.

Figure D.1. General map of the Nenana and Teklanika valleys.


1977 SURVEY AREA
GENERAL AREAS OF SURVEY
METERS ABOVE SEA LEVEL —900—
5KM
N
TEKLANIKA RIVER
NENANA RIVER
CALIFORNIA CREEK
BEAR CREEK
ROCK CREEK
McADAM CREEK
LIGNITE CREEK
PANGUINGUE CREEK
DRY CREEK
HEALY CREEK
480
900

Research Design

The research design or survey strategy employed in 1977 was developed on the basis of two major considerations. The first was topographic context and the second was sedimentary or stratigraphic context. Testing for archeological sites was focused on localities which combined a topographic situation with high site potential and a sedimentary context which would permit good preservation and effective dating of materials. In the Nenana and Teklanika valleys the most attractive topographic context appeared to be the surface of terrace margins at the confluences of side valley streams. The most suitable sedimentary context was thought to be the aeolian silt and sand deposits which typically overlie the terraces.

These observations are based on the known occurrence of sites on the terrace margins at the confluences of side valley streams in the Nenana Valley (Dry Creek, Panguingue Creek) and the Teklanika valley ("First Creek"). Archeological sites of late Pleistocene age also occur in similar topographic locations in Siberia (Mochanov, 1977) and on the Russian Plain (Klein, 1969).

In the Nenana Valley these localities are universally adjacent to clearwater streams and afford commanding views of the surrounding countryside. Also, they all face south and receive the maximum amount of direct sunlight regardless of the season. In addition, because of the commanding heights, game movements in the valley can be easily monitored.

The Nenana Valley preserves an excellent set of river terraces formed over the course of the Quaternary Period by cutting and filling cycles of the Nenana River. These terraces are composed of alluvium and outwash deposits. Tributary valleys also preserve deposits of both types and in addition, contain alluvial fan deposits formed where these streams were graded to different floodplain levels in the past.

This topography is the result of three episodes of glaciation: the Dry Creek, the Healy and the Riley Creek, including the Carlo Readvance (Wahrhaftig, 1958).

The Dry Creek Glaciation is probably of pre-Upper Pleistocene age, and is recorded in isolated terrace remnants.

In contrast, the deposits of the Healy Glaciation are wide-spread in the survey area. It is represented by a prominent moraine west of Healy and extensive alluvial and outwash terraces along both sides of the valley.

The last episode of Pleistocene glacial activity (Riley Creek) is represented today in the survey area by the outwash and alluvial terraces. The youngest terraces in the valley are attributed to the Carlo Readvance.

In addition to the terraces and side valley fans, loesses and sands occur as covering deposits on the terrace systems. These terraces have been dissected in numerous places by the erosion of tributary streams flowing into the Nenana River via their present valleys or in ancient channels long since abandoned. This stream erosion has opened up a significant amount of territory where both aeolian and alluvial deposits are exposed and can be examined. In addition, terrace edge erosion, and slumping are also processes which have produced exposures.

As mentioned earlier, for these terrace edge promontories to be archeologically productive they must possess a suitable sedimentary context that will preserve artifactual data in primary positions.

Ideally, these deposits should also preserve organic remains which would allow for paleoecological analysis and effective dating.

The wide spread aeolian deposits overlying the terrace surface of the Nenana Valley fulfill this requirement.

Our investigations at Dry Creek and Panguingue Creek had demonstrated that the loess formations covering the Healy terrace had undergone minor solifluction disturbance except on the more gentle-sloping terrace margins. Cryoturbation became a serious problem approximately 30 m in from the edge of the terrace where bog vegetation prevented any deep thawing.

The Dry Creek site also contained faunal remains in the frozen, lower part of the section. It appeared then, that the loess covering the Healy terrace was a potentially excellent medium for preserving both archeological and paleoecological information.

The thickness of the loess was another important consideration since shallow, and/or compacted deposits could produce compacted stratigraphy and the probability of encountering vertically-mixed cultural material would increase substantially.

In addition to the Dry Creek site, a loess mantle in excess of 2 m in thickness had been noted further down the valley at Rock Creek on top of another terrace-edge headland. Also, the 1976 Teklanika survey party had reported a 20 m thick loess deposit (Sec. E-14) along the eastern margin of that valley (Thorson, 1977). A sample of wood collected from the middle of this loess unit produced a radiocarbon date of 41,000 ± 800 B.P. (SI-3236)(Robert Stuckenrath, personal communication). As a result of this preliminary geological research it appeared that the Teklanika Valley contained a longer Late Pleistocene sequence of aeolian sediments than the Nenana Valley and that if people had been in Alaska prior to 12,000 B.P., the Teklanika Valley would be a likely place to look for the evidence of their activity.

In summary, the probability of discovering datable archeological sites of terminal Pleistocene age in the Nenana Valley appeared excellent. The valleys of the Nenana and Teklanika rivers fulfill the basic requirements for both the discoverability and preservability of archeological sites: 1) topographic localities known to produce sites with aeolian covering formations, and 2) relatively undisturbed sedimentary contexts capable of producing organic remains and dates.

Because of the conjunction of these basic geological requirements, the probability of discovering datable archeological sites of terminal Pleistocene age, or older, in the Nenana and Teklanika valleys appeared excellent.

Survey

NENANA VALLEY

During the period between June 9 and July 15 and August 22 to August 25, a survey for Pleistocene age sites was conducted by three to four archeologists accompanied (except during August) by one or two students from the ongoing Dry Creek Archeological Field School. Access to the areas surveyed was achieved by foot and vehicle. The sampling performed at these localities is described below (Figs. 2 and 3).

At Birch Creek, situated at the north end of the valley, three days were devoted to digging three test pits on the southeast face of the Nenana Gravels bluff south of the creek. The total depth of the surficial sediments is 135 cm.

Another tested locality lies several kilometers south of Bear Creek (one day reconnaissance) where a total of nine small test pits were placed in the silt mantle overlying the edge of the Healy terrace. Maximum observed sediment thickness was 70 cm. Road cuts and gravel pits in this area were also examined.

The Rock Creek area was intensively sampled for a period of seven days. Testing concentrated on the southeast bluff face of a terrace remnant mapped as Dry Creek by Wahrhaftig (1958) located several hundred meters south of the creek. Here, two large trenches were cut into the loess capping the terrace gravels, which reached a thickness of 275 cm. A series of soil auger tests were performed on the bluff top, and a sequence of small exposures on the east side of the bluff were also examined. The Dry Creek age and Healy age terrace edges within a radius of a kilometer were surveyed by individual team members, who dug occasional test pits (typically terminated by frozen ground at a depth of one meter or less). A two day reconnaissance in the upper Rock Creek area located a site (FAI-140) situated on the Healy age terrace on the north side of the creek, initially represented only by surface finds. Subsurface testing (consisting of two test pits) revealed several flakes within the modern soil (uppermost 10 cm) but were terminated at 130 cm by frozen ground.

In the Slate Creek area, one day was devoted to examining a large exposure (apparently generated by a road cut) along the Dry Creek age terrace, situated several hundred meters north of the creek.

Figure D.2. Map of the Nenana Valley (northern section).

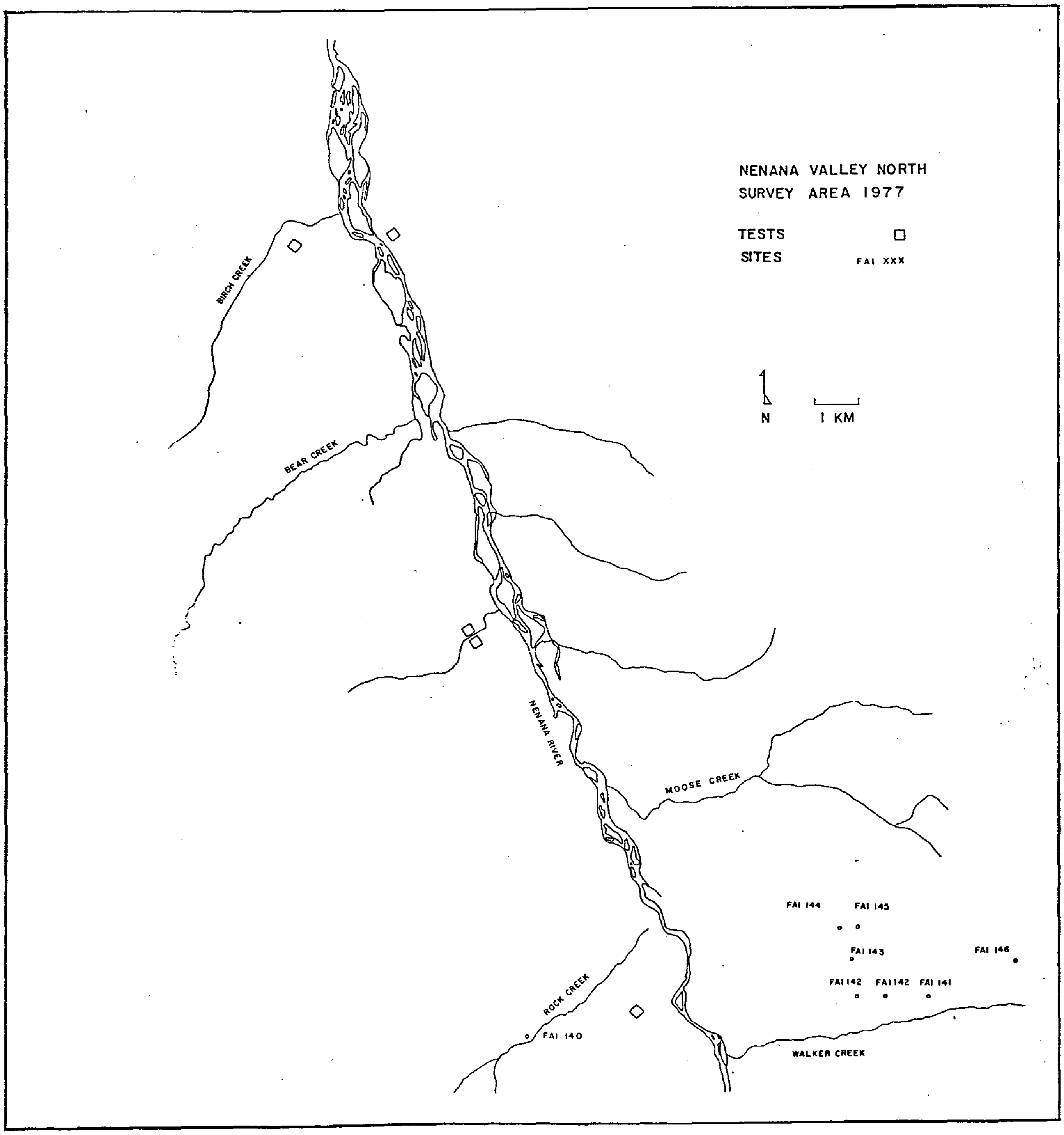
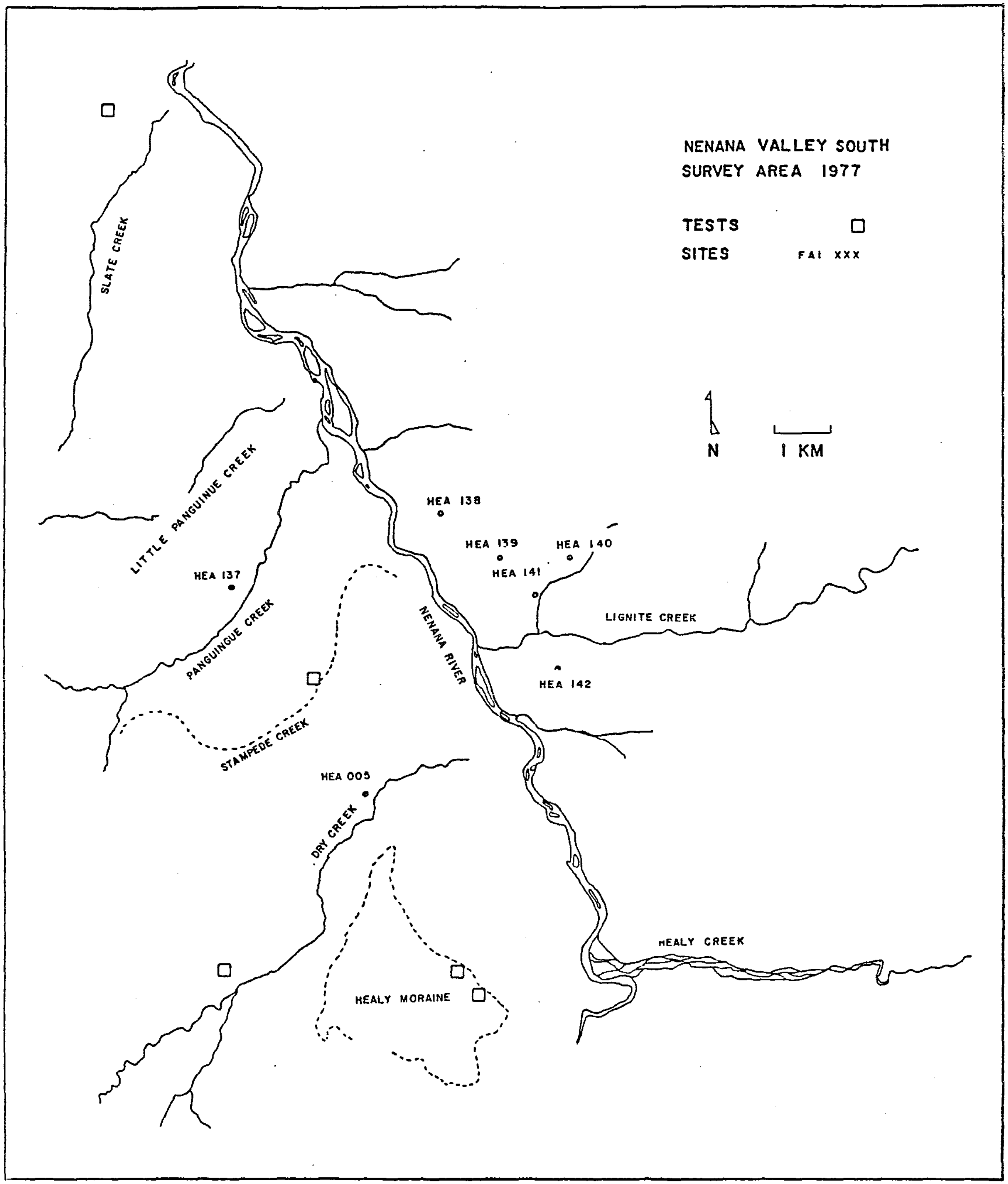

NENANA VALLEY NORTH
SURVEY AREA 1977
TESTS
SITES
FAI XXX
N
1 KM
BIRCH CREEK
BEAR CREEK
NENANA RIVER
MOOSE CREEK
ROCK CREEK
FAI 140
WALKER CREEK
FAI 144
FAI 145
FAI 143
FAI 146
FAI 142
FAI 142
FAI 141

Figure D.3. Map of Nenana Valley (southern section).


NENANA VALLEY SOUTH
SURVEY AREA 1977
TESTS
SITES
FAI XXX
N
1 KM
SLATE CREEK
LITTLE PANGUINUE CREEK
HEA 137
PANGUINGUE CREEK
STAMPEDE CREEK
HEA 138
HEA 139
HEA 140
HEA 141
LIGNITE CREEK
NENANA RIVER
HEA 142
HEA 005
DRY CREEK
HEALY CREEK
HEALY MORAINE

Approximately 110 cm of loess overlies the terrace gravels in this area.

Intensive testing was performed on the Healy-age bluff on the north side of Panguingue Creek for a period of three days, near where a site (HEA-35) had been found in 1976 (Plaskett, n.d.). A datum point was established at the east end of the bluff, and a 10 x 1 m test trench was plotted against the datum and excavated to the top of the terrace gravels. The depth of the surficial sediments here is approximately 70 cm. Frozen ground was reached 45 cm below surface. A series of auger holes were dug to the west of the trench in an effort to establish the extent of the occupation area, and two radiocarbon samples were collected.

In the area west of the Parks Highway-Stampede Trail Junction, Healy-age terrace surfaces were examined (one day reconnaissance) on the north side of the trail. Several small test pits were dug at intervals along the terrace edge; the loess mantle is 65 cm thick here.

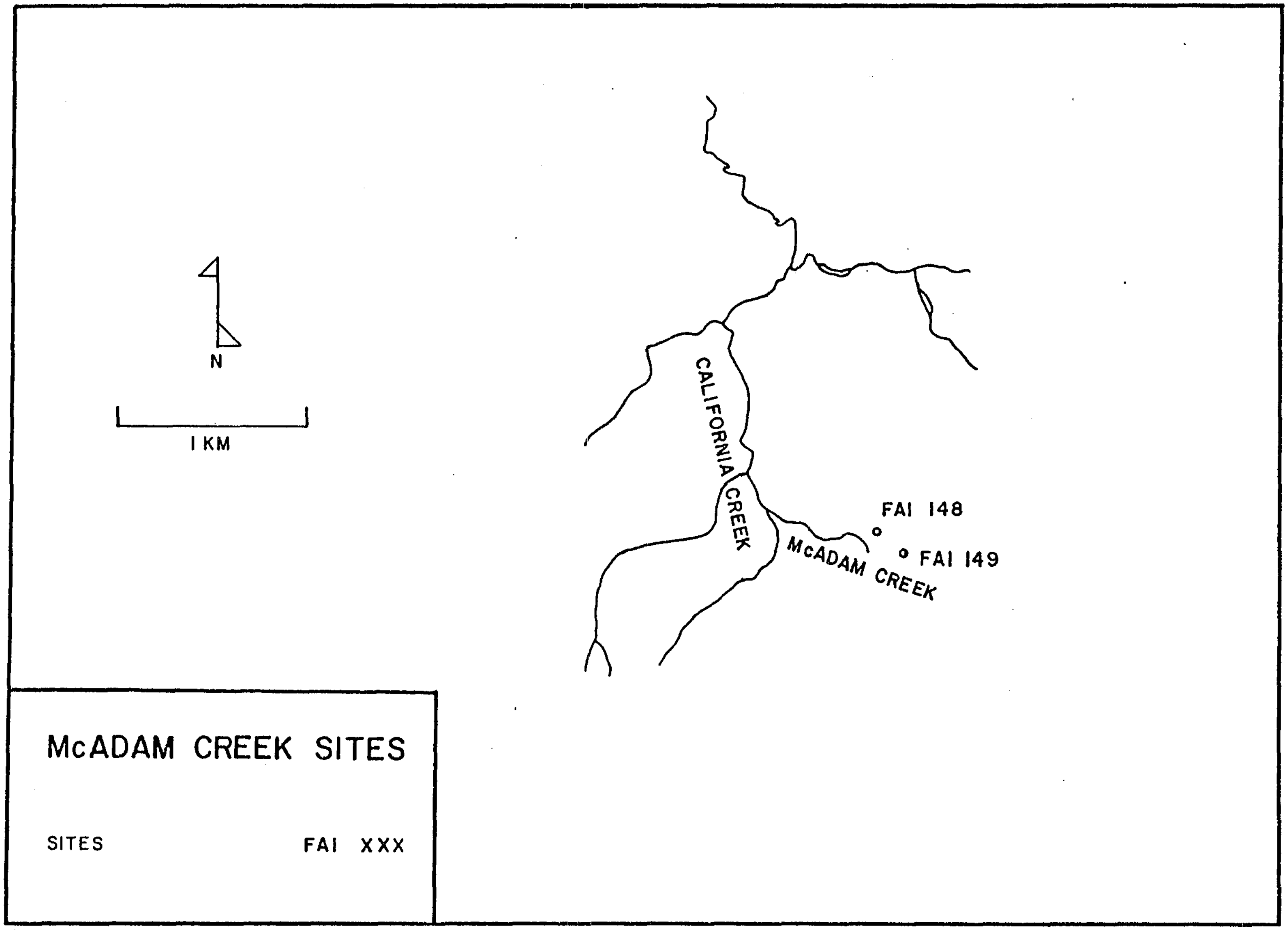
In the upper Dry Creek area the Nenana Gravel terrace of the north side of the creek was investigated during a one day reconnaissance. Loess exposures on the south face were examined and several test pits were excavated on the north side, but reached frozen ground at 50 cm below the surface.

A one day reconnaissance was performed on the Healy moraine located west of the town of Healy. Road cuts and natural exposures were examined along the east edge of the moraine; however, the shallow character of the loess (5-30 cm) indicated limited potential for sites in an adequate stratigraphic context.

On the east side of the Nenana River, a total of four days was devoted to sampling numerous localities in the Lignite Creek area.

Initially, testing was concentrated along the south face of a prominent headland, mapped as a Healy-age terrace (Wahrhaftig 1958), on the south side of the creek. A site (HEA-142) represented by surficial artifacts was discovered along the exposed edge of the terrace and a series of small test pits and trenches were excavated in the loess mantle (40-50 cm thick) in an effort to locate _in situ_ material. This attempt proved unsuccessful, and the focus of the survey was shifted to the north side of the creek. In this area, a number of terrace edges and knolls were examined and, where possible, tested for artifacts in sedimentary context. A surface site (HEA-138) was discovered on the Healy age terrace approximately two kilometers south of an unnamed creek below Lignite Creek. Several test pits were excavated in the 50 cm thick loess cap, but failed to reveal artifacts _in situ_. Approximately two kilometers southeast of HEA-138, another surface site (HEA-139), consisting of several flakes, was located on a higher Dry Creek age terrace, but the loess mantle was insufficient to warrant subsurface testing. A fourth site (HEA-140) was discovered on a higher ridge to the east of HEA-139, apparently composed of Tertiary sediments. Flakes were discovered along the exposed west face, and nine small test pits were dug at random locations along the ridge top in the 30 cm thick loess cap, but no material was found in stratigraphic context. Exposures along the Healy age bluff on the north side of Lignite Creek were also examined, although only a flake (HEA-141) was recovered here, located several hundred meters up its lowest tributary. No _in situ_ material was observed.

Figure D.3a. Map of the upper California Creek drainage showing location of McAdam Creek sites.


N
1 KM
CALIFORNIA CREEK
McADAM CREEK
FAI 148
FAI 149
McADAM CREEK SITES
SITES
FAI XXX

Four days were spent surveying the Dry Creek age terrace north of Walker Creek, where a total of five sites was discovered, but the surficial sediments were consistently too shallow to comprise an adequate stratigraphic context. Surface finds were observed on the south edge (FAI-141 and FAI-142) and the west edge (FAI-143, FAI-144, and FAI-145) of the terrace. These sites were chiefly represented by flake scatters of varying area and density, deposited on deflated gravel surfaces or a thin mantle of loess. Only one site (FAI-142), produced artifacts in situ, which were recovered from test pits at a depth of 9-10 cm in a 33 cm deep loess unit. Two additional surface sites (FAI-146 and FAI-147) were located during a two day reconnaissance of the upper Walker Creek area, situated on high Nenana Gravel promontories on the north side of the creek. No loess mantle is present here.

A one day reconnaissance of the upper California Creek area east of Walker Creek, produced another pair of surficial sites (FAI-148 and FAI-149) on the deflated bluffs (Nenana Gravels?) on the east side of McAdam Creek (Fig. D.3a).

At the north end of the valley, on the east side, a period of two days was spent surveying localities south of the Parks Highway. The west-facing edge of the Healy age terrace, which possesses a loess mantle of 30-50 cm, was examined along numerous exposures to the point at which the terrace terminates in Nenana Gravel bluffs. The top of the latter is capped by a loess layer of varying thickness (0-200 cm), and several test pits were excavated at the promontory on this surface which overlooks both the Tanana Flats and the Nenana Valley.

TEKLANIKA VALLEY

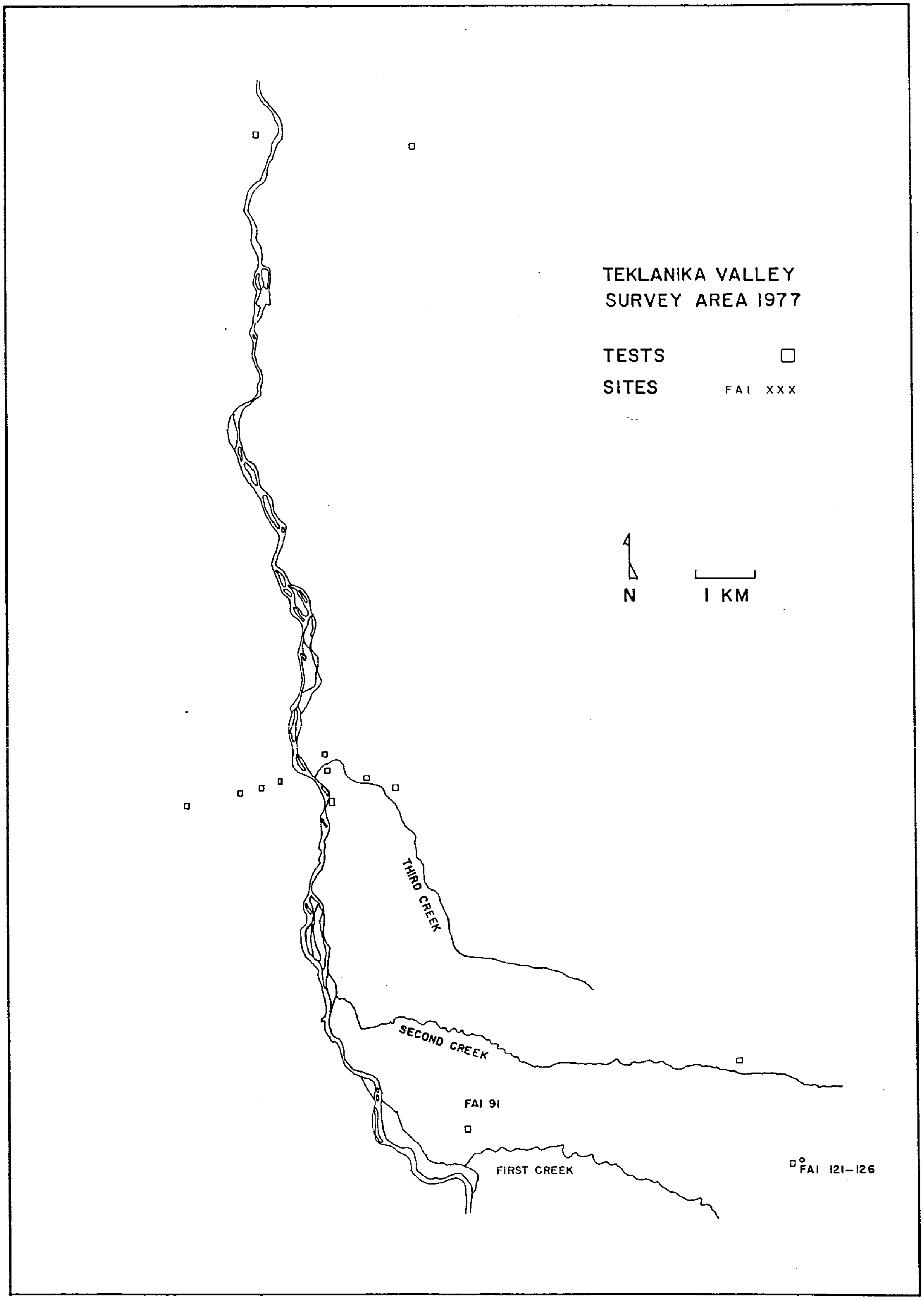
During the period of August 3-16, various locations were surveyed by a team of six archeologists, accompanied by a geologist. Access to the localities tested was achieved by foot and horse. The areas surveyed are described below (Fig. 4).

In the First Creek area, four days were expended testing several localities. On the high bluffs on the north side of the middle course of the creek valley, a series of surface sites (FAI-121-127) reported previously (Plaskett, n.d.) were examined for additional surface artifacts as well as material in stratigraphic context. Surficial sediments here consist of undulating sand dunes. On the second Teklanika terrace, near the creek mouth, exposures were examined and several test pits were excavated at another previously recorded site - FAI 91 (Plaskett, n.d.). The loess cap at this locality reaches a thickness of at least 165 cm and forms an excellent stratigraphic context for early sites. No artifacts were found *in situ*, however. The west edge of the terrace was examined for additional exposures for several hundred meters north of the creek mouth without success.

The upper Second Creek area was subjected to a one day reconnaissance of the north side of the creek, approximately 8 km east of its confluence with the river. The surfical sediments in this locality achieve a thickness of 80 cm; numerous exposures and blow-outs were examined.

In the area of the Third Creek - Teklanika confluence, five days of testing were focused on the silt mantle overlying the ca. 30 m terrace, on the north and south side of the creek, as well as what appear to be exposed fluvial sands several hundred meters south of the

Figure D.4. Map of the Teklanika Valley.


TEKLANIKA VALLEY
SURVEY AREA 1977
TESTS
SITES FAI XXX
N
1 KM
THIRD CREEK
SECOND CREEK
FAI 91
FIRST CREEK
FAI 121-126

confluence. The terrace top silts were frozen at shallow depths, and could not be excavated below approximately 50 cm. from the surface. Nevertheless, a series of pits were placed at three locations north, and one location south of the creek. The fluvial sand exposures were sampled where accessible, and produced a small assemblage of Pleistocene mammal bones (including a mammoth mandible). A one day reconnaissance of the west side of the river in this area was performed in the course of which

small test pits were excavated on each terrace level opposite the mouth of Third Creek. Surficial sediment cover varied between 50-90 cm. in depth.

Two days of survey were spent at the north end of the valley where exposures of bluff top silt overlying a ca. 40 m. terrace were examined on the west side. A brief reconnaissance of the east side revealed an insufficient sedimentary context for sustained testing.

Archeological Sites

ROCK CREEK

FAI-140 N = 15

This isolated site is located on the north side of Rock Creek approximately 3.5 km from the point where Rock Creek flows under the Parks Highway (Fig. D.2). It lies at 64°0' north latitude and 149°11'west longitude in Sec. 31, T9S, R8W of the Fairbanks A-5 quadrangle. The site is situated on the Healy Terrace.

Two bifaces and a retouced pebble were found on the gravel slope beneath a loess exposure. While clearing vegetation for a test pit, flakes were discovered in the sod. The test pit (1 x 1 m) was excavated to a depth 130 cm when permafrost was encountered just above the Healy alluvium. No further artifacts were found.

Surface Finds (3)

Ovate Biface (1)(Fig. D.5A) Pumice 122 x 56 x 29 mm

This specimen is a well executed bifacial implement. It has an ovate outline and a thick lenticular cross-section. One edge is sinuous. Two-thirds of the opposite edge was sheared away along a plane of crystalline material in the pumice. However, bifacial reduction continued utilizing the break as a platform.

Biface fragment (1)(Fig. D.5B) Black Chert 52 x 36 x 15 mm

This piece is either the base or the tip of a biface. The outline cannot be determined but the cross-section is lenticular, both edges preserve bifacial reduction platforms. It appears to be unfinished.

Retouched pebble (1) (Fig. D.5C) Green Chert 86 x 55 x 31 mm

This artifact is a water rounded pebble with two, large, highly polished flake facets traversing one side. The facet at one end served as a platform for minor retouching.

Excavated Finds (12)

Twelve flakes were found in the sod layer while clearing vegetation for a test pit at this site.

Flake (1)	Pumice
Flake (1)	Chalcedony
Flake (1)	Gray chert
Flake (9)	Diabase

Figure D.5. Artifacts from site FAI-140 (Rock Creek).

A Biface

B Biface fragment

C Retouched pebble

scale = 10 cm

Comments

Of the materials found at Rock Creek site, only the nearly complete biface found on the surface is of any diagnostic value. It can be duplicated in the ovate biface series from Component II in the Dry Creek site. Unfortunately, generalized bifaces of this morphology could have long history in the region and our lack of a fully developed sequence of typologies and chronological controls obviously undermines our ability to securely establish the affinities of such artifacts.

PANGUINGUE CREEK

HEA-137 N = 359

Panguingue Creek is located 4.2 km northwest of Dry Creek along the Parks Highway (Fig. D.2). It lies at 63°55' north latitude and 149°5' west longitude in Sec. 34, T11S, R8W of the Healy D-5 quadrangle.

The two stream valleys are separated by a broad, flat expanse of the Healy outwash terrace. North of Panguingue Creek another terrace rises approximately 84 m above the bed of the stream. This surface is also mapped as the Healy terrace although it is 31 m higher than the same terrace to the south of Panguingue Creek (Wahrhaftig, 1958).

Incision by Panguingue Creek has created extremely steep slopes on both sides of the stream. The south side of the creek is densely forested but the north side, because of its southern exposure, is open and covered with xeric plant communities. The surface of the terrace north of the creek is covered with mixed deciduous and coniferous forest which is considerably stunted due to exposure to the desiccating effects of the wind.

The basic topographic situation is identical to Dry Creek, i.e. it is a prominant headland formed by the intersection of a tributary stream with the older, higher flood plains of the Nenana River. The site area faces south and commands a better view of the countryside than Dry Creek.

The edge of the high Healy terrace is undergoing gully erosion which has created small lobate headlands between the gullies. The test excavation was placed on the southernmost of the these headlands which overlooks both the small valley of Panguingue Creek to the south and the Nenana valley to the east. The test excavation (1 x 10 m trench) was positioned in the center of this area and oriented to magnetic north (29° east of true north) which is also the axis of the promontory.

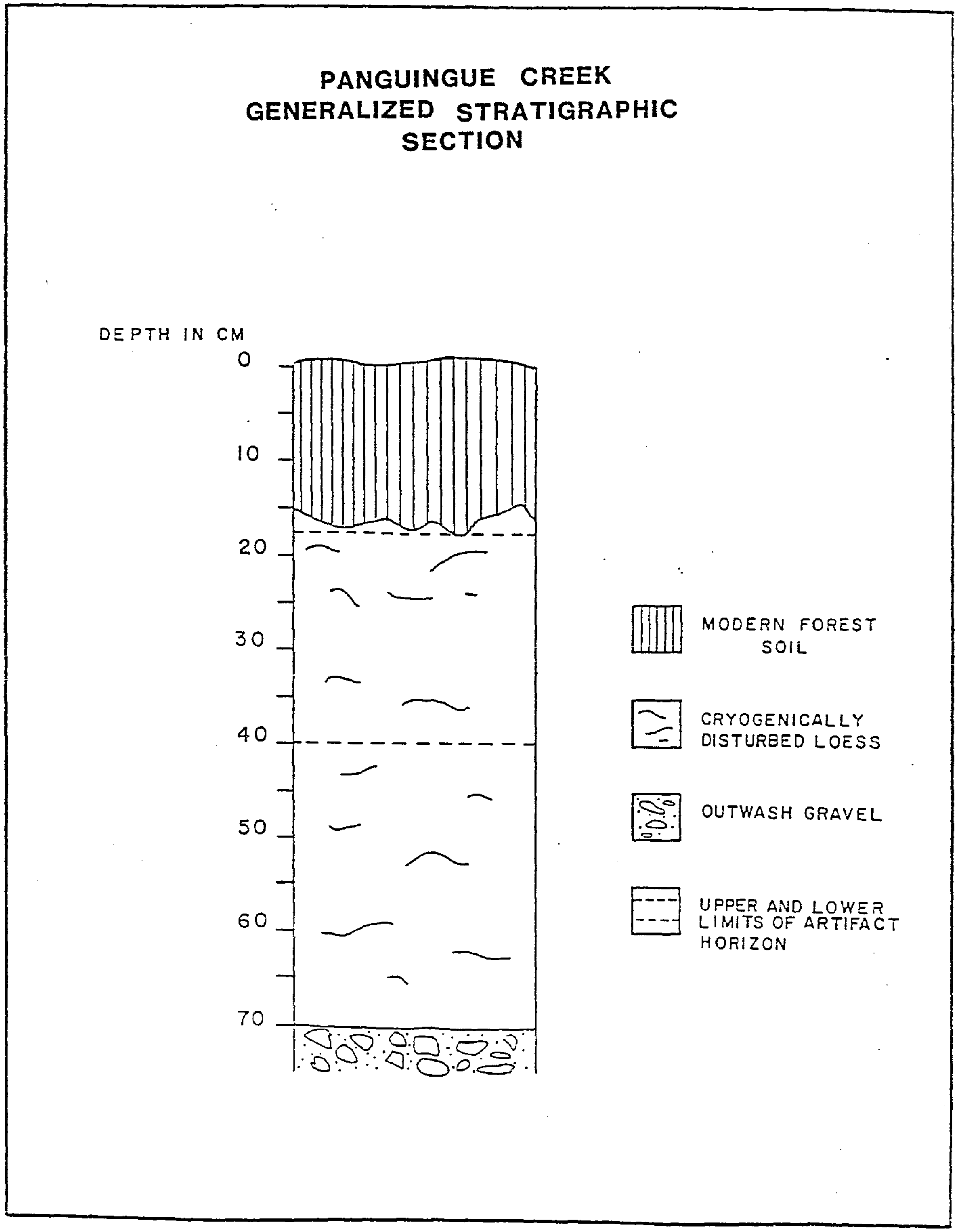
Stratigraphy

Excavation revealed a simple stratigraphic section (Fig. D.4). A thin vegetation matt overlies a well developed forest soil which extends downward to a depth of 15 to 20 cm. Below this soil, a uniform loess unit was encountered which extended down to the surface of the outwash. There are discontinuous, highly contorted soil stringers throughout this loess unit. The contact between the loess and outwash is 70 cm. Permafrost was encountered at a depth of 45 cm throughout the test.

Artifacts were first encountered at the base of the forest soil and continued to occur scattered throughout the trench to a depth of 40 cm. Individual excavation units were excavated in the surface of the outwash and in those units the loess below a depth of 40 cm was sterile. As a result, no more time was spent excavating further squares.

Lithic artifacts were found lying at almost every conceivable

Figure D.6. Stratigraphic section of site HEA-137 (Panguingue Creek).


PANGUINGUE CREEK
GENERALIZED STRATIGRAPHIC
SECTION
DEPTH IN CM
0
10
20
30
40
50
60
70
MODERN FOREST SOIL
CRYOGENICALLY DISTURBED LOESS
OUTWASH GRAVEL
UPPER AND LOWER LIMITS OF ARTIFACT HORIZON

angle. No discernable horizontal pattern could be detected in the distribution of the artifacts. There are no typological differences between artifacts found at differing depths. It is also unfortunate that no faunal remains were recovered. The cultural remains possibly represent a single component which may have been more compact at one time, while their vertical distribution is due to subsequent cryogenic action. One radiocarbon date was obtained for the site of 5620 ± 65 B.P. (SI -3237). This date was obtained from a sample of charcoal which was collected throughout the trench area at a depth of approximately 20 cm. It is not certain that this charcoal is cultural. It is very possible that it is the remnant of a brush or forest fire. Also, its proximity to the base of the soil within an active root zone would provide a matrix in which the sample could have been contaminated. We view this date with considerable suspicion.

Artifacts

Test excavations at Panguingue Creek recovered 359 lithic artifacts. Of these, 323 are flakes which reflect a full range of stone working from bifacial and unifacial flaking to core production. By far the most common raw material is quartzite (232 flakes). Black chert (38 flakes), rhyolite (25 flakes) and chalcedony (19 flakes) also are important. The remaining rock types are weakly represented: green chert (3), gray chert (4), diabase (1) and sandstone are represented by a few flakes each.

Of the remaining 36 pieces from this site, 27 are the result of core manufacture and blade production and can be categorized as follows: core tablets (3), detached core face (1), microblades (14), blades (6), and blade-like flakes (2). Of the remaining 9 pieces there is 1 burin, 1 burin spall, 3 bifacial tools (1 complete biface and 2 biface bases), 2 transverse scrapers, 2 utilized flakes, and 1 retouched flake.

Cores and Blades

Both microblades and macroblades were produced at Panguingue Creek. Unfortunately, the cores from which these blades and microblades were detached were not recovered. The only information on core morphology is derived from the core tablets.

Macrocore tablets (3)

Two of the tablets were struck from large quartzite wedge-shaped cores. Both of these tablets retain truncated blade facets at their thickest ends. One of these tablets (Fig. D.7E) probably represents the first removal of the platform as its dorsal surface preserves the facets resulting from initial platform preparation. This specimen measures 46 x 32 x 13 mm.

The second tablet in this group shows evidence of previous platform rejuvenation episodes on its dorsal surface. It measures 46 x 37 x 16 mm.

It is possible that both tablets were removed from the same core although a firm rearticulation of the tablets could not be managed.

These tablets were both struck from the core by blows directed at the right hand corner of the fluted arch. As a result, only the very front of the platform was removed.

We recovered only two blade segments (1 proximal and 1 medial) and 1 blade-like flake of this raw material.

Microcore tablet (1)

This single gray chert specimen is unusual (Fig. D.7D). It retains truncated microblade facets at one corner. The edge running from these facets to the right is very thin and feathered from flat retouch directed onto the face of the tablet. The opposite edge is thick and steeply flaked. The blow which removed the tablet was directed at the edge opposite the microblade facet. This method of platform rejuvination suggests that the core may have been conical. It measures 24 x 22 x 7 mm.

Only 2 microblade segments (1 medial and 1 distal) of this raw material were found at the site.

Fluted face of a core (1)

This artifact is possibly the entire portion of the face of a microcore which bears the facets of microblade removal (Fig. D.7F). One microblade facet on the edge of this piece lies at about a 50° angle to the remainder of the facets. It appears that this blow removed one side of a strongly fluted face. Unfortunately, such a piece could have come from either a wedge-shaped or conical core. This piece measures 33 x 19 x 5 mm.

Four microblades (1 complete, 1 medial, and 2 distal segments) of this material were found at the site.

Microblades (14)(Fig. D.7C)

High quality cryptocrystalline rocks were used for microblade production: chalcedony, black chert, grey chert, and a high quality rhyolite. Chalcedony microblades are represented by 1 complete specimen, 1 medial segment, and 1 distal segment. The black chert microblades are represented by 2 complete specimens, 4 proximal segments, and 1 medial segment. The gray chert microblades are represented by 1 medial segment and 1 distal segment. Rhyolite is represented by 1 proximal segment.

The complete microblades (3) range from 13 to 20 mm in length. The segments are consistently 4 to 8 mm in width and 1 to 3 mm. in thickness. There is no variation based on raw materials.

As mentioned above, we have core parts and microblades for gray chert and chalcedony. However, we have black chert and rhyolite microblades but no corresponding core parts. The sample is so small that no behavioral significance can be attached to this pattern. None of the microblades show retouching or evidence of use.

Blades (6)(D.7B)

The blades were detached from quartzite and coarse rhyolite cores. The 2 complete specimens are 35 mm and 47 mm in length. The segments and complete specimens range 12 to 16 mm in width and 2 to 6 mm in thickness regardless of raw material.

As we mentioned earlier, quartzite wedge-shaped core tablets exist, but no core parts of rhyolite were found. Again, no retouching or evidence of retouching is present.

Blade-like flakes (2)(Fig. D.7A)

One of these specimens is quartzite and is complete. It measures 42 x 20 x 8 mm. The second specimen is of black chert and is a distal

Figure D.7. Artifacts from site HEA-137 (Panguingue Creek).

A Blade-like flake

B Blade

C Microblade

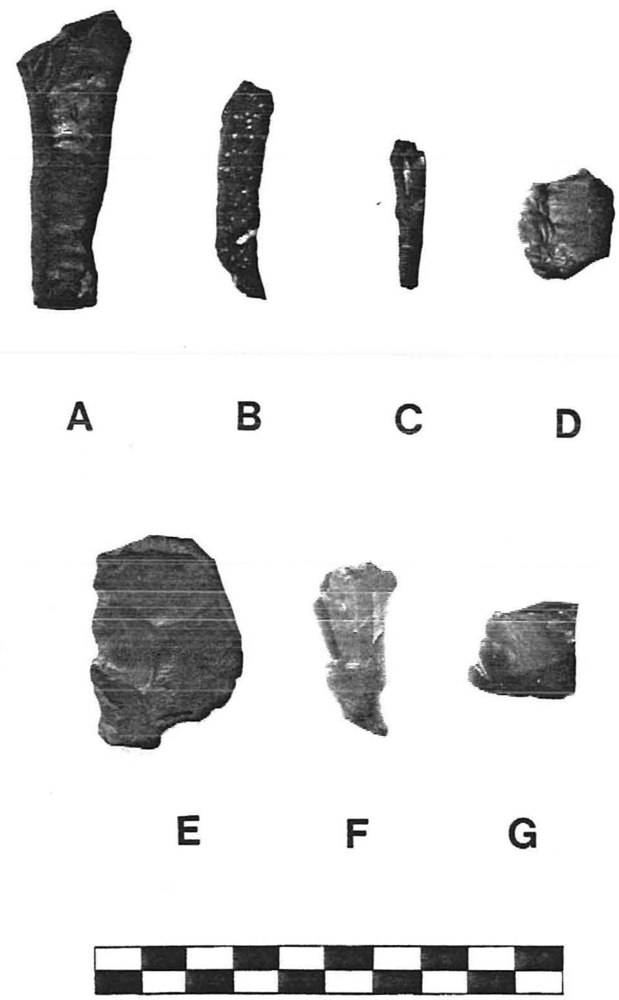
D Microcore tablet

E Macrocore tablet

F Fluted core face

G Burin on a snap

scale = 10 cm


A
B
C
D
E
F
G

segment. It measures 64 x 25 x 6 mm. Neither piece was retouched or utilized.

Burin (1)(Fig. D.7G)

One burin was recovered at Panguingue Creek. It is a burin on a snap or "single blow burin." At least one, and possibly two burin spalls were struck from one edge of a gray chert flake. A hinge fracture served as the striking platform. There is minor nicking along the edge of the burin facet. The edge opposite the burin facet is thin and irregular. It displays irregular, fine, almost microscopic chipping. The flake measures 23 x 21 x 6 mm. The burin facet is 20 mm. long and 6 mm wide.

Burin spall (1)

A single gray chert burin spall was found. It measures 14 x 5 x 2 mm.

Bifacial Tools

Complete biface (1)(Fig. D.8F)

This specimen is undoubtedly the most spectacular find made at Panguingue Creek. It is a complete, lanceolate biface made on an enormous flake of tan chert. A band of red chert runs across the base of the artifact. It ranges from lenticular to slightly plano-convex in cross section and has slightly excurvate edges. The base is unfinished and lies at an angle to the long axis of the piece. The tip is purposely blunt and asymmetric. The piece was parallel-flaked from tip to base. This flaking ranges from transverse to oblique. There are

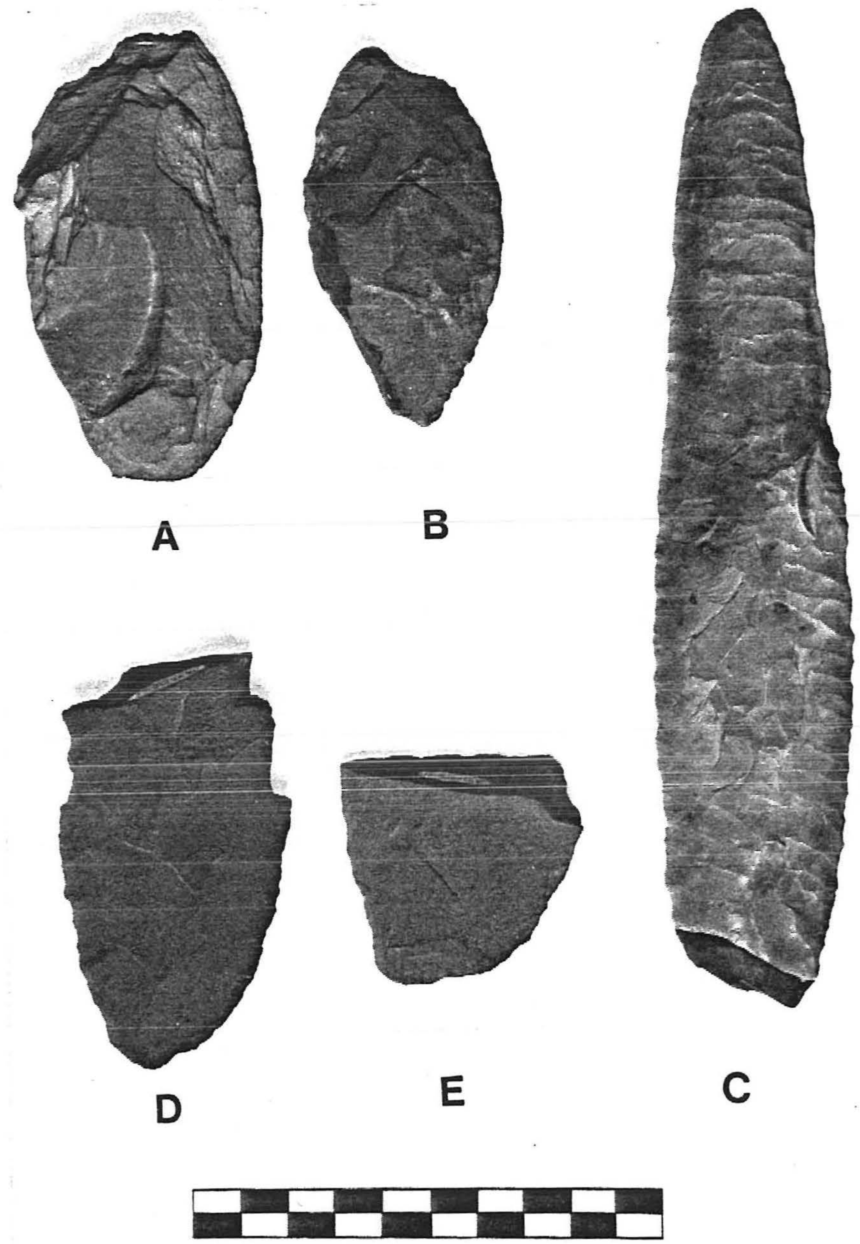
Figure D.8. Artifacts from HEA-137 (Panguingue Creek).

A–B Transverse scrapers

C Complete biface

D–E Biface fragments

scale = 10 cm


A
B
C
D
E

numerous examples of flaking interruptions when the fabricator removed too much material. There is also a thick nob on one face which would not detach leaving a deep hinge fracture facet. Based on these observations and the slight irregularities of the edges, it appears this piece is unfinished. It measures 210 x 4 x 12 mm.

Biface fragments (2)(Fig. D.8D)

The first specimen in this group is quartzite. It is one end of a roughly lanceolate biface with a lenticular cross section which is pointed at one end and has a hinge fracture at the other end. One edge bears two, deep burin-like facets originating at the hinge fracture.

It is not clear if these facets resulted from a heavy blow at the end of the piece which snapped it and sheared away the edge, or if the facets were for the purpose of developing a massive burin. There is no evidence of retouching or use wear on the edges of the various fractures. It measures 88 x 49 x 14 mm.

The second specimen is diabase. It is one end of a biface (Fig. D.8E). It is roughly lenticular in cross-section and slightly asymmetric in outline. There is minor nicking on one edge of the hinge fracture indicating possible use as a scraper. It measures 49 x 52 x 14 mm.

Scrapers

Transverse scrapers (2)

Both of these specimens are quartzite. Each specimen displays a well shaped, convex working edge which is transverse to the long axis of the flakes on which they were made. One piece (Fig. D.8A) was worked with blows which hinged out just in from the margin creating a working edge which lies at a 40° angle to the ventral face. It measures 90 x 51 x 22 mm.

The flaking pattern on the second piece is even and gradually merges with the dorsal face (Fig. D.8B). The working edge on this piece lies at a 27° angle to the ventral face. It measures 80 x 42 x 14 mm.

Other Tools

Retouched flake (1)(Fig. D.8C)

This single specimen is a chunk of a gray chert cobble. There is regular chipping along one edge. It measures 43 x 35 x 19 mm.

Utilized flakes (2)

There are two large flakes in the collection which display sporadic nicking along the edges. Both were struck from cobbles and retain cortex on the dorsal surface. One piece is sand stone and measures 111 x 59 x 12 mm. The other piece is quartzite and measures 64 x 45 x 14 mm.

Comments

Panguingue Creek is the only other site in the Nenana Valley containing cultural material associated with a radiocarbon date.

When we compare the Panguingue Creek assemblage with Dry Creek Component II we can see definite similarities and also some notable differences. The two collections share a microblade technology although we are not certain of the core type from which they were detached at Panguingue Creek. The single burin for Panguingue is duplicated at Dry Creek. The large, transverse scarpers also occur in both sites. The Dry Creek scrapers are morphologically the same but were not as excellently executed as the Panguingue scrapers. The two biface fragments would fit perfectly into the Dry Creek series of large bifaces.

While blade-like flakes occur in both sites, a true macroblade industry is absent at Dry Creek. The Panguingue Creek blades were detached from wedge-shaped cores which were much larger than those found at the Dry Creek site. However, the size of the Panguingue cores is probably due to the use of a coarse grained raw material.

The most obvious feature of the Panguingue Creek assemblage is the large, parallel flaked, lanceolate point. There is no comparable lithic point technique at the Dry Creek site or in the Nenana Valley. A comparable flaking technique can be seen on Choris lithic points (Giddings, 1967; Dumond, 1977) but they are much smaller than the Panguingue Creek specimen.

Parallel flaking is also an important attribute in the undated Kayuk complex at Anaktuvak Pass which was provisionally related in Plano cultures and assigned a date of 5,000 - 7,000 B.P. (Campbell, 1962). However, the age and cultural affinities of this complex is uncertain (Dumond, 1977).

The resemblance of the Panguingue Creek point to one illustrated by Giddings (1967, Fig. 86) from the Old Whaling Culture is remarkable. The two pieces are of identical length and width and share a similar flaking technique. Giddings (1967) dated Old Whaling to between 3,450 and 3,750 B.P. on the basis of radiocarbon dates. However, Dumond (1977) has suggested that these dates are too old.

Regardless of the differing opinions concerning the affinities of Choris, Kayuk, or Old Whaling, the age of these cultural units is considerably younger than the single date from Panguingue Creek.

Apart from these similarities, one is left with the obvious possibility that this style of projectile point is related to the parallel-flaked point tradition of the North American Plains. This comparison is consistent with the single date from Panguingue Creek.

The discomfort with the radiocarbon date at Panguingue Creek has already been pointed out. In view of this, and also because of the sample is small and may be mixed, any attempt to establish both chronological position and cultural affinity should be avoided. It is possible that the Panguingue assemblage reflects the appearance of flaking techniques and point styles in Alaska during the early or mid-Holocene which originated on the North American Plains. It is also possible that the Panguingue Creek assemblage falls much later in time and relates to a spread of people bearing Arctic Small Tool type implements (in this case Not-So-Small-Tool!). Clarification of this problem must await future field work.

LIGNITE CREEK

HEA-138 N=2

This site is situated at the edge of the Healy Terrace, .3 km south of an unnamed creek which flows with the Nenana River opposite the mouth of Panguingue Creek. The site is .4 km east of the Nenana River. This locality lies at 63°56' north latitude and 149°02' west longitude in Sec. 25, T.11S, R.8W of the Healy D-5 quadrangle (Fig. D.3).

Artifacts

End scraper (Fig. D.9A) Rhyolite 21 x 33 x 7 mm

This end scraper appears to have been made on the distal end of a blade. No polish is evident.

Retouched flake (1) Rhyolite 25 x 18 x 4 mm

HEA-139 N=0

This locality is situated on a knoll at the back of the Healy Terrace, 3 km southeast of HEA-138. This locality lies at 63°55' north latitude and 148°58' west longitude in Sec. 31, T.11S,R.7W in the Healy D-4 quadrangle.

Two flakes were found on the surface. Neither was collected.

HEA-140 N=16

This site is a diffuse flake scatter less than 10 m in diameter lying on the slope of a loess-capped bluff composed of Tertiary age coal-bearing deposits. This site is located 1 km due east of HEA-139. This locality lies at 63°55' north latitude and 148°57' west longitude in Sec. 32,T.11S,R.7W in the Healy D-4 quadrangle.

Artifacts

Blade-like flake (1)(Fig. D.9B) Chalcedony 47 x 15 x 8 mm

Flakes (15) Rhyolite

HEA-141 N=14

This site lies at the edge of the Healy Terrace at the head of a small east side tributary flowing into Lignite Creek from the north.

Figure D.9. Artifacts from the Lignite Creek and Walker Creek areas.

A HEA-138 End scraper

B HEA-140 Blade-like flake

C FAI-141 Wedge

D FAI-141 Burin on a snap

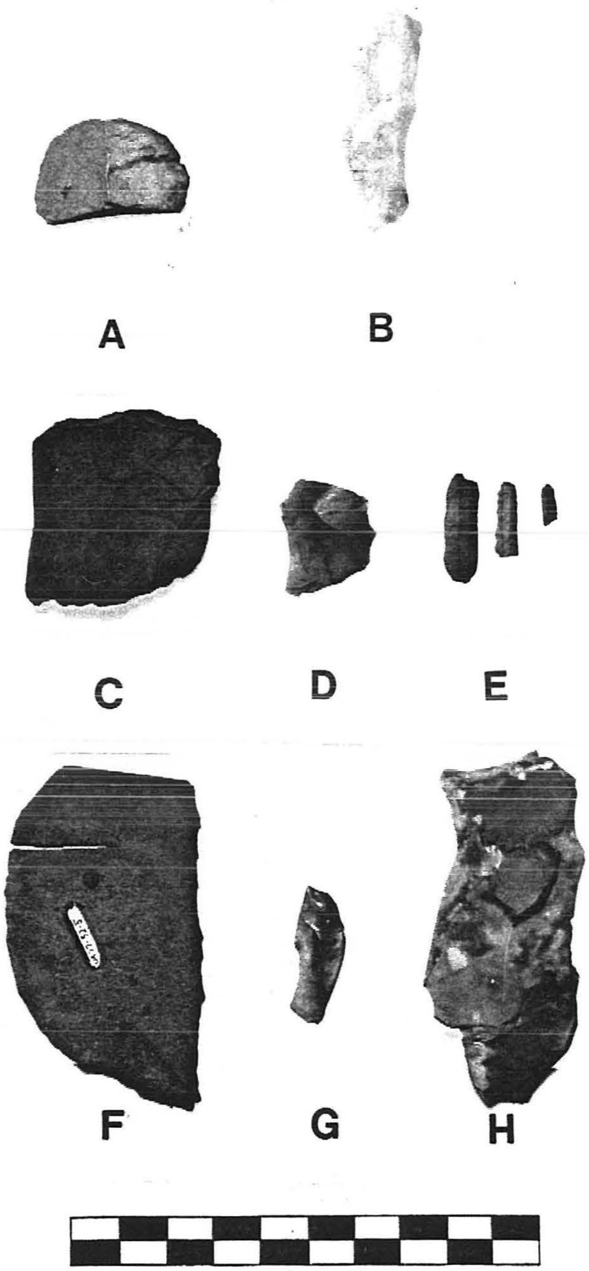
E FAI-142 (Locality 1) Microblades

F FAI-142 (Locality 2) Retouched flake

G FAI-143 Blade-like flake

H FAI-145 Blade-like flake

scale = 10 cm



This locality lies at 63°55' north longitude and 148°58' west longitude in Sec. 32,T.11S,R.7W in the Healy D-4 quadrangle.

Artifacts

Flakes (13)	Diabase
Flake (1)	Rhyolite

This specimen has two small nicks on one edge which could have resulted from use.

Comments

The only formal tool found in the Lignite Creek area was the end scraper from HEA-138. It is impossible to assign age or cultural affinity to this piece.

WALKER CREEK

FAI-141-147

These localities are small flake scatters located on north side of Walker Creek on the south- and west-facing lip of the Dry Creek terrace. The area lies between 64°1' and 64°2' North latitude and 149°0' and 149°3' west longitude in Sections 23, 24, and 25, T10S, R8W of the Fairbanks A-5 quadrangle.

FAI-141 N=10

This tiny lithic scatter is situated on the top of the Dry Creek terrace riser about .3 km north of Walker Road at a point approximately 4.7 km from the Nenana River.

Artifacts

Wedge (1)(Fig. D.9C)	Dark gray chert	39 x 40 x 12 mm

This piece has a roughly square outline and a rectangular cross-section. One edge is thick and heavily battered. The opposite edge is thin and heavily indented from tiny hinge fractures.

Burin on a snap (1)(Fig. D.9D)	Gray chert	24 x 20 x 4 mm

This is a flake with a single burin facet struck on a hinge fracture. Both edges of the burin facet display fine nicks. The other edges of the flake likewise show nicking.

Edge fragment from a biface (1)	Brown chert	35 x 20 x 10 mm
Flakes (7)	Dacite	
Flake (1)	Chert	

This piece is fire crazed and has pot-lid fractures.

FAI-142 (Locality 1) N=76

The surface scatter is approximately 1 km west of FAI-141 on the lip of the Dry Creek terrace.

<u>Artifacts</u>

Microblades (10)(Fig. D.9E) Rhyolite

Proximal segments (5)

Medial segements (5)

The proximal segments range from 3 to 8 mm in width and 1 to 3 mm in thickness. The medial segments range from 5 to 7 mm in width and 1 to 2 mm in thickness. These microblades are unretouched.

Proximal segment of blade(1)	Rhyolite	34+ x 16 x 8 mm
Flakes (65)	Rhyolite	

FAI-142 (Locality 2)

This lithic scatter lies .5 km to the west of FAI-142 (locality 1) at the point where the Dry Creek terrace turns to the north.

Artifacts

Retouched flakes (1)	Rhyolite	90 x 45 x 9 mm
Retouched flakes (1)	Pumice	72 x 42 x 5 mm

This piece has a thin symmetrical incision. This was probably done with a metal saw. We have no explanation for this phenomenon.

(Fig. D.9F) Microblade (1) Medial Segment	Dacite	8 x 5 x 2 mm
Flakes (38)	Rhyolite	
Flake (1)	Obsidian	
Flake (1)	Green chert	

FAI-143 N=4

This tiny flake scatter lies about .8 km north of FAI-142 (Locality 2).

Artifacts

Blade-like flake (1)(Fig. D.9G)	Obsidian	30 x 11 x 2 mm
Retouched flake (1)	Dacite	21 x 20 x 4 mm
Flakes (2)	Rhyolite	

Both of the flakes are fire crazed.

FAI-144 N=9

This artifact concentration lies about .8 km north of FAI-143.

Artifacts

Biface fragment (1)	Rhyolite	26 x 27 x 8 mm
Notched flake (1)	Rhyolite	40 x 26 x 7 mm
Flakes (7)	Rhyolite	

FAI-145 N=4

This tiny flake scatter lies .4 km east of FAI-144.

Artifacts

Blade-like flake (1)(Fig. D.9H)	Chert	75 x 33 x 9 mm
Flakes (2)	Chert	
Flake (1)	Rhyolite	

FAI-146 N=8

This site is located at the top of a prominent bluff overlooking the Walker Creek Valley about 5.3 km from the Nenana River. The top of the bluff is about 1 km north of Walker Creek. It lies at 64°1' north latitude and 148°58' west longitude in Sec. 20, T10S,R7W of the Fairbanks A-5 quadrangle.

The artifacts lay on the surface of the Nenana gravels.

Artifacts

Blade, complete (1)(Fig. D.10A)	Rhyolite	70 x 30 x 14 mm
Blade, complete (1)(Fig. D.10B)	Rhyolite	87 x 30 x 15 mm
Blade, complete (1)(Fig. D.10C)	Rhyolite	101 x 37 x 18 mm
Blade, proximal (1)	Rhyolite	56 x 29 x 8 mm
Blade, medial (1)	Rhyolite	40 x 23 x 7 mm

Figure D.10. Artifacts from the Walker Creek and McAdam Creek areas.

A FAI-146 Complete blade

B FAI-146 Complete blade

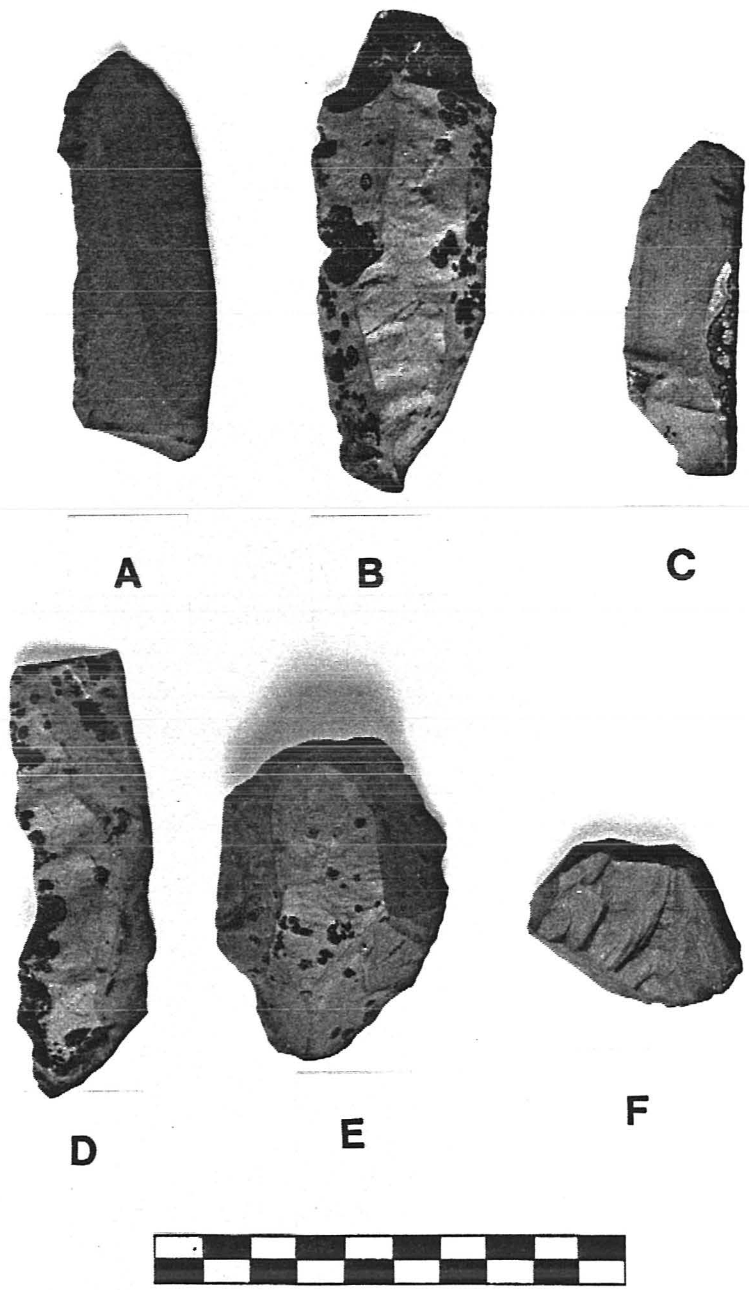
C FAI-146 Complete blade

D FAI-146 Blade, distal

E FAI-146 Core

F FAI-149 Core tablet

scale = 10 cm



A
B
C
D
E
F

Blade, distal (1)(Fig. D.10D)	Rhyolite	95 x 32 x 14 mm
Core (Fig. D.10E)	Rhyolite	67 x 52 x 39 mm

This irregular, prismatic core was used to detach small flakes and blades.

Flake (1)	Rhyolite

FAI-147 N=14

This flake scatter is located about 1.5 km. east of FAI-146 on a ridge situated on the north side of the unnamed north fork of Walker Creek. The ridge is about .3 km north of the stream. The site lies at 64°1' north latitude and 148°57' west longitude in Sec. 18, T10S, R7W of the Fairbanks A-5 quadrangle.

Artifacts

Retouched flake (1)	Rhyolite	75 x 42 x 12 mm
Retouched flake (1)	Rhyolite	85 x 40 x 16 mm
Retouched flake (1)	Black chert	77 x 50 x 13 mm
Flakes (8)	Rhyolite	
Flakes (1)	Green chert	
Flakes (1)	Black chert	
Flakes (1)	Gray chert	

Comments

The burin on a snap from FAI-141 is duplicated in both Component II at Dry Creek and at Panguingue Creek. The same is true of the microblades found at FAI-142. In both of these cases, the artifacts could be either terminal Pleistocene or Holocene in age.

The blades and the core from FAI-146 are different. The core is not duplicated in any known Nenana Valley site. Blades are known from the Panguingue Creek site although they are not as massive as those picked up at FAI-146. Cores from which this size of blade could have been detached were found in Component II at Dry Creek. However, the facets on the cores indicate that only blade-like flakes were detached in the last removal series.

The cultural materials found on the surface sites in the Walker Creek area provide no basis for assigning specific age or cultural affinity. Based on the thin data base presently existing for the Late Quaternary of the Nenana Valley it can be suggested that this blade technology is possibly of Holocene age.

McADAM CREEK

FAI-148 N=2

This tiny sample was found on the top of an unvegetated hill about .9 km north of the source of McAdam Creek. It lies at 64°1' north latitude and 148°35' west longitude at the intersection of Sections 19, 20, 29 and 30, T10S, R6W, Fairbanks A-4 quadrangle.

These artifacts were recovered from a rubble surface.

Artifacts

Retouched flake (1)	Rhyolite	82 x 58 x 24 mm
Flake (1)	Rhyolite	

FAI-149 N=5

This small scatter was found at the top of an unvegetated hill which stands out promanently about 1.4 km east of the source of McAdam

Creek. It lies at 64°1' north latitude and 148°34' west longitude in Sec. 29, T10S, R6W, Fairbanks A-4 quadrangle.

Artifacts

Blade-like flake, proximal (1)	Rhyolite	58 x 25 x 9 mm
Blade-like flake, proximal (1)	Rhyolite	37 x 20 x 6 mm
Core-tablet (Fig. D.10F)(1)	Rhyolite	47 x 34 x 25 mm
Flake (2)	Rhyolite	

This tablet was struck from some type of prismatic core although the specific morphology cannot be determined.

Comments

Only the core tablet from FAI-149 is notable. The blade-like flakes associated with it may reflect a blade technology similar to that found at FAI-146 (Walker Creek). As stated above, this material cannot be dated or assigned to any known cultural unit.

Although such blade and core technologies may be of Holocene age, it is note worthy that they have not yet been isolated in a stratigraphic context capable of being dated. It is also not known whether these blades constitute a new lithic complex or if they are simply an undiscovered aspect of existing cultural units.

FIRST CREEK

FAI-121-127 N=10

A group of 6 separate blowout localities were discovered here in 1976 by David Plaskett and Robert Thorsen (Plaskett, n.d.; Thorson, 1977). They are located at the top of the watershed between two unnamed streams which flow into the Teklanika River from the east (Fig. D.4). These streams were named "First" and "Second" creeks by Plaskett and Thorson. The sites lie at 64°0'30" north latitude and 149°26' west longitude in Sections 35 and 36, T10S,R10W, of the Fairbanks A-5 quadrangle.

We could not be certain of the exact location of our sample with respect to these site designations. Our collections were taken from pebble pavements and sand dune surfaces in an area about 30 m in diameter.

<u>Artifacts</u>

Biface base (1)(Fig. D.11A) Gray chert 4+ x 24 x 7 mm

This specimen is the base of a stemmed or slightly lanceolate point with a lenticular cross-section. The basal extremity is straight. Both edges are slightly polished up to the point where the tip end of the piece begins to contract. This specimen is similar to the bifacial points bases found in Component II in the Dry Creek site (See Fig. 4.27 in this volume).

Biface base (1)(Fig. D.11B) Chalcedony 22 x 21 x 6 mm

This piece is the base of a well executed small biface, probably a projectile point. The edges are straight and while the base is slightly irregular, it is generally straight. The piece has a lenticular cross-section. The edges are unpolished.

This specimen appears to be very similar to the small triangular point found in Component I at Dry Creek. However, such a comparison can only be noted since a stratigraphic context and dates are completely lacking.

Figure D.11. Artifacts from the First Creek dunes.

A–B Biface bases

C Biface fragment

D End scraper

scale = 10 cm


A
B
C
D

Biface fragment (1)(Fig. D.11C)	Ignimbrite	54 x 27 x 9 mm

This piece is a crudely worked lanceolate biface missing both ends. The edges are very irregular and the cross-section is plano-convex.

This specimen is unfinished and was apparently discarded after numerous problems in bifacial thinning were encountered.

End scraper (1)(Fig. D.11D)	Black chert	27 x 28 x 9 mm

Most of the features of this piece have been obscured by wind and sand polish.

Retouched flake (1)	Black chert	28 x 25 x 26 mm
Retouched flake (1)	Chalcedony	23 x 17 x 7 mm
Flake (1)	Pumice	
Flake (1)	Rhyolite	
Flake (1)	Gray chert	
Flake (1)	Ignimbrite	

Comments

The tiny sample of artifacts from this area indicates that early hunters visited this area and that they carried tool kits similar to both components I and II at Dry Creek. Unfortunately, there appears to have been a tremendous amount of reworking of the aeolian sediments in this area. It is possible that a very detailed, long-term testing program might locate areas with undisturbed sediments and potentially isolate additional terminal Pleistocene sites.

CONCLUSIONS

The central objective of the 1977 survey, the discovery of new Pleistocene age sites, was not achieved. In the analysis which follows, an attempt is made to come to grips with the probable reasons for this lack of success, in order to better design and conduct future surveys for Pleistocene sites in this region, and perhaps elsewhere.

In retrospect, it would appear that the following factors acted as serious constraints on the effectiveness of the survey:

1. High frozen ground levels which frequently prevented or inhibited sampling of Pleistocene deposits in deep stratigraphic context. In many areas on the west side of the Nenana Valley, and at the heavily tested Third Creek area of the Teklanika Valley, frozen ground forced the termination of test pits before probable Pleistocene levels could be reached. It is quite possible that sites in this time range remain to be discovered at these localities.

2. Insufficient stratigraphic context in many areas explored by the survey team. In many areas on the east side of the Nenana Valley, the survey team expended significant amounts of time in localities lacking an adequate sedimentary context for effective dating of Pleistocene-age sites. This situation points out the need for a detailed preliminary reconnaissance prior to committing a whole archeological team into new areas.

3. Lack of adequate resolution in sampling methods. Subsequent research in the Nenana (Hoffecker, 1980) and Teklanika (Phippen, personal communication) valleys suggest that the testing procedures employed by the 1977 survey team lacked the degree of resolution necessary for a high rate of discovery.

Excavation of test pits by shoveling, skim shoveling, or rapid troweling seem likely to miss artifacts in this time range and region which typically consist of small flaking debris. Careful, fine troweling and screening of "back dirt" are recommended.

4. Failure to locate and test sedimentary contexts of demonstrable pre-terminal Pleistocene age. Subsequent research (Hoffecker, 1979) has indicated that the sediments tested by the survey team probably do not substantially pre-date the terminal Pleistocene (ca. 12,000 year B.P.). Thus, survey for sites significantly older than those already known in interior Alaska was not achieved. An alternative stratigraphic context must be found to effectively sample the region for archeological remains of this age.

Any future surveys for Pleistocene sites in the north Alaska Range should give careful consideration to the issues and problems raised here. Testing must be concentrated on localities which possess an adequate sedimentary context; areas which lack sufficiently deep stratigraphy should be identified and avoided. The effects of frozen ground would be minimized by working during the later part of the summer, and by excavating open-ended test pits along bluff margins where necessary, to encourage rapid thawing. In some situations, it might be advisable to rotate testing of high potential localities, gradually troweling down test pits during repeated visits. Sampling procedures should employ high resolution methods including fine troweling and screening.

The research design developed by this project seems to be basically sound, having apparently suffered from an ineffective implementation during 1977. Subsequent research (Hoffecker, 1978, 1980) has demonstrated that new Pleistocene sites can continue to be found in the topographic and stratigraphic contexts targeted by the 1977 survey. These sites would seem to be confined to the terminal Pleistocene time range, however. Locating sites from earlier time ranges will require the identification of older stratigraphic contexts and probably new topographic situations.

LITERATURE CITED

Abramova, Z.A.

1967 O vkladyshevykh orudiiakh v Paleolita Yeniseia. Kratkie Soobshcheniia Instituta Arkheologii 111:12-18. Moscow: Nauka.

1973 Concerning the cultural contacts between Asia and America in the Late Paleolithic. Paper prepared for the IXth International Congress of Anthropological and Ethnological Sciences. Chicago.

1979 K voprosu o vozraste Aldanskogo paleolita. Sovetskaia arkheologiia 1979(4):5-14. Moscow: Nauka.

Agenbroad, L.D.

1978 The Hudson-Merg Site. Washington, D.C.: University Press of America.

Ager, T.A.

1975 Quaternary environmental history of the Tanana Valley, Alaska. Institute of Polar Studies, Report 54, Ohio State University.

Aigner, Jean S.

1970 The unifacial core and blade site on Anangula Island, Aleutians. Arctic Anthropology VII(2):59-88. Madison.

1978 The lithic remains from Anangula: an 8500 year old Aleut coastal village. Urgeschichtliche Materialhefte No. 3. Tübingen.

Anderson, Douglas D.

1968a A Stone Age Campsite at the Gateway to America. Scientific American 218(6):24-33.

1968b Early notched point and related assemblages in the western American Arctic. Paper presented at the annual meeting of the American Anthropological Association, Seattle.

1970a Akmak: an early archeological assemblage from Onion Portage, northwest Alaska. Acta Arctica Fasc. XVI. Copenhagen.

1970b Microblade traditions in northwestern Alaska. Arctic Anthropology VII(2):2-16.

1978 Continuity and change in the prehistoric record from North Alaska. Alaska Native Culture and History, Senri Enthological Studies No. 4, National Museum of Ethnology, Osaka, Japan.

Bacon, Glenn and Charles Holmes
1980 Archaeological survey and inventory of cultural resources at Fort Greely, Alaska 1979. Final report prepared by Alaskarctic for the Alaska District, Corps of Engineers.

Bandi, H.
1969 Eskimo prehistory. College: University of Alaska Press.

Bell, R.H.V.
1969 The use of the herb layer by grazing ungulates in the Serengeti. *In* Animal Populations in Relation to Their Food Resources. A. Watson (ed.) Oxford: Blackwell.

Binford, L.R.
1978 Dimensional analysis of behavior and site structure: learning from an Eskimo hunting stand. American Antiquity 43(3):330-361.

Binford, L.R. and S.R. Binford
1966 A preliminary analysis of functional variability in the Mousterian of Levallois facies. American Anthropologist 68(2):238-295.

Bonnichsen, R.
1979 Pleistocene bone technology in the Bering refugium. Archaeological Survey of Canada, Paper No. 89.

Bottema, S.
1975 The use of gastroliths in archaeology. *In* Archaeozoological Studies. A.T. Calson (ed.). New York: Elsevier Publishing Co., Inc.

Bowers, Peter M.
1978 Research Summary: 1977 investigations of the Carlo Creek site, central Alaska. Report submitted to the University of Alaska Museum.

1980 The Carlo Creek site: geology and archaeology of an early Holocene site in the central Alaskan Range. Occasional Paper No. 27, Cooperative Park Studies Unit, University of Alaska, Fairbanks.

Butler, B.R.
1978 A guide to understanding Idaho archaeology. The Idaho Museum of Natural History. Pocatello.

Campbell, John M.
1961 The Tuktu complex of Anaktuvuk Pass. Anthropological Papers of the University of Alaska 9(2):61-80.

1962 Cultural succession at Anaktuvak Pass, Arctic Alaska. *In* Prehistoric Cultural Relations between the Arctic and Temperate Zones of North America. Arctic Institute of North America, Technical Paper No. 11.

Chard, C.S.
1974 Northeast Asia in prehistory. Madison: The University of Wisconsin Press.

Cinq-Mars, Jacques
1979 Blue Fish Cave I: a Late Pleistocene eastern Beringian cave deposit in the Northern Yukon. Canadian Journal of Archaeology 3:1-32.

Clark, Donald W.
1978 Discussion on "Clovis Culture." Abstract of the Fifth Biennial Meeting of the American Quaternary Association, Edmonton.

Clark, J.D.G.
1954 Excavations at Starr Carr. Cambridge University Press, Cambridge.

Clark, P.J. and F.C. Evans
1954 Distance to nearest neighbor as a measure of spatial relationships in populations. Ecology 34(4):445-453.

Cohen, D. and L.H. Keeley
1980 Not less than two, not more than three. World Archaeology 12(2):166-180.

Cook, J.P.
1968 Some microblade cores from the western boreal forest. Arctic Anthropology V(1):121-127. Madison.

Cook, John P.
1969 Early prehistory of Healy Lake, Alaska. Ph.D. Dissertation, Department of Anthropology, University of Wisconsin-Madison.

Cook, J.P. and R.A. McKennan
1970 The village site at Healy Lake, Alaska: an interim report. Paper presented at the 35th annual meeting of the Society for American Archeology, Mexico City.

Corbin, J.
1975 Aniganigaruk: A study in Nunamiut Eskimo archaeology. Doctoral dissertation, Washington State University, Dept. of Anthropology.

Crabtree, D.E.
1967 Notes on experiments in flintnapping: 4. Tools used for making flaked stone artifacts. Tebiwa 10(1):60-73. Pocatello.

Currey, J.D.
1979 Mechanical properties of three different bone tissues. Journal of Biomechanics 12:313.

Cwynar, L.C. and J.C. Ritchie
1980 Arctic steppe-tundra: a Yukon perspective. Science 208:1375-1377.

Dacey, M.F.
1973 Statistical tests of spatial association in the location of tool types. American Antiquity 38(3):320-328.

Davis, C.W., D.C. Linck, K.M. Schoenberg and H.M. Shields
1981 Slogging, humping and mucking through the NPR-A: an Archaeological interlude. Occasional Paper No. 25, Cooperative Park Studies Unit, Fairbanks.

Del Bene, Terry A.
1981 The Anangula lithic technological system: an appaisal of eastern Aleutian technology circa. 8250-8750 B.P. Ph.D. dissertation, University of Connecticut.

Dikov, N.N.
1977 Arkeologicheskie pamiatniki Kamchatki, Chukotki i verkhnei Kolymy. Moscow: Nauka.

1978 Ancestors of Palaeoindians and proto-Eskimo-Aleuts in the Palaeolithic of Kamchatka. *In* Early Man in America from a Circum-Pacific Perspective. Alan L. Bryan (ed.). Occasional Papers No. 1 of the Department of Anthropology, University of Alberta. Edmonton.

Dixon, E. James
1975 The Gallagher Flint Station, an early man site on the North Slope, Arctic Alaska, and its role in relation to the Bering Land Bridge. Arctic Anthropology XII(1):68-75. Madison.

1976 The Pleistocene prehistory of Arctic North America. Colloque XVII, IX^{e} Congress, Union Internationale des Sciences Prehistoriques et Protohistoriques, pp. 168-198. Nice.

Dumond, Don E.
1977 The Eskimos and Aleuts. London: Thames and Hudson.

1978 A chronology of native Alaskan subsistence systems. Alaska Native Culture and History, Senri Ethnological Studies No. 4, National Museum of Ethnology, Osaka, Japan.

Ewers, J.C.
1955 The horse in Blackfoot Indian culture. Bureau of American Ethnology Bulletin No. 159.

Freeman, L.G.
1978 The analysis of some occupation floor distributions from Earlier and Middle Paleolithic sites in Spain. *In* Views of the Past: Essays in Old World Prehistory and Paleoanthropology. L.G. Freeman (ed.). The Hague: Mouton.

Frison, G.C.
1968 A functional analysis of certain chipped stone tools. American Antiquity 33(2):149-155.

1974 The Casper site. New York: Academic Press.

1976 Cultural activity associated with prehistoric mammoth butchering and processing. Science 194:728-730.

1978 Prehistoric hunters of the High Plains. New York: Academic Press.

Gal, Robert and Edwin S. Hall
1982 Provisional culture history. *In* Archaeological investigations by the U.S. Geological Survey and the Bureau of Land Management in the National Petroleum Preserve in Alaska. Anthropological Papers of the University of Alaska 20(1-2):3-5.

Geist, V.
1971 Mountain Sheep, a study in behavior and evolution. Chicago: University of Chicago Press.

1978 Life strategies, human evolution, and environmental design. New York: Springer-Verlag.

Giddings, J.L.
1967 Ancient men of the Arctic. New York: Alfred A. Knopf.

Guthrie, R.D.
1966 The extinct wapiti of Alaska and the Yukon Territory. Canadian Journal of Zoology 44:45-57.

1968 Paleoecology of the large mammal community in interior Alaska during the Late Pleistocene. American Midland Naturalist 79:246-263.

1970 Bison evolution and zoogeography in North America during the Pleistocene. Quarterly Review of Biology 45:115.

1980 Bison and man in North America. Canadian Journal of Anthropology 1:55-73.

1982 Mammals of the mammoth steppe as paleoenvironmental indicators. p. 307-326. *In* Paleoecology of Beringia. P.M. Hopkins, J.V. Matthews, C.E. Schweger, S.B. Young (eds.). New York, Academic: 489 pp.

Guthrie, R.D.
n.d. Mosaics, allelochemics, and seasonality: A new theory of Late Pleistocene megafaunal extinctions. *In* Late Pleistocene Extinctions, 2nd Edition. P.S. Martin and R.G. Klein (eds.). Tuscon: University of Arizona Press: (in press).

Hamilton, T.D.
1973 Quaternary glaciation of the Brooks Range, northern Alaska. *In* IXth INQUA Congress Abstracts:136-137 Christchurch, New Zealand.

Hammatt, H.
1970 A Paleo-Indian butchering kit. American Antiquity 35(2): 141-152.

Harington, C.R.
1978 Quaternary vertebrate faunas of Canada and Alaska and their suggested chronological sequence. Sylloques 15:1-105.

Hayden, B. (ed.)
1979 Lithic use-wear Analysis. New York: Academic Press.

Haynes, C. Vance
1978 The Clovis culture. Abstracts of the Fifth Biennial Meeting of the American Quaternary Association:129-135. Edmonton.

Heimer, W.E.
1973 Dall sheep movements and mineral lick use. Final Report Job No. 6.1R. Alaska Department of Fish and Game, Juneau.

Henn, Winfield
1975 Current research on Eskaleut prehistory in the Ugashik River drainage, Alaska Peninsula. Paper presented at the Annual Meeting of the American Anthropological Association. San Francisco, 1975.

1978 Archaeology of the Alaska Peninsula: the Ugashik drainage 1973-1975. University of Oregon Anthropological Papers No. 14.

Hesse, A.
1973 Essai sur les distributions spatiales des vestiges en prehistorie et en archeologie. pp. 551-563. *In* L'Homme Hier et Aujourd'hui. M. Sauter (ed.). Paris: Cujas.

Hester, T., D. Gilbrow and A. Albee
1973 A functional analysis of "Clear Fork" artifacts from the Rio Grande Plain, Texas. American Antiquity 38(1):90-96.

Hoefs, M.E.G.
1974 Food selection by Dall sheep *Ovis dalli dalli*. *In* Behavior of Ungulates and its Relation to Management. V. Geist and F. Walther (eds.). International Union for Conservation of Nature and Natural Resources. Morges, Switzerland, New Series No. 24.

Hoffecker, John F.
1978 On the potential of the north Alaska Range for archaeological sites of Pleistocene age. A report to the National Geographic Society and the National Park Service, December 1978.

1980 Archaeological field research 1980: The north Alaska Range Early Man project. Report to the National Geographic Society and the National Park Service.

1982 The Moose Creek Site: An early man occupation in central Alaska. A preliminary report to the National Park Service and the National Geographic Society.

Holmes, Charles F. and Glenn Bacon
1982 Holocene Bison in central Alaska: a possible explanation for technological conservatism. Paper prepared for presentation at the 9th Annual Meeting of the Alaska Anthropological Association, April, 1982, Fairbanks.

Horejsi, B.
1976 Suckling and feeding behavior in relation to lamb survival in big horn sheep (*Ovis canadensis canadensis* Shaw). Ph.D. thesis, University of Calgary, Alberta.

Hoskins, C.M., R.D. Guthrie and B.L.D. Hoffman
1970 Pleistocene and Recent bird gastroliths from interior Alaska. Arctic 23:14-23.

Isaac, G. Ll.
1977 Olorgesailie. Chicago: University of Chicago Press.

Jarman, P.J.
1974 The social organization of antelope in relation to their ecology. Behavior 48:215-266.

Jones, P.R.
1980 Experimental butchery with modern stone tools and its relevance for Palaeolithic archaeology. World Archaeology 12(2);153-165.

Keeley, L.H.
1980 Experimental determination of stone tool uses: a microwear approach. Chicago: University of Chicago Press.

Kehoe, J.F.
1973 The Gull Lake site: a prehistoric bison drive site in southwestern Saskatchewan. Milwaukee Public Museum, Publications in Anthropology and History, No. 1.

Klein, D.R.
1965 Ecology of deer range in Alaska. Ecological Monographs 35:259-284.

1970 Tundra ranges of the boreal forests. Journal of Range Management 23:8-14.

Klein, R.G.
1973 Ice-age hunters of the Ukraine. Chicago: University of Chicago Press.

1969 Man and culture in the Late Pleistocene. San Francisco: Chandler Publishing Company.

Kobayashi, T.
1970 Microblade industries in the Japanese Archipelago. Arctic Anthropology VII(2):38-58.

Kurtén, B. and E. Anderson
1972 The sediments and fauna of Jaguar Cave: II. The fauna. Tebiwa 15:21-39.

Larsen, H.
1968 Trail Creek: Final report on excavations of two caves on the Seward Peninsula. Acta Arctica, Fasc. XV. Copenhagen.

Laughlin, W.S.
1967 Human migration and permanent occupation in the Bering Sea area. *In* The Bering Land Bridge, D.M. Hopkins (ed.). Stanford University Press, Stanford, California.

Laws, R.M., I.C.S. Parker and R.C.B. Johnson
1975 Elephants and habitats. Oxford: Oxford University Press.

Lee, R.B. and I. Devore
1968 Man the hunter. Chicago: Aldine.

Leroi-Gourham, A.
1967 L'habitation Magdalenienne No. 1 de Pincevent pres Montereau (Sienne-et-Marne). Gallia Prehistoire 9(2):263-385.

Levenson, H.
1979 Sciurid growth rates: some corrections and additions. Journal of Mammology 60:232-234.

Lewis, M. and W. Clark
1893 History of the expedition under the command of Lewis and Clark 1804-5-6, new edition, 4 vols., illus. New York: Elliot Coves.

Lewis, R.O.
1978 The use of opal phytoliths in paleoenvironmental reconstruction at the Hudson-Meng Site. *In* The Hudson-Meng Site. L.D. Agenbroad (ed.). Washington, D.C.: University Press of America.

McHugh, T.
1972 The time of the buffalo. New York: Knopf.

Medvedev, G.I.
1968 K voprosu ob iznachal'nykh formakh nakonechnikov strel v Priangar'e. Trudy Irkuskogo gosudarstvennogo universiteta im. A.A. Zhdanova, Tom. LV, Vypusk 1. Irkutsk.

Medvedev, G.I., G.M. Mikhniuk and I.L. Lezhenko
1974 O nomenklaturnykh oboznacheniiakh i morfologii nukleusov v dokeramicheskikh kompleksakh Priangar'ia. Drevniaia istoriia narodov iuga vostochnoi Sibiri, Vypusk 1. Irkutsk.

Mobley, Charles M.
1982 The Landmark Gap Trail site, Tangle Lakes, Alaska: another perspective on the Amphitheater Mountain Complex. Arctic Anthropology 19(1):81-102.

Mochanov, IU.A.
1973 Early migrations to America in light of a study of the Dyuktai paleolithic culture in northeast Asia. Paper prepared for the IXth International Congress of Anthropological and Ethnological Sciences, Chicago, 1973.

1977 Drevneishie etapy zaseleniia chelovekom severovostochnoi Azii. Novosibirsk: Nauka, Sibirskoe otdelenie.

1978 Stratigraphy and absolute chronology of the Paleolithic of northeast Asia, according to the work of 1963-1973. In Early Man in America from a Circum-Pacific Perspective. Alan L. Bryan (ed.). Occasional Papers No. 1 of the Department of Anthropology, University of Alberta. Edmonton.

Morlan, R.E.
1970 Wedge-shaped core technology in northern North America. Arctic Anthropology VII(2):17-37. Madison.

1974 Gladstone: an analysis of horizontal distributions. Arctic Anthropology XI (Suppl.):82-93.

Morlan, R.E.
1977 Fluted point makers and the extinction of the Arctic-Steppe Biome in eastern Beringia. Canadian Journal of Archaeology 1:95-108.

1978 Technological characteristics of some wedge-shaped cores in northwestern North America and northeast Asia. Asian Perspectives 19(1):96-106.

Murie, A.
1944 The wolves of Mount McKinley. Fauna of the National Parks of the United States, Fauna Series No. 5. Washington, D.C.: Government Printing Office.

Murie, O.J.
1951 The elk of North America. Stackpole, Harrisburg.

Murphy, E.C.
1974 An age structure and a reevaluation of the population dynamics of Dall sheep (*Ovis dalli dalli*). M.S. thesis, University of Alaska, Fairbanks.

Nelson, E.W.
1899 The Eskimo about Bering Strait. Johnson Reprint Corporation, New York (1971 edition).

Nelson, N.C.
1935 Early migration of man to America. Natural History 35(4):356. New York.

1937 Notes on cultural relations between Asia and America. American Antiquity 2(4):267-272. Menasha.

Norden, H.C., I.M. Cowan and A.T. Wood
1968 Nutritional requirements of black tailed deer in captivity. *In* Comparative Nutrition of Wild Animals. M.A. Crawford (ed.). Symposia of the Zoological Society of London, No. 21.

Peden, D.G., G.M. Van Dyne, R.W. Rice and R.M. Hausen
1974 The trophic ecology of *Bison bison* on short grass prairie. Journal of Applied Ecology 11:489-498.

Petocz, R.G.
1973 Marco Polo sheep of the Afghan Pamirs. Unpublished report FAO/UNDP.

Péwé, T.L.
1975 Quaternary Geology of Alaska. U.S. Geological Survey Professional Paper No. 835. 212 p.

Pike, R.L. and M.L. Brown
1967 Nutrition: an integrated approach. New York: Wiley and Sons.

Plaskett, D.C.
1977 The Nenana River Gorge site: a late prehistoric Athabaskan campsite in central Alaska. M.A. thesis, University of Alaska, Fairbanks.

Plaskett, David C.
n.d. Preliminary report: a cultural resource survey in an area of the Nenana and Teklanika rivers of central Alaska. Unpublished manuscript.

Powers, W.R.
1973 Palaeolithic man in northeast Asia. Arctic Anthropology X(2):1-106. Madison.

1978 Perspectives on Early Man. Abstracts of the Fifth Biennial Meeting of the American Quaternary Association, Edmonton.

Powers, W.R. and T.D. Hamilton
1978 Dry Creek: a late Pleistocene human occupation in central Alaska. *In* Early Man in America from a Circum-Pacific Perspective. Alan L. Bryan (ed.). Occasional Paper No. 1 of the Department of Anthrolopology, University of Alberta. Edmonton.

Powers, M.C
1953 A new roundness scale for sedimentary particles. Journal of Sedimentary Petrology 23:117-119.

Price, T.D.
1978 The spatial analysis of lithic artifact distribution and association on prehistoric occupation floors. *In* Lithics and Subsistence: The Analysis of Stone Tool Use in Prehistoric Economies. D. Davis (ed.). Vanderbilt University Publications in Anthropology No. 20.

Reher, C.A.
1974 Population study of the Casper site bison. *In* The Casper Site: A Hell Gap Bison Kill on the Great Plains. New York:Academic Press.

Roseneau, D.G.
1977 Kutchin caribou fence studies. Northeast by East: Review of Alaskan Arctic Gas Research, Vol. 2, no. 2.

Sadek-Koores, H.
1966 Jaguar Cave: an early man site in the Beaverhead Mountains of Idaho. Ph.D. dissertation, Harvard University.

Semenov, S.A.
1964 Prehistoric technology. Translated by M.W. Thompson. London: Gary, Adams and MacKay.

Skarland, Ivar and Charles J. Keim
1958 Archaeological discoveries on the Denali Highway, Alaska. Anthropological Papers of the University of Alaska 6(2):79-88.

Skinner, M.P. and O.C. Kaisen
1947 The fossil bison of Alaska and preliminary revision of the genus. Bulletin of the American Museum of Natural History 89:125-256.

Smith, Timothy Alan
1977 Obsidian Hydration as an independent dating technique. M.A., University of Alaska, Fairbanks.

1981 Spatial analysis of the Dry Creek archaeological site. NPS-NGS Early Man Studies Program. Progress report to National Park Service and National Geographic Society.

Speiss, A.E.
1979 Reindeer and caribou hunters: an archaeological study. New York: Academic Press.

Straus, L.G.
1977 Of deerslayers and mountain men: Plaeolithic faunal exploitation in Cantabrian Spain. *In* For Theory Building in Archaeology. L.R. Binford (ed.). New York: Academic Press.

Summerfield, B.L.
1974 Population dynamics and movement patterns of Dall sheep in the Atigun Canyon area Brooks Range, Alaska. M.S. thesis, University of Alaska, Fairbanks.

Ten Brink, Norman W.
1979 Glacial geologic and related geomorphic history of the north Alaska Range, with particular emphasis on prehistoric archaeologic potential. Proposal to the National Geographic Society and the National Park Service.

1980 Late Wisconsin glacial chronology of the north-central Alaska Range -- a regional synthesis and its implications for early human settlements. *In* North Alaska Range Project: Preliminary Progress Report on 1978 and 1979 Geo-Archaeological Studies, To the National Geographic Society and the National Park Service from N.W. Ten Brink.

Thorson, Robert M.
1977 Reconnaisance surficial geology of the Savage-Teklanika rivers region with particular emphasis on prehistoric archeologic potential. Unpublished manuscript.

Thorson, R.M. and T.D. Hamilton
1977 Geology of the Dry Creek site; a stratified Early Man site in interior Alaska. Quaternary Research 7:149-176. Seattle.

Vanstone, James
1974 Athapaskan adaptations. Chicago: Aldine.

Vereshchagin, N.K.
1967 The mammals of the Caucasus. Israel Program for Scientific Translations (English translation).

Wahrhaftig, C.
1958 Quaternary geology of the Nenana River Valley and adjacent parts of the Alaska Range. U.S. Geological Survey Professional Paper 482.

1965 Physiographic divisions of Alaska. U.S. Geological Survey Professional Paper 482. Washington, D.C.: U.S. Govenment Printing Office.

Walker, P.L.
1978 Butchering and stone tool function. American Antiquity 43(4):710-715.

Weeden, R.B.
1964 Spatial separation of sexes in rock and willow ptarmigan in winter. Auk 81:534-541.

West, Frederick Hadleigh
1967 The Donnelly Ridge site and the definition of an early core and blade complex in central Alaska. American Antiquity 32(2):360-382.

1975 Dating the Denali Complex. Arctic Anthropology XII(1):76-81.

1981 Archaeology of Beringia. New York: Columbia University Press.

Whallon, R.
1973a Spatial analysis of Paleolithic occupation floors. *In* The Explanation of Culture Change. C. Renfrew (ed.). London: Duckworth.

1973b Spatial analysis of occupation floors: I. Application of dimensional analysis of variance. American Antiquity 38(3):266-278.

1974 Spatial analysis of occupation floors: II. Application of nearest neighbor analysis. American Antiquity 39(1):16-34.

Wheat, J.B.
1972 The Olsen-Chubbuck site: A Paleoindian bison kill. Society for American Archaelogy Memoir No. 26.

Whitten, K.R.
1975 Habitat relationships and population dynamics of Dall sheep (*Ovis dalli dalli*) in Mt. McKinley National Park. M.S. thesis, University of Alaska, Fairbanks.

Wilmsen, E.N.
1974 Lindenmeier: A Pleistocene hunting society. New York: Harper and Row.

Wilson, M.
1975 Holocene fossil bison from Wyoming and adjacent areas. M.A. thesis, University of Wyoming, Laramie.

Yoshizaki, M.
1961 Shirataki iseki to Hakkaido no Mukoki bunka. Minzokugako Kenkyu 36(1):13-23. Tokyo.