THE PARKHILL SITE: AN AGATE BASIN SURFACE COLLECTION IN SOUTH CENTRAL SASKATCHEWAN

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THE PARKHILL SITE: AN AGATE BASIN SURFACE COLLECTION IN SOUTH CENTRAL SASKATCHEWAN

BY

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ABSTRACT

The Parkhill site (EbNj-4) is an Agate Basin surface site located south of Moose Jaw, Saskatchewan. The artifacts are described in terms of their manufacturing sequence and wear patterns. The results of this study indicate that the points/bifaces may have functioned both as projectile tips and as knives, and that fragments were refurbished and reused, possibly several times. A quantitative definition of the Agate Basin complex is operationalized to identify which artifact classes other than pointed bifaces are Agate Basin. There is a south to north trend in the dates for Agate Basin, with dates in the south being as much as 4,000 years older than those in the north. Based on this finding, a date of 8000 to 8500 years BP is suggested for the Agate Basin occupation of the Parkhill site. The northward movement of the Agate Basin complex appears to occur at the same rate as the northward recession of the Laurentide ice and the vegetational zones that followed it; both the ice and the complex may have disappeared simultaneously, with the latter giving rise to the Early Shield Archaic.

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CHAPTER ONE

INTRODUCTION

A. History of the Research

The Parkhill site (EbNj-4) is an area from which amateur collectors and the staff of the Saskatchewan Museum of Natural History, Regina, have gathered a large number of artifacts over the last 40 years. Robert Nero (1959) reported on the site and identified the majority of the projectile points as Agate Basin. While conducting studies of the artifacts from the site in 1975, I learned that a number of additional recoveries had been made; and I noted that some artifacts other than projectile points, such as scrapers, drills, spalls, and reworked point fragments, resembled those from sites as widely separated as Texas and the Northwest Territories. This observation suggested that Parkhill may be related to these distant sites. These possible connections prompted the present investigation.

There are several reasons why a more detailed Parkhill site report and a summary of the Agate Basin complex is justified. First, since Nero's report, the artifact inventory has increased substantially. Second, recent trends in archaeology call for more detailed artifact descriptions that facilitate a better understanding of their manufacture and wear patterns. Third, a description of the entire

Parkhill collection will permit other researchers to make more use of the assemblage than has been possible in the past.

B. Objectives

1. To describe the Parkhill collection, concentrating on the manufacturing sequence of the artifacts.
2. To compare the Parkhill collection with artifacts from excavated Agate Basin sites to determine which artifact classes from Parkhill may potentially belong to the Agate Basin complex.
3. To explore the temporal and geographical range of the Agate Basin complex with respect to early Holocene environments and discuss the implications.

C. Definition

Because one of the objectives of this thesis is to investigate the relationship between the Parkhill site and excavated Agate Basin sites, it is necessary to understand what is meant by the term "Agate Basin complex." Roberts (1961) used the term to describe the leaf-shaped points and associated artifacts that he recovered from the Agate Basin site in Wyoming. Apart from the projectile points, Roberts felt that none of the other artifacts from Agate Basin were diagnostic, because they were indistinguishable from similar artifacts recovered in association with other paleo-Indian projectile points.

Since Roberts' investigations, a number of sites containing Agate Basin points have been excavated. For purposes of comparing them, a more workable definition is needed. The Agate Basin complex, as defined in Chapter 3, consists of Agate Basin points plus those artifact classes found in 30% or more of the eight excavated sites considered here.

D. Theory

The theoretical guidelines for this thesis are summarized by Little and Morren (1976:6) who state that:

> ...the culture of a population is a set of learned responses which are (a) solutions to environmental problems, and which are (b) solutions to problems arising from past solutions to environmental problems... this definition points to an extremely important characteristic of adaptation--that all successful responses to environmental problems or stresses create new problems. Thus the optimal solution is to "stay in the game."

It should be understood that this statement serves as a guideline and as such, is not being tested here. The key point is the idea that "culture" includes solutions to problems. Archaeological assemblages usually represent remnants of a population's technological solutions to such economic problems as hunting, woodworking, clothing manufacture, etc. These solutions may shift in response to new challenges such as those posed by environmental change. From Little and Morren's statement, it may be inferred that certain long-lasting technologies, such as the Agate Basin complex, apparently provided successful solutions to wide ranging and varied economic problems.

CHAPTER TWO

THE PARKHILL SITE

A. Introduction

The Parkhill site (EbNj-4) has yielded over 300 artifacts, 137 of which are identified as Agate Basin points or bifaces. The artifacts have been recovered from deflation basins over the past 40 years by amateur collectors who usually did not record exact recovery locations. These collections consist mostly of finished artifacts, usually projectile points, bifaces, and end scrapers. Apparently, flaking debris was not gathered.

In 1959, Robert Nero, then of the Saskatchewan Museum of Natural History in Regina, published a descriptive report of the site that included a discussion of 85 projectile points, 65 of which he identified as being Agate Basin points. He noted that the Parkhill points were shorter than the type specimens from Wyoming, but otherwise, the two collections were quite similar in shape, flaking pattern, and the occurrence of "ground lateral edges." He concluded that the presence of "thick basal fragments" indicates that "a larger form of lanceolate point is part of the complex" (Nero 1959:32). Nero also suggested that Parkhill was a camp-site based on the numerous recoveries of basal fragments of these points, and the presence of quantities of flaking debris.

Since Nero's report, additional recoveries have increased the sample. Unfortunately, at least two of the artifacts illustrated by Nero (1959:33, Figure 1, A1 & A3) have been lost. The artifacts discussed below are presently the property of the Moose Jaw Museum of Art; the Saskatchewan Museum of Natural History, Regina; Bernie Forbes of Regina and Ron Hill of Moose Jaw, Saskatchewan.

1. The Parkhill Site in the Literature

Since Nero's report, comment on the site has appeared in several publications. Wormington (1957:141) mentions it briefly in her discussion of Agate Basin points. Wormington and Forbis (1965:20) summarize Nero's findings from the site, emphasizing point morphology. Noble (1971:105) mentions the site as an undated Agate Basin site from Saskatchewan. Wright (1976:96) includes Parkhill as part of his analysis of northern versus southern Agate Basin. He concluded, based on the artifact assemblage, that the site is most closely related to sites in Wyoming.

2. Site Physiography

a. Geography and Location

The Parkhill site is located in south-central Saskatchewan (Figures 1 & 2) near the northern edge of the North American plains (Wedel 1961:23). One prominent feature of this part of Saskatchewan is the Missouri Coteau escarpment which rises to a height of 60 to 90 meters above an extensive, flat tract of land known locally as the Regina Plains. In the vicinity of the Parkhill site, this flat region is the bottom of Glacial Lake Moose Jaw and is

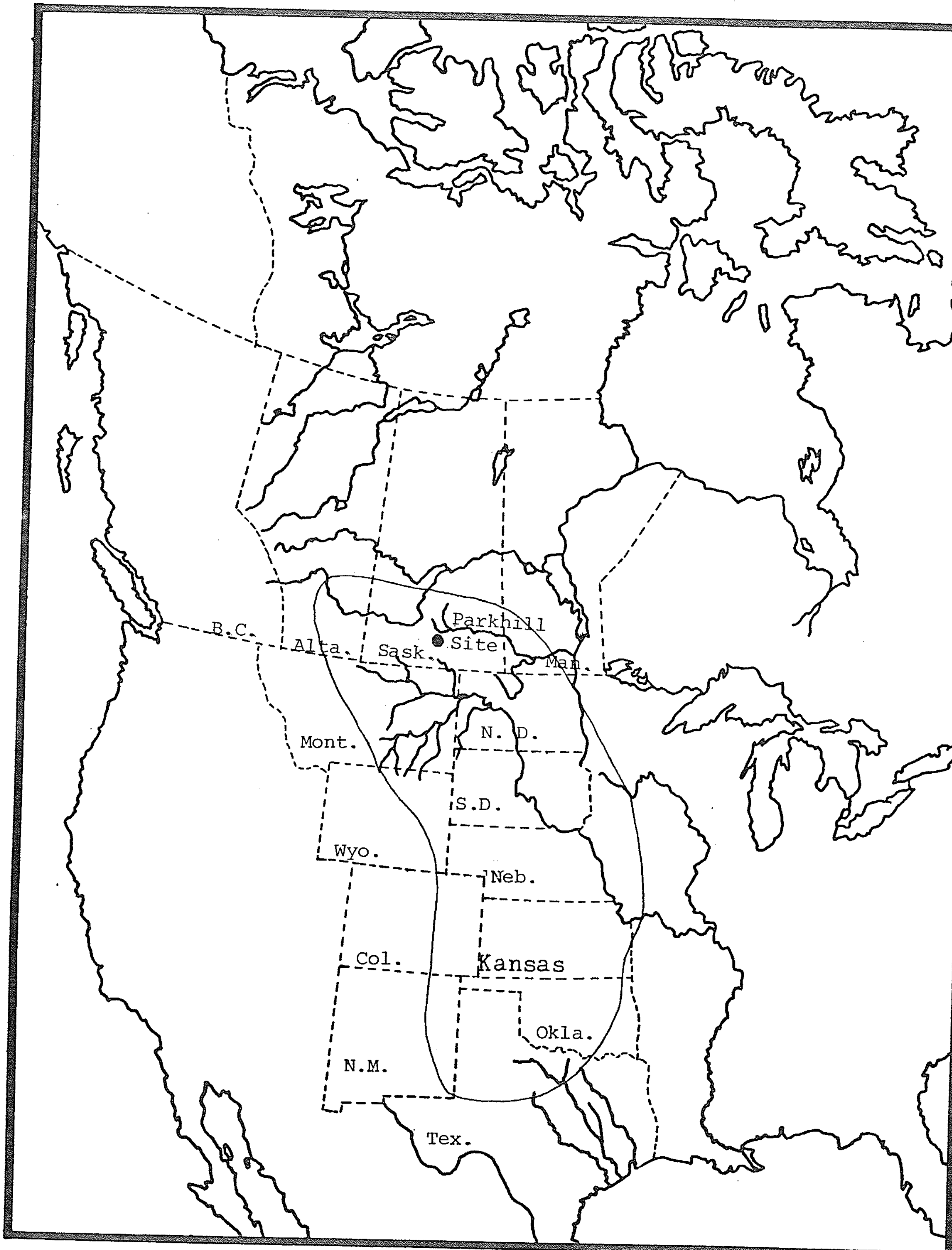

Figure 1. Map of North America showing the location of the Parkhill site (EbNj-4). The solid line encloses the North American plains region (after Wedel 1961:23).

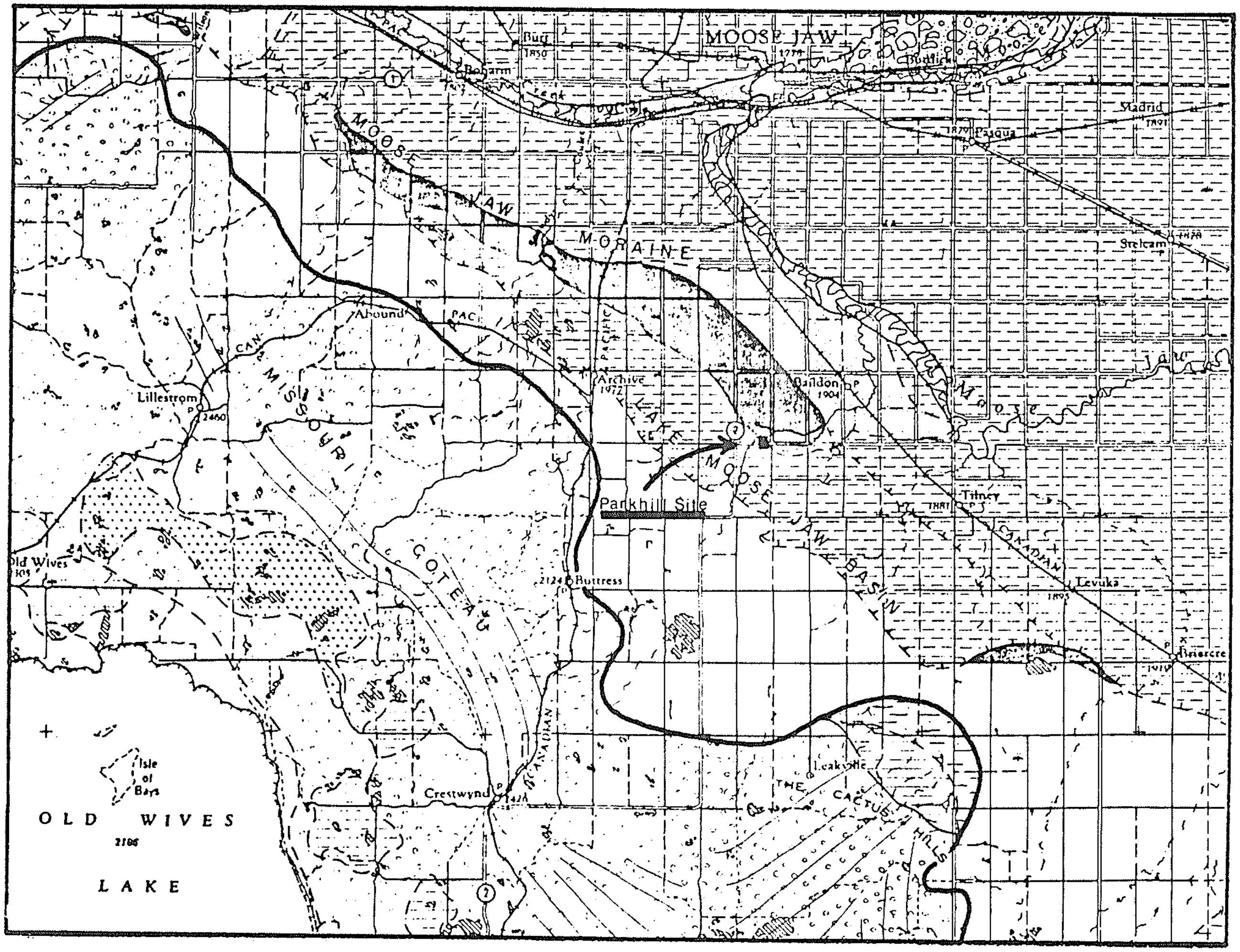

Figure 2. Location of the Parkhill site in relation to late Pleistocene geological features (Christiansen 1961, Plate 1).

occasionally broken by shallow, underfit rivers and streams as well as by low, sandy morainic deposits.

The site is situated on top of the southwest end of the low, sandy moraine, known as the Moose Jaw moraine (Christiansen 1961); and its legal land description is the southeast quarter of Section 16, Township 15, Range 26, West of the Second Meridian at 600 meters above sea level (Figure 3).

From the vantage point of this low, wind-swept, sandy hill, there is a panoramic view of the Missouri Coteau escarpment extending from west-northwest to southeast, affording an excellent vantage point for sighting game as well as providing protection from insects (Ebell 1976). Between the Missouri Coteau and the site is a broad, flat valley which is part of the Lake Moose Jaw basin (Christiansen 1961). To the north and east, the view is blocked by the Moose Jaw moraine upon which the site is situated. Less than a quarter mile west and north, a small drainage channel is incised into the moraine and is marked by a shallow valley containing a chain of sloughs which, in the spring, drain east into the Moose Jaw River, the main drainage feature of the area.

The site is presently under cultivation, and experiences erosion by wind almost every spring, making it a popular collecting area for local amateur archaeologists. This collection area is approximately three hectares in size. Artifacts have been recovered from both sides of the municipal road, which roughly bisects the site (Figure 3).

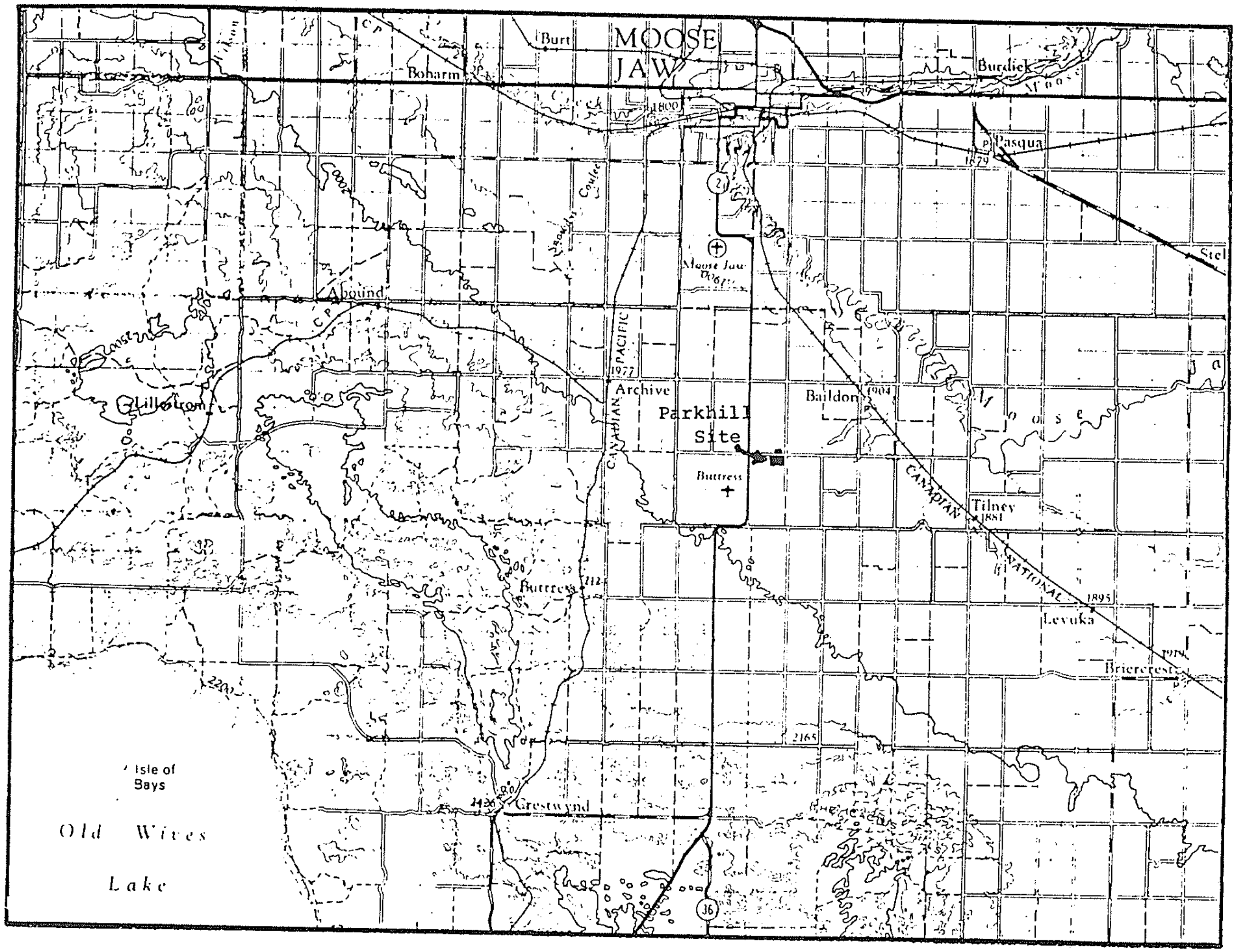

Figure 3. Contour map locating the Parkhill site. Source: A detail from Canada National Topographic System Regina Quadrangle 72-I. Scale 1:250,000.

b. Soils

The soils of the Moose Jaw moraine are clearly differentiated on the Reconnaissance Soil Survey of Southern Saskatchewan (Department of Mines and Technical Surveys, Ottawa 1963). It is shown to be an elongated area of fine, sandy loam exhibiting dune topography. North of the moraine, the soils are designated as "heavy clay," which composes the bed of former Glacial Lake Regina. These soils are not easily eroded by the wind, and are highly productive agricultural land. Between the Moose Jaw moraine and the Missouri Coteau escarpment, the soils are identified as being "loam" and "light loam." Except for the absence of dune topography, this area is much the same as the moraine.

c. Vegetation

This area of Saskatchewan is mixed prairie consisting for the most part of spear grass (Stipa comata) and wheat grass (Agropyron dasystachyum) (Coupland and Rowe 1969:73). These, along with other less common species, are sod-forming, drought-resistant grasses which dominate the region between the Aspen parkland to the north and the Missouri Coteau escarpment to the southwest. Because the soils at Parkhill are somewhat more sandy than the surrounding area, it is likely that grasses adpated to well-drained land such as spear grasses were predominant (Coupland and Rowe 1969:73).

d. Fauna

It is diffucult to determine the faunal inventory for the Parkhill area during its prehistoric occupation; however, Maher (1969:80-82) lists the following species as present-day residents: Bison (Bison bison), Pronghorn Antelope (Antilocapra americana), White-tailed Deer (Dama virginianus), Mule Deer (Dama hemionus), Mountain Lion (Felis concolor), Bob Cat (Lynx rufus), Lynx (Lynx canadensis), Long-tailed Weasel (Mustela frenata), Badger (Taxidea taxus), Skunk (Mephitis mephitis), Least Weasel (Mustela rixosa), Ermine (Mustela erminea), Raccoon (Procyon lotor), Grizzly Bear (Ursus horribilis), Coyote (Canis latrans), Gray Wolf (Canis lupus), Red Fox (Vulpes fulva), Swift Fox (Vulpes velox), Porcupine (Erthizon dorsatum), sixteen species of Rodentia, including Beaver (Castor canadensis) and Muskrat (Ondatra zibethicus), three species of hare or rabbit, six species of bat and three species of shrew.

e. Climate

Rainfall in southern Saskatchewan is scanty, due mainly to the rain shadow effect of the Cordillera. Most of the rain falls in the early summer, specifically in the month of June. The mean average precipitation recorded at the Regina weather station 60 km east of the site is 394.5 mm. Monthly average rainfall records show a high standard deviation, indicating that the major characteristic of Saskatchewan's precipitation is its variability (Frost 1972:217).

The mean average annual temperature, at Regina from 1884 to 1959, was 1.5°C with annual temperature extremes from -48.8°C to 43.3°C. The months from November to March are cold enough to keep the soil continuously frozen (Christiansen 1961:12).

Wind is almost continuous in southern Saskatchewan. Average wind roses for Regina indicate that wind is almost equally distributed between the northwest and southeast with a yearly average wind velocity of 6 m/sec. Strong summer winds cause extensive erosion, but this may have been less important before the land came under cultivation. However, winter winds are severe, and blizzards are commonplace (Frost 1972:226). Frost also points out that tornadoes are known to occur usually in the month of July, but are highly localized.

f. Summary

Some suggestions can be made as to why the Parkhill site was chosen by its ancient inhabitants. First, the site is close to water. The small seasonal sloughs occupy what was clearly a former stream channel. This channel could also have served as a trap for procuring bison.

Second, this area, now identified as the Moose Jaw moraine, is unique in the Moose Jaw vicinity because of its dune topography. This suggests the possibility that sand dunes were available for use as animal traps as well (Frison 1974), although no well developed dune field is in evidence today that displays the features required for a bison trap.

B. Artifact Analysis

1. Introduction and Methodology

Most artifact analyses are descriptions of tools using terms suggesting function (eg. Irwin and Wormington 1970; Irwin-Williams, et al., 1973; Frison 1974, 1978a). Recent research demonstrates that many artifacts were used in a variety of ways. For example, a number of 'projectile points' show evidence that they also served as knives (eg. Ahler 1970; Wheat 1977, 1979; Greiser 1977). This suggests that it may be advisable in this study to employ functional terms with caution until a better understanding of artifact use is ascertained. In keeping with this, the following artifact analysis is based on morphology with an emphasis on manufacturing technique.

Frameworks used to describe lithic artifact manufacturing sequences have been suggested by Collins (1975) and Schiffer (1976). Both suggest that artifacts may progress through stages of manufacture, use, and repair before they are deposited in the archaeological record.

In this study a primary distinction is made between bifacial and unifacial tools. Under both categories, further distinctions are made based on ascertained stages within a reduction sequence. The reduction sequence consists of stages in the manufacture of artifacts in which the artifacts are modified either through wear, breakage, or additional flaking, resulting in morphologies that are different from previous stages. Tools may be worn or broken and subsequently repaired, perhaps several times, resulting in further changes in size and shape.

Application of the reduction-sequence approach to studies of excavated artifacts has produced useful results. An example of this is Wheat's (1977, 1979) study of artifact use and repair from the Jurgens site in Colorado. Wheat identified projectile point preforms that displayed a specialized flake-scar morphology which permitted the removal of what he terms "small platform Pentaloid flakes" in the final stage of projectile point manufacture. Further, he was able to identify several stages of projectile point reduction. First, projectile points were employed as the tips of projectiles; second, broken points were employed as knives, either with or without further modification; third, larger point fragments were reflaked, sometimes creating artifacts that were quite different from their original morphology; fourth, these "secondarily complete points" as Wheat calls them, were employed as knives, as some of them display serrated edges. At the Jurgens site, some projectile point-knives were consumed by being broken and repaired possibly several times before they were disposed of. Wheat thinks that fragments less than 40 mm in length were discarded, while longer ones were recycled.

Huckell (1978), in his analysis of the Hudson-Meng site lithics, postulates a similar manufacture-use sequence. Unfortunately, no preforms were found, but Huckell suggests that they were present and used as knives until projectile points were required. This permitted the slow consumption of scarce lithic resources. Several of the projectile points and one Cody knife from Hudson-Meng are thought by Huckell to be recycled point fragments. Succinct diagrams summarize

Huckell's ideas concerning the reduction sequence of artifacts, and suggest a pattern similar to that believed by Wheat to have operated at the Jurgens site.

In 1972, Hill and Evans published a paper in which they discussed, among other things, the reasons why artifact types are established by archaeologists. One of their most important points is that artifact types are not inherent in the artifacts themselves but are perceived by the archaeologist. Furthermore, these types are established to meet specific research needs and therefore, should not become entrenched as immutable concepts. Narrow definitions of diagnostic paleo-Indian projectile points (or pointed bifaces) have often become entrenched in the literature (eg. Wormington 1957; Irwin and Wormington 1970). Such definitions present a mental picture of rigid morphological uniformity to which similar artifacts from other sites must adhere. This does not allow variation to enter subsequent discussion of the artifacts and creates the impression that only one style of point occurs within a given paleo-Indian assemblage or time period. In reality, a wide morphological range dominates the assemblages from many paleo-Indian sites such as Olsen-Chubbuck (Wheat 1972), Lime Creek (Davis 1962), Casper (Frison 1974), Jones-Miller (Stanford 1978), Jurgens (Wheat 1979), and the Portales complex from Blackwater Locality No.1 (Hester 1972), to mention a few.

Accepting variation within points as well as other artifact classes allows for questions to be formulated concerning history and function as well as other considerations.

For example, variation within a sample may provide clues about past (or future) morphological trends. An example of this is the ancestral relationship between Agate Basin and Hell Gap suggested by similarities in point morphology.

In terms of function, it is now clear that pointed bifaces served both as knives and projectile tips. This fact, together with the recycling of bifaces described above, accounts in part for the morphological variation within an assemblage (see Wheat 1979).

The Parkhill assemblage consists of only surface recoveries and thus, it is impossible to determine, except by analogy, if the artifacts are part of a single complex. In the following analysis, comparisons between the recovery from other Agate Basin sites and the Parkhill site will be made in order to determine whether or not specific artifact classes are part of the complex.

There is another difficulty with the analysis of the Parkhill site material. Samples of the flaking debris were not obtained by the amateurs who collected at the site. The debris could have been used in the lithic reduction analysis, perhaps in a manner similar to that used by Wheat (1979) at the Jurgens site. Lacking this data, lithic reduction must be determined from the physical features observed on the artifact alone.

2. Analysis

The data discussed below were obtained in the following manner. Lithic materials were identified as a result of personal experience with the material or by comparison with hand specimens. Wear patterns (ie., crushing, polish, grinding, etc.) were observed on the edges of the artifacts using a 10x and 20x binocular microscope and with low power eye lupes. Biface measurements were based on six indices used by Ahler (1970:21-23), for lanceolate points. For other artifacts only length, thickness and lithic types were noted. Appendix 1 records the measurements for all the artifacts from Parkhill. Flaking patterns were observed directly from the Saskatchewan Museum of Natural History specimens, and from detailed colour slides for the remainder.

3. Lithic Raw Material

a. Introduction

The lithic variety composing the Parkhill site assemblage is summarized in Table 1. Chert is the most common material, with Knife River flint a close second. These two materials comprise 80% of the sample. With the exception of Knife River flint, limonitic shale and procelainite, the sources of lithic material are uncertain.

b. Chert (138 artifacts)

The most popular material used was chert. Under this rather inclusive heading are found a wide range of textures and colours some of which resemble Swan River chert (Syms 1977:27-28). Chert that was almost indistinguishable from Swan River varieties has been observed in a gravel pit near Glasneven, Saskatchewan about 80 km south of the site. Several sources of other chert varieties are known but no

Table 1. Lithic raw material types represented in the artifacts from the Parkhill site.

	n	%
Chert	138	45.0
Knife River flint	107	35.0
Quartzite	11	3.0
*Chalcedony	9	3.0
*Brown chalcedony	9	3.0
Fossil wood	8	2.0
Porcelainite	3	0.9
Yellow jasper	2	0.6
*Translucent chalcedony	1	0.3
Limonitic shale	1	0.3
Moss agate	1	0.3
Purple jasper	1	0.3
Unidentified	14	4.0
Total	305	97.7

* May be Knife River flint

Saskatchewan quarries have been noted. Parizek (1964:17) mentions that chert is present in the Wood Mountain formation that is exposed in the southwest corner of Saskatchewan. No other information is available concerning this source.

c. Knife River Flint (126 artifacts)

Knife River flint is a form of silicified lignite whose distribution is limited to Dunn and Mercer Counties in North Dakota (Clayton, et al., 1970). Personal experience with Knife River flint from quarries in North Dakota shows it to be quite variable in colour and it is probable that the Brown chalcedony, the Chalcedony, and the Translucent chalcedony listed in Table 1 are from the same source.

d. Quartzite (11 artifacts)

Quartzite is available from almost any stream bed or gravel deposit. The nearest source is in the City of Moose Jaw, where the Moose Jaw River has exposed extensive gravel deposits. Here brown and grey quartzite cobbles can be found in abundance.

e. Fossil Wood (8 artifacts)

Fossil wood is widely scattered within the glacial till. No quarry sites for this material are known in Saskatchewan. Parizek (1964:17) mentions the presence of petrified wood associated with the Wood Mountain formation, although it is not known if the Wood Mountain variety is suitable for artifact manufacture.

f. Porcelainite (3 artifacts)

Porcelainite is known to occur in the gravels near Souris, Manitoba. It is opaque, grey or red in colour, with good conchoidal fracture, and in its natural state, is covered with a soft, white or red chalky substance. It is softer than either chert or chalcedony. Other sources are not known.

g. Limonitic Shale (1 artifact)

Limonitic shale is found 190 km west of the site near East End, Saskatchewan. The artifact made from it is yellow and soft enough to mark with the fingernail. Its lithological characteristics have probably changed since the artifact was made. At its time of manufacture, it was hard enough to produce a conchoidal fracture (D. Kent, personal communication).

h. Moss Agate (1 artifact), Purple Jasper (1 artifact), Yellow Jasper (2 artifacts)

All three of these types are thought to be forms of chalcedony, but sources specific to each type are unknown.

4. Bifaces

a. Introduction

Bifacially-flaked artifacts are described below. Most reduction stages represent what are believed to have been the final form of finished, functional artifacts. The flow chart in Figure 4 illustrates the succession from one stage of biface manufacture to the next.

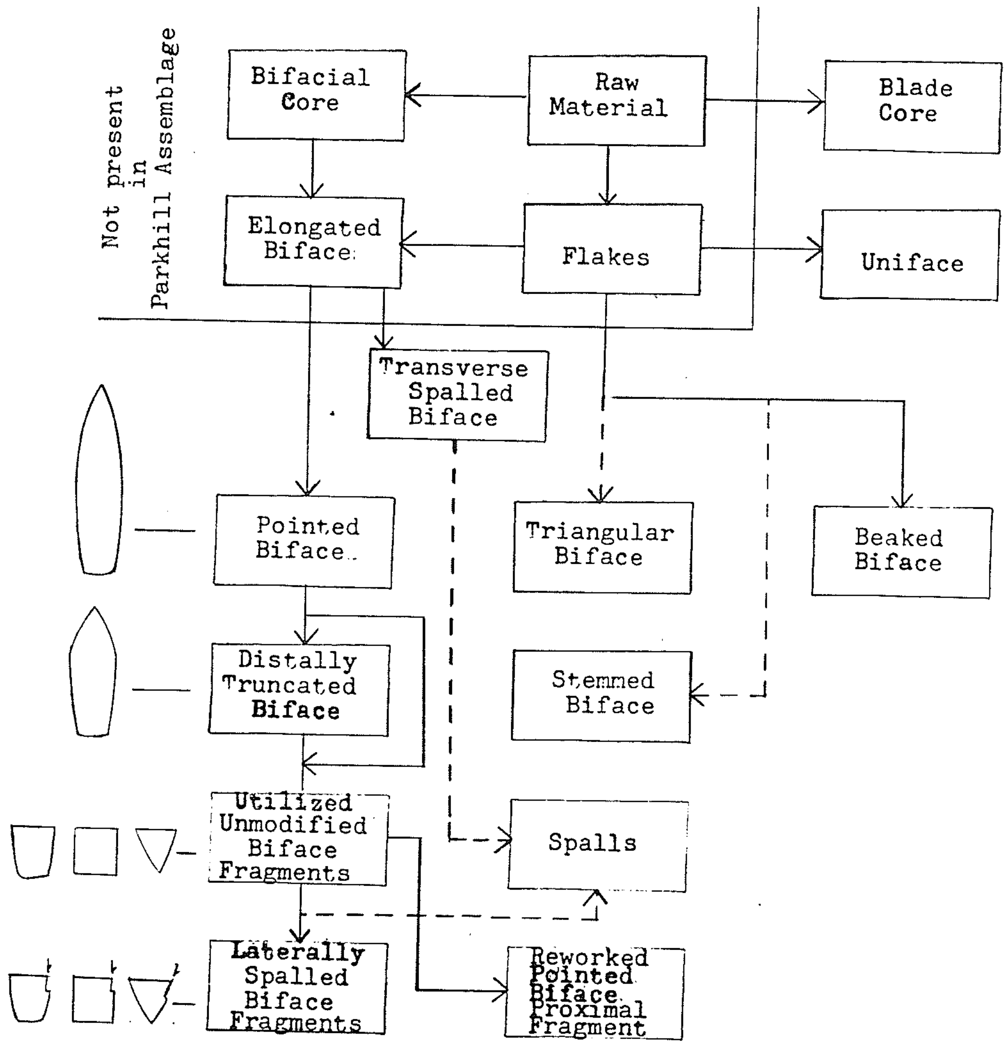

Figure 4. Flow chart depicting the reduction sequences for the artifacts from Parkhill.

b. Elongated Bifaces

None of these artifacts were recovered from Parkhill, however, they were found at the Hell Gap site (Irwin-Williams et al., 1973) associated with the Agate Basin component. As mentioned above, similar bifacial tools are considered to be preforms for projectile points (Huckell 1978; Wheat 1977, 1979; and Tunnell 1977). Huckell and Wheat both believe that these artifacts functioned as knives before some were made into projectile points. In this way, the elongated biface served as a functioning store-house of material for future artifacts. Undoubtedly, one or several stages preceeded this one (see Figure 5) although there is no evidence from Parkhill suggesting the forms involved. Elongated bifaces may represent reduction of large flakes (Huckell 1978:182) and/or the refinement of bifacial cores.

c. Pointed Bifaces (n=9 complete, 106 fragments)

The complete artifacts are illustrated in Plate 3 (Nos. 1, 2, 4, 6-8 and Plate 4, Nos. 1, 4, & 6). Two of the complete specimens are among those that are now missing (see Nero 1959, Figure 1, A1 & A3). Also included in this category are all proximal fragments and all medial fragments displaying flaking that resembles the flaking on the complete specimens.

In general, pointed bifaces exhibit the following attributes: concave, convex or flat bases, longitudinal bilateral symmetry, lenticular cross-sections in both longitudinal and transverse plains, a lanceolate outline and fine, pressure flaking resulting in smoothly curved edges, terminating in a sharp tip. They measure from 55 mm to 85 mm in length with a mean of 63.2 mm. Table 2 summarizes the measurements obtained from the nine complete pointed bifaces that are available for study, plus three attributes obtained from two artifacts illustrated by Nero (1959:33).

The hypothesized manufacturing sequence of pointed bifaces consists of the reduction of either large flakes or bifacial cores (A) into what are termed "elongated bifaces" (B). These were in turn further worked to form pointed bifaces (C), (see Figure 5). The last reduction step is inferred from flake scar patterns on the pointed bifaces. The flake scars are, as a rule, broad, overlapping and centrally directed, but vary in width and length. The pattern is usually irregular with only two specimens demonstrating what may be termed parallel transverse flaking (Plate 3, No. 4 & 6). One artifact, which lacks a base, is diagonally parallel-flaked (Plate 4, No. 10). Some specimens retain evidence of a previous stage in their manufacture, as the flake scars found on the surface have originated outside the present boundaries of the artifact. In such cases, the negative bulb of percussion is absent, indicating removal of the part of the artifact which once bore the bulb. This phenomenon may be observed along the right margin of the biface illustrated in Plate 3, No. 1.

All of the pointed bifaces show evidence of having been used. This evidence takes several forms:

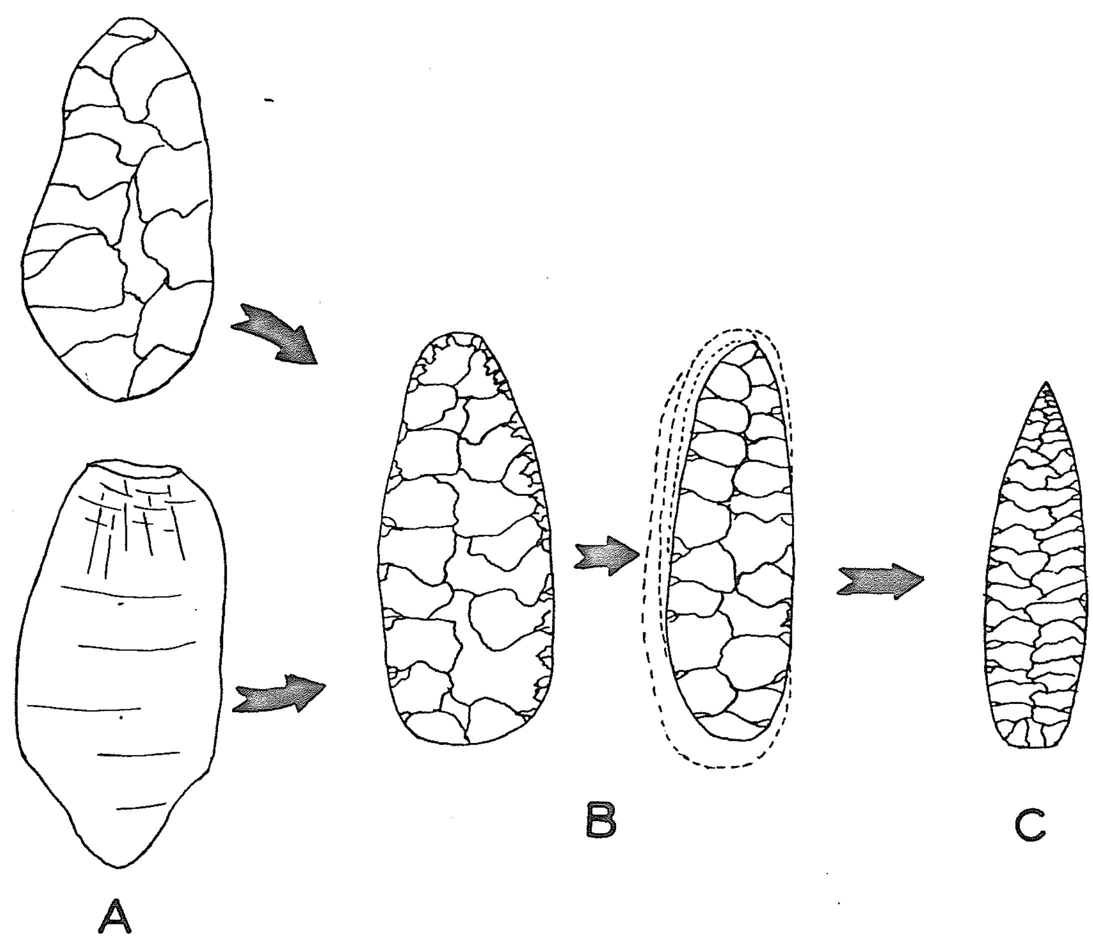

Figure 5. Hypothesized manufacturing sequence for Parkhill pointed bifaces. A and B are not present in collection.

A - flake/rough biface

B - elongated biface

C - pointed biface

Table 2. Metric attributes of complete pointed bifaces in mm.

Plate	a	b	c	d	e	f	Thick-ness	Wear on Distal Lateral Edges
3 No.1	-	14.0	28.5	34.0	29.0	36.0	7.0	Yes
3 No.2	76.5	14.0	23.5	23.5	24.5	34.0	8.0	No
3 No.4	78.3*	12.5	26.0	32.0	26.0	32.0	8.0	Yes
3 No.6	85.0	13.0	26.0	35.0	26.5	38.0	7.0	Yes
3 No.7	57.5	12.5	21.5	30.5	22.0	31.0	6.5	Yes
3 No.8	69.0	14.0	25.5	24.5	25.5	25.5	8.0	Yes
4 No.1	57.6	13.5	-	-	21.1	30.1	7.0	Yes
4 No.4	48.0	11.0	21.0	19.0	22.0	21.5	8.0	Yes
4 No.6	37.5	8.0	15.0	20.0	15.5	20.5	7.0	No
A-1	71.0	10.0	-	-	23.0	-	-	No data
A-3	52.0	8.0	-	-	20.0	-	-	No data
$\overline{X}$	63.2	11.9	23.3	37.3	23.2	29.8	7.4	
s	15.1	2.3	4.2	6.3	3.7	6.2	.6	

Note: Wear includes polish and crushing. See Figure 6 for attribute legend. Metric attributes for artifacts A-1 and A-3 obtained from photographs appearing in Nero (1959:33).

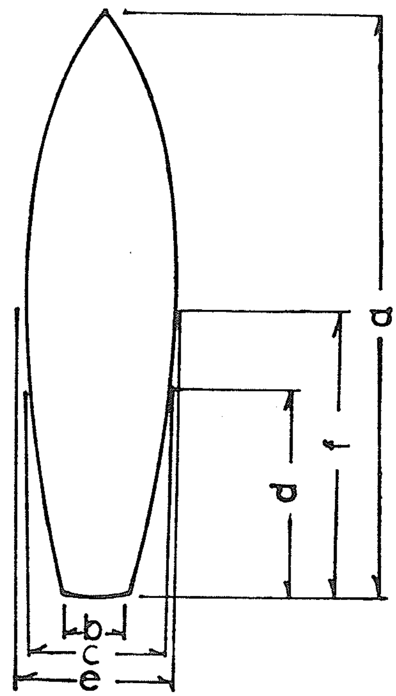

Figure 6. Projectile point measurements (after Ahler 1970).

a. total length

b. base width

c. width at distal end of haft element

d. length of haft element (lateral grinding)

e. maximum width

f. maximum width length (distance from base to widest point on the artifact)

1. Grinding occurs along the lateral edge near the base on all specimens except one (Plate 4, No. 1 and Table 2) and is the phenomenon usually described as "basal grinding" (cf. Wormington 1957; Irwin-Williams et al., 1973:47). This corresponds with Ahler's "edge grinding," but is more in keeping with the morphology of what he describes as "edge rounding" (Ahler 1970:38 and 39). There are no striations apparent on the Parkhill specimens along the lower lateral edge as are associated with "edge grinding" (Ahler 1970:38), but rather, the edge is rounded, forming a smooth junction with the obverse and reverse surfaces similar to "edge rounding." In addition, the ground edge is straight. This can be observed in the plates, by noting where the smoothed, straight area near the base intersects the irregular un-smoothed area (Plate 3, No. 4).

2. Gloss along the distal lateral edges may be observed as shiny areas that reflect light from the high points along the sinuous edge of the artifact. This corresponds closely to Ahler's "edge polish" (1970:38). Some of this polish could be attributed to corrasion by sand (Moore 1944: 36). However, among the Parkhill specimens, "edge polish" is associated with the occurrence of small, step-terminated flake scars giving the distal lateral edge the appearance of having been crushed and not sandblasted. This crushing is similar to that described by Ahler as "edge crushing" (1970: 38). Polish and step flaking are found on the distal lateral edges of 77% of the pointed bifaces and 58% of the distal fragments (Table 3).

Table 3. Occurrence of wear on the distal lateral edges of pointed bifaces, truncated pointed bifaces, and distal fragments.

	Gloss and/or Crushing on Distal Lateral Edges			
	Present	Absent	Total	% Present
Pointed bifaces	7	2	9	77
Truncated pointed bifaces	7	4	11	64
All distal fragments	15	11	26	58
Grand Total	29	17	46	63

Note: No data available for two pointed bifaces.

3. Breakage also suggests use. There are 15 distal fragments (14%), 30 medial fragments (28%), and 61 proximal fragments (58%) of a total of 106 pointed biface fragments.

Two pointed bifaces (Plate 3, Nos. 4 & 8) suffered damage when spalls were struck from the tip removing a portion of the lateral edge. Wright (1976) refers to this as vertical burination. Both specimens with this damage show edge polish and crushing along the remaining lateral edges. It may be possible to infer the activities that were responsible for the removal of material through fracture. Many researchers feel that the grinding that occurs along the basal lateral edges facilitates hafting by reducing the tendency of the artifact to cut its binding or split the bone or wooden haft into which it was socketed. In an experiment, Frison (1978a) socketed bifaces similar to those from Parkhill into wooden shafts. Hafted in such a manner, these artifacts were found to be highly efficient as they easily penetrated deeply into bison carcasses (Frison 1978a:333).

Attrition along the distal lateral edges of some of the bifaces suggests that they were used as knives. Frison (1978a:325) points out that if these artifacts functioned as knives, they required a bulky sinew wrapping to support the added lateral pressure experienced in cutting. Wrapping, that severely curtails the ability of the weapon to penetrate, suggests that these bifaces were used either as the tip of a projected weapon or as a knife blade, depending upon the nature of the haft. It is possible that to facilitate both functions, these bifaces may have been rehafted several times.

Wheat (1977, 1979) demonstrated that projectile points served the dual functions of weapon tips and knife blades. At the Jurgens site, most point fragments were used unmodified as knives. Other point fragments were refurbished and also employed as knives. Based on both Wheat's observations and the evidence presented here, it seems that paleo-Indian pointed bifaces functioned both as weapon tips and as knife blades.

But why are there so many biface fragments and what caused them to become fragmented? It may be safe to assume that damage often occurred as 115 out of the total of 137 pointed bifaces (84%) are fragments. As stated above, 63% of the distal fragments show signs of being used as knives, suggesting that breakage during cutting was responsible for the loss of the distal end of a biface. It is more difficult to ascertain what caused the breakage that left the proximal and midsectional fragments at the site. Frison's experiments show that fracture patterns similar to those found at Parkhill occur when bifaces are utilized as weapon tips (1978a: 333).

Wear in the form of burin-like spalls removed from the distal lateral edge, is present on two specimens (Plate 3, Nos. 4 & 8). As mentioned above, both crushing and polish are also in evidence on these artifacts. Ahler (1970:83) observed during experimental butchering, that a similar spall was inadvertently removed from a knife when its tip struck bone. This adds further support to the contention that some of the pointed bifaces from Parkhill were employed as knife blades.

d. Truncated Pointed Bifaces (n=11 complete, 11 fragments)

These bifaces appear forshortened. They differ from the pointed bifaces in that they do not exhibit an even, gradual curve along the lateral edge; but near the distal end the sides rapidly converge to form a blunt point (see Figure 7C; Plate 3, Nos. 3, 5, 9, 10 & 11 and Plate 4, Nos. 2, 3, 5, 7 & 8). Included in this category are 11 distal fragments that display the same tip shape as the complete specimens. Several specimens are asymmetrical, with their points offset from the long axis of the biface. The forshortened appearance of the truncated bifaces probably results from repairing their distal ends (Figure 7C). These artifacts measure from 26.5 mm to 88.0 mm in length with an average of 44.6 mm (see Table 4).

Recent research at the Agate Basin site in Wyoming reveals the presence of forshortened points which strongly resemble the truncated bifaces from Parkhill. However, none from Agate Basin were shorter than 51 mm (Peterson 1978).

In many respects the truncated bifaces exhibit similar kinds of attrition as the pointed bifaces. In both, the lower lateral edges have been ground smooth. The distal lateral edges of 64% of the complete specimens show wear in the form of gloss and crushing (see Table 5). If the 11 distal fragments which can be identified as truncated bifaces are added to the sample, 14 of a total sample of 22,

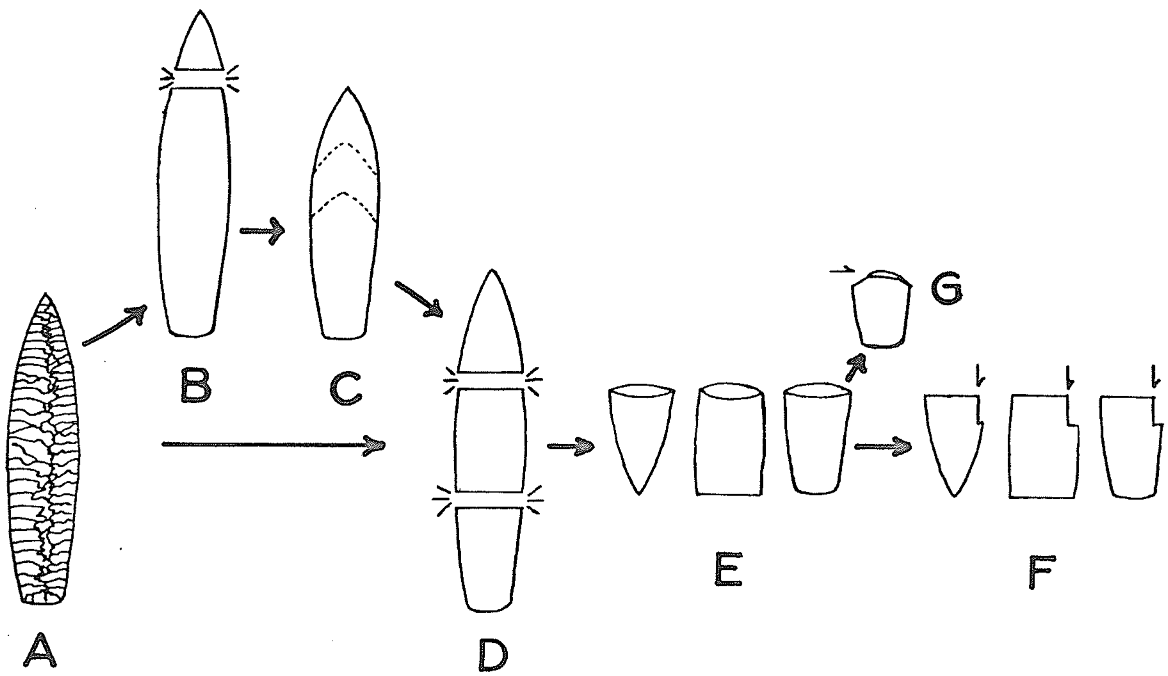

Figure 7. Reduction of pointed bifaces.

a. pointed biface

b. distally fractured pointed biface

c. truncated pointed biface

d. pointed biface fractured at distal and/or proximal end

e. utilized, unmodified biface fragments

f. laterally spalled biface fragments

g. reworked, pointed biface proximal fragments

Table 4. Metric attributes of truncated pointed bifaces in mm.

Plate	a	b	c	d	e	f	Thick- ness	Wear on Distal Lateral Edges
3 No. 3	64.0	15.5	26.5	40.5	27.5	40.5	8.5	Yes
3 No. 5	88.0	13.5	26.0	58.0	26.0	58.0	9.0	Yes
3 No. 9	52.0*	12.5	20.0	19.0	21.5	28.0	6.0	Corrasion
3 No. 10	26.5	6.0	15.5	18.0	15.5	18.0	5.5	Yes
3 No. 11	44.0*	11.0	21.5	27.0	22.0	28.0	7.0	Yes
4 No. 2	48.0	9.0	22.0	29.5	22.0	30.0	7.0	Yes
4 No. 3	33.5	9.0	18.0	21.0	18.0	21.0	6.5	Yes
4 No. 5	34.0	10.5	18.0	18.0	18.0	18.0	6.0	Yes
4 No. 7	41.0	13.0	-	-	18.0	18.0	8.0	Yes
4 No. 8	33.0	10.5	13.5	9.0	15.0	15.0	5.5	Yes
Not shown	26.5	7.0	15.0	15.0	15.0	15.0	5.5	No Data
$\overline{X}$	44.6	10.7	19.6	25.5	19.9	26.3	6.8	
s	18.3	2.8	4.5	14.4	4.3	13.1	1.3	

Note: See Figure 6 for attribute legend.
* Estimated length

Table 5. Wear on the distal lateral edge of truncated pointed bifaces and truncated pointed biface fragments in the form of crushing or polish.

	Wear on distal lateral edge			
	Present	Absent	Total	% Present
Truncated bifaces	7	4	11	64
Truncated biface fragments	7	4	11	64
Grand total	14	8	22	64

or 64%, display polish and crushing along the distal lateral edge. Of the 11 distal fragments of truncated bifaces, 7 display crushing and polish. Of this latter sample, 64% have been worn (Table 5). These data suggest about two-thirds of the truncated pointed bifaces were employed as cutting tools.

There are two unusual specimens in the sample of truncated bifaces. The first artifact (Plate 4, No. 9) is stemmed. The base is an unmodified fracture, and the shoulders result from heavy grinding. The distal lateral edges of the biface are truncated, but rather than having curved edges as is usually the case, they are straight. Wear in the form of polish and crushing is in evidence along the distal lateral edges.

The second artifact has had a spall removed from its lower lateral edge (Plate 4, No. 2). The spall has removed part of the lateral grinding.

e. Utilized, Unmodified Biface Fragments (n=30)

These artifacts are distal (n=5), proximal (n=11), and medial (n=14) fragments of either pointed bifaces or truncated pointed bifaces that have experienced right-angle transverse fractures, and show signs of wear, but have not been modified by reknapping (Figure 7, D & E). The worn area is along the broken transverse edge (Figure 8). What appears to be polish is discernable under 10x to 20x magnification. Artifacts made from coarse material having a rough surface such as quartzite, are smoother in the polished region. Sometimes the polish is accompanied by striations that are oriented perpendicular to the edge of the fracture. These striations are usually not distinct.

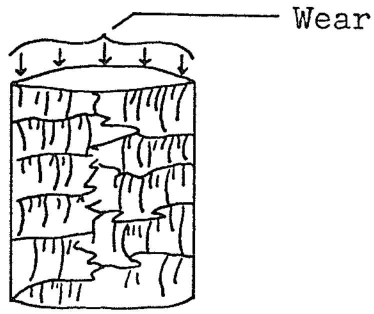

Figure 8. Schematic representation of a point fragment showing the location of wear on the edge between the fracture and obverse or reverse face. Arrows show locations of wear.

There are a total of 117 distal, proximal and medial fragments from the site, 30 of which, or 26%, show evidence of wear in the area just described. Table 6 provides a breakdown of the number in each fragment category. These artifacts may have served in scraping or gouging. No previous mention of the same kind of wear has been found in the Agate Basin literature. Wright (1976) describes similar artifacts from the Grant Lake site, but these are point fragments that have been thinned vertically from the fracture. Wright does not mention if the retouched areas show evidence of use.

The sample of pointed biface fragments consists of 52% proximal fragments, 26% medial fragments, and 22% distal fragments (Table 6). This differs somewhat from the Agate Basin site where 41% were proximal fragments, 1% were medial fragments and 58% were distal fragments (Peterson 1978). The high incidence of proximal fragments at both sites is attributed to the greater probability that they would be recovered along with the presumably reusable haft.

f. Laterally Spalled Biface Fragments (n=12)

Lateral spalling has been discussed previously under the rubric of burin faceting (Epstein 1963). Because the term "burin" has a special meaning in European Paleolithic terminology, it seems best to qualify its use as applied to North American bifaces. Here the term "lateral spall" is used. The main advantage of this term is that it is descriptive and does not have the functional implications of the term "burin". The term lateral spalling refers to the removal of

Table 6. Wear (polish) frequencies on pointed biface fragments.

Fragment	Polish on Edge of Fracture: Present	Absent	Total	% Present
Distal	5	19	26	19
Proximal	11	50	61	18
Medial	14	17	30	47
Grand Total	30	86	117	26

burin-like spalls from the lateral edge of pointed bifaces, truncated pointed bifaces, and distal, proximal or medial biface fragments (Plate 9, Nos. 1 & 2 and Figure 7F). At Parkhill, lateral spalling assumes five configurations:

1. At the distal end, facets originate at the tip of the biface and extend down the lateral edge towards the base (n=3, Plate 3, Nos. 4 & 8).
2. At the proximal end, facets originate at the corner of the base and extend up the lateral edge towards the point (n=1, Plate 4, No. 2).
3. On medial fragments that have fractured at right angles to the long axis of the biface, facets are found originating at the corner between the fracture and the lateral edge of the fragment. These facets may be multiple and occur at either the proximal or distal end of the fragment (n=5, see Figure 7, f and Plate 9, No. 2).
4. On distal fragments that have fractured in the same manner as described above, facets are found that originate at the proximal end of the fragment and extend up the lateral edge towards the tip (n=2, see Figure 7,f).
5. On proximal fragments that have fractured in the same manner as described in 3 above, facets originate at the distal end of the fragment and extend down the lateral edge towards the base (n=5, see Figure 7, f and Plate 9, No. 1).

In the assemblage, all specimens, except the one spalled at the proximal end, show rounding adjacent to the area where the spall occurs. This suggests that spalling is a result of such uses as scraping or gouging.

At the Parkhill site, 12, or 10% of all pointed biface fragments have been laterally spalled. All of these display wear on the edge between the fracture and the obverse or reverse face rather than on the corner formed by the spall (see Figure 8). Among the laterally spalled fragments, five (42%) are medial fragments, five (42%) are proximal fragments, and two (16%) are distal fragments.

g. Re-worked Pointed Biface Proximal Fragments (n=2)

These artifacts are proximal fragments that have been bifacially flaked on their distal end, producing sloping shoulders. A flake was then struck transversally across the shouldered area producing a flat curved surface (Plate 5, 9 & 10 and Figure 7,g). Similar artifacts appear in the assemblage excavated from the Acasta Lake site (LiPk-1) in the Northwest Territories (Noble: personal communication and 1971: 104 & 121) where they have been identified as "transverse burins." Their function has not been ascertained.

h. Summary and Analysis - The Pointed Biface Reduction Sequence

Figure 7 schematically depicts the reduction sequence for the pointed bifaces from the Parkhill site. In A, the pointed biface is complete. Use either as a point or a knife results in the fractures depicted in B and D yielding two kinds of fragments. Proximal fragments (B) may be reworked, possibly several times, to yield the truncated pointed biface, while fragments from D may be initially employed as tools without modification (E). These utilized fragments from E may be either intentionally or accidentally spalled to produce the laterally spalled fragments depicted in F. Some of the proximal fragments from E are specially treated to yield the reworked pointed biface proximal fragment depicted in G.

This analysis is not intended to summarize all of the possible reduction activities that could have been applied. For instance, Peterson (1978) mentions that proximal, medial and distal fragments were all refurbished at the Agate Basin site yielding pointed bifaces (points) of various shapes and sizes.

Table 7 illustrates the relationship between the total length of the pointed bifaces and the truncated pointed bifaces expressed as a percentage. These proportions are established by dividing the haft element length (d) by the length (a) and multiplying by 100. The haft element length is the ground area near the base of the biface. Comparison of these ratios from both pointed bifaces and truncated bifaces shows that: (1) the haft element on the complete pointed bifaces averages around 38% of the total length of the artifact, while on the truncated bifaces, the haft element is over 50% of the artifact's length. (2) With only one possible exception (Plate 4, No. 8), only the distal ends of broken bifaces were repaired, thus decreasing the length of the distal portion and proportionately lengthening the haft element.

Table 7. Comparison of the ratios of haft element length (d) to total length (a) between pointed bifaces and truncated pointed bifaces.

Pointed bifaces Artifact No.	%	Truncated, pointed bifaces Artifact No.	%
1	-	3	63
2	30	5	66
4	41	9	36
6	41	10	68
8	25	11	61
15	40	13	61
17	53	14	63
132	-	16	53
$\bar{X}$	38.5	18	-
s	8.9	19	27
		135	57
		$\bar{X}$	55.5
		s	13.5
		With #19 deleted from the sample	
		$\bar{X}$ =	59
		s	9.6

Note: $\text{Ratio (\%)} = \frac{\text{Haft element length}}{\text{Total length}} \times 100$

Artifact No. refers to Appendix I.

One specimen from each category falls far outside the calculated average. Pointed biface 17 (Plate 4, No. 6) is well above average with 53% of it being haft element. On the other hand, truncated biface 19 (Plate 4, No. 8) is below average at 27%. This biface is exceptional in that the distal lateral edges are bevelled and the flaking that produced this probably removed part of the hafting element.

i. Triangular Bifaces (n=11)

These artifacts are roughly triangular in outline (Plate 7, Nos. 1, 2 & 3). Two of the larger specimens are missing their distal end. All are asymmetrical with the bases not perpendicular to the long axes, and have one straight and one curved side. Table 8 summarizes the metrics of those illustrated in Plate 7; metrics for the remaining eight are in Appendix I.

j. Transversely Spalled Biface (n=1, Table 8)

One biface fragment that is thin, lenticular and well flaked, has a spall removed from across one end (Plate 6, No. 5). Bandi (1963) refers to this kind of artifact as a "pseudo-burin." The biface that has been spalled is not a fragment of a completed biface, as a portion of the cortex remains in evidence opposite the spalled end.

k. Beaked Biface (n=1, Table 8)

There is only one example of this kind of biface in the assemblage (Plate 6, No. 3). It is a blade-like flake that has a long narrow bifacially-flaked projection on one end. The point of the projection is polished.

Table 8. Biface Metrics

	Length (mm)	Width (mm)	Thickness (mm)	Material
Triangular biface				
Plate 7, No. 1	32.0	26.0	8.5	Grey Chert
Plate 7, No. 2	30.0	29.9	6.6	Pink & Black Chert
Plate 7, No. 3	33.0	30.0	9.6	Grey Chert
Transverse spalled biface				
Plate 6, No. 5	31.0	22.5	6.0	Brown Fossil Wood
Beaked biface				
Plate 6, No. 3	36.3	13.2	7.2	Burned Chalcedony
Stemmed biface				
Plate 6, No. 1	40.1	25.0	6.1	Brown Fossil Wood

l. Stemmed Biface (n=1, Table 11)

This artifact (Plate 6, No. 1) is well made, with the flake scars meeting smoothly in the middle of the artifact. The distal or pointed end was never flaked. The outside surface of the original flake blank may be seen as a flat area at the tip. The lateral edge of the stem is sharp, and there is no evidence of its having been used.

m. Notched, Pointed Bifaces (n=5)

These artifacts are apparently not part of the Agate Basin complex and are usually associated with the McKean complex (Brumley 1975), the Oxbow complex (Nero and McCorquodale 1958), the Besant complex (Wettlaufer 1955), and a complex that is yet unnamed. A metric summary of the bifaces is in Appendix I. The unnamed specimen (Plate 8, No. 5), which is missing its proximal end, resembles others from the Stoney Beach sites (EdNh-1 and EdNh-10) and from sites near Ogema, Saskatchewan.

5. Unifaces (Figure 9)

a. Introduction

Figure 9 summarizes the reduction sequence of unifacially flaked artifacts. Notice that one uniface category, the "spalls," is illustrated in the bifacial reduction flow chart, Figure 4, page 21.

b. Blade Tools

Blades are long narrow flakes usually obtained from specially prepared polyhedral cores. A number of artifacts were recovered that were made from blades, although only

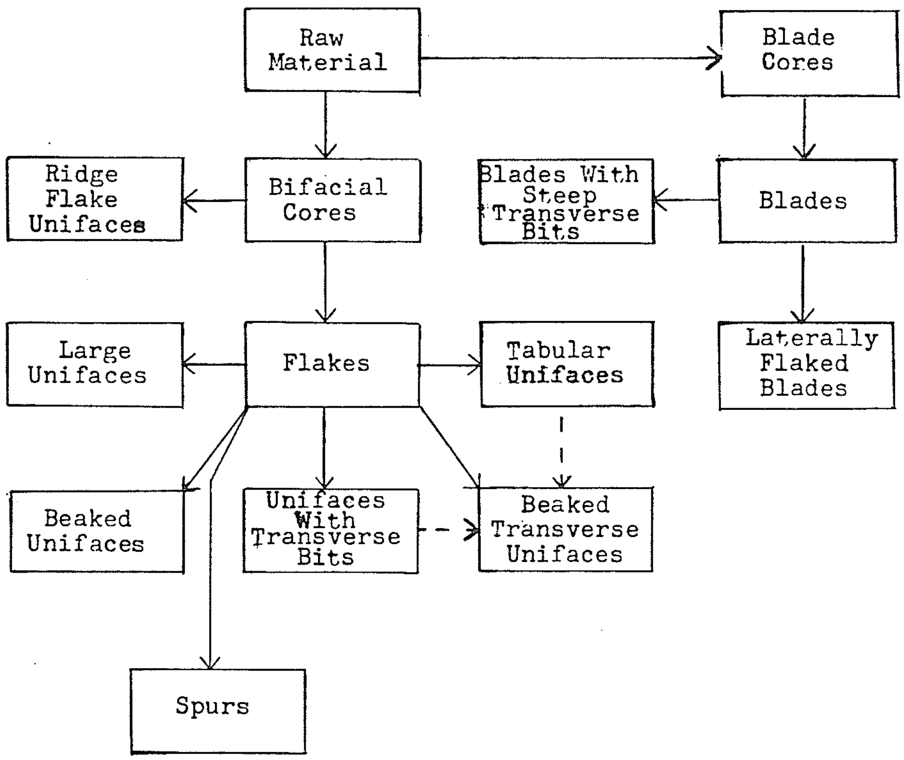

Figure 9. Flow chart depicting uniface reduction sequence.

one small blade core is represented.

i. Microblade Core (n=1)

One small tabular blade core was recovered made from brown chalcedony (probably Knife River flint, Plate 9, No. 4). Small blades have been removed from only one side, while the other side remains unmodified. The blades obtained would have been quite small, from two to three cm in length, and would be similar to those usually referred to as microblades (Sanger 1968: 191).

ii. Laterally Flaked Blades (n=3)

Two of these specimens are steeply flaked along the lateral edge, while the third has been completely unifacially flaked around its margin (Plate 6, No. 6, 7 & 8). There is no evidence of wear on these artifacts.

iii. Blades with Steep Transverse Bits (n=20)

A sample of these artifacts is illustrated in Plate 8, Nos. 7 and 8. They are blades that have had a steep edge worked transversely across one end. Usually there is little other modification. In two cases the lateral edges of the tool are polished smooth.

c. Spalls (n=3, Plate 9, No. 3)

Three small spalls of brown chalcedony closely resembling those described by Bandi (1963:25) as "spall burins," have been recovered. Bandi states:

> ...they are four-sided and their upper edges may bear traces of the retouching of the blades from which they have been struck....On the distal end of most of these spalls a very fine retouch can be seen.

Giddings (1967:264-265) illustrates similar specimens from the Arctic that are associated with the Denbigh Flint complex. Based on Bandi's description of "spall burins," and his proposed manufacturing sequence for them, it seems likely that the Parkhill specimens were struck from cores resembling that described above as a "transverse spalled biface" or from "laterally spalled biface fragments." These spalls then, are the product of advanced stages of biface reduction (Figure 4).

d. Tabular Unifaces (n=17)

Seventeen tabular tools with steep transverse bits have been recovered (Plate 8, No. 10). These artifacts are usually thin, parallel-sided and have the end opposite to the worked transverse edge snapped off. The lateral edges, adjacent to the steeply worked transverse bit are usually also steeply flaked.

e. Unifaces with Transverse Bits (n=66)

Variability in morphology characterizes these artifacts, but all have steep transverse bits worked across one edge. Some of the larger specimens resemble Irwin and Wormington's (1970:29) type 17 end scrapers that are described as being "much larger than others in their sample " (Plate 8, No. 8).

f. Ridge Flake Uniface (n=1)

A steep transverse bit has been flaked across one end of a ridge flake (Sanger 1968). The dorsal side of the artifact is completely covered by flake scars that originate at the apex of the dorsal ridge (Plate 8, No. 9). Such ridge flakes are usually detached from the lateral edge of thick bifaces in one of the initial steps in preparing micro-blade cores (Sanger 1968).

g. Beaked Transverse Unifaces (n=30)

These artifacts resemble Irwin and Wormington's (1970) beaked end scraper type 14. The beak is formed when the steep transverse bit extends beyond the lateral edge. These sometimes occur on both sides of the bit. One specimen is made on a blade (Plate 8, No. 6).

h. Beaked Uniface (n=1)

This is a flake that has had a long projection unifacially worked onto one end (Plate 6, No. 2). Nero (1959: 38) illustrates two others recovered from the site, but these have subsequently been lost.

i. Large Unifaces (n=16)

Nine fragmentary and seven complete unifaces are in the sample. These artifacts are generally thick flakes that have had various amounts of unifacial retouch around the margin, causing little modification in the original flake morphology (Plate 7, Nos. 4 & 5).

j. Spurs (n=1)

This artifact is a thin flake that has two small spur-like projections along one edge (Irwin and Wormington 1970: 29) (Plate 6, No. 4).

C. Discussion

In this section an attempt will be made to compare the Parkhill pointed bifaces with those from excavated Agate Basin sites. Also, the other artifacts will be compared, to determine whether or not they belong with the Agate Basin assemblage at Parkhill.

1. Pointed Bifaces

Although there are few reports concerning paleo-Indian artifacts which include even cursory metrical data, it is not difficult to relate the pointed bifaces from Parkhill to "projectile points," from other localities. For example, Irwin-Williams et al., (1973:47) define Agate Basin points as:

> ...typically relatively long and slender, lanceolate, and with convex edges reaching maximum width somewhat above the midpoint. Initial flaking was evidently done by percussion, final retouch by a combination of very regular centrally-directed pressure and percussion flaking. Points are edgeground along about 40 percent of their length.

This general definition holds only if size range is not considered. However, Agate Basin assemblages show a wider size range than is envisioned by the above definition (eg. Frison 1978a) and more closely matches Roberts' (1960:130) description of the points from the type site and those from the Brewster site as follows:

> The Agate Basin points are consistent in pattern yet have considerable range in size. In all of the large and easily identifiable fragments found at the original site no shouldered, barbed or tanged forms appear. The points are long and slender with parallel or slightly convex sides. The flaking is always of the horizontal type, although in one or two cases there are a few facets running diagonally from the upper right tip to the lower left base. Their bases

> may be convex, concave or straight. The blade is flat-lenticular in longitudinal section and generally flat-lenticular with a slightly low median ridge on one face. On some examples, however, the cross-section may be lozenge-shaped. The lateral edges are ground from the base towards the tip for a distance of from one-fourth to one-half the total length of the blade. (Emphasis mine.)

Although there are no "parallel sided" specimens illustrated from the type site (cf. Wormington 1957:142; Frison 1978a: 158, 160 and 161), the wide range of variation described by Roberts is strikingly similar to that found in the Parkhill assemblage.

Because of the variation it is impossible to characterize these artifacts by a few simple statements. The similarities and differences among the Parkhill pointed bifaces are enumerated below. The similarities are:

1. Apparently all of the pointed bifaces were made from bifaces that were wider and longer than the artifact as it was recovered. Many of the specimens display broad shallow flake scars whose percussion bulbs would have been outside the present margin of the artifact. "Elongated bifaces" which would serve as preforms for the pointed bifaces are found in other Agate Basin assemblages.
2. All of the pointed bifaces but one are edge ground near the base. As stated above, this facilitates hafting.
3. All of the pointed bifaces and truncated pointed bifaces have convex sides and lenticular cross-sections.

4. Sixty-four percent of all the distal lateral edges of the pointed bifaces bear evidence of use wear.
5. All of the pointed bifaces and fragments that are laterally spalled show evidence of wear adjacent to the area from which the spall was removed. There are some biface fragments, however, that are worn on the fragment edge without corresponding spalls.

The differences noted among the Parkhill pointed bifaces are:

1. There is a wide variation in length. Specimens complete enough to measure (n=21) are from 88 mm to 26.5 mm, with a mean of 53.4 mm and a standard deviation of 19 mm. This high standard deviation may be accounted for by the fact that all of the shorter specimens are truncated pointed bifaces that have been repaired at the distal end.
2. There is a great variety in basal morphology, ranging from concave, to convex, to flat.
3. There is a variety of raw materials represented.
4. There is a wide range in flaking pattern. Many of the pointed bifaces show evidence of previous preform stages in the flaking pattern, as mentioned above, while others are transversally flaked with flake scars obliterating all evidence of previous stages. Still others are diagonally parallel flaked.

Both the similarity and the variation found among the Parkhill pointed bifaces is not at odds with Roberts' (1960: 130) observation, as stated above. Few other excavated sites have yielded enough artifacts to illustrate much variability.

A notable exception is the Grant Lake site, where 135 points identified as Agate Basin were recovered (Wright 1976 and see Chapter 3). The points illustrated by Wright appear uniform in outline although flaking patterns cannot be discerned from the photos. However, the Grant Lake points appear similar to the pointed bifaces from Parkhill.

Based on the physical attributes illustrated in reports from the type site, Grant Lake, and other sites, it is concluded that the pointed bifaces from Parkhill are Agate Basin.

2. Lateral Spalling

Laterally spalled pointed bifaces occur in assemblages from the Agate Basin site, Wyoming, the Casper site, Wyoming, and the Grant Lake site, N.W.T. None of the reports describe the location of spalling on the bifaces. Most artifacts illustrated have been spalled at the distal end.

3. Other Artifacts

This section discusses the artifacts other than pointed bifaces from the site, and is directed toward determining which of these other artifact classes belong to the Agate Basin assemblage.

a. Bifaces

Triangular bifaces were recovered from the Levi site (Alexander 1963) and were associated with a paleo-Indian component. These were identified as "knife type 2" and were associated with "Plainview-Angostura" points. These bifaces are longer, but are same width and thickness as the Parkhill specimens. Other differences between the Parkhill and Levi specimens are that those from Parkhill are asymmetrical, usually with one straight and one curved edge. None from Levi fit this description. Because no similar artifacts are found at Agate Basin sites the triangular bifaces are probably not related to the Agate Basin component.

No transverse spalled bifaces are found in paleo-Indian sites. This single biface is well flaked and in this respect resembles the pointed bifaces. Based on this fact alone, it is probable that this artifact is part of the Agate Basin assemblage.

The beaked biface from Parkhill has counterparts in the Hell Gap, site that are identified as "drills" (Irwin and Wormington 1970:29). These take on a variety of forms at Hell Gap. "Drills" were also recovered from Levi (Alexander 1963:517) and were associated with the "Plainview-Angostura" level.

Generalized "drill" forms are associated with most prehistoric assemblages and have been mentioned as part of the tool kit of historic tribes. It is impossible to determine whether or not this tool is part of the Agate Basin assemblage at Parkhill. The same holds true for the stemmed biface, as it has the same general morphology as the beaked biface. The notched, pointed bifaces are all diagnostic artifacts from different time periods and are, therefore, not part of the Agate Basin complex.

b. Unifaces

Blade cores, blades, and blade tools were all recovered from the site. Prismatic blades and polyhedral cores have been recovered from the Levi site associated with the earliest components (Alexander 1963:523). Blades were also recovered from the Agate Basin type site (Frison 1978a:165). Based on their presence in other dated sites, it seems likely that the blade core, blades and blade tools are part of the Agate Basin component at the Parkhill site.

Spalls have been recovered from the Levi site and have been referred to as "burin spalls" by Alexander (1963:253). At Levi, 29 were recovered that were described as "scraper-edged," and were associated with "Plainview-Angostura" points and other early styles.

Spalls are commonly associated with the Denbigh Flint complex in Alaska (Giddings 1954:229-237; Bandi 1963; Anderson 1968) that dates between 2,200 and 1,800 B.C. Giddings' description of the morphology of these artifacts closely matches that of the Parkhill specimens. Similar artifacts have been reported by Nash (1970:88) from the Thyazzi site in Northern Manitoba. This site is part of the Arctic Small Tool tradition usually considered to date ca. 1,500 B.C. They are also present in the Pre-Dorset settlements at Seahorse Gully near Churchill, Manitoba and are considered to be about 3,000 years old (Meyer 1977).

This artifact type, it seems, is most commonly associated with northern archaeological components usually around 3,000 years old, although in Texas it is associated with artifacts more than three times that age. Apart from the Parkhill site, I have found no other examples of these artifacts from the North American Plains. Although in the following discussion spalls will be considered to be associated with Agate Basin artifacts, this assignment is inconclusive.

The tabular unifaces have not been described previously and it is very difficult to attribute these artifacts to any specific assemblage. Some of the beaked specimens are similar to those described by Irwin and Wormington (1970:28) under the rubric "beaked end scraper." These are quite common in paleo-Indian assemblages. It would seem that the tabular unifaces are probably part of the Agate Basin assemblage as are the other beaked transverse unifaces from the site.

The only reference to ridge flakes is found in Sanger's (1968) discussion of microblades. It is proposed that micro-blade cores are prepared by removing the lateral edge from a biface, thus producing the first facet from which other blades may be made. The presence of blades (and microblades) in Agate Basin assemblages at Levi (Alexander 1963), Agate Basin (Frison 1978a) and Grant Lake (Wright 1976), indicates the probability that this artifact was also employed as part of the Agate Basin assemblage at Parkhill.

The unifaces with transverse bits are ubiquitous in prehistoric assemblages and it is probable that some of these artifacts are a part of the Agate Basin assemblage at Parkhill. A similar problem is associated with the large unifaces. These artifacts are common and cannot be dis-tinguished temprally or spatially.

Both beaked unifaces and spurs are found in paleo-Indian assemblages at Hell Gap (Irwin-Williams et al., 1973). Only the small spur is associated with Agate Basin at the Grant Lake site (Wright 1976). It is probable that both beaked unifaces and spurs are part of the Agate Basin assemblage at Parkhill.

D. <u>Summary and Interpretations</u>

Based on the previous discussion, the following artifact classes are likely to be part of the Agate Basin assemblage at the Parkhill site: pointed bifaces (all stages), the transverse spalled biface, blades, blade core, blade tools, spalls, tabular unifaces, beaked transverse unifaces, the ridge flake uniface, beaked unifaces, and spurs.

The lithic reduction sequence at the Parkhill site, as discerned from the artifacts (Figures 4 and 9) suggests that raw materials were transported as functioning tools and reduced through various stages as repairs or needs arose. Apparently, only the finer grained materials such as Knife River flint and chert were utilized in this manner, as their source localities were quite distant. These materials were not discarded until fragments of them were either too small for further modification or were inadvertently lost. In other words, functioning tools were preforms for more advanced reduction stages. Thus, it seems reasonable to modify our ideas about 'finished' artifacts. This is especially true of projectile points as this functional label accounts for what may only be a short, temporary stage in the useful life of an artifact. In the future, the reduction sequence itself may prove to be a significant diagnostic feature of artifact assemblages.

The preceeding discussion brings into focus some important questions concerning the Parkhill site. These include: How was the site used by its early inhabitants; and, why was that specific location chosen for use? With the data at hand, these questions cannot be answered with certainty, although some inferences may be made.

Many of the characteristics of the Parkhill site would be advantageous to hunters. First, it is situated near landforms that would facilitate capturing and killing bison, such as the neighbouring stream bed (eg. Agenbroad 1978) and sand dunes, remnants of which are found near-by (eg. Frison 1974 and 1978a). Second, the site provides a clear view of the surrounding terrain and could easily be used as a vantage point for sighting game. As well, the hill on which the site is located, is (and probably was) unobstructed by trees, allowing almost constant breezes to sweep the area free of insects.

The Parkhill site is also situated at the focal point of an historic bison migration route (Gordon 1979, Figure 3, and Arthur 1975). Gordon describes the historic bison movements as a cyclical migration of animals onto the plains in the spring and a return to the parklands in the winter.

He comments that: "Bison habits and movements undoubtedly influenced prehistoric Plains tribes (sic) territoriality, social organization, communication and vulnerability" (Gordon 1979:50). It is probable that bison migrations 8,000 years ago were similar to those observed 100 years ago because the southern edge of the boreal forest was in approximately the same position (Ritchie 1976).

The people who camped at Parkhill were wide-ranging in their seasonal hunting rounds as evidenced by the presence of lithic artifacts made from non-local materials. This fact suggests that their travels included direct or indirect contact with the Swan River valley (Swan River chert), central North Dakota (Knife River flint), southwestern Saskatchewan (limonitic shale), and with other regions that were sources of fossil wood, Jasper etc. It may be that the site was occupied as the bison were moving out of the northern parkland refugium in the spring (the Swan River valley), and/or as they headed north from the summer grazing lands (central North Dakota and southwestern Saskatchewan) toward their parkland wintering grounds (Gordon 1979, Figure 3). A seasonal subsistance pattern may have existed that was similar to that of the historic Assiniboine, who were seasonally adapted to both grassland and parkland environments (Ray 1974:46-47). It seems most likely, then, that the site was a camping area used for food processing, and weapon repair and manufacture. The presence of quantities of flaking debris, as reported by Nero (1959), the number of pointed biface proximal fragments and the high incidence of wear on the distal ends of pointed bifaces and fragments, supports this contention.

The data also suggest an additional function of the Parkhill site. If the bison did pass nearby at a specific, predictable time of the year then it is conceivable that several bands simultaneously converged on the site for communal hunting. During the historic period, such occasions were often accompanied by rites of renewal and other social events. The areal extent of the artifact recovery and the variety of lithic resources present also supports this interpretation. However, the evaluation of these ideas awaits further research. To date, no in-situ archaeological deposits have been observed at the site; but an intensive survey of the nearby dune fields and the adjacent seasonal stream may reveal the presence of Agate Basin artifacts.

CHAPTER THREE

THE AGATE BASIN COMPLEX

A. Introduction

This chapter summarizes the published data on assemblages of artifacts that either have been identified as Agate Basin or show similarities to the complex. The summaries that follow concentrate on the age of the site, its geographic location, the kind and variety of artifacts and where possible, the faunal evidence. Two assemblages usually not considered to be Agate Basin are included in the summaries that follow. These are from the Levi site, Texas (Alexander 1963), and the Casper site, Wyoming, (Frison 1974). The dominant diagnostic artifacts from both sites have not been identified by the authors as Agate Basin but they contain pointed bifaces as well as other artifact classes that are similar to those from other Agate Basin sites.

Concerning the nature of the data obtained from the various sites it should be understood that they represent only a small percentage of the actual living sites left by the populations employing what we now identify as the Agate Basin complex.

B. <u>The Agate Basin Site</u> (Roberts 1943, 1961, 1962; Bass 1961; Frison 1978a; Figure 10,No.3)

In 1942, Frank H. H. Roberts, Jr. tested a site in Moss Agate Arroyo, near Lusk, Wyoming, where amateurs had previously recovered 38 projectile points of a previously unknown form. Roberts' initial tests yielded a large number of artifacts in association with what he believed was a bison kill. The artifacts included 23 points or fragments of points, "...pieces of several large blades which probably had been used for knives, a number of end and side scrapers and portions of two bone implements..." (Roberts 1961:176). The projectile points were designated as Agate Basin. Lateral spalling was not mentioned by Roberts as being present on the Agate Basin points, but this phenomenon can be observed in Plates 3 and 4 of the 1961 publication.

In 1961 Roberts returned to the site and conducted further excavations. He recovered an additional 111 specimens including 20 points, 9 gravers, 28 scrapers, 16 "knives," 11 spoke shaves, 21 worked flakes, 5 bone tools and 1 hammer stone (Bass 1961). Bison remains were recovered but it is not known for certain whether it is the modern species or a fossil form. In addition to bison, some deer and rabbit bones were noted. Roberts (1961) also notes the presence of hackberry seeds among the remains.

Folsom points were recovered stratigraphically below the Agate Basin deposits, indicating that Agate Basin was later in time. Speaking of the people using the Agate Basin points, Roberts (1961:132) observes:

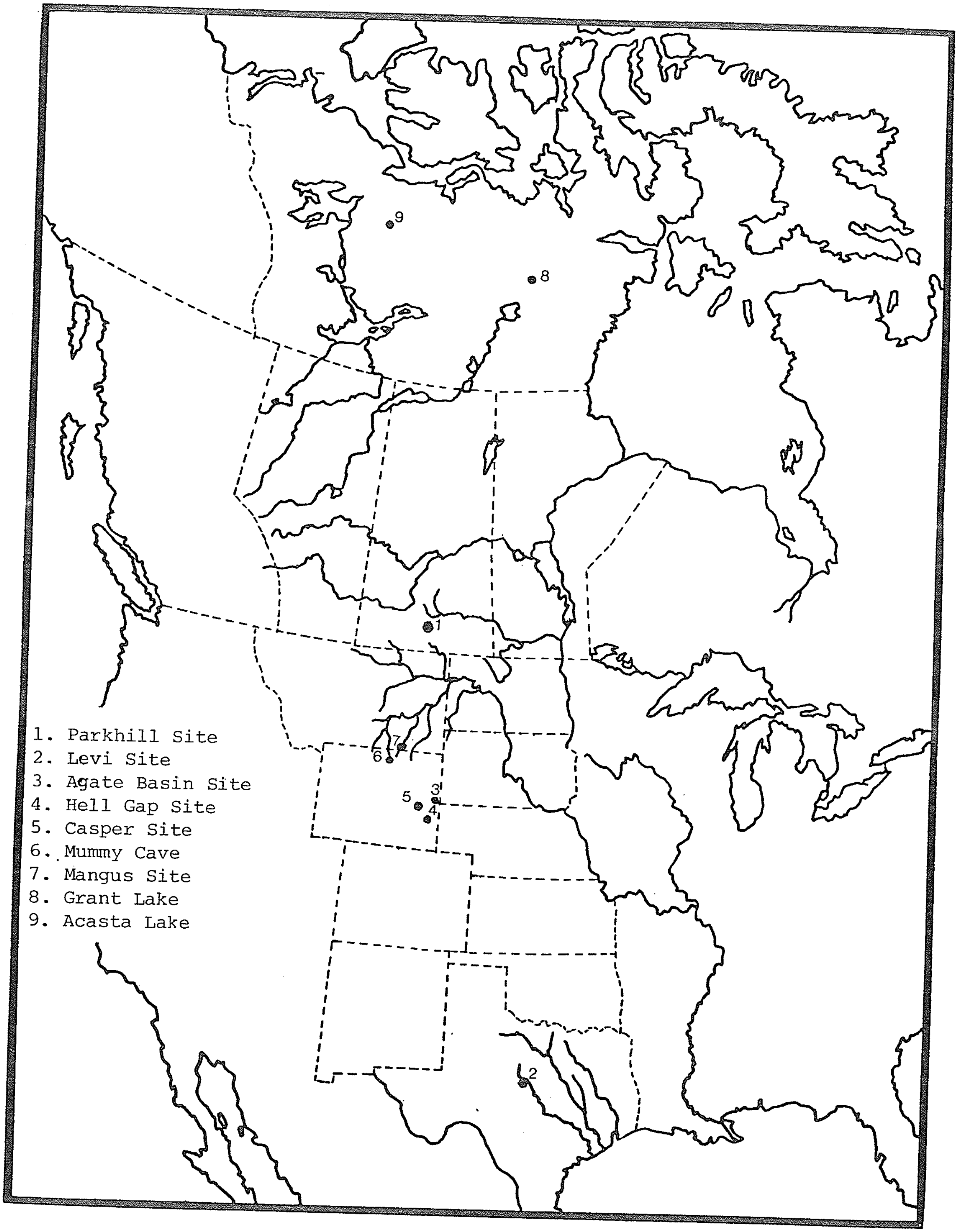

Figure 10. Location of Agate Basin and related sites.

> They probably were roaming the Central and Northern Plains area at a time when some of the Folsom people were still present in districts further south. However, they probably persisted longer than the makers of the Folsom implements because in some localities their materials occur in levels above those of the makers of the fluted points.

In 1962, Roberts published a date of 9350± 400 years BP (see Table 8 for all dates referred to in this chapter) from a sample recovered from the Agate Basin site. Since then two more dates have been obtained: 9990± 225 years BP and 10,430± 570 years BP (Frison 1978a:23).

C. <u>The Brewster Site</u> (Agogino 1955; Agogino and Frankforter 1960; Roberts 1961; Frison 1978a, 1978b; Figure 10, No. 3)

The Brewster site is only 0.4 km from the Agate Basin type site and is in the same arroyo. Three culture bearing zones were present, the upper two of which contained Agate Basin artifacts. By tracing the strata along the valley wall, it was found that the upper Agate Basin level from Brewster coalesced with a similar zone at the type station. At the Brewster locality, this zone yielded two Agate Basin points. Underlying the Agate Basin levels was a localized deposit which contained Folsom points and bison bone. As with the type site, none of the bison bone recovered with the Agate Basin points was suitable for speciation, as there were no horn cores present. However, based on other faunal elements, it was tentatively concluded that the bison were of the modern variety. Two dates were obtained from Brewster for the Agate Basin deposits. The upper level produced a date of 9440 years BP while the lowest Agate Basin component is dated at 9979 years BP (no standard deviation given). Recently work has recommenced at the Agate Basin and Brewster sites under the direction of George Frison (1978b), Wyoming State Archaeologist. Most of the work is being undertaken at the Brewster locality (or what is suspected to be the Brewster locality) because the original area is under water. Geological reconnaisance reveals that the site, now positively identified to have been employed as a bison trap, was in an arroyo nearly paralleling the present day Moss Agate arroyo. At the time of its use, it is estimated to have been 9 meters (30 feet) deep. Today, the Agate Basin deposit is 2.5 meters below the surface and about 0.6 meters thick.

The animals exploited were larger than those from the Casper site, which are associated with Hell Gap points. Based on fetal evidence, Frison (1978b) estimates that the kill occurred sometime late in winter, likely in January or February.

Few photographs or descriptions of the artifacts from Brewster have been published and no final report is yet available. The points illustrated demonstrate almost as great a variety in terms of reduction as do the Parkhill specimens. All stages are represented including distally truncated specimens (although not as short as some from Parkhill), midsectional, distal and proximal fragments, and laterally spalled points and fragments. No mention is made concerning the utilization of fragments, as has been noted at Parkhill and Grant Lake. It is interesting to note that, typologically, there are Hell Gap points present in the Agate Basin type site. The artifacts other than projectile points include flake tools, both retouched and unretouched, denticulates, side scrapers, an asymmetrical leaf shaped biface, end scrapers, blade tools, and gravers.

D. The Levi Site (Alexander 1963; Figure 10, No. 2)

Levi is a rock shelter located on Lick Creek in central Texas. An assemblage of artifacts was recovered from zone IV which consisted of burins, burin spalls, blades, polyhedral cores, grinding stones, "seed grinding stones," scraper edge burin spalls and lanceolate points. The points from level IV strongly resemble those described by Roberts (1961), except that several display diagonal transverse flake scars and, in some cases, deeply indented bases. Alexander illustrates two "Lerma" points from level IV that resemble pointed biface preforms. In general, there is a wide morphological range in the Levi points, but no greater than among the Agate Basin type specimens. The difference lies in that the majority of the points from Levi do not resemble those from Agate Basin.

A wide range of faunal species and the presence of grinding stones indicate that the population at Levi was well adapted to a varying food regimen. Eleven species of mammals, two kinds of reptiles, fish, and numerous snail and mussel shells make up the food remnants. Three dates were obtained from level IV. The deepest yielded the latest date and is disregarded, however, the 'middle six inches' yielded a date of 9300± 160 years BP and the 'upper six inches' yielded a date of 7350± 150 years BP. These dates overlap those obtained from the Agate Basin component at the Brewster site.

E. The Mangus Site (Husted 1965 and 1969; Figure 10, No. 7)

This site is located in a small rock shelter on the Big Horn River in southern Montana. Husted (1969:3) describes the region as lying "...athwart the border between the Great Plains and Middle Rocky Mountain provinces...and is partly in the Bighorn Basin and partly within the Bighorn Mountains." The site is located approximately 25 m above the river with talus steeply sloping to the water's edge. The shelter is 17 m across and 6 m deep. Occupation I was situated partially on a layer of decomposing breccia and partially on a layer of brown sand. This occupation level contained five Agate Basin points and fragments along with some bifacial cutting tools, choppers and grinding stones. Along with the artifacts, 14 fire hearths were excavated, two of which yielded dates of 8690± 100 years BP and 8600± 100 years BP.

Faunal remains consist of three bones from Mule Deer (*Odocoileus hemionus*) and six from cottontail (*Sylvilagus floridanus*).

F. The Hell Gap Site (Irwin and Wormington 1970; Irwin-Williams et al., 1973; Figure 7, No.4)

The Hell Gap site is located in an intermittent stream valley known as Hell Gap Valley in southeastern Wyoming. It is a multiple component site containing most of the North

American paleo-Indian tool complexes including Agate Basin. Artifacts were recovered from five different localities within the Hell Gap Valley, all but one of which contained Agate Basin components.

Data on the Hell Gap site is sketchy, but preliminary reports have stressed the uniqueness of the newly-discovered paleo-Indian complexes. However, Irwin-Williams et al (1973) list thin finely flaked bifaces, beaked end scrapers, single and double side scrapers, spur perforators and retouched flakes as part of the Agate Basin complex. One important feature to come to light was evidence of three small structures represented by superimposed circles averaging just over two meters in diameter made up of post holes. Apparently there was 'some' association of occupational debris with the structures but there was no evidence of internal features. No details concerning faunal remains have been published. The Agate Basin complex was dated at Hell Gap at 10,850± 500 years BP (Frison 1978a).

G. Mummy Cave (Husted 1978; Figure 10, No. 6)

Several occupation levels in this multicomponent site have yielded evidence of the Agate Basin complex. Leaf shaped points, most often diagonally parallel flaked, have been recovered associated with fire hearths, eyed needles, chopping and cutting tools. Husted mentions that one proximal fragment of a point has had two "graver points" worked onto the lateral edges, similar to the lateral spalled ones from the Parkhill site. Fauna from the Agate Basin level consists of porcupine, bear, deer and mountain sheep (Harris 1978). Dates for these levels are 8100± 140 years BP and 8740± 140 years BP (Frison 1978a).

H. The Casper Site (Frison 1974; Figure 10, No. 5)

A bison kill was excavated within the city limits of Casper, Wyoming, which contained the remains of approximately 74 bison (*Bison antiquus*) in association with Hell Gap points. Casper is included here because there are several points in the sample which strongly resemble Agate Basin points. It is commonly accepted that Agate Basin points are felt to be ancestral to Hell Gap points which are present at Agate Basin, Brewster and Parkhill. The Hell Gap points from these sites may be shouldered Agate Basin points. A date of 9830±350 years BP and 10,060±170 years BP was obtained from the Casper site, making it almost contemporaneous with the Levi and Agate Basin sites.

I. Champagne Phase (MacNeish 1963 and 1964)

In the southwest Yukon and the western Northwest Territories, MacNeish reports on the evidence for an early population who hunted bison, caribou, elk and muskox and who used a complex consisting of Agate Basin points, Pelley points (possibly reworked Agate Basin points), Buffalo fibula awls, gravers, bifacial choppers, flake end scrapers, and pebble hammerstones. He feels that the above tool types were obtained from the south, while blades, side scrapers, end-of-blade scrapers, snub-nosed scrapers, Ft. Liard burins and ovoid bifaces were part of the tradition it replaced in the north. This Northern Plano tradition, as MacNeish terms it, did not reach the Bering Strait.

Agate Basin points are also part of the Little Arm phase, which presumably followed the Champagne phase. Little Arm sites are smaller than those of the Champagne phase and contain fish remains. The artifact assemblages composing these two phases are similar enough to be considered together in this analysis. A summary of the artifact classes from the Champagne and Little Arm phases is found in Appendix II. On the Great Bear River in the Northwest Territories, a similar assemblage of artifacts has been radiocarbon dated at 4644± 200 years BP and 4804± 200 years BP. MacNeish feels that these are minimum dates for the Champagne phase.

J. The Acasta Lake Site (LiPk-1) (Noble 1971; Figure 10, No.9)

This site is located between Great Bear Lake and Great Slave Lake in the Northwest Territories. The artifacts recovered include leaf-shaped points which resemble Agate Basin points, and others which are leaf-shaped but notched near the base. Included within the artifact assemblage are laterally spalled points, fragments, tabular end scrapers, transverse burins on point fragments, and pseudo-burins (Noble: personal communication). A small quantity of caribou bone has been recovered. Two dates have been obtained for the site: 6970 ± 360 years BP and 6850± 150 years BP.

K. <u>The Grant Lake Site</u> (Harp 1959, 1961; Wright 1976; Figure 10, No. 8)

The Grant Lake site (KkLn-2) is located on the north end of Grant Lake in the Keewatin District of the Northwest Territories. The site was first discovered in 1955 when a collection of Agate Basin points and other artifacts were found eroding from an esker (Harp 1959). In 1973, J. V. Wright (1976) directed excavations in the area, concentrating on or near the locality described by Harp.

The artifact inventory from Grant Lake consists of Agate Basin points, many of which are laterally spalled, scrapers, thin bifaces, gravers and circular quartzite chopping tools called chithos. Some of the point fragments were unifacially thinned at the fracture, but no mention is made of attrition. Wright has been able to join some of the fragments he excavated with some of those previously collected from the surface.

Several structures have been identified. These are similar to those at Hell Gap except they are stone circles, with artifacts concentrated in and about them. Six of these features are positively associated with Agate Basin artifacts. Wright obtained several dates from the site, all but one of which he feels are too late. The acceptable date is 7220± 850 years BP (Wright 1976:86) obtained from a stratum containing charcoal and flakes, but apparently no Agate Basin artifacts. Based on the data obtained from Grant Lake and comparisons with the plains Agate Basin complexes, Wright porposed that there may have been a northern Agate Basin expression that he terms the Beverley unit of the Agate Basin complex. This differs from the Plains complex which he terms the Brewster unit, in that chithos, adzes, wedges, saws, "gravers-on-a-point" and scraper knives are missing in the south. Wright states:

> At a more specific level, the relatively high instance of burination and corner-use of broken points in the Beverley unit is very rare in the Brewster unit. Bi-pointed projectile points are also absent from the Beverley unit. The small end scrapers, characteristic of the Brewster unit, deviate from the large end scrapers that are more typical of the Beverley unit. Also the large side scrapers that converge to a point found in the southern unit appear to be absent in the north. These differences permit a clear separation of the Brewster and Beverley units although both units share a basically similar lithic technology which includes many very specific attributes that are particularly obvious with reference to projectile points (1976:95-96).

L. Discussion

Table 9 and Figures 10 and 11 summarize the spatial and temporal data for the Agate Basin complex. These data demonstrate that the Agate Basin complex is more recent in the north than in the Central Plains and persisted for nearly 4,000 years, outlasting most, if not all, the late paleo-Indian complexes. The graphic representation of the dates for Agate Basin in Figure 11 suggests that there is a south to north trend with the dates in the south being older than those in the north. This relationship was tested using a Spearman's r rank correlation (Thomas 1976:395-405, and 510), in which the sites were ranked in relationship to their

Table 9. Radiocarbon dates for excavated Agate Basin and similar archaeological complexes and the estimated date for the Parkhill site.

Lab. No.	Date C-14 Years (BP)	Site
No data	4644±200	Champagne Phase, N.W.T. (MacNeish 1964)
No data	4804±200	Champagne Phase, N.W.T. (MacNeish 1964)
GAK2377	6850±150	Acasta Lake, N.W.T. (Wright 1976)
I-3957	6970±360	Acasta Lake, N.W.T. (Noble 1971)
S-1056	7220±850	Grant Lake, N.W.T. (Wright 1976)
I-2354	8100±140	Mummy Cave, Wyoming (Frison 1978a)
I-2353	8740±140	Mummy Cave, Wyoming (Frison 1978a)
SI-98	8690±100	Mangus site, Montana (Husted 1969)
O-1128	7350±150	Levi site, Texas (Alexander 1963)
O-1129	9300±160	Levi site, Texas (Alexander 1963)
RL-125	9830±350	Casper site, Wyoming, (Frison 1978a)
RL-208	10,060±170	Casper site, Wyoming (Frison 1978a)
O-1252	9350±400	Agate Basin site, Wyoming (Frison 1978a)
M-1131	9990±225	Agate Basin site, Wyoming (Frison 1978a)
RL-557	10,340±570	Agate Basin site, Wyoming (Frison 1978a)
	8000-8500	Parkhill site, Saskatchewan (estimate)

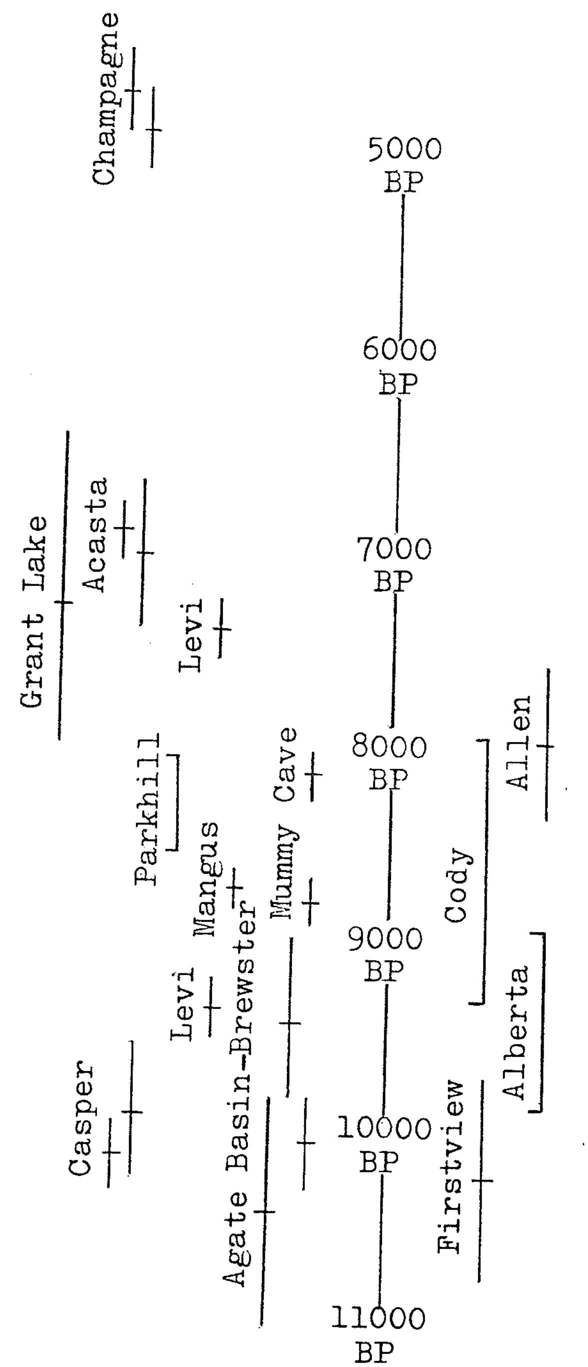

Figure 11. Comparative chronologies of Agate Basin and related complexes plotted against other paleo-Indian complexes from the Central Plains.

Radiocarbon date with standard deviation.

Estimated age range.

Source of dates, Table 10 and Frison 1978a.

south-north location with Levi ranked as number one and Acasta Lake ranked as number seven (see Appendix 3). The dates from the sites were then ranked according to age, with the oldest ranked number one. When a site had more than one date, an arithmetic average was obtained and the result ranked. The test statistic had a value of $r_s = +0.82$ with an associated probability level of $\alpha \leq 0.05$. This finding suggests a direct relationship between site location latitude and age.

As the Parkhill site is situated between Mangus and Grant Lake, and there is a correlation between geography and age for the Agate Basin complex, it seems reasonable to estimate that Parkhill was occupied sometime between 8,000 and 8,500 years ago. This estimate generally agrees with Nero's guess of from 7,000 to 8,000 years ago (1959:40).

Appendix II summarizes the artifact classes obtainable from the literature illustrating that a great variety is present in Agate Basin sites. This could be the result of several factors, including:

1. No standardized descriptive format being employed by the various authors, thus making it difficult to determine which artifact classes are the same among the sites. This difficulty is compounded when researchers create new artifact classes.
2. The sites contain the remains of different economic activities, each of which may have employed specialized tools.

3. Tools were undoubtedly added or deleted as a result of technological change over the 4,000 or more years represented by the sites.

In chapter 1 it was suggested that the meaning of the term "complex" was unclear. Do artifact complexes consist only of artifacts that may be identified with the complex when the pointed bifaces are not present (such as Cody knives), or is a complex all of the artifacts recovered _in situ_ along with diagnostic artifacts? In either case, these alternatives do not aid in determining what is or is not part of a complex when dealing with artifacts that have been recovered from the surface. To help solve this problem, it was proposed in chapter 1 that "complex" be defined and operationalized here in quantitative terms. In this case, there are eight excavated Agate Basin sites considered. If an artifact class occurs in one third or more of the sites, then for the purposes of the thesis, it is considered to be part of the Agate Basin complex (Table 10). Therefore, the Agate Basin complex consists of artifacts that tend to occur together along with Agate Basin pointed bifaces. Because of the wide temporal differences among the sites being considered here, this definition has chronological implications, in that the artifact classes tend to persist over a long time span. Using these criteria, some of the artifact classes that are included in the Agate Basin complex are, for the most part, undiagnostic and may be found with later archaeological assemblages. These artifacts include flake tools, spoke shaves, semilunar bifaces, drills, and hammerstones. However, blade tools,

Table 10. Artifact categories that occur in 38% or more of the Agate Basin sites. Data obtained from Appendix 11. Parkhill site data not included. n=8 sites.

Artifact Category	% Occurrence
Agate Basin points/bifaces	100
Blade tools	75
Spurs	75
Flake tools	63
Laterally spalled points/bifaces	50
Spoke shaves	50
Truncated points/bifaces	38
Chi-thos	38
Stemmed points	38
Scraper planes	38
Semilunar biface knives	38
Drills	38
Hammerstones	38
Denticulates (saws)	38

spurs, laterally spalled points/bifaces, truncated points/bifaces, and denticulates are usually associated with paleo-Indian assemblages elsewhere (Irwin and Wormington 1970). At the Parkhill site, the only paleo-Indian points/bifaces present are Agate Basin, so it is probable that the above artifacts are part of the complex. The beaked transverse unifaces, the blade core, the ridge flake uniface and the spalls, using the above definition, were found not to be part of the complex. As these artifact classes usually occur in association with paleo-Indian assemblages elsewhere, there is a chance that these artifacts are also part of the Agate Basin tool kit at Parkhill.

In sum, the following artifact classes from Parkhill are considered part of the Agate Basin complex: points/bifaces (all stages of reduction), all blade tools and artifacts resulting from or related to blade manufacture, and spurs. Tabular unifaces and beaked unifaces have been recovered at two other sites along with Agate Basin artifacts, but their infrequent occurrence in the Agate Basin sites as a whole prevents them from being included as part of the complex at Parkhill.

CHAPTER FOUR

THE NORTHWARD MOVEMENT

A. Introduction

In the foregoing chapter it was suggested that sites containing Agate Basin artifacts tend to be found in progressively more northerly locations over a period of about 4,000 years. This movement is summarized here along with the paleo-environmental data. For the paleo-environments past vegetation zones are taken from Ritchie (1976) and ice front positions from Prest (1970). The more recent work of Wendland (1978) is not used extensively here because there are discrepancies between his mapped ice front positions and those of Prest, specifically after 7000 BP.

1. ca. 10,000 Years BP

By 10,000 years BP, the Plains grassland was well established, stretching from Texas to Canada, including the southwest corner of Manitoba, southern Saskatchewan and southern and central Alberta (Wendland 1978:276, Figure 2). Ritchie (1976) shows the grassland extending into Saskatchewan to approximately 53^{o}N by 9500 years BP with a zone of boreal forest between it and the ice (see Figure 12).

In a review of the Pleistocene fossil fauna recovered from the three Prairie Provinces, Pettipas (nd.) makes it clear that *Bison occidentalis* was present as early as

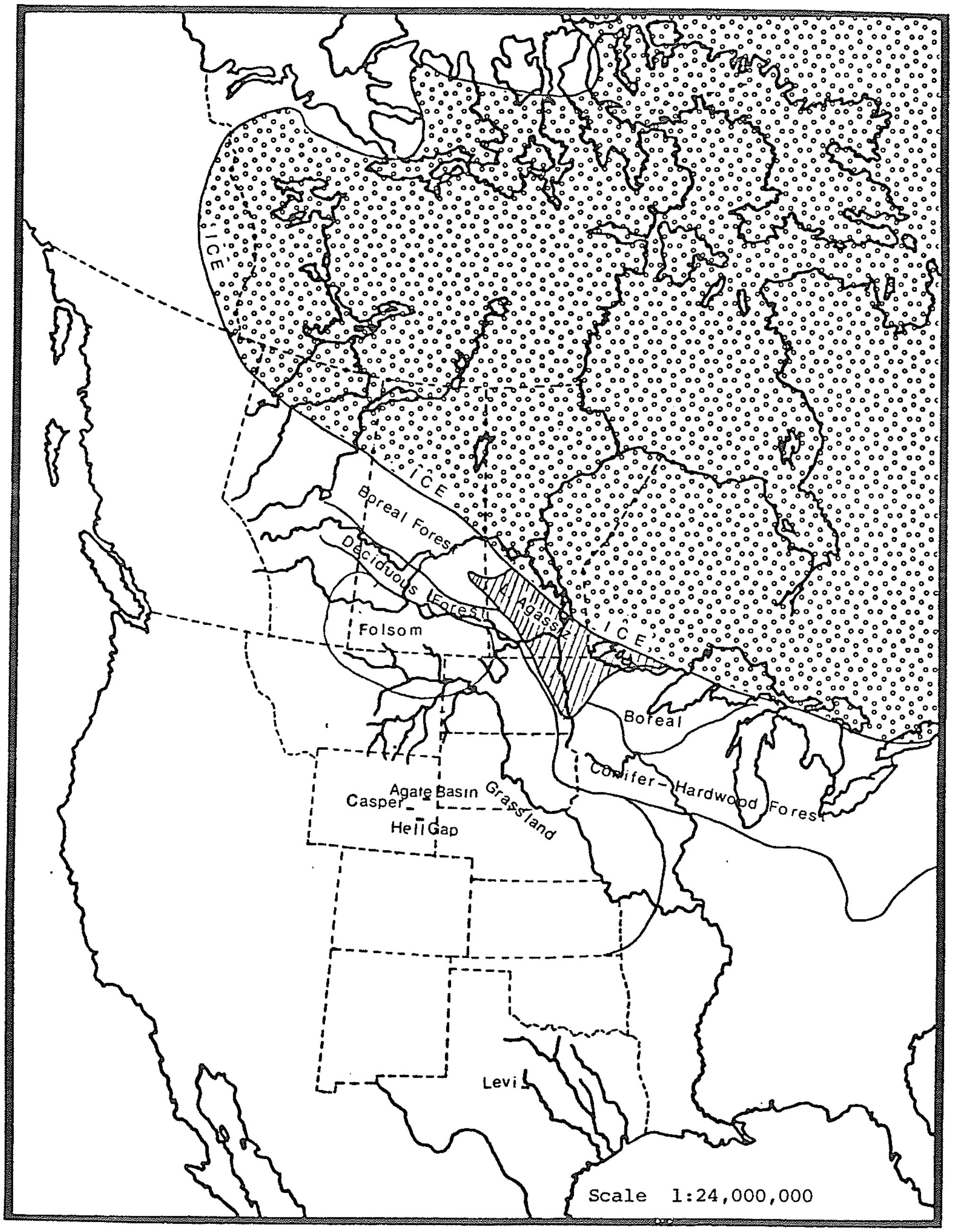

Figure 12. Paleo-Environment - Agate Basin Relationships ca. 10,000 BP (after Wendland 1978 and Prest 1970).

14,000 years BP. Elsewhere, Pettipas (1975) notes the presence of mammoth in southern Saskatchewan as late as 10,000 years BP. Thus, animal resources were present in the northern Plains well before the Agate Basin complex appeared there. Isolated surface recoveries of Folsom points from southern Saskatchewan are thought to be 10,000 years old (Kehoe 1966). The presence of these artifacts suggests that there were human populations already occupying the southern Prairie Provinces before Agate Basin emerged. Folsom artifacts are not common in the southern Prairie Provinces and Pettipas (1976) argues that this may be a function of subsequent natural disturbance due to soil movement caused by the wasting of dead ice underneath the till (see Clayton 1967). Artifacts deposited on such unstable surfaces could have been subsequently buried to depths beyond the reach of cultivation or wind erosion.

Figure 12 shows the location of the Agate Basin sites occupied ca. 10,000 years BP, and the northern Plains region felt to have been inhabited by people using Folsom artifacts. Note that the most northerly Agate Basin site is 950 to 1,000 km south of the contemporaneous ice front and well south of the northern border of the grassland at that time.

2. ca. 9000 years BP

Figure 13 illustrates the proximity of the Mangus site to the glacial ice and the vegetation zones. The site is situated at the northern end of the Bighorn Canyon

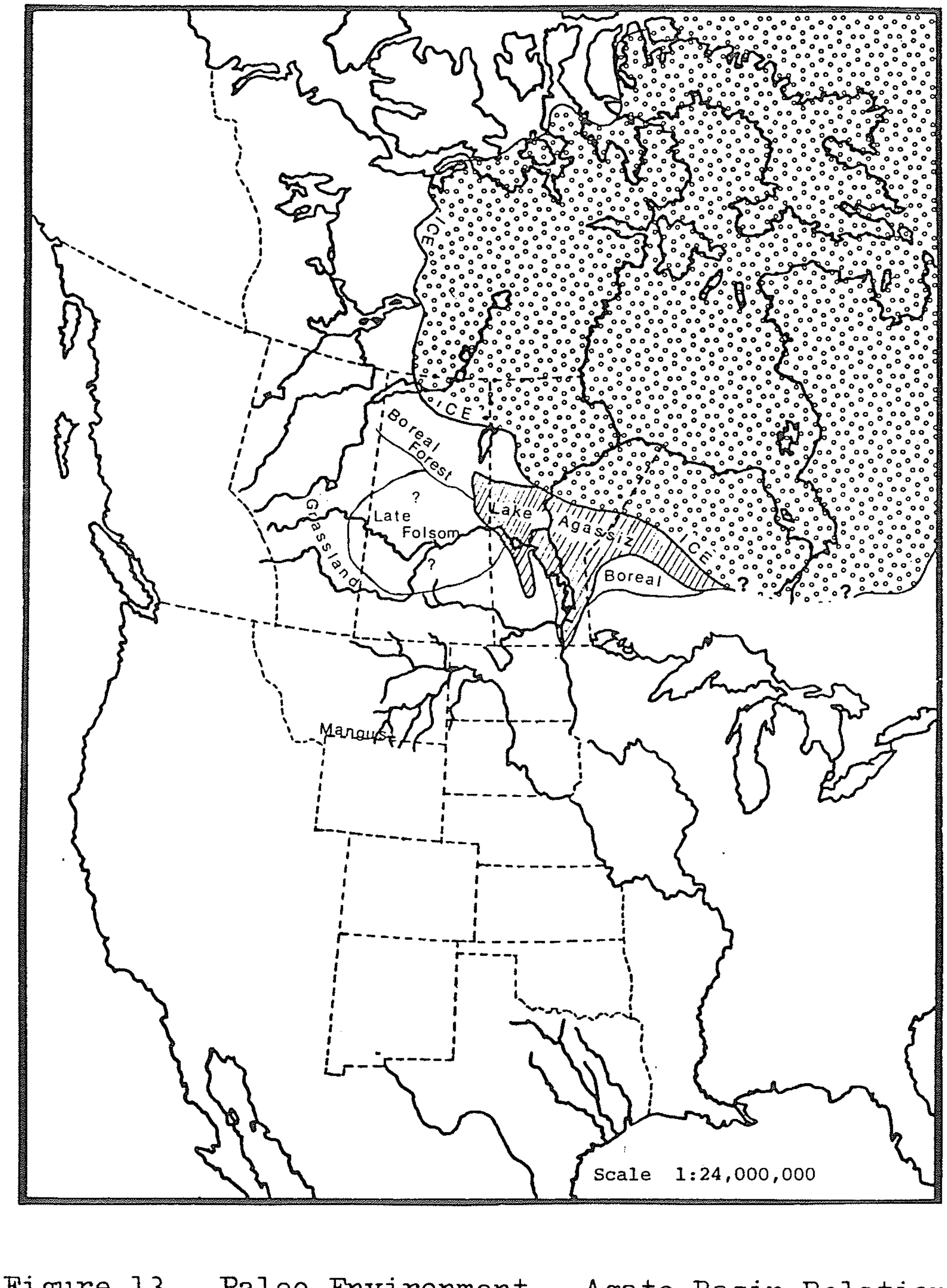

Figure 13. Paleo-Environment - Agate Basin Relationships ca. 9000 BP (after Prest 1970 and Wendland 1978).

in Montana, between 950 and 1,000 km south of contemporaneous glacial ice. At this time, there is evidence to suggest that the bison resources on the plains were being exploited, at least in Nebraska, by populations using the Alberta complex (Agenbroad 1978). With only one dated Agate Basin site from this time period, it is impossible to ascertain whether the complex was restricted to the Bighorn Mountains region.

3. ca. 8000 Years BP

Figure 14 illustrates the location of the Parkhill site in relation to paleo-environments ca. 8000 years BP. Little is known of contemporaneous paleo-Indian sites from Saskatchewan but Agate Basin artifacts are common as isolated finds from surface sites throughout the province (Ebell 1976; Minni 1976). Other paleo-Indian artifact types, usually considered to post-date Agate Basin on the plains in the United States, such as the Alberta complex and the Cody complex, are less common. Such artifacts resemble Kersey and Firstview artifacts that are 10,000 years old in Colorado. It is thus, difficult to determine whether the Saskatchewan artifacts represent the earlier Firstview-Kersey complex or the later Cody complex, or both. Both types are probably present.

During its occupation, the Parkhill site was surrounded by grassland that extended as far north as its present limit.

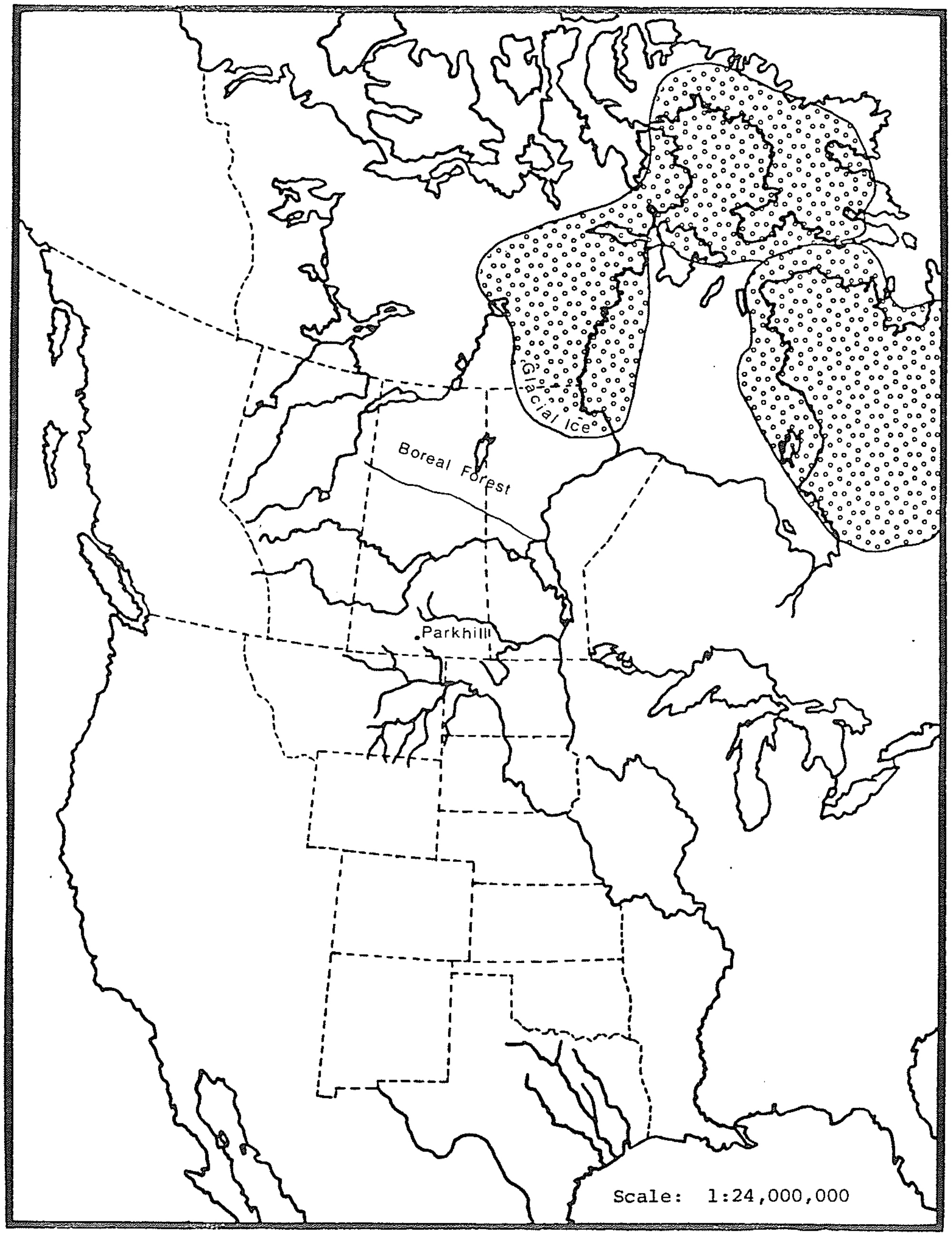

Figure 14. Paleo-Environment - Agate Basin Relationships ca. 8000 BP (after Prest 1970).

Terasme (1973:208) suggests that a pronounced warming trend began sometime before the Parkhill site is thought to have been occupied. "....around 10,000 (C-14) years ago the climate became semi-arid..." (David 1972:49) and by 8,500 years ago "...a large part of the prairies was affected by a climatic change to higher temperatures when... only the deepest and largest lakes retained water, (and) many of the smaller depressions became dry and their sediments lay exposed to the elements " (Delorme 1965:109). This apparent warming trend was in progress when Parkhill was occupied and probably modified human ecological patterns, perhaps by encouraging continued northward movement.

4. ca. 7000 Years BP

Figure 15 shows the location of the Grant Lake and Acasta Lake sites in relation to contemporaneous paleoenvironments. The economies of both northern paleo-Indian populations are similar. Caribou was present at Grant Lake while caribou, black bear, hare, eagle and fish remains were preserved at Acasta. Today, these two sites lie within different vegetation zones with Grant Lake in the tundra and Acasta Lake in the transition zone between boreal forest and tundra. However, 7,000 years ago, at least Acasta Lake was within the boreal forest, although Gordon (1976:42) believes that tundra conditions prevailed at Grant Lake. In the western subarctic, Ritchie and Hare (1971) present evidence from pollen records in the Mackenzie

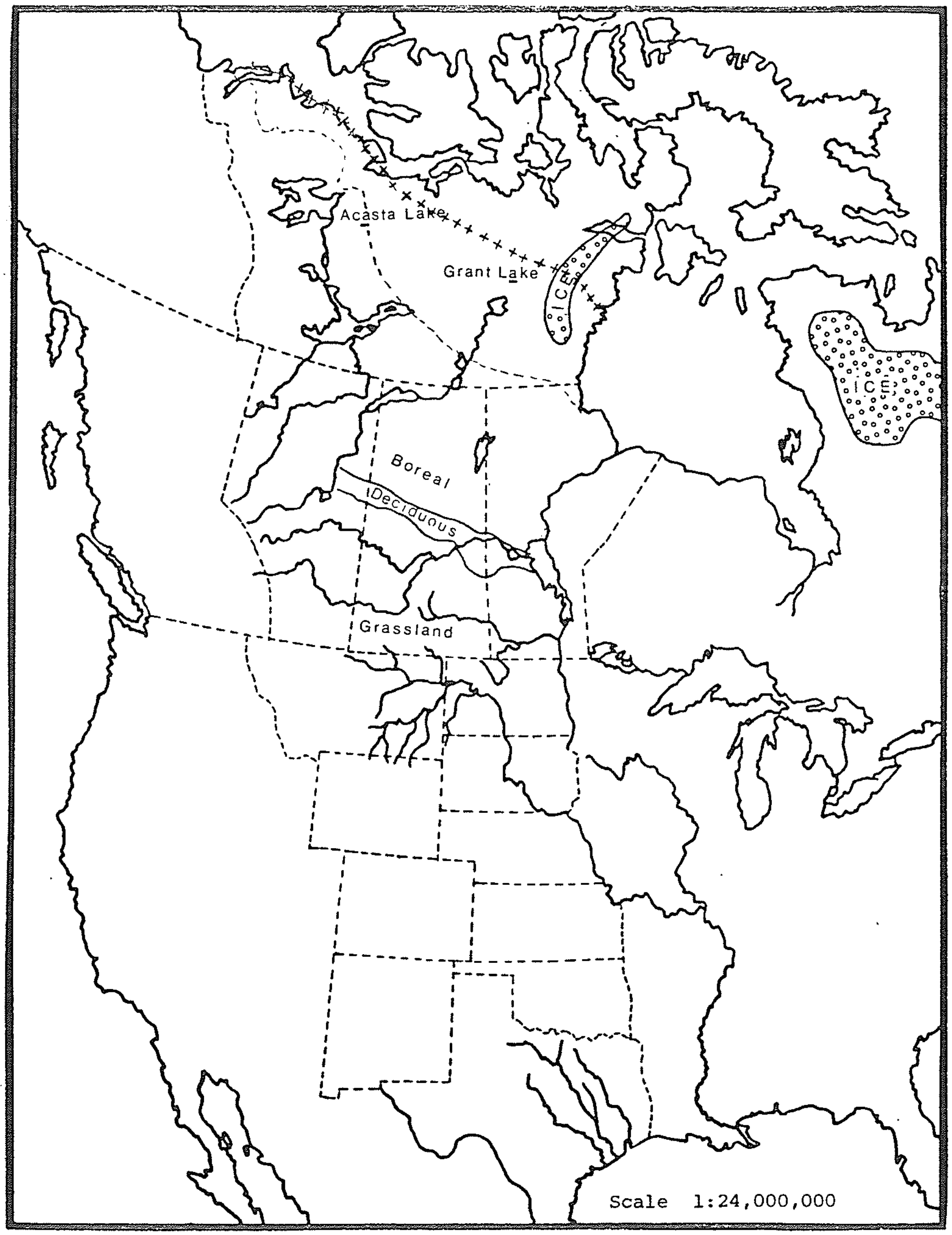

Figure 15. Paleo-Environment - Agate Basin Relationships ca. 7000 BP (after Prest 1970).

----- Present treeline after Rowe (1972).

+++++ Hypothesized treeline ca. 7000 BP.

Delta indicating that the northern forest boundary was considerably farther north than today, extending almost to the Beaufort Sea. They state: "Over the Mackenzie Delta area, where closed-crown spruce forest was established by this date (8,000 years BP), we have assumed a conservative northward displacement of 350 km (it may well have been more),..." (1971:341). This conclusion is based on their belief that the Mackenzie Delta experienced a much milder climate than it does at present, with the mean daily temperature for the warmest months being about 5°C higher than today, allowing for a 30-day extension of the growing season (Ritchie and Hare 1971:339). Terasme (1973) estimates that 8000 years BP marks only the beginning of a trend toward increased temperatures that does not peak until around 5500 years BP.

Delorme, Zoltai, and Kalas (1976) suggest that temperatures as high as 10°C warmer than present prevailed in the northwestern arctic. This was accompanied by 13 - 16 mm more annual precipitation than today. Further, Nichols (1975) suggests that "summers were substantially warmer than now from 6800 BP to 3000 BP, with tree growth up to 400 km north of modern forest, resulting from mean summer temperatures 4°C higher than now." With Grant Lake situated approximately 100 km northeast of the main body of the present forest-tundra transition zone and about the same distance southeast of an area of forest-tundra extending along the Thelon River (Rowe 1972), it is possible that the temperature and precipitation increases of the magnitude mentioned above would have resulted in trees being present there 7,000 years ago. This, in general, conforms with Wright's (1976:84) observation that the pollen evidence "...suggests that the tree margin was closer to the site during the period of occupation than in pre-occupation times and that, therefore, the climate was probably somewhat warmer than when the pre-occupation pollen bearing sediments were deposited."

Similarly, it is probable that the southern edge of the boreal forest was also considerably further north than it is today. According to Mott (1973:14) "open grassland" characterized the Prince Albert region in central Saskatchewan at 53°N, during the early postglacial, and a "parkland type of vegetation similar to that existing in the modern aspen parkland" lay directly to the north. Beyond that, in the Lac La Ronge district (Latitute 55°N), the "parkland" gave way to birch dominated forest (Mott 1973:12).

This northward displacement and distribution of vegetation zones was climatogenic. However, once plant communities had become established, it can be expected that fire acted to produce a mosaic of forest and successional herbaceous and shrub communities. This is implied, for example, by evidence from Lake of the Clouds, Minnesota, where "the charcoal profile shows an increase in influx after 9,500 y.a. reflecting an increase in fire frequency and thus in warmth and dryness...The charcoal levels remain consistently high from 9,000 to 6,000 y.a...." (Swain 1973:395). Also, sediments from Nungesser Lake bog, located just east of the Manitoba-Ontario border about 200 miles north of Lake Nipigon, contain charcoal (Terasme 1967). The fires inferred from such evidence would have created and maintained a "...bison habitat by aiding the regional development of grasslands and setting back the successional sequences of the more pioneering communities." (Schweger 1974:178).

5. ca. 5000 Years BP

By this time all but a small area of Northern Quebec and areas of the mountains of Alaska and the Yukon were ice-free. The Agate Basin complex had disappeared in central Keewatin, being replaced by the Shield Archaic (Gordon 1976). In southwest Yukon, possibly relict occurrences of the complex are found as part of the Champagne phase. MacNeish's (1964) date estimates of ca. 4500 years BP for Champagne may be too young. However, only further work in the region will clarify this problem.

B. <u>Discussion</u>

The foregoing has shown, within the limits of the data, that the Agate Basin complex moved northward at approximately the same rate as the disintegrating glacial ice and the advancing boreal forest. The Agate Basin-Brewster sites, the Mangus site, and the Parkhill site are all situated approximately 950 km south of contemporaneous ice fronts. The Acasta Lake site is 950 km west of the ice, while the Grant Lake site is only approximately 120 km distant. It is during this period when the Agate Basin complex was moving northward that rapid climatic and environmental changes took place. The plains changed from boreal forest to grassland apparently in response to temperature ameleration that was also causing the glacier to melt. The northward spread of the Agate Basin complex may have been in response to the northward spread of grassland and herd animals.

Sometime after 8000 years BP, populations using Agate Basin artifacts penetrated the boreal forest becoming established at Grant Lake, and slightly later, at Acasta Lake. At both sites, there is evidence of adaptation to boreal forest resources.

Of special interest is the fact that the Agate Basin complex persisted for 4,000 years. The reasons for this persistence await experimental technological replication studies, but some suggestions may be advanced as to why the complex lasted so long. First, the tools of the complex may have been both efficient and generalized enough in their form and function to meet a wide variety of needs; and as such, there would be little incentive to change them. Consider the leaf-shaped biface that occurs in the sites discussed and which may have been designed to serve several needs. Their efficiency as projectile points has been experimentally demonstrated by Frison (1978a), and wear studies from Parkhill (Chapter 2) suggest that they were also used as knives. Biface fragments were refurbished as points or used as is, perhaps for scraping or cutting. Consider also that the leaf shape may have lent itself to the efficient use of raw material. Unlike similar artifacts that are shouldered or notched, only a minimal amount of retouch would render a suitable fragment functional once more.

As with the longevity of the Agate Basin complex, its disappearance is also still unexplained. However, one possibility may be suggested. Camut and Acasta points are part of the Acasta Lake assemblage. Morphologically, Acasta points are Agate Basin points with side notches; while Camut points strongly resemble Middle Shield Archaic points from the Migod Site (compare Gordon 1976, Plate 2a, and Noble 1971 Figure 2, j-n).

Wright (1976) suggests that the Shield Archaic developed out of the Agate Basin complex. If this was the case, then perhaps Camut and Acasta points will be found to approximate the morphology of Early Shield Archaic points when they are finally identified.

CHAPTER FIVE

SUMMARY AND CONCLUSIONS

The preceeding chapters have presented:

1. A report of the Parkhill site in southern Saskatchewan.
2. A review of 8 excavated Agate Basin sites to permit comparison among them and Parkhill.
3. A summary of environmental conditions that are thought to have prevailed while the Agate Basin complex was in existence, from 10,000 to 6000 Years BP.

The following major points have emerged:

1. The majority of the artifacts recovered from the Parkhill site are paleo-Indian, with many of them assignable to the Agate Basin complex.
2. Agate Basin artifacts from Parkhill were manufactured in a reduction sequence, with point/bifaces probably functioning as both projectile tips and knives.
3. Broken projectile points were refurbished and reused. Some point/biface fragments were probably used unmodified as scraping or gouging tools.
4. The Parkhill site may have been a seasonal gathering area for nomadic bison hunters.

5. There is a south to north cline in dates for Agate Basin sites, with those in the south being as much as 4,000 years older than those in the north. The Agate Basin and Brewster sites in Wyoming have been dated to 10,000 years BP, while the youngest sites, Acasta and Grant Lake in the Northwest Territories, date to approximately 6000 years BP.
6. Agate Basin sites in the Northwest Territories were probably within the boreal forest at the time they were occupied. At these sites, caribou, bear, and fish remains were recovered.
7. The persistence of the Agate Basin point/biface and related tools for approximately 4,000 years suggest that they were efficient. The Agate Basin point/biface may have persisted so long, in part, because the leaf-shape of the artifact contributes to the efficient use of raw material.
8. Early Shield Archaic points, when they are eventually isolated in the archaeological record, may bear strong resemblance to Acasta and Camut points. Further, this contention suggests that the Early Shield Archaic will be found to have developed from the Agate Basin complex.

Among the topics discussed in this thesis, there are at least three areas in which future work could be directed. These include further investigation at the Parkhill site, research into the northward movement of the Agate Basin complex, and the relationship between Agate Basin and Shield

Archaic. Survey and excavation at Parkhill should focus on gathering several types of data. This should include: information that may ellucidate the environmental conditions that existed at the time the site was occupied, collection of material for radiocarbon dating, and the recovery of plant and animal remains related to subsistence. It would also be valuable to ascertain the season or seasons of occupation, especially in light of Gordon's (1979) proposed seasonal bison movements.

As additional work in the northern plains and boreal forest is conducted, we may better understand the apparent northward movement of the Agate Basin complex. However, until stratified sites are found and excavated, valuable insight may be obtained by comparing the morphology and recording the distribution of Agate Basin and other paleo-Indian artifacts from the surface. From these recoveries, it is possible to compare reduction sequences and tool use patterns, among sites.

Replication studies may confirm much of what has been stated about how raw materials are reduced through various functional stages. Experiments have been conducted that demonstrate that Agate Basin points are efficient weapon tips (Frison 1978a), and these tests need be carried further to demonstrate how artifacts are consumed through use.

Finally, research in the Northwest Territories is needed that bears on the relationship between Agate Basin and Shield Archaic. This research should include investigations into the circumstances surrounding the disappearance of the Agate Basin complex and the emergence of the Shield Archaic. This research would test the prediction that Early Shield Archaic points resemble Acasta and Camut points.

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PLATES

Plate 1. The Parkhill site looking south towards the Missouri coteau on the horizon. The recovery area is between the arrows. The depression extending across the photograph in the centre contains an intermittent stream.

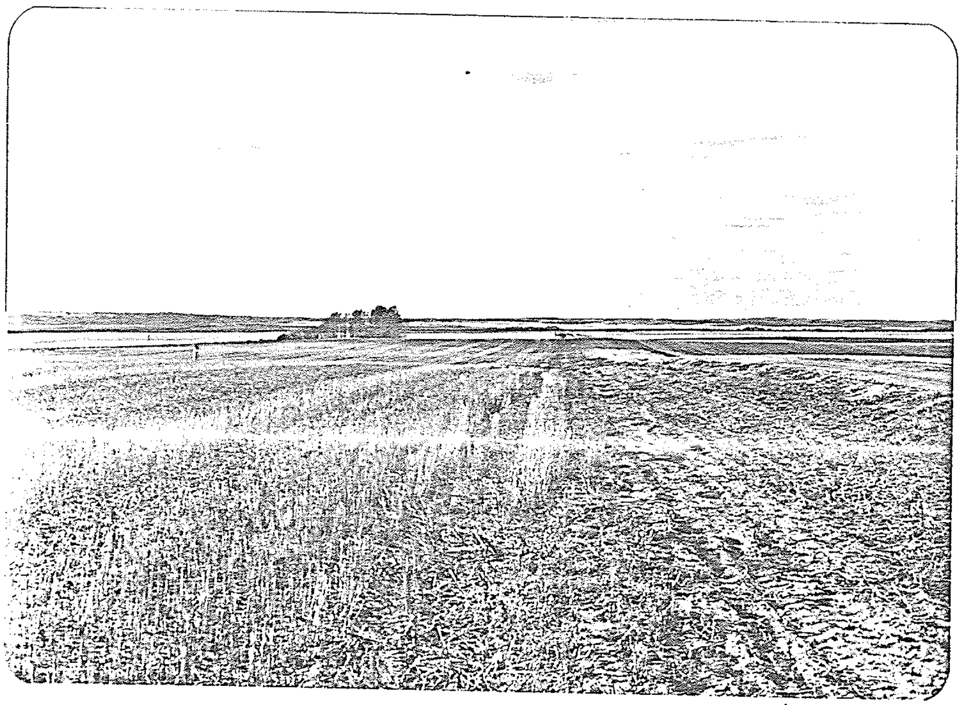

Plate 2. The Parkhill site looking west towards the Missouri coteau escarpment. Artifacts have been recovered from an area extending from the bottom of the photograph to the trees in the near distance, about 500 metres.

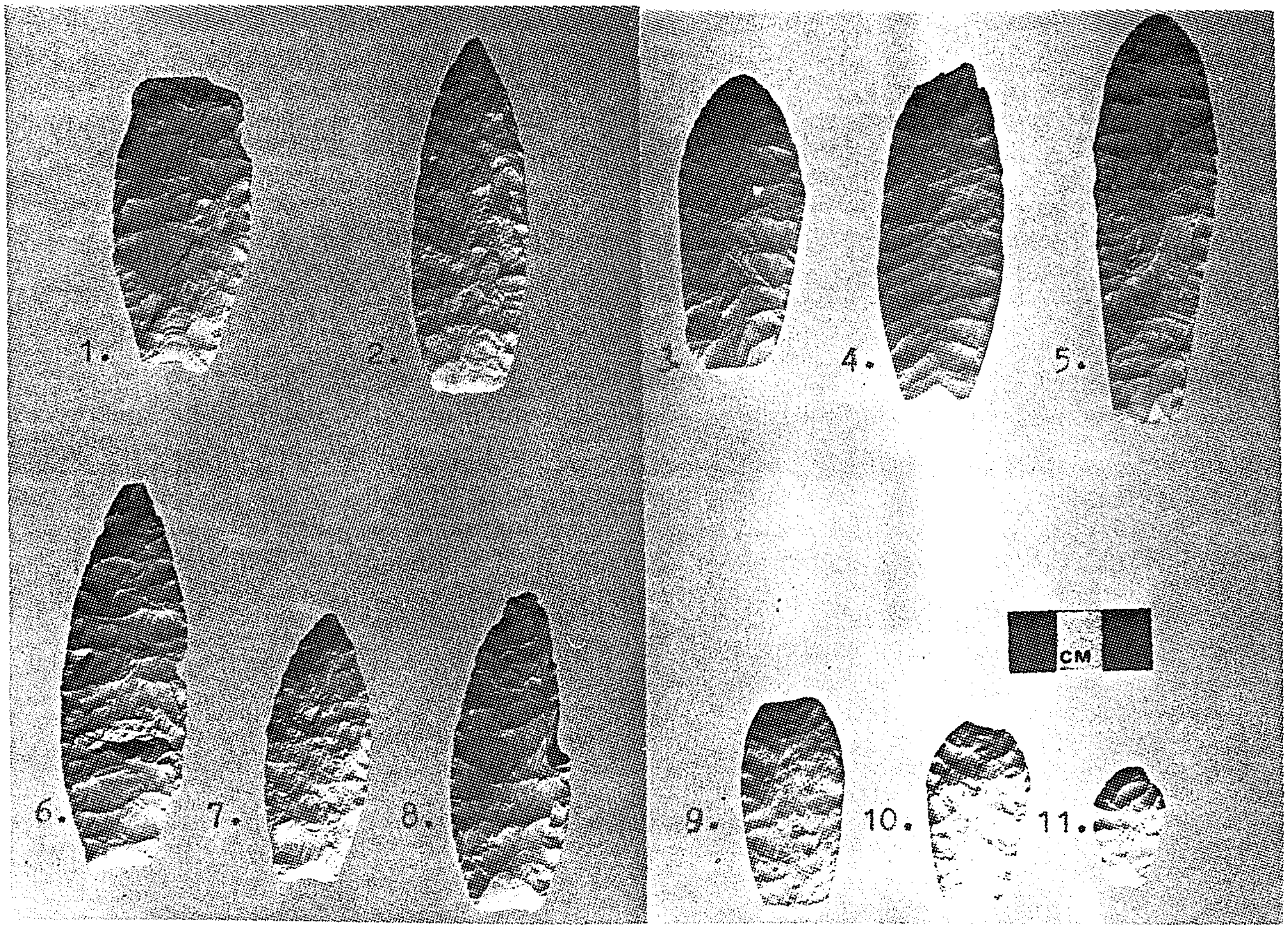

Plate 3. Pointed bifaces Numbers 1, 2, 4, 6, 7, and 8.
Truncated pointed bifaces Numbers 3, 5, 9 to 11.

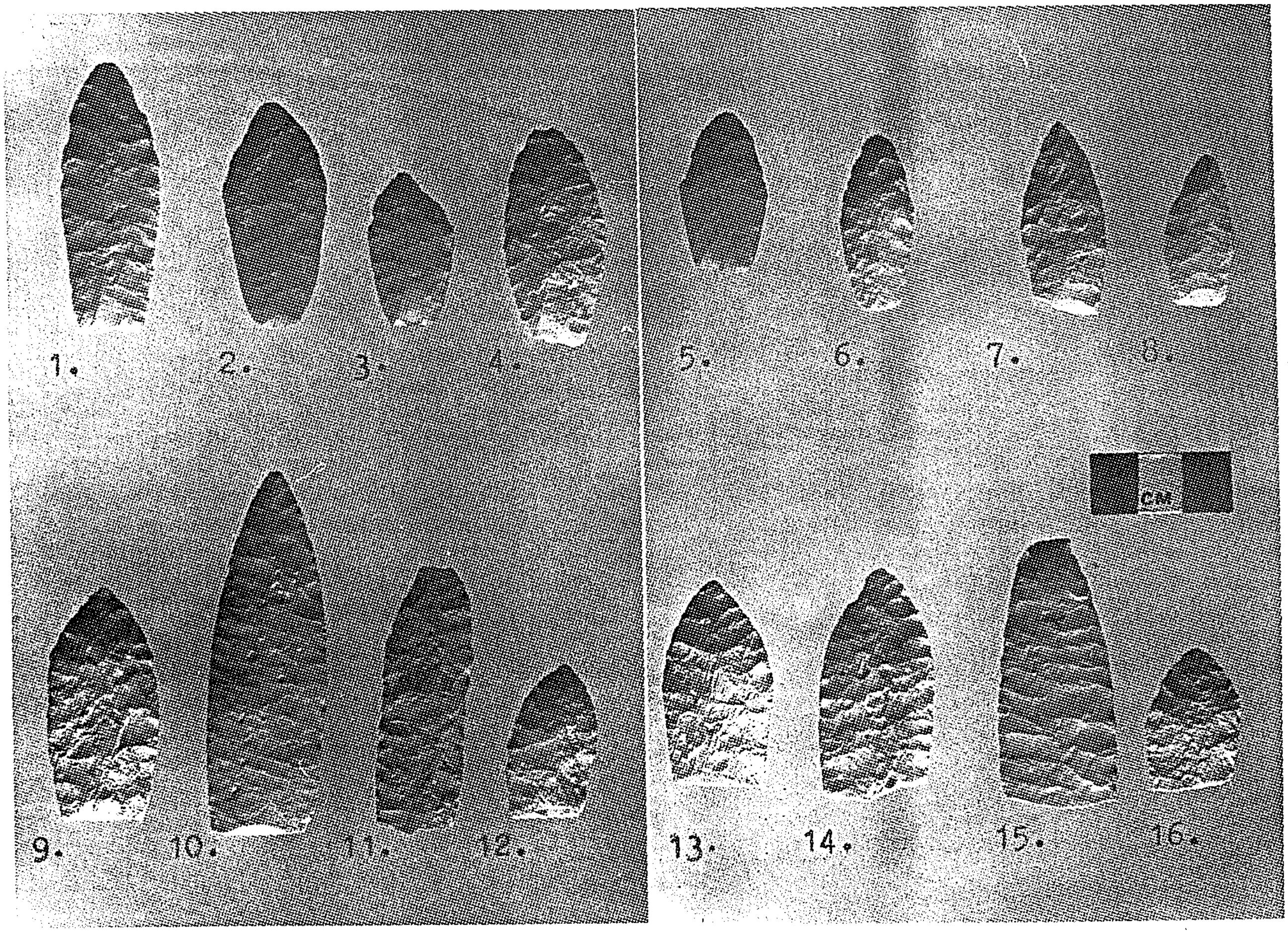

Plate 4. Pointed bifaces Numbers 1, 4, and 6. Truncated pointed bifaces Numbers 2, 3, 5, 7, and 8. Pointed biface fragments Numbers 10, 11, and 16. Truncated pointed biface fragments Numbers 9, 12, 13, 14 and 16.

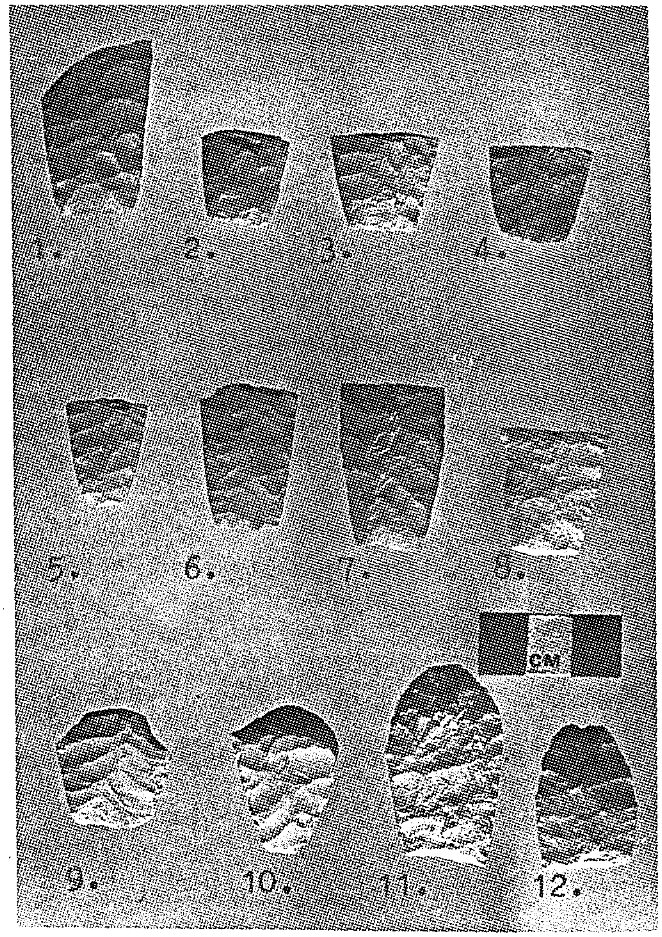

Plate 5. Numbers 1 to 8 pointed biface proximal fragments. Numbers 9 and 10 reworked, pointed biface proximal fragments. Numbers 11 and 12 distal fragments of truncated pointed bifaces.

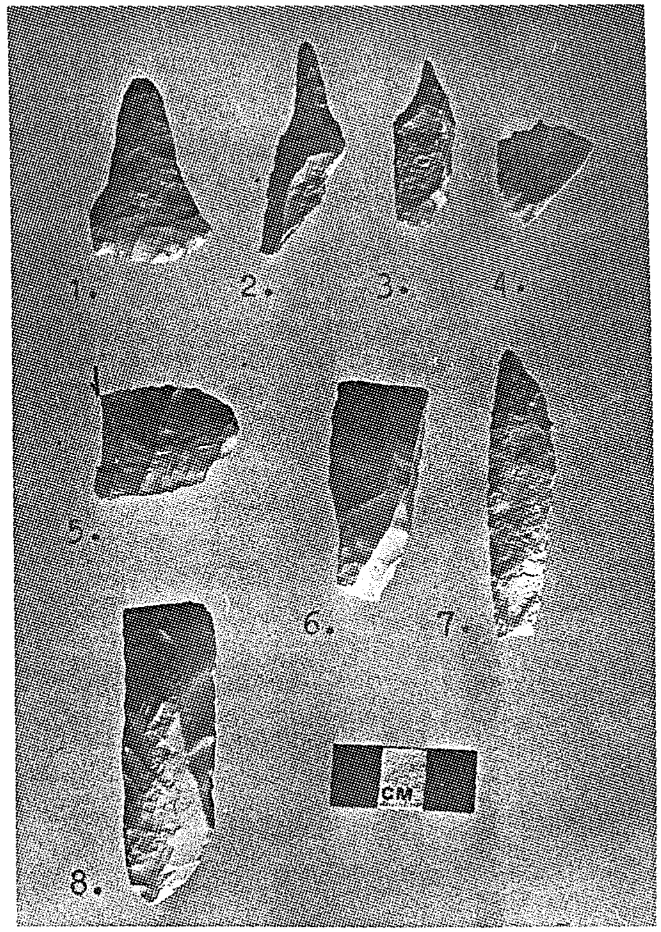

Plate 6. Number 1 Stemmed biface.

Number 2 Beaked biface.

Number 3 Beaked uniface.

Number 4 Spur.

Number 5 Transversly spalled biface.

Number 6 to 8 Laterally flaked blades.

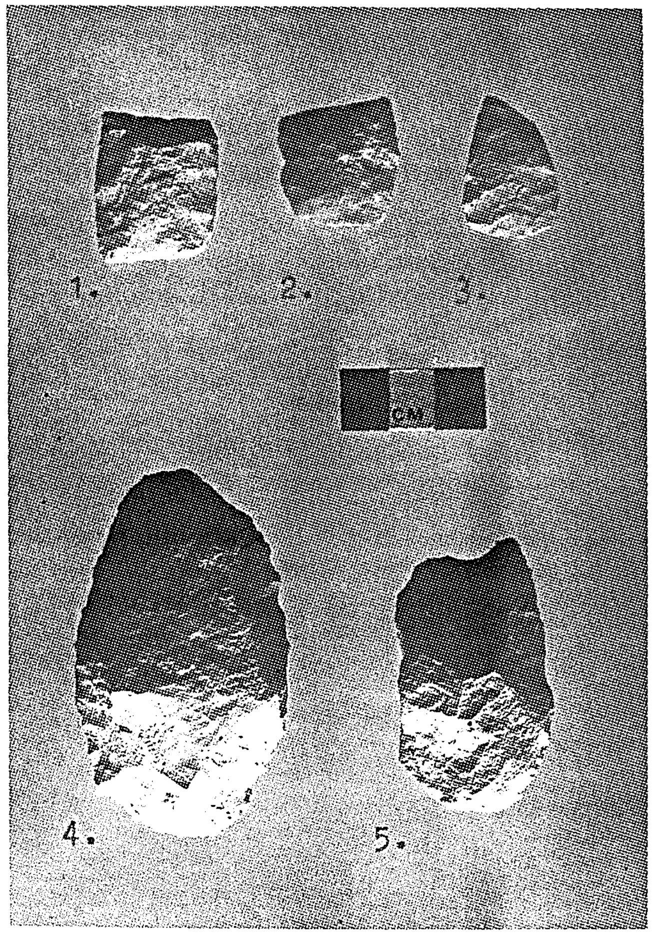

Plate 7. Numbers 1 to 3 Triangular bifaces.

Numbers 4 and 5 Large unifaces.

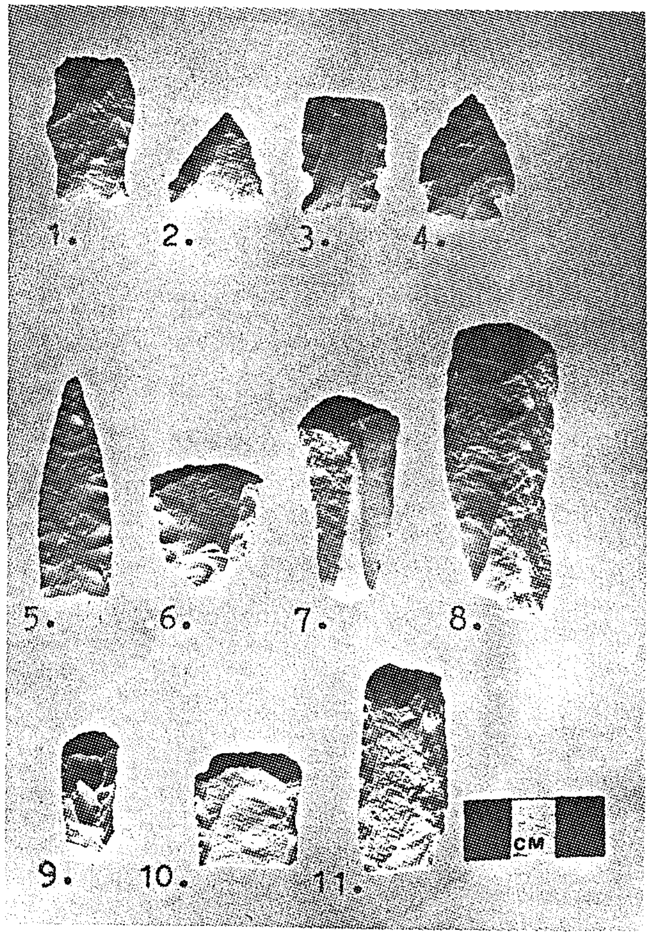

Plate 8. Numbers 1 to 5 Notched pointed bifaces.

Number 6 Beaked transverse uniface.

Numbers 7, 8 and 11 Blades with steep transverse bits.

Number 9 Ridge flake uniface.

Number 10 Tabular uniface.

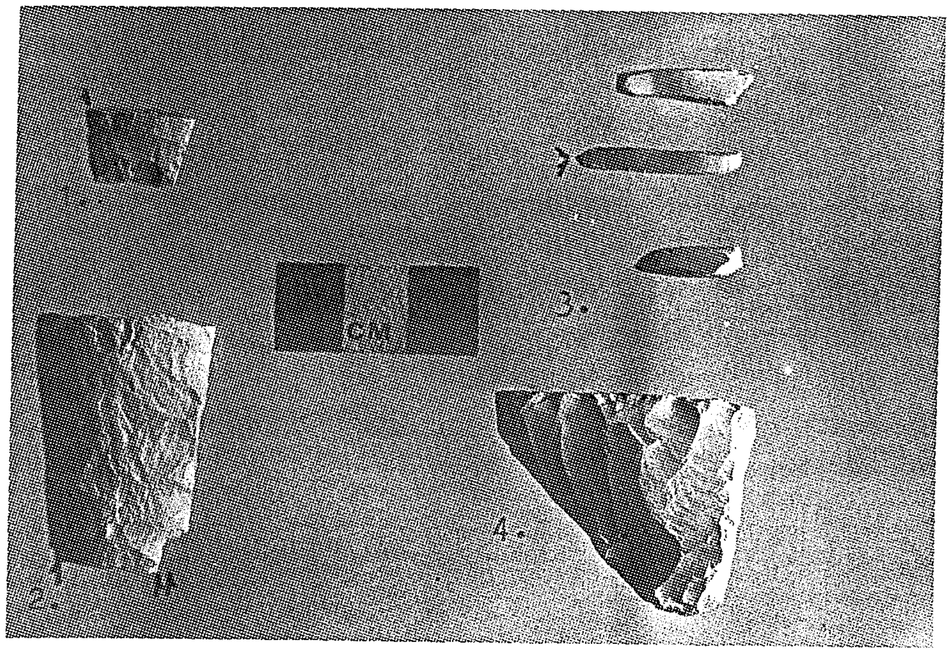

Plate 9. Number 1 Laterally spalled proximal fragment. The arrow shows the direction of spalling.

Number 2 Laterally spalled medial fragment. Note multiple faceting on the base.

Number 3 Spalls. Note faceting on the left end of the middle spall.

Number 4 Micro-blade core. Flake scars are confined to the side shown.

APPENDICES

APPENDIX I

ARTIFACT MEASUREMENTS AND DESCRIPTION

a. Pointed Bifaces

Point No.	a** (mm)	b** (mm)	c** (mm)	d** (mm)	e** (mm)	f** (mm)	Weight (gms.)	Thick-ness (mm)	Material	Plate No.		Remarks
1	N.A.	14.0	28.5	34.0	29.0	36.0		7.0	K.R.F.	3	1	Concave base, patinated distal polish
2	76.5	14.0	23.5	23.5	24.5	34.0	17.0	8.0	Orange & White Chert	3	2	No distal polish
3	64.0	15.5	26.5	40.5	27.0	40.5	15.2	8.5	K.R.F.	3	3	Base incomplete, patinated both surfaces, distal polish
4	78.3*	12.5	26.0	32.0	26.0	32.0		8.0	K.R.F.	3	4	Distal end "burinated" and polished
5	88.0	13.5	26.0	58.0	26.0	58.0	20.6	9.0	K.R.F.	3	5	Blue patina distal polish
6	85.0	13.5	26.0	35.0	26.5	38.0	16.5	7.0	B.C.	3	6	Distal polish, extreme tip missing
7	57.5	12.5	21.5	30.5	22.0	31.0	9.5	6.5	White Chert	3	7	Concave base, distal polish
8	69.0	14.0	25.5	24.5	25.5	25.0	9.0	8.0	B.C.	3	8	Distal polish, patinated
9	52.1*	12.5	20.0	19.0	21.5	28.0		6.0	Limonitic Shale	3	9	Heavily polished, tip missing, with brown patina probably from the Cretatious Beds near East End, Saskatchewan
10	26.5	6.0	15.5	18.0	15.5	18.0		5.5	White Chert	3	10	Reworked distal polish
11	44.1*	11.0	21.5	27.0	27.0	28.0		7.0	Fossiliferous White Chert	3	11	Convex base, tip missing, distal polish

* Estimated length

** See Figure 6

B.C. = Brown Chalcedony

K.R.F.= Knife River Flint

APPENDIX I

Point No.	a	b	c	d	e	f	Weight	Thick-ness	Material	Plate No.	Remarks
12	39.0	18.5	21.0	12.0	21.0	12.0		5.5	B.C.		Reworked - not Agate Basin type, distal polish
13	48.0	9.0	22.0	29.5	22.0	30.0	7.2	7.0	Grey & White Chert	4 2	Convex base, no distal polish, mottled fossiliferous
14	33.5	9.0	18.0	21.0	18.0	21.0		6.5	K.R.F.	4 3	Reworked, distal crushing
15	48.0	11.0	21.0	19.0	22.0	21.5	8.5	8.0	Grey Quartzite	4 4	Extreme tip missing, distal polish
16	34.0	10.5	18.0	18.0	18.0	18.0	3.8	6.0	K.R.F.	4 5	Reworked, distal polish
17	37.5	8.0	15.0	20.0	15.5	20.5	3.8	7.0	White Chert	4 6	Convex base, no distal polish
18	41.0	13.0	--	--	18.0	18.0	6.3	8.0	Orange Chert	4 7	Reworked, basal corner missing, not ground, no distal polish
19	33.0	10.5	13.5	9.0	15.0	15.0	2.9	5.5	White Chert	4 8	"Domed" profile, lengthwise cross-section, distallaterally surfacial polish
<u>Distal Fragments</u>											
20	--	--	20.5	--	23.5	--		8.0	Yellow & White Chert	4 9	Shouldered from grinding, distal polish
21	--	--	--	--	24.5	--		8.0	K.R.F.	4 10	Parallel diagonal flaking upper left to lower right, heavily patinated, slight distal polish(?)

APPENDIX I

Point No.	a	b	c	d	e	f	Weight	Thick-ness	Material	Plate No.	Remarks
22	--	--	19.5	--	21.0	--		6.5	Grey Chert		Fracture polish*
23	--	--	18.0	--	19.0	--		6.5	Fine Grained Pink Quartzite	4 11	Distal polish
24	--	--	24.5	--	25.0	--		9.0	Grey Brown Quartzite		Distal polish, fracture polish
25	--	--	19.5	--	20.5	--		7.0	Yellow Chert		Distal polish, fracture polish, proximal end laterally spalled
26	--	--	23.5	--	23.5	--		8.0	Cream Coloured Chert	4 13	Distal polish one side, fracture polish
27	--	--	24.0	--	24.0	--		7.5	Pink Chert	4 14	No polish
28	--	--	--	--	17.0	--		7.0	Porcelainite		Polished surface, marginal retouch, heavily sand blasted, not Agate Basin (?)
29	--	--	--	--	22.0	--		--	Pink Ghert		Distal polish intermittent, hafting element completely gone
30	--	--	--	--	25.0	--		--	K.R.F.		No distal polish, parallel flaking, hafting element missing
31	--	--	--	--	30.0	--		10.5	White & Grey Chert		No distal polish, hafting element missing
32	--	--	20.5	--	21.0	--		6.5	Grey chert Quartzite	4 16	No distal polish

* See e., page 35 and Figure 8, Page 36.

APPENDIX I

Point No.	a	b	c	d	e	f	Weight	Thick-ness	Material	Plate No.	Remarks
33	--	--	--	--	--	--		--	K.R.F.		"Eden"(?) point, base missing, slight distal polish (?)
34	--	--	23.5	--	24.0	--		6.0	White Chert		No distal polish
35	--	--	20.0	--	20.5	--		6.5	Grey & Brown Chert		Distal polish
36	--	--	--	--	--	--		8.0	Grey Quartzite		Distal polish, hafting element missing
37	--	--	--	--	--	--		--	White & Grey Chert		Slight distal polish, distal end laterally spalled
38	--	--	--	--	--	--		--	White Chert		Distal polish
39	--	--	--	--	--	--		--	Yellow Chert		Heavy distal polish
40	--	--	--	--	--	--		--	White Chert		Heavy distal polish
41	--	--	--	--	--	--		--	White, Grey & Red Chert		No distal polish
42	--	--	--	--	--	--		--			Identity of material impossible likely due to burning
43	--	--	--	--	--	--		--	Orange Chert		
Mid-Sectional Fragments											
44	--	--	30.0	--	30.5	--		8.0	White & Brown Chert		

APPENDIX I

Point No.	a	b	c	d	e	f	Weight	Thick-ness	Material	Plate No.	Remarks
45	--	--	--	--	--	--		--	Light Pink Chert		
46	--	--	--	--	--	--		--	White Chert		Fracture polish
47	--	--	--	--	--	--		--	Brown Streaked Fossil Wood		Fracture polish
48	--	--	22.5	--	--	--	--	--	Pink Chert		
49	--	--	--	--	--	--		--	Pink Chert		Fracture polish, distal end
50	--	--	21.5	--	22.5	--		8.5	K.R.F.		
51	--	--	29.0	--	31.5	--		10.5	Pink Chert		Fracture polish basal end
52	--	--	--	--	--	--		--	Pink Chert		
53	--	--	--	--	--	--		--	Pink & Orange Chert		Some fracture polish, restricted to corner
54	--	--	--	--	--	--		--	Pink Chert		Hafting element only
55	--	--	--	--	--	--		--	Red Quartzite		Fracture polish
56	--	--	--	--	--	--		--	Grey Chert		
57	--	--	--	--	--	--		--	Orange Chert		Hafted element only, laterally spalled proximal end
58	--	--	--	--	--	--		--	Cream Chert	9 2	Laterally spalled proximal end

APPENDIX I

Point No.	a	b	c	d	e	f	Weight	Thick-ness	Material	Plate No.	Remarks
59	--	--	--	--	--	--		--	Red & White Mottled Chert		Lateral spalls at both ends, fracture polish one side of base
60	--	--	--	--	--	--		--	Brown & White Chert		Three lateral spalls removed from base
61	--	--	--	--	--	--		--	Red Quartz Breccea		Extremely weathered
62	--	--	--	--	--	--		--	Burned K.R.F. (?)		
63	--	--	21.5	--	--	--		--	Cream Chert		Fracture polish on proximal end
64	--	13.2	--	--	--	--		--	Pink & Grey Chert		Base unthinned
65	--	--	--	--	--	--		--			Burned
66	--	15.0	--	--	--	--		--	Dark Red Chert		Base fragment, not thinned
67	--	--	--	--	--	--		--	Cream Chert		Fracture polish on base
68	--	--	--	--	--	--		--	Cream Chert		Laterally spalled with wear on the corner formed by the spall
69	--	--	--	--	--	--		--	K.R.F. (?)		Burned
70	--	--	--	--	--	--		--	Undetermined		Burned
71	--	--	--	--	--	--		--	Cream Chert		Fracture polish

APPENDIX I

Point No.	a	b	c	d	e	f	Weight	Thick-ness	Material	Plate No.	Remarks
72	--	--	--	--	--	--		--	White Chert		
73	--	--	--	--	--	--		--	K.R.F.		Patinated
74	--	--	--	--	--	--		--	Orange Chert		Distal Polish
<u>Proximal Fragments</u>											
75	--	10.0	--	--	--	--		--	White Chert		
76	--	13.0	--	--	--	--		--	White Chert		Fracture polish
77	--	14.0	--	--	--	--		--	Pink Chert		Fracture polish
78	--	11.0	--	--	--	--		--	White Chert		Fracture polish
79	--	13.5	--	--	--	--		--	White Chert		
80	--	12.5	--	--	--	--		--	K.R.F.		Patinated white
81	--	17.0	--	--	--	--		--	K.R.F.		Parallel diagonal flaking upper left to lower right, concave base
82	--	11.0	--	--	--	--		--	K.R.F.		Heat fractured (?)
83	--	13.5	--	--	--	--		--	Orange & White Chert		
84	--	11.0	--	--	--	--		--	Moss Agate		
85	--	12.5	--	--	--	--		--	Cream Chert		Not ground
86	--	15.0	--	--	--	--		--	Cream Chert		

APPENDIX I

Point No.	a	b	c	d	e	f	Weight	Thick-ness	Material	Plate No.	Remarks
87	--	10.0	--	--	--	--		--	White & Brown Chert		
88	--	14.5	--	--	--	--		--	White Chert		
89	--	11.0	--	--	--	--		--	White Chert		Faces show polish
90	--	11.0	--	--	--	--		--	White Chert		
91	--	14.0	--	--	--	--		--	Pink Chert		Laterally spalled distal end, fracture polish
92	--	15.5	--	--	--	--		--	Orange & White Chert		
93	--	14.0	--	--	--	--		--	K.R.F.		
94	--	--	--	--	--	--		--	Pink Chert		Base completed but too convex to permit measurement
95	--	15.0	--	--	--	--		--	K.R.F.		One basal corner missing
96	--	11.5	--	--	--	--		--	K.R.F.		
97	--	11.5	--	--	--	--		--	Cream Chert		Fracture polish one side
98	--	15.0	--	--	--	--		--	White Chert		Laterally spalled distal end, fracture polish
99	--	13.5	23.0	35.0	25.0	46.0		8.0	Blue & Grey Chert		Fracture polish on base fragment

APPENDIX I

Point No.	a	b	c	d	e	f	Weight	Thick-ness	Material	Plate No.	Remarks
100	--	16.0	--	--	--	--		--	K.R.F.	5 1	Laterally spalled distal end, fracture polish
101	--	13.0	--	--	--	--		--	K.R.F.		
102	--	12.0	--	--	--	--		--	White Chert	9 1	Laterally spalled distal end, fracture polish
103	--	11.0	--	--	--	--		--	White Chert		
104	--	14.0	--	--	--	--		--	White Chert		Laterally spalled distal end, fracture polish
105	--	15.0	--	--	--	--		--	K.R.F.		
106	--	13.0	--	--	--	--		--	Grey (?)		
107	--	14.0	--	--	--	--		--	Black Quartzite		
108	--	14.0	--	--	--	--		--	Orange Chert	5 4	
109	--	9.0	--	--	--	--		--	K.R.F.	5 5	
110	--	13.0	--	--	--	--		--	K.R.F.		
111	--	13.0	--	--	--	--		--	Grey Quartzite	5 7	Completely polished likely as a result of sand blast
112	--	15.0	26.0	32.0	--	--		--	Pink Chert		
113	--	14.0	--	--	--	--		--	White Chert	5 8	

APPENDIX I

Point No.	a	b	c	d	e	f	Weight	Thick-ness	Material	Plate No.	Remarks
114	--	14.0	--	--	--	--		--	Burned K.R.F. (?)		One basal corner missing
115	--	14.0	--	--	--	--		--	Porcelainite		Extremely heavily sand blasted
116	--	20.0	--	--	--	--		--	K.R.F.		Patinated
117	--	17.0	--	--	--	--		--	K.R.F.		Heavily patinated
118	--	10.5	--	--	--	--		--	White Chert		
119	--	11.0	--	--	--	--		--	Pink Chert		One basal corner missing
120	--	15.0	--	--	--	--		--	K.R.F.		Burned, one basal corner missing
121	--	13.0	--	--	--	--		--	White Chert		Not thinned basally
122	--	18.5	--	--	--	--		--	White Chert		
123	--	12.0	--	--	--	--		--	K.R.F.		Burned, not thinned basally
124	--	16.0	--	--	--	--		--	K.R.F.	5 9	"Transverse Burin"
125	--	8.0	--	--	--	--		--	K.R.F.	5 10	"Transverse Burin," patinated
126	--	--	--	--	--	--		--	Pink Chert		Base complete but too convex to measure
127	--	12.6	--	--	--	--		--	White Chert		
128	--	--	19.0	--	--	--		6.4	Pink & Orange Chert		

APPENDIX I

Point No.	a	b	c	d	e	f	Weight	Thick-ness	Material	Plate No.	Remarks
129	--	--	--	--	--	--			Burned K.R.F. (?)		
130	--	--	--	--	--	--			Burned K.R.F. (?)		
131	--	--	--	--	--	--			Burned K.R.F. (?)		
132	57.6	13.5	--	--	21.1	30.0	8.7	7.0	Yellow Chert	4 1	Distal lateral edge has more polish than basal lateral edge
133	--	--	25.0	--	25.0	--	--	7.0	Orange Chert	5 11	Distal edge reworked, laterally spalled proximal end
134	--	--	21.4	--	21.4	--	--	7.0	Pink Chert		Distal end reworked
135	26.5	7.0	15.0	15.0	15.0	15.0	2.0	5.0	Pink Chert		Distal end reworked
136	--	13.6	--	--	--	--	--	--	Yellow Chert		Small retouch flakes at fracture with polish
137	--	--	26.8	29.2	27.0	9.0	--	--	Yellow Chert		Polish on all lateral edges
138	--	--	--	--	--	--	--	--	Grey Chert		Base convex
Total	17	75	39	22	43	23	13	42			
Mean Average	52.355	13.4	22.1	25.6	23.1	27.1	9.1	7.3			

APPENDIX I

b. Transverse Unifaces

Artifact No.	Type	Maximum Thickness (mm)	Maximum Length (mm)	Maximum Width at Distal End (Work Surface) (mm)	Material	Remarks
1	Type 1 "Beaked" (Irwin & Wormington 1970:26)	8.0	29.0	21.5	K.R.F.	Two "beaks"
2		6.0	26.5	24.0	Yellow Chalcedony	Beak on right side only, patinated
3		6.5	25.0	22.0	Pink Chert	Beak on left side only
4		6.0	32.5	18.5	White Chert	Beak on right side, chip broken from left side
5		9.0	41.0	20.5	K.R.F.	Two beaks
6		8.5	37.5	24.0	White & Pink Chert	Two beaks
7		4.5	24.0	17.0	K.R.F.	Two beaks
8		5.5	24.5	17.0	K.R.F.	Two beaks
9		6.0	28.0	19.0	Orange Chert	Two beaks
10		5.0	19.0	18.0	Grey & Orange Chert	One beak - right side
11		6.0	27.0	18.0	K.R.F.	One beak - left side
12		5.0	22.0	21.0	K.R.F.	Two beaks
13		5.5	32.0	19.0	K.R.F.	One beak - left side
14		5.5	25.0	21.0	K.R.F.	Two beaks
15		6.0	33.5	16.0	K.R.F.	Two beaks
16		5.0	23.0	26.0	K.R.F.	One beak-left side, made on short, broad, thin flake

APPENDIX I

Artifact No.	Type	Maximum Thickness (mm)	Maximum Length (mm)	Maximum Width at Distal End (work surface) (mm)	Material	Remarks
17		4.0	23.0	20.0	K.R.F.	One beak - right side
18		5.0	21.0	19.0	White Chert	One beak - right side
19		10.0	25.0	27.0	K.R.F.	Two beaks - broad cutting edge
20		6.0	23.5	18.0	K.R.F.	Two beaks
21		4.5	23.0	15.5	K.R.F.	Two beaks
22		4.0	25.0	24.5	Orange & Pink Chert	One beak - left side only
23		6.5	25.0	18.0	K.R.F.	One beak - right side
24		5.0	20.0	19.0	K.R.F.	One beak - left side
25		7.0	22.0	23.0	K.R.F.	Two beaks
26		7.0	27.0(?)	20.0	Burned K.R.F.(?)	One beak - right side, somewhat fragmentary
27		5.0	--	19.5	K.R.F.	Two beaks, broken at butt end
28		9.0	27.0	21.7	Pat.K.R.F.	Made on blade
29		6.6	29.9	26.5	Pat.K.R.F.	Polish on beak
30		3.5	21.5	16.3	Pat.K.R.F.	Polish on lateral edges
31	Type 2 Transverse Unifaces 17 - large (Irwin & Wormington 1970:26 & 29)	8.0	43.0	26.0	Grey & White Chert	
32		12.0	41.5	24.0	K.R.F.	Beak on right side - not too pronounced
33		11.0	49.0	22.0	Cream Chert	

APPENDIX I

Artifact No.	Type	Maximum Thickness (mm)	Maximum Length (mm)	Maximum Width at Distal End (work surface) (mm)	Material	Remarks
34		12.0	41.0	21.0	K.R.F.	Graver tip? on butt end
35		10.0	42.0	25.0	White Chert	
36		12.0	47.0	26.5	Orange & Yellow Chert	
37		11.5	34.0	25.0	Yellow Chert	
38		10.8	64.2	22.0	Grey Chert	Dorsal side heavily polished
39		13.4	44.0	21.6	Grey Chert	Dorsal side polished
40		28.0	28.3	12.0	Pink & White Chert	Made on a flake removed from lateral edge of a biface
41	Type 3 Tabular Unifaces. Thin, flat blade, butt broken, parallel sided, flat top.	3.0	18.5	20.5	K.R.F.	Maximum length taken to broken base - breaking may be intentional?
42		5.0	25.0	22.5	K.R.F.	
43		3.5	19.0	20.0	Red Porcelainite	
44		5.5	22.0	23.5	Grey Chert	Max. thickness caused by convex fragments
45		5.0	23.0	21.0	K.R.F.	
46		3.0	16.0	17.0	K.R.F.	
47		4.0	17.0	18.0	Translucent White Chalcedony	

APPENDIX I

Artifact No.	Type	Maximum Thickness (mm)	Maximum Length (mm)	Maximum Width at Distal End (work surface) (mm)	Material	Remarks
48		5.0	19.0	25.0	K.R.F.	
49		7.0	21.0	25.5	Pink Chert	
50		4.0	20.5	20.0	Pink Chert	
51		4.0	15.5	17.0	K.R.F.	
52		3.0	16.5	16.0	K.R.F.	
53		3.5	16.0	17.0	K.R.F.	
54		4.0	17.0	21.0	K.R.F.	
55		3.0	17.0	18.0	K.R.F.	
56		2.0	13.5	15.5	K.R.F.	
131		4.5	18.5	17.5	White Chert	
61	Type 4, Blade with steep transverse bits on end of blade, more of less parallel sided	10.0	53.0	19.0	Brown Fossil Wood	
62		8.0	39.0	10.0(?)	K.R.F.	Frag. missing from left side
63		9.0	46.0	16.0	Grey Chert	"Beak" tip on right side, with inclusions of Magnatite Quartz and Hematite
64		7.0	42.0	24.0	Yellow Chert	
65		4.0	30.0	19.0	K.R.F.	Patinated
66		5.0	31.5	19.0	Purple Jasper	Retouch on all margins
67		6.0	--	24.0	K.R.F.	Butt end snapped off, doubl ridge on dorsal surface

APPENDIX I

Artifact No.	Type	Maximum Thickness (mm)	Maximum Length (mm)	Maximum Width at Distal End (work surface) (mm)	Material	Remarks
68		10.0	27.0	19.0	K.R.F.	Beak on right side, double ridge on dorsal surface
69		5.0	20.0(?)	19.0	K.R.F.	Butt end snapped off, single dorsal ridge
70		5.5	26.0	22.0	Yellow Chert	
71		6.0	28.0	18.5	Yellow Chert	
72		9.0	33.5	23.0	Yellow Chert	
73		5.0	22.0	19.0	Yellow Chert	
74		4.0	21.0	18.0	K.R.F.	
75		6.0	29.0	19.0	Yellow Chert	
76		4.5	26.0	21.0	Yellow Chert	
77		8.0	27.5	17.5	K.R.F.	Patinated
78		8.0	26.0	18.5	Grey Fossil Wood	
79		5.5	26.5	17.5	Pink Chert	
80		4.2	17.0	21.0	K.R.F.	Patinated
	Miscellaneous					
81		6.5	29.0	22.0	Yellow & Pink Chert	
82		7.0	28.5	19.0	Burned K.R.F. (?)	
83		10.0	34.0	17.0	White Chert	
84		11.0	29.0	24.0	K.R.F.	Patinated

APPENDIX I

Artifact No.	Type	Maximum Thickness (mm)	Maximum Length (mm)	Maximum Width at Distal End (work surface) (mm)	Material	Remarks
85		5.5	27.0	18.5	K.R.F.	
86		6.0	27.0	20.0	K.R.F.	
87		5.0	31.0	21.0	K.R.F.	Patinated
88		5.5	23.0	18.0	Burned K.R.F.	
89		8.0	26.0	22.0	Black Quartzite	
90		5.5	23.5	19.0	K.R.F.	
91		7.0	24.0	17.5	K.R.F.	
92		5.5	24.0	17.0	White Chert	
93		8.5	31.0	19.0	Grey Chert	
94		8.0	24.0	16.0	White Chert	
95		6.5	24.0	17.5	White Chert	
96		5.0	23.5	22.0	K.R.F.	
97		7.0	24.0	21.0	Yellow Jasper	
98		6.0	22.0	16.5	B.C.	
99		6.5	27.5	18.0	K.R.F.	Patinated
100		7.0	33.0	16.0	Cream & Red Chert	
101		5.5	20.0	17.5	Yellow Chalcedony	
102		7.5	19.0	17.0	K.R.F.	Patinated
103		9.0	20.0	17.0	Yellow Chalcedony	

APPENDIX I

Artifact No.	Type	Maximum Thickness (mm)	Maximum Length (mm)	Maximum Width at Distal End (work surface) (mm)	Material	Remarks
104		6.0	24.0	12.5	Yellow Jasper	
105		8.0	21.0	19.0	K.R.F.	Patinated
106		11.0	25.0	17.5	Burned K.R.F.(?)	
107		6.5	24.0	20.0	Burned K.R.F.(?)	
108		7.0	19.0	23.0	K.R.F.	
109		6.5	18.5	18.5	K.R.F.	Butt end snapped off
110		8.0	22.0	23.5	White Chert	
111		7.5	19.0	23.5	Pat.Chal.	Made on short broad flake
112		9.0	22.0	21.0	Burned Chal.	
113		6.0	21.0	15.5	K.R.F.	Patinated
114		10.0	22.5	21.0	Yellow & Pink Chert	
115		5.0	29.0	19.0	K.R.F.	Patinated
116		6.5	--	23.0	Burned?	Butt end fractured
117		8.0	33.5	15.0	Orange & Grey Chert	
118		12.0	21.5	22.0	Yellow Chert	
119		4.0	18.0	16.0	Black Chal.	
120		4.0	15.0	13.0	B.C.	Butt end snapped off
121		5.0	--	15.5	White & Orange Chert	Butt end fractured

APPENDIX I

Artifact No.	Type	Maximum Thickness (mm)	Maximum Length (mm)	Maximum Width at Distal End (work surface) (mm)	Material	Remarks
122		4.5	12.0	16.0	Brown Fossil Wood	
123		3.0	19.5	15.0	K.R.F.	
124		4.0	20.0	18.0	K.R.F.	
125		5.5	--	19.0	K.R.F.	Butt end snapped off
126		5.0	21.0	--	White Chert	Part of worked end fracture
127		7.0	21.0	16.5	Brown & White Fossil Wood	Beak on right side
128		5.0	20.0	19.5	B.C.	
129		6.0	--	16.0	Black Chal.	Butt end fractured
130		5.0	--	--	Black Chal.	Left side fractured
131		8.0	20.0	19.0	Yellow & White Chal.	
132		6.5	27.0	18.5	Yellow Chert	
133		10.7	33.5	21.4	K.R.F.	Patinated
134		11.0	28.0	18.5	Yellow Chert	Lateral edge heavily polished
135		4.0	13.0	16.8	Grey Chert	
136		5.0	23.0	15.0	Red Fossil Wood	
137		6.5	19.5	25.5	White Chert	

APPENDIX I

c. Spall Tools

No.	Plate	No.	Length (mm)	Width (mm)	Thickness (mm)	Material	Remarks
1	9	3	16.0	5.0	2.5	B.C.	One end polished
2	9	3	21.0	5.5	2.5	K.R.F.	One end steeply flaked with polish at edge
3	9	3	25.0	4.0	2.0	B.C.	Worked tip. A tiny projection at one end shows polish
Laterally flaked blades							
4	6	7	24.0	7.0	5.5	Pink Chert	Burned, bladelike
5	6	6	24.5	9.0	5.5	B.C.	Bladelike
6	6	8	21.0	9.0	3.0	Grey Chert	Tapered, worked on one side

d. Transverse spalled biface

No.	Plate	No.	Maximum Length (mm)	Maximum Width at Burinated End (mm)	Maximum Thickness (mm)	Length of Burin Spall (mm)	Thickness at Burinated End (mm)	Material
1	6	5	31.0	22.5	6.0	15.0	3.0	Brown Fossil Wood

APPENDIX I

e. Beaked bifaces and unifaces

No.	Plate	No.	Length (mm)	Width (mm)	Thickness (mm)	Material	Remarks
1	6	1	40.1	25.0	6.1	Brown Fossil Wood	No wear on "Bit" "Stemmed biface"
2	6	3	47.0	14.4	4.0	Patinated K.R.F.	Unifacially flaked "beaked uniface"
3	6	2	36.3	13.2	7.2	Burned K.R.F.(?)	Polish on point "Beaked biface"
f. Spurs							
1			17.0	23.5	4.0	Pink & White Chert	Two beak-like projections with polish
2	6	4	40.3	35.7	4.6	K.R.F.	Two beak-like projections, small retouch between beaks
3			32.0	39.4	11.1	K.R.F.	
g. Miscellaneous Points							
1	8	1	31.8	18.0	6.5	Grey Chert	Duncan Point
2	8	2	20.0	20.0	4.5	White Chert	Oxbow-like
3	8	3	--	17.3	4.7	Brown Fossil Wood	Oxbow-like
4	8	4	27.5	20.5	5.2	Yellow Quartzite	Besant-like
5	8	5	--	15.4	5.1	Porçelainite	

Appendix II

Levi	Agate Basin	Casper	Hell Gap	Mangus	Parkhill	Acasta Lake	Grant Lake	Champagne	Artifact Category	
X	X				X			X	Concave Base	Agate Basin Points/Bifaces
	X	X	X	X	X	X	X	X	Convex Base	
X	X	X	X	X	X	X	X	X	Flat Base	
X	X	X	X	X	X	X	X	X	Ground Basal Lateral Edge	
					X				Utilized, Unmodified Biface Fragments	
X	X				X	X	X		Laterally Spalled Biface Fragments	
					X			X	Attrition on Distal Lateral Edge	
	X	X			X			X	Truncated, Points/Bifaces	
						X			Acasta Points	
						X			Camut Points	
					X	X			Reworked Proximal Fragments	
X					X				---Transverse Spalled Biface	
			X		X	X			---Beaked Biface	
X	X	X	X		X		X	X	---Blade Tools	
					X				Microblade Core	
								X	Microblade	
					X				Laterally Flaked Blade	
					X			X	Blade with Steep Transverse Bit	
X					X			X	---Spalls	
				X	X			X	---Tabular Unifaces	
			X		X			X	---Beaked Transverse Uniface	
					X				---Ridge Flake Uniface	
				X	X			X	---Beaked Uniface	
X			X	X	X	X	X	X	---Spur	
								X	---Tongue Shaped Polyhedral Core	

Appendix II (Continued)

Levi	Agate Basin	Casper	Hell Gap	Mangus	Parkhill	Acasta Lake	Grant Lake	Champagne	Artifact Category
								X	--- Conical Polyhedral Core
								X	--- Fibula Awl
								X	--- Fort Liard Burin
								X	--- Rib Bone Point
								X	--- Keeled End Scraper
				X			X	X	--- Chi-Tho
								X	--- Ovoid End Scraper
								X	--- Flat Topped Scrapers
								X	--- Split Pebble Choppers
								X	--- Net Sinkers
X						X			--- Thick Bi-pointed Bifaces
X				X		X			--- Stemmed Points
	X	X			X				--- Hell Gap Points
		X					X		--- Stemmed Scrapers
X						X		X	--- Scraper Planes
	X					X	X		--- Semi-lunar Bifacial Knives
	X	X	X	X			X		--- Flake Tools
X			X			X			--- Drills
X			X			X	X		--- Spoke Shaves
X			X						--- Needles
			X						--- Eyed Needles
X									--- Stone Awl
	X	X							--- Bone Butchering Tools
X									--- Levi Knife 2
X	X								--- Levi Scraper 1
X	X								--- Levi Scraper 3
X									--- Levi Scraper 4

Appendix II (Continued)

Levi	Agate Basin	Casper	Hell Gap	Mangus	Parkhill	Acasta Lake	Grant Lake	Champagne	Artifact Category
X									--- Levi Burin 1
X									--- Levi Burin 2
X				X					--- Hand Grinding Stone
X									--- Seed Grinding Slab
X				X			X		--- Hammer Stones
				X					--- Pyriform Bifaces
				X					--- Subrectangular Scraper
							X		--- Wedges
			X				X		--- Asymetrical Scrapers
							X		--- Adze
							X		--- Graver-on-a-Point
	X		X				X		--- Denticulates (Saws)

APPENDIX III

Using the Spearman's rank-order correlation coefficient, a test was run to determine if the relationship between the geographical position of seven Agate Basin sites correlates with their dates. By inspection, the seven sites were ranked from one to seven based on their latitude; the furthest south ranking one, and furthest north ranking seven (see table). The dates for the sites were similarly ranked with the oldest ranked one and the latest ranked seven. If more than one date was available for a given site, the dates were averaged, and that date was ranked.

Spearman's Rank Order Correlation Coefficient is defined as:

$$r_s = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$

where d_i is the raw difference between the rankings of the variate pair and n is the total number of pairs. Spearman's r ranges from +1 for a perfect positive correlation to -1 for a perfect negative correlation (Thomas 1976).

A table was prepared as follows, and the values obtained substituted into the formula.

Site	Rank (Latitude)	Rank (Date)	d_i	d_i^2
Levis	1	3	-2	4
Agate Basin	2	2	0	0
Casper	3	1	2	4
Mummy Cave	4	5	-1	1
Mangus	5	4	1	1
Grant Lake	6	6	0	0
Acasta	7	7	0	0

$\Sigma d_i^2 = 10$

$$r_s = 1 - \frac{(6)(10)}{7(7^2-1)}$$

$$r_s = +0.82$$

A level of significance of $P \leq 0.05$ was chosen because; the sample was small, the dates were averaged, some of the sites were spatially, very close. The critical value of r_s for 7 variables and a significance of 0.05 is +0.714 (Thomas 1976: 510). The calculated value for this test statistic is larger than the critical value, therefore, there appears to be a positive correlation between latitude and age.