CHAPTER 8

EXPERIMENTAL TOOL MICROWEAR ANALYSIS

8.1 Introduction

Subsequent to the experimental component of this study (Chapter 7), all ten experimental tools were subjected to a descriptive, comparative, and interpretive microwear analysis according to the same procedures and methods outlined in Chapter 6.1. Detailed descriptive analysis results are presented in Appendix 9 and Tables 6, 9 and 10. In this chapter, the experimental tool microwear data are judgementally and inferentially compared with results obtained during analysis of the 35 prehistoric microwear sub-sample specimens (Chapter 6). Further detailed statistical analyses of the prehistoric microwear sub-sample specimens and the eight experimental woodworking tools are presented in Chapter 9.

8.2 Descriptive Comparison of Experimental Woodworking Tool Microwear Patterns

The eight experimental tools used for bark stripping and woodworking activities (Chapter 7; Appendix 9) were collectively analyzed as a sample. A general description and comparison of their salient microwear trace patterns with those of the prehistoric microwear sub-sample specimens, and with results documented in previous microwear studies, are presented in this section. Additional detailed descriptive and comparative data are presented in Appendix 6, Tables 6, 9 and 10, and Figures 54 to 61, 63 and 65. The microwear traces observed on the two experimental tools used on antler and bone are described separately in Chapter 8.3 (below).

This descriptive and judgemental comparison of microwear trace patterns between the experimental woodworking tools and the microwear sub-sample specimens was undertaken to test the hypothesis that the primary function of prehistoric key-shaped formed unifaces involved mainly woodworking activities. It was reasoned that woodworking could be inferred if the majority of microwear trace patterns on the experimental woodworking tools closely matched, or were notably similar to, those observed on the majority of the prehistoric microwear sub-sample specimens. If the dominant microwear traces represented for these two samples were observed to be notably dissimilar, then the woodworking hypothesis would be rejected.

All eight experimental tools engaged in bark removal and woodworking activities developed microwear that can be easily seen by the unaided eye (see Figures 54 to 61, 63 and 65). Variability in dulling rates, and slight differences in microwear traces were noted for the six tools used exclusively on green saskatoon stalks and branches. The observed variation is probably due to physical property differences inherent in each lithic raw material type, and/or to idiosyncratic motor pattern behaviours (Chapter 7.7; Appendix 9).

The relative percentages of specific lithic material types comprising the experimental woodworking tool sample are very similar to those represented for the prehistoric microwear sub-sample. Therefore, when both samples are compared, any significant statistical or observational variation for microwear trace patterns indicated between the two samples cannot be directly attributed to factors relating to disproportionate representation of specific lithic raw material types.

One of the woodworking tools (E.T. #10) was made of fine-grained "Cache Creek" basalt (Lithic Type 6). In a previous study, Odell (1980:40) concluded that the basic fracture properties of Cache Creek basalts are similar enough to cryptocrystalline silicates (e.g., flint) to permit identification of specific tool activities (see also Richards 1987,1988). Given this, I reasoned that the basalt and silicate tools should develop similar microwear traces when engaged in woodworking, and consequently, data contributed by the basalt tool would not appreciably affect or distort the general qualitative and quantitative character of microwear trace patterns representing the collectively analyzed experimental woodworking tool sample.

It could be argued that the eight experimental woodworking tools constitute an uncomfortably small sample size for the purposes of generating descriptive statistics, and that ideally, a larger sample would have been more desirable to ensure greater representative accuracy. However, a great deal of time and effort would have been required to increase the experimental tool sample size and satisfy this consideration. Also, it could be questioned as to whether statistical measures generated from a larger sample would have been significantly different from those obtained, given the overall high level of microwear trace pattern similarity shared between the eight experimental woodworking tools.

Although it is acknowledged that some minor degree of sampling error undoubtedly exists, frequencies and percentages generated for attribute variables indicated on the eight experimental woodworking tools are regarded to generally represent the general salient characteristics of the sample. Consequently, they were used as indices for comparison with the same statistical measures generated for the 35 prehistoric microwear sub-sample specimens (Appendix 6; Tables 6, 9 and 10).

Distal Projection Tip

All eight expermimental woodworking tools retained their distal projections. It appears that if the primary function of prehistoric key-shaped formed unifaces *did* involve woodworking activities, accidental removal of distal projections during use was probably a relatively rare occurrence. Several possible scenarios for accidental distal tip removal are discussed in Chapter 7.7.

The distal tips of most experimental woodworking tools were used to remove secondary branch nodes employing gouging, prying, and lateral side-to-side sawing motions (Figure 9b and 9c); and to incise and engrave grooves into primary stalks and branches (Figure 9d) (Chapter 7.6.1; Appendix 9).

For experimental woodworking tools, distal projection tip mean microflake scar frequency, mean microflake scar size, and mean microflake scar maximum size are about half as large as those represented in the prehistoric microwear study sub-sample (Tables 5 and 6). The mean minimum microflake scar size on the distal tip was much smaller than that represented in the prehistoric microwear sub-sample specimens. A similar pattern was noted for the "opposite" margin (see below).

Both samples indicate comparable similarities for percentages representing the categories for rounding and smoothing intensity, polish intensity, and crushing intensity; and for tools bearing striations (Appendix 6). Slightly similar percentages are represented for distal tip polish location, microflake scar location, and microflake scar configuration pattern categories. Percentages for rounding and smoothing location, and crushing location categories are proportionately dissimilar between the two samples.

Concave Margin

The experimental woodworking sample and prehistoric microwear sub-sample both indicate close metric similarities for the concave margin mean maximum microflake scar size, and concave margin mean edge angle (Tables 5 and 6). The experimental tool concave margin mean microflake scar size is about .3 mm smaller than that for the prehistoric microwear sub-sample specimens. This difference is relatively minor, and a close similarity is inferred. The concave margin mean minimum microflake scar size is about half as large as that determined for the prehistoric microwear sub-sample. The most notable dissimilarity is indicated for the mean concave margin microflake scar frequency per tool; experimental tools have about three times as many more microflake scars than those in the prehistoric microwear sub-sample.

With respect to nomimal and ordinal scale attribute variables represented in the two samples (Appendix 6), there are moderate percentile similarities indicated for for concave margin edge rounding and smoothing intensity, edge rounding and smoothing location, and edge polish location categories, as well as for the frequencies of tools bearing striations. Slight percentile similarities are noted for microflake scar configuration pattern, edge crushing intensity, and edge crushing location categories. The two samples are dissimilar with respect to the percentages in edge polish intensity and microflake scar location pattern categories.

Microflakes are considered to be important in this study because many researchers have demonstrated that they have diagnostic value that can be used to infer prehistoric tool function(s) through comparison with experimental tools (Tringham *et al* 1974; Keeley and Newcomer 1977; Odell 1977,1981b; Odell and Odell-Vereecken 1980; Keeley 1980). A total of 99 microflake scars were observed on the concave margin ventral edge aspects of 25 prehistoric microwear sub-sample specimens; 108 were noted on the eight experimental woodworking tools. The number of microflake scars represented in the prehistoric and experimental samples are sufficiently large and comparable in size to assume that they constitute samples from which representatively accurate statistics can be derived.

Frequencies and relative percentages for the most common microflake scar types represented on the concave margin edge aspect of tools bearing microflake scars in the prehistoric microwear sub-sample were compared with those for the experimental woodworking tools (Tables 7 to 10). In both samples, the most commonly represented microflake scars are those with circular-expanding plan outlines and invasive terminations, followed by those with circular-expanding outlines and shallow-stepped terminations. Indeed, the relative proportions for the latter type are identical in both samples.

Approximately similar percentages are indicated for microflake scar types represented in moderate frequencies. They include those having: (1) circular-expanding outlines and deep-stepped terminations; (2) trapezoidal-expanding outlines with shallow-stepped terminations; (3) crescentic oultines and shallow-steped terminations; (4) oblique outlines and invasive terminations; and (5) oblique outlines with shallow-stepped terminations.

At least two obvious microflake scar type frequency differences exist between the two samples. First, there are at least six times as many microflake scars with crescentic outlines and deep-stepped terminations represented in the experimental tool sample than in the prehistoric microwear sub-sample specimens. However, it is important to note that most (70%) of these are associated with E.T.'s #3 and #4, which are both made of Type 2 chalcedony, a material conducive to "hingeing-out" abruptly at flake terminations (see Appendix 7).

Second, microflake scars with lamellar outlines and invasive terminations are six times more common in the experimental sample than in the prehistoric microwear sub-sample. However, all were observed on E.T. #5, which is made of Type 3 chert, which is softer and far more brittle than the majority of lithic materials represented in the prehistoric microwear sub-sample or experimental woodworking tool sample (Chapter 7.6.1; Appendices 7 and 9).

There are a few low frequency "outlier" microflake scar types represented in the prehistoric microwear sub-sample (Table 9). They exhibit five outline categories, and terminate mostly in snaps or retroflexed steps or hinges. These "atypical" forms may have been accidentally incurred by forceful traumatic contact with hard objects during tool transport, and/or as a result of being employed in a "secondary" functional capacity on contact materials other than green wood.

Where possible, concave margin microflake scar initiation types for the experimental woodworking tools were classified as being either "Hertzian" (cone) or "bending" using criteria defined by Cotterell and Kamminga (1987: 682-691). The most commonly represented initiations (81%) were determined to be the bending type, while Hertzian initiations constituted only 19%. These percentages are virtually identical to those determined for the microflake scar initiation types identified on the concave margin edge aspects of specimens in the prehistoric microwear sub-sample.

"Opposite" Margin

The "opposite" margin mean microflake scar frequency, mean microflake scar size, and mean maximum microflake scar size for the experimental woodworking tools are about half that observed on the prehistoric microwear sub-sample specimens (Table 6). The mean minimum microflake scar size on the "opposite" margins are about a third as large as that represented on the prehistoric microwear sub-sample specimens. The mean "opposite" margin edge angle for the experimental tool sample is about 10° greater than that determined for the prehistoric microwear sub-sample. However, this slight edge angle difference is not deemed to be great enough to have contributed any microwear trace pattern variations evident between the two samples.

In considering relative frequencies and percentages of various discrete variables for each of the two samples (Appendix 6), there are notable percentile similarities indicated for edge polish location and edge crushing intensity categories, and for frequencies of specimens exhibiting striations. Some weak similarities are indicated for percentages representing each of the polish intensity, microflake scar location, and edge crushing location categories. Percentile dissimilarities for the "opposite" margin are indicated for edge rounding and smoothing intensity, and edge rounding and smoothing location categories.

A total of 106 microflake scars were observed on the "opposite" margin of 23 specimens in the prehistoric microwear sub-sample. The eight woodworking tools bear only 19. The latter sample size is viewed as being uncomfortably small, consequently the validity of interpretations drawn from it could easily be open to some question. Nevertheless, the resulting measures suggest that there are a few obvious general similarities shared between the two samples.

Comparison of the relative percentages of microflake scar formal types (Tables 7 to 10) between the two samples indicate that the most commonly shared configurations are those with: (1) circular-expanding outlines and invasive terminations; (2) circular-expanding outlines and shallow-stepped terminations; (3) crescentic outlines and invasive terminations; and (4) oblique outlines with invasive terminations. Percentages for most of the less frequently represented microflake scar types in the experimental tool sample are similar to those represented in the prehistoric microwear sub-sample.

Ventral Face

Frequencies and relative percentages of nominal and ordinal scale microwear attribute variables represented on the ventral faces of the specimens in the two samples (Appendix 6), indicate that strong similarities exist for percentiles representing the categories for polish intensity, polish location, rounding and smoothing intensity, and rounding and smoothing location. Only one specimen in the experimental woodworking tool sample bears striations that extended beyond the concave margin edge aspect onto the ventral face. Consequently, striation types and patterns cannot be properly compared or used as diagnostic functional indices between samples.

General Comparisons and Observations

Some variation in polish types and intensities are evident between the eight experimental woodworking tools and the prehistoric microwear sub-sample. However, the polishes on E.T.'s #1- #4, #6, and #10 are either identical to, or very similar to, those observed on many of the specimens in the prehistoric microwear sub-sample, and on other cryptocrystalline silicate experimental and ethnographic woodworking tools (e.g., Keeley 1977:4; Keeley and Newcomer 1977:39,50; Newcomer and Keeley 1979:201; Keeley 1980:35; Kamminga 1977:207,210; Dumont 1982:214; Sabo 1982:69; Vaughan 1985:33-34,114-115,124).

Polishing on the experimental woodworking tools is very distinctive, intense, and most pronounced along the immediate working edge (Figures 54, 56, 58, 59, 61, 63 and 65). The extent and intensity of polish development along the concave and "opposite" margins varied somewhat between lithic raw material types, and with the manner and duration of tool use. Intensity and locational extent of polish on the concave margin edge aspects was noted to have increased more or less incrementally with tool use. The extent of the polished area on the ventral face back from the concave margin edge aspect depended how often, and how forcefully the ventral face contacted the wood during use.

A moderate proportional dissimilarity is indicated between the prehistoric microwear sub-sample and experimental woodworking tool sample for categories representing concave margin edge polish brightness (Appendix 6). On average, most of the experimental tools exhibit brighter polish. This is compatible with previous observations that polish formed by working green wood is usually very bright (Keeley and Newcomer 1977:39; Keeley 1980:35; Vaughan 1985:33). This difference in average polish brightness intensity between samples could be due to several reasons. Foremost of these are physical differences in lithic raw material types, and/or post-depositional factors that have reduced original polish intensity of the prehistoric specimens through chemical and/or mechanical processes (see Keeley 1980; Plisson 1983; Unger-Hamilton 1984). Also, Hayden and Kamminga (1973:4) and Kamminga (1977:207) have observed that polish produced by hard woods can be qualitatively different from those associated with soft woods. Similarly, polish developed when working seasoned wood has been noted to be less intense than that produced by working green wood (Hayden and Kamminga 1973:6; Keeley 1980:36).

Only three experimental woodworking tools exhibited striations. The mean distally-oriented striation angle vis-a-vis the average concave margin edge was determined to be identical in both samples (Tables 5 and 6). They suggest that prehistoric and experimental motor patterns were similarly executed.

Minute "sleeked" type striations appear on the concave margin ventral edge aspects of E.T.s #1, #2 and #10 (e.g., Figure 54c). They resemble those observed on several prehistoric microwear sub-sample specimens (e.g., Figures 24 and 30), and on other experimental tools used to work green wood (see Keeley and Newcomer 1977:39; Newcomer and Keeley 1979:201; Kamminga 1982:210; Mansur 1982:233). "Scratch groove" type striations are indicated on the "opposite" margin of E.T. #1 (Figure 57b), which was the only tool used on juniper. These are also similar to some examples represented in the prehistoric microwear sub-sample (e.g., Figures 24, 25, 27 and 35), and to those exhibited on experimental tools used on green wood by other researchers (see Dumont 1982:214; Kamminga 1982: 205,207; Mansur 1982:231).

The notable paucity of striations on the eight experimental woodworking tools can be attributed to at least two important factors. First, many of the tools were used primarily in contexts where abrasive particles (i.e., sand, silt, dust, and grit) were not very prevalent in the immediate work areas (Chapter 7.5). Therefore, the possibility of abrasive particles being incidentally introduced between a tool's working edge or surface and its contact material was significantly reduced. Second, none of the experimental tools were used until their use-life potential had expired (Appendix 9). This would have entailed using each tool until its concave margin had been repeatedly subjected to numerous use-episodes and subsequent resharpenings to the point of tool exhaustion. As a result, the experimental tools did not have the same opportunity to develop striations as did prehistoric tools, which were undoubtedly used for much longer periods of time. It is significant to note that E.T.'s #1 and #2, which bore striations, were both used at Keatley Creek for relatively long periods. There, sand, silt, dust, and grit were relatively abundant in the immediate working environment.

A notable difference in the mean size of microflake scars on the edge aspects of the ventral face is apparent between the experimental woodworking tools and the prehistoric microwear sub-sample specimens. On average, those on the experimental tools are about half the size of those on the prehistoric microwear sub-sample items. This suggests that many of the prehistoric specimens were probably used on contact materials that were slightly harder than the green woods used in the experiments, and/or possibly that greater levels of applied force may have been used prehistorically to work green woods than was used experimentally. The former explanation seems more likely, as very heavy pressure was often exerted by the experimenters, and these force loadings were likely comparable to those applied prehistorically.

It is important to note that of the three microflake scars removed from the concave margin ventral edge aspect of E.T. #3 when it was used to work seasoned saskatoon wood for about 1000 strokes, two scars were exceptionally large (1.5 mm and 2.0 mm diameter) (Chapter 7.6.1; Appendix 9). When this tool had been used previously on fresh green saskatoon for 15,400 strokes, eight microflakes were removed, having a size range of .3 mm to 1.5 mm, and mean diameter of .5 mm. These results support previous observations that working seasoned wood creates larger microflakes than working green wood of the same type. Therefore, the slightly larger mean microflake size indicated for the prehistoric microwear sub-sample specimens compared to the experimental tools used on green wood can be explained by the fact that the former may have been occasionally used to work seasoned wood. Working of seasoned wood would have been common during the refurbishing or repairing of dried-out wooden artifacts, notably hunting weaponry. Occasional working of antler, or possibly bone, could have also contributed to the larger mean microflake scar size represented in the prehistoric microwear sub-sample (Chapter 7.6.2.).

Microflake scar configuration pattern categories represented on the concave margin edge aspects of the eight experimental woodworking tools (Tables 9 and 10; Figures 54 to 56, 58 to 61, 63 and 65) are simlar to those exhibited on many of the prehistoric microwear sub-sample specimens (Tables 7 and 8; Figures 23, and 25 to 34), and on edges of experimental tools used by other researchers to scrape and plane soft and hard woods (e.g., Tringham *et al* 1974:187-188; Keeley and Newcomer 1977:49; Cotterell and Kamminga 1979:105; 1982:180; Odell and Odell-Vereecken 1980:101; Odell 1981b:200-203).

The majority of the microflake scars on the experimental woodworking tools and the prehistoric microwear sub-sample items exhibit invasive and shallow-stepped termination types (Tables 9 and 10). When related to contact material relative hardness categories defined by Odell (1981b) and Odell and Odell-Vereecken (1980:101), they suggest having been used on predominantly "medium-soft" and/or "medium-hard" contact materials. Woods are included in both of these categories, however, bone and antler are relegated to the "hard" category.

The high percentage of "bending"-type microflake initiations on the concave margin edge aspects of the experimental woodworking tools and prehistoric microwear sub-sample specimens (81% and 82% respectively) are virtually identical in both cases. The proportion of "Hertzian" initiations are also very similar (19% and 18% respectively). Cotterell and Kamminga (1987:682-691) maintain that bending initiations are commonly produced by working wood, bone, and antler. "Hertzian" initiations are more likely to result from much harder materials such as stone, but they can sometimes be created by bone and antler indenters if very heavy levels of force are applied. Most woods are considered to be too soft to create Hertzian initiations by pressure, although they can occasionally be produced by percussion (Cotterell and Kamminga 1979:686). The experimental results of the present study indicates that these generalized rules are not hard and fast, since both types were produced by working green bark and wood. Albiet, the bending type is clearly dominant.

8.3 Descriptive Comparison of Antler and Bone Microwear

Two experimental tools were used to work antler and bone. E.T. #7 was used on soaked antler, boiled antler, and soaked bone; E.T. #9 was used exclusively on soaked antler (Chapters 7.6.2 and 7.6.3; Appendix 9). Resulting microwear traces observed on each of these two tools are summarized and discussed below, and corresponding photomicrographs are presented in Figures 62 and 64.

E.T. #7

Microwear trace patterns described for E.T. #7 in this section refer to those incurred after this tool was used to work soaked antler for 1,700 strokes (Chapter 7.6.2; Appendix 9). Microwear on the projection tip is characterized by moderate edge rounding and smoothing on the distal edge and ventral-lateral corners (Figure 62). Polish intensity is moderately bright, and it appears on the distal edge, ventral-lateral corners, and their adjacent edge aspects. Four microflake scars were removed from the distal tip; their mean diameter size is 2.0 mm and they range between .5 and 3.0 mm. Crushing is pronounced, and appears along the entire distal tip margin.

The concave margin bears pronounced rounding and smoothing, pronounced crushing, and moderately bright polish along its entire working edge. Six microflake scars are randomly distributed along the ventral edge aspect. Their mean size is 2.0 mm, and they range between .3 and 3.0 mm. Striations were not observed. The most common microflake scar outline category is trapezoidal (n=3), followed by expanding-circular (n=2), and expanding-oblique (n=1). The most common microflake scar termination types are deep-stepped (n=2) and snapped (n=2), followed by invasive (n=1), and shallow-stepped (n=1). All six microflake initiations are the "bending" type.

The "opposite" margin was used for a very short time on soaked antler, and it did not incur any microwear that could be observed using magnifications less than 40 X. The ventral face of the distal projection bears moderately bright polish on its medial-distal aspect. Striations were not detected. Rounding and smoothing is slight, and appears on microtopographical features on the medial aspect of the distal projection.

E.T. #9

E.T. #9 was used exclusively to work soaked antler. Its distal projection margin exhibits pronounced edge rounding and smoothing on both the distal edge and ventral-lateral corners. Polish is absent, and only one microflake scar (.2 mm) is present. Edge crushing is pronounced, and appears along the entire distal tip margin. A small burin-like spall was also removed from the right ventral-lateral corner along the very distal aspect of the "opposite" margin (Figure 64).

For the concave margin, moderate edge rounding and smoothing, and pronounced crushing appear along the entire edge. Polish or striations are not indicated. Six microflake scars, averaging .8 mm in size, and ranging between .4 and 1.2 mm, appear randomly along the entire edge. The most common microflake scar plan type is circular-expanding (n=3), followed by crescentic (n=2), and one is pointed. The most frequent termination type is deep-stepped (n=4), followed by snapped (n=2). All six microflake initiations are the "bending" type.

Comparison of Figures 64a and 64b indicate that considerable portions of the edges on the distal projection tip and concave margin were lost during use. This is attributed entirely to acute edge crushing and microflake removal from the dorsal edge aspects of these margins (see below).

The "opposite" margin was used very briefly, and bears slight edge rounding and smoothing along its medial aspect. Polish, striations, or crushing were not observed. One microflake scar about 1.5 mm in diameter is present on the medial-distal edge aspect. It has a trapezoidal outline and deep-stepped termination.

Descriptive Comparison and Observations

Comparison of combined microwear trace patterns observed on E.T.'s #7 and #9, which were used on soaked antler, with the most frequently represented patterns observed on the prehistoric microwear sub-sample specimens and the eight experimental wood-working tools, display some similarities and a number of salient differences.

Major differences are apparent by: (1) the unusually acute degree of edge crushing on the distal tip; (2) the significantly larger mean microflake scar size on the distal tip margin; (3) the notably larger mean microflake scar size on the concave margin; (4) the very high incidence of deep-stepped and snap terminated microflake scars on the concave margin; and (5) the pronounced intensity and location of crushing on the concave margin.

When compared to other experimental results involving bone and antler conducted by other researchers, the microwear traces on E.T.'s #7 and #9 are noted to be quite similar. The pronounced edge damage and microwear traces exhibited on the distal projection of E.T. #7, used to engrave soaked antler, is identical to that incurred on experimental chert graving tools used on antler by Lynott (1975) and Moss and Newcomer (1982:309). The nature, intensity, and location of polish on the ventral edge aspects and ventral face of E.T. #7 is very similar to that observed on experimental tools used on bone and antler by Keeley and Newcomer (1977:39,42-44), Keeley (1980:56), and Vaughan (1985:31-33). The intensity and location of polish represented on E.T. #7 is also similar to one of the more frequent microwear pattern types represented in the sample of 35 prehistoric microwear sub-sample specimens.

There is some similarity in the degree and location of edge rounding, smoothing, and edge polish on the concave margin with those of the prehistoric microwear sub-sample. Unfortunately, in its early stages of development, antler polish has been noted to be almost indistinguishable from wood polish (Keeley 1980:56). Therefore, that polish can be regarded as a reliable diagnostic trait for distinguishing between working wood and antler is rendered suspect in this study.

One major difference between polishes represented in both contact material categories was that the intensity of bone/antler polish along the immediate edges was not as bright as was noted for many of the woodworking tools, and it tends to have more of an "even" intensity over the polished area (compare Figure 62 with Figures 54, 56, 58, 59, 61 and 63). Even though the bone/antler polish formed much more rapidly than woodworking polish, it appears that the rapid rate of attrition and edge loss along the concave margin did not permit development of bright polish in this area.

Severe edge damage and removal of considerable portions of working edges on both E.T.'s #7 and #9 is a phenomenon that has also been noted by other researchers for experimental tools engaged in working bone and antler (Brink 1978b:367; Keely and Newcomer 1977:44; Keeley 1980:44,56; Vaughan 1985:32; Richards 1987:117-130). This pronounced degree and rapid rate of edge deterioration was not observed on the eight experimental woodworking tools, nor is it commonly indicated for the prehistoric microwear sub-sample specimens (Appendix 6).

As mentioned above, one of the most striking differences between the microwear trace patterns on the two experimental tools used on bone and antler compared to those on the eight woodworking tools and the prehistoric microwear sub-sample specimens is the significantly higher preponderance of deep-stepped and snap terminated microflake scars on the working edges. They are either very rare or absent in the latter two samples (see Tables 7 to 10). This is commensurate with observations made by other researchers that such termination types are commonly associated with working "hard" contact materials, notably antler and bone (Tringham *et al* 1974:188; Keeley 1980:56; Odell and Odell-Vereecken 1980:101; Vaughan 1985:21).

8.4 Summary and Discussion of Descriptive Comparisons

Microwear trace patterns observed on the eight experimental woodworking tools are somewhat varied, although most are either identical to, or very similar to, the spectrum of attributes recorded for the prehistoric microwear sub-sample, and for other experimental and/or ethnographic woodworking tools made from cryptocrystalline silicates.

The woodworking tool sample clearly possesses higher microflake scar frequencies per tool compared to the prehistoric microwear sub-sample specimens. There are at least three reasons for this. First, three of the experimental tools were made from lithic raw materials *not* commonly used to produce prehistoric key-shaped formed unifaces. Because these materials are softer and more brittle than the other lithic types used, they are more prone to microflake removal, pronounced rounding, smoothing, and crushing (see Chapters 3.3.3; Appendix 7;

Figures 60, 64 and 65).

Second, many of the experimental tools were used until they became quite dull (Appendix 9). I argue that prehistoric resharpening practices would most likely have been initiated fairly regularly to restore optimal edge efficiency (Chapter 3.3.2), resulting in microflake scars -- and other trace types -- being regularly removed from the edge aspects of tools. Therefore, microflake scar frequencies on prehistoric specimens are logically expected to display variability owing directly to resharpening practices.

Lastly, idiosyncratic motor patterns are considered to have played an important part in the development of some microwear traces (Chapter 7.7; Appendix 9). Persons adopting aggressive motor pattern styles involving inordinately heavy loads of applied pressure were observed to be more apt to produce greater microflake scar frequencies than persons executing passive motor patterns.

Most of the other mean values for continuous microwear attribute variables observed on the experimental woodworking tools suggest that they are about half as large as those represented in the prehistoric microwear sub-sample (Tables 5 and 6). I suggest that these disparities in size can be attributed to several reasons.

First, as previously indicated, differences in the mean size of microflake scars on experimentally used lithic tools have been previously correlated with the relative hardnesses of contact materials being worked (see Odell and Odell-Vereecken 1980:101; Richards 1987:181). I maintain that on occasion, the relative hardness of contact materials worked by many of the key-shaped formed unifaces comprising the prehistoric microwear sub-sample were harder than the green woody plants used in the experimental component of this study. The significantly larger mean microflake scar size obtained by working seasoned saskatoon with E.T. #3 compared to when it was used on green saskatoon suggests that working seasoned wood can account for this size disparity. Indeed, it seems inevitable that seasoned wood must have been occasionally worked in prehistoric times, particularly when refurbishing or repairing dried-out wooden implements.

Second, incidental forceful contact of tool edges against hard objects can often produce large microflake scars. I suggest that edges of prehistoric tools probably incurred at least some degree of accidental traumatic edge damage during prehistoric transport and storage, and perhaps post-depositionally by contemporary artifact transport, handling, and storage.

Third, for prehistoric tools, the distal projection tip margin and the "opposite" margin would most probably have been resharpened much less frequently than the concave margin because of their lesser functional importance. Therefore, these margins were more likely to have retained evidence of microwear traces incurred during use, and from incidental traumatic episodes.

The intensity and magnitude of striations indicated on the ventral faces of prehistoric key-shaped formed unifaces are interpreted to be an indication of the amount of abrasive particles (e.g., sand, silt, dust, and grit) represented in the immediate working environment. Striation intensity also provides a relative index of how long tools were were used in such contexts. Those used for long periods where abrasive particles were abundant display very high striation frequencies (e.g., Figures 23 to 28). Prehistoric tools displaying moderate to pronounced microwear intensities, but lacking or having very few striations, were likely used in working contexts were abrasive particles were absent or relatively rare. That very few striations were observed on the experimental tools, despite having been used for substantial periods, suggests that many prehistoric key-shaped formed unifaces must have been used for very long periods in use-contexts where abrasive particles were far more abundant than in the experimental settings.

The relatively high incidence of striations evident on many of the prehistoric key-shaped formed unifaces has at least three other important potential implications. First, it suggests that these tools were most commonly used during drier, or non-winter months of the year, since abrasive particles are more likely to be introduced between a tool edge and contact material when they are most mobile and can be readily transported and/or transferred to contact materials by natural or cultural agencies (e.g., wind, pedestrian traffic, or resting materials on the ground). Frozen ground and snow cover during the winter, and moist ground conditions during the late fall and spring, would have severely restricted environmental exposure and mobility of abrasive agents, thereby minimizing striation development. The apparently higher recovery frequencies of key-shaped formed unifaces at non-housepit sites compared to winter pithouse village sites lends further support to this conjecture (see Chapters 3.6 and 9.2).

Second, the high incidence of striations on prehistoric specimens suggests that many were probably frequently used at residential and/or resource extraction sites located in valley bottom contexts. Because environmental conditions appear to have changed relatively little over the last 4000 years on the Plateau (Hebda 1982; Mathewes 1985; Campbell 1985:149-178; Richards and Rousseau 1987:23) I have assumed that lowland vegetation cover was typically as sparse during this period as it is today. Therefore, abrasive particles derived from exposed soils and sediments could have been readily introduced to the surfaces of contact materials. Conversely, mid-altitude and upland contexts were more likely to have had much greater vegetation and littermat cover, which would have significantly reduced the availability of abrasive agents in immediate working environments.

Lastly, and most importantly, the character and intensity of striations appearing on many of the prehistoric tools indicate that the primary contact material being worked had highly efficient abrasive particle "holding" or "fixing" properties. This refers to the ability of a contact material to transfix, stabilize, and maintain abrasive agents in direct contact with a tool during use (see Lawn and Marshall 1979:79-81; Knutsson 1988:92).

Green wood is regarded to be a very proficient fixer because when freshly exposed, its relatively yielding and moist surface can easily trap and hold abrasive particles within and between wood fibres. When green wood containing fixed abrasive particles is worked, continuous and morphologically regular striations are produced on the edges and surfaces of the stone tools used (see Knutsson 1988:92). In contrast, seasoned wood, antler, and bone do not readily trap abrasive grains because of their greater hardness and density, and particles are transfixed only momentarily or roll around freely. This produces striations that are more likely to be morphologically irregular and discontinuous. Following these criteria, it would appear that striations produced on almost all of the specimens in the prehistoric microwear sub-sample were produced by a contact material with holding/fixing properties more similar to that of green wood than with those characteristic of seasoned wood, antler, or bone.

Prehension wear resulting from contact with the experimenter's fingers (Chapters 6.1.6 and 6.3) was *not* observed on the dorsal surfaces of any of the experimental tools. I posit that such wear can only develop when appreciable amounts of abrasive agents adhering to fingers are repeatedly rubbed in specific areas of a tool's surface for very long periods of time (see also Vaughan 1985:39). This further supports the conjecture that many key-shaped formed unifaces certainly must have had exceptionally long use-lives. It can be further argued that if the primary function of key-shaped formed unifaces involved working soaked bone or antler, the resulting rapid edge loss and severe edge damage on the concave marign would have exhausted the use-life potential of most all key-shaped formed unifaces long before any finger prehension polish could develop.

Prehension wear resulting from loose hafts was also lacking in the experimental tool sample. However, this is not surprising since all experimental tools remained relatively secure in their hafts throughout most of their use-lives. The very low incidence of haft-type prehension wear represented on prehistoric specimens suggests that most hafted tools were probably also rigidly secured.

Sampling problems aside, qualitative and quantitative comparisons of microwear trace patterns exhibited on the eight experimental woodworking tools indicate that they are either identical to, very similar to, and/or are within the range of variation of characteristics exhibited by, the majority of specimens comprising the prehistoric microwear sub-sample.

Microwear trace patterns incurred on the two experimental tools used on soaked bone and/or antler display some similarities with those observed on the prehistoric microwear sub-sample specimens. Soaked bone and soaked antler polish is somewhat similar to polish resulting from working green wood. Also, the larger average microflake scar size observed on E.T. #7, used on soaked antler, is closer to that indicated for the prehistoric microwear sub-sample than it is for the experimental tools used on green woods. However, it was determined that working seasoned saskatoon also produces larger mean microflake scar sizes than was obtained working green woods.

Experimental tools used on soaked antler and bone display several salient differences when compared with most of prehistoric microwear sub-sample specimens and the experimental tools engaged in working green wood. These differences include: (1) a more homogeneous (i.e., non-differential) polish intensity on the ventral face which appeared most commonly on prominent microtopographical features; (2) slightly less polish intensity along the immediate concave margin ventral edge aspect, probably because of rapid edge deterioration rates; (3) severe edge damage in the form of pronounced crushing and rounding, and intensive dorsal microflake removal; and (4) most microflake scars terminate in deep-stepped and snap terminations, whereas these termination types are very rare or completely absent on prehistoric microwear sub-sample specimens and experimental woodworking tools.

After a collective and judgemental assessment and comparison of the microwear trace patters exhibited by the experimental tools and the prehistoric microwear sub-sample specimens, I conclude that there is greater overall similarity between microwear trace patterns observed on the eight experimental woodworking tools with those on the prehistoric specimens than there is with those represented on the two experimental tools used on bone and antler. It seems then, that the most parsimonius explanation to account for this similarity is that the primary function of prehistoric key-shaped formed unifaces involved the working of green woody plants, and on occasion, seasoned wood. Thus, the hypothesis that they functioned mainly in a woodworking capacity is accepted.

However, it should be noted that there is a modicum of similarity indicated between microwear traces exhibited on the experimental tools used on soaked antler and those noted on a few specimens in the prehistoric microwear sub-sample. Therefore, that key-shaped formed unifaces may have been used prehistorically to occasionally work soaked or boiled antler cannot be confidently negated, and it is quite possible that this may have been a "secondary" function associated with this tool type.