CHAPTER 3

THEORETICAL CONSIDERATIONS

3.1 Trends in Northwest Lithic Studies

The majority of past lithic studies in northwestern North America have focussed primarily on exhaustive empirical descriptions of stone tool attributes and production modes, and on defining artifact typologies for use as temporal horizon markers or for cross-cultural comparisons. As a result, very little close attention has been paid to functional aspects of various lithic tool types. Also, use-behaviours are often loosely inferred without being substantiated, or just simply ignored.

There have been, however, a few recent studies involving tool replication and experimental use that run contrary to this trend (e.g., Brink 1978a; Flenniken 1981; Magne 1985; Richards 1987). Such actualistic studies are crucial to the development of "middle range theory" as defined by Binford (1981,1982), and have contributed valuable information towards gaining a clearer understanding of prehistoric stone tool production and use in the Northwest.

Odell (1981a:339) remarks that:

> It appears from the environmentally and regionally specific nature of most lithic artifact collections that few morpho-functional equations possessing widespread validity in time or space are going to be possible. Much more work of a functional nature at a regional and cultural level is going to be required in order to establish basic regularities before attempting to interpret stone tool function in a wider context. In the recent past much of the relevant functional data have come from the analysis of use-wear damage, and it appears that this type of study will be increasingly valuable in constructing sound functional frameworks for future interpretations. I would argue that the establishment of these locally valid frameworks is a far more worthwhile and efficient expenditure of energy than attempting once again to employ morphological systems to accomplish tasks for which they are patently unsuited.

Since the present study is aimed primarily at exploring the significance and function of key-shaped formed unifaces on the Interior Plateau, several theoretical considerations must be addressed to effectively accomplish this objective. Specifically, these include various aspects of: (1) typology; (2) design theory; (3) lithic raw material properties; (4) microwear research; (5) hafting; and (6) curation.

3.2 Typology

Typologies have long been used to permit condensation of information into manageable analytical units, to facilitate culture historical reconstruction, and to allow recognition and comparison of inherent inter- and intra-assemblage variability (see Krieger 1944; Ford 1954; Hill and Evans 1972; Kleindienst 1975; Hayden 1984). Most typological schemes rely on morphological attributes as the basis for generating and defining artifact types, but the resulting tool forms are rarely correlated with specific use-behaviours through development and execution of rigorous research studies involving replication and experimentation (Odell 1981a:321).

It has often been stressed that it is methodologically unsound and potentially dangerous to infer lithic tool function on the sole basis of morphological criteria (Ahler 1971; Wylie 1975; Kay 1977; Brink 1978a; Cantwell 1979; Odell 1981a; Siegel 1984; Hayden 1984,1986). Nevertheless, attempting to understand how distinctive and morphologically complex tool types were used within their systemic context(s) can provide important insights into prehistoric human behaviour.

Two successive typological approaches were employed in this study. An "empricist" approach was first used to identify and define the key-shaped formed uniface artifact "type" based on physical, morphological, and technological attributes, and on culture-historical criteria. A "positivist" typological approach was then used exclusively to facilitate descriptions of various specific physical attributes of these tools, and to organize the data into analytic categories to help determine the functional significance of these tools (see Hill and Evans 1972; Hayden 1984).

The key-shaped formed uniface artifact "type" is essentially defined according to theoretical and methodological underpinnings propounded by Krieger (1944) and Ford (1954). They maintain that a "true" type should be a unit equatable with the ethnographic "culture trait", having proven culture-historical integrity and significance, and representing specific behaviour patterns transmitted through mechanisms of social interaction.

Acknowledging these requirements, key-shaped formed unifaces are considered to constitute an archaeological "type" based on the following characteristics. First, these tools are distinctive due to their recurrent, complex, and uniquely patterned constellation of physical, morphological, and technological attributes that permits them to be readily distinguished from all other lithic tool types similarly conceived. These include their unusual "key"-like shape, steep edge angles, an emphasis on the use of cryptocrystalline silicate materials, relatively restricted size range, and their specific temporal and geographic distribution. Second, not all membership attributes of this archaeological "type" are present on each specimen, therefore, the type definition constitutes a polythetic construct (Clarke 1968:37) which permits some degree of inherent specimen variability to be tolerated and accomodated. Third, these tools have demonstrable culture-historical significance by virtue of their temporal persistence for at least two and a half millennia throughout the Interior Plateau and most of the Arctic (Chapter 4). Lastly, they have specialized functional significance which involved an important and recurrent "primary" task, although it is acknowledged that they may have also been occasionally used for "secondary" functional purposes (Chapter 10).

Early ethnographic sources for the Plateau do not describe any tool having exactly the same characteristics outlined for this artifact type. This is not surprising since their use appears to have been discontinued about 1000 years ago (Chapter 4.2). However, a hooked, inversely retouched, unifacial knife with a vaguely similar formal outline is illustrated in Teit (1900:184,Fig. 126). Teit (1900:474) maintains that such knives were used to cut and carve antler and bone. The similarity in outline between these "crooked" knives and key-shaped formed unifaces is regarded as coincidental, since his illustrated example indicates several salient differences with respect to technological attributes and functional edge angles. Nevertheless, it provides an approximate analogue of how key-shaped formed unifaces may have been hafted and used. Also, Smith (1900:418) illustrates a classic key-shaped formed uniface from the Thompson River region which he maintains is morphologically similar to "carving-knives" used during the ethnographic period.

Once a clearly meaningful key-shaped formed uniface "type" was shown to exist, a "positivist" approach (see Hill and Evans 1972; Hayden 1984), was employed to better understand the significance of this type by generating contextual and use-related hypotheses. These in turn were used to organize and categorize attribute data observed on key-shaped formed unifaces to help generate descriptions and to create analytic units that could be used to help determine the significance and function(s) of these tools. This approach dealt exclusively with recognizing and defining specific attributes inherent to these tools, such as the kinds of lithic raw material employed, the different sorts of morphological and/or technological characteristics represented, the kinds of microwear trace patterns observed on their functional edges, etc. (see Chapters 2.2, 3.4, 6 and 8). I stress that these attribute "types" are etically conceived constructs to assist in resolving specific analytic problems related to descriptive and behavioural matters.

3.3 Design Theory

In its archaeological context, design theory collectively considers attribute characteristics of a tool (i.e., morphology, size, raw material, production mode, etc.), and integrates this information with use-analysis to permit behavioural inferences about decision-making processes relating to how the tool was conceived, made, used, and resharpened (Kleindienst 1975,1979:59-60). Design theory assumes that a tool is manufactured in order to solve a specific adaptive or functional problem, and that several constraints dictate its finished form, the material it is produced from, and its mode of manufacture. Such constraints interact dependently, and include functional efficiency related to morphological characteristics, raw material physical properties and availability, technological proficiency of the craftsperson, and economic factors related to tool production and use (Horsfall 1987:333-334). The manner and degree to which these factors interact can covary, and design theory acknowledges that a given problem may have a number of different, and equally effective solutions.

Bleed (1986) suggests that the overall design of a tool is influenced by either an explicit or implicit selection of alternative variables related to functional effectiveness, reliability, maintenance, material availability, aethestics, cost, and environmental constraints (see also Hayden 1987a). As a result, designs often vary for tools engaged in the same task, and some designs may be more reliable, more easily maintained, and/or more efficient than others. Reliability and maintainability are very prominent considerations in the design decision process, and although it is sometimes possible to isolate aspects related to either of these factors, they may often meld together to fulfill requirements of both systems.

There is ample reason to believe that key-shaped formed unifaces were designed to be reliable and easily maintained. The obvious selective preference for particularly hard and durable lithic materials (Chapter 3.3.3) considerably enhanced tool longevity and efficiency by reducing the incidence of required resharpenings (Chapter 3.3.2), and the possibility of accidental breakage. Also, the usual overall design of this tool type is such that it could be easily subjected to a series of repeated resharpenings (i.e., maintained) without significantly affecting tool performance or efficiency (Chapters 3.3.1 and 3.3.2; Figure 5).

The emphasis on optimizing the efficiency, reliability, and maintainability of key-shaped formed unifaces strongly supports the conclusion that most of these tools were curated, and they were designed to deal with a specific anticipated, important, and recurrent task. The significance associated with the curation of these tools is dicussed further in Chapters 3.6 and 9.3.

3.3.1 Morphological Considerations

The consistent dimensional and morphological attributes characterizing key-shaped formed unifaces (Appendix 3; Table 1; Figures 11 to 20) restricts their functional potential. Highly patterned, recurrent morphological and technological attributes, and microwear traces (Chapters 2.2 and 6.0) indicate that the most functionally important parts of this tool type are the concave margin edge, ventral-lateral corners of the distal projection tip, and occasionally the edge of the "opposite" margin (Figure 2).

The slightly to moderately concave outline of the "concave" margin, and its recurrently steep "scraper-type" edge angle (60°-85°) suggests that it is most effectively suited for scraping, shaving, and planing actions (Wilmsen 1970:70-71; Hayden 1979c; Cantwell 1979). Furthermore, it is argued that the concave edge outline and length range are ideal for working cylindrical contact materials having diameters ranging between about 5 and 30 mm. This would be most effectively realized by placing the ventral face of the tool against a cylindrical contact material with the concave margin facing the user, and then drawing the tool towards the body in repeated strokes (see Chapter 6.3 and Figures 43 and 44).

The very low frequency of tools exhibiting acute/invasive distal projection angles (Table 1), the common recurrence of blunted distal projection tips, and consistently curved concave margin oultines argues strongly against these tools having been used for piercing or perforating as has often been loosely inferred. Rather, the typical shape and character of the entire distal projection on relatively complete or nearly complete tools is logically suited to gouging, prying, graving or incising actions, such as would be required for removing secondary branch nodes on stalks and branches, or creating linear slots or grooves in wood, bone, or antler (see Figures 9, 48 and 50).

The high degree of variability indicated for edge angles and formal outlines of the "opposite" margin (Table 1) suggests that it may have had less functional importance than the concave margin and the distal projection. The generally steep edge angles suggest that it might be potentially effective for scraping, shaving, and planing cylindrical or elongate contact materials. However, this margin could only function well in this capacity when being pushed away from the user (see Figures 45 and 47). Microwear traces on several prehistoric microwear sub-sample specimens indicate that the "opposite" margin was indeed occasionally used in this fashion (Chapter 6.2).

The overall shape of these tools is conducive to being comfortably hand-held by placing the thumb on the proximal portion's dorsal surface, third finger on the ventral surface, and index finger on the dorsal face of the "opposite" margin. The formal outlines of the proximal half of the majority of these tools (Figures 11 to 20) are such that they are quite suitable for hafting, and three items bear obvious hafting features (Figures 12k, 12l and 16i'). The relatively low standard deviation values indicated for certain dimensions of the proximal half of these tools (Table 1) may reflect a conscious effort to standardize their basal form to accomodate hafting (see Chapters 3.5 and 7.3).

3.3.2 Resharpening

Hayden (1987a) has posited a model which suggests that on a general level, many lithic tool morphologies are directly related to effective resharpening strategies above all other reasons. He argues that "normative" ideas about shaping most tools were not held by their manufacturers (with exception of hafted tools), rather, they were made with an idea about a specific task to perform, the kind of edge best suited for that purpose, resharpening considerations, and hafting strategies. Economics of a resharpening strategy depended upon the amount of materials to be processed, and properties and availability of the lithic material used. Goodyear (1979:4) has raised a similar point in discussing the organizational "flexibility" of Paleo-Indian lithic technologies. He suggests that tool designs were partly governed by their ability to be continuously and reliably rejuvenated, and by their potential to be remodelled into functionally different tools.

Resharpening and rejuvenation strategies indicated for prehistoric key-shaped formed unifaces in the study sample are schematically illustrated in Figure 5. The initial formal design of the distal half of these tools can easily accomodate a number of minor resharpenings of the concave margin and distal projection tip without detrimentally affecting their functional efficiency. The most commonly executed resharpening strategy is indicated in Figure 5a, the next most frequent is represented in Figure 5b. Those indicated by Figure 5c-e are considered rare. I estimate that the concave margin of an average tool could have been resharpened as many as ten to fifteen times, however, the frequency would have largely depended on the initial tool form, lithic raw material, and the nature, degree, and extent of use-damage incurred to the concave margin edge and/or distal projection tip.

The predominant resharpening strategy patterns suggest that, for the most part, constant maintenence of a prominent and slightly blunted projection tip was important to the primary function and efficiency of this tool. Since the overall initial design of these tools demanded an optimal balance between conserving as much potentially resharpenable edge as possible on the concave margin while at the same time maintaining a useful projection tip, at the beginning of their use-lives, many tools probably resembled Figures 5a, 11a, 12g, 14d, 14l, 16z, 16a', 17n' and 19a'.

Preferential use of hard and durable raw materials would have significantly reduced the incidence of required resharpening episodes and

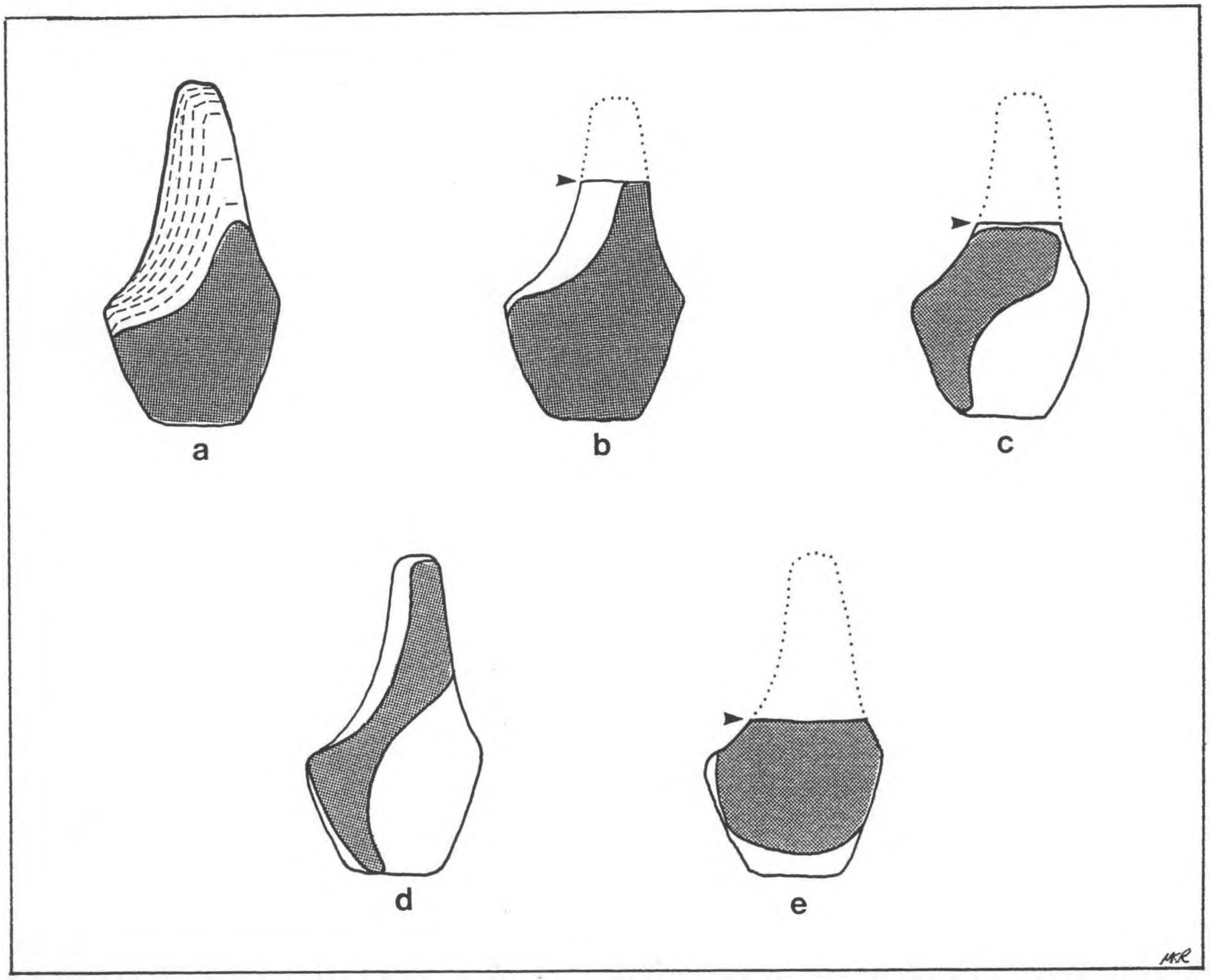

Figure 5. Resharpening, rejuvenation, and recycling strategies represented in the study sample of 129 prehistoric key-shaped formed unifaces. Shaded portions represent final exhausted tool form, solid line represents original outline, and dotted line represents a snap removal.

Strategy

(a): Typical pattern of successsive resharpenings suggested by most sample specimens.

(b): Common rejuvenation pattern for items where major portions of projection was lost to accidental removal.

(c): Relatively rare rejuvenation pattern executed when large portion of projection was lost.

(d): Rare rejuvenation pattern resulting in complete reversal of concave margin location.

(e): Rare recyling pattern where convex endscraper is produced from basal portion of exhausted or broken tool.

replacement rates, thereby affording greater tool efficiency, maintainability, and reliability (Bleed 1986). These are particularly important for curated tools designed to rapidly and effectively cope with recurrent anticipated activities undertaken by specialized task groups (Binford 1979,1980), in situations where important resource procurement scheduling and tool production conflict and create "time-stress" problems (Torrence · 1983), and/or when there was a scarcity of suitable lithic raw materials for tool production (Bamforth 1986a; Hayden 1987a). The significance and implications of preferential lithic raw material selection and its relationship to the phenomenon of curation is discussed in greater detail below, and in Chapter 3.6.

3.3.3 Lithic Raw Material Properties

Raw material properties have been largely overlooked or ignored in lithic studies, although some researchers have provided a number of significant and useful insights (e.g., Goodman 1944; White and Thomas 1972; Gardener 1976; Goodyear 1979; Greiser and Sheets 1979; Kamminga 1982; Magne 1985; Gould and Saggers 1985; Horsfall 1987).

Physical and mechanical properties of lithic raw materials should be carefully considered when assessing matters concerning tool production, design, function, efficiency, resharpening and maintenence, microwear patterns, and replacement rates. Aboriginal preferential selection of certain lithic raw materials for production of specific tool types can provide some insights into why and how they were designed and used. Several important lithic raw material properties are density, relative hardness, toughness (durability), resiliency, and flakeability (Grieser and Sheets 1979:293-296). These properties usually covary between different lithic types, and are sometimes, but not always interdependent.

A salient characteristic of the prehistoric study sample of key-shaped formed unifaces is that the majority (88.4%) of items have been manufactured from a variety of relatively rare "exotic" silicates (i.e., chalcedony [60.5%] and cherts [27.9%]) rather than from more commonly available basalts which only constitute 11.6% of the study sample tools. I regard this high frequency of exotic silicates to be directly related to specific functional concerns, as about 80 to 90% of items assigned to almost all other chipped stone tool type categories on the Canadian Plateau were made from basalts. I postulate that most chalcedonies and certain types of tough cherts available on the Canadian Plateau were often selected over the more common and less durable basalts for production of tools requiring extensive edge utilization (see also Grieser and Sheets 1979:296).

Two important properties inherent to these silicates that differ from basalt are their superior hardness and toughness (durability). Using the simple Moh scale scratch test, hardness values were determined for several types of chalcedony, chert, and basalt used by prehistoric groups on the Plateau (see Appendix 7). The average hardness of tested chalcedonies varied between about 7.0 and 8.0; cherts from about 6.5 to 7.5; and basalt between about 6.0 and 6.5.

Superior hardness and toughness of chalcedony and some types of cherts have been experimentally demonstrated by the Shore Schleroscope and Paige Impact Tester (Grieser and Sheets 1979:293-294), the Los Angeles Abrasion Test (Kamminga 1982), and in the present study (Chapter 7.7). These properties suggest that the primary use-behaviour associated with key-shaped formed unifaces likely involved working of relatively hard contact materials, such as bone, antler, or dense wood (see Kamminga 1979:299). Hard and durable lithic raw materials used for working such contact materials significantly increases a tool's use-life. This reduces the incidence of required resharpening and replacement, consequently increasing tool reliability (Chapter 3.3.2).

Although many key-shaped formed unifaces are made from brightly coloured, and/or mottled polychrome cryptocrystalline silicate materials, I doubt that these materials were selected specifically for their purely "aesthetic" or "symbolic" properties. Rather, I argue that the superior hardness and durability of these materials was being sought by prehistoric lithic technicians, and that the notable aesthetic chromatic properties observed for many specimens is simply a coincidental feature of most cryptocrystalline silicates found on the Interior Plateau.

Lithic raw materials were sometimes subjected to thermal alteration to improve or enhance certain physical properties of the stone prior to secondary reduction (i.e., tool forming) (Crabtree 1964; Purdy and Brooks 1971; Purdy 1974; Mandeville 1971,1973; Solberger and Hester 1972; Hester 1972; Mandeville and Flenniken 1974; Ahler 1983; Rick and Chappel 1983). It has been suggested that thermal alteration sometimes improves flakeability by annealing flaws, and enhances tool efficiency by increasing cutting edge sharpness (Flenniken 1981:27). Other effects may be changes in raw material colour and luster, and increased brittleness.

Thermal alteration of lithic materials can usually be detected by the presence of "potlidding" or differences in luster. If a flake blank (lacking cortex) is thermally altered and subsequently retouched, the unretouched surface will often have a relatively dull waxy or pearly luster and texture, whereas retouched surfaces will have a glassy luster (Mandeville 1973; Purdy and Brooks 1971; Crabtree 1964; Rick and Chappell 1983). Using these criteria, 27% of key-shaped formed unifaces in the study sample (most of them chalcedony) had been intentionally subjected to thermal alteration (Appendix 3).

Most Plateau chalcedonies in their "raw" (i.e., unaltered) state are usually difficult to flake using direct hard hammer percussion because of their remarkable hardness and resiliency. Also, moderate to high incidence of fracture planes, large inclusions, and other flaws often hinder effective production of large flake blanks with smooth ventral faces which are required for producing key-shaped formed unifaces. I suggest that many chalcedony and some chert flake blanks were thermally altered prior to being produced into key-shaped formed unifaces -- and perhaps into other formed tool types for that matter -- to anneal internal flaws which in turn enhanced flakeability, and perhaps to improve edge sharpness. These improvements would have consequently afforded greater functional efficiency, and also enhanced the reliability and maintainability (Bleed 1986) of tools made from altered materials compared to those produced from unaltered materials of the same type. Thermal treatment of flake blanks used to produce key-shaped formed unifaces is discussed further in Chapter 9.3.

Considering all the above aspects of design theory as they relate to key-shaped formed unifaces, I conclude that:

(1) the concave margin appears to have been the primary functional edge, and its morphology is functionally suited for scraping, shaving, and planing elongate cylindrical contact materials with diameters ranging between ca. 5 and 30 mm;

(2) the relatively blunt tip of the distal projection is best suited for gouging, prying, or scraping actions rather than for piercing or perforating as has often been suggested, and the ventral-lateral corners of the projection tip are ideal for gouging, incising, and graving relatively hard contact materials such as wood, antler or bone;

(3) the "opposite" margin is also usable for scraping, shaving, and planing actions, but it is considered to have had secondary or incidental functional importance because of greater variation in edge angles, formal outlines, and retouch patterning;

(4) the proximal morphology of these tools suggests that some may have been used hand-held, whereas others were probably hafted;

(5) the morphology of the distal half of the tool is such that it can accomodate successive resharpenings of the concave margin and distal projection tip without significantly altering functional efficiency; and

(6) the obvious preferential selection of "exotic" silicates suggests that relatively hard contact materials (e.g., bone, antler, or hard wood) were worked, and by using these materials, the incidence of required edge resharpening and tool replacement was significantly reduced, and maintainability was enhanced.

3.4 Microwear Research

The primary objective of microwear (use-wear) research is to determine the function of prehistoric stone tools and thereby contribute to our understanding of certain aspects of prehistoric human behaviour. It usually involves experimental replication and use of tools, observing resulting microwear patterns, and subsequently applying these data to prehistoric artifacts to infer their probable function(s) (Semenov 1964; Tringham *et al* 1974; Keeley and Newcomer 1977; Lawrence 1979; Newcomer and Keeley 1979; Odell 1979,1980; Keeley 1980; Brink 1978a; Flenniken 1982; Kamminga 1982; Sabo 1982; Vaughan 1985; Richards 1987). Ethnographic observations have also been used to advance inferences regarding prehistoric tool functions (Gould, Koster, and Sontz 1971; Nissen and Dittemore 1974; Hester and Follett 1976; Hayden 1976a,1979b).

The experimental approach to microwear research requires an understanding of how typical wear traces (i.e., polish, rounding, striations, use-fracturing) are formed in response to specific aboriginal use-conditions (Witthoft 1967; Brink 1978a,1978b; Kamminga 1978,1979, 1982; Cotterell and Kamminga 1979,1987; Del Bene 1979; Diamond 1979; Lawn and Marshall 1979; Tsirk 1979; Odell 1981b; Mansur 1982; Meeks *et al* 1982; Unger-Hamilton 1983,1984; Bettison 1983,1985).

The physical and/or mechanical processes responsible for formation of some types of microwear traces are complex and not completely understood. As a consequence, several hypotheses regarding their formation processes exist. These, and other important aspects of microwear research have been summarized and discussed by Keeley (1974), Olausson (1980), Odell (1982), and Vaughan (1985). Current models for microwear trace formation and their potential interpretive significance are presented and discussed in Chapter 6.

3.5 Hafting

Keeley (1982) has pointed out that effects of hafting and retooling have been sorely neglected in lithic studies. He maintains that hafted tools tend to be small, extensively retouched, commonly curated, often have special features related to hafting (e.g., notches, shoulders, tangs), and are usually easily assigned to "classic" morpho-typological categories because of repeated resharpening and morphological standardization (see also Binford 1979; Ebert 1979). Keeley suggests that hafted tools also tend to be discarded at base camps within or adjacent to retooling areas such as around hearths or within shelters (Keeley 1982:802).

There is direct evidence that a few tools in the study sample were hafted. Three items in the study sample bear opposing notches on their proximal-lateral margins (Figures 12k, 12l and 16i'). Another nine exhibit typical polish and rounding microwear traces on the dorsal and ventral surfaces of their proximal aspects, which may have been caused by hafting prehension abrasion. One item is coated with a polymerized plant resin (Figure 40) which is interpreted to be hafting mastic residue. Also, 23 items in the study sample bear retouch on the ventral face along the proximal margin, a practice that increases hafting efficiency by removing all, or part of a salient bulb of percussion from a flake blank. The actual proportion of hafted tools in the prehistoric study sample cannot be determined, but it is suggested that it may have been quite large, perhaps as high as 75% to 90%.

There are at least two important behavioural implications that can be inferred from hafted items. First, hafting helps support the contention that all, or many key-shaped formed unifaces were curated as a component of personal gear (Binford 1979). Hafted/curated tools would have been particularly useful to specialized and highly moblile task groups engaged in extracting, processing, and transporting large quantities of resources (Binford 1980); during periods of "time-stress" when conflicts arose between resource procurement and processing scheduling and tool production (Torrence 1983); or when suitable lithic raw materials for tool production were scarce (Bamforth 1986a) (see also Chapter 3.6). Second, hafting must have somehow enhanced functional considerations, perhaps by permitting greater ease of manipulation and/or by increasing efficiency. Indeed, the experimental component of this study clearly demonstrated that hafted key-shaped formed unifaces functioned more effectively, efficiently, and with greater comfort than unhafted tools (Chapter 7.7; Appendix 9).

3.6 Curation

An important organizational aspect of lithic technologies is the concept of curation. Curated tools are used, maintained, and transported about for extended periods of time. They are often made of high quality materials (i.e., durable and sharp with fair-to-good flakeability), exhibit evidence for considerable investments of production time, and many are hafted.

Binford (1979,1980) regards curation as an integral component of personal gear, involving items designed to cope with anticipated and/or frequently recurring task situations. He suggests that curation is more likely to be practiced by people participating in a collector or "logistical" settlement and subsistence system, where specialized mobile task groups set out to extract and process resources from distant sources and transport them back to base camps to be consumed by larger social units. In such systems, task-specific, reliable, and easily maintainable curated tools would have been desirable, as they permitted large quantities of materials to be processed with less time and energy than would have been possible using less efficient expediently-produced tools.

On a similar bent, Torrence (1983:11-13) proposes that curation was most practical during "time-stress" situations where conflicts arose between resource extraction and processing activities and time required to produce tools to undertake these tasks. She maintains that scheduling stress could be alleviated by using curated tools manufactured prior to periods of mutually disruptive subsistence tasks when timing was not a problem. This ensured that tool production time did not directly conflict with important subsistence activities, and that the tools could be appropriately designed to help reduce the time requried to execute them.

In a review of technological efficiency and curated technologies, Bamforth (1986a) correctly points out that curation is a complex phenomenon that cannot be adequately attributed to any single factor. Although he acknowledges that subsistence and settlement systems are important, he argues that curational behaviour can also be explained as being a response to local raw material scarcity. In situations where raw materials were rare, or access to them was restricted, production of efficient and highly maintainable curated tools helped to offset stresses caused by material shortages by extending tool longevity and by reducing the incidence of required tool replacement (see also Hayden 1987a).

Identification of curated tool types and determining their related functions can assist in disclosing the nature of anticipated and recurrent task situations encountered by their aboriginal users. Exhausted items, particularly hafted ones, were often discarded at retooling stations which may or may not have been associated with their location of use (Hayden 1976b, 1987b; Keeley 1982).

It is apparent that many key-shaped formed unifaces were curated. This is suggested by the observations that: (1) they indicate reasonable amounts of time invested in their manufacture; (2) most are made of relatively rare, durable, "exotic" materials; (3) a number of excavated items are made from materials whose quarry sources are considerable distances away, and other artifacts of the same materials were not encountered at the sites; and (4) several items were clearly hafted (Chapter 3.5), a practice regarded to be highly indicative of curated tools (Keeley 1982:798-799).

That key-shaped formed unifaces appear to have been highly curated has several important implications for our understanding of Plateau prehistory. Following Binford's (1979,1980) arguments regarding curational behaviour and subsistence-settlement systems, the use of key-shaped formed unifaces during the late prehistoric period on the Plateau is consistent with the established interpretation that people participated primarily in a "collector/logistical" subsistence and settlement system that was particularly intense during the non-winter months. Large winter pithouse villages and evidence for reliance on stored salmon are also considered to be components of this type of subsistence and settlement strategy (Richards and Rousseau 1987:50; Campbell 1985:490).

The presence of key-shaped formed unifaces in components radiocarbon dated between ca. 4000 and 1000 BP on the Plateau (Chapter 4.2; Table 2) supports the conjecture that curated technologies may have been important for executing some tasks, thereby helping to alleviate time-stress problems created by mutually conflicting resource procurement activities (Torrence 1983). This may have been particularly true during non-winter months when timing of resource procurement and processing was most critical, and task conflicts were likely to have been more common. The apparently higher relative frequency of key-shaped formed unifaces at non-winter, non-housepit sites (Chapter 9.3) compared to winter pithouse village sites supports this hypothesis. During winter months when group mobility significantly decreased and pithouse villages were occupied, time-stress situations rarely occurred because of predominant reliance on stored food and lithic resources. Consequently, simple expediently produced lithic tools with high replacement rates were more commonly used since there was ample time to make them. Indeed, high proportions of expediently produced lithic tools is a consistent assemblage patterning noted at many excavated winter pithouse village sites on the Canadian Plateau (see also Parry and Kelly 1987).

It might be further speculated that use of task-specific curated technologies may have been most common during the Plateau horizon (ca. 2400 to 1200 BP) on the Canadian Plateau when it is hypothesized that salmon populations declined, and exploitation of secondary resources (e.g., upland game and plants) was intensified to offset shortages of this important storable resource (see Lawhead, Stryd, and Curtin 1986:31-32; Richards and Rousseau 1987:56-57). Because availability of many of these secondary resources was probably just as prevalent then as they were during the ethnographic period (see Teit 1900,1909; Ray 1933; Palmer 1975), extensive use of curated tools (including key-shaped formed unifaces) would have helped to relieve scheduling problems and enhance the efficiency of logistical resource extraction and processing activities.

Bamforth's (1986a) argument concerning curational technology and lithic raw material scarcity also has some value for explaining why key-shaped formed unifaces were curated on the Canadian Plateau. Cryptocrystalline silicate sources on the Canadian Plateau are relatively scarce, highly localized, and difficult to access (Leaming 1971), and production of large flake blanks from these materials was hindered by small average core size and internal flaws (Chapter 3.3.3). A considerable amount of time and energy would have been required to constantly replace expediently produced tools made from these highly prized materials, therefore, curational behaviour, efficient maintenence, and recycling (Chapter 3.3.2) were initiated as economizing measures. On most of the Columbia Plateau where cryptocrystalline silicates are more common (Campbell 1985:290-299), cost-benefits afforded by such mitigative strategies may not have been required, which may partially account for comparatively lower average frequencies of key-shaped formed unifaces at sites in this culture sub-area.

Curated chipped stone tools can easily incur incidental trauma-produced microwear traces (i.e., scratches, microflake scars, polish) caused by edges or faces of the tool coming into forceful contact with hard objects during periods of transport. However, for prehistoric key-shaped formed unifaces this type of microwear is expected to be randomly represented, and should be less intense and less frequent than microwear traces produced by use. Traumatic damage due to curation may account for at least some of the rarer types of wear observed on the 35 prehistoric microwear sub-sample specimens (Chapter 8.4). Similarly, rarely executed task activities not related to the primary function of these tools would impart microwear patterns atypical to those perceived as representing the "norm" (see also Hayden 1987b).