Chapter 13

The Formation of Lithic Debitage and Flake Tool Assemblages in a Canadian Plateau Winter Housepit Village: Ethnographic and Archaeological Perspectives

William C. Prentiss

Introduction

Studies into the formation of the archaeological record have been termed "middle range" (Binford 1977a, 1981), typically focussing on the identification of probabalistic relationships between organized behavior (as in the organization of lithic technology) and the formation of archaeological patterning. Middle range research into the formation of lithic assemblages, has utilized a largely economic approach considering factors such as the effects of raw material accessibility (Andrefsky 1994; Hayden 1989; O'Connell 1977; Wiant and Hassan 1985), activity requirements (Hayden 1989), and mobility strategies (Binford 1977b, 1979; Kelly 1988). Some recent discussion, however, has also turned to social organization, gender, and ideology as conditioning factors as well (Gero 1989, 1991; Sassaman 1992). Finally, taphonomic processes such as soil mixing, trampling, fluvial modification, and downslope movement have received attention (Cahen and Moeyersons 1977; Prentiss and Romanski 1989; Rick 1976; Shackley 1978; Turnbaugh 1978).

Probably, one of the most important areas of lithic research today stems at least in part from taphonomic studies of faunal assemblages where multiple agents and processes are recognized as contributory towards the final appearance of archaeological assemblages (cf., Behrensmeyer and Hill 1980; Binford 1981; Brain 1981). Hayden (1990) has researched the sequential effects of multiple activities on use-wear formation on single tool edges. Dibble (1987) has researched the effects of use and resharpening strategies on the morphology of individual tools. A number of researchers have initiated research into the effects of occupation span and reoccupation type and tempo on archaeological lithic assemblage composition (Camilli 1983; Ebert 1992; Wandsnider 1992).

In this chapter, I present a case study in the formation of archaeological lithic debitage and flake tool assemblages from a housepit village in the Middle Fraser Canyon of south-central British Columbia. The ethnographic data (Vol. II, Chap. 2; Teit 1900, 1906, 1909) are used to develop a model of winter household occupation focussing on the sequence of processes occurring during a given winter period leading to the formation of lithic assemblages. I then examine the debitage and flake tools from the floor of a large housepit at the Keatley Creek site from the Middle Fraser Canyon in order to explore the possibility that similar formation processes occurred during the winter occupation of Late Prehistoric winter housepit villages. The debitage and flake tool analysis relies on pattern recognition criteria derived from utility index based mathematical models of assemblage composition (Prentiss 1993). Essentially, this approach allows the effects of multiple sequential processes on flake tool and debitage assemblage composition to be explored experimentally. Archaeological data can then be interpreted with the aid of the experimental models. Conclusions of the study are similar to those of Dibble (1987) and Hayden (1990), in that I argue for increased attention not only to the effects of individual agents (trampling, reduction strategy, etc.), but also for increased consideration of formation sequences.

This study is important to the goals of the Fraser River Investigations into Corporate Group Archaeology project for several reasons. First, it reconfirms some of the basic lithic strategies (block core, bifacial reduction, bipolar reduction) proposed and discussed by others using independent criteria (see Vol. I, Chap. 12; Vol. II, Chap. 11). Second, it reconfirms much of the basic activity patterning across living floors using debitage analysis, and hence it also reconfirms inferences concerning basic socioeconomic organization in HP 7. Third, this study helps document aspects of site formation processes concerning lithics, not dealt with by other studies, in particular trampling and recycling. These aspects assist in the modeling of the lithic economy at the site, help explain the overall similarities between deposit types, and also help identify high versus low traffic or activity areas.

Risk Management, Mobility, and Activities

The Upper Lillooet and the Canyon Division Shuswap utilized a wide range of tactics for reducing risk, or the potential for shortage or a loss of resources (Winterhalder 1986) including territoriality, resource sharing, socio-political organization, potlatching, trade, warfare, mobility and technology, and storage (Hayden 1992a). Most notably, these people relied on a strategy of intensive storage, logistically organized resource collecting, a biseasonal pattern of winter sedentism and spring, summer and fall mobility (Alexander 1992b), and a relatively complex technology (Teit 1906, 1909). These groups are also known for a fair degree of socio-political complexity with ownership and control of certain critical resources by individual bands and high ranking families (Romanoff 1986, 1992; Teit 1906:254), slavery (Teit 1906:264), household crests (Teit 1906:256), and extensive trade and warfare controlled by community leaders (Cannon 1992; Hayden 1992a, b; Teit 1909:576). Most critical for understanding archaeological assemblages produced by winter housepit occupations are the roles of mobility and technology, corporate group organization (cf., Hayden et al. 1985), and labor organization.

Kelly (1983) has drawn a distinction between the mobility strategy and the seasonal round, noting that while the seasonal round refers to the geographic movement of people, the mobility strategy refers to the decision making process behind residential group and task group movement. Mobility strategies in the Middle Fraser Canyon were organized in a logistical fashion (cf., Alexander 1980) being seasonably sedentary in winter villages.

At winter villages, Teit's ethnographic descriptions and Alexander's broader analysis (Vol. II, Chap. 2) indicate a primary focus on wood-working and hide-working using tools such as chisels, carving-knives, scrapers, and arrow smoothers for wood-working and knives and scrapers for working hides. It is assumed that lithic reduction was most typically oriented towards making tools for these purposes. The situation of intensive lithic tool use and possibly production, oriented towards production of other more complex tools, clothing, and shelter, probably occurred most commonly during the winter "down" time (cf., Vol. I, Chap. 12; Binford 1979; Bleed 1986). It was also at this time that lithic resources were most inaccessible due to snow and ice cover and difficult travelling conditions. Given this situation, it is likely that raw material stockpiling was practiced, perhaps in a somewhat similar way to that described by Parry and Kelly (1987) and as argued in the preceding chapter. If raw material stockpiling did occur in this fashion, then it most likely was accomplished by production and storage of cores and various sizes and shapes for use in producing tools throughout the winter months. Following Goodyear (1989), I also suggest that bipolar reduction strategies could have been a useful late winter activity for extending raw material use-life. During longer winters this strategy may have been common, particularly when combined with strategies for intensive reuse of tools and scavenging and reuse of discarded tools.

A Model of Lithic Assemblage Formation Processes for Middle Fraser Canyon Winter Housepit Villages

The composition and spatial organization of lithic artifact assemblages are expected to have been affected by three types of processes: lithic reduction and tool use/discard strategies, the spatial positioning of activities on the housepit floor, and taphonomic processes. The sequence of individual agents and events operating across a winter's occupation are considered to be the responsible factors governing housepit floor lithic assemblage formation. There may also be effects from reoccupations through different winter periods on the same floor. I consider these effects within the lithic reduction and taphonomic processes categories. All conclusions and predictions are drawn or extrapolated from the Middle Fraser Canyon ethnographic record.

Lithic Reduction, Tool Use, and Discard

Lithic reduction strategies are expected to have been most affected by economic considerations related to raw material conservation, immediate tool needs and expected future tool needs. If access to lithic raw materials is substantially reduced or eliminated, one would expect to see an increasing focus on raw material conservation. This might be indicated by higher degrees of edge preparation during core reduction, coupled with salvaging of flakes from exhausted tools and cores using bipolar techniques. In this fashion, flake tools might continue to be used, but in a more curated fashion. This could be indicated by more intensive resharpening of some tools and reuse for new purposes of other previously discarded tools. Archaeological assemblages resulting from this process would contain a range of heavily retouched and broken, but minimally retouched flake tools. On initial inspection, these assemblages could appear to represent largely expedient tool use, while the actual formation process may have been far more complex with some tools undergoing curated use and many others used expediently on multiple occasions (or serial expedient use). Teit's descriptions of a range of different types of specialized flake tools indicates that this could be likely.

The selection and use of flakes (or flake culling from debitage assemblages) can be predicted to have operated in three fashions. First, reoccupation of old house floors may have resulted in scavenging of flakes produced during earlier occupations. Second, lithic reduction likely focussed on production of primary flakes for either curated or expedient use. Thus flake culling focussed initially on those flakes, which were probably larger with either high or acute edge angles, depending on needs. Flakes culled for hafting and exceptionally long use probably had edge angles that facilitated further reduction and shaping. Third, specialized tool needs and late winter raw material shortages probably encouraged people to intensively use secondary biproducts of the reduction process. These are broken flakes resulting from accidental breakage of either primary or platform preparation flakes.

"Gearing up" is expected to have been an extremely important activity, particularly during late winter. Lithic reduction activities are expected to have focussed on production of flakes for use in manufacturing and repairing other gear. Some specialized lithic tools are expected to also have been manufactured at this time for use during spring hunting and gathering activities. Some of these included bifacially flaked projectile points, processing knives, and scrapers.

To summarize lithic reduction and tool use/discard processes, I argue that the primary goal of chipped stone technology in the Middle Fraser canyon was for the production and maintenance of other organically based tools including arrows, spears, traps, nets, digging sticks, baskets, and hide bags and clothing. A substantial amount of manufacture and maintenance of these items was conducted during the period of winter sedentism. An important, though secondary goal (in terms of raw material quantity used) was in production of lithic tools to be used as personal gear during hunting and gathering activities after winter-village abandonment in the spring. This required enough lithic materials to be available for continuous use over a period of at least three months. This was accomplished by stockpiling raw materials in the form of cores in winter housepits during the fall and second, by producing specialized flake tools for curated and serial expedient use during this period. Late winter shortages were dealt with using bipolar reduction techniques to salvage additional flakes from exhausted cores and worn out bifacial and flake tools.

Spatial Organization

The spatial associations between lithic artifacts on housepit floors is expected to be the result of a number of factors related to the spatial positioning of domestic (family) units, the social status of those families, the organization of activities on housepit floors, and any clean-up activities undertaken. It is expected, that unless modified by taphonomic processes or clean-up activities that the effects of social and activity organization will be recognizable on winter housepit floors. Clean-up activities are discussed further along with taphonomic processes below.

Teit (1909:492) described the interior spatial organization of Thompson and Shuswap winter houses as having four major "rooms." The "head" or "upper room" was located closer to uplands outside of the house. The "kitchen" or "storeroom" was located on the side of the house closer to water, opposite the upper room. The third area was called the "under-room" or the space under the ladder by which one entered the house from the roof. Finally, the space opposite the ladder was termed the "bottom room." In houses large enough to contain multiple families, individual family or domestic units were distributed around the walls with storage, work, cooking, and sleeping space set behind a prominant "fireplace" (Teit 1906:214). Though Teit's (1906) description is for a Lillooet wooden longhouse, it seems likely that a similar arrangement would have been practiced in larger housepits during earlier times.

By combining Spafford's analysis of stone tool occurrences across housepit floors (Vol. II, Chap. 11) together with Teit's various descriptions of winter residences it is possible to arrive at a composite picture of potential spatial organization of larger winter housepit floors, where multiple families may have wintered (particularly among larger co-resident corporate groups; Hayden and Cannon 1982; Hayden et al. 1985). In roughly the center of the floor existed the "under-room" containing the ladder and immediately surrounding space, perhaps also used by occupants moving between different parts of the house. The surrounding space adjacent to the walls was likely filled by domestic units, each with associated hearths and storage areas. If Teit's descriptions of the kitchen room are applicable here, then domestic units may have concentrated most intensively on the river-side of the house. The opposite or upland side of the house may have contained domestic units as well, depending upon population size, but it may also have housed special activity areas. Certainly space was required for some of the intense winter activities associated with gearing up for spring which might have included relatively intensive working of wood and bone and production and regular use of substantial numbers of stone tools.

Some effects of gender and status on

may be recognizable on winter housepit floors. Family social status could potentially have effects on lithic assemblage content through differences in the intensity of certain activities. Teit (1900, 1906, 1909) has documented substantial variability in status and ownership of property ranging from higher status families flush with high quality deer hide clothing and deer meat for food to lower status, poorer members of communities with only sagebrush bark clothing, salmon skin shoes, and limited food resources often resulting in "mooching" from other families and individuals (Romanoff 1992). Following Hayden (1990), it is expected that higher status families would produce more evidence for hide working in particular, perhaps as indicated by more numerous discarded hide working tools such as hide scrapers and piercers. Gender based differences in activities could also be recognizable. Traditionally female oriented activities such as food preparation and clothing manufacture may also be expected to have produced slightly different lithic assemblages from those of men, which consisted of tool and weapon manufacture (Teit 1900:295–296). It seems likely, however, that both men and women produced lithic tools, perhaps with women's lithic tools typically more expedient in nature and men's more durable and curated (Gero 1991; Sassaman 1992). At least one exception to this would be hide scrapers which were made for longer term, more intensive use by women.

To summarize some of the effects socio-political and activity organization on housepit floors, it is expected that regularly spaced domestic areas around the walls of the house would produce lithic assemblages which varied in terms of male versus female activities. From a spatial perspective, female activities might be more prominant around hearths and food storage areas, while male activities might be somewhat removed from these places, perhaps adjacent to sleeping areas near the walls or in special activity areas away from domestic areas entirely, as in the "upper" room opposite the "kitchen" room. Female activities, other than hide working, may have produced more flake tools and by proxy a greater degree of tool recycling and serial expediency, while male activities may have produced more robust and somewhat more intensely used and curated lithic tools. It is likely that men and women produced stone tools. Status differentiation is more difficult to recognize, perhaps best reflected by variability in manufacture of status related items such as deer hide clothing and ornamental items such as dentalium jewelry. The central portion of the house, below the ladder, may have had few activities in walking areas, though there could be expected to have been public work areas as well for situations where more space was needed. Thus, central portions of houses could be expected to contain lithic assemblages ranging from very sparse to dense and complex, depending upon activity intensity and variability.

Taphonomic Processes

The formation of housepit floor lithic assemblages is also expected to have been affected by taphonomic processes associated with human behavior such as trampling, sweeping, and burning. Middle Fraser Canyon winter housepits are thought to have been occupied by relatively high numbers of people often through a period of several months (Hayden 1992a, b; Teit 1900). As lithic reduction and tool use was probably a commonly practiced activity throughout the housepit, I expect that trampling of lithic artifacts was an equally common activity. Areas of reduced foot traffic could be the only locations exempt from trampling. Some of these areas might include floor margins, particularly under benches, immediately adjacent to posts or groups of posts, and in fireplaces used throughout the winter.

Some fireplaces may have received intermittent use, leaving open the possibility of containing trampled lithic artifacts. Some limited crushing of lithic artifacts may also have occurred during roof collapse.

Reoccupation of housepits used during previous winters is expected to have been preceded by some degree of floor cleanup. Thus, in many instances, floors may have been swept or even shovelled out to create an uncluttered, cleaner living surface for the inhabitants moving in for that particular winter. This process is expected to have removed many if not all lithic items, except possibly some micro- or meso-debitage. During the winter occupation, it is possible and perhaps likely that some degree of cleanup may have occurred, producing areas of swept-up lithic items. This process may also have resulted in dumps of lithics in pits, inside or outside of the house, not being used for food storage.

A final agent, potentially responsible for modifying lithic artifacts, may have been fire. Certainly lithic reduction occurred adjacent to fireplaces or hearths within the floor. Items falling into fires may have become heated resulting in thermal fracturing such as potlid and crenated fractures (Purdy 1975). The burning of old housepit roofs may also have created enough heat on some occasions to fracture previously discarded lithic debitage and tools.

Summary

The formation of housepit floor lithic assemblages is expected to be affected by a sequence of behavioral and taphonomic processes. It is likely that both biface and core reduction was practiced on Middle Fraser Canyon housepit floors with biface reduction oriented both towards production of small specialized flakes for tool-use and towards production of more specialized bifacial tools (knives and projectile points; cf., Kelly 1988). Core reduction is expected to have been oriented entirely towards flake production for tool-use. Many tools may also have been acquired through scavenging of available flakes and previously discarded tools. This and bipolar reduction of previously exhausted tools and cores may have become increasingly common during late winter occupation of housepits. Spatial associations of tools and flakes may have been greatly affected by the organization (perhaps gender-based) of a variety of activities ranging from food and clothing preparation to tool and equipment manufacture. The spatial organization of individual domestic units may also have affected lithic artifact assemblages, particularly in association with hearths. A variety of taphonomic processes may also have affected lithic assemblages. Trampling, in particular, is expected to have been common on crowded housepit floors.

Lithic Debitage and Flake Tool Assemblage Formation at the Keatley Creek Site

The large and diverse lithic assemblage excavated from the floor of HP 7 provided the ideal opportunity to study winter housepit floor lithic assemblage formation processes in the Middle Fraser Canyon. Excavations at HP 7 have defined a distinctive compact floor containing numerous post-holes, hearths, and storage pits (Vol. II, Chap. 11 and Vol. III Chap. 5). Research in HP 7 has focussed on identifying the locations of domestic and gender specific work areas on the house floor (Vol. II, Chap. 11). To date, a fair degree of success has been achieved. Spafford has defined a minimum of three primary domestic areas (located in the west-northwest, south, and east-northeast portions of the floor) and two probable gender specific work areas (female oriented activities in the central portion and male activities around the margins). Additional variability in artifact contents through these areas has led Spafford to argue that HP 7 was more complex in its internal arrangements than some of the other excavated housepits (i.e., HP 3 and HP 12). He has suggested that it may have been occupied by a multi-family residential corporate group, as opposed to a lower status extended family.

My research at HP 7 is complementary to that of Spafford. My primary intent is to evaluate the effects of the formation processes defined above (i.e., lithic tool production and use, spatial organization of activities, and taphonomic processes). I focus specifically on identifying the sequence of processes responsible for assemblage patterning across the floor of the house. I draw conclusions regarding the role of lithic technology in risk management strategies of the prehistoric occupants of the house. I also evaluate Spafford's conclusions regarding domestic areas and gender based organization of labor in light of these data.

Though many lithic raw material types were found on the floor of HP 7, the most common type was vitreous trachydacite (often referred to as vitreous basalt). This raw material type was used exclusively in this study in order to facilitate a "distinctive assemblage" approach to recognizing patterning in debitage and flake tool assemblages (cf., Sullivan and Rozen 1985). A more complex version of Sullivan and Rozen's (1985; Sullivan 1987) debitage typology, referred to as the Modified Sullivan and Rozen Typology (MSRT) was utilized as the basic instrument for gathering data and drawing conclusions on assemblage formation (Prentiss 1993). Pattern recognition was facilitated using experimental utility index data (Prentiss 1993).

Analytical Methods

For analytical purposes, a distinction was made between subsquares, analytical units, and analytical sectors. Ideally each of the 16 subsquares per excavation square would have been considered independently in the analysis. Unfortunately, flakes were not common enough on the floor to allow each subsquare to be considered in this manner. Thus, a grouping strategy was used. First, the floor was divided into 102 analytical units and 13 sectors, using Spafford's (1991) density significant sectors (Figs. 1 and 2). I added two additional sectors to the east side of the floor to segregate the bench from the floor areas. With few exceptions, each analytical unit was defined as four subsquares (1 m^2). Occasionally, three or five subsquares had to be used as an analytical unit to fit within each sector. Another complicating factor involved the placement of analytical units over features and adjacent to features such that a single unit was located either nearly entirely over or off of a feature. The purpose of this was to examine the contents of areas of significantly different densities and feature associations independently, assuming that different processes may have affected their formation. Analytical units were used to defined debitage assemblages for multivariate analysis, while sectors were used to define flake tool assemblages.

Both unmodified flakes and flake tools were sorted into MSRT flake types. The MSRT was chosen over the original five flake type Sullivan and Rozen (1985; Sullivan 1987) debitage typology (SRT: complete and split flakes, and proximal, medial-distal, and nonorientable flake fragments) due to the fact that in a reliability and validity analysis, the SRT failed to demonstrate substantial differences in debitage assemblage composition between tool production and core reduction, while the MSRT was able to segregate a wide range of reduction strategies and taphonomic effects (Prentiss 1993). The success of the MSRT led to the development of utility indices for use in conjunction with the MSRT for creating mathematical models of debitage assemblage formation processes (Prentiss 1993). Results of the modelling sequences are used to aid in the recognition of patterning in archaeological debitage assemblages from Keatley Creek.

Flake tools were defined as those flakes with evidence for use and/or modification in the form of retouched edges. Formal tools such as bifaces and end scrapers were not considered. The key to sorting flake tools into Sullivan and Rozen's flake types was to look closely at margin characteristics. Minimally retouched edges without evidence for fracturing were considered to be intact margins. Heavily abruptly retouched edges were considered not to be intact. For example, flakes with lightly retouched distal margins, which were clearly intact before modification were defined as complete. Flakes with invasive retouch, with margins which appeared to be intact before modification were

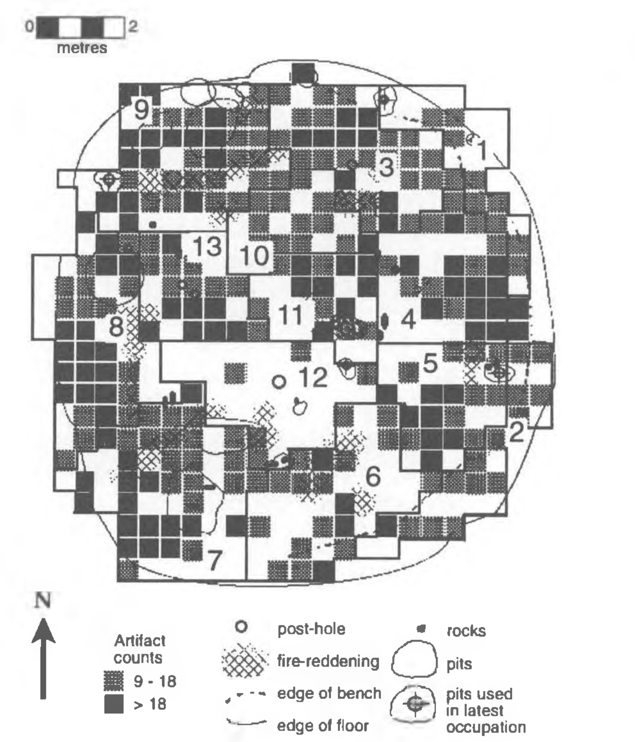

Figure 1. Housepit 7 floor artifact density and sector distribution (adapted from Spafford 1991).

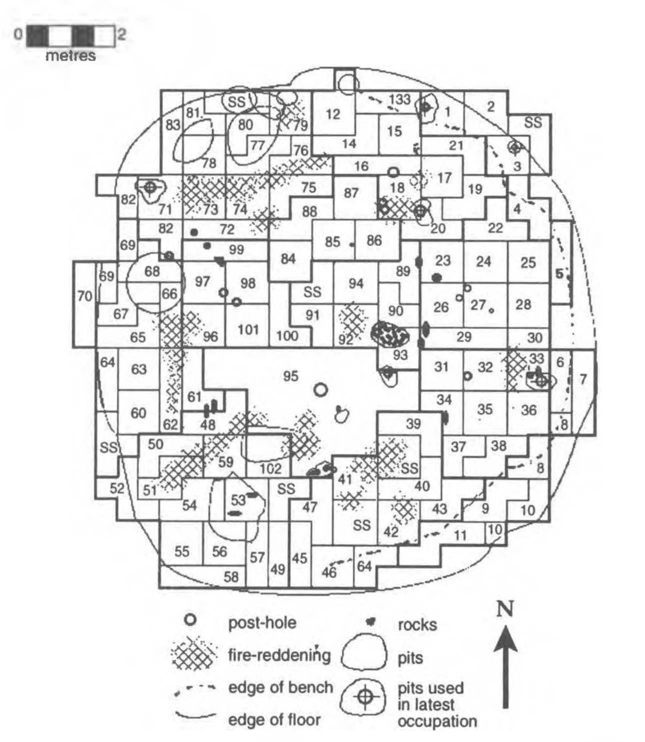

Figure 2. Division of analytical units on the floor of HP 7.

also defined as complete. Flakes with intensively abruptly retouched distal margins were defined as proximal, as they may have started with broken edges. Occasionally, platforms were partially removed to produce more working edge or to facilitate hafting. Where it was clear that the platform had been removed after production of the flake itself, the flake was defined as platform bearing and categorized into the complete or split flake, or proximal fragment types, depending upon margin characteristics. Approximately 95% of the flake type identifications from flake tools were accomplished unambiguously, as marginal retouch was typically minimal. In more difficult cases, strict adherence to these typological rules was followed.

All raw MSRT data were rescaled to facilitate multivariate analysis. Because of the large size of the tables containing these data, they are not reproduced here, but can be consulted in Prentiss (1993). I have found this scale to be extremely useful in allowing a close look at differences in the proportions of flake types present while eliminating problems resulting from assemblages with different sized flake counts. It also allows direct comparisons between archaeological MSRT distributions and experimental and modelled MSRT distributions. These distributions also require less data transformation for multivariate analysis than do chi-square scores (Binford 1989), or log transformations (Draper 1985) and the analyst remains closer to the raw data. In other words, by looking at rescaled data, the analyst is actually interpreting distributions which are closer to raw data than that of heavily transformed data sets. This produces fewer errors in interpretation (Jack Nance, personal communication).

The complex data matrices were analyzed using principal components analysis (see Prentiss 1993 for details). The interpretation of each analytical unit debitage assemblage (represented as cases in the principal components analysis) was accomplished by first gaining an understanding of the basic dimensions of variability in the data set as a whole. This process involved a thorough review of the rotated loadings matrices. Factor scores allowed an assessment of the contribution of each case to each factor (Prentiss 1993).

I employed debitage utility index data to enhance the interpretation of debitage and flake tool assemblage variability in a similar fashion to that of Binford (1981), Speth (1983), and Todd (1987), who used Binford's (1978) utility indices to enhance interpretations of faunal data (Prentiss 1993). Archaeological MSRT distributions were compared to two types of utility index distributions: utility indices and utility index residual models (Prentiss 1993). Utility index data reflect the potential utility of a class of flakes (i.e., complete flakes) within a given reduction strategy and when rescaled, can serve to anticipate the composition of culled flake or flake tool assemblages. Three utility indices were developed: the Flake Volume Index (FVI) measures overall flake size; the Acute Angle Edge Length (AAEL) index measures available flake edge with low edge angle, as might be useful in cutting activities; and the High Angle Edge Length (HAEL) index measures available flake edge with high edge angle, as might be more useful in scraping, planing, or engraving activities. Residual models simulate the contents of debitage assemblages previously culled for certain classes of flakes as predicted by the utility indices (see Prentiss 1993).

Debitage distributions were compared to trampled and untrampled reduction assemblage data and residual models in order to recognize reduction strategies and flake removal or culling strategies. In situations of very complex potentially mixed debitage assemblages, further mathematical sequences were developed to better understand the processes responsible for the patterning. Flake tool distributions were compared to trampled and untrampled utility index data in order to evaluate origins of these assemblages through reduction strategies and culling decisions. The formation of flake tool assemblages was assumed to be a complex process depending on the sequential effects of a number of processes including flake production technique, culling decisions, use, breakage, discard, trampling, scavenging, and reuse. The goal of this analysis was to identify as closely as possible, the sequence of processes affecting the formation of flake tool assemblages on the floor of HP 7. This required the construction of additional mathematically derived sequences designed to demonstrate the effects of multiple processes on basic utility index data sets (Prentiss 1993).

Analysis

I briefly review the results of both principal components analyses in order to focus the remainder of the paper on the results and implications of this study. Details regarding the interpretation of the individual data sets, including further MSRT utility index modelling and pattern recognition are found in Prentiss (1993).

The principal components analysis of debitage from the HP 7 floor produced six significant factors (eigenvalues greater than 1.00). Factor one emphasized medium size medial-distal fragments and small complete and split flakes in its positive dimension. No significant negative loadings were present (Prentiss 1993). Using factor scores to identify cases contributing to the factor solution, assemblages with high positive factor scores (> 1.0) from factor one were attributed to hard hammer reduction of prepared cores with acute edge angle flake culling (AAEL model) and trampling (Table 1). Cases with high negative dimension factor scores were considered to be the result of prepared block core reduction, trampling and culling for larger acute edge angle flakes (FVIxAAEL model). Some additional high scoring cases were also attributable to other processes better considered in relation to other factors.

Significant positive loadings from factor two were found only on small medial-distal fragments, while significant negative loadings were found on small and medium proximal fragments. As small medial-distal fragments are commonly produced in most lithic debitage assemblages, the negative dimension of this factor was considered most worthy of detailed consideration. Cases with strong negative factor scores were interpreted as the result of tool edge resharpening/modification with the possibility of biface reduction present as well, associated with acute edge angle flake culling and some trampling (Table 1).

Factor three produced significant positive loadings on large proximal fragments and medium nonorientable fragments. No significant negative loadings were produced. Factor three cases were attributed to associations between biface and block core reduction, and bipolar core reduction. All assemblages appear to have been culled for acute edge angle flakes and in a few cases high edge angle flakes. All were trampled, though some appear to have been trampled before bipolar reduction and associated flake culling occurred.

Factor four contained significant positive loadings on large complete flakes and significant negative loadings on small split flakes. High positive factor score cases were interpreted as minimally or unculled, trampled, prepared block core reduction assemblages. High negative factor score cases appear to have been heavily size sorted either through intensive larger flake culling or through cleanup, sweeping, and/or trampling.

Factor five produced significant positive loadings on large medial-distal fragments and medium split flakes. High factor score cases are not unique to this analysis focussing on trampled prepared core reduction.

Factor six contained significant positive loadings on medium complete flakes and proximal fragments and small complete flakes and nonorientable fragments. These are the flake types most modified by trampling (Prentiss 1993; Prentiss and Romanski 1989), indicating that factor six was a trampling factor. Most strongly patterned positive dimension cases were attributable to a lack of trampling, while those strongly patterned in the negative dimension were likely to have been trampled heavily (Table 1).

Principal components analysis of the *flake tool* MSRT data produced a five factor solution. Factors four and five are not considered here as their results are redundant with those of factors one through three. Interpretation of each factor was difficult and required construction of additional utility index modelling sequences to aid in understanding the sequence of formation processes (Prentiss 1993).

Factor one produced significant positive loadings on large medial-distal and medium proximal and medial-distal tool fragments, while high negative loadings were produced on small nonorientable tool fragments and split flake tools. As the significant positive dimension loadings are common to almost all cases, it was considered to be of limited usefulness in recognizing variability. A consideration of the negative dimension revealed two potential sequences of assemblage formation processes. The first consisted of the production of flake tools from prepared core reduction flakes culled for larger size and acute edge angles. Following a short period of use, these tools were discarded and subsequently culled from their discard contexts for additional use. Final discard found the original tools in much more damaged states due to intensive use, modification, and trampling (cases/sectors 3 and 4; Prentiss 1993). The second sequence of possible formation processes for the negative dimension of factor one appears to have been the result of a greater degree of larger tool curation. Essentially, smaller tools appear to have been much more intensely trampled than larger tools suggesting the possibility that they represent tools more quickly discarded, either through very short-term use and/or through discard of fragments of larger more curated tools (cases/sectors 1 and 2; Prentiss 1993).

Factor two contained significant positive loadings on large medial-distal tool fragments, medium nonorientable tool fragments, and small proximal tool fragments. Cases contributing strongly to factor two were interpreted as the result of a similar process as in factor one (intensive use, trampling, and reuse of prepared core reduction flake tools with acute edge angles), with the addition of discarded acute and high edge angle flakes from bipolar core reduction (cases/sectors 5, 10–13; Prentiss 1993).

Factor three produced significant positive loadings only on small medial- distal fragments. Like factor one, factor three aided in the recognition of two patterns of flake tool assemblage formation. The first, appeared to have resulted from a combination of intensive prepared core and biface reduction flake tool use, discard, trampling, and reuse (cases/sectors 6, 7, and 9). The second pattern was again related to larger tool curation with intensive trampling of smaller flake tools (case/sector 8; Prentiss 1993).

Table 1. Interpretation of Debitage Assembly Modifications by Subsquare Cases

Case	Interpretation
1	Tr., Prep. Core Reduction, FVIxAAEL type cull
2	Tr., Bipolar and Prep. Core Reduction, HAEL type cull
3	NT., Prep. Core Reduction, No cull
4	Tr., Prep. Core Reduction, FVIxAAEL type cull
5	NT., Prep. Core Reduction, FVIxAAEL type cull
6	Tr., Biface Reduction, AAEL type cull
7	Tr., Prep. Core Reduction, HAEL type cull
8	Tr., Prep. Core Reduction, FVIxAAEL type cull
9	Tr., Prep. Core Reduction, HAEL type cull
10	Tr., Prep. Core Reduction, FVIxAAEL type cull
11	Tr., Prep. Core Reduction, FVIxAAEL type cull
12	Tr., Prep. Core Reduction, FVIxAAEL type cull
13	Tr., Prep. Core Reduction, FVIxAAEL type cull
14	Tr., Prep. Core Reduction, FVIxAAEL type cull
15	NT., Prep. Core Reduction, No cull
16	Tr., Prep. Core Reduction, FVIxAAEL type cull
17	Tr., Resharp. and Biface Reduction, AAEL type cull
18	Tr., Prep. Core Reduction, FVIxAAEL type cull
19	Tr., Prep. Core Reduction, FVIxAAEL type cull
20	Tr., Prep. Core Reduction, FVIxAAEL type cull
21	Tr., Bipolar and Prep. Core Reduction, FVIxAAEL cull
22	NT., Prep. Core Reduction, HAEL type cull
23	NT., Prep. Core Reduction, HAEL type cull
24	Tr., Prep. Core Reduction, FVIxAAEL type cull
25	Tr., Prep. Core Reduction, FVIxAAEL type cull
26	Tr., Prep. Core Reduction, FVIxAAEL type cull
27	NT., Prep. Core Reduction, HAEL type cull
28	Tr., Prep. Core Reduction, FVIxAAEL type cull
29	Tr., Prep. Core Reduction, FVIxAAEL type cull
30	Tr., Prep. Core Reduction, FVIxAAEL type cull
31	Tr., Prep. Core Reduction, FVIxAAEL type cull
32	Tr., Prep. Core Reduction, FVIxAAEL type cull
33	Tr., Prep. Core Reduction, FVIxAAEL type cull
34	Tr., Prep. Core Reduction, FVIxAAEL type cull
35	Tr., Prep. Core Reduction, FVIxAAEL type cull
36	Tr., Prep. Core Reduction, FVIxAAEL type cull
37	Tr., Biface Reduction, AAEL type cull
38	Tr., Prep. Core Reduction, FVIxAAEL type cull
39	Tr., Biface Reduction, No cull
40	Tr., Resharp. No cull.
41	Tr., Prep. Core Reduction, SS or HAEL+AAEL cull
42	Tr., Prep. Core Reduction, No cull
43	Tr., Prep. Core Reduction, FVIxAAEL type cull
44	NT., Prep. Core Reduction, HAEL type cull
45	Tr. (minor), Biface Reduction, AAEL type cull
46	Tr., Prep. Core Reduction, FVIxAAEL type cull
47	Tr., Prep. Core Reduction, FVIxAAEL type cull
48	Tr., Prep. Core Reduction, FVIxAAEL type cull
49	Tr., Prep. Core Reduction, SS or HAEL+AAEL cull
50	Tr., Prep. Core Reduction, HAEL type cull
51	Tr., Prep. Core Reduction, FVIxAAEL type cull
52	Tr., Resharp. and Biface Reduction, No cull
53	Tr., Prep. Core Reduction, HAEL type cull
54	Tr., Biface Reduction, AAEL type cull
55	NT., Prep. Core Reduction, No cull
56	Tr., Prep. Core Reduction, FVIxAAEL type cull
57	Tr. (minor), Biface Reduction, no cull
58	Tr., Prep. Core Reduction, no cull
59	Tr., Prep. Core Reduction, HAEL type cull
60	Tr., Prep. Core Reduction, FVIxAAEL type cull
61	Tr., Prep. (FVIxAAEL cull), Bipolar (HAEL) reduct.
62	Tr., Biface Reduction, AAEL type cull
63	Tr., Prep. Core Reduction, FVIxAAEL type cull
64	Tr., Prep. Core Reduction, no cull
65	Tr. (minor), Biface Reduction, AAEL type cull
66	Tr., Prep. (FVIxAAEL cull), Bipolar (HAEL) reduct.
67	Tr., Bipolar and Prep. Core Reduction, no cull
68	Tr., Prep. Core Reduction, FVIxAAEL type cull
69	Tr., Prep. Core Reduction, FVIxAAEL type cull
70	Tr., Prep. Core Reduction, FVIxAAEL type cull
71	NT., Resharp. and Biface Reduction, HAEL cull
72	Tr., Prep. Core Reduction, FVIxAAEL type cull
73	Tr., Prep. Core Reduction, FVIxAAEL type cull
74	Tr., Prep. Core Reduction, HAEL type cull
75	Tr., Prep. Core Reduction, FVIxAAEL type cull
76	Tr., Prep. Core Reduction, FVIxAAEL type cull
77	Tr., Prep. Core Reduction, FVIxAAEL type cull
78	Tr., Prep. Core Reduction, FVIxAAEL type cull
79	Tr., (minor) Biface Reduction, AAEL type cull
80	Tr., Prep. Core Reduction, FVIxAAEL type cull
81	NT., Prep. Core Reduction, HAEL type cull
82	NT., Biface Reduction, No cull
83	Tr., Prep. Core Reduction, FVIxAAEL type cull
84	Tr., Prep. Core Reduction, FVIxAAEL type cull
85	Tr., Prep. Core Reduction, FVIxAAEL type cull
86	NT., Prep. Core Reduction, No cull
87	NT., Prep. Core Reduction, HAEL cull
88	Tr., Resharp, No cull
89	Tr., Prep. Core Reduction, no cull
90	Tr., Prep. Core Reduction, no cull
91	Tr., (minor) Biface Reduction, AAEL type cull
92	Tr., Prep. Core Reduction, FVIxAAEL type cull
93	Tr., Prep. Core Reduction, SS or HAEL+AAEL cull
94	Tr., Prep. Core Reduction, FVIxAAEL type cull
95	Tr., Prep. Core Reduction, FVIxAAEL type cull
96	Tr., (minor) Biface Reduction, AAEL type cull
97	Tr., Bipolar and Biface Reduction, AAEL cull
98	Tr., (minor) Biface Reduction, AAEL type cull
99	Tr., Prep. Core Reduction, FVIxAAEL type cull
100	Tr., Resharp, No cull
101	Tr., (minor) Biface Reduction, No cull
102	Tr., Biface Reduction, AAEL cull

Tr = trampled; NT = non-trampled; SS = small sample; HAEL = High Angle Edge Length; AAEL = Acute Angle Edge Length; FVI = Flake Volume Index. Spatial Patterning in Lithic Reduction, Flake Culling, and Trampling.

Following a complete interpretation of the principal components analyses, spatial patterning of lithic reduction and culling activities and trampling was explored by plotting the results across the floor of HP 7.

Cases interpreted to be the result of tool edge resharpening or other minor modification were located almost entirely adjacent to hearth features (Fig. 3). Cases interpreted to be the result of biface reduction also cluster tightly around hearths (Fig. 4). Prepared core reduction is ubiquitous on the floor (Fig. 5). Several areas adjacent to hearths have been least affected by prepared core reduction. It is important to realize here that some core reduction (and other reduction types) overlaps may occur in units not identified as primarily the result of this technology. As interpretations are based on flake breakage and size distributions it is inevitable that minute inputs from other reduction types will not be recognized.

Bipolar core reduction occurs intensely in two restricted areas, the northeast corner and the west-central side of the floor (Fig. 6). An independent analysis of bipolar reduction flakes has identified some bipolar flake clustering as well in the northwestern part of the floor, though not enough to pattern strongly in this analysis (Prentiss 1993). Bipolar reduction overlaps with prepared core reduction on the northeast side and biface and prepared core reduction on the west side.

Trampling is common throughout the floor with some significant exceptions (Fig. 7). Untrampled areas tend to be located where post-holes are dense, in some hearth areas, and along walls. This is to be expected as these are the types of places least likely to receive foot-traffic. Lack of trampling in some hearth areas may indicate continuous use or designation of that location as a place not to be stepped on. Presence of trampling in other hearth areas may indicate discontinuous reuse of those places.

Culling for acute edge angle flakes from biface and prepared core reduction is found throughout the floor (Fig. 8). Culling for high edge angle flakes is found in the southwest, northeast, and northwest corners of the house floor (Fig. 9). Cases without indications of culling behavior are found primarily against walls or in clusters of post-holes (Fig. 10). Exceptions to this pattern are found in the southeast corner and in the west-central portion of the floor. One of these is a maintenance assemblage which would have been of little value to the prehistoric inhabitants of the housepit due to the small size of the products. The other is harder to explain as it is the result of biface reduction. In this case, the primary goal of reduction may have been the biface, not the flakes.

The results of the flake tool analysis presented a spatial pattern of flake tool discard closely paralleling that of the debitage. Cases (sectors) 1–3, and 4 were

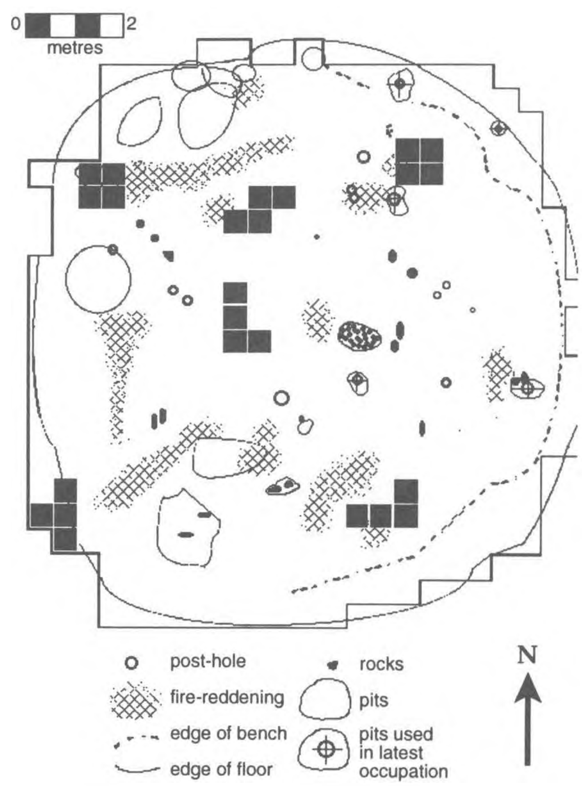

Figure 3. Distribution of analytical units interpreted to be associated with tool maintenance/resharpening.

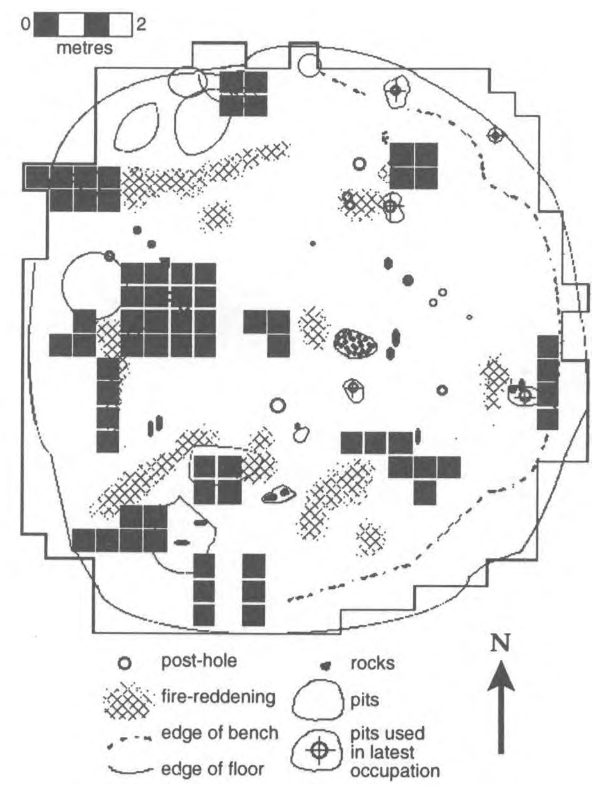

Figure 4. Distribution of analytical units interpreted to be associated with biface reduction.

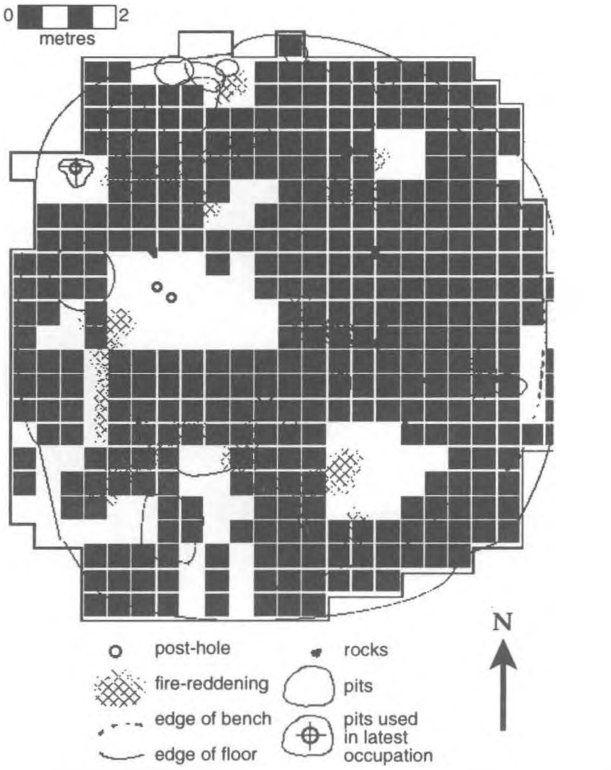

Figure 5. Distribution of analytical units interpreted to be associated with prepared core reduction.

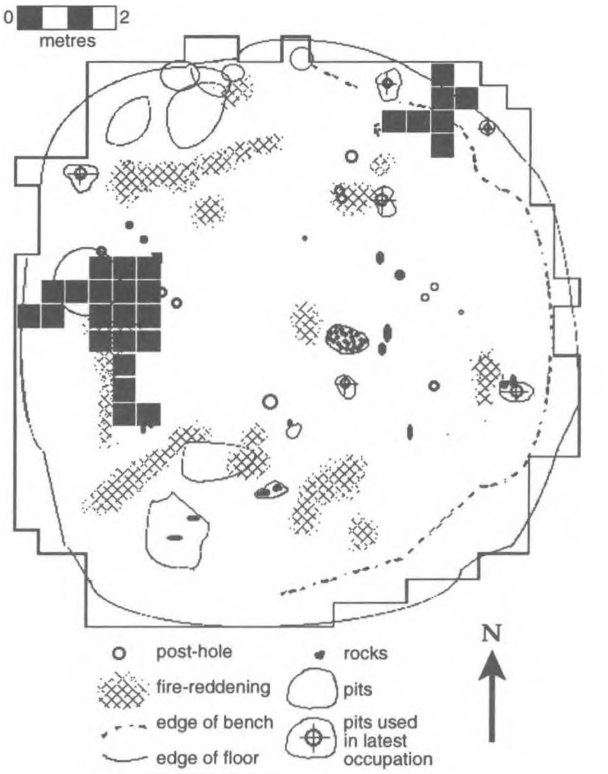

Figure 6. Distribution of analytical units interpreted to be associated with bipolar core reduction.

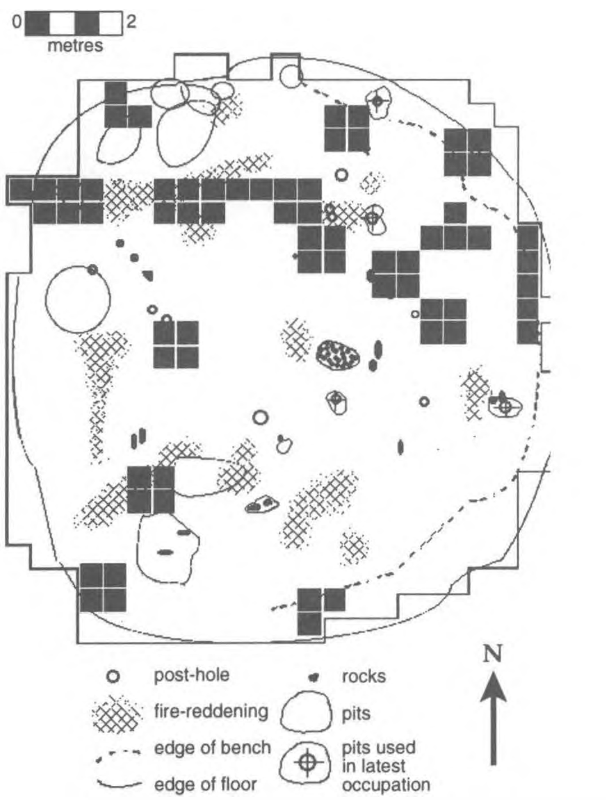

Figure 7. Distribution of analytical units not interpreted to be associated with trampling.

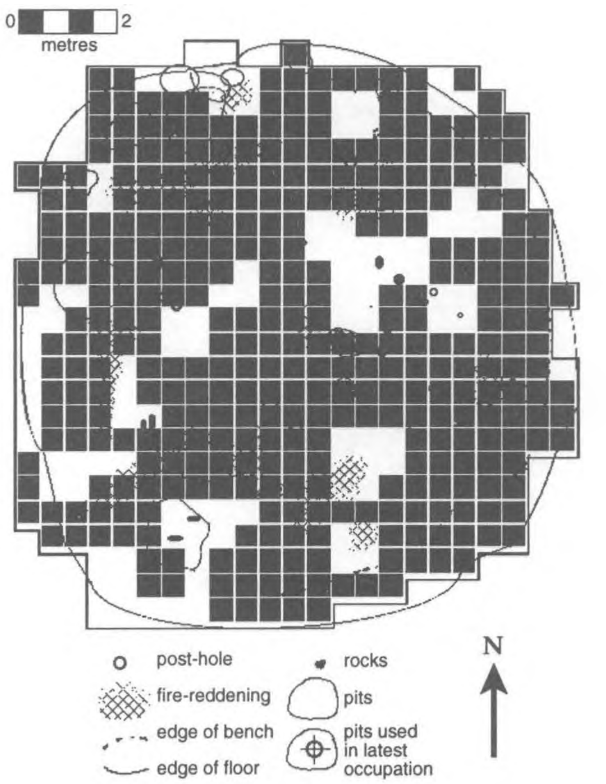

Figure 8. Distribution of analytical units interpreted to be associated with acute edge angle flake culling.

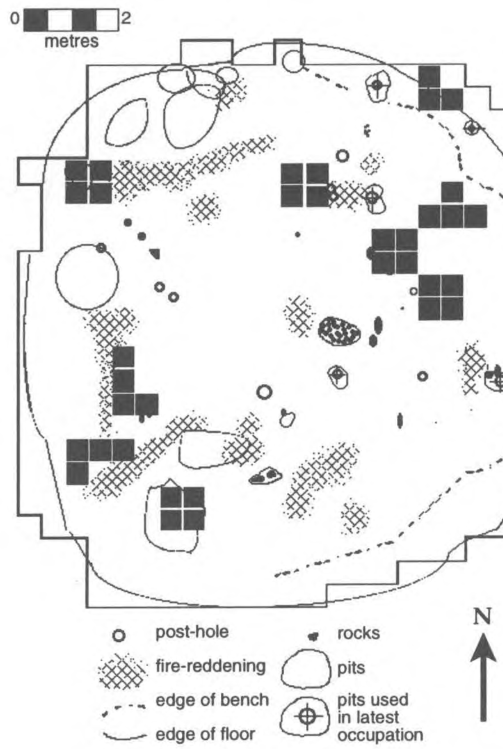

Figure 9. Distribution of analytical units interpreted to be associated with high edge angle flake culling.

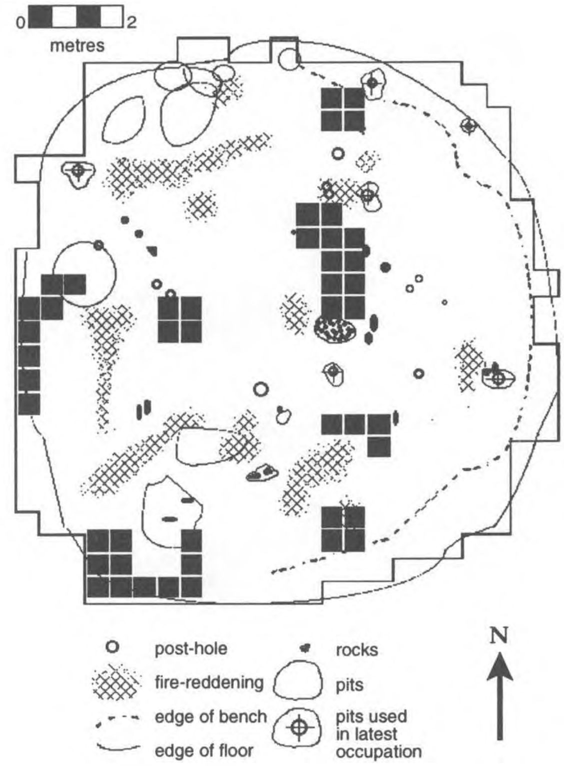

Figure 10. Distribution of analytical units interpreted not to be associated with any form of flake culling.

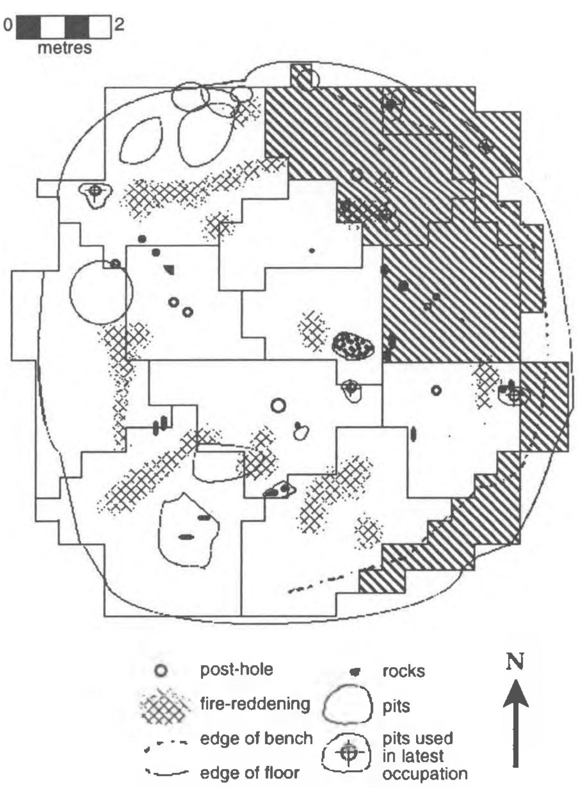

Figure 11. Distribution on the HP 7 floor of sectors with flake tool assemblages interpreted to be derived from prepared core reduction flakes only.

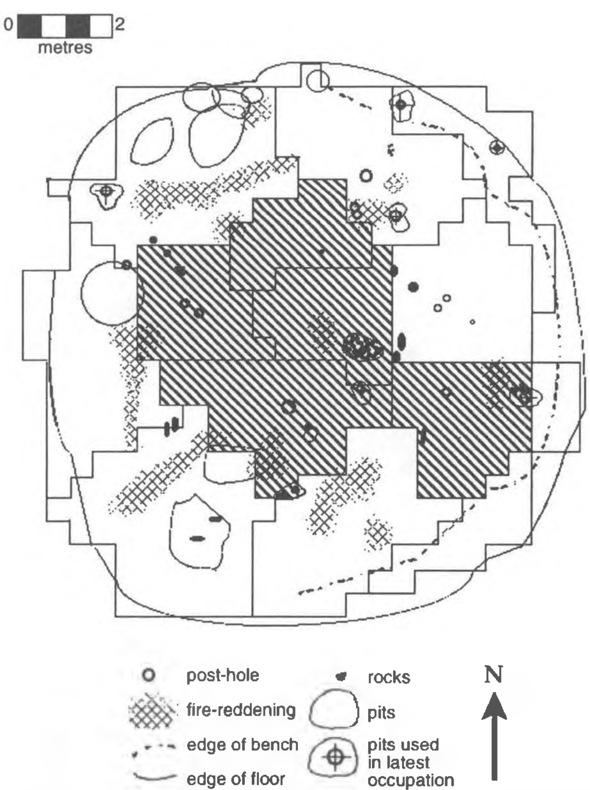

Figure 12. Distribution on the HP 7 floor of sectors with flake tool assemblages interpreted to be derived from prepared and bipolar core reduction flakes.

interpreted to be the result of prepared core, flake production followed by culling of larger acute edge angle flakes for use as flake tools, expedient tool use, discard and trampling, culling and recycling of previously discarded tools, reuse, and final discard (Fig. 11).

Flake tool assemblages resulting from mixed prepared core and bipolar core flake production occur in the central and southeastern part of the floor (Fig. 12). Prepared core reduction flakes appear to have been culled for larger size and the presence of acute edge angles, while bipolar flakes were culled for acute and high edge angles. The flake tool assemblages produced through prepared core reduction have been heavily culled following initial tool discard while bipolar flake tools do not appear to have been intensely culled in this manner. All have been trampled.

Mixed biface and prepared core flake production assemblages occur around the western side of the floor (Fig. 13). Culling of previously discarded tools does not appear to have been a major factor here, though culling of the original flake assemblages focussed on both acute and high edge angle flakes.

Cases 1–3, 6, and 8 distribute roughly around the edges of the floor. They contain patterns of intense use of larger flakes, while small flake tools are trampled far more intensely than the larger ones (Fig. 14).

Discussion

Earlier in this essay I discussed some of the potential agents identified from the ethnographic literature, including reduction and tool use strategies, spatial organization of activities, and taphonomic processes, which could be expected to contribute towards the formation of lithic assemblages in Middle Fraser Canyon winter housepits. From this analysis of the debitage and flake tools at HP 7 at the Keatley Creek site (and as corroborated by Spafford in Vol. II, Chap. 11), it is clear that similar processes occurred during the occupation of Late Prehistoric winter housepits.

The floor of HP 7 contained a dense concentration of lithic artifacts reflecting fairly intensive lithic reduction and tool use during its final occupation. The most typical form of lithic reduction was that of flake production from prepared platform block or spheroid cores. This activity was apparently practiced in all portions of the housepit floor. Biface reduction was practiced more typically on the western or "kitchen" side of the house. Tool resharpening activities were typically located adjacent to hearths, presumably to aid in visibility, though this may also reflect the use locations of many lithic tools. Bipolar reduction was practiced on the western and northeastern sides of the house. Flake tool discard paralleled the locations of

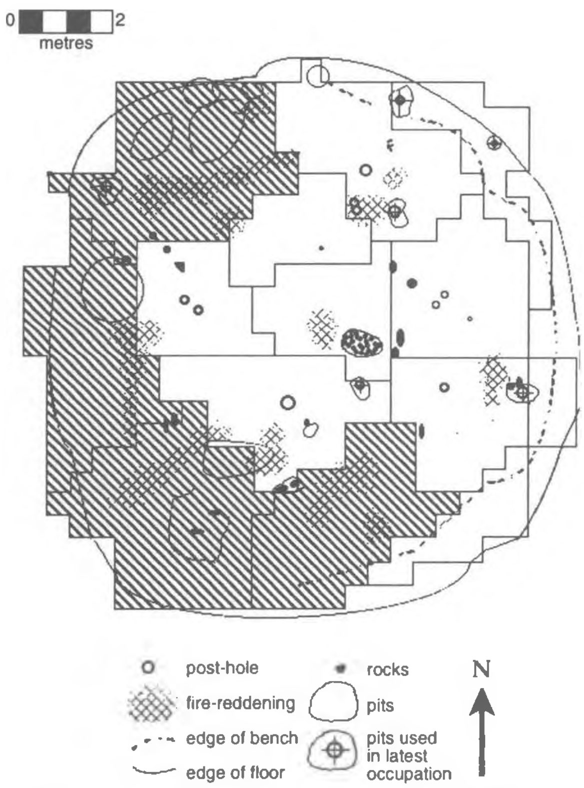

Figure 13. Distribution on the HP 7 floor of sectors with flake tool assemblages interpreted to be derived from prepared core and biface reduction flakes.

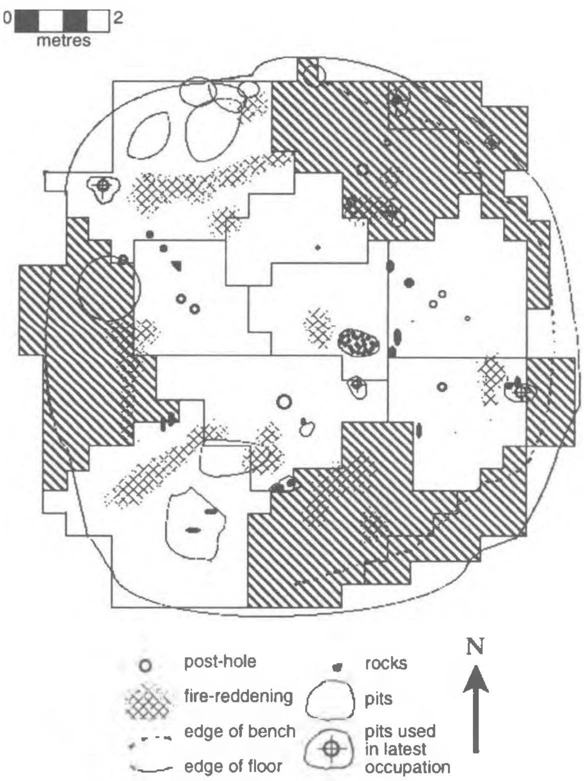

Figure 14. Distribution on the HP 7 floor of sectors with flake tool assemblages interpreted to be derived from some degree of larger flake tool curation.

reduction areas to a large degree. Core reduction flake tools were discarded throughout the housepit floor, while biface reduction flake tools were primarily discarded on the west side of the house. Interestingly, bipolar flake tools were discarded in the center of the housepit. Larger tool curation appears to have occurred around the margins of the housepit floor, while central areas of the floor received more intensive short term tool use-reuse cycles, accompanied by intensive trampling.

The focus on reduction of prepared cores to produce flake tools is reminiscent of the ethnographic prediction that lithic raw materials would be stockpiled for winter use in preparing food for daily consumption and tools for spring and summer use. Likewise, the intensive reuse of flake tools either through curation, as indicated around the floor margins, or serial expediency, suggests the need for raw material conservation. Finally, there were some indications that bipolar assemblages were minimally or even untrampled, as opposed to all other lithic assemblages which were heavily trampled. This may suggest that bipolar reduction was an activity practiced late in the winter occupation as a means of extending the use-lives of some cores and tools during this time. This also suggests that the lithic assemblages from this floor are the result of only one winter's occupation. I suggest that it is likely that if the house was occupied during previous winters, the latest occupation was preceded by intensive floor cleanup activities, allowing for the development of the crisp spatial patterning recognized here.

It appears unlikely that many flake tools were exported from the housepit during the final occupation. Dense lithic artifacts are found in the rim deposits of the housepit (Vol. I, Chap. 15) and appear to be largely the result of older reoccupations of the houspit which excavated old floors and collapsed roofs, depositing debris on the rim of the housepit. Distributions of tool types between the floor and the rim deposits at HP 7 are very similar. Further, the intensive recycling industry on the floor of HP 7 is not expected to have left many flakes or flake tools in conditions warranting further use beyond the confines of the housepit floor. Finally, the ratio of flakes (larger than 1/4 inch square) to tools is approximately 4/1. Even considering intensive tool breakage, through use, trampling, and possibly purposive action, this is a high number of tools compared to waste flakes. Certainly, some flake tools were removed from the house. However, there does not appear to have been enough for this to have significantly affected the overall patterning of debitage and flake tool assemblages within the house.

Based upon these arguments, I suggest that, similar to ethnographic descriptions and derived expectations, lithic tools were primarily used to produce other tools from organic materials (wood, bone, horn, and leather). Some lithic tools such as bifaces and some formal unifacial tools such as end scrapers were likely produced for export and use during group movements in the spring and summer. This implies an approach to risk management, using technology and mobility very similar to that described ethnographically. I conclude that lithic assemblages from the floor of HP 7 formed during the period of winter sedentism used as down-time for the production of anticipatory gear (Binford 1979) critical for survival in winter and throughout the rest of the year.

The repetitive patterning of lithic assemblages around hearth features has led Spafford (Vol. II, Chap. 11; 1991) to identify three and possibly more domestic areas located in the northwest (sectors 8, 9, 13, and west half of 10), the northeast (sectors 1, 3, 4, east halves of 10 and 11) and southern (sectors 2, 5, 6, and 7). He argues that each area potentially contained a multi-family group belonging to the larger household social unit and that each domestic unit used several hearths. Some hearths were used more as domestic hearths (large hearths in sectors 6, 7, 8, and 11), while others were perhaps more often used for warmth and light during special activities (hearths in sectors 3 and 5). The hearth in sector 9 appears to have been used for both domestic and special activities. In addition, Spafford identified a number of specialized activity areas in different portions of the floor. Based on cached spall scraper tools, a portion of sector 5 was identified as a possible hide working area. He also identified a portion of the northwest corner of the house as a special activity area, based on a concentration of heavily retouched scrapers, utlized flakes, and fire-cracked rock. The south-central portion of the floor (sector 12) was classified as a possible corridor area. Finally, Spafford has provided a distinction between inner and outer zones on the housepit floor. He notes that the outer perimeter contains high numbers of heavily retouched tools and far fewer numbers of minimally retouched tools. The inner zone is characterized by high numbers of minimally retouched, possibly expedient tools, biface fragments, spall tools, fire cracked rock, and numerous hearths. On the basis of these distinctions, he argues that the inner zone was possibly the focus of most female activities such as food and hide processing, while the outer zone was more commonly associated with male activities such as equipment repair and lithic reduction acivities.

Spafford's identification and explanation of spatial variation in artifact patterning were based largely on criteria not considered in this study. However, the results of this study reflect his conclusions to a substantial degree. From the perspective of vitreous trachydacite use, sectors 4, 10, 11, and 12 appear to be places where a fair degree of human movement occurred, as might be expected from the central location of three of these sectors. Tool production and use appear to have been consistently of an expedient nature, focussing on hand-held core reduction and bipolar reduction based flake tool production, use, and discard. Sector 12 is particularly sparse in artifacts, though the general pattern is no different from that of the central or eastern sides of the floor with core reduction and large acute edge angle flake culling. This corresponds to Spafford's identification of sector 12 as a corridor. I add that sectors 10, 11, and 4 may also have received a fair amount of foot-traffic.

Sector 5, identified by Spafford as a hide working area, contains some elements of hearth-oriented patterning such as associated core and biface reduction debris, both culled for acute edge angle flakes. This sector does not contain any strong indicators of tool edge retouch/modification and it has been heavily trampled. Flake tools discarded here are primarily the combination of core reduction flakes with some bipolar core reduction flakes. All have been used and reused expediently and heavily trampled. Thus, this area appears little different from sectors 4, 10, 11, and 12 other than the presence of minimal biface reduction. Spafford's argument, based on available space and the presence of spall tools, may be a useful explanation of this sector. Identification of this sector as a female oriented activity area is concordant with my identification of this area as generally more similar to the central portions of the floor. The presence of biface reduction in sector 5 indicates, however, that some male oriented activities may also have been conducted in this area. This is likely given the proximity to the edge of the housepit floor.

My analysis has identified a consistent hearth associated pattern in sectors 1, 3, 6, 7, 8, and 9. This pattern is one of continuous core reduction and large acute edge angled flake culling which is also associated with clusters of biface reduction and acute edge angle flake culling and tool edge maintenance/resharpening clustering immediately adjacent to hearths. Flake tool use/reuse/discard strategies of mixed core reduction and biface flake use and discard are found in sectors 6–9. Sector 1 and 3 flake tools are primarily the result of core reduction flake culling and use. Biface reduction appears to be far less intense in these sectors than in others. This repeated patterning around hearths appears to be indicative of regular domestic activities requiring flake tools and biface preparation. This generally supports Spafford's identification of the northeastern, northwestern, and southern sectors as domestic areas. It also indicates that other hearths may have been the loci of additional independent domestic units. Further support comes from the distribution of high edge angle flake culling, which occurs in clusters in the southwest, northeast, and northwest portions of the floor.

The identification of domestic activities on the northeast side of the floor (sectors 1 and 3) is still somewhat problematical as the hearth is small, food storage pits are few and, although small amounts of tool maintenance and biface reduction are present, core reduction is by far the dominant lithic reduction activity. Further, the hearth is separated from the central portion of the floor by a row of post holes. Debitage assemblages from this area of dense posthole patterning have only been minimally trampled and, in places, not culled for any flakes. This suggests that some form of barrier existed between these areas. Thus, one must keep open the possibility that the northeast portion of the floor may have served as a place where special activities occurred, rather than an exclusively domestic occupation. Another possible explanation is that it is possible that lower status people occupied this area. Lithic reduction and tool use activities certainly appear little different from other potential domestic areas, only in somewhat different proportions. A third possibility is that this area was used domestically by lowest status people such as slaves and, because of this, the area was also used as a special activity area (possibly wood working) by slaves and possibly others, as indicated by the focus on culling high edge angle flakes and the presence of numerous cut beaver teeth from this area (Vol. II, Chap. 7).

My identification of flake tool use/reuse variation between the perimeter and interior portions of the floor is concordant with Spafford's identification of outside and central gender-related areas. Spafford argued that the use of outer areas focussed on tool curation, while the central areas saw more expedient tool use. My results indicate a system of intense trampling of small lithic artifacts and very minimal trampling of larger artifacts around the perimeters. Interior floor flake tools were all heavily trampled regardless of size. This variability in potential flake tool use and discard strategies may well have been gender-related as suggested by Spafford.

Conclusions and Implications

The results of this study demonstrate a link between predictions about lithic assemblage formation processes derived from the ethnographic record and those recognized from archaeological study of a Late Prehistoric winter housepit. In particular, ethnographic predictions regarding the economic use of lithic raw materials through reduction of cores to produce flake tools and use of flake tools to aid in winter food preparation and in gearing up for spring activities appear to be relatively accurate predictors of Late Prehistoric behavior at HP 7 at Keatley Creek. Likewise, ethnographically predicted housepit floor spatial arrangements including a series of domestic units around the margins of the floor, more intense "kitchen" oriented activities on the river-side of the house (west), spatially segregated gender based activity areas, and a central corridor area associated with housepit access (ladder), are also borne out at HP 7. Finally, taphonomic processes such as trampling are highly visible among the lithic artifacts in HP 7.

Probably the most crucial aspect of this research has been the identification of spatially bounded assemblage formation sequences. Patterning in lithic reduction, culling, tool discard, and trampling, are tight enough that, even without associated features, floor spatial structure could have been recognized. Floor boundaries, hearth areas, and post-hole clusters are partially identifiable through artifact trampling and culling patterns in that it is these areas which received the least intense foot traffic (and thus artifact trampling) and scavenging of flakes or previously discarded tools. Clusters of tool edge modification, biface reduction, and high edge angle flake culling activities clearly are associated with hearth based work areas. Presumably gender based activity areas are identifiable by examining flake tool assemblage formation sequences. Possible female activity areas are defined based on intensive expedient tool use/reuse cycles (or serial expediency) associated with prepared and bipolar core reduction, and biface reduction to a reduced degree on the west side of the house. Potential male activity areas are associated with a different sequence of flake tool use/reuse derived from prepared core and biface reduction, indicating a higher degree of tool curation and resharpening around the margins of the house.

I suggest that while understanding distributions of flake and tool types (i.e., Vol. II, Chap. 11; Spafford 1991) is very important for assessing spatial organization, researchers need to focus much of their efforts on understanding the sequence of processes responsible for the final associations between artifact types. To date, much attention has focussed on the processes of individual tool formation through resharpening (Dibble 1987) and tool use (Hayden 1990). While these studies will continue to be extremely important, further attention must be placed on examining the combination and sequence of events and actions of each agent responsible for affecting assemblage composition (Todd et al. 1987:40). Within this study, a number of agents were identified (reduction techniques, flake culling, trampling, tool use, tool discard, tool scavenging/reuse) and an attempt was made to recognize variation in the effects of those agents. Probably one of the biggest near-future contributions towards the goal of better understanding assemblage formation processes will be further experimental work designed to develop linkages between organizational behavior, site occupational sequences, and lithic assemblage formation. Researchers will wish to experimentally consider not only the effects of reduction strategies, culling, trampling, and discard processes, but also variation in the application and sequence of these agents under different economic, social, and occupational conditions.

References

Alexander, D.
1992b A Reconstruction of Prehistoric Land Use in the Mid-Fraser River Area Based on Ethnographic Data. In B. Hayden (Ed.), *A Complex Culture of the British Columbia Plateau*, pp. 99–176. University of British Columbia Press, Vancouver.

Andrefsky, W. Jr.
1994 Raw Material Availability and the Organization of Technology. *American Antiquity* 59(1):21–35.

Behrensmeyer, A.K. and A.P. Hill
1980 *Fossils in the Making*. University of Chicago Press, Chicago.

Binford, L.R.
1977a General Introduction. In L.R. Binford (Ed.), *For Theory Building in Archaeology*, pp. 1–10. Academic Press, New York.

Binford, L.R.
1977b Forty-Seven Trips: A Case Study in the Character of Archaeological Formation Processes. In R.V.S. Wright (Ed.), *Stone Tools as Cultural Markers: Change, Evolution and Complexity*, pp. 162–168, Australian Institute for Aboriginal Studies, Canberra.

Binford, L.R.
1978 *Nunamiut Ethnoarchaeology*. New York: Academic Press.

Binford, L.R.
1979 Organization and Formation Processes: Looking at Curated Technologies. *Journal of Anthropological Research* 35(3):255–273.

Binford, L.R.
1981 *Bones: Ancient Men and Modern Myths*. New York: Academic Press.

Bleed, P.
1986 The Optimal Design of Hunting Weapons: Maintainability or Reliability. *American Antiquity* 51:737–747.

Brain, C.K.
1981 *The Hunters or the Hunted*. University of Chicago Press, Chicago.

Cahen, D., and J. Moeyersons
1977 Subsurface Movements of Stone Artefacts and their Implications for the Prehistory of Central Africa. *Nature* 266:812–815.

Camilli, E.L.
1983 *Site Occupational History and Lithic Assemblage Structure: An Example from Southeastern Utah.* Ph.D. dissertation, Department of Anthropology, University of New Mexico.

Cannon, A.
1992 Conflict and Salmon on the Interior Plateau of British Columbia. In B. Hayden (Ed.), *A Complex Culture of the British Columbia Plateau,* pp. 506–524. University of British Columbia Press, Vancouver.

Dibble, H.L.
1987 Reduction Sequences in the Manufacture of Mousterian Implements of France. In O. Soffer (Ed.), *The Pleistocene Old World,* pp. 33–46. Plenum Press, New York.

Ebert, J.I.
1992 *Distributional Archaeology.* University of New Mexico Press, Albuquerque.

Gero, J.M.
1989 Assessing Social Information in Material Objects: How Well Do Lithics Measure Up? In Robin Torrence (Ed.), *Time, Energy, and Stone Tools,* pp. 92–105. Cambridge University Press, Cambridge.

Gero, J.M.
1991 Genderlithics: Women in Stone Tool Production. In J.M. Gero and M.W. Conkey (Eds.), *Engendering Archaeology: Women in Prehistory,* pp. 163–193. Blackwell, Cambidge.

Goodyear, A.C.
1989 A Hypothesis for the Use of Cryptocrystalline Raw Materials of North America. In C.J. Ellis and J.C. Lothrop (Eds.), *Eastern Paleoindian Lithic Resource Use,* pp. 1–10. Westview Press, Boulder.

Hayden, B.
1989 From Chopper to Celt: The Evolution of Resharpening Techniques. In Robin Torrence (Ed.), *Time, Energy, and Stone Tools,* pp. 7–16. Cambridge University Press, Cambridge.

Hayden, B.
1990 The Right Rub: Hide Working in High Ranking Households. In B. Graslund (Ed.), *The Interpretive Possibilities of Microwear Studies,* pp. 89–102. AUN 14, Societas Archaeological Upsaliensis, Upsala.

Hayden, B.
1992a Introduction: Ecology and Culture. In B. Hayden (Ed.), *A Complex Culture of the British Columbia Plateau,* pp. 3–46. University of British Columbia Press, Vancouver.

Hayden, B.
1992b Conclusions: Ecology and Complex Hunter/Gatherers. In B. Hayden (Ed.), *A Complex Culture of the British Columbia Plateau,* pp. 525–564. University of British Columbia Press, Vancouver.

Hayden, B., and A. Cannon
1982 The Corporate Group as an Archaeological Unit. *Journal of Anthropological Archaeology* 1:132–158.

Hayden, B., M. Eldridge, A. Eldridge, and A. Cannon
1985 Complex Hunter-Gatherers in Interior British Columbia. In T.D. Price and J.A. Brown (Eds), *Prehistoric Hunter-Gatherers: The Emergence of Cultural Complexity,* pp. 155-190. Academic Press, New York.

Kelly, R.L.
1988 The Three Sides of a Biface. *American Antiquity* 53(4):717–734.

O'Connell, J.F.
1977 Aspects of Variation in Central Australian Lithic Assemblages. In R.V.S. Wright (Ed), *Stone Tools as Cultural Markers,* pp. 269– 281. Australian Institute for Aboriginal Studies, Canberra.

Parry, W.J., and R.L. Kelly
1987 Expedient Core Technology and Sedentism. In J.K. Johnson and C.A. Morrow (Eds.), *The Organization of Core Technology,* pp. 285–304. Westview, Denver.

Prentiss, W.C.
1993 *Hunter-Gatherer Economics and the Formation of a Housepit Floor Lithic Assemblage.* Ph.D. dissertation, Department of Archaeology, Simon Fraser University, Burnaby, B.C.

Prentiss, W.C., and E.J. Romanski
1989 Experimental Evaluation of Sullivan and Rozen's Debitage Typology. In D.S. Amick and R.P. Mauldin (Eds.), *Experiments in Lithic Technology,* pp. 89–100. BAR International Series 528.

Purdy, B.
1975 Fractures for the Archaeologist. In E. Swanson (Ed.), *Lithic Technology: Making and Using Stone Tools.* Aldine Press, Chicago.

Rick, J.W.
1976 Downslope Movement and Archaeological Intrasite Spatial Analysis. *American Antiquity* 41(2):133–146.

Romanoff, S.
1986 Fraser Lillooet Salmon Fishing. *Northwest Anthropological Research Notes* 19(2):119–160.

Romanoff, S.
1992 The Cultural Ecology of Hunting and Potlatches Among the Lillooet Indians. In B. Hayden (Ed.), *A Complex Culture of the British Columbia Plateau,* pp. 470–505. University of British Columbia Press, Vancouver.

Sassaman, K.E.
1992 Lithic Technology and the Hunter-Gatherer Sexual Division of Labor. *North American Archaeologist* 13(3):249–262.

Shackley, M.L.
1978 The Behaviour of Artefacts as Sedimentary Particles in a Fluviatile Environment. *Archaeometry* 20:55–61.

Speth, J.D.
1983 *Bison Kills and Bone Counts: Decision Making by Ancient Hunters.* University of Chicago Press, Chicago.

Sullivan, A.P. III
1987 Probing the Sources of Variability: A Regional Case Study Near Homolovi Ruins, Arizona. *North American Archaeologist* 8(1):41–71.

Sullivan, A.P. III, and K.C. Rozen
1985 Debitage Analysis and Archaeological Interpretation. *American Antiquity* 50(4):755–779.

Teit, J.A.
1900 The Thompson Indians of British Columbia. *Memoirs of the American Museum of Natural History* 1(4):163–392.

Teit, J.A.
1906 The Lillooet Indians. *Memoirs, American Museum of Natural History* 2(5):193–300.

Teit, J.A.
1909 The Shuswap Indians. *Memoirs, American Museum of Natural History* 4:443–758.

Todd, L.C.
1987 Taphonomy of the Horner II Bone Bed. In G.C. Frison and L.C. Todd (Eds.), *The Horner Site, Type Site of the Cody Cultural Complex*, pp. 107–198. Academic Press, Orlando.

Todd, L.C., R.V. Witter, and G.C. Frison
1987 Excavation and Documentation of the Princeton and Smithsonian Horner Site Assemblages. In G.C. Frison and L.C. Todd (Eds.), *The Horner Site, Type Site of the Cody Cultural Complex*, pp. 39–92. Academic Press, Orlando.

Turnbaugh, W.A.
1978 Floods and Archaeology. *American Antiquity* 43(4):593–607.

Wandsnider, L.
1992 The Spatial Dimension of Time. In J. Rossignol and L. Wandsnider (Eds.), *Space, Time, and Archaeological Landscapes*, pp. 257–284. Plenum, New York.

Wiant, M.D., and H. Hassen
1985 The Role of Lithic Resource Availability and Accessibility in the Organization of Technology. In S.V. Vehik (Ed.), *Lithic Resource Procurement: Proceedings from the Second Conference on Prehistoric Chert Exploitation*, Center for Archaeological Investigations Occasional Paper No. 4, Carbondale.