CHAPTER ONE:
INTRODUCTION AND THEORETICAL CONTEXT

1.1 Stratified Foragers and Anthropological Theory

Variability in hunting-gathering societies has been a topic of considerable anthropological interest in the past two decades because characteristics once considered unique to states (e.g. social inequality, sedentism, slavery) have been found to occur in foraging groups lately known as 'complex' (Kelly 1995), ‘transegalitarian’ (Owens and Hayden 1997) and/or ‘intermediate’ (e.g. Arnold 1996). The 'foraging spectrum' once considered typified by small, mobile egalitarian groups, has been expanded to include large, sedentary, socially-stratified groups. Further, these groups’ social structures are not thought to be the products of contact with socially-differentiated groups, but indigenous developments: in North America’s Northwest Coast culture area (Kroeber 1939), the study area of this dissertation, social stratification is thought to originate more than three thousand years ago (Ames 2001, Carlson 1995).

Thus social inequality emerged on the Northwest coast millennia before contact among sedentary foragers. Because social inequality and power relationships are structuring variables in human society, how they emerge, are organized, and change through time are central questions of archaeology and anthropology.

To understand the origins and evolution of complex Northwest Coast foragers they must be understood in an historical context, and this in turn requires that they be understood archaeologically. The culture-historical sequence of the Northwest Coast is generally well-known (e.g. Carlson 1995, Ames and Maschner 1999) and some research has addressed the evolution of social complexity (e.g. Coupland 1988; see review below), but we are still in a period of gathering basic information on patterning and variability in this record. Before extrapolating theory too far from the current handful of exhaustive excavations (see review below) we require further basic data for the assembly of a regional database. I argue that we are near to achieving such a database, in part with the results of this dissertation, which is a detailed investigation of the organization of labour among three contemporaneous late precontact/early-contact (c. 1400-1800 AD) residential corporate groups (sensu Hayden and Cannon 1982) which occupied separate, large plank houses of the Lower Columbia River. The organization of labour is one of several structuring components of the household (sensu Wilk and Rathje 1982: see review below in Section **2.1 Household Theory and Archaeology**), the most important social unit on the Northwest Coast (Ames 1996).

Because details of precontact labour organization on the Lower Columbia River were largely unknown prior to this study it was necessary to use both exploratory (inductive) and confirmatory (deductive) approaches. Inductively, I characterized the range and nature of activities carried out by these populations by analyzing their most mundane artifacts of production; stone, bone and antler tools and the usewear thereupon. Usewear analysis was the main analytical tool in this research phase. With the pattern (activities carried out) derived from particulars (usewear and other data) in this mode, I switched to deduction to evaluate two competing hypotheses regarding the organization of labour in the sampled plank houses. This was carried out by analyzing the statistical characteristics of the spatial distribution of a variety of material correlates of activities. Spatial distribution analysis was the main analytical tool in this research phase.

1.2 Contributions to the Wapato Valley Archaeology Project and Northwest Coast Archaeology and Anthropology

The Wapato Valley Archaeological Project (hereafter, **WVAP**) has since 1987 investigated the pre- and early-contact archaeology of the Greater Lower Columbia River (hereafter, **GLCR**) area, a region extending from the Sandy River to the Lewis River and the associated banks and islands (Figure 1). Excavations, detailed below in **Chapter 3, Site Formation Processes**, have focused on the single-plank house Meier Site (35CO5; see Ames et al 1992) and the multiple-plank house Cathlapotle Village (45CL1; see Ames et al 1999). These excavations, both filling out a regional culture history and focusing on the special topic of the organization of labour, have sampled multiple plank houses.

Over 20,000 artifacts of bone, antler, stone and various contact-era materials, as well as a rich faunal and botanical sample and over 100,000 debitage items, have been excavated. Preliminary analyses (e.g. Hamilton 1994, Davis 1998, Kaehler 2002, Wolf 1996 and at least ten MA and PhD studies underway at this writing) have aided in the characterization of the range and nature of activities carried out at these sites. This dissertation is therefore an integral part of a large, interdisciplinary, nationwide research orchestrated by professor Kenneth M. Ames of Portland State University.

This dissertation is also the first systematic, high-power, high-quality usewear analysis on a Northwest Coast assemblage. Common morphofunctional typologies used on the Northwest Coast are empirically tested for the first time, supporting the use of some such labels and cautioning us on the use of others. Usewear results are integrated with multiple independent lines of evidence to characterize activities carried out and evaluate how they were spatially organized: implications for the social organization of labour are presented and discussed.

In my conclusions I note that the many productive results of this study should not be extrapolated spatially (e.g. to other regions) or temporally (e.g. into remote prehistory) without first being integrated with the many faunal, floral and other analyses currently underway. Though it is tempting to do so, I propose that evaluating competing hypotheses about the evolution of social complexity on the Northwest Coast be carried out with larger and more integrated data sets than have been commonly used to date. Having said this, note that (a) I am confident that the results of the present study will be an important part of this analytical integration and (b) that we are close to having such a data set with the results from excavations at Dionisio, Ozette, Meier and Cathlapotle, all discussed below.

1.3 Contributions to Archaeology and General Anthropological Theory

The study of Northwest Coast Complex Foragers, and particularly those of the GLCR, can assist general anthropology and anthropological archaeology in several ways:

(a) it can identify material correlates of one example of complex foragers, which may be useful in other analytical contexts, e.g. Jomon, Natufian

(b) it can assist in understanding the origins of inequality on the Northwest Coast and elsewhere by describing the precontact organization of labour, widely regarded as a critical element of the development of social complexity

and

(c) it can assist in understanding how GLCR's complex foragers were economically organized in the early-contact period, partially as a test of the accuracy of historical reports.

1.4 Scope and Methodology

The scope of this research is the delineation of the nature and organization of labour within three GLCR plank houses of the late precontact period. I do not discuss extra-plank house activities, such as plank house-plank house interactions, except in passing; that is a topic for another study. Also, I limit my analysis to the organization of utilitarian activities carried out in two basic activity classes: (a) extraction, the acquisition and processing of calories for human metabolism and (b) maintenance, the production and modification of artifacts. While some ritual activities may have left material correlates impossible to distinguish from correlates of these activities, ritual is not my target; it is also a topic for specialized study. Finally, my analysis is limited to the implements used in extraction and maintenance, rather than any other of the many lines of evidence referable to extraction and maintenance, such as faunal and botanical remains. These lines of evidence are being dealt with in other dissertations underway at this writing.

In short, this dissertation is about the activities represented by the implements used in common production activities and how those activities were socially organized in the Meier and Cathlapotle plank houses. To address these issues, my research was carried out in two distinct phases: inductive and deductive. The inductive phase was necessary because prior to this research the nature of activities carried out at Meier and Cathlapotle was incompletely known. Induction served to provide basic data on these activities. The deductive phase evaluated two competing hypotheses about the organization of labour, namely that labour would be organized either (a) heterogeneously by social rank or (b) homogenously by social rank (for reasons specified in Chapter 5).

The research sequence is outlined below, along with more specific research questions. The most detailed discussion of research questions, scope and methods occurs in the appropriate chapters.

Inductive Phase
- *Questions:*
  - What was the range of activities carried out at these sites?
  - What was the nature of activities carried out at these sites?
- *Method:*
  - Usewear analysis (Chapter 4)

Deductive Phase
- *Question:*
  - Was labour organization strictly defined by social rank?
- *Method:*
  - Spatial Distribution Analysis (Chapter 5)

Synthetic Phase
- Consideration of results of induction and deduction *to extract meaningful generalizations from the characteristics of samples*; this is the aim of any statistical research (Chapter 6).

1.5 Dissertation Organization

In **Chapter 2**, **Household Archaeology on the Northwest Coast**, I review (a) the theory of household archaeology and (b) theories of the organization of labour as a structuring element of socially unequal societies; these reviews contribute to the case for their relevance on the Northwest Coast and as a fundamental unit of study in this research. I also review the application of these models in Northwest Coast archaeology to date. I conclude that the methodology is sound and that it has been fruitfully applied in this region, and that application in this study is justified. In **Chapter 3, Site Formation**

Processes I review natural and cultural site-formation processes and their effects on (a) various material correlates of behaviour and (b) sampling decisions at the Meier and Cathlapotle sites. I submit a model of site-formation processes for generic GLCR plank houses. I conclude that the identified formation processes are comprehensible and were controlled for by sensitive research design, and the inclusion of certain artifact types in, and deletion of other types from, the analytical process.

In **Chapter 4, Usewear Analysis** I introduce the theory and methods of usewear analysis and describe the usewear sample as well as the results of the sample examination. I conclude that the usewear analysis greatly assisted the general study by adding greater specificity to statements about the organization of labour: scrapers, for example, could be assigned to bone/antler-, hide- or wood-working, a level of specificity not available in other studies. In **Chapter 5, Spatial Distribution Analysis** I integrate the usewear results with many other lines of evidence to characterize the spatial organization of the activities (read 'labour') identified by the usewear analysis. This chapter details the study of over 80 variables, sometimes referable to a variety of more inclusive activity groups, the spatial distributions of which are used to infer the social organization of labour. In **Chapter 6**, **Conclusions** I conclude that the data generated and analyzed are reliable within certain limits, and I characterize the ways in which labour was organized according to an aboriginal social hierarchy. I also make a number of Suggestions for Future Research.

References follow the conclusions with Tables, Figures, and Plates.

CHAPTER TWO:
HOUSEHOLD ARCHAEOLOGY ON THE NORTHWEST COAST

2.1 Theoretical Context (i): Household Theory and Archaeology

The household as an anthropological concept was first programmatically proposed by Wilk and Rathje (1982) after which it was quickly recognized as archaeologically relevant (e.g. Hayden and Cannon 1982). The concept as outlined below has been expanded (e.g. Lawrence 1999), refined for archaeological aims (e.g. Coupland and Banning 1996, Tringham 1991, Steadman 1996), widely and fruitfully applied (e.g. Bermann 1994, Hayden, Bakewell & Garget 1996, Meskell 1998) as well as re-examined (e.g. Allison 1999, MacEachern, Archer and Garvin 1989). At present, ‘household’ and ‘residential corporate group’ are valid and indeed structuring concepts in archaeological research, in both theory and practice. The household is particularly important on the Northwest Coast, as will be discussed below.

Household theory views the household as an adaptive unit, a 'survival vehicle', the structure of which (a system), is an arrangement of matter and social relations arrayed according to the requirements of a particular selective environment. I view this selective environment as both ecological and cultural (see Durham 1991); each contributes to any given household form. The structure of the household system functions to promote survival of the membership. The evolutionary, functionalist and materialist bases of household theory are sound as we recognize that any complex interaction of variables may be considered a system which is potentially comprehensive, including the recently-researched 'complex adaptive system' (e.g. see Dooley 1997, Lansing 2003), an ‘evolving information entity’ which I consider synonymous with culture. These underpinnings in no way weaken the household concept, as suggested by Hendon (1996), who suggests the household is viewed by archaeologists as a passive, reactive entity. I do not do so and I note that humans are clearly a proactive species; I view the systemic adaptation(s) of a given household as much a product of planned proaction as of intelligent reaction. I therefore discard this critique.

The household system is also seen as the fundamental unit of economic and social cooperation: the scale (e.g. n of members) and complexity (e.g. social relations of members) may vary, but the unit remains fundamental to society. Variation may include the presence of multiple families in a single household, and these multiple families may even occupy separate dwellings, but fundamental economic and social cooperation is the binding concept and reality. Household scale on the Northwest Coast is addressed at the end of this discussion.

This cooperative unit is composed of social, material and behavioural elements. The social element is manifest in demography, or the number and social relations of members. The material element is the dwelling structure(s) and associated artifacts, and the behavioural element is the activities performed by the household, structured by some discrete organization of labour. These elements are arranged (in different ways at any given moment) to facilitate four household functions.

The first function, <u>production</u>, is the procurement and/or value-modification of resources. Production of a given raw material can be variously scheduled, e.g. it may be done simultaneously or sequentially, and understanding such organization is crucial to understanding the household. This function is well-understood in archaeology and is the focus of this study. It is generally studied by the examination of the organization of labour via artifact uselife sequences. <u>Distribution</u> is moving resources from producers to consumers (horizontally, among contemporaneous generations) and includes consumption. It is also organized in certain ways, e.g. various resources may be pooled or redistributed. This may be tracked archaeologically by analysis of resource movement within and between households. <u>Transmission</u> is the transfer of rights, roles and property from one generation to the next (vertically, from one generation to the next); it can also be complexly organized, e.g. such resources may or may not be partible. Transmission is as important as other functions, but may be difficult to track archaeologically. It may be tracked by the longevity of a given plank house, as discussed below. <u>Reproduction</u> is the rearing and enculturation of children; it may also be complexly organized and is difficult to track archaeologically. Table 1 summarizes the theoretical household schematically.

As noted in Section 1.4, **Scope and Methodology**, I am most concerned in this dissertation with the organization of labour, synonymous in household theory with the first function mentioned above, production. Production is the focus because (a) labour organization was poorly known at the time of initiating this research, (b) it is widely recognized as at least one important element in the emergence of social inequalities (see Arnold 1993, 1996), (c) it is a structuring element of the household which is readily visible archaeologically and (d) historical data indicate that labour differed by social rank in the early 19th Century AD, suggesting that it was an important aspect of Chinookan society. All of these points are revisited in the appropriate sections of this dissertation.

Scale is important to discuss here. Northwest Coast plank houses typically (and in the cases of Meier and Cathlapotle, certainly) contained multiple nuclear families. This is evidenced by multiple hearths scaled not for the use of the entire plank house population, but family groups of nuclear size (which I estimate to have ranged from two to seven persons) evident in plank houses dating to over 3,000 BP. The population of a plank house, then, can be considered the aggregate of separate nuclear families, which may themselves be households. Mitchell and Donald (1988) found that within plank houses of the entire Northwest Coast, the nuclear family was the most common unit of labour, not the entire plank house population. However, as will be made clear below, cooperative labour was critical to some Northwest Coast activities, so that entire plank houses must have cooperated on very important occasions. Thus the generic Northwest Coast plank house can be said to have contained a population whose identities shifted in time, according to the tasks being carried out. This dissertation examines how such tasks were organized within several plank houses, in areas which would have been occupied by different nuclear families of different social ranks, at least as a working hypothesis (see below). Whether these populations carried out their activities as a single household, a differentiated residential corporate group, or as independent nuclear families, is a central question of this research.

2.2 Theoretical Context (ii): Household Archaeology and Labor Organization on the Northwest Coast

Three main points illustrate the utility of the household as a fundamental unit of observation on the Northwest Coast. **First**, the household was the largest stable socio-political unit on the Northwest Coast for at least the three thousand years prior to sustained European contact (Ames and Maschner 1999, Matson and Coupland 1995), and it is an essential scale of analysis in this region. **Second**, Northwest Coast households commonly occupied single large plank house structures (generally, see Mitchell and Donald 1988; on the Lower Columbia, see Ray 1938 and Silverstein 1990), the various remains and contents of which are the highly visible material correlates of the household. Thus the household unit, or at least the residential corporate group (sensu Hayden and Cannon 1982) can readily be tracked archaeologically. **Third**, the social inequalities known to have emerged before 3,000 BP were expressed in various ways, including (a) differences in activities performed by peer groups of different social strata (e.g. see Ray 1938) and (b) at least part-time spatial segregation of peer groups of different social strata within the plank house structures (generally, see Drucker 1951; on the Lower Columbia, see Curtis 1970) and the forthcoming review in Sobel, n.d. as well as discussion below.

Combined, the above facts suggest that the archaeological record may preserve traces of the social organization of a variety of activities, including production activities fundamental to household operation, which may be evident as spatially-ordered differentials in activity-specific artifact frequencies. This possibility is the focus of investigation in this dissertation.

Ethnohistoric data have been used to reconstruct basic aspects of the organization of labour in Southern Northwest Coast societies from the early contact period (e.g. Hajda 1984, Panowski 1985, Wike 1951), but the applicability of such models to the distant precontact period is unclear. Thus one object of Northwest Coast archaeology has been to characterize that labour organization, a central objective of this study.

Several Northwest Coast excavations south of the mid-coast have focused on the household with the plank house as either implicit or explicit surrogate. I review a partial list of these below and then summarize their findings, placing my own research in context. Figure 2 is a schematic illustration of the excavated plank houses for comparison and Table 2 summarizes some basic dimensions and analytical characteristics. Figure 3 illustrates a regional chronology based on Ames and Maschner (1999), placing these excavations in a regional context.

2.2.1 Maurer, c. 4,800 BP

The Maurer site, inland of Vancouver, British Columbia, Canada, was rather poorly excavated in the 1970s, but was recently reanalyzed by Schaepe (2003). While he focused on reconstruction of the site from the poor records of the excavator, he also examined the spatial distribution of lithic implements to infer activity organization within this dwelling, which is roughly 11m long and contained one hearth: the number of inhabitants and their social organization is unknown, but the dwelling may have included more than one nuclear family sharing the hearth. Schaepe concluded that activities were spatially segregated within the dwelling, and that this was probably for purposes of orderliness (see Clark 1991) rather than as a result of multi-family economic activity differentiation.”

2.2.2 Paul Mason, c. 3,000 BP

Coupland's excavations tested several plank houses of a mid-coast 10-structure village on the Skeena River (Coupland 1988). These houses contained multiple hearths and were likely occupied by 12-13 people each, possibly arranged as two families, each using one of the two interior hearths. Although excavations were too limited to reveal details of intra-plank house production variation, there appears to be a broad similarity both among and within the plank houses, which were equipped for a variety of domestic tasks, such as cooking and the processing of wood, bone and antler.

2.2.3 Keatley Creek, c. 2,000 BP

Although this site is on the Canadian Northwestern Plateau, and it is not a plank house site, the excavations and analyses are on a scale and have aims similar to my own. Extensive excavations sampling several housepits have yielded a rich artifact assemblage and details of site-formation processes (Hayden 1997, 2000a, 2000b). Spatial distribution analyses of faunal remains, shaped artifacts, debris and phosphates revealed significant heterogeneity, interpreted as evidence for socioeconomic differentiation, particularly in the multifamily housepit 7 structure. Spafford (1992) concluded that 'Some of the differences were attributed to sex-specific activities, craft specialization, or status distinctions… [in the largest house there was compelling] evidence for the division of space among several somewhat independent domestic groups within a hierarchically-organized corporate group'.

2.2.4 Tualdad Altu, c. 1,700 BP

This site is discussed below, with the Sbabadid site.

2.2.5 Dionisio Point, c. 1,600 BP

Grier (2001) sought to identify the social economy of a Marpole-period plank house near Vancouver, British Columbia, Canada, within which he proposed that social ranking might condition labour organization. Grier found convincing evidence of some activity differentiation within the plank house, which was clearly large enough (c. 16 m long) to accommodate several families.

2.2.6 Ozette, c. 500 BP

Ozette provides us with the best-preserved precontact Northwest Coast plank houses, three of which, buried by a mudslide around 1500 AD, yielded thousands of stone, bone, antler, fiber and wooden artifacts, most of which were in situ or less than 10 cm distant from their place of discard/storage (Samuels 1989). Clearly, if archaeologists cannot observe and reconstruct economic organization in these plank houses, it will be impossible elsewhere, where such preservation is unknown. The many and varied analyses of Ozette have yielded several main lessons pertinent to this study.

First, the three plank houses (roughly 50% of a likely six-house village) had essentially the same architecture and internal layout (see Figure 2), and were roughly the same size. **Second**, the three plank houses each contained artifacts and debris reflecting a wide range of domestic activities; no plank house population, it seems, was entirely excused from any production activity. **Third**, while all people of all houses engaged in all known activities, there were significant differences in the degree to which plank house populations engaged in these activities. That house 1 contained proportionally far fewer mammalian bone items than other houses, is argued (as one of several lines of evidence) as evidence for it being the high-status, more-often-cleaned of the three houses. Such conclusions will be returned to in the conclusion of this dissertation.

For the moment it is sufficient to note that the Ozette analyses (a) have addressed the organization of labour on a plank house / household scale and (b) have found convincing evidence of such differentiation, and have characterized it.

On a methodological note, Grier (2001:256-257) argues that spatial differences in density figures (artifacts per m^3) are difficult to interpret because '…differences in production and breakage rates of artifacts associated with various tasks [and] differences in housecleaning strategies'. I feel that both are sufficiently understood at Ozette to allow interpretation of the density data there. Production and breakage rates should be almost equal in all areas of the plank houses, as the most abundant tool types were essentially the same design, and same utilitarian function. Also, cleaning strategies are better understood than in any other Northwest Coast site: it is clear, for example, that in house 1 bone was diligently removed to the midden more frequently than in houses 2 and 5, and the pattern of non-faunal debris being concentrated away from high-traffic areas applies equally to all houses (Samuels 1983). Essentially, to me, if such site-formation processes are understood, all other things being equal (as they are more reliably assumed at Ozette than any other archaeological site I know), artifact location and frequency should be very clearly reflective of degree of engagement in a given activity.

2.2.7 Meier, c. 500 BP

The Meier site (35CO5) is the remains of a 14 m-wide, 30 m-long plank house 14C dated to roughly 1400 AD - 1830 AD (Ames et al 1992); it is analyzed in detail in this study. At this point it is sufficient to note that research was designed from the start to sample the long axis of the plank house to identify activity differences within the structure, the long axis acting as an indicator of social stratum. Several investigations (e.g. Davis 1998, Smith 1996, and Wolf 1996) have attempted to identify status-related production variation, with moderately convincing results. The present dissertation is a more thorough investigation and should supersede most of the previous results in this regard; results are discussed in Chapters 5 and 6.

2.2.8 Cathlapotle, c. 500 BP

The Cathlapotle site (45CL1) is the remains of a village of multiple plank houses, often c. 9 m wide and >10 – 20 m long, 14C dated to roughly 1400 AD – 1830 AD (Ames et al 1999); several plankhouses of this village are analyzed in detail in this study. At this point it is sufficient to note that, as at Meier, research was designed from the start to sample the long axis of the plank houses to identify activity differences within and between the structures. As at Meier, the working hypothesis is that the long axes are surrogates of social stratum within plank houses. The assemblage has not yet been treated in detail, this dissertation being among the first high-fidelity descriptions (but see Banach 2002 and Kaehler 2002) that attempt to identify status-related production variation, with moderately convincing results. The present dissertation is a more thorough investigation and should supersede most of the previous results in this regard; results are discussed in Chapters 5 and 6.

2.2.9 Sbabadid, c. 200 BP

This 27 m x 9 m plank house site (45K151) was excavated and analyzed by Chatters (1989), as was the above-mentioned Tualdad Altu plank house of 17 m x 7 m. Chatters interpreted his spatial analyses of these sites to indicate ‘economic specialization’ evident in both structures, but I discount these interpretations.

The main problems with the Sbabadid and Tualdad Altu analyses are lack of discussion of site-formation processes, low counts of artifacts and inadequate reporting of methods. As will be seen below in Chapter 3, any spatial distribution analysis must come to grips with site formation processes; Chatters only briefly mentions such processes. Low counts of non-status artifacts (e.g. the hunting implements reported by Chatters) are suspect because mundane tools are less formally treated than status items, and the presence/absence of a handful of these artifacts may be severely affected by even a single cleanup or depositional episode. Also, methods of calculating expected values for the chi-square test are not reported, and this is a critical step in using chi-square. Other methodological issues make me reject these analyses, for example, Chatters' division of the Sbabadid assemblage into bone/antler and stone implements in the examination of economic activity. There is no a priori reason to do this, as a woodworker, for example, may use both bone/antler and stone tools in working wood. Until these assemblages are better understood and discussed, Chatters' analyses should be considered suspect. Thus, while these analyses have sought to characterize plank house / household economic organization, I am unsatisfied that they have done so for methodological reasons. The sites, then, should be re-analyzed and at present are rejected.

2.2.10 Cla-Cle-Lah, 200 BP

Cla-Cle-Lah (45SA11) was excavated in the 1970's, sampling a seven plank house Upper Chinookan village near The Dalles, Oregon (Minor, Toepel and Beckham, 1989). These plank houses are rather small compared to those of the Lower Columbia, with average dimensions of 8 m x 10 m. Detailed analysis of the plank house contents is underway, and forthcoming work by Sobel (n.d.) will be very interesting.

2.2.11 Summary

Table 2 summarizes selected results from the excavations noted above. Essentially, 11 sites have excavated or sampled roughly 30 Southern Northwest Coast plank houses dating from 3,000 BP to the contact period. Of these, data sufficient for characterizing and understanding the organization of production is available from six dwellings (Keatley Creek, Dionisio Point, Ozette, Meier and Cathlapotle, with Cla-Cle-Lah data incomplete at this writing). The important excavations at Richardson Ranch (Fladmark 1973), not included in Table 2, should in future be reevaluated and included in a regional analysis. This study develops the Meier and Cathlapotle data and adds them to this comparative set. Comments on general trends are made in Chapter 6.

2.3 Cultural Context: Stratified Foragers of the GLCR

From the above it is clear that in archaeological remnants of plank houses we may expect to observe some trace of the organization of labour critical to the functioning of a household (Hendon 1996). This is particularly important in the large, socially-stratified plank houses which contained residential corporate groups (sensu Hayden 1994) on the Northwest Coast. In the following section I summarize what we know of such groups in the GLCR from the ethnohistoric and archaeological records. This necessarily provides a static phase portrait of a once-dynamic cultural entity, but it is all we have, and is of course the reason for doing archaeology. I focus on the plank house as an archaeological phenomenon and scale of analysis for the reasons noted above.

Historical Context

When American and British explorers first examined the Lower Columbia, in 1792 AD, it was densely occupied by native peoples speaking several varieties of the Chinookan language group. The first Euro-American explorers to comment substantially on GLCR peoples were Lewis and Clark. They visited the Cathlapotle village site excavated by the WVAP two times, in Fall 1805 on the way to the Pacific and in Spring 1806 on the return voyage. Their comments contain several details useful to the archaeologist and are reproduced below before going on to a general discussion of traditional Chinookan life of the early-contact period.

On November 5, 1805, Clark wrote:

> *'...passed an Isld. Covered with tall trees & green briers Seperated from the Stard. Shore by a narrow Chanel at 9 [8?] miles I observed on the Chanel which passes on the Stard Side of this Island a Short distance above its lower point is Situated a large village, the front of which occupies nearly 1/4 of a mile fronting the Chanel, and closely Connected, I counted 14 houses [NB: Quathlapotle nation] in front here the river widens to about 1/2 miles. Seven canoes of Indians came out from this large village to view and trade with us, they appeared orderly and well disposed, they accompanied us a fiew miles and returned back...'* Moulton 1983[6]:23

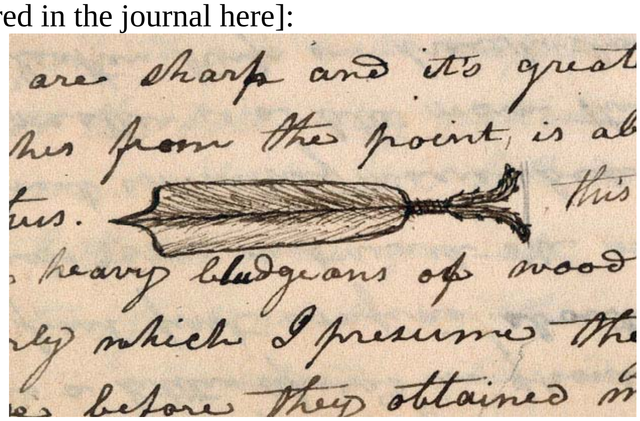
On March 28, 1806 Clark wrote:

> *'...we were visited by a large canoe with ten nativs of the Quathlahpohtle nation who are numerous and reside aboiut fourteen miles above us on the N.E. side of the Columbia above the Enterance of a small river which the Indians call Chah wah-na-hi-ooks…'* Thwaites 1969: 212

Lewis and Clark visited Cathlapotle for several hours the next day: Lewis wrote:

> *'...on the North side of the columbia a little above the entrance of this inlet a considerable river discharges itself. this stream the natives call Cah-wah-na-hi-ooks. it is 150 yards wide and at present discharges a large body of water, tho'from the information of the same people it is not navigable but a short distance in consequence of falls and rappids a tribe called the Hul-lu-et-tell reside on this river above it's entr.- at the distance of three miles above the entrance of the inlet on the N. side behind the lower point of an island we arrived at the village of the Cath [X: Quath]-la-poh-tle wich consists of 14 large wooden houses. here we arrived at 3 P.M. the language of these people as well as those on the inlet and wappetoe Island differs in some measure from the nations on the lower part of the river. tho' many of the words are the same, and a great many others with the difference only of accent. the form of their houses and dress of the men, manner of living habits custom &c as far as we could discover are the same. their women wear their ornaments robes and hair as those do below tho' [NB: Indian women on Wappato Island & in that Valey] here their hair is more frequently braded in two tresses and hang over each ear in front of the body. in stead of the tissue of bark*

woarn by the women below, they wear a kind of leather breech clout about the width of a common pocket handkerchief and reather long. the two corners of this at one of the narrow ends are confined in front just above the hips; the other end is then brought between the legs, compressed into a narrow foalding bundel is drawn tight and the corners a little spread in front and tucked at the groin over and arround the part first confind about the waist. the small robe which dose not reach the waist is their usual and only garment commonly woarn be side that just mentioned. when the weather is a little warm this robe is thrown aside and the leather truss or breech-clout constitutes the whole of their apparel. this is a much more indecent article than the tissue of bark, and bearly covers the mons venes, to which it is drawn so close that the whole shape is plainly perceived. the floors of most of their houses are on level with the surface of the earth tho' some of them are sunk two or 3 feet beneath. the internal arrangement of their houses is the same with those of the nations below. they are also fond of sculpture. various figures are carved and painted on the peices which support the center of the roof, about their doors and beads. they had large quantities of dried Anchovies strung on small sticks by the gills and others which had been first dryed in this manner, were now arranged in large sheets with strings of bark and hung suspended by poles in the roofs of their houses; they had also an abundance of sturgeon and wappatoe; the latter they take in great quantities from the neighbouring bonds, which are numerous and extensive in the river bottoms and islands. the wappetoe furnishes the principal article of traffic with these people which they dispose of to the nations below in exchange for beads cloth and various articles. the natives of the Sea coast and lower part of the river will dispose of their most valuable articles to obtain this root. they have a number of large symeters of Iron from 3 to 4 feet long which hang by the heads of their beads; the blade of this weapon is thickest in the center tho' thin even there. all it's edges are sharp and it's greatest width which is about 9 inches from the point is about 4 inches. the form is thus.[a drawing is entered in the journal here]:



> *this is a formidable weapon. they have heavy bludgeons of wood made in the same form nearly which I presume they used for the same purpose before they obtained metal. we purchased a considerable quantitiy of wappetoe, 12 dogs, and 2 Sea otter skins of these people. they were very hospitable and gave us anchovies and wappetoe to eat. notwithstanding their hospitality if it deserves that appellation, they are great begers, for we had scarcely finished our repast on the wappetoe and Anchovies which they voluntarily sat before us before they began to beg. we gave them some small articles as is our custom on those occasions with which they seemed perfectly satisfyed. we gave the 1st Cheif a small medal, which he soon transfered to his wife. after remaining at this place 2 hours we set out & continued our rout between this island, which we now call Cath-lah-poh-tle after the nation, and the Lard shore. at the distance of 2 miles we encamped in a small prarie on the main shore, having traveled 19 miles by estimate...'* Moulton 1983[7]:26-29

On the return voyage Clark described the second encounter with Cathlapotle on March 29, 1806:

> *'...we proceeded on to the lower point of the Said island accompanied by the 3 Indians, & were met by 2 canoes of nativs of the quath-lah-pah-tal who informed us that the chanel to the N E of the Island was the proper one. we prosued their advice and Crossed into the mouth of the Chah-wah-na-hi-ooks River which is about 200 yards wide and a great portion of water into the columbia at this time it being high. The indians inform us that this river is crouded with rapids after Some distance up it. Several tribes of the Hul-lu-et-tell Nation reside on this river. at 3 oClock P. M. we arrived at the Quath lah pah tle Village of 14 Houses on main Shore to the N E. Side of a large island. those people in their habits manners Customs and language differ but little from those of the Clatsops and others below. here we exchanged our deer Skins killed yesterday for dogs, and purchased others to the Number of 12 for provisions for the party, as the deer flesh is too poore for the Men to Subsist on and work as hard as necessary. I also purchased a Sea Otter robe. we purchased wappatoe and Some pashaquar roots. gave a Medal of the Small Size to the principal Chief, and at 5 oCclock reembarked and proceeded up on the N E. of an Island to an inlet about 1 mile above the village*

> *and encamped on a butifull grassy plac, where the nativs make a portage of their Canoes and Wappato roots to and from a large pond at a short distance. in this pond the nativs inform us they Collect great quantities of wappato, which the womin collect by getting into the water, Sometimes to their necks holding by a Small canoe and with their feet loosen the wappato or bulb of the root from the bottom from the Fibers, and it imedeately rises to the top of the water. they collect & throw them into the Canoe, those deep roots are the largest and best roots. Great numbers of the whistling swan, Gees and Ducks in the Ponds. Soon after we landed 3 of the nativs came up with wappato to sell a part of which we purchased...'* Moulton 1990[7]:30

Lewis and Clark's journal entries are interesting for many reasons, but are a 'snapshot' of a larger cultural system in operation. What is known of this larger system is summarized below first for the historic period, and second in precontact contexts.

Ecological Context

The GLCR encompasses the North and South banks of the Columbia River, as well as all its islands and tributary mouths, from the Sandy River to the Pacific Ocean (Figure 1), a distance of over 320 km (200 miles) as the river flows. The GLCR thus contains the lower reaches of the Columbia River, a multitude of islands and waterways, and the adjacent riverbanks, which were before damming occasionally capped with overbank deposits in flood years. The highest elevations of the region reach over 1,000 m (1,500 ft) in the Coast Range, west of the Portland basin (also known as the Wapato Valley, discussed more below) where landforms are generally well below 100 m (300 ft) in elevation. Rainfall averages >1,700 mm (70 inches) per year west of the Coast Range, but only c.1,000 mm (40 inches) per year in the Wapato Valley. Temperatures range from 0C (32F) to 29C (81F) seasonally.

Before the Columbia was dammed (Musil 1998 suggests that modern landforms emerged by roughly 2,400 BP), the Wapato Valley area of the GLCR was ecologically rich and diverse in both plant and animal species. Flora and fauna recorded in both historical descriptions (e.g. the journals of Lewis and Clark) and archaeological sites (see Ames et al 1999) allowed Hamilton (1990) and Saleeby (1983; see also Saleeby and

Pettigrew 1983) to reconstruct the early 19th-century ecology of the Wapato Valley. Seven floodplain habitats were defined by Hamilton (1990), containing grasses, reeds, wapato (*Sagittaria*) and tree species dominated by oak (*Quercus*), alder (*Alnus*), pine (*Pinus*), fir (*Pseudotsuga*) and cedar (*Thuja*). These wetland, riparian and savanna mosaic micro-habitats of the Wapato Valley supported a rich and diverse flora and fauna. Chinookan staples included elk (or wapiti; *Cervus elephas*), deer (*Odoceolious sp.*), bear (*Ursus*) among many other mammals, wapato (*Sagittaria latifolia*), camas (*Camassia quamash*), salmon *(Oncorhinchus*), sturgeon (*Acipenser*), smelt (*Spirinchus thalerchthys*), among a wide array of other mammalian, fish and avian species (see Ames et al 1999 Figure 1 and Table 1)..

In short we may say that the GLCR and the Wapato Valley were ecologically rich and diverse in species useful to humans as food as well as raw materials for clothing, housing and other artifacts. This is reflected in the high population density of the Wapato Valley, recorded in the historic period and suggested in the archaeological record, as discussed below.

Subsistence and Associated Technologies

Salmon were a staple on the Lower Columbia, gathered with a variety of tools including stone-weighted nets, various types of canoes and fishing platforms equipped with dip nets as well as lines with composite bone hooks; these technologies were used to gather other schooling fishes as well and all except the net weights were illustrated in vignettes by Lewis and Clark. The large, solitary sturgeon was taken with bone or antler armatures (such as the common toggling harpoon head) on long staffs. Processing of these fish essentially included initial division of the carcass followed by either cooking for immediate consumption or drying for storage in pits and/or racks. Mammalian staple animals were deer and wapiti (elk), taken with bow and arrow (chipped stone points are ubiquitous and discussed at length in Chapter 5) and similarly processed. Marine animals were hunted and gathered nearer the coast, but would have been imports to the Wapato Valley; while the Chinook built at least six types of canoes, none were seagoing vessels for hunting whales, as practiced by the Makah of the Olympic peninsula. Among the many plant species used as food, wapato (*Sagittaria*; the ‘indian potato’) was paramount (see Darby 1996); it was collected rather easily by ‘plucking’ from water with feet (noted by Lewis and Clark). Camas (*Camassia*) was collected with a digging stick with an antler handle: Meier site artifacts 6585 and 2810 most likely such handles. Feature 54 in Cathlapotle excavation unit N168-172W88-89 is a camas oven, containing fire-cracked rock, ash and burned camas bulbs.

Native people of the Wapato Valley were hunters of solitary animals (aquatic and terrestrial) and gatherers of both schooling fishes and a variety of plant products. Archaeologically, their basic subsistence technologies are evident in the region over 3,000 BP (Pettigrew 1990). After 1,500 BP there is a dramatic increase in radiocarbon dates in the region, believed to reflect an important population increase (Ames et al 1999).

Population and Group Sizes

Ames et al (1999) estimate the precontact, pre 1830’s epidemic population of the Wapato Valley at up to 120/km^2, or from an average of 12,000 up to 30,000 during the winter season. These are high figures for any foraging society (Kelly 1995). Local group size is not so unusually high, generally, as seen in Table 4. Therefore, the Wapato Valley appears to have been occupied by a high density of local groups. As noted below, there is good reason to believe that these groups were not often confederated for long periods, and that the most important social unit, even above that of the village of allied plank houses, was the household, the central scale of this analysis. Whether or not a single plank house was considered a single household, or composed of several cooperative constituent households, is also an important question of this study and is addressed by analysis of the scales of labour organization discussed in the conclusions.

Scales of Identity and Interaction

Table 3 indicates the basic scales of identity and interaction on the Northwest Coast in a scheme adapted from Gamble (1999). These scales begin with the individual and extend to many hundreds of kilometers outwards from that individual. These multiple social relationships required social maintenance and we may be sure that individuals and their households were engaged in complex relations outside the physical dwelling.

This dissertation does not address extra-plank house activities or interactions directly, but they are important, and are being investigated at present by Sobel (n.d.) and myself (Smith 2004). A synthetic treatment of the Meier and Cathlapotle results will have to address the economic systems identified in this dissertation in relation to those outside the plank houses.

While Table 3 hints at the complexities of social relations among GLCR peoples and their neighbours, it does not identify some of the most important relations known, those between different social strata. These are discussed below.

The Organization of Society and Labour

The historic record clearly indicates that GLCR societies, among others of the Northwest Coast, were socially differentiated, with discrete elite, commoner and slave ranks (Hajda 1984). In Hayden's terminology (Hayden 1995) we may qualify that there existed at contact a native social hierarchy of access to (a) social and (b) economic resources within these societies. What Hayden calls political hierarchy was apparently absent, according to Ames (1991), because of the difficulties of using canoes to exert will in distant regions. Thus GLCR social stratification was evident mainly on the scale of the individual, local group (Mitchell and Donald 1988) and/or, occasionally and maximally, the scale of the multi-plank house confederation. On these scales, as we see below, an important element of this hierarchy was the labour a given rank group was expected to carry out.

Historically, Chinookan society was divided into herediterially-ascribed statuses of free (elites and commoner) and non-free (slave) peoples (Ames 1995); slaves were both conspicuous indicators of wealth (Panowski 1985) and labour sources to generate further wealth (Donald 1997). Elites could be excused from some activities, such as paddling canoes, and harder labour is often reported as falling to the slave ranks: commoners engaged in a variety of labour tasks, including occasional production to satisfy specific elite demand (Ames 1995, Hajda 1984). While such distinctions are sometimes clear-cut, rank expression varied in poorly-understood and complex ways. Commoners, for example, could increase their social status by accumulating social and material wealth, but they could rarely join the elite; some slaves were prized over others (and in rare cases could become free), but slaves owned nothing, not even their own bodies; elites had the power of death over slaves, but these same elites could be disgraced and even abandoned by entire plank house populations if they failed in some way (Hajda 1984, Panowski 1985, Ray 1938). Also, slaves might have lived in the same domestic areas as their elite masters, or well apart from them; they may have been engaged in more drudgery than elites, but elites may not have been excused from every domestic task. The historical record is highly variable and inconclusive on these matters (see Donald 1997, Hajda 1984, Panowski 1995 and Wike 1951) and consequently we know little about the organization of labour within any given GLCR plank house; this applies to both the historic and precontact periods.

One aspect of social differentiation that is repeatedly mentioned is that of the differentiation of work, whether or not we can be sure what work was carried out by what rank. Such work (e.g. woodworking, the production of hides or the preparation of food) may well have left material correlates, a topic addressed specifically in Chapters 3, 4 and 5. For the moment it is sufficient to say that the organization of labour was both important and potentially archaeologically visible in the GLCR and is thus a topic of considerable interest.

Generally I divide GLCR activities into two classes (maintenance and extraction, as discussed above), tasks carried out either (a) individually or (b) communally. As in most foraging societies, most individuals appear to have been capable of and engaged in both the production of many of the artifacts they required in daily life (Ray 1938). Divisions of labour by gender, age and ability did occur, and there are hints of part-time labour specialization by individuals (e.g. woodworkers), but there is little evidence of full-time economic specialization (*sensu* Costin 1991).

In addition to individual labour was communal labour, and it must have been an important aspect of GLCR life. Communal tasks requiring many simultaneous actions and/or large numbers of workers would have included plank house construction and maintenance, the use of very large nets, the capture and processing of salmon (particularly in the fall run, where failure could mean winter starvation for the whole group), slave raids and warfare.

Although any free peoples could try to initiate some types of cooperative labour (e.g. commoners could carry out small fishing excursions together), elites appear to have had a head-start in coercive power to orchestrate activities requiring individuals, nuclear families, multiple households, entire residential corporate groups (e.g. plank house populations) or even the populations of multiple plank houses (e.g. villages) temporarily confederated for one purpose. This head-start was due to both the honours of the elite bloodline and the material resources they could marshal, such as titles to resource patches and the number of slaves available for labour. Commoners could occasionally enter the elite rank, and it is conceivable that this occurred due to increased respect derived from the results of good planning, which increased chances of association and marrying into elite ranks (village-exogamously in the historic period), but this is only speculation. Elites could benefit from absorbing or at least recruiting good organizers, (the closer to themselves the better, perhaps) who must have occurred in the commoner stratum.

We know that elites did sometimes manage risk and information as proposed in what Ames (1995) calls the 'elite as manager' model of elite role in complex foraging societies (e.g. Ames 1995, Peebles and Kus 1977). They also appear to have occasionally acted in self-interest as self-aggrandizers in the 'elite as thug' model (e.g. Ames 1985). I take this model, minimally, to apply to any situation in which slaves are utilized as labourers, because by definition slaves expend energy to their detriment and for the benefit of another, a de facto aggrandizer. Elites, then, were both manager and thug, thuggery being the price of management for group survival. That price was paid largely by the slave population, which composed as much as 25% of the native GLCR population in the first quarter of the 19th Century (Donald 1997).

Thus we know that elites were both managers and thugs on the scale of the plank house population, but we do not know whether their power was manifest in the organization of activities within the plank houses over which they held sway -- a major gap in our knowledge. This dissertation addresses this last aspect of the GLCR society in the immediate precontact period; the aspect of the social organization of labour within the sampled plank houses. Questions asked are introduced in Section **1.4, Scope and Methodology**, and detailed in the appropriate chapters.

Housing and Associated Technologies

As noted, the plank house was the physical structure which served as the basic Northwest Coast dwelling. Architecture is described in detail in Chapter 3. Here it is sufficient to say that these structures, particularly in the Wapato Valley (see Table 2 and Figure 2) were longer than wide, occupied by up to ten or more families each, and were equipped with large hearths arranged in a row on the long axis of the structure. Ethnohistorically, most residents were arranged as nuclear families, one or two per hearth; the highest-ranked families occupied the area most distant from the common door, at the end of the plank house (discussed further below). Much production (e.g. see Samuels n.d.) and consumption (e.g. see Huelsbeck 1989) took place within the structure, which was also a storage facility (Ames 1996, Ames and Smith n.d.). The plank house was also the location of various rituals and in sum it materially, as well as socially, represented the primary social, political and economic allegiance of its member population. Thus the plank house may be discussed in Material and Social terms.

2.3.1 The Material Plank House

Materially, plank houses of the GLCR are distinctive in several ways:

1. They were equipped with multiple and voluminous storage pits beneath floorboards; these were not exclusively refuse facilities (as demonstrated below in Chapter 3), but also contained valued items. In a way, such facilities may be thought of as representing wealth in the form of surpluses and they are an immediately obvious difference from all other excavated plank houses.

2. Most are larger than plank houses to the North. Ames (1996) indicates that this larger-house trend begins at the Fraser River (see Figure 2 and Table 2). The Meier and Cathlapotle I plank houses are the largest excavated on the Northwest Coast, with areas of 490m^2 and 550m^2, respectively, at least twice the size of any other excavated plank house. The populations occupying the plank houses were also large, a point returned to below in a discussion of GLCR population. Here it is sufficient to note that these structures were indeed dwellings (that is, the large size is not accounted for by other structure functions) and that they were occupied by populations roughly at least twice those of plank houses further North. In the Wapato Valley, there are two classes of plank house, the large class such as the Meier site and Cathlapotle House I, and the small class, such as Cathlapotle House IV. This study examines two large and one small Chinookan plank houses.

3. They were equipped with large hearths bounded by box-frames, while other houses had amorphous hearths with boundaries which 'wandered' through time. This is evident in excavations at both sites as well as in historical illustrations presented in Figures 8a and 8b. The box-bound hearths at Meier and Cathlapotle would have been necessary to accommodate the next distinction.

4. They had plank floorboards to cover the voluminous, sub-floor pits (discussed extensively below). These pits provided several hundred cubic meters of storage space in the Meier and Cathlapotle plank houses (see analysis in Ames 1996).

The significance of these points is found in Chapter 3, a comprehensive discussion of site formation processes.

2.3.2 The Social Plank House

The use of space in society is clearly conditioned by social as well as utilitarian concerns: Rappoport (1969, 1982) goes so far as to state that architectural form is first social and second utilitarian. On the Northwest Coast domestic space was certainly socially charged in the early contact period. Marshall indicates that among the Nuu-Chah-Nulth space '…materially manifests the stability and stasis of rank, by fixing the spatial arrangements of people within houses…' (Marshall 1989:21). Kent places historic Chinookan space use in category IV (of five) in terms of the complexity of social organization and social ‘charging’ (my term) of space, with V being the highest expression (Kent 1990), although she does not discuss that use of space in detail. Nevertheless it is variously reported both visually (e.g. in Figure 8b) and in text (e.g. Swan 1857) that the highest-ranked residents of a plank house occupied one end of the plank house, which might also be equipped with the ritual paraphernalia restricted to those of higher rank. Sobel (n.d.) is currently documenting such reports, but confirms that there are several historic statements to this effect (Sobel n.d.).

It is the working hypothesis of the WVAP, and this dissertation, that at the Meier plank house, as described below, the North was the high-status end. This is because the North contained the only unequivocally embellished art item in the assemblage (artifact 10,108, an anthropomorphically-carved pumice item with one face on each of two surfaces), most of the perforated net-weights (‘expensive’ items in terms of construction costs) and the remains of a musket barrel (a prized item in the early contact period). Also, the South end of the plank house faced the slough leading to the Columbia River, and the common entrance door is reported to have normally faced the water. At Cathlapotle, it is the South end of each house, I and IV, analyzed in this study that is considered to be the elite residence, because the South end of Cathlapotle House I also contained an anthropomorphic, carved pumice face (#52,053) as well as more net weights (in count and density) than the North end. As no comparable items were found in Cathlapotle House IV, this designation is extended to that house only as a working hypothesis.

I suggest that until floral and faunal data are analyzed and integrated with the results of other studies, these labels should not be reified. Having said that, what is very likely is that the ends of the plank houses would have been occupied by peer groups of quite different social ranks, regardless of which occupied which area. Thus, as I describe in Chapter 5, I do not specifically seek the material correlates of elites, commoners, or slaves. What I do seek is whether or not the activities carried out within the plank houses varied appreciably on the long axes. As I note in Chapter 5, all other things (site formation processes, essentially) being equal (as I suggest they are in Chapter 3), labour variation on the plank house long axes may well be attributable to social rank differences in labour engagement: the social organization of labour.

CHAPTER 3:
SITE FORMATION PROCESSES

Numerous excavations (see Ames and Maschner 1999) have made it clear that at Northwest Coast plank houses which stood in the same location for centuries, site-formation processes were particularly complex, generating palimpsests (Binford 1981a, 1987) more often than discrete occupation floors. Archaeologists have found that the interpretation of a palimpsest can be very difficult (Carr 1984, Carr 1985) and the degree to which a given palimpsest may be unpacked into episodes must be identified in order to design the research strategy (Binford 1987:504-507). This is returned to in Section 6.3, Suggestions for Future Research.

3.1 The Meier and Cathlapotle Sites

The Meier site (35C05) is a large southern Northwest Coast plank house excavated by Portland State University's Wapato Valley Archaeology Project from 1987-1991 (inclusive). The project has sampled both sites, focusing on understanding (a) site formation processes and plankhouse depositional histories, (b) subsistence economy, and (c) social economy. Field methods included the use of standardized 2x2m or 1x4m excavation units, screening with ¼-inch and 1/8-inch screens, the standardized collection of bulk samples and on-site water-screening: these methods are detailed in Ames et al 1992 and Ames et al 1999. Meier is situated on a slough with easy access to the Columbia River (Figure 4). Roughly 35% of the interior of the plank house was exposed in controlled excavations, which were primarily research-oriented, although with a significant salvage component because the eastern half of the site had been extensively pothunted. Figures 5 and 6 indicate the layout of excavation units and features encountered for Meier and Cathlapotle sites respectively. Excavation volumes per excavation unit are noted in Table 2. Cathlapotle village (45CL1), just a few miles from Meier, downriver and across the river on the Washington shore, is the remains of not just one plank house, but of up to 14 plank houses (with at least eight identified by 1999: see Ames et al 1999). It was a large and rather important village, at least by 1805, when

Lewis and Clark arrived. Two of the Cathlapotle houses were extensively excavated from 1991 to 1996, inclusive. These, houses 1 and 4, were sampled along with the Meier house to provide a largely contemporaneous sample of the three extensively excavated lower-Columbia plank houses in this study.

Because basic aspects of Cathlapotle (Ames et al 1999) and Meier (Ames et al 1992, Smith 1996) have already been described in detail, I focus here on specific data regarding site formation processes. I begin with a brief discussion of chronology and the period of occupation, during which the sites formed. I then review what has been deduced about the architecture of the plank houses to develop a holotypical, heuristic plank house model for each site. In any given case, this holotype may be considered a structuring phenomenon that largely dictated site formation. As will be shown, plank house architecture was conservative, changing little over centuries of occupation; it required maintenance to be thus conserved, and such maintenance contributed to the site as excavated. Also, it is within the plank house that many production activities took place, necessitating arrangement of production artifacts and products in space and time. Finally, plank house arrangement was socially charged, with peer groups of different social ranks occupying, according to the working hypotheses of the Wapato Valley Archaeology Project, different areas of the plank house interior.

After describing plank house architectural facilities and comparing the Meier and Cathlapotle plank houses, I go on to evaluate a set of natural and cultural formation processes (sensu Schiffer 1995) that could have structured the archaeological sites. I conclude this chapter by presenting and discussing a heuristic model (substantiated by multiple, independent lines of evidence) of the flow of artifacts associated with these plank houses through space and time, and the analytical ramifications of such trajectories for present and future studies.

3.1.1 Chronology

Figure 7 plots the seven radiocarbon dates from Meier and the 37 dates from Cathlapotle (all dates are calibrated). These dates have been discussed (Ames et al 1992,

1999) and here it is sufficient to summarize the most important points regarding this study.

There are several ways to define ‘contact date’, and sustained European contact may not be the only contact of importance. Artifact #5,142 from the Cathlapotle site is nonmeteoric iron, apparently shaped into an adze, found in a level dated to roughly 1400 AD; this must be of Asian origin, but how it arrived at Cathlapotle is unknown – it could be from a shipwreck or it may have been traded down the coast as a curio. It has been proposed that Sir Francis Drake landed in Oregon in the 16th Century AD (Bawlf 2003). While I do not address the issue here, it should be remembered that even unsustained contact could have important cultural effects, and should be investigated. For this study, the period from 1600 AD to undisputed contact is considered the ‘protohistoric’. Undisputed European contact begins at 1775 AD, and sustained European contact, largely related to the fur trade, begins at 1792 AD (Ames and Maschner 1999).

The Meier site has a lower-limit (one-sigma) date of c. 1190 AD, and an upper limit (also one-sigma) of c. 1850 AD; the dates center around 1490 AD, with sufficient sample overlap data to indicate a very likely occupation between 1400 AD and at least 1700 AD, and likely beyond 1800 AD. These data indicate that much of the Meier site’s roughly 400-year occupation occurred during the precontact era. Still, there is some evidence of significant European contact at Meier, in the form of artifacts made of glass (e.g. beads: see Kaehler 2002) and manufactured copper (Banach 2002) as well as butchery marks from metal blades on bone and antler (Davis 1998). Such ‘historics’ (glass, metal and ceramic items) at Meier (n of historic artifacts =679, historic artifact density overall = 4.39 item per cubic meter), however, were less frequently encountered than at Cathlapotle (n of historic artifacts =1,286, historic artifact density overall = 5.31 items per cubic meter).

Cathlapotle House I was also occupied from well in the precontact era to well into the contact era. Radiocarbon dates in Figure 7 indicate that this house has a lower (one-sigma) occupation date of just after 1200 AD, and an upper (one-sigma) date of just after 1600 AD, centering around 1500 AD. Many historic items were recovered in House 1 (n of historic artifacts =503, historic artifact density overall = 6.18 items per cubic meter).

Cathlapotle House IV has the shortest and most recent occupation (Figure 7), with lower and upper (one-sigma) dates around 1500 AD and 1800 AD, centering around 1630 AD. Many historic items (n of historic artifacts =268, historic artifact density overall = 5.62 items per cubic meter) were recovered.

The nature of the cessation of use of these plankhouses appears to be similar. There is an absence of any evidence of catastrophe (e.g. large-scale flooding or fire episodes, which would leave discrete traces); there is a lack of human remains; and highly-valued status items such as exotic raw materials, art objects and large volumes of metal, are very rare. All these circumstances suggest planned abandonment of the sites (Stevenson 1982). The late (1833: see Boyd 1999) history of the Lower Columbia native populations was marked by widespread disease, probably malaria (Boyd 1995), with rapid population decline (Boyd 1999, Hajda 1984) and little time for burial of many individuals. This scenario does not fit the archaeological data as described above, and therefore the nature of abandonment is being investigated at present. I favor the archaeological data to the historical in this case, as the historical is not geographically specific with regard to where bodies were left unburied, but we have three plank houses in which the mentioned characteristics were found, which constitutes highly specific data. Although the issue must be considered unresolved at this writing, I suspect that the last Chinook chose to leave the Meier and Cathlapotle sites, taking many of their most valued goods with them.

3.1.2 Architecture

Extensive feature evidence provides a detailed understanding of the plank house architecture at both the Meier and Cathlapotle sites. The archaeological plank houses differ little from those described in early historical documents with the exception that the archaeologically-documented sub-floor storage facilities (discussed extensively below) are never mentioned historically in graphic or text

Early historic plank houses of the Greater Lower Columbia River are relatively well-known (Ames 1996, Ames and Maschner 1999, Hajda 1984, Drucker 1951, 1963, Nabokov and Easton 1990, Ray 1938, Silverstein 1990. See Figure 8.) They were typically rectangular, composed essentially of (a) corner posts, up to one meter in diameter, describing the rectangle, (b) a gable roof with heavy vertical planks supporting the central gable and (c) walls and a roof composed of planks split from logs, sometimes lashed together but designed to be moveable. These houses were normally entered and exited through a single door, often a circle or oval cut into a special wall plank at one of the narrow ends of the plank house. The orientation of the plank house long axis evidently varied. Sometimes it was perpendicular to the waterway near which most houses were built, as at Meier, in which case the common door would be to the South, facing the slough leading to the Columbia. In other circumstances, the long axis paralleled the waterway, as at Cathlapotle where over 14 plank houses were parallel to the Columbia. Here, several doors may have faced the river, cut into the side-walls, rather than an end-wall, of these houses; the issue is unresolved at this time and awaits further study. Compared to any other artifact on the Northwest Coast, plank houses required large amounts of wood to construct and maintain, and it has been suggested that the size of a plank house was an indicator of the wealth of the inhabiting residential corporate group (Ames 1996), a point returned to in the Section Discussion.

The interior of early historic Greater Lower Columbia Region plank houses is also rather well known (see references above), but the sub-floor storage facilities described below are not indicated in the historical texts, probably because they were hidden from view beneath floor planks.

Three major architectural facilities structured activities and the movement of people, resources and artifacts, in space and time, within the plank houses. Benches were areas immediately adjacent to the plank house walls, where people slept and stored clothing and other personal items. Historic illustrations (see Figure 8) indicates that they could have had several ‘decks’, with a lower activity and storage area, and an upper sleeping deck, nearer the roof. Space under the bench platform also served as a storage area. They differ somewhat in the Meier and Cathlapotle plank houses, but, as I mention below, in terms of the scale of the present analysis, these differences are not significant. In the Meier plankhouse, bench areas were roughly two meters broad (that is, extending roughly 2m hearthward of the walls). In this area, postholes indicate that a wooden platform was built *above* the parent sands and clays; presumeably, boxes and other containers stored items under these platforms, on which people slept, as seen in Figure 8. Thus, at Meier, the benches are lacking in artifacts, because (apparently) few artifacts escaped the boxes and baskets in which they were stored. At Cathlapotle, the houses were considerably narrower, and while the bench area was also about two meters broad, large pits *were dug directly under the bench platforms*, into the parent sands. Thus, taphonomically, at Cathlapotle, there is no bench, only pits (discussed at length below) which contained artifacts and other items under the bench platforms. Figure 9 shows bench deposits at Meier, and Figure 10 bench deposits at Cathlapotle, heavily cut by pits. Figure 14 shows the wooden platform above the bench area at Meier, and Figure 15 the pits immediately under the bench platform at Cathlapotle. Analytically, for this study, the bench at Meier was dealt with by not sampling it, but only sampling the artifact-rich pits and hearth periphery area, as discussed implicitly in section 3.5, Summary of Site Formation Processes, and explicitly in section 4.2.1, The Lithic Sample.

Extensive complexes of pits excavated by the inhabitants were aligned roughly with the long axis of the plank houses. Collectively, these rows of closely-spaced pits are termed the cellar context. At the Meier site they were dug in the ground between the bench and the center of the plank house where hearths (see below) were stationed: 119 pit features were recorded. At Cathlapotle, the 89 recorded cellar pits dug into houses 1 and 4 were normally (with a few exceptions) directly beneath the bench platforms. Cellars are not encountered in either early-historic writing or illustrations of Lower Columbia plank houses. This is not surprising, however, as historic Chinookan houses were equipped with floorboards as mentioned in Silverstein 1990: 538, Figure 3, as well as being inferred in the following data. Many pits were at least 100 cm in diameter and could be one meter or more deep, with average diameters of 73 cm at Meier, and 51 cm at Cathlapotle, and average volumes of 1.9 cubic meters at Meier and 1.2 cubic meters at Cathlapotle. During use, these were very large holes in the ground. At Meier, they lay directly between the bench and the hearth and would have to be covered with floorboards, lest the occupants make constant mandatory 2 m leaps between hearth and bed. At Cathlapotle, most pits are directly beneath the bench platform, and may have been uncovered, though more material could be stored if they were covered. It is certain that Meier, at least, had a plank floor. Archaeologically, cellars invariably contained deposits of dark, organic- and artifact-rich matrix; many preserved stratigraphic detail (Figures 11 and 10) while others were very turbated. The extraordinary cellar deposits at Meier and Cathlapotle are the most extensive domestic storage facilities excavated on the Northwest Coast. They complement the racks and other above-floor storage facilities of a plank house, adding roughly 300 cubic meters of storage space to Cathlapotle House I and 200 cubic meters of storage space to the Meier house; these are substantial increases over comparably sized houses without sub-floor storage, an issue investigated by Ames (1996).

Several hearths were also aligned with plank house long axes, arranged in a row in the middle of the plank house. Hearths were separated from one another, whereas the benches and cellars appear to have been largely continuous along the length of the plank house. Thus, hearths were surrounded or separated by spaces that must have been work areas (as is commonly encountered with domestic hearth facilities: see Kroll and Price 1991) as well as conduits of foot traffic. At the Meier and Cathlapotle sites these hearths (n=21 at Meier and 88 at Cathlapotle) were bounded by planks, forming a square or rectangular hearth box, found during excavation as heavy plank features sometimes containing charcoal from charring. This is in stark contrast to other excavated Northwest Coast plank houses, where hearths are often irregular in form and larger than Meier and Cathlapotle hearths, indicating their boundaries ‘wandering’ through time (e.g. see Ozette unbounded hearths in Figure 2). For analytical purposes, distinct hearth box complexes and their few surrounding square meters are analytically referred to as hearth/periphery contexts. Figures 12 and 13 depict typical Meier and Cathlapotle hearth features, respectively. Features show that these hearths were bounded by a frame of wooden planks, forming a ‘hearth box’ (see Figure 2); just outside the hearth box were found numerous peg- and post-molds for structures associated with the hearths.

Excavations and augering tests revealed that the bench, cellar and hearth/periphery facilities were spatially uniform (found in all areas of the plank houses) as well as redundant (regularly spaced on both west and east side of plank house interiors). This redundancy and spatial regularity support the use of these architectural facility designations in both general terms of discussion and as discrete analytical units, as they are employed in this study.

Heuristic reconstructions of the Meier and Cathlapotle plank houses, based on both ethnohistoric and excavation data, are presented in Figures 140 and 15. These indicate three main points. First, pits, benches and hearths and their peripheries are essentially of the same structure and apparent function at both sites. Feature functions are discussed in detail below; for the moment it is sufficient to say that they were all used for the same purposes. Second, the presence of similar facilities on similar scales, and within the same essential architecture, strongly suggests similar formation processes; this suggestion is supported with artifact and feature evidence presented below. Third, as a consequence of the first two points, comparable analytical units representing facilities can be developed. For the purposes of this study, these facilities are bench, cellar, and hearth/periphery. Some modification is required in the Cathlapotle houses, where cellars exist under benches, and these are dealt with below as required.

3.2 Cultural and Natural Formation Processes

Understanding the formation processes of palimpsests such as those of the Meier and Cathlapotle sites must consider (a) the activities of past peoples (b) the material correlates of those activities, (c) the various movements of those material correlates, by a variety of taphonomic agents and (d) analytical approaches that delineate which phenomena are to be recorded and which are not of interest to a given study. Such formation process understanding must be explicitly demonstrated, rather than assumed, prior to any spatial analysis.

I evaluate a range of C- and N-processes (sensu Schiffer 1995) with the potential to condition the initial assemblage composition as well as transform the deposited assemblage (in kind or spatial distribution) on a scale relevant to the questions of this research. Generally that scale is the roughly 10-meter long north, central, and south analytical units of the Meier and Cathlapotle plank house interiors.

I follow Schiffer (1995) in general and Carr (1985) in particular, in identifying and evaluating formation process potentially responsible for the absence of artifact types from (a) events and/or (b) deposits. I also consider processes that may have moved artifacts (a) in systemic context and/or (b) in archaeological context, after deposition. I follow rather closely Carr (1985:349-350, Table 13.4) in his exhaustive treatment of site-formation processes as related to intrasite spatial analysis. Although some of Carr's objectives and methods are quite different from my own, as is the nature of the site he examines, his treatment of site formation processes is optimistic, solutions-oriented and applicable to all spatial analyses. I first examine processes in the systemic context which may be responsible for the absence of artifact types from events in which their use might be expected.

3.2.1 Cultural Formation Processes

Artifact Multifunctionality

Specifically, I examine Carr’s proposal that several alternative tool types may be used to accomplish the same task. Essentially this addresses the question of multifunctionality: a single functional type may actually have been used for several tasks, or several different types may have been used for the same task. Thus, absence of an artifact type, expected to be used for an expected task, may not represent the absence of that task. Therefore, to reconstruct tasks, we are served best when we have discrete, rather unifunctional tool types. One important point of this dissertation is to provide just this sort of specificity with usewear analysis, but it is only carried out on chipped lithic implements, which are 52.2% and 49.6% of the entire Meier and Cathlapotle assemblages, resepectively. Therefore this issue is addressed for each of the main artifact raw material classes, as those classes also contribute large counts to both the overall site assemblages and the samples of this study.

Chipped lithics were classified using a functional typology of largely mutually exclusive types; in some analyses I refer to the pre-usewear morphofunctional types, and in others, I refer only to items assigned a function solely on their usewear characteristics. Most important is that while some chipped lithics were multifunctional (discussed at length below in the section **Usewear Analysis: Results**), 85% were unifunctional, with usewear indicating only a single work action, such as scrape or perforate, though they exhibit occasionally usewear from other, incidental uses. By analogy, usewear on a modern screwdriver would primarily indicate driving or removing screws, though sometimes usewear from prying, e.g. prying the lid from a tin of paint, or pounding, using the butt of the handle for a variety of tasks, might occur. The tool is shaped for one primary task, and most usewear reflects this task, but other usewear is also occasionally present. This was evident because in this study I focused on 'utilized elements per lithic item' (n of utilized edges per lithic item, hereafter, UE) rather than function per item (which assumes a single function per item) as analytical categories. Although the results are discussed at length below, here it is sufficient to say that (a) most chipped lithics were largely unifunctional and (b) that the classification reflects such unifunctionality.

The bone and antler artifact typology used at Meier and Cathlapotle was developed by Davis (1998) based on a large body of ethnographic data regarding the function of bone and antler tools on the Northwest Coast as well as a typology developed for a functionally analogous assemblage (Ames 1984). Bone and antler wedges, adzes and chisels are rather self-evident in both their form and the gross usewear they exhibit, such as battering on the proximal end and sharpening and abrasion on the distal (working) end (Davis 1998). Wedges would have been used in a variety of activities, from plank production to firewood splitting (Ray 1938), and are difficult to assign to a specific activity. Adzes and chisels, however, are somewhat more diagnostic, representing woodworking in the later (e.g. ‘post-roughout') stages of production of a variety of wooden artifacts.

The function of bone and antler items assigned to the perforator class is less clear. Although their precise function is unknown and was likely quite variable, they are clearly different from bone and antler wedges, adzes, chisels, points, bipoints and harpoon valves. They are therefore classified separately and, though I cannot be certain of their function, I suggest that they were used, minimally, for perforation of relatively yielding raw material, such as hide, and perhaps in some basketry tasks. Lithic perforators would have been used on more resistant raw materials, such as bone or antler.

Bone and antler points and bipoints are ethnographically well-documented as being used for aquatic hunting, primarily for fish, but sometimes for mammals, and bone and antler harpoon valves are well-known to have been used on the Northwest Coast both for a variety of aquatic hunting, the largest gear for whales, the moderately-sized armatures for sea mammals and the smallest for fish (Roy Carlson 2004, personal communication and Ray 1938). Pinnipeds are known to have ventured as far as Celilo Falls, 200 miles (324km) up the Columbia River as early as 10,000 BP (Lyman et al 2002), and Meier and Cathlapotle are about 80 miles (128 km) upriver. I suggest that due to their moderate size, Meier and Cathlapotle harpooning equipment are more likely to have been used for sea mammal hunting, with the bone and antler points and bipoints used for fishing. There are so many lithic projectile points, of so many sizes and shapes (see discussion below) that I consider them most reflective of most moderate- to large-land mammal hunting.

The ground stone artifact typology includes artifacts shaped largely by grinding and/or percussive crushing. The classification used here is based on that developed in Wolf (1994). While formal usewear study has not been undertaken on these items, most classes are self-evident in general function (e.g. net weights, mortars, bowls, adze bits) if not in specific use (e.g. mortars used for processing what?). Again, multifunctionality seems unlikely in most categories, though some items such as those assigned to the type maul exhibit scarring consistent with use as an anvil for bipolar reduction of small lithic cores as seen in comments in Ames et al (1999) regarding such scarring on artifacts from the nearby Cathlapotle village site.

In sum, I am confident that the 16 major functional artifact types (Table 5) do indeed reflect gross utilitarian function; end-scrapers are not perforation tools, projectile points are not wedges for splitting planks, net weights are not end-scrapers, and so on. These artifact types often reflect field designation of artifacts that have not been subjected to usewear analysis. Counts of chipped lithic types changed after usewear analysis specifically identified utilitarian function. It may be said that if a certain artifact function is missing from the assemblage in an area of interest, it is not likely missing because that function was carried out by a tool which does not preserve evidence of that function. It is more likely that absence is the result of the activity never having been carried out there, or because of physical removal of the material correlate of an action or function from the area of interest. Section 5.1.3 assigns all of the discussed artifact types to activity groups.

Such physical movement of the material correlates of behaviour by both cultural and natural formation processes may now be investigated. We may proceed with an analysis of what Carr (1984) refers to as Processes Responsible for Absences of Artifact Types from Deposits in Which They Might Be Expected; note that the emphasis is on the absence from archaeological deposits, rather than systemic context as examined in the section immediately above.

Carr indicates that there are two main ways in which such absence can occur: they may never have appeared in a given area because of spatial localization of the production system which precludes the deposits of some artifact types in some areas, and/or they may be moved by people in the course of maintenance of an activity area.

Production Systems: Stages and Material Correlates

With regard to the possibility that artifacts may be missing from an area because activities were localized, it is important to demonstrate rather than assume the range of artifact production and use stages which occurred within the plank houses. If we find that some stages of manufacture, use and so on are absent, we must adjust our analysis accordingly. For example, if projectile points were made exclusively outside the plank house -- which can only be determined by identifying where the material correlates of projectile point manufacture are and are not found – then we would not consider the absence of projectile points in plank houses an indicator that no terrestrial hunting occurred. Subtler variations on this theme may be imagined for other artifact types and production systems.

To track production, use and discard of artifacts types, I determine on a presence / absence basis whether material correlates of different stages of production, use and discard, are found for each of the main production systems of the Meier and Cathlapotle sites. These are the chipped lithic, ground lithic and bone/antler production systems which generated most of the artifacts discovered during excavation. Of the artifacts found at Meier and Cathlapotle, 89.8% and 86.6%, respectively, are of these raw materials. The wood production system would have created many artifacts (note that at Ozette, over 90% of the artifacts were of wood) but is under-represented at Meier and

Cathlapotle as not more than the most fragmentary remains of wooden items were preserved. Much the same may be said of the hide production system, but as the hideworking artifacts and usewear data are so prominent in these assemblages this production system is included here, and will be demonstrated later in this thesis.

Note that procurement and transport of raw materials, preforms and/or finished artifacts are not discussed. This is because (a) they are implicit, as the raw materials used could not have been mined or harvested within the plank houses and (b) these activities are difficult to track, and the analytical emphasis of this study is on activities within the plank houses. Also note that non-production-related artifact types, e.g. art items, are present at Meier and Cathlapotle in very small numbers (this is discussed below), but such items are not the focus of this study of the social organization of production.

Tables 6 and 7 indicate the presence or absence of these data for the chipped and ground lithics, and the bone/antler and wood and hide production systems, respectively in the Meier and Cathlapotle plank houses. Some quantification has been carried out, and such data are interesting but out of the scope of this study. For our purposes it is sufficient to state that Tables 6 and 7 indicate that material correlates representing all stages of the main productive systems were found within the plank houses. These structures were the site of a wide variety of activities, including processing, use and discard of artifacts. Importantly, observable phenomena representing each stage of the productive system are usually available in at least one variety of data (although the wood and hide production systems are not as well represented), suggesting that it is possible to track production organization with great fidelity; this is carried out later in this dissertation, in a more refined manner and with the addition of more detailed usewear data than is reported here.

Post-Depositional Movement of Archaeological Deposits by Plank House Inhabitants

At least two requirements for tracking the organization of production are present; these are (a) that production activities took place within the sampled areas, the plank houses, and (b) that such activities precipitated at least some durable material correlates available for study. Those material correlates were introduced to the archaeological record differentially in space and time. Understanding the spatial distribution of such material correlates (and their properties, such as usewear characteristics) within the plank houses is at the heart of this study. Before examining such distributions, it is necessary to evaluate the potential effects of a set of formation processes that could have moved artifacts after deposition. Below, I complete the examination of Cultural formation processes by evaluating a variety of activities related to plank house architecture such as maintenance activities and trampling.

Several centuries of occupation of constrained and intensely-used areas such as domestic dwellings is expected to result in the movement of artifacts, as well as matrix containing artifacts from the point of deposition, whether by storage, loss or discard or other mechanisms, carried out by a number of reconstruction and maintenance activities by inhabitants of the dwelling (Hayden and Cannon 1982, Murray 1980). As will be demonstrated below, such activities in the Meier and Cathlapotle plank houses can be broadly classified as (a) digging out matrix, (b) packing in matrix, (c) general clearing of high-traffic areas and (d) specific movement of some debris types to special refuse facilities. Each of these deposit-moving activity types must be addressed for each of the architectural facilities described above (in the Section **Architecture**) because different facilities may have been maintained in different ways, possibly selectively moving some production system material correlates, while leaving others in place. If this were not investigated, one would have to assume identical maintenance and cleanup activities, in the present case, for sleeping and storage areas, high-traffic hearth peripheries, and the large, complex and artifact-rich sub-floor cellars.

In addition to identifying the directions in which artifacts and artifact-bearing matrix were moved during reconstruction and maintenance, it is critical to identify the scale of such movement. Analytical techniques and units may be fitted to account for the directions and scales of post-depositional artifact movement, but only if such are demonstrated. If they are not known, but assumed, the credibility of any spatial analysis is considerably undermined.

In the following section I examine maintenance and reconstruction effects in the bench, cellar and hearth/periphery architectural facilities. Table 8 may be consulted as a summary of these effects and the analytical strategies used to control for them.

Bench Maintenance

Bench facilities are in large part restricted to the Meier site, as at Cathlapotle pits were dug just inside the plank house wall in most cases. At the Meier site, maintenance of bench facilities did not involve a great deal of digging. Figure 9 indicates typical bench deposits in the south profile of Meier site unit south 0-2 east 16-18. To the right is the sandy bench, typically undisturbed by strata or artifacts. To the left is the artifact-rich cellar trench: one is looking down the long axis of the plank house. Meier benches are typically two meters wide, and only half of a bench is visible here. While it is clear that the cellar pits would have to be covered by floor planks, the same is not necessarily the case for the bench. If the bench were exposed, the sandy floor surfaces may have been swept, possibly moving larger artifacts (e.g. above 5 cm in maximum dimension) some meters from the point of deposition (Clark 1991) and possibly packed, moving some both small and large artifacts vertically by some centimeters (Gifford-Gonzales et al 1985:804, Yellen 1977:103). Resetting of bench supports did occur, although clearly not as frequently as resetting pegs and posts around the hearth facilities as discussed below.

Resetting wall planks may have disturbed the bench deposits closest to the wall. Small lost or discarded artifacts may have fallen into the wall trench or gaps between wall planks and their supporting matrix. If so, they should still represent artifacts stored in a given bench area, rather than artifacts stored in some other portion (read analytical unit) of the plank house. Hayden & Cannon (1983) suggest that items in such peripheral areas, in the dark, under wooden benches, next to wall planks, of the dwelling would likely be low-value refuse items, the sort of mundane scrapers, wedges and other tools which are the focus of this study.

The ethnohistoric data indicate that floor space under bench platforms was often used as storage space for boxes and other containers (e.g. see Vastokas 1966). The general absence of highly-valued items, such as exotic dentalia, slate, obsidian cores and large metal items, at the Meier and Cathlapotle sites suggest that the sites were abandoned in a planned fashion (see further discussion below), in which case we would expect valued goods to have been removed consciously (Cameron 1993, Stevenson 1982).

Thus, at times of abandonment benches would simply be a bare surface with few artifacts to be affected by water or other taphonomic agents. If the site were abandoned for a period of seasons or years it may have been necessary to remove vegetation from the bench deposits. Root casts, however, were not commonly encountered in bench deposits and palaeosols were absent.

Bench facility maintenance appears to have been minimal, but sweeping can move artifacts several meters, and valued items stored in such areas are unlikely to have been lost, but to enter the archaeological record in the bench deposits. Benches are not stratified as hearth and cellar deposits, and a rather uniform bench elevation was used throughout occupation. Maintenance that did occur would likely move artifacts and matrix into the adjacent cellar and/or the midden outside the plank house as discussed below.

For the bulk of artifacts required to track production organization, the direction of movement here is largely horizontal, rather than vertical, and the magnitude is potentially on a scale of meters. While I see no evidence that production tools and debris from bench deposits would be systematically moved, conveyor-like, from one end of the Meier plank house to another, from areas (hypothetically) occupied by the highest social ranks to areas occupied by people of distinctly lower social ranks, this cannot be ruled out. For these reasons, I did not sample the benches in the usewear study.

Cellar Maintenance

In contrast to benches, complexes of pit features collectively termed cellar deposits at both Meier and Cathlapotle exhibit a great deal of reworking, some due to maintenance activity, evidenced in the form of stratigraphic cutting and re-filling, and some due to rodent activity (discussed further below) certainly after final abandonment and very likely during periodic, short-term abandonment. Figure 11 illustrates typical cellar deposits in the south profile of Meier site unit south 8-10 east 24-26; cellars are also seen in Figure 10, illustrating the north profile of unit north 157-159 west 90-92 of the Cathlapotle site.

Both Meier and Cathlapotle cellar matrices were dark (often Munsell coded as 10YR 2/3 or 10YR 2/2), ‘greasy’ to the hand in texture and odorous. These observations, in addition to the large volumes of bone and antler in the pits indicate that over time these features filled in with a variety of decaying organics. Most likely they included organic artifacts, e.g., basketry, planks lining pits, bone/antler artifacts; soil, possibly shaken from vegetation, hides and clothing and decaying floorboard undersurfaces as well as ashes and charcoal. Interestingly, the pits also contained large numbers of useable, that is non-exhausted, artifacts, caches of valued items, and foodstuffs.

Because the cellars are such important features at Meier and Cathlapotle, and because they contain both large numbers of non-debris and debris items, it is necessary to investigate their function in comparison with other architectural facilities. Assuming that they are simply storage features is insufficient, as both refuse and non-refuse items may be stored; and such items inform us of different activities in the past.

To investigate the function of the cellar pits, I examine the distribution of a variety of refuse and non-refuse items among pits and hearth facilities; I exclude benches as they have consistently low artifact densities, and for the taphonomic reasons noted above. Figure 16a displays whisker plots of the density of all artifacts in pit and hearth periphery facilities in the plank house units sampled for usewear study (n=4,218 in the sampled units), and the attendant plank house middens (n=466 in the sampled units). What is most clear is that the highest artifact densities were consistently encountered in the pit features. Figure 16b displays these whisker plots for shaped but unused lithic tools (n=125 in the sampled units); items which reflect an investment of time and labour, and are in a useable condition, and therefore were most likely being stored because they were valued rather than debris items. These artifacts also are found in the highest densities in the cellar pits.

The same distribution occurs if we examine only debris items (defined as ‘hindering’ artifacts: see Murray 1980), even if we separate the debris into large items, fire-cracked rock (hereafter referred to as FCR), often between 10 cm and 15 cm in maximum dimension, and small lithic debitage, always below 5 cm in maximum dimension. Their densities (in kg per cubic meter and count per cubic meter, respectively) are displayed in Figure 17a and 17b respectively. These are not insignificant debris:

18,551 debitage items were found in the Meier plankhouse sample units, and 10,895 at Cathlapotle sample units, as well as 1,410 kg and 2,360 kg of fire-cracked rock, respectively. Large and small debris both were placed in the pits, along with shaped but unused tools.

The pattern is repeated when we examine the distribution of artifacts representing different stages of the chipped lithic production, use, and discard system (Figures 18a, 18b, 18c).This is indicated by tested and untested crypto-crystalline silicate (toolstone) nodules (n=189 in the sampled units), utilized but unexhausted crypto-crystalline silicate cores (n=703 in the sampled units) and exhausted crypto-crystalline silicate cores (n=158 in the sampled units), respectively. Each stage of artifact uselife is represented in the cellars, in nearly all cases in the highest densities. As with debris mentioned above, the activities generating these artifacts could not conceivably have taken place within the cellar pits, and we must conclude that these artifacts were consciously deposited into the cellars, some as stored goods, others perhaps as garbage.

The same pattern is seen, with a few exceptions, in Figures 19 and 20, plotting densities of lithic projectile points (n=819 in the sampled units) and hide-scraping tools (n=266 in the sampled units), respectively, at various points in the production system.

The above data demonstrate that cellars were important for storage of both refuse and valued goods representing all stages of the main production systems evident at these sites. They also contained the bulk of faunal remains, which are being analyzed at this writing, along with botanical remains. They contain, and contained during use, as will be demonstrated below, large volumes of both means, and results, of production activities. Pit features for such storage were not uniform in volume or construction. Cylindrical, semi-hemispherical, boulder-footed, plank-lined, shell-lined, rock-lined and unlined pits of varying volumes have all been documented (Ames et al 1992, 1999); they are currently being studied in detail, an analysis beyond the scope of this research. Some of this variation may be related to the segregation of valued and unvalued items.

However pit contents were segregated, it is clear from stratigraphic records that cellars were occasionally dug out by the plank house inhabitants, leaving the plank house with clean, new pits which in turn eventually filled in over the centuries; this is evidenced by a repeated pattern, seen in profiles, of pit ‘cleanout’ and reconstruction activities. The question of the frequency of such cleaning episodes is beyond the scope of this research, but is an important issue to pursue and is discussed further in **Suggestions for Future Research**. The critical question at this point is where the matrix dug out of these pits was deposited, because artifacts would have been moved with this matrix.

The normally uniform, sandy bench deposits at Meier indicate that cellar fill was not dumped in these areas. It is inconceivable that cellar deposits would simply be heaped on the high-traffic plank floor areas above the pits, and it is clear that pitfill was not deposited in the very orderly hearth boxes or the adjacent hearth/periphery areas, where much work near light and heat must have taken place. To maintain order within the plank house, to prevent living, working, ceremonial and sacred spaces being hindered by large volumes of debris, the accumulated cellar matrix would have to be taken either outside, possibly to the midden, or, perhaps to wall and structural support foundations to be used as buttressing, or have to be dumped into other, empty, pits within the plank house. Each of these possibilities is discussed below.

DumpingPit Fill in the Midden

If cellar fill were dumped on the midden, the relatively uniform cellar matrix color and texture would probably make it indistinguishable from the similarly highly organic midden fill. It may not be possible to identify cellar matrix dumps in the midden. Dumping cellar fill in the midden would of course move artifacts on a scale of many meters, from the cellar to the midden. It is interesting that at least in terms of chipped lithic assemblage structure, both the Meier and Cathlapotle plank house assemblages are very similar to their attendant midden assemblages (Ames et al 1999, Smith 1996). I suggest that this reflects the continual movement of cellar matrix to the midden and it is my working hypothesis that the middens are largely composed of cellar matrix or pit fill that originated within the plank houses. Midden deposits, seen at Cathlapotle in Figure 21 are essentially the same at both sites: relatively undisturbed stacks of strata composed, as I argue, of plank house debris.

Dumping pitfill into the midden (Table 8), would, in summary, have the effect of moving large and small artifacts of all values, from debris to stored items, some meters horizontally from the point of deposition in the cellars. Artifacts from the middens, then, cannot be reliably assigned to any particular region of the plank house interiors (e.g. north, center or south). With regard to vertical movement of pit contents related to maintenance activities, it is essential to note that new pit features sometimes were cut entirely to the bottom of the cellar, and sometimes were not, preventing the accumulation of orderly strata as in the middens. Thus, in these cellars, deeper does not always necessarily mean older, and artifacts could easily be moved by tens of centimeters vertically. For this reason, there is little useful stratification within the plank houses (stratification is also lacking in the hearth areas; see below) and the assemblage from any cellar must be considered a palimpsest, rather than discrete accumulations representing certain occupation episodes, and as noted in Table 8, the solution is not to stratify pit sampling in an attempt to monitor episodes; the palimpsest must be accepted as a time-averaged phenomenon. This is not a horizontal palimpsest, however, as will be demonstrated below, a distinction of great importance to the understanding of spatial distributions at these sites.

Dumping Pit Fill in the Toft

If cellar fill were dumped as a toft (wall buttressing outside the plank house), it and its artifact contents would be moved several meters horizontally, and spatial distributions in the toft would have to be viewed as suspect. This may be something of a problem in excavation units that include bench, wall trench and toft deposits. In each case, identification of whether a given artifact derives from the toft portion of the unit, or the bench portion, should allow segregation of these deposits. Also, note that there is little wall buttressing and essentially no discrete toft at either Meier or Cathlapotle. As indicated in Table 8, the solution to these problems is to exclude toft matrix and toft-derived artifacts from spatial analyses.

Dumping Pit Fill into Other Pits Within the Plank House

Were pits in use at all times, in all plankhouse areas? If not, pit fill may have been dumped into pits distant on the long axes, moving artifacts many meters on this important scale. Figures 22 and 23 indicate that most of the pits within the Meier (n=119) and Cathlapotle (house 1 n=67, house 4 n=19) plank houses were used at the same time. These figures plot the pits which occurred at levels 5 through 8 (Cathlapotle house 1), 4 through seven (Cathlapotle house 4) and within 10cm of 90cm BSD (at Meier): these are depths at which most pits were encountered in each of the plank houses. Most of these features do not overlap, but are constructed next to one another, often with rims separated by roughly 10 cm or more of matrix. Pits, then, were indeed built as separate facilities, and were used on the entire plank house long axes contemporaneously, rather than having part of a given plank house cellar filled in with pit fill from some other zone of that plank house.

What may we conclude, then, about the destination of the 'scooped-out-pit fill' that was occasionally evidently dug out of the plank house? In short, there is no good evidence that the pit fill scooped out of, say, northern pits was dumped in central or southern pits, or vice-versa: all areas of the plank houses were using pits at the same time. I propose this restricted horizontal movement of artifact-bearing cellar matrix to under 1 m or so, as the result of unintentional spillage during maintenance (shoveling, scooping, etc.). Some pit fill does appear to have been used as a sort of plaster, to buttress other pits at the Meier site (Ames et al 1992) but this is rare. To control for such horizontal movement, and the possibility of vertical movement of artifacts for the same reason and on the same scale, I take the measures of (a) not stratifying cellar samples and (b) not assigning pits immediately adjacent to one another to different spatial analytical units (Table 8). Measure (a) is accomplished easily, and measure (b) is accomplished best by not drawing lines between spatial analytical say, Southern and Central zones, where pit features in other excavation units are immediately adjacent. These measures were used in the selection of excavation units for usewear sampling in this study (see section 4.2.1, The Lithic Sample).

Hearth / Periphery Maintenance

Minimally, hearths were used for cooking on personal, nuclear family, extended family and feasting scales; as light, heat and smoke sources for processing meat arrayed on racks above the hearths; as lithic raw material 'ovens', and as heat sources to maintain a comfortable temperature in winter (Ray 1938, Silverstein 1990). Hearths at Meier and Cathlapotle are rather similar and standardized in form and composition; indurated ash and small fragments of shell and bone (often <.5 cm in maximum dimension) are found in a compact, orange-colored aggregate, often 1m in diameter, circular in plan view, ovate in section view and often bounded within a box apparently made of planks, which have left features encountered archaeologically; such boxes were more common at Meier than Cathlapotle, but even at Cathlapotle, as mentioned above in the section **Architecture**, hearth boundaries did not ‘wander’ much through time, perhaps because houses were narrow (due to landform constraints) and space was at a premium. Floor planking here may have been more mobile than that serving as a bridge above the cellars, to allow flexibility in the placement of such posts and pegs. However, see the figure in Wilkes 1844-45 (Vol IV:131), which shows very orderly planking extending to and sealing the margins of hearth boxes in one early 19th century AD Lower Columbia plank house.

Whatever the case, hearth matrix itself only very rarely contained artifacts. FCR in the hearth periphery (outside the hearth boxes), but never in the hearth matrix proper; this appears to have been meticulously maintained in order to be rock-free. This suggests a high degree of concern for control of temperature; such control is required for heat-treatment of lithic raw material, which is common at Meier (Hamilton 1994) and Cathlapotle (see Table 6 regarding production stages of chipped lithic production system). The condition of bone in the hearths suggests a hot, oxidizing atmosphere (Bowman 1990 in Ames et al 1992:283). Figures 12 and 13 depict typical hearth features at Meier (excavation unit south 6-8 east 22-24, north profile) and Cathlapotle (excavation unit N174-176 west 89-90, west profile), respectively. Both cases show a lack of deep stratification, although multiple hearths are seen to be stacked upon one another; another indication of the conservative use of space with regard to hearths, which are not allowed to ‘wander’, but for some centuries occupy essentially the same space. Interestingly it is the same space in which they were placed at earliest occupation of the plank houses.

Clearly, hearth maintenance was mainly concerned with the removal of rocks and periodic cleaning out of hearth bowls in order to maintain an orderly, controlled source of heat for a variety of consumption and production activities. Thus, the removal of relatively artifact-free hearth matrix would not have moved large numbers of artifacts.

The movement of at least some hearth matrix may be tracked. Intact hearth matrix lenses were discovered in both Meier and Cathlapotle refuse deposits. They reflect episodes of hearth bowl cleanout; ongoing cleanout probably occurred as well. FCR would have originated in the hearth proper, and are found commonly in the cellar and hearth/periphery, but very rarely in bench deposits. Some of the copious FCR at Meier was used to line some pits, probably to facilitate draining, as well as draining footings beneath posts, though they were not found beneath the largest structural posts, which were occasionally footed with boulders. Much FCR, however, was simply refuse which was dumped into the midden; excavation units here contained the highest FCR densities, site-wide. Although the FCR distribution at Cathlapotle has not yet been thoroughly studied, initial data suggest a very similar pattern.

The frequent excavation of peg- and post-molds around the hearths (likely supports for processing racks as suggested at Ozette: see Samuels 1989) would have continually moved small amounts of hearth periphery matrix, sometimes containing artifacts. Also, hearth areas would be the site of much activity, being sources of heat and light in cool and often dark plank houses, and thus would have been carefully kept clean by moving away hindering debris (Clark 1991, Keeley 1991, Stevenson 1991). Indeed, hearth periphery areas have obviously lower densities of all varieties of artifacts and debris than cellars (see Figures 16 and 17 and discussion above) and follow the archaeological expectation that intensely used areas will be the focus of cleaning episodes, to varying degrees of success.

In sum I suggest that artifacts in the hearth/periphery were not accidentally moved in significant numbers during normal hearth maintenance, which focused on the removal of FCR and hearth matrix proper. However, artifacts of all sizes (but focusing on larger items: see Stevenson 1991) were moved, mainly horizontally, by less than two meters out of the work-space and probably into adjacent cellar pits, that contained both refuse and valued items for convenience of discarding refuse and/or to have useful items ready to hand. Items remaining in the hearth area may have been used there frequently, stored in boxes or other containers, or above ground on racks; one feature excavated immediately adjacent to a hearth appears to have been a storage box.

In this case the solution is to consider only pits immediately adjacent to a given hearth the recipients of material from that hearth periphery, as well as to remember in the analytical phase that hearth peripheries may have lower densities of artifacts not because activity was not common around hearths, but because it was common, and the areas were being intensively cleaned.

Summary of Maintenance Activity Effects

In a variety of maintenance activities, artifact-rich matrix was moved from some area within a given plank house to a cellar, from where it was later moved to the midden. Rocks and hearth matrix were moved from the hearth/periphery area to the adjacent cellars, as well as to the midden. Artifacts removed from hearth areas were probably stored conveniently nearby, in adjacent cellars in or above bench deposits. Bench areas were used to store artifacts, but were not the site of significant refuse disposal or storage.

Importantly, none of the movements of matrix reconstructed or proposed above would have systematically moved artifacts from one end of a given plank house interior to the other, along the socially meaningful long axis of the plank house. Unpublished data from an exercise in refitting of Meier artifacts (Roselya 2001) clearly shows that a number of broken bone and antler artifacts were very infrequently excavated more than a meter or two from their partner element. Further, it is clear that all areas of each plank house, north, central and south were equipped with facilities for production, storage of the means (tools) and products of production, and storage of the detritus resulting from production. These areas were all inhabited contemporaneously, with functionally identical architectural facilities. I suggest that people of each area stored and disposed of their refuse in very similar ways, preserving material correlates of zone-specific activities within those zones, to the extent that a given material correlate was preserved within the plank house.

Based on this understanding of the activities in the plank house, Figures 24 and 25 reconstruct the general spatial trajectory of a generic artifact from production through final discard at the Meier and Cathlapotle plank houses. Some artifacts were likely moved to and from non-plank house, non-midden, 'exterior' contexts ('Outside Space': see Newell 1987:112-119); this issue is beyond the scope of this study but is of importance and is addressed in the section **Suggestions for Future Research**.

Trampling by Site Inhabitants

Trampling generally has the effect of moving larger artifacts horizontally, out of high-traffic areas, and small items vertically, downward into a given 'living floor' (Gifford-Gonzales et al 1985:804, Yellen 1977:103); it may also damage stone tool edges, mimicking modifying usewear traces (Hiscock 1985, Shea and Klenck 1993) and thereby affecting functional classifications. As mentioned above, a plank floor must have been used at Meier and is very likely at Cathlapotle, where no living floor laminae were exposed during excavations (Ames et al 1999). Note also that the interior of the plank house seen in Silverstein (1990: 538, Figure 3) is very orderly, with no sign of artifacts strewn on the floor; like all historical illustrations, this is inconclusive, but suggestive. Finally, it is unreasonable to imagine the Chinookan plank house inhabitants, likely with bare feet (Silverstein 1990:540), trampling sharp chips of lithic, bone and antler debitage into the hard plank flooring of their houses; it is much more likely that such hindering and dangerous refuse types were carefully controlled, cleared from, or infrequently deposited in, high-traffic areas.

The careful handling of such debris is demonstrated and discussed above, and I conclude that the effects of trampling at Meier and Cathlapotle were negligible in terms of artifact usewear modification, but such modification was considered during examination of the lithic sample. The horizontal movement of artifacts was probably restricted to <2 m, when artifacts stabilized after being kicked aside during walking, so that trampling must be controlled for in the same way as hearth periphery (Table 8) by not assigning immediately adjacent excavation units to different (e.g. 'North' and 'Central') analytical units for spatial analysis.

Post-Depositional Movement of Archaeological Deposit by Non-Inhabitants of the Plank Houses

'Mining' of abandoned parts of a site or an abandoned site by precontact individuals or modern pothunters.

Some GLCR peoples regularly moved their house planks from one site to another for a number of seasons or years; on such occasions the plank house frame may have been left largely intact, or elements of it may have been submerged in nearby bodies of water for preservation (Hajda 1984). If plank houses were abandoned for substantial periods of time their contents would have been physically unprotected and therefore subject to scavenging or mining by Lower Columbia contemporaries. Here, mining includes surface collection of small items such as artifacts brought up by worms or rodents as well as large items such as house planks by Lower Columbia contemporaries. As I show below, there are good reasons to suspect that such scavenging probably did not occur, and that if it did occur, it would probably not have removed most artifact types related to production, the focus of the present study.

In the first case, planning to move the bulk or entirety of a plank house and its population from one residential site to another, possibly for a period of several months or even years, would have required long-term planning (see Stevenson 1982). Such planning would include the transport of the means of production critical to subsistence economy as well as items constituting and indicating wealth (Hayden's 'practical' and 'prestige' technologies: Hayden 1998). Items left in situ at the 'abandoned' plank house would most likely have been the most mundane of practical technologies, such as reduced chipped stone items as well as commonly encountered raw material such as bone and antler (perishable prestige items, such as food, may have been left in cellars, but we have no evidence of this). Chinookan contemporaries, likely knowing the mode of such seasonal abandonment in terms of items left behind and items taken away, would have little to gain by systematically mining out old pit deposits. It is possible that such mining did occur on occasion, for example, during times of local resource stress; note, however, that 98% of the Meier and lithic tools are made of unremarkable, locally-abundant crypto-crystalline silicates (Hamilton 1994) or basalts (Wolf 1994) and that the bone and antler raw material would have been similarly abundant in the Wapato Valley (Ames et al. 1999, Saleeby, 1983). At Cathlapotle, crypto-crystalline silicate nodule deposits and large basalt outcrops are found just a few kilometers, and a few hundred meters from the village site, respectively, and these most common lithic raw materials (over 97% of the sampled lithic assemblage) cannot be considered highly-valued exotics.

I suggest that if scavenging did occur, it would probably have targeted wood. Planks could be removed with little or no disturbance to artifact distributions, as they were not deeply set; Meier and Cathlapotle site plank features average 11 cm and 13 cm in depth, respectively. Removal of such lumber may have simply consisted of picking it up and carting it away. The large corner and other major structural timbers may have been the object of scavenging; these were substantially embedded in the ground (30 and 50 centimeter average depths for the largest structural features at Meier and Cathlapotle, respectively). The removal of these elements would also not have dramatically affected the distribution of artifacts buried in pit deposits, because the largest and most valuable timbers stood at the house corners as seen in features exposed during excavations.

If these timbers of a meter or more in diameter were cut down before being hauled away, artifacts would not be moved appreciably. Considering the work involved, it would have been easier for scavengers to dig out the base of the post and then tip it over before hauling it away. There is no evidence of this at Meier or Cathlapotle, however, where corner posts appear as well-defined, circular features, rather than the ovate or oblong (and less distinct in outline) features one would expect had these supports been dug out. There is little evidence, then, to suggest that scavenging of lumber at the site did, or could have, substantially affected the spatial distribution of the assemblage.

Statigraphic traces of any scavenging episode may have been obliterated after reoccupation of the plank house. In this case, however, I assume a resumption of activity within the plank house and the renewed deposition of artifacts in the newly re-excavated pits. Some evidence for late, short-term post-abandonment occupation of some Cathlapotle site plank house depressions exists in the form of very small, ephemeral campfire traces only a few centimeters below the surface in a few excavation unit profiles, but these data are inconclusive and, as at Meier, there is no good evidence of substantial post-abandonment activity cutting into habitation deposits. I conclude that both contemporary mining and scavenging were probably not significant site formation processes at Meier or Cathlapotle. As a safety measure, however, to guard against the possibility of corner-post scavenging, in Table 8 I indicate that sampling house corners is potentially unsafe from a spatial analytical perspective.

Pothunting

Local oral landowner tradition suggests that a house frame may have stood on the Meier site in the mid- to late-19th Century and it is also rumored that a military man, perhaps stationed at nearby Fort Vancouver (occupied throughout the 19th century), visited the site and removed from it an unspecified number of artifacts. Cathlapotle was certainly known to residents of Fort Vancouver in the early 19^{th} Century (Wuerch 1979), and it is possible that it could have been looted after abandonment. Cathlapotle was definitely opportunistically pothunted, by landowners of the parcel on which Cathlapotle stands, in the 19^{th} century. In addition to attracting artifact looters, these sites may have attracted scavengers: abandoned Meier-sized houses would each offer 40,000-55,000 board-feet (Ames et al 1992) of free, processed lumber.

At Meier pothunter excavations, some of unknown date, were clearly evident along portions of the eastern interior of the plank house. No such intrusive excavations were exposed at Cathlapotle. Damage at the Meier site was controlled for by focusing excavations on the western half of the plank house interior; the solution also includes eliminating artifacts recovered from pothunter-damaged area from spatial analyses, as they may easily have been moved tens of meters horizontally (Table 8). At Cathlapotle this was not necessary.

Ploughing

The Meier site was historically ploughed extensively by mechanical means. Ploughing can have a variety of effects, but may at least be said to move artifacts similar to those of the Meier site in terms of size on a scale of several meters (Boismier 1997, Orton 2000:57-66). Therefore 850 artifacts excavated from the stratigraphically distinct plough-zone, approximately 30 cm in depth, were eliminated from the spatial analysis of this site. No such ploughing or ploughzone occurred at Cathlapotle, where a stand of cottonwood trees, now moderately mature, stands on the village site, where they probably began to flourish after abandonment of the village in the first half of the 19th Century.

3.2.2 Natural Formation Processes

Note that these should not target the architectural facilities as selectively as human agents, thus they are described in general terms; they might affect facilities differently, but should be shown rather than assumed.

Carnivore Activity

Hunting dogs were common within Chinookan plank houses, as indicated ethnographically in text (Ray 1938) as well as in early historic illustrations (Figure 8). We know that Lewis and Clark bought a dozen dogs from Chinook at the nearby Cathlapotle village site, in 1806 (Moulton 1983[7]:29). Thus, dogs may be considered a potential site-formation agent in their capacity to move faunal elements because the material correlates of production include bone and antler tools, some of which may have been moved by dogs between the analytical zones of north, central and south, as well as bench, cellar and hearth.

The main reason canids move bones and other organics is to bury them for later use, or for immediate use, eating, gnawing, etc.. (Binford 1981b). In either case, bone and antler items gnawed by dogs should exhibit the characteristic scratches, pitting, crushing and other chewing-related damage familiar to faunal analysts and taphonomists (e.g. Binford 1981b, Lam 1992). These characteristics are not found on random, spatially-stratified samples of Meier (n=100) or Cathlapotle (n=100) bone and antler artifacts I examined in 2001, nor were they noted in Davis' analyses (Davis 1998) (my cursory examination is qualified by my training in identifying carnivore damage marks to bone while analyzing faunal material from a modern hyaena den (see Lam 1992)). In an unpublished preliminary study, Lyman does note carnivore damage to *non-artifact* faunal material from the Meier site (Lyman 1994), which is expected, as artifacts would be cleaned of much nutrient-bearing tissue during production.

In summary, it is very unlikely that dogs significantly altered the spatial distributions of bone and antler artifacts within the Meier plank house. Table 8 indicates that the non-tool faunal assemblage (not investigated in this paper) should be evaluated for carnivore damage and element movement.

Water Washing

The Meier site is situated at roughly 4.57 meters (ca 15 feet) above sea level (masl), just above the elevation of both modern and pre-dam flood levels (US Fish & Wildlife Service geoarchaeologist Alex Bordeau, personal communication), and this may be a reason for its apparently continual occupation in contrast to the regular site abandonment and resettlement due to flooding evidenced at Cathlapotle (Ames et al 1999). High-energy flood deposits were never encountered during excavations at Meier, either within the plank house boundaries, or in units placed outside the plank house to sample the midden or other areas for their sedimentary history; nor was evidence of erosion observed. Sediments forming the ploughzone capping the bulk of the Meier site deposits are largely low-energy, silty overbank deposits deriving from the Columbia River. Slightly higher-energy deposits were observed at Cathlapotle, where several massive sand beds, some up to 20 cm thick and continuous over large areas of the landform, were identified. A microstratigraphic examination carried out by me and geoarchaeologist Charles Hodges in November 2001 found that while these deposits are of significantly higher energy than at the Meier site, they derive from water flowing at less than 6 mph (Bordeau, personal communication). Floods did affect Cathlapotle village, but like Meier, most of the village sat just above the pre-dam flood levels, between 4.4 masl (ca 14 feet) and 7.4 masl (ca 24 feet). Whatever their frequency, the effect of such low energy flow on the distribution of stone, bone and antler artifacts of the dimensions addressed in the present study would have been negligible (e.g. see

Behrensmeyer 1975) and is not considered in the selection of data for spatial analyses (Table 8).

Wind Sorting

Wind sorting is also discounted as an important site-formation agent at both Meier and Cathlapotle, as only the uppermost deposits could have been effected at any given time (recall that most artifacts were found in the cellar deposits) and the National Weather Service reports an Annual Daily Average Wind Speed of 7.0 mph (standard deviation <1.5 mph) for Portland, Oregon, located near enough to the Meier and Cathlapotle sites to be a reasonable estimate of winds which are unlikely to have changed significantly since the early Holocene. The high winds of the Columbia River Gorge generally do not reach beyond Portland, more than 60 km (c .30 miles) upriver of the Meier and Cathlapotle sites, and from these data I conclude in Table 8 that wind sorting was not a structuring taphonomic factor at these sites.

Biologically Caused Soil Movements: Burrowing Mammals, Earthworms and Roots

Rodent activity at both Meier and Cathlapotle was evident and occasionally extensive in the organic-rich cellar deposits. Bench (at Meier) and hearth/periphery deposits, containing less organic matter and often largely composed of a sandy and ashy matrix respectively, were not commonly disturbed by rodent burrows, as evidenced stratigraphically. Movement of artifacts in the rodent-disturbed cellar deposits may be expected to move items smaller than 5 cm or so in maximum dimension: Bocek found that artifacts larger than 5 cm are unlikely to have been moved horizontally in substantial numbers through burrows of pocket gophers, ground squirrels and moles, species likely common at Meier (Bocek 1986). Because the vertical distribution of artifacts in this palimpsest is not a major concern in this study (see discussion above in the Section **Cellar maintenance** and below in the Section **Depositional Mode History**) we may ignore the likely undermining and occasional vertical displacement of artifacts larger than 5 cm in maximum dimension.

Horizontal movement of artifacts is of more concern here, particularly movement of artifacts less than 5 cm in maximum dimension (which includes many Meier and Cathlapotle stone tools sampled for usewear examination, with average maximum dimensions of 29.9 mm and 27.3 mm, respectively, see Chapter 4) on the long axis of the plank houses. Bocek found artifacts of this size to have been moved up to 1.5 m in any direction before ejection to the surface (Bocek 1986). This is a negligible distance considering the proposed north, central and south analytical units, so long as immediately adjacent units are not assigned to different such units. Note however that rodent activity is common only in the highly-organic cellar units; substantial horizontal displacement from such units to the sandy, less-favored bench and hearth/periphery units adjacent is very unlikely. Thus, only immediately adjacent cellar units need to be monitored carefully for rodent action.

Colonial burrows of the California ground squirrel (a species found in Oregon: Small mammals of North America) may include up to 700 feet of tunnels (Burt and Grossenheider 1976). No evidence of such a colony was observed at Meier or Cathlapotle, however. An exhaustive examination of fieldworkers' notes and level drawings, as well as photographs and profiles, and consideration of the conditions encountered in the field, indicated that rodent burrows at the sampled sites were normally less than two meters in length.

Artifact displacement by earthworm activity is likely restricted to the vertical, and in such cases, to small movements. Earthworms may be responsible for the occasional lack of clear stratigraphy at both Meier and Cathlapotle, as found by Stein (1983). Because earthworms normally only move sediments of less than 2 mm in size (Waters 1992:316), they are unlikely to have significantly moved artifacts of the macro-scale examined in this study, either directly or indirectly as a result of soil movement.

Large, intrusive roots (or rootcasts) were not encountered at Meier, and were uncommon at Cathlapotle. Based on an examination of level drawings and fieldworkers' notes, it is clear that where they occurred at Cathlapotle, they could only have moved very small numbers of artifacts very short distances. Modern treefalls, where root boles may have vaulted once-buried artifacts, were identified at Cathlapotle, and may well have occurred.

Table 8 indicates the effect of biological action, which could have moved artifacts of the type sampled in this analysis. These artifacts may have been moved from centimeters to meters but this movement would probably not have been systematic, resulting in patterning. Therefore artifact location to the centimeter scale is suspect; artifacts could easily have been moved several centimeters in any direction after deposition. To account for this cell-frequency analysis is more suitable at these sites than point-pattern analysis. I return to sampling and analysis strategy in Chapter 5.

Geologically-Caused Soil Movements

Solifluction and cryoturbation are both ruled out as major agents of site formation at Meier and Cathlapotle. While infrequent seasonal freezing of the upper (ploughzone) sediments may have occurred such would be rare given the annual temperature range in the Wapato Valley; NOAA, using more than 130 years of weather records for Portland, reports that freezing episodes sufficient to freeze soils are rare and limited in duration. Also, frost does not normally penetrate more than about 2-6 inches at this latitude (even in much colder Eastern Oregon: see Greenwalt et al 1983). Thus even in rare cold snaps it is not credible that ground frost significantly altered the Meier or Cathlapotle deposits in a systematic fashion.

Artifacts can be moved by soil creep, essentially driven by gravitation. Due to the relatively flat topography at both Meier and Cathlapotle, however, such movement is unlikely. At Meier, the only possibly significant soil creep would have been from the midden deposits westward toward the eastern exterior house wall; but I must emphasize that this scenario is very unlikely due to the flat topography at the site both during occupation and at present. On average, the midden is just a few centimeters higher than the level of the plank house; the midden was dispersed (away from the house) rather than piled high. In the unlikely event that such creep took place, significant deposits would be unlikely to encroach on the plank house interior; they would be hindered by the house wall. During an occupational hiatus, with the house wall removed, some creep might have introduced midden deposits to the eastern half of the plank house interior; but no evidence of such creep is seen in the stratigraphy of the relevant excavation unit.

Regardless, refurbishing of the plank house at the time of re-occupation would probably clear off any encroaching deposits. Finally, midden creep which may have occurred is very unlikely to have affected most of the excavation units, which focus on the western half of the plank house. Most of these excavation units are roughly 12-15 m West of the midden centrum (see Figure 5, although this does not indicate the midden excavations). The same conditions apply to the Cathlapotle site, where topography, although more varied than at Meier, is still largely flat, and where significant slopes do not descend towards the house depressions, which are only 60 cm to 100 cm deep across roughly 10m wide houses.

Spatial distributions within the middens may have been affected by slight creep, but horizontal distributions in the midden deposits are not my research interest. It is instructive, however, that occasional thin and well-stratified lenses of shell as well as hearth matrix dump deposits were found intact in the Meier and Cathlapotle lobe middens (differentiated at Cathlapotle from the expansive sheet middens, such as those associated with house 1), again suggesting little or no creep from these middens in any direction. Finally, it is possible that the organic-rich lobe middens would have been largely overgrown at the time of occupation, with roots serving to retard erosion. This does not apply to the Cathlapotle House I sheet midden, which stood directly between the house and the beach, and would most likely have been cleared to allow unimpeded movement and activities in this area. I conclude with confidence that creep did not significantly affect the Meier or Cathlapotle assemblages (Table 8).

Differential Preservation

Of the lithic raw materials recovered at Meier and Cathlapotle mostly crypto-crystalline silicates, basalts, sandstones and pumices, in order of frequency, (see Ames et al 1999, Hamilton 1994, Smith 1996, Wolf 1994), only pumice artifacts exhibit macroscopic decay and non-percussive fracture not associated with evidence of heat damage possibly attributable to chemical processes. Pumice artifacts are occasionally found to be rather friable, although distinguishing between items broken during excavation and items broken before excavation is a relatively simple matter of determining whether break facets are clean or imbedded with matrix. Such breakage was evaluated and found negligible in a previous treatment of the ground stone assemblage (Wolf 1994).

Bone and antler artifacts are of course more liable to differential preservation. One indicator of the good organic preservation conditions at Meier and Cathlapotle is the presence of thousands of fish vertebrae and ribs, elements much smaller and less robust than the bone and antler artifacts commonly made from higher-density elements such as distal metapodials of land mammals or antler tines (Binford 1981b, Butler 1999, Davis 1998). Differential preservation of bone and antler items between facilities, such as sandy Meier bench deposits, highly organic cellar deposits, and sandy hearth/periphery deposits, also seems to be a relatively trivial matter. An examination of the most common bone and antler tools, perforators (which, incidentally, are normally the most fragile bone/antler tools), indicates that they are not differentially found, as a whole, between facilities within the plank house. Expectedly-high frequencies are found in the cellars, with lower numbers in benches and moderate densities in the hearth areas.

As indicated in Table 8, I do not accept that differential preservation affected the concerns of this study.

3.2.3 Analytical Formation Processes

A final set of processes contributes to the generation of archaeological phenomena. These are theoretical concerns in the mind of the archaeologist that directly affect observation and therefore raw data generation by conditioning what the analyst chooses to observe and what not to observe. These are manifest, according to Carr (1984) in misclassification of artifact function, use of an overly divisive functional classification scheme and use of a non-functional artifact classification scheme. A gross artifact classification scheme has been described above in Section 3.2.1, **Cultural Formation Processes** and is summarized in table 5. This typology is functional, conservative and reflective of the gross production activities that are the focus of the present study of production organization. This classification is described in greater detail, slightly modified and enhanced with usewear data in the final analysis of forthcoming chapters. For the moment it is sufficient to state that the gross classification indicated above, and the final classification arrived at below are both acceptably accurate in terms of technomic or utilitarian functional analysis.

Because this thesis is concerned with the social organization of labour, to be understood via analysis of production, one of the main elements of the Wilk and Rathje (1982) household, I operationally define the household in the following sentence. *The Meier and Cathlapotle households are each the sum totals of artifacts and features (including the properties of those artifacts and features, such as usewear traces), occurring within the North, Central and Southern thirds of each of the excavated plank house boundaries*. Although it is clear that household organization may change substantially through time (e.g. Ashmore and Wilk 1988), and households are dynamic interplays of language, kinship relations, and ritual (e.g. Levi-Strauss 1987, Waterson 1993), these aspects were not emphasized in this thesis, the objectives of which have been described above. Archaeologically, the plank houses each represent a single population, but each of those populations is broken down into three households; North, Central and South. The following analyses are an attempt to understand the social organization of labour within and among these households.

3.3 Summary of Site-Formation Process Evaluations

The potential site formation processes I have reviewed here address behavior which generated and could have affected the original plank house assemblages and their characteristics, as well as cultural and natural transforms that could have affected the site as an archaeological phenomenon.

Artifacts were deposited within the plank houses at all stages of post-transport production, including processing, discrete discard and loss. Artifacts were deposited and curated differentially, according to architectural facility. Within the cellars, the main storage and deposit areas, valued and debris items were stored in absolutely and relatively high densities. The most important movement of artifacts took place via transport of cellar deposits to the midden. No evidence was found for systematic artifact movement (in systemic or archaeological contexts) which would have moved items significantly on the crucial long axes of the plank house. Most artifacts were probably moved on a scale of some centimeters between the point of last deposition and the point of excavation; I suggest that most artifacts were moved roughly 10 cm - 20 cm in any given direction (ramifications for field recording of artifact location data are discussed in **Suggestions for Future Research**). By the type of evaluation suggested by Carr and carried out above, these directions and scales of movement (a) can (and must) be identified and (b) can (and must) be controlled for in research design (Table 8).

3.4 Modes of Deposition

The Meier and Cathlapotle assemblages were generated over some centuries each. Figures 11 and 10 typify the unfortunate lack of clear stratigraphy in cellars where most artifacts were deposited and excavated due to the maintenance activities outlined above. Although clear stratigraphy exists in the midden deposits, they do not preserve, of course, the spatial information required to characterize north, central and south activities of their attendant plank houses. These circumstances all present us with what I call a 'vertical palimpsest'. I specify vertical because the horizontal component of the assemblage, of great interest to this study, does not appear to be mixed as I have shown above. Rather, it appears to be spatially segregated in both the behavioral and archaeological contexts so far as the gross north, central and south areas (read analytical units) are concerned.

One way to approach understanding of the vertical palimpsest is to identify the history of the depositional modes responsible for the assemblage. Broadly speaking, I consider that depositional modes may be continuous or punctuated. In continuous deposition artifacts are regularly deposited through time, though nothing is implied here about the specific rate or density of deposition. Punctuated deposition introduces artifacts sporadically; deposition frequencies may or may not be redundant through time. The artifact load of a given excavation (or analytical) unit may be of interest for a variety of reasons, but that load itself indicates nothing of the mode of deposition because it is seen from the top down. By examining depositional mode history, we can evaluate analytical unit artifact loads better; we can tell, for example, whether a high score is simply a 'one off' (e.g. a concentration of artifacts in a cache, representing a restricted time period) or the result of a long history of slow accumulation. Depositional mode may be investigated by considering the occurrence of artifacts in the vertical dimension. Here the vertical dimension examined is the excavation level (normally 10 cm in depth) as three-point provenience is not always available for an artifact, whereas excavation level is always available.

Artifact Elevation Data

Although most deposits at Meier and Cathlapotle may not be assigned to any discrete ‘occupation level’, and some lower elevations of artifacts are simply due to their being deposited in deep pits, perhaps near the end of occupation, some vertical resolution is visible. In Figures 10, 12, and 13 for example, we do see some slight evidence of a gradual vertical accumulation (deposition) of matrix (read artifacts) through time: pits do not always get cut entirely down to the old pit or cellar floor level, and hearths do stack upon one another. To find an assemblage ‘bottom heavy’, with most artifacts occurring at the lower levels would be quite different than to find it ‘top heavy’, with most artifacts towards the upper excavation levels. It is on this crude level that I wish to identify whether such depositional histories are a major structuring element of artifact loads per excavation or analytical unit.

Continuity of Deposition

Plank house architecture, as characterized above in the section **Architecture**, was very conservative through time. The Meier site long axis was reoriented by less than five degrees over four centuries of occupation; the same is seen at Cathlapotle. Also, at both sites stratigraphic profiles illustrate that cellars were excavated into parent ground in one position at the beginning of occupation, and remained essentially in that area until abandonment, and hearths are found stacked one upon the other within the boundaries of hearth boxes. No evidence has been found that these architectural facilities, which were sampled for the usewear analysis, changed in function through time. Thus, here I do not focus on examining depositional mode history by architectural facility, but by north, central and south analytical zone in each plank house.

Figure 26 plots the percentage of artifacts, of a plank house's total assemblage, per excavation level for the Meier (n=8,552), Cathlapotle House I (n=4,389) and Cathlapotle House IV (n=1,587) plank house artifact assemblages. In each case, the data are split into the same plots for the north, central and south areas of each plank house, with percentages of total assemblage in that area only. The vertical scale is excavation level.

The plots immediately illustrate that no long-term occupational breaks are evident: artifacts are found in each excavation level and in a broad sense depositions may be considered gradual rather than punctuated. Note that the same numbers of excavation levels are not always found in each house and house zone. This continuity of deposition is also evident when deposition is examined in the sub-plots of deposition per north, central and south analytical zone per plank house. Although there is evidence of considerable variation here (discussed at length with all other depositional variation below in the section **Discussion**), for present purposes it is most important to note that insofar as deposition reflects occupation, occupation of each plank house was continuous, and continuous in all areas of the plank houses. No significant stratigraphic breaks occur to indicate complete abandonment of the plank houses, or plank house zones, for appreciable time periods. Thus, in broad terms, artifact loads per excavation unit may be said to reflect long-term accumulation in the area sampled by the excavation unit.

Feature Elevation Data

The distribution of features can also be used to investigate depositional history. Figure 27 plots the upper and lower elevations of 1,999 pit, post, plank and hearth features recorded within the Meier, Cathlapotle House I and Cathlapotle House IV structures. In large part, they support the inferences of the artifact depositional study described above. First, it is clear that no plank house has any discrete 'living floor' which would be manifest in feature evidence as discrete horizontal stripes of feature upper elevations. Though some do occur, they are localized and the overall pattern is of continual placement of new features through time. This, then, supports the inference that there were no discrete occupational breaks. Second, it is clear that architectural rebuilding and/or maintenance occurred in each zone of each plank house, north, central and south: none appear to have been built in one episode, and then sealed off, for example, and abandoned. Although there are anomalies worthy of detailed examination (see discussion in **Suggestions for Future Research**), the gross patterns mentioned above are clear, and they support the inference of artifact accumulation data that the plank houses were occupied in similar ways, and that the sites formed in similar ways, and that they are therefore largely analytically comparable.

Continuity of Activity

The assemblage elements were continuously deposited; was there similar redundancy, through time, in the activities carried out within the plank house? In other words, what activities were represented by material correlates at the beginning of occupation, and did these persist, or perhaps change through time? If basic aspects of production changed radically, and this were not accounted for, variations in certain tool type frequencies may be misinterpreted. For this reason, it is important to establish the degree of activity continuity at the site.

Figures 28 and 29 display the number of a given raw materials per excavation level within the plank houses (I deliberately avoid artifacts assigned to activity classes against excavation level here: that is a future study requiring sensitive adjustment: however, do see Figures 36 and 37, below, and the discussion of them in section 5.2.1.2). These figures demonstrate that most raw materials were being worked (by other tools) throughout the life of each plank house. From the very start, people were using all of the main raw materials, such as bone and antler. This continued until abandonment of the plank houses under whatever circumstances. The most numerous tools, projectile points, dominate the lithic category, and are clearly represented without punctuation. Variation is discussed at length in the section **Discussion**, but at the coarse scale investigated here, it is sufficient to say that basic activities did not change radically through time. By extension, we need not discount certain classes of artifact from production organization analyses, because they were, say, introduced late in the sequence, or abandoned early in the sequence. Future research will examine the occurrence of specific activities through time, an idea returned to in the section **Suggestions for Future Study**.

3.4.1 Summary of Modes of Deposition

It is important not to reify the patterns presented in Figures 28 and 29: there are problems with the assumption that at these sites, deeper always means older, as outlined above. Nevertheless, some themes resound from the examination presented here.

First, it was assumed, for good reason, that the functions of the architectural facilities sampled for usewear analysis did not change radically through time; for example, throughout occupation, benches contain relatively few artifacts, in contrast to higher-density cellars.

Second, all areas of the plank houses were occupied from beginning to end, with artifacts being deposited in these areas from beginning to end; the exception appears to be the north area of Cathlapotle House I, discussed at length below.

Third, the full range of basic extractive and maintenance tools, such as scrapers, projectile points, woodworking tools and so on, are found throughout the life of the plank houses; there is no evidence, so far as these depth data may be trusted, for radical changes in productive economies through time at the gross level examined here: the issue is re-examined in greater detail below, in the section **Discussion**.

3.5 Summary of Site Formation Processes

Drawing on all the data presented above, I submit the following reconstruction of the generation and transformation of the Meier and Cathlapotle assemblages.

All varieties of raw material, in the form of cobbles, antler tines and beams, metapodials, and so on, were transported into the plank houses; here, they were stored, sometimes in cellar pits (occasionally manifested archaeologically as discrete caches of intact, useable items, such as net weights, or untested lithic cores), and sometimes in the bench areas, perhaps in boxes or other containers.

Most production activity, utilizing such raw materials, took place near the best sources of heat and light, the area near the hearths. Hearth peripheries were the scene of much activity, and were therefore cleared of much hindering production debris, such as bone, antler, wood and lithic debitage. This refuse was either transported immediately to the midden, or stored temporarily in refuse pits beneath plank house floorboards. Also stored in the sub-floor cellar pits were foodstuffs, evidenced by the extensive faunal remains, as well as large amounts of fire-cracked rock cleared from the very orderly hearth boxes. The cellars also contained all manner of baskets, boxes and bags with the intact, useable artifacts found here. Some cellar pits were carefully lined with rock floors and slat walls, in the manner of a barrel. This suggests a care for the protection and/or segregation of pit contents which one would not expect of simple refuse pits. Pits had multiple designs, interior partitions and functions.

Over time, decaying organics and slumping pit walls filled in or deformed these pits. To maintain the cellars, it was necessary to dig out these in-filling pits. The excavated fill was not dumped in the bench areas, in the hearth boxes, on the high-traffic hearth peripheries or in substantial tofts; it was dumped outside, away from the plank houses, sometimes in discrete midden heaps some meters from the plank houses: in these middens are found the highest densities of exhausted and broken tools, as well as intact lenses of hearth matrix indicating discrete hearth cleanout episodes, as well as the results of ongoing hearth cleaning, such as fire-cracked rock, ash and indurated bone. Some of these waste deposits were first stored in cellars within the plank house.

The benches, with the lowest artifact loads, were carefully swept or otherwise cleared of hindering debris. The same maintenance was attempted in the hearth areas, but over time greater production intensity and/or less concern with orderliness in these areas generated higher artifact loads than in the benches.

All of this activity was time-redundant, in that the plank houses were built early on as large structures with discrete long axis orientations which did not change appreciably through time, and architectural facility arrangements which were also diligently maintained for up to four or more centuries. No major additions were annexed to the plank houses, and no areas were sealed off to be used, for example, as temporary middens or other special-use areas. I infer that social information of the built environment was similarly conserved by socially transmitting the same ideals via conservative maintenance of the structure's 'Bauplan'. Working backwards from the historic period, where I am reasonably sure that elites lived at the far end of the plank houses, I feel comfortable projecting the same social spatial arrangement into the past, to the origins of the Meier and Cathlapotle plank houses, at least as a working hypothesis.

After deposition, most artifact movement was a result of cultural rather than natural site formation agents. Much of this movement is potentially comprehensible as a result of patterned behavior, even if that behavior results in disorganization (Ascher 1968). Artifacts were found in certain contexts not because of the often disorganizing/disassociating natural processes, but as a result of a culturally-organized/association-preserving system of artifact movement which, essentially, can be understood. All identified formation processes were controlled for by sensitive research design, which considered the directions and magnitude of artifact movement, dictating which contexts were to be sampled, and which were to be deleted from sampling.

Artifacts were continually moved from the hearth to the bench, and then to the cellar before being moved to the midden. Figures 24 and 25 summarize the artifact flow.

No evidence for systematic, large-scale movement of deposits between the north, central and south analytical units of the plank houses, expected to represent the residences of elite, commoners of middle status, and commoners of low status, was found. In each plank house each of these populations maintained their own facilities for processing and storage of a wide variety of artifacts in all stages of production. In large part, cellar contents (in particular) of the discrete north, central and south analytical units should reflect activities carried out in those areas of a given plank house.

In this case, an exhaustive site-formation investigation seems 'only' to have led in a sort of 'full circle'. Early in my research I optimistically assumed that artifact location would reflect behavior with high fidelity. As I examined site formation processes over the course of a year, I came to a low point where I suspected that cellar and hearth periphery maintenance would have obliterated any useful horizontal and vertical spatial distributions. Looking into site formation more carefully, however, I returned to the original proposition that spatial distributions may indeed be useful to investigate so long as analytical units and methods were properly scaled to account for formation processes.

The credibility of any spatial analysis depends largely on coordinating the scale of the analytical units, such as artifact class boundaries or zones of deposition, with the scale of various formation process effects, such as the movement of certain artifacts by meters, or centimeters, vertically and/or horizontally. Such scales and trajectories may affect different artifact and feature types in different ways. Their absence or presence must be demonstrated rather than assumed. Spatial distribution studies which do not explicitly demonstrate formation processes (e.g. Chatters 1989) may indeed be observing meaningful patterning, but until formation processes are exhaustively analyzed, cannot be considered credible.

Figure 30 displays some common Chinookan material culture items. These sorts of artifacts would have traveled the paths of artifact movement illustrated in Figures 24 and 25. Figure 31 displays my reconstructions of several of the main feature types discussed above for comparative purposes.

CHAPTER 4:
USEWEAR ANALYSIS

4.1 Usewear Analysis Methods

As noted in section 1.4, usewear analysis was the main method implemented in the inductive research phase. Methods and results of this analysis are described below.

4.1.1 Principles and Literature Review

The principal justification of usewear interpretation is that when a stone tool is used for some task the working edge will become modified by the forces to which it is subjected. Many of the wear traces can only be observed with the aid of a microscope, but in sum all such wear is referred to as 'usewear' whether macro- or microscopic. Because of differences in the properties of material being worked by the toolstone and the physics of contact between toolstone and worked material, different activities necessarily generate different forces applied to the toolstone, generating abrasion, flaking, striations and other usewear. This usewear can be assigned to specific activities if the usewear 'signatures' of different work activities are sufficiently well understood. To understand usewear signatures, the analyst uses analogy based on a set of experimental stone tools meant to replicate as accurately as possible the most likely range of activities carried out by populations whose artifacts are to be examined. Stone tools are made and used by the analyst in ways and on materials likely to have been worked by the prehistoric population. Usewear signatures for each of these activities are compared with the wear on artifacts excavated at sites, and conclusions are made regarding the most likely use of the excavated implements. These conclusions normally identify (a) whether or not a given lithic item was used for some task, (b) the 'work action' (e.g. sawing or scraping) and (c) the 'worked material' (e.g. bone or hide). These basic methods are discussed below after a summary of the current state of the art in usewear studies.

Usewear analysis was programmatically initiated by Sergei Semenov (1964) and has been a largely successful enterprise, generating useful results in a wide variety of chronological and cultural contexts, for example the Mousterian Levantine (Shea 1991), Eastern Mediterranean Upper Palaeolithic (Donahue 1988) and throughout the Americas in time and space (Bandy 1994, Lindner 1996, Smith 1996, Yerkes 1987). In fact, nearly all post-Acheulean lithic industries have been subject to some form of usewear analysis. For reviews see Cook and Dumont 1987, Juel-Jensen 1988 and Grace 1996. A review of the literature indicates several main points.

First, it is clear that significant problems remain in the interpretation of some usewear; see Bamforth et al 1988, but also the associated debate in that journal. Because of unknown sources of variability, analysts must continue to preface their studies with statements of their performance in 'blind tests' (see below) of their interpretive aptitude (for an introduction see Keeley and Newcomer 1977, Odell and Odell-Vereecken 1980). Such scores are imperfect though they vary in rather predictable ways for reasons poorly understood at present, and thus some degree of ambiguity is always associated with certain elements of any usewear study.

Second, however, rather than abandoning the method, usewear analysts have continually refined both theory and method (e.g. Hayden 1979, Grace 1989, 1990, 1993, 1997, Vaughn 1985), including applying the method to materials such as bone (LeMoine 1994; though Semenov did address bone usewear) and basalt (Richard 1988) as well as integrating usewear findings with other analyses (e.g. Keeley 1982, 1991). Usewear analysts have also fruitfully focused on the re-evaluation of commonly-held morphological 'types', such as 'key-shaped bifaces' (Roussseau 1992) and 'gravers' (Barton Olszewski and Coinman 1996). The overall pattern is that analysts are increasing the specificity of usewear studies, rather than re-examining basic principles, largely because such principles are generally accepted. Different activities do generate different usewear signatures, and can be recognized by analysts within stated and acceptable limits.

Thus, whatever its limitations (discussed further below), usewear analysis remains the best-known method to date of identifying the utilitarian function of stone implements.

As will be demonstrated below, it is certainly more fruitful, in cases of examining ancient labour organization, than assuming that form is directly reflective of specific function.

Modern usewear analyses are carried out in a three-phase research sequence, in which analogue usewear is generated by experiment, the analyst's interpretive capacities are tested, and the assemblage is examined. These phases are described below in terms of theory and execution in this study.

4.1.2 Phase 1: Replicative Experiments

This is the production and use of experimental tools in order to replicate the range and nature of activities reasonably expected of the assemblage to be examined. The use-wear on the experimental set is then studied in order to gain a familiarity with its generation and variability. In addition to gaining an understanding of the expected work actions and worked materials, most analysts also have experience with different worked materials and work actions as a result of the many experiments required to understand lithic usewear generation and interpretation. This is in effect a hedge against 'forcing' all usewear observed on excavated materials into categories expected of the assemblage.

Three main methods are used to systematically define a set of the work actions and worked materials most (and least) expected of a given assemblage.

First, the range of materials and actions expected to have been worked in a given context may be relatively straightforward: for example, it is unreasonable to expect assemblages of desert peoples to contain large proportions of tools used to perforate shell, or butcher fish (though see Smith 2000), activities more reasonably expected in coastal contexts. In this study, the potential worked materials most abundant in the Wapato Valley were the various products of a variety of mammals, generally divisible into soft products such as flesh and hide, and resistant products, such as bone and antler, a variety hard and soft woods, mostly mesic vegetal matter and fish (Thwaites 1969, Saleeby 1983). Table 9 indicates that all these materials were worked in the experimental programme in a wide variety of work actions such as sawing, scraping, etc. where such action was appropriate to a given raw material.

Second, and very useful in more generalized contexts (e.g. the mixed riparian wetland/woodland of the Wapato Valley), the raw materials composing the non-lithic artifact assemblage may be used as a guide to expected work actions and worked materials. If such materials bear production marks referable to stone implements, one may outline a minimum set of expected work actions and worked materials. In this study, bone and antler artifacts were numerous in the Meier and Cathlapotle assemblages (see Davis 1998), and are known to have been important raw materials on the Northwest Coast in precontact times (Rahemtulla 2001). The same applies to wood; at the well-preserved precontact Ozette site, more than 90% of all recovered artifacts were wood, bone or antler, rather than stone, which is normally most prominent in Northwest Coast assemblages (Samuels 1989). Many of these artifacts were clearly worked with stone, though some bear marks attributable to metal blades. Table 9 indicates that bone and antler were worked with stone tools, in the experimental programme, in ways comparable to those required to manufacture and maintain the main bone and antler (and inferred wood) artifacts of the Meier and Cathlapotle assemblages.

Third, ethnohistoric data may be used to identify expected work actions and worked materials. In this study, the journals of Lewis and Clark (see Ames et al 1998) and the ethnographic data collected by Ray (1938) provide the most detailed non-archaeological picture of early-contact-period lower Columbia artifacts, and by inference, the tools and work actions required to make and maintain them. These artifacts were typically made of wood, bone, antler, hide and stone; mammalian and fish butchery are also reported and would clearly have been important to the sedentary hunter-gatherers of the Lower Columbia. Largely absent from these reports are indications of stone tools to work vegetal matter, although plant material was worked in the experimental programme (Table 9).

Finally, the shape of some artifacts may be, from an engineering standpoint, obvious, and their shape may also identify the specific material on which they were used; items we classify 'projectile points', for example, in the field, have such a narrow potential range of utility that it would be counterproductive to reject our intuitive classifications. We need not expend hundreds of hours examining each item classified in the field as a projectile point when a sample shows that 98% bear no wear other than impact wear expected on projectiles, which is what I identified in an examination of 106 randomly selected items classified as 'projectile points' in the field. Certainly these items were not wedges made to split cedar into planks, or abraders or even knives for large-scale butchery, but were projectile points. Thus, the lithic items selected for usewear examination did not include the projectile points; sampling is discussed below.

Note that while the nature of the lithic raw material may differ greatly at a given site, the fine-grained chipped lithic assemblages of Meier and Cathlapotle average 98% crypto-crystalline silicate (hereafter, CCS) in composition. Thus, I examined the wear on, and replicated wear on, exclusively CCS toolstone, such as any of a wide variety of locally abundant (in the Wapato Valley: see Hamilton 1994) cherts.

In sum, the experimental reference set for this study used chert (overwhelmingly the most common raw material) to replicate a range of work actions on a range of worked materials (for a review, see Silverstein 1990) which can reasonably be expected of the Meier and Cathlapotle assemblages.

Table 9 indicates the count of stone item edges worn in the replication study. Note that a given lithic item may bear more than one worn edge, and any lithic item (flake or angular item) may bear more than one 'utilized element', hereafter referred to as a 'UE'). The experimental sample (n=1,324 stone UEs) was generated and used over a period of nine years, from 1991 and 1999 (that is, through the course of my MA studies, and into the present doctoral study), inclusive; 74% (n=979) were generated by 1997 (the end of the first year of the present study), and intermittent usewear generation was carried on thereafter; this was simply done to maintain my familiarity with the generation and interpretation of usewear traces. Note that 17 bone/antler UEs were used to perforate hide. This was done to confirm the utility of bone/antler for this function. A usewear analysis of bone/antler implements may be useful as well, but was not attempted in this study.

Table 9 indicates the number of UE’s employed by work action and worked material. ‘NA’ entries indicate that the kinetic work action is not appropriate to a particular raw material. The eight work actions (cut, scrape, shave, saw, wedge, grave, perforate and abrade) are rather standardized in usewear studies (see Grace 1989 and Shea 1991) and are generally applicable to the raw materials of the Wapato Valley. Since

I was examining the fine-grained assemblage, the larger implements (e.g. flaked cobbles) were not examined, and the work action ‘chop’ was not used in this study. Also, although I did experiment with abrasion of wood, bone, and antler with pumice (which was very effective), pumice tool usewear has not been studied, to my knowledge, and pumice artifacts were not examined in this study; like bone/antler implements, however, a functional analysis would be welcome.

The appearance of wear resulting from UE use on these different raw materials is generally well-known in the usewear literature (see Grace 1996, Vaughan 1985 and Yerkes 1987) and does not bear extensive repetition here. Here it is sufficient to say that wear traces identified in this study were consistent with such studies noted above, and that samples of these are found in the microphotographs in the Appendix. Wear traces are described briefly below, in section 4.2.2, Utilized Element Functional Types.

Just over half of the UE’s were used on wood. A wide varieties of wood were worked, including cedar (*Cedrus* spp.), pine (*Pinus* spp.), spruce (*Picea* spp.), elm (*Ulmus* spp.), ash (*Pyrus* spp.), and fir (*Abies* spp.), in both dry and wet (‘green’) states. I have been unable to identify differences in woodworking usewear based on moisture content, unless the wood is very dry indeed, in which case it could be quite similar to bone/antler when worked, although the usewear does *not* normally then mimic that of bone/antler working. Bone (normally cattle, *Bos* spp., or deer, *Odocoileus* spp.) was normally worked semi-dry, and antler (deer) was almost always softened by soaking for 10-12 hours before working. Again, differences between wet and dry states were detectable, but did not result in wear mimicking that of other worked materials. Over 30 deer-hide-scraping experiments were carried out; these removed soft tissues from the interior (non-hair) side of the hide just after butchery of the animal. These were done with endscrapers hafted in bone or antler handles. Butchery of fish (normally salmon, *Oncorhynchus* spp.) and mammals (normally cattle, *Bos* spp., or deer, *Odocoileus* spp.) was carried out, but (as in other studies) no systematic differences were noted in the wear resulting from these different animal classes. Large mammal butchery, often of deer, tended to include more bone contact than during fish (normally salmon) butchery, but the differences were not sufficient to discriminate between these activities archaeologically; neither was any of the butchery wear easily confused with other usewear. Plant matter was cut in 26 experiments (only 2% of the total UE’s), but it tends to generate such very distinctive wear, and require such distinctive utilized elements, that it should be relatively easily identified by any usewear analyst.

As will be discussed below, most of the usewear observed on the artifact sample was comprehensible when compared to that generated in the usewear programme; incomprehensile or alien usewear was not encountered, suggesting that the activities and worked materials of the experimental programme were well-matched to such in the protohistoric Wapato Valley.

UEs were examined with naked eye as well as the light microscope in the same manner as the archaeological sample: the methods are described below in the 4.1.4, Phase 3: Examination of Artifacts.

4.1.3 Phase 2: Blind Testing

The blind test is an evaluation of the analyst's capacity to correctly interpret usewear or the absence of wear, an important distinction. In such tests, accomplices utilize stone implements of the expected raw materials in the variety of ways (work actions) and on a variety of materials (worked materials) broadly comparable with those expected archaeologically and replicated experimentally. The analyst then examines these items, without knowledge of their use, and compares their interpretations to a master record of actual use. The analyst at this time is using his familiarity with usewear, generated in the experimental phase, to interpret the wear observations on the blind test set. Test results generally indicate the analyst's capacity for correct interpretation. Microscopic examination equipment and methods are described below, in section 4.1.4.

It should be noted that long-term familiarity with microscopic usewear patterns is necessary for the analyst to discern the subtle differences in wear which may be used to classify items on functional grounds. Only long-term training can cultivate an appreciation for the variation conditioning usewear traces and their formation.

Table 10 indicates the results of three blind tests I conducted in 1990, 1994 and 1997, as well as the results of blind tests published by other analysts.

Three main criteria are evaluated: first, the ability to identify whether wear was present or absent; second, the ability to identify work action (technically, kinetic action, such as sawing, scraping, incising, graving, and so on: see below for a full discussion) and third, the ability to identify the worked material (e.g. hide, wood, bone, antler, flesh and so on). Table 10 indicates that my ability to identify utilized region and work action of experimental tools is comparable to that of other analysts. It is also evident that usewear analysis must be considered a probabilistic endeavour, and as in other realms of anthropological and archaeological inquiry, it is necessary always to use multiple, independent lines of evidence to make the best case for a given argument. Within these boundaries, however, usewear remains our best available method for the determination of the utilitarian function of stone tools.

On average, I correctly identified whether or not an implement was used in 86% of the tests, the work action in 72% of the tests and the worked material in 68% of the tests. My results are noticeably higher in the identification of worked materials than most analysts, and this deserves comment. The reason is likely that I limited my identification to very broad categories, only discriminating between three classes: wood, bone/antler, and flesh. Since plant wear is so easily spotted, I did not test it in this study (though I am familar with it, having generated and examined much plant usewear in other studies), and since bone and antler generate such similar wear, and are used for such similar purposes in traditional technologies, I combined them as a single analytical class. In the final test, I identified worked material correctly 82% of the time, a very high score. Again, this is because I assigned wear only to one of these three groups; other analyst's lower scores on this test often reflect their trying to distinguish between bone and antler usewear. While it would be good to identify these differences, to identify the distribution of bone- and antler-working, present methods are insufficient.

The results in each of these tests (a) generally increased (or at least, did not deteriorate) through time, (b) varied in the same way in each test, and (c) are, in the interpretation of worked material, somewhat better than those of other analysts. This is largely due to my practice of not attempting to differentiate between bone and antler usewear, and this is based in my observation that their wear patterns are too similar to be confidently distinguished.

Table 10 indicates that my results are typical of modern usewear studies (note that test results of different analysts vary in the same way), and may be considered acceptable with the indicated provisions. The significance of these provisions is discussed in section 4.2.1, below, as well as in **Chapter 5: Results of the Usewear Study**.

4.1.4 Phase 3: Examination of Artifacts

In this phase a sample of the archaeological assemblage is examined in order to investigate the range and nature of activities represented. Typically, these are combined with analyses which focus on variation in (a) space and/or (b) time. Sampling to adequately characterize variation in space and time may require different methods, and is discussed below in section 4.2, Spatial Distribution Analysis.

Usewear examination of any sample is the visual examination of a lithic item to identify whether the item was used, the work action and the worked material. Magnifications from 0-300x are typically employed to characterize different types of wear. Types of wear can vary with different toolstone raw materials, different work actions and of course different worked materials, so that each analysis tends to be unique in the specific wear characteristics observed. Still, nearly all analysts use several conventional wear types. In this study, the state of 17 usewear variables, as well as data describing basic dimensions of each UE and lithic item, were recorded: these are introduced in **Chapter 5, Results of the Usewear Study**. Here it is sufficient to say that (a) the variables and their state were carefully selected, tailored to the characteristics of this assemblage, and (b) they were found to be adequate to accurately identify wear in the blind tests, and, by inference, we must assume pragmatically, in the archaeological assemblage as well.

Usewear examinations require the lithic item to be cleaned of adhering matrix or worked material, which may obscure wear traces. This is typically done simply with soap and warm water, followed by wiping with alcohol to remove oils from fingers, which can also obscure wear traces: these methods were used in this study. Surgical gloves were worn to prevent the accumulation of new oils or other substances on the lithic item. Once cleaned, each item was examined at 0x-300x with naked eye or a variety of microscopes.

This study used methods and equipment equal to those of other modern studies (for a good review see Shea 1991 or Grace 1989). Microscopes were binocular Wild M8, American Optical Series 110 and Leitz Laborlux 12POL, instruments variously capable of magnification from 7.5x - 400x. The Wild microscope was used to examine items up to 60x, the Leitz and American Optical for closer examination up to 400x. A fiber-optic incident lighting system was used to illuminate the specimen on the stage; one element provided general illumination while another was adjusted continually to highlight different aspects of the specimen. Specimens were attached to the stage with synthetic modelling putty which left no residue on the specimen, but allowed the specimen's position and attitude to be adjusted for optimal viewing.

Microphotography was also conventional and the specific methods were based on years of experience. Photos in the Appendix are samples of documentation shot by a Canon T70 SLR mounted on the Laborlux 12POL microscope. Monochrome ASA100 print film was used exclusively.

4.1.5 Summary of Usewear Study Methodology

In sum the methods utilized in this usewear study were (a) derived from previous, successful studies, (b) tailored to the physical properties and expected activities recorded in the target assemblage usewear, (c) carried out with analytical expertise typical of modern analyses and (d) used to examine a sample of items sensitively selected to account for site formation processes, spatial and chronological variation (see Chapter 3).

Thus we may be confident that -- within the stated limits -- the usewear study was methodologically adequate to address the questions of the study.

4.2 Usewear Analysis Results

The following sections describe the size characteristics (dimensions) of lithic items bearing UEs and the specific usewear traces such as polishes, striations, etc. found on the UEs. Following these descriptions, summary comments are made regarding the range and nature of artifact functions and activities carried out by the Meier and Cathlapotle people, as reflected in their chipped lithic implements.

4.2.1 The Lithic Sample

A total of 2,097 lithic items were examined, drawn from the non-projectile point, fine-grained chipped lithic assemblages of the Meier house and midden, Cathlapotle House I, Cathlapotle House IV and Cathlapotle sheet midden contexts. Figures 5 and 6 show the excavation units from which the sample was drawn. The sample was judgmentally drawn from excavation units (a) arrayed along the long axes of the plank houses and (b) representing mostly hearth and cellar deposits, where artifacts were most commonly used and stored (see **Chapter 3**, **Site Formation Processes**).

The samples unambiguously represent deposits in the North, Center and South areas of the Meier and Cathlapotle plank houses. Cathlapotle plank house I is slightly different from Meier and Cathlapotle IV, as it had an internal division of space, with several earthen berms, probably supporting walls, perpendicular to the long axis. These walls formed several ‘compartments’ in the plank house. The southernmost compartment is somewhat larger than the more northerly compartments, and for several reasons (discussed in section 2.3.2, The Social Plank House) is considered to have been the high-status end of this plank house. Importantly, each of these compartments was sampled. In Figure 6, excavation units U2, V2, R2 and Q2 sample the northernmost compartment, units P2, K2 and M2 represent the central compartment, and the remainder of the units represent the southernmost compartment.

The 2,097 item sample (1,073 from Cathlapotle and 1,024 from Meier) represents 29% and 13% of the Cathlapotle and Meier fine-grained, non-projectile point, non-core, crypto-crystalline silicate artifact assemblages (totaling 3,600 at Cathlapotle and 7,671 at Meier), respectively. They are all non-point and non-core items, regardless of previous field or lab designation. Cores and points were tabulated, and are discussed below, but their function is largely self-evident and focus was on the many items classified only in terms of technical execution (e.g. 'biface fragment') or a field guess at whether the artifact had been used or not (e.g. 'utilized flake') .

Table 15, variable 81, indicates that of these 2,097 items, 623 (29.7%) were found to have usewear, and 160 items (7.6%) were determined to be shaped for use, but unused. Most of the remaining 62.3% were too small or fragmentary to retain diagnostic usewear traces (722, or 34.4%; Table 14, variable 68), projectile point fragments (454, or 21.6%; Table 14, variable 69), or bipolar or freehand cores (138 or 6.5% Table 14, variables 66-67). The net effect of the usewear study in terms of adding to the artifact catalogs, was to add 138 cores and to convert 1,077 artifact designations (those of the projectile point fragments and usewear-bearing items) from general field designations such as 'retouched flake' or 'biface fragment' to functionally specific terms such as 'hide scraper' as discussed below.

4.2.2 Utilized Element Functional Types

Table 13, variables 50 - 60, and Table 14, variables 61 – 65, indicate the 16 functional types to which the 623 utilized elements were assigned. Each assignment was the result of a comparison of the usewear characteristics on a given UE with the wear characteristics generated in the experimental and blind tests, and a consideration of UE and lithic item morphology: no single characteristic was used to make functional assignments.

Most of the UEs were easily and confidently assigned to one of 16 functional types. The many items assigned to the indeterminate (hereafter INDET) category include items that bore some sign of use, but were too small to be diagnostic of that use. Nonetheless, the patterns of most common usewear were rather quickly realized in this sample: a small set of activities was carried out with a rather small set of opportunistically shaped (but not entirely expedient), simple lithic implements, with little differentiation within the assemblage. Note that the assemblage was examined in random order so that spatial characteristics of the sample would not be imagined and allowed to affect interpretations.

Each UE represents one minimal unit of behaviour recognizable by the methods of this study. Each is a portion of the raw data from which the activity classes analyzed in the final section of this study are composed.

The following are general adjectival descriptions of the 16 UE function classes. I also present my conclusion of the most likely specific function of these UE types, data relevant to the assignment of UEs to variables examined in **Chapter 5, Spatial Distribution Analysis.** Sections 4.2.3 and 4.2.4 describe UE characteristics in terms of size and the specific usewear codes. The Appendix contains drawings of some typical artifacts with UE's identified.

Bone/Antler Graver (n=10). These UEs typically occurred on robust elements of angular lithic items (rather than flakes) with high plane intersection angles; this is an obvious requirement for a UE used on a dense raw material in a static motion which generates relatively high forces on a relatively small UE. The UE was typically well below 2 cm long and somewhat gracile; for these reasons I do not accept that these UEs were used for grooving bone or antler in the 'groove and splinter' technique. That method, clearly evident on unfinished bone and antler items at Meier and Cathlapotle, must have been carried out with an as-yet-unidentified implement. Nevertheless, the bone/antler polish is distinct on these items, and I propose they were used in later stages of bone and antler manufacture, incising fine, shallow lines into bone and antler. Based on UE dimensions, these lines would have been roughly 2–3 mm wide and 5-10 mm deep.

Bone/Antler Perforator (n=7). These UEs were similar to those of gravers but somewhat longer and bore, of course, evidence of rotary action. The bone/antler polish was well-developed and appeared on less, and higher, rugosities than on wood-perforation UEs due to bone and antler being denser than wood. Most of these UEs were used to bore holes less than 20 mm deep and less than 10 mm wide; such holes are typically made during later-stage working of bone and antler, such as in the creation of passages for lanyards and the like.

Bone/Antler Saw (n=10). These UEs were relatively robust, as required for working bone/antler, and bore usewear indicating static contact with a high-density raw material in a two-way, longitudinal (incising) action. They were relatively rare, and I expected to find more. These UEs are responsible for some of the transverse grooves on the many bone (e.g. metapodial) and antler (e.g. tine) items in the Meier and Cathlapotle assemblages, but I do not believe they are responsible for all of them. First, the grooves so far observed are normally very narrow, often suggesting a metal blade, and second, bone/antler were important raw materials transformed into many implements: ten UEs are simply insufficient to account for them. Thus while bone/antler sawing UEs are easy to spot and securely assigned to this action, they are not the only implements used to carry out this activity.

Bone/Antler Scraper (n=33). Bone/antler scraping UEs were somewhat unexpected, as during many experimental studies I have found that scraping with chipped lithic implements is rather inefficient on bone and antler (and wood, as I note below). Typically, a bone/antler scraper, in experimental tasks, quickly removed some surficial rugosities, but was then simply too gracile to remove much material with further strokes. Far faster and easier was the use of abrasive stone, such as pumice or even coarse-grained basalt, both raw materials common in the Meier and Cathlapotle assemblages. A few strokes of these raw materials quickly removed as much bone or antler raw material as several minutes of more laborious work with a scraper. Pumice artifacts bearing grooves are common in these assemblages, and I propose that many are the result of using pumice to make bone and antler points, based on the roughly 1 cm diameter grooves typical on these items. Still, some scraping of bone and antler with fine-grained UEs is useful, for example in the finest 'finishing' stages where maximum control of the UE is required, and I propose this work to have been the main focus of these UEs.

Bone/Antler Shaver (n=5). Attempting to shave bone/antler with a fine-grained chipped lithic UE is even less productive than to attempt scraping. The UE typically slides across the surface of the bone/antler, and if it hits a rugosity, it snags and breaks rather than slicing off that rugosity. These few UEs probably represent failed experiments and not much should be read into them analytically.

Bone/Antler Wedge (n=3). I was surprised to find less of these UEs than I expected, as in experiments they bear distinctive wear from forceful hammering and distinctive patches of bone/antler polish well into the interior of the toolstone surfaces and ridges rather than on the distal elements as one might expect.

Butchery (n=105). Butchery UEs are rather distinct; they bear distinctive characteristics of incising deeply into a yielding raw material, such as small, bifacially-distributed, feather-terminated microflakes, invasive polish and relatively long UEs. Note that in experiments, these traces are generated after roughly 20 minutes of use. If butchery is not carried out for that long, wear may be very light or invisible. For these reasons I suspect that butchery is under-represented in these assemblages. Nevertheless, where it is identified here, the UE assignments are very secure; butchery UEs are very distinctive. These UEs were typically relatively long, with low edge angles and the toolstone was normally large enough to hold in the hand (see quantification of these adjectives below). Few had substantial indications of contact with bone, suggesting rather later-stage butchery than initial disarticulation, in which meat is separated from bone. Thus I propose that most butchery UEs were used in the division of previously-divided meat, and that as a rule, initial carcass reduction took place outside the plank houses; this may be investigated with faunal data. This meat could be mammalian, avian or fish; my experiments in butchering each of these animal classes have yielded no useful distinguishing criteria.

Hide Cutter (n=23). These UEs are similar to those assigned to butchery, but they bear more and larger flake scars and some had slightly higher edge angles than the butchery UEs due to their use on more resistant raw material. They were probably used in the later stages of hide reduction as I suspect that initial disarticulation of carcasses, and hence the initial division of hides, normally took place outside the plank house boundaries (see argument above in discussion of butchery UEs) .

Hide Scraper (n=196). These are among the most common UEs and are distinctive in many ways, making them relatively easy to identify. They bear unifacial marginal polishing which has been found to be distinctive in many studies (e.g. see Hayden 1979 and Vaughn 1985) and this occurs on a convex lithic element which has specific design criteria, making the identification of unused hide-scrapers also somewhat easy. These design criteria include a typically convex form in plan view, a steep edge angle to prevent the UE from slicing into the worked hide, as well as to prevent the UE from breaking and a lithic element size suitable for hafting. Figure A137 indicates that some of these UEs were clearly purposely serrated, with five to seven notches between distinct teeth on the UE; the function of these has yet to be determined. Most of these UEs, however, were unserrated. Three further variations on the general UE theme were observed, none of which are understood at this point: (a), some UEs were straight, rather than convex, (b) some of the flakes or angular items on which the UEs were found were distinctly longitudinally 'flexed' and (c) some lithic items on which the UEs were observed were very thin (less than 10 mm) while most were almost twice this thickness. Experimentation with such variation will be the only way to find out. (See section 6.3, Suggestions for Future Research).

Hide Perforator (n=1). This UE is clearly designed for rotary perforation (as described above and below) but bears a more diffuse and invasive polish than found on wood- or bone/antler-perforators, as well as microflaking characteristics consistent with perforation of a more yielding raw material. This UE’s wear most closely matches that generated in hide-perforation experiments and it is assigned to that function. The low count of this UE is not surprising. Bone/antler perforators are longer, to penetrate thicker hide; sharper, hence more controllable, less brittle, and quickly resharpened with an abrasive stone when broken rather than requiring more laborious pressure-flaking, and are therefore far superior to stone for hide perforation. For this reason, I believe the many bone and antler perforators at these sites are in fact the hide-perforation tools of choice. This single hide-perforation UE cannot be considered analytically diagnostic of any trend and it is generally disregarded.

Plant Cutter (n=1). Since the cutting of vegetal matter with a UE quickly generates a most distinctive polish (when there is significant silica in plants, as is normally the case: silica content in Wapato Valley plants should be researched), as well as other usewear characteristics very familiar in usewear studies (e.g. see Keely, 1980), and since stone is better suited to cutting vegetal matter than any material but glass or metal, the absence of vegetal-cutting UEs is accepted here as indication of the absence of this activity. If stone were being used to cut plant matter, it must have occurred outside the plank houses. I am also certain plant-cutting occurred, as plant matter was used to make many types and large numbers of items of GLCR material culture, including clothing; the processing of some foods (e.g. wapato) may also have included vegetal tissue cutting. This may have occurred more frequently at extra-plank house special activity areas, such as wapato patches or wapato-processing sites on riverbanks. Archaeological traces of such sites are numerous in the GLCR and should be investigated specifically for vegetal-cutting usewear (a pilot project is discussed in Smith 2004).

Wood Graver (n=29). These graving UEs bore microflaking and polishing wear indicative of relatively heavy-load static incision into a raw material less dense than bone/antler, but denser than leather. They are characterized by robust working elements with high plane intersection angles and marginal polish. These UEs could only have been used in the later stages of wood-reduction, as the grooves they would have cut would have been less than about 10 mm deep and a few mm wide. Such incisions are too small to divide wood in early manufacture stages and I am confident to assign these items to later reduction or modification of wooden items.

Wood Perforator (n=9). These UEs are designed essentially identical to bone/antler perforators, but their usewear indicates contact with a less dense raw material than bone/antler, but a denser raw material than leather or hide. Their dimensions indicate perforation of holes roughly 14 mm or less in diameter, and roughly 30 mm or less in depth. They were likely used in later stages of wood-processing than other tools, such as wedges made of bone and antler used to split wood into slabs or planks.

Wood Saw (n=28). These UEs are similar to the bone/antler sawing UEs, but bear indications of contact with a less-dense material, such as a more diffuse polish spread over a larger surface area. That these UEs have an average length of only 39 mm (though this is long for Meier and Cathlapotle UEs in sum: see discussion in the next section, below) indicates that they could only have been used to reduce wooden items of less than roughly 40 mm wide or in diameter such as very small branches. Thus, indicate a later wood reduction stage than, for example, bone and antler wedge, which would have been used initially to split wood into manageable items.

Wood Scraper (n=23). These UEs are relatively rare for the same reasons discussed above with regard to bone/antler scraping. Having said this, wood is somewhat less dense than bone/antler, and thus scraping it can be productive, though mass reduction of wood is still easiest with an abrasive stone. Wood-scraping UEs are typically smaller than wood-sawing UEs, would have also been used, and are therefore assigned to some later-than-first reduction stages.

Wood Shaver (n=139). Wood-shaving UEs are numerous and easily-identifiable, with moderate edge angles and distinctive polish distributions and microflaking patterns. Shaving wood with such UEs quickly reduces the wood in a whittling manner, though many times the UE hits a snag and breaks as there is simply not enough energy or toolstone mass attacking the snag. Thus they cannot profitably be used in the earliest stage of wood reduction, which is far more effectively carried out with more massive cobble tools, items which should be studied further at these sites. These UEs include spoke-shavers, items with a distinct semicircular notch on the UE. These are present, but in numbers too few to account for what would be one of the most numerous of artifacts in the plank houses, namely arrows, judging from the large number of lithic projectile points. Some other tool, for example coarse-grained abraders (discussed variously above) must have been used to smooth out arrow shafts. Wood-shaving UEs are assigned to some later-than-first stage of wood reduction.

Unused Items (n=160). These are items bearing morphologies essentially identical to items with UEs, but bearing no traces of wear. They represent the possession of implements in a state ready for specific use, and I infer from this ownership and use of these items by populations near which they were stored. In **Chapter 5** they are included in some spatial distribution variables and omitted from others, for reasons described in that chapter.

In sum, the identified UEs were divided into a few main groups: these are the most numerous hide-scrapers, butchery implements and wood-working implements. All UEs can be confidently assigned to later-than-first stage reduction of wood, bone/antler, hide or flesh, the main materials worked at these sites. The significance of their reflection of later-than-first stage reduction is that many of the artifact types already tabulated at Meier and Cathlapotle (e.g. bone and antler wedges, abraders) can be used to indicate early-stage reduction while the UEs can be used to indicate later-stage reduction, allowing an examination of the organization of labour by raw material reduction stages. This is carried out, among other analyses, in **Chapter 5**, **Spatial Distribution Analysis**.

The following section details the dimensions and specific usewear characteristics of the UEs assigned to the 16 UE functions discussed above.

4.2.3 Dimensions of Artifacts Bearing Utilized Elements

Length

Length is the measurement, in millimeters, of the flake or fragment of stone on which the UE is found, on the axis of percussion, if apparent, from proximal to the distal if apparent. Length is distinct from UE length, discussed below. The average length of all artifacts bearing UEs is 29.70 mm.

Length variation by UE type seems to fall into two main groups, those items below 25 mm in length, and those above. Those below are the bone/antler saws, bone/antler wedges the single plant cutting implement, the very numerous hide-scrapers, and the single hide perforator, with a pooled average length of 22.9 mm. The longest implements were used for perforating wood, scraping bone/antler and wood, graving wood, and sawing wood: these implements have a pooled average length of 35.6 mm. These measurement trends can easily be explained as a function of utilitarian design. The most numerous of the shorter-artifact group are the hide-scrapers, with an average length of 22.5 mm; these account for 95% (n=196) of the 210 items averaging below 25 mm in length. Hide-scraping implements are bits hafted into large handles and they required relatively large amounts of time to perfect in shape (compared to the bulk of the non-projectile-point tools, which are unshaped). Being thus somewhat valuable, they were reused multiple times, and resharpening of these items, often to exhaustion, is not uncommon (discussed below). Resharpening reduced the size of these items that were designed to be small in the first place, as they are hafted: the hand is not mean to hold the hide-scraper, but rather the haft. Most of the sampled items, however, bore no trace of haft wear, and were well over 22 mm in length: the most numerous implements, wood shavers and butchery tools, have average lengths of 29.3 mm and 28.9 mm, respectively. I have consistently found that lithic items below 20 mm in size are very difficult to hold in the hand and use effectively, and I suggest that the larger size of most items in the sample is a result of most of these items being unhafted. Note that wood and bone/antler perforators have average lengths of 32.4 mm and 31.3 mm, respectively; in addition to an absence of hafting wear, these dimensions suggest that these implements were hand-held, as, I infer, were the wood gravers, with an average length of 34.5 mm.

Artifact length is also explainable in terms of other specific UE functions. Butchery is best carried out with rather long, low-edge-angle UEs, and butchery implements have both of these characteristics. The very largest implements on average were used for sawing and scraping wood, with average lengths of 39.0 mm and 39.7 mm, respectively; these also include the highest length scores in the sample, at 66 mm and 72 mm, respectively. In sum, artifact length appears to be related to utilitarian rather than stylistic concerns.

A t-test of artifact length indicates that the Meier and Cathlapotle assemblages are statistically almost indistinguishable, with means of 27.3 mm at Cathlapotle and 29.9 mm at Meier ($t=-2.966$, $p=.998$).

In sum it may be said that artifact length varied (a) grossly by whether or not an artifact was hafted (that is, differentiating largely between the many hide-scraper bits) and (b) this variation occurs in the same way in the Meier and Cathlapotle assemblages.

Width

Artifact width is the greatest distance, in millimeters, between two points on the artifact margins perpendicular to the long axis or axis of percussion. The average artifact width of all artifacts bearing UEs is 21.19 mm.

As with artifact length, widths fall into two general groups: those items narrower than 20 mm and those wider than 20 mm. The group narrower than 20 mm on average include hidescrapers (actually exactly 20.00 mm wide on average), bone/antler gravers and perforators, wood perforators, hide-cutters, and the single hide perforator and plant cutter: pooled, these number 245 items (39% of the UE sample) and have an average width of 14.9 mm. The wider tools on average include the common woodshavers (n=142, with an average width of 25.9 mm) and bone/antler wedges (n=3 with an average width of 30.6 mm) with average widths at least 10 mm greater than those of the narrower group. Much of this variation seems to be related to UE function. Many of the narrowest implements are the hidescrapers, the size of which has been mentioned above. The narrow group also includes most of the gravers and perforators, used to make narrow channels or perforations in wood, bone or antler. From a utilitarian design perspective, this is a design necessity. Artifact width seems to be related most to utilitarian design concerns.

A t-test of artifact width indicates that the Meier and Cathlapotle assemblages are indistinguishable, with means of 23.7 mm at Cathlapotle and 21.96 mm at Meier ($t=2.593$, $p=.004$).

In sum it may be said that artifact width varied (a) grossly by whether or not an artifact was to be hafted (in the case of the many hide-scrapers) or to make small incisions or perforations in resistant raw material (e.g. wood, bone/antler) and (b) this variation occurs in the same way in the Meier and Cathlapotle assemblages.

Thickness

Thickness is the greatest distance between any ventral and dorsal surfaces, when they are evident, or the greatest distance between any two points perpendicular to the long (often striking) axis of the lithic item. The average thickness of all artifacts bearing UEs is 7.09 mm.

Thickness measurements form two main groups, those above 7 mm and those below 7 mm. Artifacts which on average have thicknesses lower than 7 mm had UEs assigned to wood, bone/antler and hide perforation, scraping hide, cutting hide, butchery and sawing bone/antler: in sum, these items (n=346, or 55% of the UE sample) have an average thickness of 5.6 mm. This is clearly in contrast to the thicker implements assigned UE functions of shaving, scraping, graving, and sawing wood, as well as graving, shaving and wedging bone/antler, and the single case of cutting plant material; these items (n=274, or 45% of the UE sample) have an average thickness of 8.2 mm. Aside from the plant-cutting implement, most of this size variation is clearly related to utilitarian design: thicker implements are generally used on wood, bone and antler, the more resistant materials worked, which require a more robust implement, whereas the more yielding worked materials, hide and raw flesh were worked with thinner implements.

A t-test of artifact thickness indicates that the Meier and Cathlapotle assemblages are statistically almost indistinguishable, with means of 7.31 mm at Cathlapotle and 6.90 mm at Meier ($t=1.269$, $p=.205$).

In sum it may be said that artifact thickness varied (a) grossly by the resistance of the worked material, with thicker implements used on wood, bone and antler and thinner implements used on hide and flesh and (b) this variation occurs in the same way in the Meier and Cathlapotle assemblages.

UE Length

The UE length is the distance, in millimeters, from the most proximal to the most distal usewear traces of a given UE, on the axis of percussion or long axis if such is not present or identifiable. On perforators and gravers, the UE length on both left and right edges of the UE, as seen from the dorsal, are added, raising their scores. The average UE length was 18.65 mm.

Two distinct UE length groups are identifiable; those UEs above and those below 20 mm in length. Those below 20 mm include UEs used for all bone/antler-working actions, the single plant-cutter, the 28 wood-gravers and the 142 wood-shavers: this group numbers 233 UEs (37% of the UE sample) and have an average UE length of 16.9 mm: they include a very low UE length average of 1.2 mm for the wood-gravers. The numerous hidescrapers are on average exactly 20 mm in width, numbering 199 items (32% of the UE sample). The above-20 mm group includes all of the hide-working implements, the numerous butchery implements and all of the woodworking implements save the gravers mentioned above: they number 188 items (30% of the UE sample) and have an average UE length of 23.6 mm. This variation is explainable by utilitarian design: longer UEs are desirable as slicing/incising blades for hide and flesh-cutting implements which must cut deeply into yielding material; they are also desirable on hand-held implements used to shave and scrape wood, common actions used to remove large amounts of material in a short time (recall, however, that wood-scraping, as bone/antler-scraping, is less effective than may be expected: see comments in section 4.2.2). Note that wood-shavers, a numerous category (n=142) have a rather low score.

Higher scores are found on the nine wood-perforators and the single hide-perforator (in sum averaging 29.4 mm), in great contrast to the very small bone/antler and wood graving UE lengths, averaging only 4.5 mm. This strongly suggests that the wood- and bone/antler gravers were used to cut very shallow channels (well below 10 mm deep) into their respective worked materials, whereas the perforators were penetrating, on average, about 15 mm into theirs. The length of the lithic item and the UE length are not well-correlated as a whole (Pearson's r^2=.04, p=.22), as even graving implements, with very small UEs must have enough lithic mass to grasp in the hand. Most UE length variation seems to be directly reflective of utilitarian design considerations.

A t-test of artifact UE length indicates that the Meier and Cathlapotle assemblages are statistically distinctly different, with means of 10.23 mm at Cathlapotle and 14.89 mm at Meier (t=-4.65, p=.000). Most of the smaller size in the Cathlapotle sample is driven by the numerous hidescrapers, 151 (76%) of which were found at Cathlapotle, and in general the artifact UE lengths are essentially the same.

In sum it may be said that UE length varied (a) grossly by the resistance of the worked material, with longer implements used on wood, hide and flesh (with the exception of the medium-sized, hafted hidescrapers, and the numerous unhafted wood-shavers) and (b) this variation occurs in the same way in the Meier and Cathlapotle assemblages

Size Index

The size index is single number derived by multiplying length, width and thickness of an artifact and dividing the product by 100. The number thus condenses several variables into a single summary statement of artifact 'massiveness'.

Artifact 'massiveness' ranged from 6 for bone/antler scrapers to 121 for wood-shavers, with an average of 48.2. The sample is easily divisible into two gross classes, those larger items with an index above 50, and those below. The group above index 50 is composed of the hide-cutters, bone/antler perforators, wedges, saws and gravers, and the many wood-shavers: these relatively massive implements have an average size index of 74.1 and number 215 items, or 35% of the UE sample. The below-index-50 group is composed of 405 bone/antler scrapers and shavers, the butchery implements, wood gravers, scrapers and perforators, the single plant cutter, the numerous hide-scrapers and the hide perforators, or 65% of the UE sample, with an average size index of 28.4. The size of items comprising the less massive group, then, is roughly half the size of the more massive group. Some of the small size of the smaller group is driven by the many (n=199) hide-scrapers, and the larger wood-shavers (n=142) drive much of the large size average in the larger group. The two are clearly distinguished by the hide-scrapers being hafted implements, whereas the wood-shavers are hand-held implements used in a whittling manner, and must therefore be large enough to grasp comfortably in the hand.

A t-test of artifact size class (a measure derived from size index) indicates the Meier and Cathlapotle assemblages are statistically almost indistinguishable, with means of 2.32 at Cathlapotle and 2.44 at Meier ($t=-2.016$, $p=.044$).

In sum it may be said that artifact size, expressed as a summary value of general massiveness, varied (a) grossly by whether or not the artifact was hafted or to be held in the hand, and (b) this variation occurs in the same way in the Meier and Cathlapotle assemblages.

Thus, artifact dimensions of the entire 620-UE sample varied rather predictably; generally, larger items were used to work more yielding raw material, such as hide, flesh and wood, with unhafted implements, while smaller items were often hafted to work either yielding raw material (hide) or quite resistant raw materials, such as bone and antler, with a smaller, more precise and controllable working element. These variations occurred similarly in the Meier and Cathlapotle samples, and appear to be results of completely utilitarian design considerations. Whereas some nonutilitarian design variation is seen in the Meier (largely stemmed) and Cathlapotle (largely side-notched) projectile points (data not presented here but obvious on classification by lab assistant Greg Baker, with a quantitative report pending), no such variation is seen in the 620 items bearing UEs referable to the 16 UE functions identified in this study. Artifact design in these items was strictly utilitarian.

4.2.4 Usewear Codes

Each UE was documented by recording the state of 17 variables indicating the shape of the UE, whether or not it was retouched, and the appearance of a variety of key types of usewear. These variables and their states were generated by drawing appropriate methods from Shea 1991, Keely 1980, Grace 1986, Semenov 1963, and Yerkes 1987 and adapting such methods to the specific characteristics of the Meier and Cathlapotle raw lithic materials, most likely-worked raw materials, and so on (Hamilton 1994, Smith 1996). As noted above, magnifications of 0-350x were used to determine the state of each variable per UE; the magnification used normally towards the lower end for variables MOD1 through MOR3, and towards the 200x to 300x range for the variables ALC through TRJ (code designations such as MOD1 and TRJ are detailed below).

Scores for each variable for each UE are found in Table 16. A summary of the numerical modes of each UE variable, per UE function, is found in Table 17. The variables are introduced below, before being discussed in terms of their most common configurations (essentially, numerical modes) by UE function. Variable states did not vary appreciably by site or plank house. Thus, in addition to size UE technological modifications, morphologies and usewear characteristics of the Meier and Cathlapotle assemblages were essentially identical.

Edge Angle

Edge angle is the mean of three measurements of the angle of intersection of the dorsal and ventral planes of the UE. The average artifact UE angle of all artifacts bearing UEs is 53.49 degrees.

Two main groups of edge angle are apparent: UEs with values below 45 degrees and UEs with angles above 45 degrees. Those below 45 degrees are typically below 30 degrees on average and were used to cut hide, plant matter and flesh (n=125, or 20% of all identified UEs). These items have an average edge angle of 26 degrees. UEs with edge angles largely above 45 degrees were used to scrape, shave, grave, saw and perforate wood, bone and antler, and/or were used in an edge-transverse motion rather than an edge-longitudinal motion (n=495, or 80% of all identified UEs).

From a design standpoint, the low edge angle of plant-, hide- and flesh-cutting implements is logical as in each work action the UE, a blade, is required to incise deeply into a material, and should be somewhat narrow, facilitated by a low edge angle; the angle must not be too low, however, as the UE would be too gracile to use, even on butchery UEs, the edge angle rarely dropped below 13 degrees. In contrast, consistently higher edge angles are found on UEs used on more resistant raw materials, such as wood (average 60 degrees) and bone/antler-working (average 70 degrees). This is also logical from a design standpoint, as the greater the edge angle, the more stable and robust the UE, an important consideration in working resistant raw materials. A few exceptions stand out: UEs used to perforate material of any resistance (hide, wood or bone/antler) are almost always rather high, with an average of 66 degrees for the 54 UEs attributed to perforation. Also, hide-scraping UEs (n=199) average 75 degrees, though they were used on some more yielding raw material. This apparent discrepancy is explained by the manner of use of the hide-scraper, which has to be used uni-directionally and edge-transversely, and cannot have imperfections which might tear the hide being scraped. Thus a UE which is highly optimized for scraping is crucial, and shape optimization of hide-scraping UEs very commonly included a convex and highly symmetrical UE (see discussion of UE morphology modes, below). Additionally, resharpening would continually steepen the edge of these implements, and as they would have been hafted tools, they would be considered rather valuable (Keely 1982) and resharpening would be common.

Some variation in edge angle must be a result of differences in uselife stage. Early-stage UEs might have lower edge angles than resharpened, heavily-worn UEs shaped for the same function. However, note that as found in Hamilton (1994), Smith (1996) and discussed throughout this dissertation, most Meier and Cathlapotle non-projectile point chipped lithic implements were expediently produced, shaped and used, and few are heavily resharpened. Thus, while edge angle may occasionally reflect uselife stage, in most cases, it should reflect utilitarian design considerations.

In sum, the lowest edge angles are found on flesh- and hide-cutting implements, the medium edge angles on wood-working UEs and the highest edge angles on UEs used (a) for perforation of any raw material, (b) for working the most resistant raw material (bone/antler) and (c) for scraping hides with hafted bits which would be resharpened quite often. Edge angles may be considered largely reflective of utilitarian design concerns.

Although the raw data are not reported here, note that these edge angle measurements are broadly the same in the Meier and Cathlapotle assemblages. For example, used Meier hide-scraping UEs (n=48 or 24% of all hide-scraping UEs) have an average UE angle of 78 degrees, quite comparable to Cathlapotle's average of 80 degrees (n=148). Another similarly numerous UE category, woodshaver, has average figures of 39 degrees and 40 degrees at Meier (n=70) and Cathlapotle (n=69), respectively.

In sum it may be said that UE edge angle varied (a) grossly by the resistance of raw material worked, that is, differentiating largely between flesh/hide-working and bone/antler- and wood-working, and (b) this variation occurs in the same way in the Meier and Cathlapotle assemblages

MOD

MOD indicates the degree of technological modification (retouch or grinding) of a UE. MOD code 1 indicates an unmodified UE; MOD code 2 indicates unifacial retouch; MOD code 3 indicates bifacial retouch; MOD code 4 indicates unifacial and bifacial retouch, and MOD code 5 indicates edge grinding. Considering the small size of most of the Meier and Cathlapotle chipped lithic artifacts bearing UEs (mean length of 29.7 mm) and the morphology and small size of macro-and microflakes removed by these technical modifications, the bulk would have been done with bone and/or antler pressure-flakers. Unfortunately, pilot studies seeking diagnostic pressure-flaking wear on bone/antler items have been unfruitful, though I suggest the search be refined and continued.

Table 17 indicates that of the 16 UE functions, 14 (87%) typically were MOD4, or both unifacially and bifacially retouched. This means that most UEs were retouched. As will be noted below, however, this retouch, except on a few types of artifacts, was typically not highly developed. Normally a UE appears to have been minimally shaped before use.

ANG

Edge angle is the mean of three measurements of the angle of intersection of the dorsal and ventral planes of the UE. The average artifact UE angle is 53 degrees; as noted in Section 4.2.2, edge angle generally varied by the resistance of worked material: harder materials, such as wood and bone/antler, were worked with steeper edges, while more yielding matter, which needed to be deeply incised, was worked with UEs bearing lesser edge angles.

MOR1

This variable describes the UE shape in plan view. MOR1, 1 is convex, MOR1, 2 straight, MOR1, 3 concave, MOR1 4 recurved, MOR1 5 a 3-sided point, MOR1 6 a four-sided point, MOR1 7 a convex surface, MOR1 8 a flat surface, MOR1 9 a concave surface. MOR1 states 7-9 were not encountered. MOR1 codes are roughly divided into three categories: convex edges (normally on hidescrapers), straight edges (on the numerous shavers and scrapers of non-hide raw material, and the numerous butchery implements) and a variety of points and projections, comprising 6%, 43%, and 31% of the UE functional types, respectively; the remaining 20% are a variety of shapes used for a variety of actions on wood, bone and antler.

MOR2

MOR2 is the UE shape seen edge-on, that is from a point on a plane parallel with the lower (normally, ventral) surface of the lithic item. MOR2 code 1 is straight, MOR2 2 is curved, MOR2 3 is recurved (i.e. 'serrated'), and MOR2 4,5 and 6 are three-sided projections, four-sided projections and surfaces, respectively.

MOR2 is, of course, conditioned in part by, and conditions in part MOR1 and MOR3. Projections are always projections, in whatever view. Aside from the projections for graving, perforation and so on (31% of UE functions), most MOR2 scores (68%) are code 1, or straight. Even though most UEs are somewhat modified by flaking, the overall shape of the UE remains, in the perspective of MOR2, straight, rather than radically recurved.

MOR3

MOR3 is the UE shape in cross-section, that is, the shape of the UE if the lithic item were sliced perpendicular to the striking/long axis. MOR3 codes are 1 for bi-planar, 2 for plano-convex, 3 for plano-concave, 4 for concavo-convex, 5 for biconvex, and 6, 7 and 8 for three-sided projections, four-sided projections and surfaces, respectively.

Almost all MOR3 scores are 4, indicating that, aside from the points and projections (31%), 56% of UE shapes are concavo-convex. Note that hidescrapers, being only 1 of the 16 (6%) UE function types, are numerically abundant (n=199, or 32% of all identified UEs), are nearly score 1 for MOR3, indicating that they are typically bi-planar. This shape has been created by more energy investment (edge-tuning by pressure-flaking) than expended on the rest other non-projectile-point and non-perforator artifact types.

Clearly, MOR1, MOR2 and MOR3 were designed by the stoneworkers to work together to form a UE suitable to specific work actions on specific raw materials. The anticipated work action may have been more important in design than the anticipated worked material.

ALC

ALC is the first variable indicating UE modification normally referable to use. ALC is the location of abrasive wear, which can include polishing (abrasion of and creating surfaces), striations (abrasion in long, narrow channels) and/or dulling (contiguous abrasion of large [>1 mm] surfaces or terminal elements of UE edges). ALC code 1 indicates no abrasion, 2 indicates unifacial abrasion, 3 indicates bifacial abrasion, 4 indicates that a single of multiple facets or intersecting lithic planes is abraded, 5 that multiple such facets or planes are abraded, 6 that surfaces >5 mm from any terminal edge are abraded, and 7 that abrasion is bifacial, but unevenly distributed on the UE.

ALC scores vary most clearly with work action, because work action largely dictates UE shape and UE shape dictates which portions of a UE are most likely to come into contact with a worked material, and in what way(s). ALC scores fall into three broad categories: unifacial (4 of 16 UE functions, or 25%), bifacial (7 of 16 UE functions = 43%) and on multiple facets of ridges or planes (5 of 15 UE functions, or 33% of UE functions). Most bifacial abrasion is found on UEs used longitudinally, in which the UE incises into a raw material, and both facets come into contact with the raw material: this includes UEs used to cut into hard as well as yielding raw materials, as seen on bone/antler and wood saws and butchery and hide-cutting. The one transversely-utilized UE that is typically bifacially abraded (normally with polish) is the numerically common wood-shaver; in this case, the UE slips between the worked material core, and the shaving peeling off from the core, abrading both dorsal and ventral surfaces. Most unifacial abrasion is seen on the scrapers of wood and bone/antler, as well as the much more yielding hide, as seen in the hide-scraping UEs. In these cases, UEs were clearly used uni-directionally, rather than 'scrubbing' the UE back and forth on the worked material. The distribution of abrasive modification of perforators and gravers often also indicated unidirectional wear, which in the case of more gracile UEs is likely a means of preventing the breakage of such elements. Long, narrow perforation bits or gravers can shatter easily if not carefully handled, and it is easier to control the stresses these UEs are subjected to by carefully resetting the UE in the raw material at each work action movement than by 'working' the UE into the material with a 'back-and-forth' motion.

DUL

DUL indicates the degree of topographic dulling or smoothing of the UE. DUL scores are subjectively measured by eye; attempts at quantification (see Grace 1989) have not yet been widely adopted in usewear studies. DUL code 1 indicates a freshly-fractured edge with jagged rugosities visible at 200x (this was rare), while codes 2, 3 and 4 indicate isolated patches of rounding in a field of fresh fractures, contiguously-dulled regions of a size at least 50% that of the UE length, and flattened areas, >1mm in maximum dimension, with no rugosities visible at 250x, respectively.

DUL scores fall into three broad groups: code 2, with isolated dull patches in a field of fractures (18% of the UE function classes), code 3, with moderately large patches of contiguously-smoothed raw material (62% of the UE function classes) and code 4 (18% of UE function classes) with large areas of the UE very reduced by abrasion.

Degree of dulling does not vary very predictably with worked material resistivity: code 3 (patches of contiguous dulling) is common on UEs used to work bone/antler, wood and hide, materials of radically different density. Degree of dulling represents more likely the duration of use, long a confounding variable in usewear studies (Bamforth 1988). This variable was most profitably used in the initial stages of analysis, in which the potential UE was scanned for any type of dulling. Although freshly fractured edges may or may not have been utilized (e.g. three minutes of butchering a small flesh, or boneless meat, might leave no visible wear), a worn element nearly always indicated human use, some dulling can occur with water rounding, for example.

POL

POL indicates polish, the nature of reflectivity of light from a surface. Polish reflectivity is generally considered an important indicator of the duration of use as well as the resistance of worked material.

POL code 1 indicates an absence of polish, 2 matte, diffused polish, 3 bright polish on isolated regions of the UE, 4 a brilliant, vitreous-appearing polish reflected from surfaces where rugosities have been worn down almost entirely at 100x - 200x, 5 polish of any nature somewhat obscured by unknown substances adhering to the polished area, 6 mixed matte and bright polish, 7 mixed matte and vitreous polish, and 8 mixed bright and vitreous polish.

Most UEs (12, or 75% of 16 UE functions) were most commonly encoded as POL state 3, indicating well-developed polish on isolated UE regions. The remainder bore matte polish, mainly on the numerous butchery implements, or mixed matte and bright polish, as in the case of the numerous woodshavers.

This variable appears indicative of duration of use as well as nature of the worked material. In experimental butchery implements, a vitreous polish (code 4) is never attained, as the raw material is too yielding to abrade the stone surface, resulting in matte polish over relatively large areas (code 2). However, on experimental UEs used to work bone/antler, vitreous polish could form after extensive use; this is not seen in the usewear sample; the same applies to woodshavers. These facts suggest that most of the sample UEs were used for a moderate period; long enough to develop polish, but not long enough to develop polish reflective of long use. The numerous hidescrapers are an important exception. Their UEs typically bore a very dulled edge with a bright, marginal polish, as well as rather extensive resharpening -- in sum suggesting long use of the UE.

This is an example of how several UE usewear characteristics must be considered in unison for fruitful interpretation; reliance on any one variable alone would be unwise.

PIV

PIV indicates polish invasiveness, the extent to which polish is found medially of the UE edge. PIV code 1 indicates absence of polish, 2 marginal polish not extending beyond the smallest microflake scars, 3 medium invasiveness of polish, extending as far as most microflakes, but not beyond, 4 invasive polish found beyond most microflake termini, and 5, polish obscured by unidentified materials adhering to the UE.

PIV variable states are highly variable. Butchery implements (only one UE functional type, but containing 105, or 16% of all UEs) often had no polish, though when it was present, indicated by POL, it was typically matte, and then, normally invasive. Marginal polish was typically found on UEs assigned to edge-transverse work actions, such as scraping and perforation of bone/antler, hide and wood, accounting for 31% of all UE functional types (containing 257, or 41%, of all UEs). More invasive polish was typical of UEs assigned to bone/antler perforation and shaving, hide-cutting and wood graving, shaving and perforation, a group of UEs accounting for 44% of the UE functional types and 210, or 34% of all UEs. A significant number of UE functional types (4, or 25% of all UE functional types) and UEs (47, or 7% of all UEs) were assigned code 5, indicating that while polish reflectivity (POL: see above) was identifiable, unidentified matter obscured the polish such that the average extent of polish invasiveness could not be identified. This matter was left in place for future study (it was not removed by routine cleaning of the lithic item, as described in Section 4.1.4). Sometimes the polish was obscured by labeling paint used to number artifacts, and lab personnel should be trained to put such labeling well away from potential UEs.

Polish invasiveness appears to vary predictably both with the resistance of the worked raw material and work action. More resistant worked materials come into contact with smaller portions of a UE than more yielding materials, and thus in edge-transverse work actions the polish is typically marginal on scraping UEs. On butchery UEs, where polish has formed, and on hide-cutting UEs it is moderately invasive, as the UE is immersed in the material being worked, flesh or hide. The most invasive polishes can come from contact with such materials, or in the case that an edge-longitudinal action (e.g. sawing) or edge-oblique action (e.g. shaving) is executed on resistant rather than yielding raw materials. In sawing, the UE edge in most contact with the raw material may be blunted and continually broken away during work, leaving few stable elements to develop a high polish: on surfaces more towards midline, however, polish patches commonly develop as these surfaces abrade the channel being cut into wood, bone or antler. In the case of shaving bone/antler or wood, polish is somewhat invasive as the low angle of UE attack exposes more surface area to the worked material.

In sum, polish invasiveness can be indicative of work action and/or the density of the worked material: other characteristics of UE morphology and wear traces must be used in conjunction with PIV to assign a UE function.

POC

POC is polish continuity, or the degree of isolation of polishes on the UE. POC code 1 denotes an absence of polish, 2 isolated 'islands' of polish on a field of rugosities, 3 polish 'islands' joined by narrow, irregular ('ropy') bands of polish on ridges between polish 'islands', 4 contiguous, large polished areas =>1mm^2, and 5, a mixture of isolated and contiguous polished areas.

Most POC observations returned code 3, isolated islands of polish connected by irregular bands of polished stone: such was found to characterize 11 (69%) of the UE function types, including a wide variety of work actions and worked materials. This group (containing 594, or 96%, of all UEs) includes bone/antler gravers, saws and scrapers, butchery implements (in the rare cases where polish was developed) hide cutters and scrapers, and all woodworking UEs aside from perforation. Most of the remaining UEs are perforators of hide, wood and bone/antler, which typically had either mixtures of contiguous and isolated polishes, or simply isolated polish patches.

POC did not, then, vary consistently with work action (except for the case of perforators: see below) or worked material. I believe POC is more indicative of duration of work: experimentally, I have observed contiguous polishes develop on UEs used for nearly all work actions and on all worked materials more resistant than hide. Typically, islands of polish first appear as the larger UE rugosities come into contact with the worked material; weak UE elements are worn away, becoming polished with time, and eventually contiguous areas >1mm^2 are polished. In the case of perforators and some graving implements, polish typically must form as islands as it is restricted to surfaces (ridges between bit facets) that come into most contact with the normally rather dense wood, bone and antler worked. POC, then, as noted above, must be used in conjunction with other wear and UE morphology data to assign a UE function.

STR

STR indicates the typical orientation of striations on the UE. STR 1 indicates an absence of striations, 2 striae parallel with the long axis of the UE, 3 striae oblique to the UE, 4 perpendicular to the UE, 5 apparently randomly-oriented striae and 6 any combination of the above.

Most UEs did not bear striae, with 13 of 16 UE function types (81% of UE function types and, numerically, 603 UEs or 97% of all UEs) typically coded as state 1. Most striae were found on bone/antler gravers (normally oblique striae) and perforators (normally perpendicular striae); the single plant-cutting UE bore oblique striae. These latter three configurations fit the expectations of the work action suggested by UE morphology: perforators rotate around their long axis, and edge-perpendicular striae are generated; gravers delve into a raw material, but with a moderate angle of attack to allow the user to view and control the incision, generating oblique striae. The oblique striae on the plant-cutting implement are also typical, as in experiments it has been noted that when a blade is drawn through plant material, oblique striae are most commonly generated.

In experiments it was clear that striation orientation can be a very useful indicator of work action as e.g. edge-transverse actions typically generate edge-perpendicular striae, edge-longitudinal actions typically generate edge-parallel striae, and edge-oblique actions typically generate edge-oblique striae. However, striae develop at different rates for a variety of reasons. They develop rapidly if a gracile UE is being 'broken in', and bits of lithic broken from the implement are rolled and crushed between the worked material and the UE particularly when dense bone/antler or wood are being worked, but slowly if the raw material is yielding such as flesh, the UE has been stabilized for the reason just mentioned, or if an implement is simply used for a short period.

Above it was noted that many of the examined UEs were somewhat dulled, suggesting that UEs may have been used more than once; this is supported by polish development scores (POL) and it is reasonable to say that most UEs were used for a moderate period, though not to exhaustion. The lack of striae on most of these UEs is not a contradiction to this generalization, but an indication that UEs were generally stabilized, probably by edge modification, before use. The overall impression, based on these lines of evidence, is that most of the Meier and Cathlapotle implements were briefly shaped by pressure-flaking, to remove weaknesses, and then used for a period long enough to generate islands of polish, but not striae.

MF1

MF1 codes for the modal location of microflake scars (hereafter microflaking). Microflakes larger than 4 mm^2 were generally attributed to pressure-flaking, and the following observations were made on microflakes typically <=1mm^2. Code 1 indicates that microflaking is absent, 2 that it is unifacial, 3 that it is bifacial, 4 and 5 that microflaking occurs on one or opposed facets of a projection or point, respectively, and 5 that microflakes are found in some UE areas unifacially and in some areas bifacially.

Microflaking was almost ubiquitous, except for absence on some butchery implements and two major groups are evident. Unifacial microflaking was most commonly encountered on UEs assigned to edge-transverse work actions, including scrapers of bone/antler, hide and wood, as well as some gravers; this group accounts for 6 UE function types (37% of UE function types), and 284 (46%) of all UEs. Bifacial microflaking was also common, occurring most commonly on bone/antler gravers, wedges and saws, butchery implements, some perforators, and wood saws and shavers; this group contains and is composed of 9 (56%) UE function types containing 323 (52%) of all UEs.

Clearly, microflaking location generally can be used to distinguish between edge-transverse and edge-longitudinal work actions. Edge-transverse work actions stress one face, and break flakes off the opposite face; edge-longitudinal work actions allow the UE to roll around the axis of effort, alternately pressuring and flaking both ventral and dorsal UE faces. Edge-oblique actions, such as shaving, commonly subject the UE to forces from both facets, as the UE is immersed in the raw material and snags are occasionally encountered; this typically generated bifacial wear. Pointed implements, such as gravers and perforators, develop unifacial microflaking when the axis of rotation is one-way, and bifacial flaking when it is two-way (e.g. the bit is twisted one way, then, continuing to exert force, twisted the opposite way). The Meier and Cathlapotle perforators most commonly bore bifacial microflaking, indicating a preponderance of two-way rotation.

In analytical terms, MF1 is most reflective of work action, as described above. The fact that the many unifacially-microflaked UEs are generally as dulled and edge-prepared as the bifacially-microflaked UEs (see discussions above) suggests that unifacially-microflaked UEs were used uni-directionally. This suggests that UEs were considered and/or designed for a specific purpose, and then used for that purpose, rather than being used for quite different tasks. This inference will be returned to below.

MF2

MF2 reflects the continuity of distribution of microflakes on the UE. MF2 code 1 indicates absence of microflakes, 2 indicates continuous microflaking, in which scars cut into previous scars, 3 indicates microflakes close to one another, often with shared flake ridges, but not cutting into one another, 4 that microflakes are unevenly distributed, separated from one another by at least 1 mm, 5 that clusters of microflakes are arranged as in state 4, and 6 that there is a mixture of microflake continuities.

Most UEs exhibited microflaking and microflake scars, almost regardless of worked material or work action, were normally continuous on the UE, but not often overlapping (code 3). This group is composed of 14 of the 16 UE functions (87%) and contains 514 (83%) of all UEs. The remaining UEs were most commonly marked by microflakes separated by at least one millimeter, on UEs attributed to butchery and the single hide perforator.

MF2 is thus found to be largely reflective of some variable other than work action or worked material, as code 3 is found across all UE function types. Based on experiments, it appears to reflect the specificity of work action of the UE best. In experiments it was repeatedly found that UEs used for any action on any material go through an initial period of 'stabilization', in which weaknesses are broken away and the UE becomes in a sense 'optimized' for a task. After this, if the UE continues to be used for the same task, it generally does not change radically, but begins to accumulate (a) polishing and striations and (b) occasional microflaking resulting from 'snags', unexpected forces on the UE resulting from its hitting any sort of rugosities in the worked material. Only if a new work action is initiated do redundant traces of new forces applied to the UE appear. That most UEs have contiguous but not overlapping microflake scars suggests that they were stabilized (sometimes by pressure-flaking, sometimes by abrasion and sometimes by use, and sometimes by all three) and were subsequently used for the same general tasks through time.

MF3

MF3 indicates the nature of microflake scar terminations. MF3 code 1 indicates an absence of microflake scars, 2 that most are feather-terminated, 3 that feather-terminations with indistinct ends predominate, 4 that most are hinge-terminated, 5 that most are step-terminated, 6 that most are shear or snap-terminated, 7 that there are multiple overlapping microflake scar termination types, 8 that feather and hinge terminations predominate, 9 that feather and step terminations predominate and 10 that hinge and step terminations predominate.

Table 17 indicates that many UE function types (9 of 16, or 56%) and UEs (484, or 78%) are code 8, with roughly equal amounts of feather and hinge terminations encountered on UEs attributed to scraping bone (though this is the only code 8 mode for bone/antler), cutting hide, scraping hide, and all woodworking actions. This is in contrast to the microflake terminations most common on UEs attributed to working the more resistant bone/antler, which typically code 9 (feather and hinge) for gravers and perforators, 10 (hinge and step) for saws, and 7 for wedges (communition, as in crushing of the UE). The remainder is dominated by the feather-terminated microflake scars common to UEs attributed to butchery and hide perforation.

Microflake termination appears to be a rather useful criterion for discriminating between flesh, bone/antler and wood as worked materials. This is expected from general usewear studies (Vaughan 1985, Yerkes 1987) as well as experiments performed in this study. The fact that most UEs do not have a chaotic mixture of termination types, along with several lines of evidence suggested above, fortifies the inference that UEs were optimized for certain tasks, and then somewhat dedicated to those tasks, rather than used interchangeably for other tasks.

MF4

MF4 indicates microflake size. Code 1 indicates an absence of microflakes, 2 that small (<1 mm^2) microflake scars predominate, 3 that medium (<2 mm^2) microflake scars predominate, 4 that large (2.1-4.9 mm) microflake scars predominate, 5 small and medium, 6 small and large, 7 medium and large and 8 the presence of macro-fractures (>5 mm^2).

As with variable MF3, MF4 states fall into two general categories: state 5 (small and medium-sized microflake scars) on all bone/antler-working UEs (37% of UE function types and 62, or 10%, of all UEs) as well as wood saws and wood scrapers, and state 2, a preponderance of small flake scars, on the bulk of the remaining UEs, including the many butchery UEs and the most numerous woodworking UEs, wood-shavers.

MF4, then, may be used as a general indication of the resistivity of worked material, with a trend towards larger (though still medium-sized) microflake scars on UEs used on the hardest worked materials (bone/antler) and smaller scars on UEs used to work wood and flesh.

TRJ

TRJ indicates the most common trajectory of microflake scars medially from the UE terminus. TRJ code 1 indicates an absence of microflake scars, 2 that most are perpendicular to the UE, 3 that most are oblique to the UE and 4 that there are both perpendicular and oblique microflake scars.

TRJ states generally form two groups; those UEs with perpendicular (code 2) microflake scars (basically, all scraping UEs as well as some gravers and some perforators), composed of 7 (43%) of all UE function types, and 280 (45%) of all UEs, and those with oblique and/or oblique and perpendicular scars.

TRJ generally discriminates between edge-perpendicular and edge-longitudinal work actions, largely regardless of worked material.

4.3 Summary Comments on Work Actions, Worked Material and Activities Identified in the Usewear Analysis

Summary comments may be made regarding the activities as well as technological organization recorded in usewear traces on the examined UEs.

4.3.1 Work Actions

Seven work action classes were identified in the sample of items bearing UEs (Figure A155. In rank order these are scraping (41%), shaving (23%), cutting (20%); graving and sawing (6% each), perforation (3%) and wedging (<1%); the first three classes containing 520, or 84%, of all UEs. These are work actions expected of the fine grained chipped lithic assemblage examined in this study, in terms of utilitarian engineering of the lithic items on which UEs were observed. Figure 32 displays the assemblage compositions of the Meier and Cathlapotle sites by (a) gross analytical category, (b) UE function, (c) work actions and (d) worked materials. Figure 33 displays the same variables as percent within the sites.

Thus we do not find a restricted but rather a wide range of work actions. The Meier and Cathlapotle assemblages have similar variation in the frequency of work actions represented (Figure 33c). Scrapers, representing the most numerous work action as a whole, account for 26% of Meier UEs and 55% of Cathlapotle UEs: while these numbers are quite different, they are the second-ranked and first-ranked percentage scores for these assemblages, respectively. Shaving accounts for a further 24% and 22% of the Meier and Cathlapotle UEs, and cutting, 28% and 13%, respectively: all other actions are represented by less than about 10% of either assemblage. While there is important variation, particularly with regard to scrapers (discussed below), the overall pattern is similar in work actions identified between the Meier and Cathlapotle assemblages.

4.3.2 Worked Materials

Wood, bone/antler, hide and flesh were the most commonly-worked raw materials. The assemblage as a whole was used to work, by rank: wood (37%), hide (35%), flesh (17%), bone/antler (11%) and plant material (<1%). In these categories, wood, hide and flesh were most commonly represented, accounting for 562 UEs (89% of all UEs); the remainder was used to work bone/antler, with only one UE assigned to plant-cutting. Thus the usewear represents working of the most common raw materials available and expected to be worked in the Wapato valley, rather than, say, a restricted range of raw materials.

The Meier and Cathlapotle assemblages exhibit similar degrees of variation by worked material. This variation will be discussed in detail in the spatial distribution analysis (Chapter 5).

4.4 Discussion and Conclusions on the Usewear Study

First, Meier and Cathlapotle usewear characteristics are essentially identical. They reflect the working of the same sets of raw materials in the same basic work actions.

Second, most UEs were dedicated to a single basic work action, being optimized for that action sometimes by retouch, and sometimes by use which readily breaks away weaknesses. The implements are more task-dedicated than they may seem, particularly considering that few are shaped with much apparent care, the exceptions are the hidescrapers, the mule-ear knives and the finely-shaped perforators. Nevertheless, UEs were quickly stabilized and were not used for a wide, but restricted range of tasks.

Third, most UEs were used long enough to stabilize, blunt, and develop some polish, but few developed heavy polish or striations, suggesting that most were used for less than an hour. Most of the UEs could still be used efficiently today for the same functions they served in the past. That most UEs examined are not exhausted (e.g. resharpened beyond further utility, or too small to hold or use) suggests that they were found archaeologically in a context of use, rather than discard.

Fourth, the artifacts on which UEs are found are typically the size of the unexhausted (viable) cores; the mean length of the artifacts bearing UEs is 28.6 mm, compared to a mean of 35 mm for 725 viable cores in the sampled excavation units; less than a centimeter, on average, of toolstone is removed between core state and tool state. Thus, most artifacts bearing UEs are unlikely to be so reduced by reuse and resharpening that a continuum of shape and/or size, as suggested by Dibble (1984) for some lithic assemblages, need be evoked to explain morphological or size variation. Note also that the standard deviation of the length of artifacts bearing UEs was 11 mm. Rather, it appears that such variation is almost entirely related to the design concerns of utilitarian function. The Meier and Cathlapotle folk made these tools, fairly quickly and with little fuss, for specific work on specific materials, and did not often interchange artifacts for different activities. They appear to indeed have had 'mental templates' regarding the proper shape of artifacts based on an anticipated use of the implement.

The usewear study successfully identified a significant amount of usewear on over 600 artifacts, allowing them to be assigned to actions more specific than reconstructed solely on artifact morphology. Also, utilized elements were assigned to (a) different raw materials and (b) different stages of several production systems.

CHAPTER 5:
SPATIAL DISTRIBUTION ANALYSIS

5.1 Spatial Distribution Analysis Methods

As noted in section 1.4, deduction via spatial distribution analysis to test two competing hypotheses was the method used in this phase of investigation. In this chapter I outline the theory and method of the analysis and present my findings, which are synthetically discussed in Chapter 6.

5.1.1 Hypotheses and Test Expectations

Much of this study has necessarily been inductive and exploratory, concerned with characterizing the range and nature of activities carried out in the Meier and Cathlapotle sites. This has been accomplished in part by the usewear analysis discussed above; these results may be added to other data reflecting production activities for a fuller understanding of labour organization, as will be seen below.

When these descriptive data were assembled, it became clear that it was also possible to investigate more deductively the organization of labour by evaluating hypotheses about that labour organization. This could be done because exploratory analyses had generated multiple and independent data sets with frequencies (raw counts) sufficient for statistical examination.

Two alternative hypotheses were evaluated in the spatial distribution study described below. They are:

(a) social rank strictly defined production activities measured by this study

and

(b) social rank did not strictly define production activities measured by this study

Note that nothing is implied about which social ranks were engaged in which activities.

Test implications are what one expects to observe empirically under different hypothetical conditions, e.g. hypotheses (a) and (b) above. Empirical tests should be conducted using data generated specifically to evaluate these hypotheses, which include sampling and data-class concerns. Sampling and site-formation processes have been discussed above, and data-class selection is discussed below in Section 5.1.2 Material Correlates of Behaviour.

The test implication for hypothesis (a) is that material correlates of production activities would be significantly spatially heterogeneous among analytical units because plank house residents of different social ranks were engaged in different production activities. The test implication for hypothesis (b) is that material correlates of production activities would be significantly spatially homogeneous among analytical units because plank house residents of different social ranks were engaged in the same production activities.

The selection of methods to evaluate these hypotheses is discussed below in sections 5.1.4 and 5.1.5. Here it is sufficient to state that the alternative hypotheses mentioned above could be evaluated by a single test, which would characterize spatial distributions in terms of homogeneity or heterogeneity. If a test showed that some material correlate of production was significantly heterogeneously distributed, this would support hypothesis (a); homogeneity (in test terms, the null hypothesis) would support hypothesis (b).

The site-formation process study was undertaken primarily to identify factors which could result in equifinality in this regard. If it had been found that there were cultural practices (e.g. differential storage or discard of artifacts among house zones) or natural agents (e.g. burrowing animals) that could have systematically moved artifacts among the North, Central and South analytical zones of this study, then there would be several ways in which artifact differences by analytical zone could occur. However, as shown in Chapter 3, this is not the case, and there is good reason to believe that the artifacts reflect the activities of each plank house zone's population.

Also, as noted in Chapter 2, the plank house long axis was socially charged, and it is the working hypothesis of the WVAP that social rank differed significantly by a peer group's residence location on this long axis. Thus, if artifact frequency variation cannot be accounted for by (a) cultural, natural or analytical site formation processes and (b) social rank differed on this long axis (these points having been supported above) we may suggest that such variation reflects activity variation by social rank.

Thus we may go on to examine the material correlates of those activities to characterize labour differences by social rank.

As will be seen below, the spatial distribution of a wide variety of independent, production-related variables was examined to evaluate these hypotheses: some variables were found to have inadequate data frequencies while others are abundant. No single line of evidence was used; rather, multiple lines of evidence are synthesized to characterize production at and within these sites.

5.1.2 Analytical Units and Material Correlates of Behaviour

In this study test expectations were evaluated by observing the spatial distribution of material correlates of ancient behaviour representing different production activities within specified analytical units representing different social ranks.

Two sets of analytical units were used in this study. The first set simply divides the assemblage into sites: Meier and Cathlapotle. These are compared to investigate gross characteristics of the two sites. The second set of analytical units specifically targets the long axes of the sampled plank houses, because these axes are believed to represent some form of 'social gradient' (as discussed in Section 2.3, **The Social Plank House**), with people of different social ranks occupying different areas of the plank houses. Thus, North, Central and South analytical units or zones were developed and sampled to represent these differing peer-groups' activities in terms of the material correlates of those activities.

The North, Central and South analytical units are the smallest analytical units of this study; each contains all of the data classes being examined in a given test. Table 11 indicates which excavation units were assigned to which analytical units.

In each statistical test, the spatial homo- or heterogeneity of production-related material correlates of behaviour were examined. Rather than rely solely on the usewear data I wished to characterize the distributions in as many useful ways as possible to identify recurrent patterns as well as unexpected deviations from patterns. In this effort I generated nine groups of data containing 82 variables; some of these include the usewear data, while others were completely independently generated. Eight of the nine groups are directly reflective of production activities, while one group deals largely with sample characteristics. Variables include single utilized element assignments (e.g. 'hide-scraping'), single artifact types (e.g. 'freehand lithic core'), the condition of artifact variables (e.g. 'exhausted core') and summary labels with scores derived from several artifact types combined (e.g. 'stone-working stage 1' which includes lithic raw material and viable cores).

Tables 11 to 15 are a master record of material correlates used in this study.

5.1.3 Nine Data Groups and their Membership

The nine groups and their membership are discussed below in terms of definitions and potential for use as representatives of production which may be used to evaluate the hypotheses introduced above.

Table 18 identifies the nine data groups and their memberships; it also identifies the members of variables within groups, when those variables contain more than one data class. For example, the variable LIT STOR, in Group 4, represents the storage of lithic raw material, representing an early stage of lithic production: the score for that variable per analytical unit is generated by summing all lithic manuports, lithic raw material nodules and viable (non-exhausted) lithic cores. In Table 18, House Sum indicates the sum for observations in the North, Central and South analytical units of the Meier sample and the Cathlapotle House I and House IV samples. House Unit Average indicates the average number of a given variable found in an excavation unit, regardless of whether it is from Meier or Cathlapotle.

Group 1: Gross Sample Characteristics

These represent characteristics of the lithic usewear sample. SAMPLE indicates the number of items examined in the sampled plank houses. The usewear examination first divided the lithic sample into several gross categories; these are SAMPLE (the number of artifacts in the usewear sample -- discussed above), UE (utilized elements, also discussed above), INDET items (too small and/or fragmentary to retain usewear, and/or to be analyzed), UU items (items shaped for use, but bearing no usewear), BPC items (bipolar cores: these were simply added to the existing bipolar core counts), CORE items (freehand cores, also simply added to the existing core assemblage) and PF's (production failure; items clearly broken in the process of being shaped into projectile points, based on their morphology).

Group 2: UE Function Categories

These are assignments of wear characteristics to the 16 identified UE Functions described in Chapter 4. They represent the specific activity represented by individual utilized elements of lithic implements; they do not include shaped but unused items. Because most excavation units contained less than five of most of these artifact categories, they are sometimes added to other data classes to investigate production activity (as discussed below). While most have low counts, making even the simplest statistical test invalid, some have counts sufficient for statistical characterization. If these are found to be heterogeneously distributed, one could support the hypothesis that labour was organized by the very specific activities identified by each UE function.

Group 3: UE Work Action Categories

These are the assignment of the UEs to the main work actions identified at Meier and Cathlapotle, being graving, perforation, sawing, scraping, shaving, wedging and cutting. If these variables were found to be highly heterogeneously distributed, we could support the hypothesis that labour was strictly organized according to work action.

Group 4: Lithic, Bone/Antler, Wood and Hide Chaine-Operatoires

The chaine-operatoire approach to artifact analysis examines the material correlates of different stages of production sequences (for an introduction see Grace 1997). It allows the analyst to dissect a production sequence and may identify patterning not identified in less-sensitive methods. Essentially, this approach identifies the stages of production of a given artifact or raw material type, largely through experimental replication studies, and examines the distribution of the products of the different stages of production. All other things being equal (e.g. site-formation processes accounted for, and used to design sensitive sampling strategies, as in the present study), the spatial organization of labour may be revealed. The approach is thus particularly useful for the present analysis.

Chaine-operatoire sequences for the main materials worked by the Meier and Cathlapotle folk were reconstructed with a wide variety of data, including replication studies and archaeological inference. These production sequences were found to be largely reductive, or at least their main reduction stages could often be identified archaeologically in these assemblages. Chinookan chaine-operatoires as observed by this study were represented by five main stages: (1) gathering and storage of raw material, (2) an early reduction stage (Production Stage I), (3) a later reduction stage (Production Stage II), (4) a use stage and (5) an exhaustion / end of uselife stage. These are commented on below; specific variable memberships are tabulated in Table 19.

In the lithic production system gathering and storage (LIT STOR) are represented by CCS raw material in the form of unused cobbles (manuports) as well as raw material items including tested cobbles (items with less than three flake scars) and viable freehand lithic cores (those >3 cm in maximum dimension, thus meeting or exceeding the average chipped lithic artifact size). Bipolar cores, frequently found at Meier and Cathlapotle, are expected to represent a later stage of reduction, discussed below. In the bone/antler production system, gathering and storage (BASTOR) are represented by unutilized metapodials used to make wedges, chisels, and all splinter-derived items, such as points, bipoints and perforators; ulnae for the common ulna awls, and antler elements (e.g. tines). In the wooden artifact production system, gathering and storage are unrepresented as wood was not preserved at these sites in analytically useful quantities, excluding it from this study. Lithic projectile points are representative of collection of animals yielding the hides used in the hide production system (HIDESTOR), and are therefore considered representative of gathering and storage for that production system. Note that these points would also have been used to gather bone and antler from land mammals (see Rahemtulla and Hodgetts 2001), as well as to procure food, but since bone/antler gathering and storage were relatively well-represented, and hide-gathering has only this material correlate, the present assignment was made. The analytical significance of lithic projectile points is further discussed in several sections below.

Reduction Stage I

Reduction Stage I is essentially the division of a given resource into more manageable items for further reworking. 'Precision tools' are not required or used in this stage, which is evidenced by, for example, the large hammerstones (c. >8cm in maximum dimension) and bone/antler wedges for splitting wood into planks. At Meier and Cathlapotle it is clear that this consisted of the production of generic blanks with grossly different characteristics such as CCS flakes versus angular items, or bone splinters versus beveled metapodials. These blanks were occasionally stored, but are not prominent in the artifact assemblage; it appears they were relatively soon converted, in Reduction Stage II, into more specific shapes for specific work activities.

In the lithic production system, reduction stage I (LITRED 1) is the initial disintegration of cores, producing flakes and angular fragments further shaped in Reduction Stage II into common CCS tools. This stage is represented by lithic anvils (on which bipolar reduction takes place) and large hammerstones (size classes 3 and 4, that is, larger than 10 cm in maximum dimension); it is also represented by G1 and G2 debitage (items larger than 1/2" in maximum dimension). Since counts of these artifacts are often very high compared to those of cores and anvils, and tend to ‘swamp’ such scores analytically, debitage sizes are examined in Group 6. In the bone/antler production system, Reduction Stage I (BARED 1) is the initial splitting of bone and antler items into splinters and tablets which are shaped in Reduction Stage II into common items such as points and chisels. This is represented by lithic wedges used to split bone and antler and worked bone and antler items, which are often marked with longitudinal or transverse grooves, clearly the result of early-stage bone/antler artifact production, perhaps in preparation for the 'groove-and-splinter' technique. For specifics see Davis 1998 on the Meier worked items; generally, see LeMoine (1994) regarding bone/antler artifact production. Note that lithic gravers are not assigned to this stage of reduction, as all observed gravers' UEs were too gracile for such heavy work. In the wooden artifact production system, Reduction Stage I (WOOD RED 1) is the division of wood stocks into manageable units; this work would include the use of bone and antler wedges, which are too large to split any other conceivable raw material in the Lower Columbia and too soft to work bone, antler or stone. In the hide production system, stage I (HIDERED1) is represented by lithic scrapers with hide-scraping usewear; these items were used to remove fascia from the ventral surface of hides, an early stage in the working of hides.

Reduction Stage II

Reduction Stage II is essentially the working of the 'blanks' generated in Reduction Stage I into shapes specific to certain activities. This stage requires production tools that afford the craftsperson more control, and they are often smaller (e.g. hammerstones less than 8 cm in maximum dimension), have less robust working elements than those used in Reduction Stage I and may have been hafted for greater control of the utilized element (e.g. perforators).

In the lithic production system, Reduction Stage II (LITRED 2) is the retouch of flakes and angular items into desired final shapes. This is represented archaeologically by G3 and G4 debitage (that, is less than 1/2" in maximum dimension, many items of which are pressure flakes), but for the reasons noted above, debitage is again dealt with separately, in Group 6. In the lithic chaine-operatoire, stage II is represented by small hammerstones (less than 8 cm in maximum dimension; size classes 1 and 2 in this study), as well as by viable bipolar cores, viable freehand cores and projectile point failures. In the course of study it was clear that projectile points were found in all areas of the plank houses, and because they represent the most numerous artifact type at these sites (n=3,067 or 13% of the 23,463 items found at Meier and Cathlapotle, respectively) and they are not amenable to differential preservation, their production and use is particularly important to understand. For these reasons I consider projectile point failures an unambiguous signal of Reduction Stage II, that is, pressure-flaking. These items are normally projectile point tips without the communitive crushing of the distal end usually resulting from impact (see Shea 1991). They are essentially identical to the tips I have broken off of experimental points during final pressure-flaking.

In the bone/antler production system, Reduction Stage II (BARED 2) is the shaping of splinters and tablets of bone and antler into points and bipoints, as well as the beveling of metapodial and other items. Thus, lithic abraders may be assigned to this activity, though they are also used to infer wooden artifact Reduction Stage II. Unfortunately, currently there is no way to discriminate between their use on wood, bone or antler, but in experiments I found them very useful in reducing all of these raw materials, and it is likely that the Chinook similarly used them to work any raw material. Certainly, they were not regularly used to work stone, or hide, or to cut flesh in butchery, or for other extractive tasks (see below) and I consider it analytically safe to assign them to both wood and bone/antler reduction Stage II; they were not used in the earliest reduction of these raw materials, or on any other raw materials (e.g. flesh or hide) and may by default be considered indicative of Reduction Stage II. This stage is also represented by all UEs referable to bone/antler contact, as all UEs were relatively gracile when one considers the heavy-duty work carried out in bone/antler Reduction Stage I. The absence of artifacts attributable to this stage may reflect the use of metal in Stage I: the issue is unresolved. In the wood-working production system, stage II (WOODRED 2) is represented by bone and antler chisels (too soft to work stone, too hard and large to work bone/antler) used to shape items pieced apart in Stage I, and all UEs attributed to woodworking in the usewear analysis. In the hide-working production system, Reduction

Stage II (HIDERED 2) is indicated by lithic tools bearing hide-cutting and hide-perforation wear, as well as bone and antler perforators. Based on my experiments, these perforators are too delicate to be used to perforate bone, wood or antler, and I conclude they are most indicative of this stage of hide-working.

Use

Use is the employment of finished implements. In the lithic production system (LIT USE) this score is the sum of all lithic items in a given analytical zone, including utilized and unutilized but shaped items. Following suit, in the bone/antler production system (BAUSE) this score is the sum of all bone and/or antler implements. Since wood and hide were not systematically well-preserved at these sites, their use cannot be estimated in this study, and USE variables do not exist for wood and hide.

End of Uselife

This is the final stage of production, in which artifacts are so worn that they are no longer viable. This is only archaeologically detectable, in this study, in the lithic production system (LITEND) where exhausted cores (freehand and bipolar) are clear indicators of the final stage of production. Since lithics were well-preserved at these sites, they are the focus of much discussion (see below). It is important to remember, however, that they are one element of the production system, and that other elements (working bone, antler and wood) can be fruitfully investigated, as they are in this study.

Group 5: Lithic Production Details.

This group tracks lithic production in finer detail than the chaine-operatoire approach above; it was generated partly to take advantage of data collected for other reasons but available for analysis at the time of this study. The group also contains data classes generated specifically for this study. Because lithics are the least-likely items to be affected by differential preservation, and because their production stages are rather well-known, and they are abundant, I examined them more closely than other raw material categories. These items are all crypto-crystalline silicates, typically cherts, used in most chipped-lithic production at Meier and Cathlapotle.

Lithic manuports (MANUPORT) are items brought to the site; some are unmodified nodules, while others have more than one but less than four flake strikes. They are expected to represent the storage of raw material. Viable cores (VIABLECORE) are lithic cores which are >=30 mm in maximum dimension, which could be productively flaked; they are all freehand cores (FREECORE), as bipolar cores (BIPOLARCORE), even though they may be viable, are expected to represent a later stage of production, when cores are being worked in their late, small state and must be fractured with the bipolar method because they are too small to be held in the hand. Viable freehand cores are expected to represent early-stage reduction of lithic raw material. Exhausted lithic cores (EXCORE) are <30 mm in maximum dimension and/or could not be any further productively flaked. They are considered to represent a much later stage of production, as are the mentioned bipolar cores. Note that bipolar technique may be used early in the manufacturing process if the core material is small and/or rounded, so that the analytical utility of these items may be unclear; this is discussed further below.

Lithic projectile points were examined and found to be divisible into whole points (WHOLEPOINT), representing the storage of points to be used, points broken during manufacture (PF in Group 1 and POINTFAILURE in the present Group 5), being small bifaces, typically laterally truncated by an erroneous pressure-flaking-derived hinge fracture (indicating point production), and points broken by use (BROKENPOINT), evident by distal crushing, lateral snapping of the tip and fracturing most likely resulting from use (indicating use of projectile points in the activity for which they were designed).

Hammerstones were divided into small groups (SMALLHAMMER size 1 and 2, all being <8 cm in maximum dimension) and large groups (LARGEHAMMER size 3 and 4, all being >8 cm in maximum dimension); the 8 cm division was a qualitative decision based on my own replication experience in which I have found that hammers less than 8 cm are of little use for core initiation, and that hammers over 8 cm are inappropriate for secondary product (core or flake) reduction on the scale of the Chinookan assemblages of this study. Thus, the larger hammerstones are expected to represent earlier stages of reduction, while smaller hammers represent later stages. Major spatial heterogeneity of these broad classes may well identify a production system in which different core-opening stages were engaged in by different plank house populations.

While hammerstones could be used for a wide variety of purposes, all bore some traces of surficial crushing and pitting consistent with use as a hammer on raw materials of similar density, such as stone. Most are quartzite, with a typical Moh's scale hardness of 7 to 7.5, while most cherts have a Moh's hardness of 6.5 to 7.5.

Group 6: Debitage Details.

As mentioned above, debitage sizes are expected to reflect different stages of production. While there remains considerable debate over some aspects of debitage analysis, it is generally true that the later stages of lithic reduction produce more small debitage, and that earlier stages, while also producing some amounts of small debitage, are the only stages which can produce the largest pieces of debitage. In a general sense, then, G1-G4 debitage frequencies (see Table 18 for definitions), from largest (G1) to smallest (G4) can be used to investigate production organization: if they are heterogeneous, different people were working on different stages, in a 'conveyor-belt' fashion (e.g. population A opens the core, and then gives it to population B, who reduce the core). The variable DEBITAGE simply records the total of all debitage items, as a measure of the degree to which a given analytical unit's population was engaged in debitage production, or, that is to say, lithic production. Remember that in **Chapter 3**, **Site Formation Processes**, I investigated and outlined the main trajectories of artifact movement within the plank houses, concluding that for a variety of reasons, we may be confident that where we excavated artifacts is close enough to their point of storage, ownership and/or use to be considered analytically viable. This applies to debitage, a type of hindering debris commonly specially treated within domestic structures, as well as to finished artifacts.

Group 7: Major Raw Material Production Stages.

These are production stage classes composed of sets of variables. They are similar to the chaine-operatoire classes but sometimes add or remove data classes to the chaine-operatoire schema. These are more inclusive variables that may be used to test or temper the results of the chaine-operatoire study.

STONE1 includes all lithic manuports and raw materials, but does not include opened cores or shaped tools: it is meant to track storage only, and no trace of use is implied. STONE2 is composed of larger hammerstones, anvils and viable but unutilized cores: it is meant to track early-stage reduction. STONE3 includes size 1 and 2 (<8 cm) hammerstones and broken projectile points, all surely representing the later stages of lithic production. WOOD1 represents wood storage, and was deleted from study for reasons noted above: it is indicated by NA and should be ignored. WOOD2 is the reduction of wood with bone and antler wedges, like WOODRED2, but with the inclusion of a few (n=3) woodworking saws. The latest stage of woodworking, WOOD3, includes 99% of all woodworking UEs, as well as antler and bone chisels, lithic abraders, lithic adzes and celts, as well as unused but shaped items assigned to the UU SHAVER class (discussed above). All models for BA1, the earliest stage of bone/antler production, were found to be flawed, having very few representatives of the earliest stages of bone/antler working: as mentioned above this may be due to metal tools being used to work bone and antler, even before the typically-accepted contact date of 1792 AD: note that nonmeteoric iron, presumably from an Asian vessel, was dated to c. 1400 AD at Cathlapotle. Whatever the reason for this absence, I apply NA in this category as well. BA2 is not so impaired, and clearly indicates secondary-stage reduction of bone and antler with lithic wedges and unused, but shaped lithic wedges used to split bone and antler; unfortunately, only seven of these were recovered in the plank house samples. BA3 contains all bone/antler UEs and lithic abraders. HIDE1 is the gathering of mammals for hide, and is represented by lithic projectile points: this is discussed further below, as these points could have multiple functions in terms of the animals and resources collected with them. HIDE2 is very clearly the reduction of hides by scraping, incorporating the numerous hide-scraping UEs which are functionally very diagnostic: it is identical to HIDERED 1. HIDE3, like HIDERED2, contains bone and antler perforators, as well as hide perforators and cutters, but also includes shaped but unused

(UU) hide-cutters and perforators. As above, spatial heterogeneity observed in these categories may indicate the organization of production by gross production stages. Perhaps these more inclusive categories are more reflective of the Meier and Cathlapotle production systems than are the chaine-operatoires devised above, and the 1, 2, 3 stage categories were devised in part to be compared to the chaine-operatoire data.

Group 8: Gross Worked Material Categories

These are categories of materials worked, generally in maintenance tasks, as indicated by usewear traces, unused items shaped for specific raw materials (when evident) and, in the case of STONE, a simple sum of all lithic items. They are meant to indicate in a gross manner the degree to which different populations, occupying different analytical units, were engaged in the working of such raw materials. Spatial heterogeneity here may indicate the organization of production around raw material categories.

Group 9: Gross Hunting Categories

These are categories of hunting artifacts (extraction implements) as indicated artifacts unambiguously shaped for specific targets. LINEFISH represent antler and bone points and bipoints used as armatures in fishing with a line. NETFISH is a different category, in which schooling fishes are collected with nets, represented by net weights. TERRHUNT is the pursuit of terrestrial mammals with lithic projectile points, for meat, hides, bone, antler and many other products. AQMAMM is the pursuit of aquatic mammals with harpoons, represented by bone and antler harpoon valves: unfortunately they are very rare in the sample (n=3) and are not extensively analyzed, although I do return to discuss them in section 5.2.1.9.

These categories are meant to indicate in a gross manner the degree to which different populations, occupying different analytical units, were engaged in the pursuit of different prey. Spatial heterogeneity here may indicate the organization of production; in this case, largely in the acquisition/procurement stage of any production system around basic prey animal categories.

The data categories defined above and tabulated in Tables 11 – 15 and 18 composed the raw data for the statistical evaluation of the hypothetical test expectations. Below, I discuss units of measure used to quantify these data categories before discussing statistical methods and, finally, the patterns which emerged from analysis.

5.1.4 Measures: Counts, Densities, Percentages

Several measures of the phenomena being analyzed, and methods used to analyze them, must be explicated. In addition, I explain my reasoning for not using some methods that are sometimes employed in spatial analyses, but which I discount in this study.

Counts indicate the number of phenomena in a given sample. As will be discussed below, these figures indicate the presence or absence of an artifact class in a given area, but that is all that may, analytically, be derived from them alone for analytical purposes. This is because counts are found to be strongly positively correlated with excavation volumes, and excavation volumes per excavation unit (often 2x2 m or 1x4 m) differed throughout the 89.09 m^3 of matrix excavated in the nine units composing the Meier (sample figures average = 8.63 m^3, min = 6.65 m^3, max = 10.6 m^3) and Cathlapotle (sample figures average = 10.53 m^3, min = 4.69 m^3, max =17.47 m^3) plank house samples for a variety of field reasons. Raw counts are thus unreliable indicators of ancient behaviour unless different excavation volumes in different analytical units are accounted for. This is accomplished in the main statistical method used in this study, the chi-squared test, described in this section below.

Percentage figures indicate the proportion of a given phenomenon in a constrained set of phenomena. The analytical crux here is similar to that of the procedural crux in making significance tests; in the case of the chi-squared test, assuming data are accurately collected, all rests on the expected figures. If more observations are expected to be found in a certain cell than in another, it must be accurately modelled in the expected figures, and thus the method of generating expected figures is crucial. The same concept conditions the interpretive utility of percentage figures; all rests on the internal coherence of the constrained set of phenomena expected to be observed. It is not necessary or even the point to model expected percentages, but it is crucial (in archaeology at least) that the constrained set be reflective of a real system of ancient behaviour. It would be analytically meaningless to examine the percentage composition of, say, scrapers, antler flakes and pits in a set of excavation units, unless one first demonstrated that they were part of a system of ancient behaviour.

Percentage figures are also in this study of no value for examining artifact differences across North, Central and South plank house zones, as those zones have differing excavation volumes. There is however an excellent case for using percentage figures to examine the percentage composition of the eight labour classes within each analytical zone; this indicates (a) the range of activities carried out in each zone (presence or absence) and (b) something of the degree to which those work actions were engaged in, in each zone.

Density figures indicate the number of phenomena encountered per some unit of observation: in this case, the number of artifacts found per cubic meter of excavated matrix in each excavation unit (ultimately compiled as items per m^3 in each plank house zone). Figure 34 clearly indicates that n of artifacts encountered is strongly positively correlated in both the Meier (squared multiple $r = .848$, $p = 0.026$, $F = 16.69$) and Cathlapotle (squared multiple $r = .881$, $p = 0.001$, $F = 44.23$) sampled units (the same applies to the sites as a whole, though those data are not plotted here). Thus, counts of artifacts are strongly conditioned by excavation volume, and raw counts are suspect. In this study, then, density figures indicate the intensity to which a given activity was carried out in a plank house zone.

The **chi-squared test** reports on the significance of differences between observations (O) and hypothetical distributions or expectations (E) (Snedechor and Cochran 1989). Chi-squared is used heavily in this study for several reasons: (a) it allows the use of raw counts, staying as close to the raw data as possible, (b) it allows the analyst to adjust expectations (read 'hypotheses') according to data-collection contingencies (discussed further below) and (c) it guards against the over-optimistic use of very low counts to make substantial statistical statements. In this study, I present the chi-square and *p* value for each test, rather than picking an arbitrary cutoff, such as the often-used .05 significance threshold. Where necessary, I also discuss the context and raw numbers driving the chi-square values; rather than computing Cramer's V or phi as a measure of the magnitude of difference between O and E, I prefer to stay nearer to the raw counts. This allows the identification of low counts, the significance of which I discuss below.

I use a somewhat arbitrary figure of ten to discriminate between reasonable and unreasonable counts of phenomena (read 'artifact types') per excavation unit, much less per analytical unit. While some configurations of the chi-squared test can accommodate O and/or E values below 5, I am unconvinced that five observations of any artifact type I examine (notably, all of which are related to mundane, daily production activities rather than being, say, prestige items) can really inform us of anything useful in the present contexts. As demonstrated in Chapter 3, the plank house assemblages contain thousands of artifacts each, and are composed largely of mundane items deposited in palimpsests generated over several centuries. Most excavation units in the samples contained roughly 200 artifacts (Tables 11 - 15), of which five of any type (2.5%) could easily be deposited in one behavioral episode, or swept up and removed from a given deposit in a single episode. I prefer to see at least ten items (on average, 5%) of a unit's artifact load exhibit some kind of patterning before I begin to accept that count as an indicator of some ancient behavioural trend. Even ten, considering these site-formation processes, may be suspect. For these reasons I am very careful to investigate and report the raw numbers 'driving' the statistical results, and I discount many analyses, even when they indicate 'significant' results, due to low counts. It is better to eliminate these data and insist on more reasonable data than to allow low counts to hide behind statistical procedures (e.g. chi-squared, Cramer's V or phi results reported without concern for the raw numbers which generated them).

Regression analysis, as used in Smith (1996; see also Wolf 1994) for similar spatial distribution analyses, is unacceptable for this study because (a) there are too few data points (only a few excavation units per analytical unit, e.g. North, Center or South zones) for reliable tests and (b) since raw counts can be affected by excavation volume, data must be transformed to densities, which for reasons outlined above, are of ambiguous value to this study.

T-tests compare sample distributions, requiring large data sets (e.g. more data points than the pooled North, Central and South analytical unit characterizations of this study) and are only really useful for pair wise comparisons.

Multivariate methods such as correspondence analysis, principal components analysis and factor analysis can clearly be useful in studies such as the present, but my experiences with them continually reveal that (a) they are 'far' from the raw data, involving transformations which must be 'read backwards', (b) in the current data sets, they simply reveal what is clearly evident in less complex plotting procedures and (c) they cannot account for the influence of very high or very low scores. The last point is particularly important; no matter how many transformations are conducted on a data set, low counts are low counts and they are particularly difficult to interpret. The presence (or absence) of a handful (say, less than five) of any of the mundane artifacts types in the artifact-rich contexts of the Meier and Cathlapotle sites cannot be taken to mean much at all in terms of the organization of production; a handful can be dropped in a moment, or swept up in a moment. In the multi-century palimpsests of these sites, such low numbers are unconvincing of any trend. Multivariate methods need data sets with more abundant constituent artifacts, but classes thus analyzed are often 'driven' by single artifact classes that have high counts, which 'swamp' artifact classes with low counts.

In sum, chi-squared tests, for reasons noted above, were superior to all other methods, being simple, robust, easily interpreted and applicable to raw counts often with low scores. The chi-squared test procedure and results are discussed below.

5.1.5 Tests of Statistical Significance

Statistical methods make generalizations about populations based on the characteristics of samples. Samples may be examined inductively, seeking patterns in an Exploratory Data Analysis mode, or more deductively, comparing observations with theoretical expectations (Hartwig and Dearing 1979). In my years of study of the Meier and Cathlapotle data sets I have often worked inductively, re-expressing the data many times with a wide variety of visual displays and gaining a close familiarity with the data.

In this study, I wished to specifically test observations against expectations of certain distributions.

I begin with the raw data of observations (artifacts, UEs, and so on), per excavation unit. Excavation unit scores are pooled into analytical zone (e.g. North, Central and South) scores. In evaluating different possible analytical methods I wished to (a) stay 'close' to the raw data, by not transforming them unless absolutely necessary and (b) identify a robust, well-known and simple technique that compares pooled, observed raw data, in a limited number of analytical units, with expected frequencies which may be manipulated to fit the circumstances of initial data generation. These requirements are met by chi-squared testing, discussed below after a review of some basic concepts and their relevance in this study.

A critical aspect of chi-squared testing is the calculation of expected figures to which observed figures are compared. The chi-squared test procedure allows the analyst to generate expected counts, rather than comparing observations to theoretical distributions bearing no relation to the realities of sampling or site-formation procedures.

In the tests carried out in this study, expected values were computed as a function of excavation volume. Since artifact count was shown to vary predictably with excavation volume (see above), and since excavation volume differed in different analytical units (e.g. sites, houses, house interior areas), it is unreasonable to assume an even distribution of artifacts in each analytical unit (an even distribution). Rather, we expect to observe more artifacts where more excavation took place, all other things being equal.

For example, in the Meier house sample, 78 whole projectile points were found (read 'observed') in the North analytical unit, 131 in the Center analytical unit, and 142 in the South analytical unit. If we assumed that artifacts should be evenly distributed through the site we would expected to find 33.33% of these artifacts in the North, Central and South areas each, yielding expected values of 126 in each of these areas (summing to 380 points in the sample) and generating a highly-significant chi-squared value of 20.70, at $p<.0005$. However, since we know that only 25% of the total excavation volume from which the sample was drawn was excavated in the North (with 35% excavated in the Center and 39% in the South) we are better off expecting only 90 (25%) in the North, 125

(35%) in the Center and 136 (39%) in the South. When the observed figures are compared to these more realistic expectations, we find a chi-squared value of only 2.19, which is insignificant with $p<.025$. Thus, a chi-squared test based on inadequately-prepared expected values can be as misleading as one based on poorly-tabulated observed values.

5.1.6 Synthesis

Anthropological generalizations about ancient behaviour (hypotheses) were forwarded with attendant test implications, statements of what can be expected empirically if certain conditions obtain. It was proposed that these be examined in certain analytical units, which were defined, with certain material correlates of ancient behaviour. These material correlates, often reflective of specific stages of production, were discussed and tabulated; it was emphasized that multiple, independent lines of evidence were sought, such that the usewear data generated specifically for this study were added to other data, some extant at the beginning of the analytical phase and some generated specifically for this study.

Finally, there was a search for a means of evaluating the empirical data (counts per material correlate phenomenon per appropriate analytical unit) which compose the observations of the study. A variety of measures, all based on raw counts per analytical unit, was reviewed. It was decided that the chi-squared test was sufficient to evaluate observations. The specific methods of chi-squared testing were explained. We may now move on to examine the results of these tests to evaluate the test implications, and, eventually, the proposed hypotheses.

5.2 Spatial Distribution Analysis Results

The various results of the spatial distribution analyses are presented below.

5.2.1 Chi-Squared Test Results

Tables 20, 21, 22, and 23 present the results of a battery of chi-squared tests used to evaluate the spatial distributions of a variety of material correlates of behaviour. These correlates are coded as the 82 variables (rows in the tables), introduced above. These tests, as will be seen, are concerned with the characterization of the organization of labour between and within the sites. Using an analogy forwarded by Wylie (1989), I prefer to argue with a 'cable' of inference, composed of multiple, independent strands of evidence, rather than with a 'chain' of inferential links, each dependent on the other, and in sum only as strong as the weakest link. For this reason the results of the usewear analysis, discussed above, are included here, but are not all that is examined: I incorporate the usewear data into other data sets to make use of those data sets, which it would be foolish to ignore.

In the discussion below, I examine two basic spatial distribution characteristics of each of the 82 variables noted above. First, I examine the distribution between sites, to characterize the Meier and Cathlapotle assemblages. Second, I examine distributions within plank houses, to characterize the Meier, Cathlapotle House I and Cathlapotle House IV assemblages, specifically regarding distributions on the long axes, the significance of which has been indicated above.

In each discussion I refer to the raw data, presented in Tables 11 - 15 and the results of the chi-squared test. When productive, I also discuss raw counts, percentages and other measures (as reviewed above) conditioning the variable score and distribution characteristics. Figure 35 visually indicates the results of the chi-squared tests within the plank houses; as will be seen, results of tests between the sites are very easily summarized. I also discuss the magnitudes of difference between observed and expected frequencies. Rather than presenting Cramer’s V or phi to indicate these differences, I prefer to note how different the results are in terms of % expected and observed, as well as noting the count of phenomena driving a given score. Again, this keeps the analysis closer to the raw numbers than an index value such as V or phi. I conclude each discussion with a summary of impressions. Discussion of and conclusions derived from the statistical results are found in sections 5.3 and 5.4.

5.2.1.1 Group 1: Gross Sample Characteristics

Variables: SAMPLE to PF

Between-Site and Within-Site Distributions

It is clear from Table 20 that Meier nearly always has higher-than-expected counts of artifacts of any type; of the 65 (of 82) variables not disqualified due to low counts in the chi-square tests comparing the Meier and Cathlapotle assemblages, 55 (84%) indicate significantly more than expected found at Meier, with p values typically well below .01. This does not need to be visually displayed, as it is unmistakable in Table 20.

The distribution of the lithic SAMPLE variable is typical of this general pattern, with 296 (51%) more non-projectile point fine-grained chipped lithics found at Meier than expected at Cathlapotle, a very significant distribution at $p<.0005$. UEs and lithic INDET, CORE and PF items were similarly distributed, with scores from 58% (n=117) to 178% (n=162) more than expected at Meier than at Cathlapotle. Slightly more UU items were found at Cathlapotle than expected (n=14, for 14% with $p=.02$), and there was no significant difference in the frequency of BPC items.

Figure 32a indicates the assemblage structure, in percentage figures, for Group I variables UE through PF between the two sites. These percentage displays are instructive in that they mask some of the significant differences indicated above. Fore example, while Meier and Cathlapotle UE and INDET percentages are roughly equal, above it is clear that numerically significantly more were found at Meier; this is evident in density scores, which I do not report here but may easily be calculated from raw data in Tables 11 – 15.

Discussion and Summary of Between-Site Distributions

Generally we may say that Meier clearly contains more of most Group I variables than expected: only unused but shaped lithics (UU) are more common than expected at Cathlapotle, and these number only 14 more than expected, a relatively low count from which I would not extrapolate much in terms of behaviour. Meier contained more artifacts, probably a result of differences in site-formation noted in Chapter 3; at Meier, the voluminous cellar trench was probably less-often cleaned out than the smaller Cathlapotle under-bench storage pits, resulting in higher artifact densities. That this pattern is repeated in so many variables reflecting different activities (see below) supports this reasoning. We may also say that in terms of basic organization of production reflected by Group I variables, the sites are generally identical: at each site, roughly 30% of the lithic sample had UEs, a few more were INDET items, far less were BPC's and CORES, and so on.

In sum, Group I variables suggest broad similarity in the most basic production organization activities at Meier and Cathlapotle; at both sites, artifacts are found in used and unused form.

Figures 33b, 33c, and 33d indicate assemblage structure in percentages within the Meier and Cathlapotle samples. Again, most variables from UU to PF, inclusive, are roughly evenly-distributed; that is, the assemblages within the sites are composed of roughly the same proportions of UEs, INDET items, and so on. This suggests that some basic production-related activity organization was quite similar at both sites, a fact that is commonly found throughout the following discussion.

Within-House Distributions

In the Meier plank house two Group 1 variables (BPC and CORE) are disqualified for low counts, but it must be remembered that these are only items identified in the usewear analysis, and later added to the extant counts of freehand and bipolar cores; thus there is no loss of information here. We see in Figure 35 that of the five remaining variables, three (60%) have distributions significantly different from those expected. SAMPLE (the sum of non-projectile point fine-grained chipped lithics) was concentrated in the North (23% or 52 more than expected) and Center (17% or 54 more than expected), as was UE (number of utilized elements), at 20% (n=12) and 21% (n=19), respectively. INDET items are characterized not so much by high concentrations in any analytical zone, but by being found far less frequently than expected in the North. Only PF items were distributed as expected.

In Cathlapotle House I the same variables (BPC and CORE) are disqualified for low counts, as in the Meier house. Of the remaining Group 1 variables, the same three (60%) are found to be significantly unevenly distributed, and all are concentrated in the South analytical zone. These are SAMPLE (25% or 59 items more than expected), UE and INDET (35% or 28 items and 39% or 28 items more than expected in the South, respectively) .

Cathlapotle House IV, as will be clear below, is analytically problematic due to relatively low counts of many types of artifacts. In Group 1, five of seven variables are disqualified for low counts. Both of the remaining variables were encountered significantly more frequently than expected in the South analytical zone: these are SAMPLE (45% or 50 more than expected) and INDET (33% or n=15 more than expected).

Discussion and Summary of Within-House Distributions

In each plank house non-projectile point fine-grained chipped lithics (SAMPLE) are heterogeneously distributed among the analytical zones; identical distributions are seen in UE and INDET variables reflecting utilized implements and chipped lithics likely to have been used but beyond useful analysis typically because they are so small. Thus, in sum, we may say that non-projectile point fine-grained chipped lithics, including used items which may or may not be intact, are concentrated in the Center of the Meier plank house and the South areas of the Cathlapotle I and IV plank houses.

5.2.1.2 Group 2: UE Function Categories
Variables: BAGRAV to WOODSHAV

Between-Site Distributions

These 16 variables are the basic UE functions to which each UE was assigned. Of these, nine (53%) were disqualified for low counts. Of the remaining eight variables, five (62%) were found more commonly than expected at Meier. Of these, two (BASCR and

WOODSCR) have very few (n=7 and 3, respectively) more than expected, and I discount them for this reason. This leaves BUTCH, WOODGRAV and WOODSHAV being significantly more commonly found at Meier than at Cathlapotle, on a magnitude of 85% (n=24), 147% (n=12) and 47% (n=19) more than expected, respectively.

Discussion and Summary of Between-Site Distributions

Of the variables not discounted due to low counts, butchery, wood-graving and wood-shaving implements are clearly more common at the Meier site. That these are also more prevalent within the Meier UE function assemblage than the Cathlapotle (butchery and wood-graving implements typically comprising 50% more of the Meier than Cathlapotle assemblages: see Figure 33) is an indication of a real difference in labour organization. Meier inhabitants deposited (used) more of these tools than Cathlapotle inhabitants.

This distribution could be argued to reflect the more common use of metal implements, obtained through trade with Euro-Americans, at the slightly-more-recent Cathlapotle (see Chapter 3) than at Meier, particularly because metal implements would be better-suited to butchery and wood-, bone- and antler- shaving activities than stone, and would have been adopted for these functions, deflating their UE scores at Cathlapotle. Figures 36 and 37, as crude surrogates of UE function fluctuation through time (indicating the percentage of a given excavation level's UE function assemblage), are somewhat equivocal on this point. They indicate that butchery is never as prevalent at Cathlapotle as at Meier; they do not suggest that the importance of butchery decreases at Cathlapotle through time, however, as one might expect if imported metal were used to replace native stone knives. Wood-gravers are very rare at Cathlapotle (n=5, or 17% of wood-graving UEs at the two sites) and their distribution through time in Figure 37 is impossible to analyze. These figures are returned to below. Wood-shaving implements, however, are very numerous, and are found to be consistently more important as assemblage components at Meier than at Cathlapotle through time, with the exception of a dramatic constriction in mid-occupation (this constriction has been noted in Chapter 3 and is likely a result of cleaning activity). At Cathlapotle they decrease very slightly, but statistically insignificantly, through time. Thus, in the two somewhat reliable measures of the possible influence of the appearance of metal tools at contact, neither supports the hypothesis that more metal tools were used at Cathlapotle through time than at Meier. Nevertheless, these implements were more commonly used at Meier than at Cathlapotle.

It is important that at Cathlapotle, 10% (n=11) more hide-scraping implements were found than at Meier. Though the difference is not statistically significant (p=.10), it is obvious in every measure; it is also clear in Figures 32b and 33b, indicating hide-scraping to have been more common at Cathlapotle than Meier both on between-site and within-site-assemblage levels. Over 70% of the hidescrapers found in this study were from the Cathlapotle assemblage (Table 13, variable 58), and within the Cathlapotle assemblage they account for roughly 50% of the UE functions, whereas at Meier they account for less than 20% (Figure 33b). In sum, while hide-scraping UEs are not strictly statistically significantly unevenly distributed, they were clearly more important at Cathlapotle than Meier, from beginning to end of occupation (Figure 37, indicating a clear increase of hidescrapers through time in the upper eight levels where >85% of them were excavated).

While more wood-shavers are found at Meier than expected, on further review, it is clear that they account for roughly the same proportion of the UE function assemblage (just over 20%; Figure 32b) in both assemblages.

The larger impression derived from these distributions is that the Meier and Cathlapotle UE function assemblages are broadly similar except for the clearly greater prevalence of hide-scraping implements at Cathlapotle and butchery implements at Meier. These are evidence of significant differences in the activities of the Meier and Cathlapotle folk.

Within-House Distributions

Low counts dominate the variables of Group 2 in the Meier plank house sample; only three (19%) of the 16 variables have counts suitable for statistical characterization. These are the numerous butchery implements, hide-scrapers and wood-shavers. Of these, only butchery implements are significantly unevenly distributed, concentrated in the

Center where we find 46% more than expected; this, however, is driven by a count of only eight butchery UEs, a low count I disqualify for reasons noted above. They are slightly less-commonly found in the North than expected (chi-squared, hereafter referred to as ‘x^2’=6.96, p=.050) but this difference, too, is driven by a low count (n=5) and I disqualify it as well. The remaining variables, hide-scrapers and wood-shavers, were not found to vary significantly from expected frequencies.

Cathlapotle House I has the same low-count problem as Meier, with the same 14 variables discounted for the same reasons. Of the remaining variables, only wood-shavers (WOODSHAV) are significantly unevenly distributed, with 60% (n=11) more than expected in the South and 39% (n=5) and 26% (n=5) less than expected in the Central and North analytical units, respectively.

All Group 2 variables for Cathlapotle House IV are disqualified due to low counts.

Discussion and Summary of Within-House Distributions

Of the seventeen UE functions, only butchery, hide-scraping and wood-shaving UEs were numerous enough (in two of the three plank houses) for statistical characterization. Of these, there is a weak concentration of butchery implements in the Center of the Meier house and a slightly stronger concentration of wood-shaving implements in the South of Cathlapotle House I. Both of these, however, are driven by somewhat low counts, although the wood-shaving concentration in Cathlapotle House I is preserved as its raw numbers just exceed the admittedly somewhat arbitrary minimum of 10 items required for me to accept as potential evidence for real behaviour in the past (see Section 5.1.5).

Examining proportion data (e.g. percentages of UE function assignments per plank house analytical zone) would not be productive here, as they would still be driven by low initial counts, which I cannot support. I prefer to pool UE function data with other data (read ‘lines of evidence’) to produce more inclusive variables, as described above in section 5.1.3, Nine Data Groups and their Membership.

We can summarize the Group 2 distribution data by stating that there is no compelling evidence for strongly patterned heterogeneity in the distribution of hide-scrapers, butchery implements or wood-shavers within the Meier, Cathlapotle House I or Cathlapotle House IV plank houses. These three artifact types contain 380 (167, 90 and 123 UEs respectively) or 71% of the 534 UEs of the three plank house samples, and are normally found in frequencies high enough to be considered reasonably indicative of ancient behaviour patterns.

Thus, I conclude that the patterning is real; three common production activities -- hide-scraping, butchery and wood-shaving -- were carried out rather homogeneously on the long axes of all three plankhouses. As will be seen below in the discussion of Group 8 and Group 9 data, these patterns are generally reiterated and supported by proportion data.

5.2.1.3 Group 3: UE Work Action Categories
Variables: GRAVE to CUT

Between-Site Distributions

These variables represent solely the work action carried out by a given UE. Of the seven work actions only one is disqualified for low counts. Of the six remaining, three are clearly more prevalent at Meier than at Cathlapotle: they are graving, shaving and cutting, at 141% (n=14), 53% (n=21) and 102% (n=36) more than expected, respectively; perforation with n=3 more than expected at Meier, is discounted due to this low count. The lack of significantly more scraping UEs at Cathlapotle, considering that hidescrapers were clearly more important there than at Meier, is a result of their being 'swamped' by the numerous other scrapers (e.g. of wood) that are pooled in this variable score.

Discussion and Summary of Between-Site Distributions

The distributions noted above are 'autocorrelations' of the data in Group 2: the wood gravers, wood shavers, and cutters of that group correlate to the graving (=wood gravers), shaving (= wood shavers) and cutting (= butchery) UEs of Group 3 variables.

This suggests the relatively high degree to which UE function can be read from UE work action in these assemblages, the difference between hide-scrapers and other scrapers being an obvious but easily-dealt-with exception. With regard to inference of labour organization, the same conclusions are reached as discussed above for Group 2 data.

Within-House Distributions

In the Meier plank house sample, four of the seven Group 3 variables are discounted for low counts: of the remaining three, only CUT (cutting implements) was more common than expected in the Center analytical unit. However, this distribution is driven by low counts (only 36% (n=9) more than expected were encountered here) and the data are therefore discarded.

The Cathlapotle House I sample disqualifications are identical to those of the Meier site. Of the remaining variables, only shaving UEs were found more commonly than expected in the South analytical unit (60% or 11 items more than expected). Note that as discussed below these are the same UEs recorded as WOODSHAV in Group 2. These data are driven by a count just above the cutoff limit of ten items discussed in section 5.1.5; the significance of this distribution is discussed below.

In the Cathlapotle House IV sample, all Group 3 variables are disqualified due to low counts.

Discussion and Summary of Between-Site Distributions

The ‘autocorrelations’ discussed above also drive the within-plank house distributions and here, it is most important to note that the SHAVE UEs of Group 3 data are largely the WOODSHAV-assigned UEs of Group 2. All of the SHAVE UEs in the Cathlapotle House are wood-shavers, while a few bone/antler shavers are included in SHAVE in the Meier sample.

We can summarize the within-plank house UE work action data distribution by stating that there is no compelling evidence for strongly-patterned heterogeneity in the common scraping, shaving or cutting implements. In the Meier and Cathlapotle I plank houses, common scraping, cutting and shaving activities were engaged in by peoples all along the plank houses. This statement is accurate, but somewhat redundant considering the autocorrelation with Group 2 data.

5.2.1.4 Group 4: Lithic, Bone/Antler, Wood & Hide Chaine-Operatoires
Variables: LITSTOR to HIDERED2

Between-Site Distributions

Group 4 data pool large numbers of artifacts assignable to different stages of reduction of stone, bone, antler, hide and wood raw materials most commonly worked by Meier and Cathlapotle folk. These data afford a high-fidelity examination of labour organization by dividing activities into the finest stages visible archaeologically at these sites. As a preface to the following section, note that it is determined below, after this discussion, that these production sequences were engaged in within the Meier and Cathlapotle houses in roughly the same ways.

Among the lithic reduction sequence (LITSTOR-LITEND), all variables were more frequently found at Meier than expected, in magnitudes of 32% (n=11) to 100% (n=252) more than expected. In the bone/antler (BASTOR-BAUSE) sequence, all three of four variables not disqualified due to low counts were also found in higher frequencies than expected at Meier, with figures ranging from 84% (n=16) to 100% (n=43) more than expected observed. Wood reduction stage II is also more commonly represented at Meier, with 76% (n=47) more artifacts assignable to this activity found at Meier than expected. In the hide-reduction sequence, storage and acquisition (HIDE STOR) is represented by lithic projectile points which are far more common than expected at Meier (51% or n=118, $p<.0005$), whereas reduction stage I, represented by the above-discussed hide scraping UEs, is (misleadingly) found to be insignificantly unevenly distributed, as is stage II.

Discussion and Summary of Between-Site Distributions

Again, the Meier site yielded significantly higher densities of most variables (artifacts) than Cathlapotle. Since each raw material reduction stage sub-set of the Group 4 data represents a continuum of activity in a discrete production system, what should be measured here are proportion data, indicating the relationship of one data class to another within each subset, rather than count (interval) data, comparing the two sites across each subset variable, which inevitably results in Meier ‘swamping’ possible interesting patterning at Cathlapotle. Proportion data for these variables, and those reflecting other constrained activity sequences, are discussed below.

In sum, Group 4 data reiterate the high artifact densities of the Meier deposits but can reveal little that is useful about the differences between the two sites. They are more fruitfully examined below as indications of activity within the individual plank house borders.

Within-House Distributions

In the Meier plank house sample the lithic chaine-operatoire is well-represented (n=2,385 items), with no variables discounted for low counts. All five reduction stages are statistically significantly unevenly distributed, displaying a clear concentration in the Center analytical unit, and one in the North (e.g. 36% or 64 more representatives of storage and early reduction, in variable LITSTORE, than expected in the Center). This concentration of lithic-production artifacts in the Center of the Meier house includes representatives of all stages of production, from storage to later reduction: LITRED2, composed of 611 items, 11% or 26 of which were found counter to expectation in the Center of the plank house and tool exhaustion, LITEND, represented by 346 exhausted cores, in which 21% more than expected, or 26, were found in the Center analytical zone.

Technically we could discount LITRED1, due to a low count of only nine more items than expected in the North, but these are relatively large items with relatively long uselife (anvils, often >30 cm in maximum dimension and usually weighing more than 2kg, and large hammerstones exceeding 8 cm in maximum dimension) which are unlikely to be added or removed from deposits by the caprice of single behavioural episodes. Thus I do not eliminate them, as I would smaller artifacts with shorter uselife.

The bone/antler chaine-operatoire is also relatively well-represented (n=312 items in the Meier plank house sample), with only one of four variables (reduction stage I, BARED1 composed of lithic wedges and indeterminate bone/antler worked items) deleted for low counts (none in the North, one in the Center and only four in the South). Of the remaining three variables, only BARED2, representing later-stage reduction of bone and antler with lithic abraders and all bone/antler-working UEs, summing to 186 items in the Meier plank house sample, is significantly unevenly distributed, with 42% (n=20) more than expected encountered in the North. The raw numbers driving this distribution are significant and the data reliable.

Only two stages of the wood chaine-operatoire are archaeologically visible, and in the Meier sample one of these, WOODRED1, composed of bone and antler wedges, five in the North, none in the Center, and four in the South, is discounted for low counts. WOODRED2, composed of bone and antler chisels and wood-working UEs, is significantly unevenly distributed, with 75 (n=21) more than expected in the North of a total of 109 items in the Meier plank house sample. These data are derived from sufficiently high raw numbers and are reliable.

The hide-reduction chaine-operatoire is relatively-well represented by 351 projectile points (HIDESTOR) and 43 hide-scraping UEs (HIDERED1), but low counts of bone/antler perforators, hide-perforators and hide-cutters (only three, seven and eight in the North, Central and South analytical zones samples, respectively) disqualify HIDERED2. Still, hide-processing by hide-scrapers is a very secure inference, as discussed above in Chapter 4. Both remaining variables, representing the acquisition of some hide-bearing animals (note the extensive discussion of lithic projectile points below) and the scraping of hides with functionally very diagnostic implements, are evenly distributed among the North, Central and South analytical units. These data are based on sufficient raw counts and are considered analytically secure.

At Cathlapotle I, the lithic chaine-operatoire is also well-represented (n=1,473 items and UEs in the sample) with almost all stages represented by more than 20 artifacts and UEs in any given plank house zone. Material correlates of three (60%) of the five stages of lithic production are found in significantly higher-than-expected frequencies in the South analytical zone. These are LITSTOR, with 50% (n=36 of a house total of 214) more than expected observed, LITUSE with 25% (n=59 of a house total of 678) more than expected observed and LITEND with 37% (n=25 of a house total of 197) more than expected observed. These raw numbers are acceptable and the implications of these distributions are discussed below.

Two of the four bone/antler chaine-operatoire variables are disqualified for low counts in Cathlapotle House I. Of the remaining two, BASTOR (raw material and indeterminate worked items, numbering 38 items in the Cathlapotle I sample) and BARED2 (lithic abraders and all bone/antler-working UEs), only BASTOR is significantly unevenly distributed, with 68% (n=10) more than expected in the North. The analytical utility of bone and antler indeterminate worked items is not particularly high; they may have been used for various functions. Despite the chi-squared result, I do not accept that ten of these items in the North end of Cathlapotle I are a strong indication of heterogeneous labour organization and I thus discard this finding.

One of the two wood-working chaine-operatoire representatives (WOOD RED1) is discounted for low counts of zero, three and zero items in the North, Central and South analytical zones, respectively. WOOD RED2, represented by 50 bone or antler chisels and wood-working UEs, was found to be distributed rather evenly with little significant difference between O and E.

The Cathlapotle House I hide-reduction chaine-operatoire is well-represented, with 265 lithic projectile points indicating HIDESTOR and 82 hide scrapers representing HIDERED1, but HIDERED2 has low counts of only two, zero and one each in the North, Central and South analytical zones each, respectively. HIDESTOR is more common than expected in the South, with 26% (24 of a plank house total of 265) more than expected in this region. The 82 hide scrapers of HIDERED1 were not statistically unevenly distributed on the plank house long axis.

In the Cathlapotle House IV sample only the lithic chaine-operatoire is well-represented: all others are disqualified for low counts. Of the lithic stages represented, LITSTOR, LITRED1 and LITEND were evenly distributed and LITRED2 and LITUSE were all found in unexpectedly-high frequencies in the South analytical unit. As noted above, LITRED2 is composed of hammerstones and cores (n=152 in the Cathlapotle plank house IV sample) and LITUSE is the sum of all lithic toolstone items (n=240 in the present sample). These are good raw counts and the statistical characterization is reliable.

Discussion and Summary of Within-House Distributions

The examination of representatives of steps in a series of chaine-operatoires for lithic, bone/antler, wood and hide raw materials has been fruitful. The best results come from relatively high counts of ubiquitous artifacts reliably assignable to specific stages of production. The lithic reduction sequence is best-known. Representatives of most stages of this sequence were found to be heterogeneously distributed in each plank house. In the Meier plank house, the spatial focus for lithic production was in the Center analytical unit. In both the Cathlapotle I and IV houses, the lithic production centers were in the South analytical units. Other production systems, though not always as archaeologically visible as the lithic chaine-operatoire, were not so obviously spatially concentrated except at the Meier plank house, where bone/antler-working and wood-working material correlates clearly clustered in the North of the Meier house. At Cathlapotle I no such patterning was found, despite relatively good counts (and thus, potential archaeological 'visibility'). In Cathlapotle IV such distributions could not be commented on because of consistently low counts.

Proportion data can assist in understanding these distributions. Figures 38, 39, 40 and 41 represent the percentage composition, within each plank house sample, of chaine-operatoires for lithic, bone/antler, wood and hide raw materials, respectively. Figures 42, 43, 44, 45, and 46 are visual reconstructions of how the most common artifact types were produced by these chaine-operatoires. Table 19 indicates material correlates of each stage for analytical purposes. In each diagram, the percentage of items referable to a given stage of production found in each analytical unit is presented. The left column represents the North analytical unit, the Central the Central unit and the right column the South analytical unit. The reader must remember that these percentage figures describe the assemblage composition of each plank house's raw-material-specific chaine-operatoire, data describing relationships of variables in a constrained set; this is useful, but the percentage figures are derived from raw counts, which may of course be affected by excavation volumes, which differ by analytical unit , North, Central and South. Thus these data are interpreted in conjunction with the chi-squared results which control for excavation volume, but cannot comment on relationships within a constrained set. The two data types must be used together.

Figure 38 indicates that there is little apparent spatial heterogeneity in the material correlates of the lithic chaine-operatoire in any of the three plank houses. The exception is in the storage of raw materials at Meier, where the North and Central areas have roughly 50% more stored lithics than the South (27% or 137 and 24% or 244 of the areas' assemblages, respectively, compared to storage representing 14% or 124 of the South area's lithic chaine-operatoire assemblage). What is more evident is general spatial homogeneity. Reduction stage I, for example, has few representatives in any house and varies only by a three percent difference at Meier, four percent difference in Cathlapotle I and two percent difference in Cathlapotle IV. This is not surprising, as the group is composed of anvils and large hammerstones, which have longer uselife than most of the lithics examined in this study. The same low differentiation is seen in Reduction stage II, use and end stages, where there are only two occurrences of zone variation greater than 10%: representatives of the use stage vary by 13% in Cathlapotle IV (being found in higher percentages in the South, where 161 items are found in contrast to 41 in the North and 38 in the Center), where an 11% variation is also seen in the end stage of uselife, with these items being found in higher percentages in the Center.

Aside from these outliers, the trend is clear: there is no clear, systematic significant variation in lithic chaine-operatoire proportion data per plank house zone. This suggests that plank house inhabitants of each zone were engaged in generally the same production stages, that lithic production was organized in the same manner in each zone. The chi-squared tests, however, indicate that there is significant spatial heterogeneity in lithic production in terms of artifact quantities observed versus expected, and that that production was concentrated in the Center of the Meier house and the South zones of the Cathlapotle houses.

Combined, these data indicate that while all plank house zone inhabitants were carrying out lithic production in the same general way (proportion data), stored lithic material was concentrated in the North and Center zones of the Meier plank house, where that material was being reduced with greater intensity (chi-squared tests) than in the South. In the Cathlapotle sites, the same general spatial homogeneity is seen, with all plank house inhabitants engaged in all stages of lithic production, though with a significant focus of this activity in the South areas of both plank houses.

Figure 39 plots the bone/antler production system. Note that even though percentages for Reduction stage I are plotted in this figure, they are not discussed as they generally have very low counts (there are only eight of these items in the three plank house samples): it is better to focus on more numerous artifacts (n=461 items and UEs in the three plank houses relating to storage, Reduction stage II and use). In the Meier plank house, differences over 10% by zone are found in storage (ten items more in the South than in the North), Reduction stage II (23% or 19 items more in the North than in the South) and use (11% or 11 items more in the South than in the North). In Cathlapotle House I there is a clear lack of storage-related artifacts in the South: there are 25 items in the North compared to only 13 items in the Center and South combined. There is also a lack of Reduction stage II items as well as used items in the North and Center: 15 Reduction stage II items in the North compared to 26 in the South, and six used items in the North, one in the Center, and 13 in the South. In Cathlapotle IV, there are only 45 artifacts and UEs attributable to the bone/antler chaine-operatoire. Of these, only Reduction Stage II is well-enough represented for analysis, with 32 artifacts and UEs. These show apparent concentration in the North, but this is only driven by four artifacts which compose all artifacts in the North area related to bone/antler production). Otherwise, the data are rather similar.

In general, then, there appears to be somewhat more heterogeneity in the spatial distribution of the bone/antler production system than in the lithic system, but some of this seems to be spurious when investigated in terms of raw numbers. The chi-squared data can be used to investigate further. At Meier, the bone/antler system is generally evenly distributed both in proportion and chi-squared data, though a significant concentration of Reduction stage II items is in the Center of the plank house. At x^2=.49 and p>.25, there is a slight but strictly statistically insignificant concentration of stored items in the North as well: this is not considered significant in the chi-squared tests, but it is combined with proportion data below for a clearer picture of the situation. In the

Cathlapotle houses there is more apparent heterogeneity in production organization (proportion data), but in quantitative terms none of this can be considered clear evidence for significant zone-specific production (one case, discussed above, was discounted for low counts) in the cases where the quantities were sufficient for chi-squared testing. It is important to note that ‘negative evidence’ is possibly significant here; there are only 45 bone/antler production-related artifacts in Cathlapotle House IV, of the 157 items in the entire Cathlapotle bone/antler chaine-operatoire sample. However, only 29% (18.45m^3) of the Cathlapotle plank house sample excavation volume (63.18m^3) comes from house IV. Thus, roughly 30% of the Cathlapotle bone/antler production data come from the roughly 30% of the two-plank house sample taken from House IV. This is not compelling evidence of sampling bias and the patterning described appears unrelated to this fact.

Combined, the proportion and chi-squared data indicate that the bone/antler production system was generally the same in all plank house areas in terms of stages of work engaged in per zone: everyone essentially stored raw material items, reduced them in early and later stages and used at least some of these items, and they carried out these stages of production in roughly the same proportions. However, bone/antler raw material seems to have been stored in significantly higher quantities in two general areas: the North of Cathlapotle House I and the South of the Meier plank house. Also, people of the North of the Meier plank house seem to have been somewhat more intensely engaged in later-stage reduction of bone and antler.

The wood chaine-operatoire percentage data (Figure 40) reiterate the patterns revealed above. Note that Reduction stage I is poorly represented in any plank house, with only three items in Cathlapotle I, one item in Cathlapotle IV and nine items in the Meier plank house (WOODRED1 is disqualified in the chi-squared tests due to these counts). It is best to focus on the 191 items and UEs representing wood Reduction stage II (bone and antler chisels and all wood-working UEs). In the Meier house the differences in percentage per zone are minor, amounting only to 13%, with most difference between the South and Center zones (the South containing 26 items compared to the 34 of the Center and the 49 in the North); these data are driven by sufficient counts of more than 30 items per zone and are reliable. In Cathlapotle I, there is slightly more heterogeneity, with an obvious 21% difference between the Center and North as well as South zones (driven by 11 items in the Center, while the North contains 14 and the South, 25). Differences in Cathlapotle IV are important but complex. Although the percentage data and chi-squared data do not indicate significant heterogeneity here, it is present. In the chi-squared test, x^2 is 5.20, significant at only p=.10 and therefore discarded from significance; the test was also discarded due to an observed value of only four in the North area. However, chi-squared tests can accommodate low counts, and counts less than five can be admitted if they do not occur in more than 60% of O or E cells (Snedechor and Cochran 1967); also, the .10 significance level still indicates that there is a 90% chance that this distribution is significant, which is readily evident in the raw numbers behind the test: four items/UEs in the North, seven in the Center, and 21 in the South. Thus examining raw numbers, chi-squared data and the proportion data together reveal a significant distribution not identified readily in any one measure: there are far more wood-reduction (stage II) tools and UEs in the South of Cathlapotle House IV than expected.

Combined, the proportion and chi-squared data indicate that inhabitants of each zone of each plank house were engaged in some wood-reduction activity. Although counts are low for statistical characterization, this includes early reduction stages. More common are implements reflecting later reduction; these are also typically found in all areas of all plank houses. The major exception here is the higher intensity of later-stage woodworking activity in the North end of the Meier plank house and the South end of Cathlapotle IV.

The hide-working chaine-operatoire data are plotted in Figure 41. This data set is comprised of 907 artifacts and UEs related to hide production. Of the three stages archaeologically applicable here, HIDERED2 (Reduction stage II) was discounted in the chi-squared tests for consistently low counts: these numbers are discussed below where applicable.

At the Meier site there is only a four percent variation in storage (n=351 lithic projectile points in the sample, which actually represent procurement of hides rather than storage, but still represent an early stage of hide production) among the North, Central and South zones, and a similarly insignificant six percent difference in Reduction stage I, composed of 43 hide-scrapers. In Cathlapotle I there is only a seven percent difference between North and South percentage components in storage, but the raw numbers and chi-squared results indicate a major difference; the South zone contains 26% (n=24) more points than expected, for a total of 116 compared to 67 in the Center and 82 in the North. The scraping of hides in Reduction stage I is only differentiated by six percentage points among the North, Central and South (driven by figures of 31, 20 and 32 hide-scrapers each, respectively), which is not significant in proportion or chi-squared terms. Cathlapotle House IV displays a roughly 30% difference among North, Central and South zones in terms of storage, with points concentrated in the Center; the chi-squared test noted above indicates that this is not significant, and the raw numbers (22 in the North, 34 in the Center and 47 in the South) are high enough to be considered reliable. Reduction stage I in Cathlapotle IV is significantly unevenly distributed according to the proportion data, with the Center containing more than 25% less hide-scrapers than either the North or South areas. The chi-squared test, again, was not carried out here, due to a count of only three items in the Center, but for the reasons noted above, it is calculated at this point: the result is x^2=9.00 with p=.02, and the raw numbers (14 in the North, three in the Center and 24 in the South) are instructive. The Central zone of Cathlapotle House IV has very few hide-scrapers when the data are carefully examined.

Combining the raw numbers, chi-squared data, and proportion data we see that the hide-working production system was essentially the same in all areas of all three plank houses: all people, North, Center and South collected animals bearing hides with projectile points, as well as worked those hides with specialized lithic hide-scraping implements. The difference is once again found not in fundamental organization but intensity, but only at Cathlapotle: at Meier, there is broad homogeneity. At Cathlapotle, storage (or more accurately, acquisition) was more a concern in the South of House I and Reduction was very rarely carried out in the Center of House IV.

5.2.1.5 Group 5: Lithic Production Details

Variables: MANUPORT to UNUSED LITHIC

Between-Site Distributions

Of the 12 variables generated specifically to characterize lithic production organization, ten (82%) were more commonly encountered at Meier than expected (ranging from 32% to 117% more than expected, all with raw counts >10). Large hammerstones (>8 cm in maximum dimension) were found to be distributed as expected, and shaped but unused lithic items (variable UU, as described above) were slightly more commonly encountered at Cathlapotle than at Meier (30%, or n=14 more than expected).

Discussion and Summary of Between-Site Distributions

Group 5 data are similar to Group 4 data in that they each indicate some stage in a sequence of lithic production, and are best analyzed as proportion data comparing proportions within each plank house, as mentioned above. This is done in the section below. What can be concluded from the Group 5 data at this point is that the Meier site is again clearly shown to have had higher artifact frequencies (read 'densities') than at Cathlapotle not just in sum, but even in constrained variables with counts below 100.

Within-House Distributions

These data include stored raw material (manuports and tested items), viable cores, hammerstones, used lithics and exhausted lithics. These variables are largely the constituents of the Group 4 chaine-operatoire variables 'unpacked' in order to identify whether the results of testing Group 4 and Group 5 are internally consistent – as discussed below, they are consistent.

In the Meier plank house 11 of the 12 Group 5 variables had scores high enough for chi-squared testing (Table 21). Of these, seven (63%) were significantly unevenly distributed, and all of these indicate concentration in the Center, and occasionally North, of the plank house. The exception is bipolar cores, found to be almost absent in the North (n=2), but abundant in the Center (n=53) and South (n=38). The chi-squared test not carried out in the battery of Table 21 was excluded exactly for this reason: a count of two in the North. Testing the data now, though, reveals a highly significant result of $x^2=32.22$, $p=.0005$, which is clear in the raw data. The one element of the lithic reduction system, then, found to be very unevenly distributed, is the bipolar core. The significance of this is discussed below.

The same internal consistency is seen in Cathlapotle House I, where unpacked Group 4 variables show the same patterning revealed above: the lithic production system was fundamentally the same throughout the plank house, but a clear focus of intensity is seen in the South, evident in six (50%) of the 12 variables being found there in frequencies significantly higher than those expected. For example, 87 freehand cores were found in the South while the Center contained 44 and the North, 45 (remember, these raw numbers come from varying excavation volumes, so proportions, chi-squares and raw counts must be considered in unison for interpretation). The exception here is also bipolar cores, which are found to be concentrated in the North, where we find 54% (n=12) more than expected.

In Cathlapotle House IV, six (50%) variables are disqualified for low counts, and of the remaining six only one displays statistically significant variation: bipolar cores are found in very high frequencies in the South, where 45 were recovered compared to eight in the Center and 12 in the North.

Discussion and Summary of Within-House Distributions

The lithic production system examined in Group 4 chaine-operatoire data was unpacked in this exercise. The results are consistent with those of the Group 4 data, and significant variation was not found to be hidden by the pooling process which generated Group 4 variables.

The Group 5 data indicate that peoples of all zones of each plank house engaged in all stages of lithic reduction. Some clear variations in the degree to which such stages were engaged in are evident; these are a clear focus of lithic production in the Center of the Meier house and the South zones of both Cathlapotle houses.

5.2.1.6 Group 6: Debitage Details

Variables: DEBITAGE to G4

Between-Site Distributions

Each of the debitage variables is more commonly encountered at Meier than expected: this includes the sum of all debitage (DEBITAGE, 91% or 7,877 more than expected at Meier) as well as each size class, from G1 to G4 (128%, or 1,553 more than expected at Meier), inclusive.

Discussion and Summary of Between-Site Distributions

As in the cases of data in Groups 4 and 5, these are meant to indicate in some way stages of a discrete reduction sequence (G1 earlier, G4 later) and are best used to examine distributions within the individual plank houses. Nevertheless, these data again indicate that in variable after variable, not just in sum, Meier was far richer in artifact load than Cathlapotle.

Within-House Distributions

Lithic debitage in the Meier plank house is distributed in a way generally reiterating what has been found of the lithic production system thus far. All five Group 6 data classes (DEBITAGE to G4) were numerous enough for chi-squared testing, and all five were found to be statistically significantly unevenly distributed. The bulk of debitage items (n=16,506 items in the Meier plank house sample comprising the variable DEBITAGE) is concentrated in the North, where we find 20% (841) more items than expected. Debitage of G2 and G3 sizes are also clearly found in the North in the highest frequencies; it should be noted that they comprise 72% of the Meier plank house sample debitage assemblage. The G1 material (90 items) was concentrated in the Center, and the G4 items (n=4,544 items) were concentrated in the South. In sum, most debitage (in assemblage proportion as well as raw counts) was concentrated in the North and Central areas of the Meier plank house.

The same clear concentration is seen in Cathlapotle House I, where four of the five Group 6 variables were found in clearly higher-than-expected frequencies in the South zone, reiterating what has been revealed above. For example, debitage as a whole (n=7,681 items in the Cathlapotle House I sample variable DEBITAGE) and G2, G3 and G4 items were all found concentrated in the South.

In Cathlapotle House IV is the first internally inconsistent result so far encountered; while lithics from various reduction stages have so far been found concentrated in the South of this plank house, the debitage are concentrated in the North or, more precisely, are conspicuously absent from the Center. Analysis of the DEBITAGE variable indicates that of the 2,520 items in the plank house sample, 788 (31%) were found in the North, from which 25% of the excavation volume is derived. This has a roughly equal effect on the X^2 statistics as does the fact that 24% less than we expect (n=173) were found in the Center. This discrepancy with other lines of evidence regarding lithic production is repeated in the G3 and G4 data (which sum to 2,006 items, or 80% of the house IV sample) also concentrated in the North.

Discussion and Summary of Within-House Distributions

The data here indicate a clear concentration of lithic production debris in the North and Center of the Meier plank house, the South of Cathlapotle House I and the North of Cathlapotle House IV.

5.2.1.7 Group 7: Major Raw Material Production Stages
Variables: STONE1 to HIDE3

Between-Site Distributions

These data once again divide activities into discrete production stages, as explained above in Section 5.1.3.1, Nine Data Groups and their Membership. Six of the eight variables not disqualified for low counts were found to have significantly higher-than-expected frequencies at Meier than at Cathlapotle, at magnitudes ranging from 51% (n=118) to 117% (n=67) more than expected at Meier. One variable, HIDE3, a pooled count of hide-cutting and hide-perforation UEs, bone and antler perforators used to pierce hides, and all hide-working implements, was found to be significantly more common than expected at Cathlapotle, at a magnitude of 10% (n=11) more items than expected at that site.

Discussion and Summary of Between-Site Distributions

As these data are a more inclusive variety of Group 4, they are also meant to indicate discrete stages of discrete reduction sequences per raw material, and are best used to examine distributions within the individual plank houses (as is done below) than between them. Nevertheless, a significant result here is that even with data pooled and the very high Meier counts likely ‘swamping’ important within-plank house variation, the above-mentioned higher intensity of hide-working activity at Cathlapotle is seen in HIDE3. The significance of this will be explored below.

Within-House Distributions

The STONE1, STONE2 and STONE3 material correlates are well-represented in the Meier house (n=125, 414 and 301 items each, respectively), and of these STONE1 and STONE2 are concentrated in the Central zone. Here, we find statistically significantly more lithic manuports, anvils, hammerstones and viable core than expected. STONE3, composed of small hammerstones and broken projectile points representing late-stage stone-working, is evenly distributed. Woodworking is poorly represented (n=14 items total) except in stage 3 (WOOD3 with 216 items and UEs) where we find a clear concentration of wood-working UEs and implements in the North (33%, or 18 items more than expected). The bone/antler production sequence is also poorly represented except in stage 3, where we find 33% (n=18) more of the 136 items in the North than expected. Hideworking is well-represented in each stage (n=351, 43 and 108 items, including lithic projectile points, hide-scrapers, and other hide-working implements, respectively); none of these material correlates of this activity are unevenly distributed in the Meier plank house.

In Cathlapotle House I there are also good counts of 38 (STONE1), 209 (STONE2) and 179 (STONE3) items. While STONE1 was dismissed in the chi-squared test due to a low count of four items in the Central zone, for reasons noted above the figure may be calculated here. The result is statistically highly significant ($x^2=14.6$, $p=.0001$) with far fewer than expected in the North, but the raw number of only 11 more than expected in the South is close to the somewhat arbitrary cutoff value of 10 items. Nevertheless, a clear focus of STONE2 and STONE3 is seen in the South, in accordance with much other data reflecting stone-working. Woodworking is represented by good counts only of WOOD3, (with 48 items in the North, 25 in the Center, and 77 in the South). These are concentrated in the South, where we find 45% (n=25) more items and UEs than expected. Bone/antler-working is well-represented only in stage 3 (n=265 items and UEs), and this is concentrated in the South, where we find a moderate 13 items and UEs (56%) more than expected.

The raw numbers indicating STONE1 in Cathlapotle House IV (five in the North, two in the Center and eight in the South) are insufficient for useful testing, but there are good counts of 71 and 51 items for STONE2 and STONE3, respectively. These are quite evenly distributed, with a few percentage points of difference between most Observed and Expected values. Woodworking artifacts and UEs, well-represented by 43 WOOD3 items in the plank house, appear statistically concentrated in the South, where we find 46% more than expected; this, however, is based on a count of nine items, and it is best not to read too much from these data. Low counts are also responsible for a misleading chi-squared result for BA3, composed of 35 items, seven more of which than expected were excavated in the South; this spatial focus is ignored due to these counts. Hideworking stage 1 implements (in this house, 103 lithic projectile points) are evenly distributed. Stage 2 implements (lithic hide scrapers, 41 of which were found in Cathlapotle House IV) are well represented, and as noted above, conspicuous more for near-total absence in the Center of the plank house than for heavy concentration elsewhere. Also conspicuously absent are hide-working implements reflecting stage 3 (bone/antler perforators, hide-perforation and -cutting UEs and unused hide-working implements), only two of which were found in the entire plank house (in the South).

Discussion and Summary of Within-House Distributions

At Meier, the patterns seen so far are repeated in these data: a concentration of artifacts representing several stages of lithic-, wood- and bone/antler-working are found in Center (lithic) and, in somewhat less intensive form, the North (wood and bone/antler). Cathlapotle House I shows essentially the same polarization, with all statistically significant concentrations of artifacts, representing various stages of manufacture, in the South zone. Cathlapotle House IV has some suggestions of such concentration, of wood and bone/antler-working implements in the South, but what is most clear here is the significant lack of hide-working implements in the Center of the plank house, and complete absence of traces of the later stage of hide-working.

The data suggest that in general, stone, bone, antler, wood and hides were worked by Meier and Cathlapotle plank house inhabitants of all zones, from North to South; the exception (discussed further below) is the apparent lack of significant hideworking in Cathlapotle House IV. Also, each of these materials were worked using essentially the same reduction stages, and each plank house population was engaged in each of these stages.

5.2.1.8 Group 8: Gross Worked Material Categories
Variables: BONE/ANTLER to FLESH

Between-Site Distributions

These data describe the basic raw materials (bone and antler, wood, hide, stone and flesh) worked by the Meier and Cathlapotle folk, based largely on UE data generated in this study as explained above. The data set is 2,281 items and UEs assigned to the working of these raw materials, 1982 from Cathlapotle sample and 1,298 from the Meier sample.

Representatives of four of the five (80%) of these raw materials were far more commonly encountered than expected at Meier than at Cathlapotle. These differences from expectation occurred in magnitudes of 61% (n=40 more items and UEs than expected in the case of wood) to 85% (n=480 more than expected in the case of stone). Only hide-working implements and UEs were distributed as expected; however note that, as argued above in section **5.2.1.2**, hide-scraping appears to have been far more important at Cathlapotle than at Meier.

Discussion and Summary of Between-Site Distributions

Again the data indicate that Meier yielded far richer deposits than Cathlapotle. The recurrence of indications of hideworking being particularly important at Cathlapotle (noted variously above) should not be forgotten here; they are unambiguous even if not statistically significant in this test. Figure 32b and Figure 33b indicate that within the site assemblages, hide-working implements account for more than twice the assemblage components at Cathlapotle than at Meier. The significance of this will be discussed further below.

Within-House Distributions

All of the material correlates of working these different raw materials were present in sufficient numbers (n=1,298) in the Meier plank house zones. The chi-squared tests indicate that stone-working and flesh-working were more commonly encountered in the Center of the plank house than elsewhere, in magnitudes of 25% (n=92) and 46% (n=8) more than expected. Disregarding the low count of eight items/UEs more than expected for flesh-working, we find the same distribution as indicated many times before, in different ways: a focus of stone-working in the center of the plank house.

At Cathlapotle House I (n=722 artifacts and UEs) there is only a disqualification of bone/antler working for a low count of one item in the Center; the chi-squared test

(x^2=9.23, p=.01) suggests this may be significant, but it is driven by only six items in the North, one in the Center and 13 in the South, low counts from which we should not infer much. Woodworking is well-represented by 87 items and UEs which show convincing concentration in the South, where we find 50% (n=14) more than expected, and 38% less than expected (n=28) were found in the Center. The 86 hide-working implements and UEs are homogenously distributed on the plank house long axis (x^2=.68, p>.2500). Stone-working is concentrated in the South, where we find 27% (n=47 items) more than expected. Flesh-working UEs and implements (n=35 tools and UEs) were evenly distributed.

The 556 artifacts and UEs referable to specific raw materials in the Cathlapotle House IV sample were only present in sufficient quantities to test hide-working and stone-working, with only three, eight and one items/UEs representing bone/antler- wood- and flesh-working, respectively. Of the remainder, hide-working was very poorly represented in the Center of the plank house, as found above, even though it was deleted from the formal chi-squared test for a low count of three in the Center (x^2=9.00, p=.0100). Only stone-working was clearly more commonly observed than expected, this in the South, where we find 17% (n=19) more items than expected.

Discussion and Summary of Within-House Distributions

The patterns here reiterate those noted above in nearly every line of evidence so far: a general similarity in terms of the variety of activities carried out in each plank house, with some evidence of greater intensity in some areas. In this case, the raw materials worked by the plank house inhabitants were also generally the same. All populations, low-, middle- and upper-ranked of each plank house worked the same basic raw materials. Labour was not organized by the raw material to be worked.

5.2.1.9 Group 9: Gross Hunting Categories

Variables: LINEFISH to AQMAMM

Between-Site Distributions

These data indicate the basic hunting categories represented at the two sites with 764 artifacts, 94% of which are lithic projectile points, the remainder being net weights (12 and 17 in the Cathlapotle and Meier samples, respectively), bone and antler points (six and eight, respectively) and bone or antler harpoon valves (n=3 total). Aquatic mammal pursuit is disqualified for these low counts, but all other variables are found in significantly higher-than-expected frequencies at Meier. The most convincing of these data is that of the lithic projectile points, 118 (89%) more of which were found at Meier than expected. The line-fishing and net-fishing data are poor (though they do match a now-familiar pattern), with only three and seven more artifacts found at Meier than expected.

Discussion and Summary of Between-Site Distributions

The data here unambiguously indicate that inhabitants of all plank houses of both sites were engaged in the pursuit of schooling fishes collected with nets, aquatic mammals and large solitary fishes hunted with barbed bone implements such as hooks and harpoons, and land mammals hunted with lithic projectile points. These data are supported by initial faunal analyses (Ames et al 1999) indicating a wide variety of faunal material in each plank house.

Within-House Distributions

Unfortunately, low counts that dominate line-fishing, net-fishing and aquatic mammal hunting material culture data all must be excluded at this stage, in all plank houses, for this reason. Only terrestrial hunting is readily visible.

In the Meier house, terrestrial hunting material culture is apparently evenly distributed ($x^2=2.19$, $p>.2500$). However it should be noted that the density of projectile points in the South of the plank house is typically higher than in the North or Central areas. Still, the pattern is reiterated: everyone was engaged in terrestrial hunting, the difference in labour engaged in being one of degree rather than of kind.

The same disqualifications apply to Cathlapotle House I. Here, however, there are significantly more lithic projectile points in the South than expected (26% or 24 points). No such difference is seen in Cathlapotle House IV, where the same disqualifications again apply to three of the four variables.

discussion and summary of within-house distributions

While low counts dominated the data set here, the raw numbers remain instructive. The 14 line-fishing implements are present in each plank house, though in low numbers: the same can be said of the 29 net-fishing implements. Aquatic mammal hunting is very poorly represented by only two items (from the Meier house) and is thus eliminated from this analysis. What can be said is that in each house there are traces of the same basic hunting / gathering implements, and that where measurable by zone (in the case of lithic projectile points), they differ in degree of intensity rather than in terms of presence or absence: everyone hunted land animals, but some more intensely than others.

5.3 Activity Class Analysis

To characterize production activities in the broadest sense, it can be useful to combine data classes (variable scores) into scores reflecting more inclusive activity group labels. In this study eight such general tasks may be specified. Four are extraction tasks: these are LINEFISHING (bone/antler points, bipoints for fishes: again, the use of harpooning gear must be ignored here due to low counts), NETFISHING (net weights), TERRHUNT (terrestrial hunting with projectile points) and BUTCHERY (butchery UEs and unused butchery implements). These may be distinguished as a group from four maintenance tasks: STONEWORK (lithic cores, anvils and hammers), HIDEWORK (hide-working UEs, unused hide-scraping tools and perforators made of bone/antler; this does not include lithic points) BAWORK (all bone/antler UEs, unused chipped lithic perforators and wedges thought to be shaped for use on bone/antler, and lithic abraders) and WOODWORK (all wood UEs, unused but shaped items thought to represent woodworking and wedges and chisels made of bone/antler). Figures 47 and 48 summarize visually the eight basic maintenance and extraction activity classes.

Since no study above indicated that production was organized spatially according to production stage, I assume that each plank house area population was carrying out all stages of production of all raw materials. This study, then, is of the proportional distribution of eight general activity classes per house area rather than aspects of production stages per plank house zone. These are sometimes replicated in artifact data described above, but their component variables differ slightly, and are generally more inclusive. Here I discuss each group's composition of what I assume is an integrated, closed set of maintenance and extraction activities, using proportion data rather than the chi-squared test. The percentages can tell us about activity organization in a broad sense, but they have their weaknesses, such as being based directly on raw counts which may be related simply to excavation volume, as noted above, while chi-squared tests adjust for variable excavation volumes. It is critical that raw counts, proportions, densities, results of the chi-squared tests and the nature of artifacts and groups are considered in unison; any one measure cannot tell us (a) all we wish to know and/or (b) all that may be learned from these phenomena.

Table 24 indicates (a) raw counts, (b) row percentages and (c) densities in n/m^3 for the 3,261 items assigned to these activity classes within the sampled plank houses. The chi-squared data have been discussed. Figure 49 plots the assemblage composition in % by each activity class per plank house zone. Note that different activities produce different volumes of material correlates per episode; for example, a butchery episode may generate only a single butchery UE, while a single stage I core-reduction episode would produce a core, a hammer and an anvil, to say nothing of the debitage. Thus, what is most important in the following discussion is not the actual percentage of activities per class per house zone, but the variation of those scores between plank house zones.

LINEFISH represents the pursuit of schooling fishes, and sometimes aquatic mammals, with points, bipoints and harpooning equipment (but note that harpooning gear is not analyzed here due to a low count of only three items). LINEFISH is only represented at Meier; these artifacts are not present in the Cathlapotle assemblage. These artifacts are relatively rare and functionally quite specific. Very few are found in the

North but they occur in similar frequency in the Center and South. That ten times the amount found in the North is found in the Center and South combined, seems quite significant. These items may be said to compose an insignificant proportion of the North assemblage and a low but significant proportion of the Central and South assemblages.

NETFISH represents the pursuit of schooling fishes with nets. It is represented in all plank houses sampled. At Meier, 13 net weights are found in the North, while only four are found in the Center and South samples combined. Thus, net fishing may be said to compose a significant proportion of the North assemblage (2.7% of the activity group assemblage), and is present, but in very low frequency, in the Center (.3%) and South (.3%). In the Cathlapotle House I sample there are equal numbers of net weights in each plank house zone (three in each for a sum of nine), where they compose from .7% to 1.2% of each area's activity group assemblage. Equal emphasis on net fishing is implied in each plank house zone. In Cathlapotle House IV these artifacts are absent in the North and Center; two were excavated in the South sample, composing 1% of the sample activity group assemblage. With such a low count it is difficult to discern the significance of this distribution, but it may be suggested that net fishing was of little significance to most of the plank house, and when practiced, was only done so regularly by South zone inhabitants.

TERRHUNT is the pursuit of land mammals for their meat, bone, hide, antler and other products. In the Meier house, as in the others, it is a significant component of the activity class group. It accounts for 16% to 21% of the activity group material correlates, with the lowest figure in the North (where n=78) and the highest in the South (where n=142). Although the chi-squared test did not indicate that lithic projectile points were more common in any zone than expected, they are present in somewhat higher densities in the Central and South than in the North (Table 24b). Note this is also evident when points from all units, not just from sampled units, are examined -- one of the more striking distributions at Meier. We may say that terrestrial hunting was a significant activity in each Meier house zone, but slightly less significant in the North than elsewhere. In Cathlapotle House I we find less differentiation, with only 2.6% difference between North (n=82) and South (n=116) (with the lowest proportion in the North) compared to a 5.2% difference between the Meier North and South zones. Like fishing with net weights, terrestrial hunting was engaged in by all Cathlapotle House I people, and in very similar frequencies. In Cathlapotle House IV there is a significant spike in the Center of the plank house, where points are the most common artifact type of the set in this area and account for 47% of the assemblage as opposed to 27% in the North and 22% in the South. These data are based on a comparatively robust count of 103 points in the sample and it seems quite clear that terrestrial hunting was more of a concern in the Center of this house than in any other area. However, that only one to two more projectile points were excavated here per cubic meter (Table 24c) should temper the significance of this apparent heterogeneity.

BUTCHERY is the division of animal protein, mostly flesh, and must have been an important activity even though it represents well below 10% of any plank house area activity group assemblage. There is little score variation at Meier, with only a .8% difference between the lowest score in the North (n=12 2.5%) and the highest score in the Center (n=25 for 3.3%). This lack of differentiation is repeated in the density of butchery items, which vary by zone only by about one item more per cubic meter in the Center than in the North or South (Table 24c). We may say all Meier people participated in butchery to roughly the same degree. The same is seen in Cathlapotle House I, where there is only 1.6% difference between the score of 4.0% (where n=13) in the North (the lowest figure) and 5.6% in the South (the highest count, where n=24), resulting in the same inference as at Meier. This is supported by the fact that only about 1.6 more butchery items were found in the South than in the North. Cathlapotle House IV has similarly low figures of 5.2% in the South and 1.3% in the North, but none whatever in the Center. The North figure is driven by only one butchery implement or UE (the South has 11) and it is best to characterize butchery as concentrated in the South of this house; roughly five times the amount of butchery items were found here than anywhere else in the plank house.

The first variable representing maintenance activities, STONEWORK, is the reduction of fine-grained lithic material. In the Meier house it accounts for 50% to 53% of the assemblages per zone, with the slight spike in the Center, where n=410. This is a slight difference driving a density figure of roughly ten more items per cubic meter than in the North or South. Though the difference is small, it is clearly significant as the chi-squared tests identified many indications that the Center of the plank house was disproportionately engaged in lithic production, and I infer the same from the present data. At Cathlapotle House I there is also a Center spike, although this was not identified in the chi-squared tests. Here, stoneworking consists of 48% of the assemblage, at least 10% more than in the North or South. Percentage variation on this scale is relatively rare in the present analysis. Density data indicate a broad similarity in the amount of stoneworking data in the Center and South, with roughly half the amount in the North. The best interpretation of these numbers is that the Center and South are similar in having noticeably more traces of stoneworking than the North. In Cathlapotle House IV there is a similarly notable distribution, with the Center having roughly 10% less stoneworking material correlates than North or South. The density data support this but also indicate that the South has the highest incidence of stoneworking traces, as indicated in some chi-squared tests; note that these did identify the North and South, but not the Center, as most concerned with stoneworking. The most parsimonious interpretation of these data is that the Center was far less engaged in stoneworking than North or South.

HIDEWORKING with scrapers, cutters and perforation tools is the modification of large mammalian hides. Note that here no lithic projectile points are included, counter to some variable assignments above. This activity is quite evenly distributed at Meier, where it represents from 7.7% (in the North, driven by a score of 37 items) to 9.2% (in the South, driven by a score of 60 items) of the activity group assemblages. That the 1.5% difference between these scores is essentially insignificant is supported by the density scores (Table 24c) which differ only by about one item per cubic meter between any plank house zones. We may safely say that hideworking was carried out in roughly equal proportions by all Meier people. In Cathlapotle House I the situation is noticeably different. While the chi-squared tests did not identify hideworking as being unevenly distributed, it is clear that roughly twice the amount of hideworking implements per cubic meter were found in the North than in the Center (Table 24c) and that this drives a roughly 10% greater assemblage composition of hideworking implements in the North than in the Center. Thus, we may say that while all people were engaged in hideworking, it appears to have been more important in the North of this house than elsewhere. In Cathlapotle house IV a similar distribution is evident; roughly four times less hideworking items are found per cubic meter in the Center (n=6, density = 4.1/m^3) than in the North (n=19) or South (n=36, density = 4.2/m^3) (Table 24). Hideworking was carried out by all House IV people, but rather less in the Center than elsewhere.

BAWORK is the shaping of bone and antler with a variety of reductive methods and tools. At the Meier site it is somewhat more commonly represented than at Cathlapotle, as discussed above. In the Meier house it accounts for 8.5% (in the South, where n=55) to 11.6% (in the North, where n=56) of the activity group assemblages. This moderate, three percent difference is reiterated in a moderate, three-item difference per cubic meter between the North and South (Table 24c). We may say that all people reduced bone and antler at Meier to roughly the same degree. This work is more unevenly distributed at Cathlapotle. In Cathlapotle House I BAWORK is clearly concentrated in the North, where 25 items or traces were found compared to seven each in the Center and South, for a roughly 7% difference in assemblage composition between North and South. Note however that there are roughly two and a half times as many of these items per cubic meter in the North than in the South, a comparatively moderate difference. We may say that bone and antler shaping was carried out by all, but it was somewhat more important to people of the North of this plank house. In Cathlapotle House IV, bone/antler working seems to have been relatively unimportant, being entirely absent in the North, and carried out in low degrees, on average accounting for about 3% of the entire plank house assemblage. Densities are about five to seven times lower than at Meier, but about the same as in Cathlapotle House I. We may say that people of Cathlapotle House IV South and Central areas worked bone and antler on occasion, but that it was not a particularly important activity, and that it was even less important in the North area, where it was rarely, if ever, carried out.

WOODWORK is the reductive shaping of wood with a variety of stone, bone and antler implements. At Meier it was carried out in roughly equal proportions in the North (n=40 items and UEs, for 8.3% of the assemblage), Center (n=47 items and UEs, for 6.2% of the assemblage) and South (n=37 items and UEs, for 5.7% of the assemblage). The differences here are well below the roughly 10% differences that seem to be signals of real distinctions (discussed variously above), and the densities are on the order of one item more per cubic meter in the Center than in the South, and in the North than in the

Center. These data indicate that woodworking was carried out by all plank house inhabitants in roughly the same degrees. In Cathlapotle House I woodworking appears to be focused in the South, where it accounts for 13% of the assemblage, which is 8% more than in the Center but only 5% more than in the North. The raw numbers and densities (Table 24) suggest that the most important distribution here is the lack of items in the Center rather than their abundance in the South or North. The best interpretation is that all people carried out wood-reduction activities, but that people of the Center did so somewhat less than their neighbors in the North and South. In Cathlapotle House IV more than twice the total amount of these UEs and items was found in the South than in the Center and North combined, a figure fortified by very different densities of .4 items /m^3 in the North and Center compared to 1.2/m^3 in the South. Again, all people were engaged in woodworking, but it appears to have been somewhat more important in the South than either North or Center.

5.4 Summary Comments on Distributions

Distributions Between Plank Houses / Sites

The data presented above clearly indicate that the Meier and Cathlapotle inhabitants were engaged in roughly the same variety of production activities; each population made and used its own set of tools for both maintenance and extractive tasks. The main distinction is in the greater importance of hide-scraping at Cathlapotle, commented on in the following chapter. A second difference is in the higher artifact counts and densities at the Meier site: this was discussed in Chapter 3, and I suggest that it is not a result of more intense work at Meier, but of different storage-facility maintenance practices at Meier and Cathlapotle. At Meier, the cellars were larger and less frequently and less completely cleaned out, leaving more artifacts per cubic meter of matrix than at the more intensely cleaned out Cathlapotle houses. Based on the usewear and other data above, I consider the two sites to have been largely identical in terms of basic maintenance and production activities.

Distributions Within Individual Plank Houses

Figure 35 displays graphically a summary of the chi-squared tests discussed above. In this figure the shading of each cell indicates the strength and significance of a deviation from expectation in terms of artifact/UE frequency.

What is evident in Table 24 and the discussions above is that there is a broad homogeneity in the variety of labour and the organization of that labour which is indicated by both the presence of artifacts reflecting most production stages in each plank house zone as well as the generally similar proportions of stages of the specific chaine-operatoires per raw material.

The heterogeneity is seen in the intensity of labour carried out in different plank house zones: in the Center and (slightly less) in the North of the Meier house, and the South of the Cathlapotle houses, there are concentrations of artifacts and UEs indicating greater intensity of work resulting in higher artifact counts and densities. The South zone of the Meier house and the North zones of the Cathlapotle houses are similar in that they contain generally less artifacts than we would expect given their excavation volumes.

Figure 50 summarizes the distribution of material correlates of the eight extractive and maintenance activity classes. I consider this figure to summarize the distribution of activities within the plank houses most accurately, as it is based on a detailed understanding of multiple lines of evidence. This summary graphic is a distillation of what is indicated by raw numbers, densities, percentage component scores and the chi-squared tests. These data cannot be used independently in any sensitive analysis; they must be examined simultaneously to derive a summary statement. Such summary statements are provided below, serving as a guide to Figure 50.

Maintenance and Extraction in the Meier House

Of the 82 variables introduced in the chi-squared tests, 30 (36%) were disqualified in the Meier house due to low counts. Of the remaining 52 testable variables, 23 (44%) were found to be homogeneously distributed while 29 (55%) were heterogeneously distributed. The focus of higher than expected frequencies is clearly in the Center and the North of the Meier plank house, where the working of stone was focused, although it was carried out in all areas. There is no suggestion that any other maintenance activity was significantly spatially differentially distributed. Extraction task material correlates were more differentially distributed; fishing with nets was more commonly indicated in the North and terrestrial hunting more commonly in the South. In no case is there a high magnitude of activity heterogeneity intensity; percentage components of the eight generic activity-class assemblages per zone never diverged by more than 10% and were rarely driven by counts over 40 items. All stages of all activities were carried out in all plank house zones, with an emphasis on net fishing in the North, lithic production in the Center and terrestrial hunting in the Center and South. Thus, there is general homogeneity, with some degree, rather than kind, of heterogeneity in both maintenance and extractive tasks.

Maintenance and Extraction in Cathlapotle House I

The same pattern is seen in Cathlapotle House I, where 35 (42%) of the 82 chi-squared test variables were disqualified due to low counts, and of the remaining 47 variables, 62% were heterogeneously distributed and 48% were homogeneously distributed. Here, most variation from expectation is in the South and Center of the plank house, where stone was more commonly worked than in the North. Woodworking was noticeably less emphasized in the Center, and hide- and bone/antler-working were focused in the North. Extraction tasks were carried out in all zones to roughly the same degree. Generally speaking, all stages of all activities were carried out in all plank house zones, with an emphasis on hide- and bone/antler-working in the North and lithic production in the Center and South. Thus, there is general homogeneity, with some degree, rather than kind, of heterogeneity in maintenance tasks. Extractive tasks were carried out by all in generally even proportions.

Maintenance and Extraction in Cathlapotle House IV

Cathlapotle House IV was somewhat different. It had more chi-squared test disqualifications due to low counts (56 or 68%) and of the remaining 26 variables, 10 (38%) were heterogeneously distributed; these are related to lithic reduction only, and they are generally found in the South and North, being particularly uncommon in the Center. Maintenance activities were generally carried out by all, though there is a focus of woodworking in the South and a conspicuously low incidence of stone-working and hide-working in the Center and bone/antler-working in the North. Extractive activities were also generally carried out by all, with some heterogeneity evident in net fishing and butchery being more prominent in the South, and land hunting in the Center. Butchery does not appear to have been particularly important in the North. Thus in Cathlapotle House IV heterogeneity is roughly equal in both maintenance and extraction tasks.

Note that where there was heterogeneity in variable representation in plank house zones (55%, 62% and 38% of testable variables in Meier, Cathlapotle I and Cathlapotle IV, respectively), this was not polarity. Nearly all areas of all plank houses contained representatives of each stage of manufacture and each raw material worked.

In the following chapter I use these data to evaluate the alternative hypotheses presented at the beginning of this chapter, and I present my conclusions.

CHAPTER 6:
CONCLUSIONS

6.1 Conclusions

This study began with several major questions and approaches to those questions proposed in Chapter 2. Each is reviewed below in the appropriate context.

6.1.1. Inducted Conclusions: Lithic Usewear Analysis and the Range and Nature of Activities Among the Plank Houses

In the Inductive Phase I asked two general questions:

> What was the range of activities carried out at these sites?
> What was the nature of activities carried out at these sites?

I used usewear analysis to answer these questions. Naturally, in the course of analysis, unexpected observations were made, and I discuss several discoveries before addressing these questions directly.

The lithic usewear study was a useful exercise which identified the range and nature of activities carried out with fine-grained chipped lithics at these sites, to a degree of specificity very useful in the examination of labour organization. This specificity (e.g. assignment of UEs to specific work actions and raw materials) is not always possible with the morphofunctional classifications commonly used to examine these types of artifacts: while lithic projectile points and hide-scrapers are quite easily assigned to specific activities and raw materials, the many items simply classified in the field as LITHICRUM (Retouched, Utilized or Modified) item can, via usewear analysis, be further analyzed to reveal more aspects of production activity, as should be clear from the preceding chapter.

The principal findings of the usewear data may be summarized as follows:

1. Most materials common in the Wapato Valley region, including wood, bone, hide, flesh, and antler were commonly worked with these implements.

2. Vegetal matter was not commonly worked by these implements, with only one UE assigned to this activity of 2,108 artifacts examined. Since we know that vegetal matter was important for subsistence as well as the production of clothing and other finished goods, it must have been carried out with implements currently unknown, particularly because vegetal processing with cherts develops a highly distinctive polish very quickly which, as mentioned, is essentially absent in this assemblage.

3. Not all stages of manufacture of various raw materials were represented by usewear traces, indicating that some activities (read ‘stages of production’) were carried out by as-yet-unrecognized artifacts. For example the commonly-observed 'groove and splinter' technique requires girdling bone or antler, but this is not easily carried out with even the most robust gravers or saws of these assemblages and other unknown tools must have been used. Until these have been identified, we are missing some evidence of the various chaine-operatoires.

4. Most implements were made rather expediently, and used, with little recycling or investment of time or energy in terms of shaping or maintaining the implement; the important exceptions are the lithic projectile points and hide-scraping implements. These data extend Hamilton's (1994) characterization of the Meier lithic assemblage as expedient to the Cathlapotle site, based not only on observations of the lithic chaine-operatoire, but on the presence of many potentially-useful UEs without usewear, particularly in discard (midden) contexts. Although not much discussed here due to space limitations, it is clear that many implements were discarded before exhaustion, indicating a wasteful expedience rather than conservative recycling and reuse; this is generally expected of a locally-abundant raw material.

5. The Meier and Cathlapotle inhabitants were engaged in largely the same range and intensity of production activities reflected by fine-grained chipped stone implements; the exception is in hide-scraping, which was more important at Cathlapotle than at Meier.

6. The appearance of large quantities of metal, glass and ceramics in the Historic period did not substantially alter the use of lithics for the range of 17 general activities carried out at Meier and Cathlapotle. While a few metal projectile points and glass and ceramic scrapers have been found, they are rare. The Meier and Cathlapotle folk continued to use stone for most of their mundane production activities, well into the Historic period and indeed up to the point of abandonment of their dwellings.

7. The same general range of UE functions was found in all plank house zones in all sampled plank houses. Although there is some variation (see below), the data are best described as indicating essential similarity in the range and nature of activities carried out all along the long axes of the sampled plank houses.

6.1.2 Labour Organization Among the Plank House Sites

The usewear data indicate a broad similarity in activity in the Meier and Cathlapotle sites. Both populations used the same range of stone implements (which are morphologically similar, as a result of apparently identical production methods) for the same range of activities. As noted, hide-scraping was noticeably more important at Cathlapotle than at Meier. This is a qualitative statement, securely based in quantitative data, which may aid in the understanding of local economic variation, particularly in the Historic era, when hide-working became a particularly important activity.

In addition to the general comments made above, I can answer the specific question, ‘What was the range of activities carried out at these sites?’ by referring to Figure 32. The range is 17 UE functions on four raw material categories. Considering the engineering options and constraints of chipped crypto-crystalline silicates, and the properties of the most common raw materials of the Wapato Valley, I conclude that the range of activities was wide rather than narrow. Essentially all conceivable work actions appropriate to most Wapato Valley raw materials were carried out; the glaring exception is the lack of traces of processing vegetal matter.

I can also confidently answer my second question, 'What was the nature of activities carried out at these sites'? This is also addressed in Figure 32, where we see that both maintenance and extractive activities are represented by 17 UE function labels. Again, I characterize this as a wide range of activities expectable of an assemblage generated by sedentary peoples.

6.1.3 Deducted Conclusions: Activity Group Analysis and the Range and Nature of Activities Within the Plank Houses

In Chapter 2 I asked the question:

Was labour organization defined strictly by social rank?

I addressed this question with spatial distribution analysis of the material correlates of a variety of extraction and maintenance activities; these material correlates included, but were not restricted to, usewear traces. In Chapter 5 I presented two alternative hypotheses evaluated in the spatial distribution analysis:

(a) social rank strictly defined production activities measured by this study, because plank house residents of different social ranks were engaged in different production activities

and

(b) social rank did not strictly define production activities measured by this study, because plank house residents of different social ranks were engaged in the same production activities

as well as attendant test implications:

(a) material correlates of production activities will be significantly spatially *heterogeneous* among analytical units

and

(b) material correlates of production activities will be significantly spatially *homogeneous* among analytical units

Figure 50, the visual summary of all raw, density, proportion and expectation-evaluation data, can be used to evaluate these expectations. These are discussed below for each plank house.

Meier

At the Meier house we see that most heterogeneity occurred in extractive tasks. The North was concerned with net fishing more than any other area and the South focused on hunting on land. Note that the white spaces indicating a lack of emphasis on a given activity are as meaningful as the black spaces. Thus there is further heterogeneity in the lack of engagement in line fishing in the North, net fishing in the Central area and the South, and land hunting in the North. Of the twelve opportunities for heterogeneity or homogeneity in extractive tasks, 50% are homogeneously distributed and 50% are heterogeneously distributed. In maintenance tasks, people of all areas carried out the same labour to the same degree with the exception of stone-working, which was a particular concern in the Center. Evidence of heterogeneity of maintenance tasks occurs in only one case of twelve (8%).

In sum, labour in the Meier house was organized not by raw material or production stage: all raw materials were worked in all production stages in all areas (that is, by members of all social ranks according to the hypothetical arrangement of social ranks within the plank house). Neither were maintenance activities highly differentiated according to social rank, although free, middle-ranked people of the Center of the house were more engaged in the working of stone than any other rank group. Differentiation by social rank appears to have been by degree of engagement in extractive activities. Higher-ranked peoples engaged in more net fishing and less line-fishing and land hunting; land hunting was more commonly carried out by lower-ranked people, who did significantly less net-fishing.

In the Meier house, hypothesis (a) is supported for extractive tasks and hypothesis (b) for maintenance tasks.

Cathlapotle House I

In Cathlapotle House I there is broad homogeneity in extractive tasks, where we see no occurrences of higher- or lower-than average engagement in extraction tasks. Of the twelve opportunities for registering statistically significant heterogeneity or homogeneity in extractive tasks, there are zero cases of either. Of the same number in maintenance tasks, there are six (50%) cases of high- or low-incidence heterogeneity. Thus there is both heterogeneity and homogeneity, and it is ordered by whether a task falls into a maintenance or extractive task category.

In Cathlapotle House I, labour was not organized by raw material or production stage: all raw materials were worked in all production stages in all areas, that is, by members of all social ranks. Neither were extractive activities highly differentiated according to social rank: all people of all social ranks were roughly equally engaged in net fishing, hunting land animals and the butchery of the products of these fishing and hunting activities. Differentiation by social rank appears to have been by degree of engagement in maintenance activities. Higher-ranked peoples engaged in more stoneworking than others; such work was relatively rare among the lowest-ranked people of the North. The working of hide, bone and antler was most commonly engaged in by the lower-ranked people of the North, and middle-ranked people of the Center were less engaged in wood-working than anyone else.

In Cathlapotle House I, hypothesis (a) is supported for maintenance tasks and hypothesis (b) for extractive tasks.

Cathlapotle House IV

Cathlapotle House IV yields evidence of heterogeneity in both maintenance and extractive tasks. Of 21 opportunities for heterogeneity or homogeneity in activity distribution there are four cases of heterogeneity among extractive tasks and four cases among maintenance tasks. In this plank house most people were engaged in most of these tasks, although there is a convincing lack of traces of hideworking in the Center and perhaps an emphasis on woodworking in the South. The distribution here is difficult to characterize and does not fit that of Meier or Cathlapotle House I , where the mentioned differentiations are rather clearer. At this writing I am unconvinced of any explanation for the patterning in this plank house. If we revert to the assumption (Chapter 5) that if site formation processes are accounted for, all other things being equal, spatial variations indicate rank-based variations in labour engagement, then in this house labour was more complexly organized than in any other. However, this plank house has the most complex site formation processes of the three houses of this dissertation, and the smallest excavation sample. I withhold conclusions on this plank house until other lines of data are examined.

In sum, we find both heterogeneity and homogeneity in the distribution of labour within the plank houses. Where there is concentration of certain activities, in no case do I consider it evidence of full-time craft specialization, which by definition removes the craftsperson from other activities. Each of the concentrations should be considered a focus of work in a background of general labour tasks carried out by all. It should be noted that the activities of a single, full-time craftsperson may not be visible archaeologically in these palimpsests.

Thus we see that hypotheses (a) and (b) occur in each plank house rather than characterizing all activities in a given plank house. At Meier, extraction was varied by rank; maintenance, generally speaking, was not. At Cathlapotle House I, the opposite is evident, and in Cathlapotle House IV, there is heterogeneity in both maintenance and extraction tasks. We have multiple cases of heterogeneity, in which labour was differentially organized according to spatial location in a given plank house, and thus likely according to social rank. This organization does not occur in the same way in each house: in Meier, extraction is differentiated, whereas at Cathlapotle House I maintenance is differentiated and in Cathlapotle House IV both are differentiated.

I conclude that the Cathlapotle I and IV plank houses, within the same village and only some meters from one another, organized their food-getting and processing tasks, and tool-making and maintenance tasks, in different ways. These ways – their ecological solutions to living in the Wapato Valley – were different from those at the Meier site, occupied at the same time as the Cathlapotle sites. The Meier and Cathlapotle people were contemporaneous and must have known one another, being only a few miles apart.

They organized their most basic, mundane, daily activities in different ways. The reasons for these specific, demonstrated organizations is a topic for an entirely different study which must include the growing floral and faunal data sets, among others. Here it is sufficient to state that this would have had complex, unknown effects on interactions between plank house populations (read ‘households’).

To the question ‘Was labour organization strictly defined by social rank?’ I answer no; it was not strictly defined; most people did most activities. However I would say labour organization was defined to an extent by social rank, as there are some clear distinctions of activity in the North end of the Meier and South end of the Cathlapotle I plank houses.

6.1.4 What Was the Same and What Was Different

The same basic technologies were used in all plank houses at both sites and, as far as can be understood in this study, throughout occupation. Each plank house population, regardless of social rank, collected and stored stone, bone, antler, wood and hide, and processed them into essentially the same types of artifacts: artifact designs and sizes are essentially identical at Meier and Cathlapotle.

Also, the finished tools were used to process the same range of raw materials in the same ways, generating essentially identical usewear. Bone, wood, antler and hide were commonly worked; vegetal matter is conspicuous for almost complete absence. Hideworking was somewhat more important at Cathlapotle for reasons yet unknown, but it was also carried out in not insignificant amounts at Meier.

Thus what was similar among all sites was (a) the raw materials acquired, (b) the procedures for reducing raw materials into artifacts, (c) the use of those artifacts and (d) the use of those artifacts on specific raw materials. We may say that the technical or design solutions of sedentary foraging in the Wapato Valley were essentially identical among and within Meier and Cathlapotle.

What differs between the sites is the degree to which certain plank house sub-populations were engaged in the eight main extraction and maintenance activities. At Meier, degree of engagement varied with social rank for extractive activities, whereas maintenance activities were differentially engaged in within Cathlapotle House I. In Cathlapotle House IV, there is considerable activity heterogeneity in both extractive and maintenance tasks per plank house zone, but this plank house is harder to understand than the others because of its complex depositional history.

Thus, in terms of raw material acquisition and modification on the scale of reduction stages per raw material, we see general homogeneity within and among the plank houses. There was essentially a single set of technical design solutions to sedentary foraging in the Wapato Valley.

And, in terms of labour organization on the scale of maintenance and extraction activities, there is no evidence for a single ‘optimized forager’ solution to the problems of being a sedentary foraging group in the Wapato Valley. There were several ways to be such a group in this environment.

6.1.5 Household Labour Organization

Table 25 is a reconstruction of the Meier and Cathlapotle households; it is meant as a heuristic device not to be reified. The table is based on the elements and functions of the household (Wilk and Rathje 1982) as apparently carried out by the elite, commoners of middle rank and commoners of low rank at the Meier and Cathlapotle sites. In this reconstruction, as argued above in Chapter 5, I assume the North end of Meier and the South end of the Cathlapotle houses were the elite residences, the Centers were for commoners of middle rank and the South of Meier and North of the Cathlapotle houses were residences of the lowest-ranked commoners, which may include slaves. Note that I separate Consumption from Distribution, counter to Wilk and Rathje (1982) because they could likely be distinguished archaeologically at these sites. Note also that transmission and reproduction are not visible with the data generated for these sites in this study.

What is most evident in this table is that distribution and consumption do not appear to be strongly differentiated by social rank. These variables are tracked, respectively, by the distribution of cores and other parent material (e.g. caches of bone or antler), which appear in all plank house areas, and finished artifacts, which also appear in all plank house areas in roughly the same frequency. At least in terms of lithic, bone and antler raw materials, distribution and consumption were even by social rank. Faunal and floral analysis should be evaluated in the same way to add to this data, but not supercede it. Different resources may well have been treated differently.

The other most noticeable aspect of this table is that unevenness is only found in production, whether that production was geared towards maintenance or extraction. Social differentiation meant activity differentiation; it was not only a differentiation of rights, roles and responsibilities. This is noted generally in the historic record, and this study confirms such generalizations with archaeological data and extends them somewhat into the precontact period. This study has also specified some of the maintenance and extractive tasks which were engaged in differentially by people of differing social ranks.

The ultimate goals of my research are to (a) fill in the roles of each social rank in each of the household elements for these plank houses and (b) explain the differential participation in certain activities within the plank houses. This study has examined, with a large part of the available artifact data, several of the structuring elements of the household. Other data (e.g. faunal and floral, which are under study) should be used to supplement this characterization. Extended discussion of these sites without understanding the whole household (that is, a completely-filled-in table) would be counterproductive. This is not a plea for an infinitely-specific set of data: I do think our questions can be answered by the extant or developing data. Research goals are noted below in section **6.3 Suggestions for Future Research**.

6.2 Theoretical Implications

This study found that neither of the alternative hypotheses (homogeneous or heterogenous organization of labour) was applicable to all cases and that labour organization was more complex than anticipated. The way labour it was organized may be compared with the expectations of two specific alternative theories of labour organization among complex foragers, discussed below. However, it should be remembered that this project sought to *characterize* the organization of labour through usewear and other studies, rather than to *explain* it (as I will attempt in a forthcoming research effort). To properly evaluate any theory requires the evaluation of test expectations *specific to each theory*. The following evaluations are therefore very tentative.

It was noted in the Introduction that the organization of labour among complex foragers has been considered a structuring variable in their evolution. Arnold argues that social complexity (read 'ranking') emerges as a result of stress management, in which stresses provide fortuitous or apprehended opportunities (systemic weaknesses) for either (a) aggrandizing or (b) benign organizing behaviour in individuals or other interest groups (Arnold 1993). In this model the mechanism for gaining control (power) is that of labour organization. Emergent elites take control of the household-scale labour which characterizes 'simple' hunter-gatherers; the previous sexual and age-dependent division of labour are manipulated and the products of labour are no longer wholly available to the labourers. In this model elites may direct labour towards (a) food processing (surplus production), (b) non-food surplus production, (c) services, (d) ritual and/or (e) architectural, artistic or monumental projects, situations which may be archaeologically observable. Arnold (1993) also reviews a wide variety of theories regarding the integration of labour organization and social differentiation. Ames (1995) has categorized these alternative models as ‘Elite as Manager’ (activity management for welfare of the group: see Service 1975) and ‘Elite as Thug’ (activity management for self-aggrandizement): Coupland, paraphrasing Rathje, refers to them as the ‘functional’ (managerial) and ‘fungal’ (thuggish) alternatives (Coupland, personal communication, 2004).

Can the results of this study help us to characterize the nature of Chinookan elitehood? This study only examined production, and my comments must be restricted to that field. Regarding production, we have seen that labour was organized differently in each plank house, and that the energy that people of different social ranks put into certain activities was not equal, although they all took part in all production activities. Table 25 refined the data to suggest the most important production activities for each plank house rank group. Does this table suggest a managerial or thuggish role for elites?

If elites controlled production (a prediction of many elite-emergence models) to gain material wealth for themselves, we might expect to find concentrations of highly-valued end products in elite residences, and perhaps (though not necessarily) less-than-expected frequencies of production materials. None of the plank houses show this pattern, in the variables examined in this study. At Meier, the high-ranked North end had more net fishing equipment, suggesting a preoccupation with collecting netted fish, but net weights were also found in other areas. In a preliminary examination of the distribution of faunal remains at Meier, I found no compelling evidence for a Northerly concentration of mammalian food remains (two caveats apply here: (a) fish remain distributions have yet to be systematically studied, and (b) recall that this faunal homogeneity is unlikely to be the result of differential preservation or differences in cleanup in each zone). And, at Meier as in all the plank houses sampled, production debris was abundant in all areas of the plank houses. Thus what appears to have been *solely* in the possession of elites at Meier were some ritual items (e.g. the incised pumice face described above), but both their foods and artifacts were the same as those of all others in the plankhouses. At Cathlapotle, in both plank houses, we see the same (although, again, fish and other faunal remains have yet to be analyzed comprehensively): no unambiguous ownership of large stockpiles of resources by the elite, but a rather even distribution.

Thus elites do not appear to have controlled the production of either the most common artifacts or the most common raw materials utilized in the plank houses. If they managed that production, we might expect to find stockpiles of such materials in elite residences, for distribution during such management, but this is not found, either.

Could elites have controlled a narrower field of productive tasks, such as the production of art or other highly-valued items? This is difficult to substantiate, as the sites appear to have been abandoned in a controlled manner, allowing elites to take most of their status goods with them. In a preliminary analysis of several artifact classes and qualities as material correlates of very specialized production techniques, I found no evidence for technique differences within the Meier plank house (Smith 2003). This test has not been carried out on the Cathlapotle assemblage, but my familiarity with it suggests that the results will be the same. Thus elites do not appear to have controlled highly-specific production techniques.

It appears that, strictly regarding production (the only household function I systematically tracked in this study) there is more support for a managerial than acquisitive or aggrandizing role among Meier and Cathlapotle elites.

I must reiterate that my data are only one line of evidence, and must be integrated with other, forthcoming, data. Basing large-scale anthropological interpretations on this study alone is unwarranted. The floral, faunal and feature evidence must be integrated with the present study, some suggestions for which are outlined below.

6.3 Suggestions for Future Research

Any research effort answers some questions and generates new questions. The following studies could assist in finalizing an understanding of Meier and Cathlapotle labour organization.

1. The usewear data generated in this study should be incorporated with existing data to evaluate specific test implications of differing models of labour specialization. In a pilot study I found no compelling evidence for any of the several forms of labour specialization outlined by Costin (1991) (Smith 2003 and mentioned above). However, that study was preliminary and should be carried out again with the extant data.

2. Faunal, floral and feature data should be integrated with the current results to characterize more fully the range and nature of activities carried out within the plank houses. Essentially the same techniques for locating homogeneity and/or heterogeneity could be used to analyze these data sets, thereby adding to the multiple, independent lines of evidence for activity organization. Site-formation processes specific to each of these different data classes must be understood before they are analyzed for spatial distribution characteristics.

3. Detailed stratigraphic analysis should be conducted to identify specific pre- and post-contact deposits. If these are not visible within the plank houses boundaries, they should be visible in the middens; a pilot study I conducted on the Meier midden suggests that we can in fact separate pre- and post-contact deposits. While middens do not preserve the relationships of artifacts and UEs to analytical zones of plank houses from which they were derived, they do provide relatively undisturbed chronologies of gross activities through time. Effects on labour organization due to sustained contact should be investigated. This work has been started.

4. Stylistic and functional analyses of the most numerous chipped lithic implements (projectile points) of the two sites should be completed. A pilot project has identified significant differences; the Meier site, for example, has mostly stemmed points, while at Cathlapotle, just a few miles away, and occupied at the same time as Meier, most points were side-notched. The implications of this observation, in theoretical terms of stylistic tracking of ethnicity in archaeology, are significant.

5. The proposition that the North end of the Meier house, and the South end of the Cathlapotle houses, were elite residences, should be programmatically tested and demonstrated with data generated specifically to test these propositions.

6. Further experimentation with GLCR wood, bone, antler hide and stone technologies should be carried out for several reason. First, the production processes identified remain imperfectly understood. Experiments will refine our chaine-operatoire models and thereby our understanding of various raw materials, the artifacts they were transformed into and the resulting debris. Second, we cannot appreciate the full meaning of palimpsests without a better understanding of the number of behavioural episodes represented by a given artifact set. What does it mean that in one excavation unit of a plank house, ten lithic points were found in a four-century palimpsest, whereas in an adjoining unit, three times that were found? An answer based on artifact use-life estimates derived from experimentation must be richer than that based purely on mental exercise.

7. The data of this study should be compared with that of a very early GLCR plank house. A few such sites are known (e.g. Broken Tops at c.3,000 BP; see Connoly and Bland 1991) but have been incompletely excavated and/or analyzed. Labour organization at Meier and Cathlapotle may have been substantially reorganized through time, and there were certainly effects at contact (Panowski 1985), and even these effects probably varied in complex ways (Wike 1951). The present results must be put into a temporal context which does not exist at present. We may say that around contact, plank house labour was organized as indicated in this dissertation, but that in the distant precontact period it is completely unknown.

8. The usewear sample should be expanded to units containing useful count of data classes disqualified for low counts in the chi-squared test battery.

9. The Northernmost compartment or area of Cathlapotle House I should be sampled with at least three excavation units and the results analyzed in the present framework.

10. A concerted effort to understand Cathlapotle House IV should be mounted with a feature analysis; this may be aided by Sobel's doctoral dissertation (Sobel n.d.). If the house cannot be profitably understood, it should be deleted from analyses of labour organization, though it may still be analyzed for other reasons.

11. The understanding of the whole household, essentially through study designed to complete Table 25, should be sought before the presently-understood household is (a) widely discussed and/or (b) projected deeply into prehistory in an attempt to understand the origins of social differentiation.

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TABLES

TABLE 1.
Schematic Representation of the Household.

ELEMENT	DEFINITION	FUNCTION	COMMON ALTERNATE STATES	EXAMPLE
Production	Procurement and/or value modification of a resource.	To effectively exploit the particular characteristics of a certain resource.	Organization often reflects scheduling requirements demanded by the resourc e in question. Such scheduling may be: **linear** (accomplished by a single person) or **simultaneous** (must be done by >1 person working at the same time).	Linear = single lithic reduction sequence, simple tool production. Simultaneous = hunting from a canoe, collection / initial processing of salmon.
Distribution	Process of moving resources from producers to consumers (includes consumption).	Varies with the mode of subsistence and production. In general, the function is to make the transportation process efficient (vari ability reflects different movement requirements).	Organization reflects transport requirements demanded by the resource in question. Two main strategies: **pooling** (distribution of resource within the household) or **exchange** (distribu tion among households or between larger corporate units).	On the NW Coast, the mixed economy generated pooling of diverse resources within the household, **and** allowed exchange. In 'band' or 'state-level' organization, with a more restri cted range of products, emphasis is on exchange between households.
Transmission	The transfer of rights, roles, 'property' and responsibilities between generations.	A special form of distribution: transmission functions to transfer (distribute) owned resources or rights (etc.) between genera tions rather than amongst generations. Presumeably this is a means of propogating lineage wealth.	Varies with the level of unit in whic the property rights are vested. Often divided into property which is **partible** (may be divided between inheritors) and **impartible** (may not be divided between inheritors).	As resource availability decreases, households fission (often into nuclear units) because there is not enough resource to go around (except in the most wealthy households).
Reproduction	The rearing and enculturation of children.	Genetic and cultural survival via genetic and cultural propogation.	Least flexible of the household functions. Labour of child-care is often pooled within the household when females perform critical elements of subsistence labour.	Labour pooling may include 'day care', adoption for certain periods, etc.

TABLE 2.
Properties of Selected Plankhouses Excavated on the Northwest Coast.

Site	Date BP	Area m^2	Length m	Width m	Population	Families	Hearths	Pits	L1	L2	BA1	BA2	F	B	UW	O	Evidence for Labour Organization by Social Rank
Maurer	4800	104	13	8	13	1	1	0	x								none
Paul Mason	3000	60	10	6	14	2	2	0	x		x		x	x			none
Keatley Creek	2000	90	11	11	35	5	6	8	x	x	x		x	x		x	some
Tualdad Altu	1500	119	17	7	28	4	4	0	x								some
Dionisio Point	1500	240	24	10	28	4	4	0	x		x		x				some
Ozette	500	240	20	10	49	7	7	0	x	x	x	x	x	x		x	some
Meier	400	490	35	14	98	14	7	>60	x	x		x			x		some
Cath House I	400	550	50	11	126	18	9	>40	x	x		x			x		some
Cath IV	400	150	15	10	56	8	4	>10	x	x		x			x		some
Sbabadid	200	243	27	9	28	4	4	0	x		x		x				some
Cla-Cleh-Lah	100	80	10	8	14	2	2	5	x		x		x				unknown at this time

Data types spatially analyzed at this writing:

L1 = lithic implements
L2 = lithic debitage
BA1 = bone/antler tools
BA2 = bone/antler debitage
F = faunal material
B = botanical material
UW = usewear
0 = other category

TABLE 3.
Scales of Identity and Interaction on the Northwest Coast.
(adapted from Gamble 1999, Table 2.8)

	Emotional	Material / Exchange	Symbolic / Stylistic	Network Type
Intimate Space (meters)	significant others	generalized household	immediate household	personal
Effective Space (c.50km)	friends and colleagues	generalized village sector	friends and relatives	personal
Extended Intimate Space (c.300km)	friends of friends	balanced tribal sector	socially distant target groups	personal
Global Space (>300km)	neutral or enemy	negative intertribal sector	non-target groups very socially distant	non-personal

TABLE 4.
Cultural and Economic Characteristics of Early-Historic Northwest Coast Societies.

Area	Average Local Group Size	Units of Production and Consumption	Resource Patch Ownership	Storage of Foods	Wealth	Distribution and Redistribution
North Coast	382	Nuclear family & plank house, some multi-plank house cooperative efforts	Matrilineage subgroup (kin-group)	over-winter common and maximal	ornate & exotic items, slaves	inter-village potlatch
Central Coast	666	Nuclear family & plank house, some multi-plank house cooperative efforts	Extended family group (kin group)	over-winter common and maximal	ornate & exotic items, slaves	inter-village potlatch
South Coast	83	Nuclear family & plank house, some multi-plank house cooperative efforts	village group (non-kin) corporate ownershop	over-winter common and maximal	ornate & exotic items, slaves	fewer potlatches
GLCR	400	Nuclear family & plank house, some multi-plank house cooperative efforts	village group (non-kin) corporate ownershop	over-winter common and maximal	ornate & exotic items, slaves	no potlatch

TABLE 5.
Functional Inferencs from 16 Basic Artifact Types.

TYPE	WORK ACTION & WORKED MATERIAL	INFERRED ACTIVITY
Lithic CUT (n=123)	Incise wide variety of relatively yielding materials, including meat, hide, vegetal matter.	Multipurpose tool.
Lithic GRAVE (n=30)	Incise resistant materials, such as bone, antler and wood.	Wood, bone and antler working. Both early-stage (e.g. groove-and-splinter) and late-stage (e.g. decoration on finished artifact) work may be represented.
Lithic PERFORATE (n=44)	Perforation both rotary and simple, of a relatively resistant materials, such as wood, bone and antler.	Perforation of antler, bone and wood for a wide variety of tasks.
Lithic SCRAPE (n=205)	Scrape a wide variety of medium-hard materials, such as hide, wood, bone and antler (hide scrapers are discussed in the text).	General-purpose scraping.
Lithic SHAVE (n=110)	Shave on moderately resistant material, such as wood, but unlikely on such material as bone or antler.	Woodworking, probably in both roughing-out (early) stages, as well as later, smoothing stages.
Lithic WEDGE (n=14)	Wedge of resistant raw materials, such as bone and antler.	Splitting resistant worked materials. Small size suggests use on bone and antler rather than wood, for which bone/antler wedges are appropriate.
Lithic SAW (n=4)	Cutting resistant materials, such as wood or bone, but unlikely antler.	Wood and bone working in rather early stages.
Lithic POINT (n=819)	Puncture terrestrial animals.	Hunting terrestrial game, such as elk and deer.
Lithic ABRADE (n=214)	Abrade wide variety of raw materials, such as bone, antler and wood. Differences in abrader raw material (e.g. basalt vs-pumice) suggest differences in worked material.	General-purpose abrasion tool for wide variety of activities.
Lithic MORTAR/BOWL (n=13)	Percussive base and/or temporary container.	Probably used for a wide variety of crushing and pounding activities, including both extravtive and maintenence activities.

(continued next page)

TYPE	WORK ACTION & WORKED MATERIAL	INFERRED ACTIVITY
Lithic MAUL/PESTLE (n=32)	Percussive hammer used on variety of non-lithic materials.	Wide variety of uses in woodworking (mauls) and, in conjunction with mortars, e.g. for food preparation.
Lithic NET WEIGHT (n=33)	Sinking fishing net weights.	Fishing, likely for salmon or sturgeon.
Bone/Antler POINT+BIPOINT (n=75)	Puncture + apprehend aquatic species, such as sturgeon and seal.	In most cases, hunting of aquatic mammals, such as seal. Some hunting of terrestrial mammals as well.
Bone/Antler HARPOON VALVE (n=33)	Apprehend aquatic mammals.	Sea mammal hunting, primarily.
Bone/Antler WEDGE/ADZE (n=76)	Wedge & adze medium resistant materials, such as wood.	Woodworking, in potentially all stages (early, middle and late), but emphasis on early to middle stages such as 'roughout'.
Bone/Antler CHISEL (n=11)	Chisel moderately resistant material such as wood.	Woodworking, probably more commonly towards end of production process, such as in finishing work.
Bone/Antler PERFORATOR (n=134)	Perforate moderately resistant material, such as leather, as well as pushing material through holes, as in basketry. Possibly pressure applicant.	Probably mostly representing hide-working and basketry construction. Some may be pressure flakers.

TABLE 5.
Functional Inferencs from 16 Basic Artifact Types, continued.

TABLE 6.
Chipped & Ground Stone Production Within Plank Houses.

PRODUCTION SYSTEM AND STAGE	MATERIAL CORRELATE	PRESENT ?
Chipped Lithic		
Raw material import.	Unused fine-grained cobbles (non-local manuports).	Yes
	Fine-grained cobbles with single assay strikes.	Yes
Initial core reduction.	G1&G2 (>1/2”) debitage.	Yes
	Size 3&4 (>15cm) hammerstones.	Yes
	Non-exhausted cores.	Yes
	Anvil usewear on cobbles.	Yes
Raw material heat-treatment.	Thermal alteration evident on early-stage cores (crazing, potlidding, discoloration, etc.).	Yes
Flake production.	Flake tools.	Yes
	Much G3 (<1/2-1/8”) debitage.	Yes
	Cores bearing flake-removal scars.	Yes
Flake heat-treatment.	Thermal alteration evident on flakes bearing no usewear or reduction scars (crazing, potlidding, discoloration, etc.)	Yes
Flake reduction.	Much G4 (<1/2-1/8”) debitage.	Yes
	Antler flaking tines.	Yes
	Size 1&2 (<10cm) hammerstones.	Yes
Tool use.	Usewear.	Yes
Core & tool curation / storage.	Core and tool caches.	Yes
	Useable tool presence in discrete pits.	Yes
Tool recycling.	Tool resharpening over usewear traces.	Yes
	Tool reshaping for new use.	Rare
	Use of exhausted bipolar cores as wedges.	Yes
Tool modification for reuse.	Post-use thermal alteration evident on finished tools (crazing, potlidding, discoloration, etc.).	Rare
Tool exhaustion.	Extreme blunting of use elements.	Yes
	Rework of tools to very small size.	Yes
	Broken tools (usewear terminated by break).	Yes

(continued next page)

PRODUCTION SYSTEM AND STAGE	MATERIAL CORRELATE	PRESENT ?
Core exhaustion.	Core reduction to state where no more flakes may be reasonably removed. Some bipolar cores.	Yes Yes
Core discard.	Core presence in midden deposits.	Yes
Tool discard.	Tool presence in midden deposits.	Yes
Core and tool loss.	Useable tool presence in toft and/or wall trench.	Yes
Ground and Percussed Lithic		
Raw material import.	Unused basaltic cobbles and blocks (nonlocal manuports).	Yes
Initial core reduction/shaping.	Basaltic cobbles and blocks bearing non-use-related flaking and/or incomplete percussive shaping. Ground-stone production tools.	Yes Yes
Final shaping.	Finished ground/percussed tools (assumed not imported).	Yes
Tool use.	Usewear.	Yes
Tool curation / storage.	Tool caches. Useable tool presence in discrete pits.	Yes Yes
Tool re-use and/or recycling.	Presence of usewear on previously broken tool elements.	Yes
Tool exhaustion.	Thermal alteration of fragments of ground/percussed tools. Broken tools (uswear terminated by break).	Yes Yes
Tool discard.	Tool presence in midden deposits.	Rare
Tool loss.	Useable tool presence in toft and/or wall trench.	Yes

TABLE 6.
Chipped & Ground Stone Production Within Plank Houses, continued.

TABLE 7.
Bone/Antler, Wood and Hide Production Within Plank Houses.

PRODUCTION SYSTEM AND STAGE	MATERIAL CORRELATE	PRESENT ?
Bone and Antler		
Raw material import.	Bone and antler items bearing no butchery marks.	Yes
	Lithic projectile points (for hunting animals bearing bone & antler).	Yes
Initial bone and antler reduction.	Non-butchery-related working of bone/antler (e.g. channels for groove-splinter method).	Yes
	Bone/antler debitage shavings and flakes.	Yes
	Lithic wedges.	Yes
Later / final shaping.	Presence of lithic abraders with wear grooves.	Yes
	Presence of finished tools (e.g. unused items).	Yes
	Lithic usewear indicating bone / antler perforation, graving, scraping, and other later-stage activities.	Yes.
Tool use.	Usewear.	Yes
Tool curation/storage.	Tool caches.	Yes
	Useable tool presence in discrete pits.	Yes
Tool re-use and/or recycling.	Presence of usewear on previously broken elements.	Rare
Tool exhaustion.	Thermal alteration of fragments of ground/percussed tools.	Rare
	Broken tools (uswear terminated by break).	Rare
Tool discard.	Tool presence in midden deposits.	Yes
Wood		
Raw material import.	Indet	indet
Initial wood reduction.	Bone and antler wedges.	Yes

(continued next page)

PRODUCTION SYSTEM AND STAGE	MATERIAL CORRELATE	PRESENT ?
Later / final shaping.	Bone and antler chisels. Lithic usewear indicating wood perforation, graving scraping, and other later-stage activities.	Yes Yes
Tool use.	indet	Indet
Tool curation/storage and/or recycling.	indet	indet
Tool exhaustion.	indet	indet
Hide		
Raw material import.	Lithic projectile points (for obtaining some hide-bearing animals).	Yes
Initial hide reduction.	Lithic tools with hide-cutting usewear.	Yes
Later / final hideworking.	Lithic tools with hide-scraping usewear. Bone and antler perforators.	Yes Yes
Hide use.	indet	indet
Hide curation/storage.	indet	indet
Hide re-use and/or recycling.	indet	indet
Hide exhaustion.	indet	indet
Hide discard.	indet	indet

TABLE 7.
Bone/Antler, Wood and Hide Production Within Plank Houses, continued.

TABLE 8.
Summary of Site-Formation Process and Attendant Analytical Strategies.

PROCESS or AGENT	SIZE of ARTIFACTS EFFECTED	DIRECTION of MOVEMENT	MAGNITUDE of MOVEMENT	ANALYTICAL STRATEGY
Bench Maintenance	all	horizontal	meters	do not sample benches
Cellar Maintenance	all	horizontal vertical	10s of cm 10s of cm	do not stratify cellar sample
Pitfill Dump: Midden	all	horizontal	10s of m	do not assign midden deposits to any plank house area
Pitfill Dump: Toft	all	horizontal	several m	do not sample toft
Pitfill Dump: Other Pits	all	horizontal vertical	several m <1m	do not sample adjacent pits of different analytical units
Hearth Periphery Maintenance	large	horizontal	<2m	remember that HP artifact values may be low due to intensive cleanup
Trampling	all	horizontal vertical	<2m none	likely negligible
Site Mining or Scavenging	all (particularly valued)	horizontal	any	do not sample house corners

(continues next page)

PROCESS or AGENT	SIZE of ARTIFACTS EFFECTED	DIRECTION of MOVEMENT	MAGNITUDE of MOVEMENT	ANALYTICAL STRATEGY
Pothunting	all	horizontal vertical	several m several m	do not sample areas damaged by pothunters
Plowing	all	horizontal	any	negligible
Carnivore Activity	large (>10cm) bone	horizontal vertical	any 3-5m	do not smaple gnawed bone; treat faunal nmon-tool assemblage separately
Water Washing	all	horizontal	any	negligible
Wind Sorting	all	horizontal	any	negligible
Biological Action	small	horizontal vertical	<10m <10cm	use cell-frequency analysis, not point-pattern
Geological Action	small	horizontal	<10cm	negligible
Differential Preservation	small bone & antler	-	-	consider non-tool faunal data separately

TABLE 8.
Summary of Site-Formation Process and Attendant Analytical Strategies, continued.

TABLE 9.
Usewear Replication Studies, 1991-1999.

The number of Utilized Elements per work action and worked material are noted.
na = the work action and worked material are incompatible

	WOOD (Dry)	**WOOD (Fresh)**	**BONE or ANTLER**	**HIDE**	**FLESH (Fish Butchery)**	**FLESH (Mammal Butchery)**	**PLANT**	**SUM**
CUT	na	na	na	62	62	68	26	**218**
SCRAPE	42	52	93	34	na	na	na	**221**
SHAVE	95	21	32	na	na	na	na	**148**
SAW	104	36	44	na	na	na	na	**184**
WEDGE	9	3	28	na	na	na	na	**40**
GRAVE	56	67	70	na	na	na	na	**193**
PERFORATE (with chipped stone)	76	54	21	35	na	na	na	**186**
ABRADE (with pumice)	70	26	38	na	na	na	na	**134**
STONE UE TOTALS:	**452**	**259**	**326**	**131**	**62**	**68**	**26**	**1,324**
PRECENT:	34.1	19.6	24.6	9.9	4.7	5.1	2.0	100
PERFORATE (with bone/antler)	na	na	na	17	na	na	na	**17**

TABLE 10.
Blind Test Results.

ANALYST	USE REGION % Correct	WORK ACTION % Correct	WORKED MATERIAL % Correct	SOURCE
Driskell	90	56	52	Driskell, 1986
Odell	79	69	38	Odell & Odell Vreecken, 1980a
Odell	80	75	36	Odell & Odell Vreecken, 1980b
Keeley & Newcomer	87	75	62	Keeley & Newcomer, 1977
Gendel & Pirnay	91	82	73	Gendel & Pirnay, 1982
Richards	90	90	40	Richards, 1988
Bamforth et al	83	78	66	Bamforth et al, 1988
Shea	96	85	75	Shea, 1991
Running Average:	**87.0**	**76.3**	**55.3**	
Smith (author)	84	62	46	1990 test
Smith (author)	86	72	77	1994 test
Smith (author)	88	81	82	1997 test
Smith Average:	**86.0**	**71.7**	**68.3**	

TABLE 11.
Counts of Variables 1-20 in the Meier and Cathlapotle Samples.

UNIT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	SUM
1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	**8**
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	2	0	**8**
3	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**3**
4	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**3**
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
6	D	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**2**
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	**3**
8	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**1**
9	D	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	**4**
10	D	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	5	0	0	0	**6**
11	D	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0	1	0	**5**
12	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	**6**
13	C	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	6	0	0	0	**9**
14	C	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	10	1	3	0	**16**
15	B	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
16	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
17	-	0	3	1	5	2	0	2	2	0	0	1	0	0	8	0	2	9	1	0	**36**
18	-	0	6	1	9	0	0	3	3	20	0	0	5	2	7	0	5	9	0	0	**70**
19	-	0	1	0	2	1	0	0	0	6	0	0	0	0	4	0	2	14	2	0	**32**
20	-	0	3	0	25	1	0	4	4	0	0	0	1	0	13	0	3	22	3	0	**79**
21	-	0	1	0	7	0	0	0	0	8	0	0	0	2	11	0	5	11	1	0	**46**
22	-	0	5	0	13	0	0	0	0	0	1	2	1	1	17	0	9	21	1	0	**71**
23	-	0	0	0	4	0	0	0	0	2	0	1	0	1	2	0	2	3	1	0	**16**
24	-	0	2	1	8	0	0	0	0	10	1	0	1	1	26	0	9	11	2	0	**72**
		0	**21**	**3**	**83**	**4**	**0**	**9**	**13**	**46**	**2**	**8**	**8**	**7**	**88**	**0**	**84**	**103**	**18**	**0**	**497**

Variable Key

1 = UNIT'S APARTMENT DESIGNATION (see text)
2 = ANTLER CHISEL
3 = ANTLER DEBITAGE
4 = ANTLER HARPOON VALVE
5 = ANTLER INDET ITEM
6 = ANTLER PERFORATOR
7 = ANTLER POINT
8 = ANTLER TINE
9 = ANTLER WEDGE
10 = ANTLER/BONE DEBITAGE
11 = ANTLER/BONE PERFORATOR
12 = BONE RODENT INCISOR
13 = BONE CHISEL
14 = BONE CHISEL/WEDGE
15 = BONE DEBITAGE
16 = BONE HARPOON VALVE
17 = BONE INDET WORKED ITEM
18 = BONE PERFORATOR
19 = BONE POINT
20 = BONE HARPOON TOGGLE

See page 227 for Unit Key

TABLE 12.
Counts of Variables 21-40 in the Meier and Cathlapotle Samples.

UNIT	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	SUM
1	1	0	13	0	1	0	1	0	5	0	24	0	0	0	7	0	0	0	1	1	**54**
2	0	6	18	0	0	1	23	4	5	0	20	1	0	0	13	0	0	1	1	4	**97**
3	0	2	3	0	2	2	22	5	2	0	7	0	0	0	6	0	0	2	0	0	**53**
4	0	13	7	0	0	0	8	5	1	0	11	0	0	0	8	0	1	0	0	0	**54**
5	0	0	4	0	1	0	12	4	8	0	9	1	0	0	13	0	0	0	0	13	**65**
6	0	0	13	0	0	3	2	9	1	0	17	1	0	0	8	1	0	1	1	0	**57**
7	0	0	4	0	1	0	4	5	2	0	31	2	0	0	2	0	0	0	2	5	**58**
8	0	0	7	0	2	0	8	2	1	0	47	0	11	0	6	0	1	1	0	2	**88**
9	0	0	5	0	2	0	3	3	6	0	23	0	0	0	6	0	0	1	1	0	**50**
10	0	1	5	0	0	0	2	5	9	0	15	0	0	0	4	0	0	3	0	3	**47**
11	0	0	6	0	3	1	8	0	14	0	29	0	0	0	24	0	0	0	0	4	**89**
12	0	1	4	0	0	0	1	2	2	0	7	0	0	0	2	0	0	2	0	2	**23**
13	0	0	1	0	0	0	1	1	1	0	7	0	0	0	8	0	0	0	0	0	**19**
14	0	0	2	0	0	0	8	1	2	0	10	0	0	0	1	0	0	0	1	1	**26**
15	0	0	5	0	1	0	4	2	6	0	21	2	0	0	5	0	0	1	2	2	**51**
16	0	0	2	0	0	0	21	0	1	0	0	0	0	0	0	0	0	0	0	0	**24**
17	1	13	29	0	5	1	0	26	14	2	35	0	0	0	26	1	4	6	0	0	**163**
18	1	11	15	0	6	0	2	14	5	1	62	6	2	0	17	2	3	7	2	1	**157**
19	0	6	6	0	1	1	11	2	1	0	24	2	0	0	4	0	0	0	3	0	**61**
20	1	11	19	0	6	1	27	21	5	0	77	7	3	0	33	6	0	2	10	1	**230**
21	0	21	19	0	2	3	13	41	6	0	48	3	2	0	12	1	4	2	2	0	**179**
22	2	11	14	1	2	1	40	21	4	0	134	19	3	0	8	3	0	0	6	1	**270**
23	1	1	2	0	0	0	16	5	2	0	40	6	2	0	3	0	0	0	3	0	**81**
24	0	7	3	0	0	0	13	2	2	0	27	5	0	0	2	1	0	0	7	1	**70**
	7	**104**	**206**	**1**	**35**	**14**	**250**	**180**	**105**	**3**	**725**	**55**	**23**	**0**	**218**	**15**	**13**	**29**	**42**	**41**	**2066**

Variable Key

21 = BONE WEDGE
22 = CLAY, BAKED
23 = LITHIC ABRADER
24 = LITHIC ADZE/CELT
25 = LITHIC ANVIL
26 = LITHIC MORTAR/BOWL
27 = LITHIC BIPOLAR CORE
28 = LITHIC CRYPTO-CRYSTALLINE SILICATE MANUPORT
29 = LITHIC COBBLE TOOL
30 = LITHIC CLUB
31 = LITHIC CORE
32 = LITHIC CUTTER
33 = LITHIC GRAVER
34 = LITHIC GUN FLINT
35 = LITHIC HAMMER
36 = LITHIC INDET GROUND STONE
37 = LITHIC MAUL/PESTLE
38 = LITHIC NET WEIGHT
39 = LITHIC PERFORATOR
40 = LITHIC PIGMENT

See page 227 for Unit Key

TABLE 13.
Counts of Variables 41-60 in the Meier and Cathlapotle Samples.

UNIT	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	SUM
1	13	37	3	0	1	0	20	0	0	0	0	0	0	0	0	0	0	1	0	0	**75**
2	34	54	27	4	9	0	27	0	0	0	0	0	2	0	1	0	0	18	0	0	**176**
3	13	21	12	2	0	0	11	0	0	0	0	0	0	0	0	1	0	6	0	0	**66**
4	34	21	10	0	2	0	6	0	0	0	0	0	0	0	0	0	0	3	0	0	**76**
5	22	26	6	6	0	0	12	0	0	0	0	0	0	0	0	0	0	14	0	0	**86**
6	28	43	7	0	1	0	21	0	0	0	0	0	0	0	0	1	0	9	0	0	**110**
7	53	25	29	0	6	0	21	0	0	0	0	0	0	0	0	3	0	23	0	0	**160**
8	33	72	45	0	2	0	15	0	0	1	0	0	3	0	0	7	1	11	0	0	**190**
9	55	51	24	2	2	0	28	0	0	0	1	0	7	0	1	8	0	12	0	0	**191**
10	25	40	9	2	0	0	6	0	0	0	0	0	0	0	0	2	0	7	0	0	**91**
11	42	58	38	1	3	0	13	0	0	0	1	0	0	0	0	4	0	13	0	0	**173**
12	19	17	8	0	1	0	7	0	0	0	0	1	0	0	0	1	0	9	1	0	**64**
13	12	27	13	0	1	0	7	0	0	0	0	2	1	0	0	0	1	5	0	0	**69**
14	21	48	28	0	0	0	14	0	0	0	0	0	0	0	0	5	0	7	0	0	**123**
15	25	85	9	2	1	0	9	0	0	1	0	0	0	0	1	6	0	10	0	0	**149**
16	5	3	5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**14**
17	37	18	29	14	4	0	8	1	0	0	0	1	0	0	0	5	1	5	0	0	**123**
18	41	37	41	5	6	0	12	7	0	0	0	0	3	1	0	3	2	7	0	0	**165**
19	40	28	47	1	4	0	7	0	1	1	2	0	1	0	0	7	2	1	0	0	**142**
20	102	54	107	5	4	2	34	6	3	2	0	1	9	0	0	11	6	11	0	0	**357**
21	53	29	74	6	5	0	21	5	0	1	0	1	1	0	0	8	4	9	0	0	**217**
22	78	42	69	4	11	2	27	7	1	1	0	2	4	3	0	20	3	10	0	0	**284**
23	14	33	33	2	1	0	11	8	0	1	1	1	0	1	0	11	0	2	0	1	**120**
24	36	18	53	2	4	0	11	7	1	2	2	1	2	0	0	1	3	3	0	0	**146**
	835	**887**	**726**	**58**	**68**	**4**	**348**	**41**	**6**	**10**	**7**	**10**	**33**	**5**	**3**	**105**	**23**	**196**	**1**	**1**	**3367**

Variable Key

41	=	LITHIC PROJECTILE POINT	51	=	BONE/ANTLER PERFORATING UE
42	=	LITHIC RETOUCHED, UTILIZED OR MODIFIED ITEM	52	=	BONE/ANTLER SAWING UE
43	=	LITHIC RETOUCHED OR UTILIZED BIFACE	53	=	BONE/ANTLER SCRAPING UE
44	=	LITHIC RETOUCHED OR UTILIZED COBBLE	54	=	BONE/ANTLER SHAVING UE
45	=	LITHIC RETOUCHED OR UTILIZED UNIFACE	55	=	BONE/ANTLER WEDGEING UE
46	=	LITHIC SAW	56	=	BUTCHERY UE
47	=	LITHIC SCRAPER	57	=	HIDE CUTTING UE
48	=	LITHIC SHAVER	58	=	HIDE SCRAPING UE
49	=	LITHIC WEDGE	59	=	HIDE PERFORATION UE
50	=	BONE/ANTLER GRAVING UE	60	=	PLANT CUTTING UE

See page 227 for Unit Key

TABLE 14.
Counts of Variables 61-80 in the Meier and Cathlapotle Samples.

UNIT	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	SUM
1	0	0	0	0	1	1	0	17	5	0	0	0	0	0	0	0	0	0	0	24	**48**
2	0	0	0	0	2	10	0	49	20	0	9	1	2	0	1	0	1	0	0	95	**190**
3	0	0	0	0	3	13	0	11	6	0	1	0	1	0	0	0	0	3	0	38	**76**
4	0	0	0	0	1	5	0	23	4	0	0	0	0	0	1	0	1	0	0	35	**70**
5	0	0	0	0	2	4	0	14	6	0	0	0	0	1	0	0	0	0	0	27	**54**
6	0	0	1	1	3	1	4	41	3	0	0	0	2	1	0	0	0	0	0	57	**114**
7	0	0	0	0	4	2	1	17	13	0	0	0	2	1	1	0	0	0	1	42	**84**
8	3	0	3	2	11	1	0	29	17	0	2	9	2	1	2	0	2	2	0	86	**172**
9	1	1	1	1	17	1	0	31	19	2	2	0	3	2	0	0	2	5	1	89	**178**
10	0	0	1	0	0	2	2	23	12	0	0	0	1	0	0	0	1	0	0	42	**84**
11	0	1	0	3	9	4	0	29	25	2	8	2	0	0	0	0	8	0	0	91	**182**
12	0	0	1	0	1	1	0	12	10	0	0	0	0	1	0	0	0	1	0	27	**54**
13	0	0	0	0	3	0	0	4	0	0	1	0	1	1	0	0	1	0	0	11	**22**
14	0	0	0	1	6	4	0	29	19	0	0	3	2	3	0	0	3	4	0	74	**148**
15	1	0	7	1	5	1	0	9	0	0	0	0	6	0	0	0	0	1	0	31	**62**
16	0	1	0	0	1	21	0	2	3	0	0	1	0	0	0	0	0	0	0	29	**58**
17	1	0	0	0	7	0	1	15	19	0	1	0	0	0	0	1	0	0	0	45	**90**
18	2	2	2	0	10	1	2	47	25	0	2	1	2	2	0	0	0	1	0	99	**198**
19	1	1	2	0	6	4	4	41	21	0	0	0	0	2	0	1	0	0	0	83	**166**
20	4	1	1	7	15	10	4	87	63	0	2	4	1	0	2	0	0	0	0	201	**402**
21	5	1	1	1	6	5	1	58	41	0	1	0	1	0	0	1	0	1	0	123	**246**
22	7	1	3	2	15	20	1	72	48	0	0	2	1	2	0	0	1	0	1	176	**352**
23	2	0	1	2	6	3	1	31	32	0	0	3	0	0	1	0	1	1	0	84	**168**
24	2	1	4	2	5	2	1	31	43	0	0	1	0	0	1	0	1	0	0	94	**188**
	29	**10**	**28**	**23**	**139**	**116**	**22**	**722**	**454**	**4**	**29**	**27**	**27**	**17**	**9**	**3**	**22**	**19**	**3**	**1703**	**3406**

Variable Key

61 = WOOD GRAVING UE
62 = WOOD PERFORATION UE
63 = WOOD SAWING UE
64 = WOOD SCRAPING UE
65 = WOOD SHAVING UE
66 = BIPOLAR CORES IDENTIFIED IN USWEAR STUDY
67 = FREEHAND CORES IDENTIFIED IN USEWEAR STUDY
68 = INDET USEWEAR ITEM
69 = PROJECTILE POINT FRAGMENT
70 = UNUSED CHOPPING UE
71 = UNUSED CUTTING UE
72 = UNUSED GRAVING UE
73 = UNUSED HIDE SCRAPER
74 = UNUSED CUTTING UE / KNIFE
75 = UNUSED PERFORATOR
76 = UNUSED SAW
77 = UNUSED SCRAPER
78 = UNUSED SHAVER
79 = UNUSED WEDGE
80 = FINE-GRAINED NON-PROJECTILE POINT LITHIC WEAR SAMPLE

See page 227 for Unit Key

TABLE 15.
Counts of Variables 81-100 in the Meier and Cathlapotle Samples.

UNIT	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	0	0	0	0	0	0	0	2	5	0	7	135	24	0	0	1	0	4	7
2	23	14	863	6	207	560	89	2	6	5	0	13	81	20	3	6	18	7	17	6
3	10	5	327	3	86	224	14	0	1	4	1	6	101	7	0	2	7	1	7	3
4	4	2	542	10	67	334	131	0	3	4	1	8	61	11	3	2	5	1	18	13
5	16	1	788	5	129	523	131	0	7	6	0	13	85	9	0	5	17	2	10	10
6	15	3	544	2	121	375	46	0	0	7	1	8	67	13	1	6	11	7	20	15
7	30	5	695	1	52	204	438	0	2	0	0	2	112	30	1	4	20	10	21	24
8	42	20	1740	7	352	1036	345	0	4	2	0	6	104	47	1	11	8	10	29	28
9	50	17	1520	36	364	967	153	0	4	2	0	6	142	23	1	7	12	3	29	28
10	10	2	277	1	39	179	58	0	1	3	0	4	215	13	1	2	4	3	9	8
11	31	20	1155	3	267	714	171	1	11	8	4	24	86	29	0	2	13	2	15	28
12	14	2	736	6	89	364	277	0	2	0	0	2	68	7	1	3	9	2	6	10
13	12	4	398	3	60	283	52	0	5	2	1	8	18	7	2	0	7	2	6	5
14	19	15	546	5	132	345	64	0	1	0	0	1	18	10	0	1	13	6	11	9
15	32	7	677	43	208	355	71	0	4	1	0	5	103	21	3	4	17	6	11	13
16	3	1	88	1	9	63	15	0	0	0	0	0	14	0	0	2	0	0	3	2
17	20	2	2504	17	407	1528	553	5	18	2	1	26	286	34	4	26	4	0	12	22
18	32	8	2574	10	286	1655	623	1	9	5	2	17	333	60	11	14	1	0	18	22
19	24	3	2272	7	130	1476	658	1	2	1	0	4	240	20	12	2	4	1	13	29
20	68	9	3933	8	458	2151	1316	3	24	6	0	33	715	73	29	21	7	3	38	64
21	38	4	1853	17	313	1093	430	1	7	3	1	12	244	47	22	41	6	2	19	33
22	71	7	3369	31	450	1924	965	2	2	4	0	8	277	133	34	21	10	2	20	56
23	29	6	0	0	0	0	0	0	3	0	0	3	41	39	21	5	1	0	2	12
24	28	3	2045	3	249	1363	430	0	1	1	0	2	224	26	8	2	1	0	11	23
	623	**160**	**29446**	**225**	**4476**	**17717**	**7028**	**16**	**119**	**71**	**12**	**218**	**3770**	**703**	**158**	**189**	**196**	**70**	**349**	**470**

Because these data include counts and weights, no sum column is provided.

Variable Key

81 = SUM OF UTILIZED ELEMENTS
82 = SUM OF SHAPED BUT UNUSED ITEMS
83 = ALL DEBITAGE ITEMS
84 = G1 DEBITAGE ITEMS
85 = G2 DEBITAGE ITEMS
86 = G3 DEBITAGE ITEMS
87 = G4 DEBITAGE ITEMS
88 = HAMMERSTONE SIZE 1
89 = HAMMERSTONE SIZE 2
90 = HAMMERSTONE SIZE 3
91 = HAMMERSTONE SIZE 4+
ALL MEASURED
92 = HAMMERSTONES
93 = kg FIRE-CRACKED ROCK
94 = WHOLE, VIABLE CORE
95 = EXHAUSTED CORE
CRYPTO-CRYSTALLINE
96 = SILICATE MANUPORT
97 = WHOLE ENDSCRAPER
BROKEN / EXHAUSTED
98 = ENDSCRAPER
WHOLE LITHIC PROJECTILE
99 = POINT
BROKEN LITHIC
100 = PROJECTILE POINT

Unit key is provided on continuation in next page.

UNIT	SITE	COORDINATES	EX VOLUME	CODE	FACILITY	HOUSE	HOUSE ZONE
1	CATH	n4445w8993	5.08	**A**	WBC	6	South
2	CATH	n120122w9698	4.11	**J**	BC	4	South
3	CATH	n124126w9698	4.41	**K**	HP	4	South
4	CATH	n128130w9698	5.24	**L**	HP	4	Central
5	CATH	n130132w99101	4.69	**O**	WBC	4	North
6	CATH	n151153w8688	4.44	**W**	HP	1	South
7	CATH	n159160w99103	6.41	**F2**	SM	0	Exterior
8	CATH	n155157w9092	5.53	**I2**	WBC	1	South
9	CATH	n157159w9092	5.50	**J2**	WBC	1	South
10	CATH	n160164w8790	8.02	**K2**	HP	1	Central
11	CATH	n160162w9092	3.77	**M2**	BC	1	Central
12	CATH	n168172w8889	3.20	**P2**	WBC	1	North
13	CATH	n174176w8890	2.69	**Q2**	HP	1	North
14	CATH	n174176w9092	3.64	**R2**	HP	1	North
15	CATH	n180182w8890	5.09	**U2**	BCHP	1	North
16	CATH	n180182w9092	2.85	**V2**	HP	1	North
17	MEIER	n68e1618	3.50	**D**	B	1	North
18	MEIER	n46e1820	3.15	**F**	HP	1	North
19	MEIER	s1012e2224	4.34	**I2**	HP	1	South
20	MEIER	s1214e2022	5.72	**L2**	C	1	South
21	MEIER	s13e2022	4.54	**N**	HP	1	Central
22	MEIER	s35e1820	4.66	**O**	C	1	Central
23	MEIER	s4041e1520	5.40	**P2**	SM	-	Exterior
24	MEIER	s68e3638	4.34	**U**	M	-	Exterior
		SUM:	**110.32**				

EX VOLUME = excavation volume in cubic meters
CODE = excavation unit's alphanumeric identification code
FACIL = architectural facility represented by the excavation unit
- WBC = wall, bench & cellar deposits
- BC = bench & cellar deposits
- HP = hearth/periphery deposits
- SM = sheet midden deposits
- M = lobe midden deposits
- BCHP = as above
- B, C or HP = bench, cellar or hearth/periphery deposits only

HOUSE = site house number
HOUSE ZONE = Plankhouse Zone
- N = North
- C = Center
- S = South

TABLE 15, continued.
The following key provides information on the 'UNIT' column in Tables 11 to 15, inclusive.

TABLE 16.
Usewear Variable States for 623 Utilized Elements.
See page 243 for Key.

CAT	UEFUNC	L	W	TH	UL	RAW	LOC	MOD1	ANG	MOR1	MOR2	MOR3	ALC	DUL	POL	PIV	POC	STR	STL	MF1	MF2	MF3	MF4	TRJ
44214	BAGRAVER	34	16	6	3	1	8	2	75	5	4	6	5	4	4	3	4	6	2	1	1	1	1	1
47164	BAGRAVER	18	22	12	7	0	5	1	80	5	4	6	1	2	1	1	1	1	1	2	3	9	5	2
7527	BAGRAVER	40	19	6	6	1	5	4	39	5	4	4	3	2	3	5	2	1	1	3	3	7	5	1
7227	BAGRAVER	32	19	3	4	1	23	4	77	5	4	4	3	3	3	5	3	3	2	3	3	9	5	1
7227	BAGRAVER	32	19	3	5	1	5	4	70	5	4	4	3	3	4	5	4	3	2	3	3	7	2	2
4251	BAGRAVER	20	14	6	7	1	45	4	90	5	4	4	5	3	3	5	3	3	3	2	2	3	2	1
7432	BAGRAVER	30	22	10	7	1	45	4	60	5	4	4	5	3	3	2	3	1	1	3	3	9	5	2
4008	BAGRAVER	24	11	4	22	1	3456	4	70	6	5	4	5	3	3	5	4	6	2	5	2	10	7	2
8060	BAGRAVER	54	22	13	10	1	4	4	84	5	4	4	5	3	4	5	3	3	2	2	3	9	5	2
40294	BAPERFORATOR	21	11	3	32	1	234567	2	39	4	6	4	3	3	3	3	6	3	5	3	9	5	2	2
42267	BAPERFORATOR	24	14	6	10	1	3456	2	50	4	6	4	2	2	5	2	6	2	5	4	10	5	4	2
7268	BAPERFORATOR	42	21	9	6	1	45	2	79	5	4	4	5	3	3	5	3	6	2	5	3	9	5	2
7354	BAPERFORATOR	27	18	7	8	1	45	2	83	6	5	4	5	4	6	6	2	1	1	5	3	10	5	2
314	BAPERFORATOR	51	21	6	19	1	3456	4	65	5	4	4	5	3	3	3	2	6	2	5	2	9	5	2
5154	BAPERFORATOR	19	7	4	30	1	12345678	4	75	2	1	4	3	3	2	6	3	6	2	5	3	9	2	2
3334	BAPERFORATOR	35	20	9	22	1	45	4	80	6	5	4	5	3	3	5	1	1	1	5	3	8	5	2
50	BASAW	17	24	5	11	0	234	-	34	4	1	4	3	4	3	5	3	1	1	3	3	10	5	2
7300	BASAW	38	31	10	27	1	45	4	39	4	3	4	3	3	3	5	3	2	2	3	3	10	5	2
14589	BASAW	23	26	5	28	1	4567	4	35	1	3	4	3	3	8	6	3	2	2	3	3	8	5	2
8060	BASAW	25	22	6	20	1	678	4	67	2	1	4	3	3	3	4	4	2	4	3	3	8	5	2
6176	BASAW	23	23	6	19	1	1234	4	32	4	1	4	3	4	3	5	3	1	1	3	3	10	5	2
6176	BASAW	23	23	6	13	1	5678	4	34	4	1	4	3	4	3	5	3	1	1	3	3	10	5	2
44192	BASCRAPER	22	45	7	24	1	45	1	52	1	1	1	2	2	6	3	2	1	1	2	3	8	5	2
44214	BASCRAPER	34	16	6	16	1	123	2	69	1	1	1	2	2	3	2	2	1	1	2	3	9	2	2
44285	BASCRAPER	43	28	16	8	1	45	1	50	5	4	6	1	1	1	2	4	1	1	2	3	9	5	2
43012	BASCRAPER	22	30	7	18	1	56	1	50	2	1	1	2	3	3	2	3	1	1	2	3	8	2	2
43112	BASCRAPER	39	20	8	16	1	23	2	80	3	2	1	2	3	6	2	3	6	2	2	3	9	5	2
43112	BASCRAPER	39	20	8	26	1	5678	2	70	1	2	1	2	3	6	2	3	6	2	2	3	9	5	2
43178	BASCRAPER	55	28	16	22	1	12	1	90	2	1	1	2	3	6	2	2	6	2	2	3	8	2	2
43178	BASCRAPER	55	28	16	43	1	5678	1	50	2	1	1	2	3	6	2	2	6	2	2	3	8	2	2
43188	BASCRAPER	23	18	5	17	1	234	1	82	3	1	1	2	2	1	1	1	1	1	2	3	10	5	2
43238	BASCRAPER	25	10	4	17	1	567	1	90	3	1	1	1	3	1	1	1	1	1	2	3	10	2	2
45052	BASCRAPER	24	19	4	21	1	5678	2	66	2	1	1	2	3	2	2	1	1	1	2	3	10	5	2
40355	BASCRAPER	24	28	6	21	0	678	1	68	4	1	1	1	2	1	1	1	1	1	3	3	2	2	4
34137	BASCRAPER	31	30	10	21	1	123	1	88	2	1	1	2	3	6	2	3	6	2	2	3	9	2	2
34137	BASCRAPER	31	30	10	16	1	678	1	80	2	1	1	2	3	6	2	3	6	2	2	3	9	2	2
14248	BASCRAPER	42	23	5	20	1	234	4	88	3	1	4	2	3	3	2	3	1	1	2	4	8	2	2
10082	BASCRAPER	33	16	5	6	1	4	4	88	5	4	4	2	3	3	2	3	1	1	2	3	8	2	2
10082	BASCRAPER	33	16	5	13	1	678	4	66	1	1	4	2	3	8	2	3	1	1	2	3	9	2	2

CAT	UEFUNC	L	W	TH	UL	RAW	LOC	MOD1	ANG	MOR1	MOR2	MOR3	ALC	DUL	POL	PIV	POC	STR	STL	MF1	MF2	MF3	MF4	TRJ
7954	BASCRAPER	22	19	6	18	1	5678	4	70	2	1	4	1	2	1	1	1	1	1	2	3	10	5	2
7392	BASCRAPER	26	14	5	19	1	5678	4	86	2	1	4	2	3	3	2	4	1	1	2	3	8	2	2
5090	BASCRAPER	37	16	6	24	1	234	4	33	2	1	4	2	4	3	2	3	6	2	2	3	10	5	2
7646	BASCRAPER	28	20	9	26	1	45	4	50	2	1	4	2	2	3	2	3	1	1	2	3	8	2	2
7397	BASCRAPER	25	27	9	9	1	23	2	74	3	1	4	2	3	3	2	3	6	2	2	3	9	2	2
7396	BASCRAPER	14	26	6	14	1	5678	4	78	2	1	4	1	3	1	1	1	1	1	2	3	8	5	4
4983	BASCRAPER	40	30	11	20	1	34	4	77	2	1	4	1	3	1	1	1	1	1	2	2	8	5	2
3429	BASCRAPER	31	20	7	15	3	567	4	53	2	1	4	2	3	2	3	3	1	1	2	3	8	5	2
4983	BASCRAPER	40	30	11	8	1	5	4	18	2	1	4	1	3	2	2	2	1	1	2	2	2	2	2
5090	BASCRAPER	37	16	6	7	1	45	4	80	5	4	4	5	3	4	5	3	3	2	4	3	8	2	4
5841	BASCRAPER	34	19	12	23	1	1234	1	88	2	1	4	2	3	2	2	2	6	2	2	3	8	5	2
7884	BASCRAPER	28	34	7	33	1	5678	4	67	1	1	4	2	2	1	1	1	1	1	2	2	9	5	2
5334	BASCRAPER	46	29	11	24	1	678	4	84	3	2	4	2	2	2	2	2	1	1	2	4	10	5	2
7864	BASCRAPER	33	23	7	20	1	1234	4	86	2	1	4	2	3	3	2	3	1	1	2	4	10	5	2
7881	BASCRAPER	32	15	6	20	1	234	4	46	2	1	4	2	3	8	2	3	1	1	2	2	10	5	4
7535	BASHAVER	14	23	4	10	1	5678	4	77	2	1	4	2	3	8	4	3	6	2	2	3	9	5	3
14798	BASHAVER	36	30	9	14	1	45	2	90	3	1	4	2	3	3	3	2	1	1	2	3	9	5	2
7827	BASHAVER	24	26	9	10	1	78	4	66	2	1	4	2	2	6	4	3	1	1	2	4	3	2	3
5419	BASHAVER	29	24	6	23	1	54	4	77	3	1	4	2	2	3	2	2	1	1	2	2	8	5	3
6238	BASHAVER	49	25	11	17	1	23	2	88	3	1	4	2	2	3	2	2	1	1	2	3	8	5	2
43210	BAWEDGE	19	31	10	19	1	45	3	42	2	1	1	1	1	1	1	1	1	1	3	2	7	5	2
47095	BAWEDGE	20	19	5	18	0	45	1	50	1	1	1	3	4	3	5	2	1	1	3	3	7	5	4
34231	BAWEDGE	34	42	8	16	1	5	1	55	2	1	1	3	4	3	5	3	6	2	3	3	7	6	2
804	BUTCHERY	57	34	6	57	1	5678	3	58	2	3	5	3	2	6	4	3	2	2	3	3	8	5	3
16087	BUTCHERY	40	18	7	23	1	123	3	60	2	1	1	3	2	2	4	2	2	2	3	3	2	5	4
16118	BUTCHERY	50	28	7	84	1	12345678	3	58	2	3	5	3	3	8	6	3	2	5	3	2	8	5	3
40329	BUTCHERY	16	10	2	10	1	1234	1	5	2	1	1	1	1	1	1	1	1	1	3	4	2	2	3
40329	BUTCHERY	16	10	2	9	1	5678	1	6	2	1	1	1	1	1	1	1	1	1	3	4	2	2	3
40366	BUTCHERY	32	19	4	15	1	56	1	38	2	1	1	3	2	1	1	1	1	1	3	4	2	2	4
44006	BUTCHERY	33	34	5	16	1	23	3	20	2	1	1	3	2	2	6	3	1	1	3	3	2	2	4
44006	BUTCHERY	33	34	5	29	1	45	3	9	1	1	1	3	2	2	6	3	1	1	3	3	2	2	4
44219	BUTCHERY	35	39	8	33	1	1234	1	29	1	1	1	3	2	2	4	3	1	1	3	3	10	6	4
44273	BUTCHERY	20	32	7	19	1	567	1	25	3	2	1	1	2	1	1	1	1	1	3	3	2	2	4
40292	BUTCHERY	49	21	11	27	1	567	1	47	2	2	1	1	3	1	1	1	2	4	3	3	8	2	4
40292	BUTCHERY	49	21	11	30	1	1234	1	44	2	2	1	1	3	1	1	1	2	4	3	3	8	2	4
40296	BUTCHERY	34	31	4	22	1	1234	1	15	1	1	1	1	2	1	1	3	1	1	3	4	2	2	2
43013	BUTCHERY	18	16	5	13	1	45	1	25	2	1	1	1	2	1	1	1	2	3	3	3	2	5	3
43131	BUTCHERY	20	31	5	15	1	1234	1	20	2	1	1	3	2	2	4	3	1	1	3	3	2	2	3
43131	BUTCHERY	20	31	5	15	1	5678	1	18	2	2	1	3	2	2	4	3	1	1	3	3	2	2	3

TABLE 16.
Usewear Variable States for 623 Utilized Elements, continued.

CAT	UEFUNC	L	W	TH	UL	RAW	LOC	MOD1	ANG	MOR1	MOR2	MOR3	ALC	DUL	POL	PIV	POC	STR	STL	MF1	MF2	MF3	MF4	TRJ
43152	BUTCHERY	20	32	4	15	1	678	1	7	1	1	1	3	3	6	4	3	1	1	3	3	2	5	3
43197	BUTCHERY	24	24	8	17	1	45	1	50	2	1	1	3	3	2	3	3	1	1	3	4	2	2	2
21051	BUTCHERY	20	11	5	11	1	45	1	28	2	1	1	3	2	2	3	2	2	2	3	4	2	2	3
21082	BUTCHERY	40	29	9	23	1	567	3	10	2	1	1	3	2	2	4	3	1	1	3	4	2	2	3
42128	BUTCHERY	24	28	6	21	0	678	1	8	1	1	1	1	2	1	1	1	1	1	3	3	2	2	3
40304	BUTCHERY	18	25	6	13	1	34	1	34	2	1	1	1	2	1	1	1	1	1	3	4	2	5	3
42168	BUTCHERY	51	26	10	23	0	34	1	21	2	2	2	3	2	2	3	3	1	1	3	4	2	2	4
42268	BUTCHERY	17	26	5	20	0	45	1	33	4	3	1	1	1	1	1	1	1	1	3	4	2	2	4
19017	BUTCHERY	27	19	12	18	1	45	1	50	2	1	1	3	2	2	3	3	2	2	3	4	2	2	4
40251	BUTCHERY	15	16	3	9	1	5678	1	5	1	1	1	1	1	1	1	1	1	1	3	4	2	2	3
40289	BUTCHERY	32	20	7	21	1	5678	1	25	2	1	1	3	2	2	4	3	1	1	3	4	2	2	4
49001	BUTCHERY	26	15	9	11	1	234	1	40	2	1	1	1	1	1	1	1	1	1	3	4	8	2	2
49001	BUTCHERY	26	15	9	11	1	234	1	52	2	1	1	1	1	1	1	1	1	1	3	4	8	2	2
49003	BUTCHERY	25	13	13	6	1	4	1	45	5	4	6	1	1	1	1	1	1	1	2	3	9	2	3
40376	BUTCHERY	23	21	8	20	0	1234	1	22	2	1	1	1	1	1	1	1	1	1	3	3	2	2	4
47065	BUTCHERY	56	22	10	82	0	123678	1	42	2	3	5	3	3	6	6	2	1	1	3	3	8	5	4
47166	BUTCHERY	29	16	6	20	0	67	1	55	2	1	1	1	1	1	1	1	1	1	3	4	2	2	3
47195	BUTCHERY	13	14	2	12	0	5678	1	20	2	1	1	1	1	1	1	1	1	1	3	4	2	2	3
47195	BUTCHERY	13	14	2	10	0	5678	1	21	2	1	1	1	1	1	1	1	1	1	3	4	2	2	3
40328	BUTCHERY	46	30	8	30	1	567	1	35	2	1	1	3	2	2	4	3	1	1	3	4	2	2	3
48018	BUTCHERY	27	34	9	14	1	567	1	33	2	1	1	3	2	2	4	3	1	1	3	4	2	2	3
26038	BUTCHERY	22	17	7	14	1	1234	1	43	2	1	1	1	1	1	1	1	1	1	3	3	8	5	4
33010	BUTCHERY	42	22	10	34	1	234	1	36	2	1	1	3	1	2	3	3	1	1	3	4	2	2	4
576	BUTCHERY	30	42	11	26	1	1234	4	30	2	1	4	3	2	2	4	2	1	1	3	4	3	2	3
7514	BUTCHERY	26	16	6	11	1	5678	4	22	2	1	4	3	2	2	4	2	1	1	3	4	3	2	4
7534	BUTCHERY	26	10	3	28	1	234567	4	18	2	1	4	3	2	2	4	3	1	1	3	4	3	2	2
14367	BUTCHERY	21	14	4	16	1	1234	4	33	2	1	4	1	1	1	1	1	1	1	3	4	3	2	4
14367	BUTCHERY	21	14	4	12	1	5678	4	24	2	1	4	1	1	1	1	1	1	1	3	4	3	2	4
14427	BUTCHERY	26	20	3	17	1	234	4	19	3	1	4	1	1	1	1	1	1	1	3	3	2	2	4
14541	BUTCHERY	28	15	4	11	1	678	4	23	2	1	4	1	1	1	1	1	1	1	3	4	2	2	2
1157	BUTCHERY	37	20	5	21	1	45	4	25	1	1	4	1	2	1	1	1	1	1	3	3	2	2	2
7271	BUTCHERY	22	15	3	15	1	234	4	23	2	1	4	3	2	3	6	3	1	1	3	4	3	2	4
7300	BUTCHERY	38	31	10	32	1	1234	4	22	3	1	4	3	2	2	6	3	1	1	3	4	9	2	2
628	BUTCHERY	29	38	10	18	1	5	4	50	1	1	4	3	3	3	4	2	1	1	3	3	8	7	3
7245	BUTCHERY	23	19	5	10	1	56	4	18	2	1	4	3	2	2	3	3	1	1	3	4	2	2	3
9521	BUTCHERY	46	30	7	56	1	45678	4	40	2	3	4	3	3	6	6	3	2	3	3	4	2	5	2
9255	BUTCHERY	25	8	5	22	1	5678	4	40	1	1	4	1	2	1	1	1	1	1	3	4	2	2	4
10025	BUTCHERY	36	16	4	50	1	234567	4	30	2	3	4	3	2	2	6	2	1	1	3	4	3	2	3
10356	BUTCHERY	48	45	5	21	1	678	4	37	2	1	4	3	2	2	3	3	1	1	3	4	3	2	3

TABLE 16.
Usewear Variable States for 623 Utilized Elements, continued.

CAT	UEFUNC	L	W	TH	UL	RAW	LOC	MOD1	ANG	MOR1	MOR2	MOR3	ALC	DUL	POL	PIV	POC	STR	STL	MF1	MF2	MF3	MF4	TRJ
10352	BUTCHERY	24	11	4	24	0	5678	4	62	2	3	4	3	3	2	6	3	1	1	3	3	8	2	1
9802	BUTCHERY	26	15	3	37	1	1234567	4	32	2	1	4	3	3	6	6	3	1	1	3	3	3	2	4
10106	BUTCHERY	54	20	8	30	1	123	4	36	2	1	4	3	2	2	4	3	1	1	3	4	2	2	4
14249	BUTCHERY	17	16	6	11	1	234	4	22	1	1	4	3	2	2	3	2	1	1	3	4	3	2	2
4689	BUTCHERY	33	33	7	67	1	123678	4	35	2	3	4	3	3	3	6	3	2	5	3	3	8	5	4
4689	BUTCHERY	24	28	7	18	1	45	4	25	1	1	4	3	2	2	4	2	1	1	3	4	8	2	3
5052	BUTCHERY	18	22	5	15	1	123	4	19	1	1	4	3	2	2	6	2	2	2	3	3	2	2	3
5052	BUTCHERY	18	22	5	18	1	678	4	25	1	1	4	3	2	2	6	2	2	2	3	3	2	2	2
12876	BUTCHERY	23	35	6	22	1	3456	4	30	2	1	4	3	2	2	3	3	1	1	3	4	2	2	4
12877	BUTCHERY	20	20	7	12	1	45	4	33	1	1	4	1	2	1	1	1	1	1	3	4	3	2	3
3773	BUTCHERY	26	15	9	19	1	5678	1	40	2	1	4	1	1	1	1	1	1	1	3	4	8	2	3
4680	BUTCHERY	17	15	4	17	1	45	4	19	2	1	4	3	3	3	4	3	1	1	3	3	8	2	3
4211	BUTCHERY	19	20	3	19	1	45	4	28	3	1	4	3	3	2	6	3	1	1	3	3	3	5	2
4420	BUTCHERY	29	11	6	21	1	567	4	18	3	1	4	3	2	2	4	2	1	1	1	1	1	1	2
3459	BUTCHERY	30	12	3	38	1	234567	4	18	2	1	4	1	3	1	1	1	1	1	3	6	2	2	4
3692	BUTCHERY	14	21	2	11	1	234	4	15	2	1	4	1	1	1	1	1	1	1	3	4	3	2	2
4420	BUTCHERY	19	11	4	10	1	123	4	36	1	1	4	3	3	2	4	3	1	1	3	4	3	2	4
5002	BUTCHERY	22	17	7	9	1	678	4	26	2	1	4	3	2	2	4	2	1	1	3	4	3	2	2
7428	BUTCHERY	12	11	3	12	1	5678	4	7	2	1	4	3	2	2	6	4	1	1	3	3	2	2	2
7460	BUTCHERY	32	20	5	11	1	4	4	13	2	1	4	3	3	4	4	2	1	1	3	4	2	2	3
7429	BUTCHERY	26	19	4	22	1	567	4	11	2	1	4	3	3	3	3	4	2	3	3	3	8	2	4
7445	BUTCHERY	11	12	2	0	1	123678	4	5	2	1	4	3	3	4	6	4	2	2	3	3	2	2	4
5506	BUTCHERY	25	11	4	20	1	1234	4	24	2	2	4	3	2	2	4	2	1	1	3	4	8	2	2
5506	BUTCHERY	25	11	4	19	1	5678	4	24	2	2	4	3	2	2	4	2	1	1	3	4	8	2	4
5816	BUTCHERY	58	46	6	18	1	12	4	19	1	1	4	3	3	2	4	2	1	1	3	4	8	5	4
8033	BUTCHERY	24	28	6	19	1	1234	4	11	3	1	4	3	2	2	4	3	1	1	3	4	3	2	2
8072	BUTCHERY	39	16	11	16	1	56	2	32	3	1	4	1	2	1	1	1	1	1	3	3	3	2	3
6131	BUTCHERY	23	22	4	15	1	45	4	32	4	3	4	3	2	2	6	2	1	1	3	4	8	2	2
5897	BUTCHERY	36	20	6	28	1	234	4	32	2	3	4	3	2	2	6	3	2	2	3	3	3	2	4
6304	BUTCHERY	16	16	6	14	1	18	4	44	2	1	4	1	2	1	1	1	1	1	3	4	8	2	2
5981	BUTCHERY	31	35	7	18	1	5	4	22	2	3	4	3	2	2	3	3	1	1	3	3	9	5	4
6514	BUTCHERY	19	13	2	9	1	1234	4	21	2	1	4	3	2	2	4	2	1	1	3	4	2	2	2
6173	BUTCHERY	46	30	5	23	1	45	4	23	2	1	4	1	2	1	1	1	1	1	3	4	2	2	2
6173	BUTCHERY	46	30	5	22	1	678	4	16	2	1	4	1	2	1	1	1	1	1	3	4	2	2	3
7484	BUTCHERY	23	16	4	16	1	1234	4	11	2	1	4	3	2	3	4	3	1	1	3	3	3	2	3
7845	BUTCHERY	32	26	3	38	1	456	4	5	3	1	4	3	2	2	6	3	1	1	3	4	3	2	4
7852	BUTCHERY	39	18	7	38	1	23456	4	25	2	1	4	3	3	2	4	2	1	1	3	4	3	2	4
7882	BUTCHERY	19	14	6	19	1	45	4	40	2	1	4	1	1	1	1	1	1	1	3	4	2	2	3
7912	BUTCHERY	22	19	3	13	1	1234	4	5	2	1	4	3	2	2	4	2	1	1	3	4	3	2	3

TABLE 16.
Usewear Variable States for 623 Utilized Elements, continued.

CAT	UEFUNC	L	W	TH	UL	RAW	LOC	MOD1	ANG	MOR1	MOR2	MOR3	ALC	DUL	POL	PIV	POC	STR	STL	MF1	MF2	MF3	MF4	TRJ
14934	BUTCHERY	30	10	3	18	1	1234	4	20	2	1	4	3	1	2	3	2	1	1	3	4	3	2	4
14934	BUTCHERY	30	10	3	27	1	5678	4	16	2	1	4	3	1	2	3	2	1	1	3	4	3	2	4
14936	BUTCHERY	23	12	2	18	1	5678	4	18	2	1	4	3	1	2	4	3	1	1	3	4	2	2	3
14938	BUTCHERY	26	14	1	16	1	5678	4	30	2	1	4	3	1	2	4	3	2	2	3	4	3	2	3
6447	BUTCHERY	40	25	7	23	1	4	4	45	2	1	4	3	2	2	3	3	1	1	3	4	3	2	3
7926	BUTCHERY	25	22	3	26	1	5678	4	4	1	1	4	3	2	2	4	4	1	1	3	4	3	2	2
7937	BUTCHERY	37	39	5	33	1	5678	4	33	2	1	4	3	2	2	3	3	1	1	3	3	3	2	2
6238	BUTCHERY	49	25	11	31	1	567	4	70	2	1	4	3	2	3	3	3	1	1	3	4	3	2	3
14926	BUTCHERY	23	32	4	18	1	18	4	25	4	3	4	3	2	6	3	3	1	1	3	3	3	2	3
14926	BUTCHERY	23	32	4	15	1	56	4	15	4	3	4	3	2	6	3	3	1	1	3	3	3	2	2
6037	BUTCHERY	59	47	10	49	1	5678	4	11	2	1	4	3	3	2	3	3	1	1	3	3	3	2	3
44259	HIDECUTTER	17	12	2	11	1	567	1	3	2	1	1	3	2	6	2	3	1	1	3	4	2	2	4
45085	HIDECUTTER	34	14	4	13	1	56	3	21	2	1	4	3	2	3	3	3	1	1	3	3	8	2	3
873	HIDECUTTER	42	26	12	27	1	234	4	25	2	1	4	3	3	2	4	4	1	1	3	3	3	2	3
1062	HIDECUTTER	21	18	4	11	1	12	4	25	2	1	4	3	3	3	4	3	2	2	3	3	8	5	4
1029	HIDECUTTER	23	11	3	17	1	23	4	33	4	1	4	3	3	3	4	3	1	1	3	3	8	2	4
14224	HIDECUTTER	33	21	4	19	1	78	4	36	2	3	4	3	2	6	3	3	1	1	3	4	2	2	3
14198	HIDECUTTER	30	28	5	37	1	234567	4	29	2	3	4	3	2	6	6	3	1	1	3	4	2	5	3
3225	HIDECUTTER	25	21	7	7	1	5	4	22	2	1	4	3	2	2	3	3	1	1	3	4	9	5	4
4202	HIDECUTTER	27	14	4	28	1	234567	4	20	4	1	4	3	3	3	6	3	1	1	3	4	9	5	4
7666	HIDECUTTER	19	31	9	12	1	56	4	26	3	1	4	3	2	2	6	4	1	1	3	4	3	2	3
3433	HIDECUTTER	34	14	6	21	1	234	4	30	3	1	4	3	3	3	3	3	3	2	3	3	8	5	3
7437	HIDECUTTER	15	12	1	13	1	5678	4	13	1	1	4	3	3	7	6	4	1	1	3	3	3	2	4
3817	HIDECUTTER	30	19	4	7	1	78	4	21	1	1	4	3	3	2	3	3	1	1	3	3	8	5	4
4811	HIDECUTTER	35	14	5	36	0	23456	4	28	2	1	4	3	3	3	6	3	8	5	3	3	8	5	3
4739	HIDECUTTER	17	11	2	11	1	1234	4	18	4	1	4	3	3	8	6	4	2	2	3	3	2	2	4
6061	HIDECUTTER	55	29	6	27	1	45	4	18	4	3	4	3	2	2	3	2	1	1	3	3	2	2	3
6227	HIDECUTTER	46	19	2	38	1	123	4	40	2	1	4	3	2	2	4	1	1	1	3	4	3	2	3
5319	HIDECUTTER	30	15	3	18	1	123	4	29	4	3	4	3	3	2	6	3	1	1	3	3	8	2	4
12411	HIDECUTTER	55	19	5	46	2	5678	4	30	2	1	4	3	3	3	4	3	2	4	3	4	2	2	3
19040	HIDEPERFORATOR	20	8	4	33	1	12345678	3	60	6	5	7	5	3	3	2	2	1	1	3	4	2	2	4
58	HIDESCRAPER	19	16	6	-	1	45	2	52	1	1	1	2	3	3	2	3	6	2	2	2	8	5	2
59	HIDESCRAPER	25	21	6	-	1	45	2	62	1	1	1	2	3	3	3	4	6	2	2	2	8	5	2
62	HIDESCRAPER	19	18	8	-	1	45	2	67	1	1	1	2	3	3	2	3	1	1	2	3	8	5	2
156	HIDESCRAPER	21	14	4	-	1	45	-	57	1	1	1	2	3	3	2	3	1	1	2	3	8	5	2
348	HIDESCRAPER	8	15	5	-	1	45	2	88	1	1	1	2	2	2	2	2	1	1	2	3	2	2	2
755	HIDESCRAPER	19	22	6	-	1	5678	2	90	1	1	1	2	3	4	3	4	6	2	2	3	3	5	2
755	HIDESCRAPER	19	22	6	-	1	1234	2	77	1	1	1	2	3	4	3	4	6	2	2	3	3	5	2
980	HIDESCRAPER	24	21	7	-	0	45	2	85	1	1	1	2	3	6	2	4	1	1	2	3	8	5	2

TABLE 16.
Usewear Variable States for 623 Utilized Elements, continued.

CAT	UEFUNC	L	W	TH	UL	RAW	LOC	MOD1	ANG	MOR1	MOR2	MOR3	ALC	DUL	POL	PIV	POC	STR	STL	MF1	MF2	MF3	MF4	TRJ
982	HIDESCRAPER	25	16	5	-	1	45	2	69	1	1	1	2	2	6	3	2	1	1	2	3	8	5	2
16004	HIDESCRAPER	10	20	3	-	1	18	2	77	1	1	1	2	2	2	2	2	1	1	2	4	2	5	2
16027	HIDESCRAPER	19	34	9	-	0	45	2	80	1	1	1	2	2	2	2	2	1	1	2	3	2	2	2
16040	HIDESCRAPER	12	17	5	-	1	45	2	72	1	1	1	2	3	6	2	3	1	1	2	3	8	5	2
16080	HIDESCRAPER	41	22	9	-	0	-	-	77	1	1	1	2	2	2	2	2	1	1	2	3	2	2	2
16081	HIDESCRAPER	27	19	6	-	1	45	2	67	1	1	1	2	3	3	2	4	1	1	2	3	8	5	2
16085	HIDESCRAPER	24	24	9	-	1	45	2	80	1	1	1	2	2	6	2	2	1	1	2	2	8	5	2
16089	HIDESCRAPER	21	19	4	-	0	345	2	77	1	1	1	2	2	2	2	2	1	1	2	3	2	2	2
16097	HIDESCRAPER	24	24	9	-	1	45	2	80	1	1	1	2	2	6	2	2	1	1	2	2	8	5	2
16128	HIDESCRAPER	21	20	11	-	0	45	2	80	1	1	1	2	2	2	2	2	1	1	2	3	2	2	2
16129	HIDESCRAPER	17	19	6	-	1	1234	2	82	1	1	1	2	3	3	2	3	1	1	2	2	8	5	2
16136	HIDESCRAPER	26	15	7	-	1	45	2	64	1	1	1	2	3	2	2	3	1	1	2	3	8	2	2
16141	HIDESCRAPER	30	24	8	-	1	45	2	90	1	1	1	2	2	6	2	3	1	1	2	2	8	5	2
944	HIDESCRAPER	16	20	4	-	1	5678	2	67	1	1	1	2	3	3	3	3	6	2	2	2	8	5	2
944	HIDESCRAPER	16	20	4	-	1	45	2	73	1	1	1	2	3	3	3	3	6	2	2	2	8	5	2
599	HIDESCRAPER	23	15	4	-	1	45	2	69	1	1	1	2	3	6	2	3	1	1	2	2	8	2	2
678	HIDESCRAPER	30	20	6	-	1	45	2	77	1	1	1	2	3	6	2	3	1	1	2	3	8	5	2
694	HIDESCRAPER	42	22	8	-	0	45	-	76	1	1	1	2	3	4	3	4	6	2	2	3	3	5	2
40347	HIDESCRAPER	18	18	3	-	0	45	-	28	1	1	1	2	2	6	3	2	1	1	2	3	8	5	2
40377	HIDESCRAPER	18	16	3	-	0	45	-	49	1	1	1	2	3	3	2	4	1	1	2	3	8	5	2
40378	HIDESCRAPER	26	28	9	-	0	45	-	78	1	1	1	2	3	6	2	3	1	1	2	3	8	5	2
40379	HIDESCRAPER	20	20	5	-	0	45	-	90	1	1	1	2	3	6	2	4	1	1	2	3	8	5	2
44042	HIDESCRAPER	26	21	6	-	0	45	-	80	1	1	1	2	2	2	2	2	1	1	2	3	2	2	2
44069	HIDESCRAPER	17	20	7	-	0	45	-	30	1	1	1	2	3	2	2	3	1	1	2	3	8	2	2
44078	HIDESCRAPER	21	22	8	-	0	45	-	91	1	1	1	2	3	3	2	3	1	1	2	2	8	5	2
44239	HIDESCRAPER	24	23	5	-	0	45	1	90	1	1	1	2	3	3	2	3	1	1	2	3	8	5	2
40261	HIDESCRAPER	23	20	7	-	0	45	-	80	1	1	1	2	2	6	2	3	1	1	2	2	8	2	2
40305	HIDESCRAPER	17	23	12	-	0	45	-	105	1	1	1	2	3	3	2	3	1	1	2	3	8	2	3
40307	HIDESCRAPER	21	23	9	-	0	45	-	103	1	1	1	2	2	6	2	3	1	1	2	2	8	2	2
40332	HIDESCRAPER	21	19	7	-	0	45	-	90	1	1	1	2	2	3	3	3	1	1	2	3	2	2	2
40335	HIDESCRAPER	19	17	8	-	0	45	-	90	1	1	1	2	2	2	2	2	1	1	2	3	3	2	4
43002	HIDESCRAPER	18	18	7	-	0	45	-	65	1	1	1	2	2	6	2	3	1	1	2	3	8	2	2
43024	HIDESCRAPER	28	16	6	-	0	45	-	70	1	1	1	2	3	3	2	3	1	1	2	3	8	2	2
43029	HIDESCRAPER	17	21	6	-	0	45	-	75	1	1	1	2	3	3	2	4	1	1	2	2	9	2	2
43081	HIDESCRAPER	28	22	11	-	0	45	-	85	1	1	1	2	3	7	2	3	6	2	2	3	2	2	2
43118	HIDESCRAPER	27	20	5	-	0	45	-	85	1	1	1	2	2	6	2	3	1	1	2	3	8	2	2
43180	HIDESCRAPER	24	16	7	-	0	45	-	92	1	1	1	2	2	2	2	2	1	1	2	3	3	2	4
43232	HIDESCRAPER	27	17	5	-	0	45	-	42	1	1	1	2	2	6	2	3	1	1	2	2	8	2	2
21042	HIDESCRAPER	27	15	4	-	1	45	2	85	1	1	1	2	3	6	3	3	1	1	2	3	2	2	2

TABLE 16.
Usewear Variable States for 623 Utilized Elements, continued.

CAT	UEFUNC	L	W	TH	UL	RAW	LOC	MOD1	ANG	MOR1	MOR2	MOR3	ALC	DUL	POL	PIV	POC	STR	STL	MF1	MF2	MF3	MF4	TRJ
21066	HIDESCRAPER	29	29	6	-	1	45	2	90	1	1	1	2	3	2	2	3	1	2	2	3	8	2	2
21070	HIDESCRAPER	15	20	6	-	1	3456	2	68	1	1	1	2	4	8	2	4	1	1	2	2	8	2	2
21116	HIDESCRAPER	18	22	7	-	1	45	-	68	1	1	1	2	3	6	2	3	1	1	2	3	8	5	2
40070	HIDESCRAPER	18	15	4	-	0	45	-	48	1	1	1	2	2	6	3	2	1	1	2	3	8	5	2
40111	HIDESCRAPER	19	17	4	-	0	45	-	90	1	1	1	2	3	2	2	3	1	1	2	3	8	2	2
40118	HIDESCRAPER	18	17	4	-	0	45	-	84	1	1	1	2	3	6	2	3	1	1	2	2	8	2	2
42955	HIDESCRAPER	20	18	5	-	0	45	1	70	1	1	1	2	2	6	3	2	1	1	2	3	8	5	2
40279	HIDESCRAPER	27	19	6	-	0	45	2	55	1	1	1	2	3	6	2	3	1	1	2	2	8	2	2
40338	HIDESCRAPER	12	13	4	-	0	45	1	75	1	1	1	2	3	6	2	3	1	1	2	2	8	2	2
42021	HIDESCRAPER	27	27	6	-	0	45	-	90	1	1	1	2	3	2	2	3	1	1	2	3	8	2	2
42034	HIDESCRAPER	16	14	5	-	0	45	-	46	1	1	1	2	3	6	3	3	1	1	2	3	2	2	2
42050	HIDESCRAPER	15	19	5	-	0	45	-	33	1	1	1	2	3	2	2	3	1	2	2	3	8	2	2
42071	HIDESCRAPER	24	24	9	-	0	45	-	90	1	1	1	2	4	8	2	4	1	1	2	2	8	2	2
42125	HIDESCRAPER	22	15	5	-	0	45	-	60	1	1	1	2	3	6	2	3	1	1	2	3	8	5	2
42137	HIDESCRAPER	29	20	6	-	0	45	-	76	1	1	1	2	2	6	3	2	1	1	2	3	8	5	2
42174	HIDESCRAPER	18	17	7	-	0	45	-	90	1	1	1	2	3	6	2	3	1	1	2	3	8	5	2
42225	HIDESCRAPER	23	15	4	-	0	45	-	81	1	1	1	2	2	6	3	2	1	1	2	3	8	5	2
42253	HIDESCRAPER	16	18	7	-	0	45	-	40	1	1	1	2	3	2	2	3	1	1	2	3	8	2	2
42271	HIDESCRAPER	14	14	3	-	0	45	-	65	1	1	1	2	3	6	2	3	1	1	2	2	8	2	2
999	HIDESCRAPER	14	13	10	-	1	45	2	86	2	1	3	2	3	2	2	3	1	1	2	3	8	2	2
19018	HIDESCRAPER	18	15	6	-	1	45	2	62	1	1	1	2	3	1	1	1	1	1	2	3	8	2	2
19031	HIDESCRAPER	32	31	10	-	0	45	-	86	1	1	1	2	2	6	2	3	1	1	2	3	8	2	2
19056	HIDESCRAPER	14	19	8	-	1	45	2	68	1	1	1	2	3	7	2	3	6	2	2	3	2	2	2
19059	HIDESCRAPER	24	26	11	-	1	45	2	67	1	1	1	2	2	6	2	3	1	1	2	2	8	2	2
19064	HIDESCRAPER	32	26	9	-	1	45	2	82	1	1	1	2	2	6	2	2	1	1	2	3	8	2	2
19067	HIDESCRAPER	42	22	8	-	0	45	2	70	1	1	1	2	2	2	2	2	1	1	2	3	3	2	4
51053	HIDESCRAPER	19	18	7	-	0	45	-	90	1	1	1	2	3	3	2	3	1	1	2	3	8	2	2
51074	HIDESCRAPER	19	25	6	-	0	45	-	90	2	1	1	2	3	8	3	3	6	2	2	3	8	2	2
45052	HIDESCRAPER	32	26	9	-	1	45	2	66	2	1	3	2	3	2	2	3	1	1	2	3	8	2	2
40374	HIDESCRAPER	21	16	5	-	0	34	-	40	1	1	1	2	3	3	2	3	1	1	2	3	8	2	2
45020	HIDESCRAPER	26	16	6	-	0	45	-	75	1	1	1	2	3	3	2	3	1	1	2	3	8	2	2
45037	HIDESCRAPER	15	12	7	-	0	45	-	82	2	1	1	2	3	8	3	3	6	2	2	3	8	2	2
45053	HIDESCRAPER	22	19	5	-	0	45	-	78	2	1	3	2	3	2	2	3	1	1	2	3	8	2	2
40326	HIDESCRAPER	28	22	7	-	0	45	-	82	1	1	1	2	3	1	1	1	1	1	2	3	8	2	2

TABLE 16.
Usewear Variable States for 623 Utilized Elements, continued.

CAT	UEFUNC	L	W	TH	UL	RAW	LOC	MOD1	ANG	MOR1	MOR2	MOR3	ALC	DUL	POL	PIV	POC	STR	STL	MF1	MF2	MF3	MF4	TRJ
34135	HIDESCRAPER	26	22	10	-	0	-	-	88	1	1	1	2	3	3	2	3	1	1	2	3	8	2	2
34156	HIDESCRAPER	30	28	10	-	0	-	-	84	1	1	1	2	3	3	2	4	1	1	2	2	9	2	2
34165	HIDESCRAPER	18	18	9	-	0	-	-	33	1	1	1	2	3	3	2	3	1	1	2	3	8	2	3
34166	HIDESCRAPER	18	17	6	-	0	-	-	85	1	1	1	2	3	3	2	3	6	2	2	2	8	2	2
34201	HIDESCRAPER	21	20	6	-	0	-	-	86	1	1	1	2	3	3	2	3	6	2	2	2	2	5	4
34174	HIDESCRAPER	18	17	6	-	-	-	-	83	1	1	1	2	3	4	2	4	6	2	2	2	8	5	2
34204	HIDESCRAPER	33	26	15	-	0	-	-	90	1	1	1	2	3	3	2	3	1	1	2	3	8	2	2
34237	HIDESCRAPER	21	24	5	-	0	-	-	40	1	1	1	2	3	3	2	3	6	2	2	2	8	5	2
34243	HIDESCRAPER	17	22	8	-	0	-	-	90	1	1	1	2	3	4	3	4	6	2	2	3	3	5	2
33011	HIDESCRAPER	29	20	10	-	1	5678	2	53	1	1	1	2	3	8	2	3	6	2	2	3	2	2	2
33022	HIDESCRAPER	37	20	6	-	1	45	2	105	1	1	1	2	3	3	2	3	6	2	2	2	8	5	2
33046	HIDESCRAPER	27	20	9	-	0	-	-	84	1	1	1	2	3	6	2	3	1	1	2	3	8	5	2
33118	HIDESCRAPER	20	20	3	-	1	45	-	85	1	1	1	2	3	6	2	3	1	1	2	3	8	5	2
40112	HIDESCRAPER	17	17	8	-	0	-	-	75	1	1	1	2	3	4	3	4	6	2	2	3	3	5	2
40116	HIDESCRAPER	24	23	6	-	0	-	-	80	1	1	1	2	3	2	2	3	1	1	2	3	8	2	2
32059	HIDESCRAPER	19	19	4	-	1	45	2	72	1	1	1	2	3	3	2	3	1	1	2	3	8	2	2
32134	HIDESCRAPER	11	15	3	-	1	67	2	38	2	1	1	2	3	8	3	3	6	2	2	3	8	2	2
40114	HIDESCRAPER	15	16	6	-	0	45	-	85	2	1	3	2	3	2	2	3	1	1	2	3	8	2	2
40264	HIDESCRAPER	22	17	8	-	0	-	-	84	1	1	1	2	3	3	2	3	1	1	2	3	8	2	2
40346	HIDESCRAPER	27	24	5	-	0	-	-	86	2	1	1	2	3	8	3	3	6	2	2	3	8	2	2
52008	HIDESCRAPER	19	22	7	-	0	-	-	93	2	1	3	2	3	2	2	3	1	1	2	3	8	2	2
52012	HIDESCRAPER	23	24	10	-	0	-	-	89	1	1	1	2	3	3	2	3	1	1	2	3	8	2	2
52014	HIDESCRAPER	25	25	8	-	0	-	-	89	2	1	1	2	3	8	3	3	6	2	2	3	8	2	2
52015	HIDESCRAPER	28	34	9	-	0	-	-	90	2	1	3	2	3	2	2	3	1	1	2	3	8	2	2
52030	HIDESCRAPER	24	20	7	-	0	-	-	80	1	1	1	2	2	6	3	2	1	1	2	3	8	5	2
52043	HIDESCRAPER	25	21	8	-	0	-	-	85	1	1	1	2	3	6	2	3	1	1	2	2	8	2	2
52057	HIDESCRAPER	28	20	8	-	0	-	-	89	2	1	1	2	3	8	3	3	6	2	2	3	8	2	2
52059	HIDESCRAPER	23	19	6	-	0	-	-	90	2	1	3	2	3	2	2	3	1	1	2	3	8	2	2
52111	HIDESCRAPER	29	26	7	-	0	-	-	75	1	1	1	2	3	3	2	3	1	1	2	3	8	2	2
52124	HIDESCRAPER	21	22	9	-	0	-	-	93	2	1	1	2	3	8	3	3	6	2	2	3	8	2	2
52960	HIDESCRAPER	25	19	10	-	0	-	-	95	2	1	1	2	3	8	3	3	6	2	2	3	8	2	2
52961	HIDESCRAPER	25	18	6	-	1	45	4	80	2	1	3	2	3	2	2	3	1	1	2	3	8	2	2
51002	HIDESCRAPER	13	16	7	-	0	-	-	80	1	1	1	2	3	3	2	3	1	1	2	3	8	2	2
51050	HIDESCRAPER	22	15	5	-	0	-	-	40	1	1	1	2	3	3	2	3	1	1	2	3	8	2	2
51077	HIDESCRAPER	17	20	7	-	0	-	-	88	2	1	1	2	3	8	3	3	6	2	2	3	8	2	2
9129	HIDESCRAPER	22	15	4	-	1	45	2	90	1	1	1	2	3	3	2	3	1	1	2	3	8	5	2
630	HIDESCRAPER	12	30	6	-	1	23	4	70	1	1	18	2	3	6	2	3	1	1	2	3	8	5	2
7536	HIDESCRAPER	14	19	3	-	1	45	4	85	1	1	18	2	3	3	2	4	6	2	2	3	9	5	2
983	HIDESCRAPER	25	29	6	-	1	3456	4	70	1	1	18	2	3	3	3	4	6	2	2	2	8	2	2

TABLE 16.
Usewear Variable States for 623 Utilized Elements, continued.

CAT	UEFUNC	L	W	TH	UL	RAW	LOC	MOD1	ANG	MOR1	MOR2	MOR3	ALC	DUL	POL	PIV	POC	STR	STL	MF1	MF2	MF3	MF4	TRJ
1063	HIDESCRAPER	25	18	6	-	1	45	4	80	1	1	18	2	3	4	2	4	6	2	2	2	8	2	2
1030	HIDESCRAPER	26	19	7	-	1	45	4	90	1	1	18	2	3	3	2	3	6	2	2	2	9	5	2
10489	HIDESCRAPER	22	18	4	-	1	3456	4	84	1	1	1	2	3	7	2	3	6	2	2	3	2	2	2
8694	HIDESCRAPER	30	20	5	-	1	45	4	70	2	1	1	2	3	8	3	3	6	2	2	3	8	2	2
9010	HIDESCRAPER	19	10	10	-	1	45	4	90	2	1	3	2	3	2	2	3	1	1	2	3	8	2	2
9820	HIDESCRAPER	17	17	3	-	1	45	4	66	1	1	1	2	3	1	1	1	1	1	2	3	8	2	2
10133	HIDESCRAPER	25	21	6	-	1	3456	4	74	1	1	1	2	3	7	2	3	6	2	2	3	2	2	2
14232	HIDESCRAPER	33	27	6	-	1	1234	4	52	2	1	1	2	3	8	3	3	6	2	2	3	8	2	2
14813	HIDESCRAPER	32	20	8	-	1	45	4	77	2	1	3	2	3	2	2	3	1	1	2	3	8	2	2
14813	HIDESCRAPER	32	20	8	-	1	678	4	72	1	1	1	2	3	1	1	1	1	1	2	3	8	2	2
10014	HIDESCRAPER	16	21	5	-	1	5678	4	87	1	1	1	2	3	7	2	3	6	2	2	3	2	2	2
10014	HIDESCRAPER	16	21	5	-	1	45	4	80	2	1	1	2	3	8	3	3	6	2	2	3	8	2	2
10014	HIDESCRAPER	16	21	5	-	1	123	4	76	1	1	1	2	3	3	2	3	1	1	2	3	8	2	2
14198	HIDESCRAPER	30	28	5	-	1	18	4	82	1	1	1	2	3	7	2	3	6	2	2	3	2	2	2
3225	HIDESCRAPER	25	21	7	-	1	678	4	85	2	1	1	2	3	8	3	3	6	2	2	3	8	2	2
3892	HIDESCRAPER	18	19	6	-	0	45	4	80	2	1	3	2	3	2	2	3	1	1	2	3	8	2	2
3926	HIDESCRAPER	23	11	9	-	1	56	4	60	2	1	1	2	3	8	3	3	6	2	2	3	8	2	2
3892	HIDESCRAPER	19	19	4	-	1	45	4	80	1	1	1	2	3	3	2	3	1	1	2	3	8	2	2
7456	HIDESCRAPER	17	21	6	-	1	45	4	67	1	1	1	2	3	7	2	3	6	2	2	3	2	2	2
7661	HIDESCRAPER	32	24	5	-	1	45	4	86	2	1	1	2	3	8	3	3	6	2	2	3	8	2	2
7398	HIDESCRAPER	13	20	9	-	1	45	4	9	1	1	18	3	3	2	3	3	1	1	3	2	2	2	4
4215	HIDESCRAPER	32	26	10	-	1	45	4	55	1	1	18	2	2	3	2	4	6	2	2	2	8	5	2
4417	HIDESCRAPER	20	18	6	-	1	45	4	90	1	1	18	2	3	3	2	3	1	1	2	3	8	2	2
7433	HIDESCRAPER	26	16	9	-	1	45	4	87	1	1	18	1	3	1	1	1	1	1	2	3	8	2	2
7631	HIDESCRAPER	18	22	9	-	1	345	4	90	1	1	18	2	3	3	2	3	6	2	2	2	8	2	2
3433	HIDESCRAPER	34	14	6	-	1	5678	4	30	1	1	18	3	3	2	3	3	1	1	3	2	2	2	4
6276	HIDESCRAPER	42	26	11	-	1	45	4	87	1	1	18	2	2	1	1	1	1	1	2	4	9	7	2
5804	HIDESCRAPER	22	23	7	-	1	234567	4	80	1	1	18	2	4	4	2	4	6	2	2	2	8	5	2
8049	HIDESCRAPER	22	15	4	-	1	45	4	90	1	1	18	2	2	6	2	2	1	1	2	3	8	2	2
6305	HIDESCRAPER	18	16	3	-	1	234567	4	49	1	1	18	2	2	3	2	3	1	1	2	2	8	2	2
8066	HIDESCRAPER	24	20	6	-	1	5678	4	77	1	1	18	2	3	3	2	4	6	2	2	3	3	2	2
8070	HIDESCRAPER	15	17	4	-	1	45	4	70	1	1	18	2	4	3	2	3	1	1	2	3	10	2	2
8048	HIDESCRAPER	18	19	5	-	1	45	4	85	1	1	18	2	3	3	2	2	1	1	2	2	9	2	2
5317	HIDESCRAPER	21	21	6	-	1	45	4	72	1	1	18	2	3	3	2	3	1	1	2	3	8	5	2
8070	HIDESCRAPER	34	22	8	-	0	45	4	88	1	1	18	2	3	3	2	3	1	1	2	3	8	5	2
5268	HIDESCRAPER	32	24	13	-	1	23	4	52	2	1	18	2	3	3	2	3	6	2	2	2	8	2	2
5335	HIDESCRAPER	24	26	5	-	1	45	4	32	1	1	18	2	3	3	2	3	6	2	2	3	8	5	2
6424	HIDESCRAPER	20	26	7	-	1	234567	4	87	1	1	18	2	3	4	2	4	6	2	2	2	9	5	2
6343	HIDESCRAPER	18	19	4	-	1	45	4	45	1	1	18	2	3	4	2	4	6	2	2	3	8	2	2

TABLE 16.
Usewear Variable States for 623 Utilized Elements, continued.

CAT	UEFUNC	L	W	TH	UL	RAW	LOC	MOD1	ANG	MOR1	MOR2	MOR3	ALC	DUL	POL	PIV	POC	STR	STL	MF1	MF2	MF3	MF4	TRJ
5330	HIDESCRAPER	21	26	5	-	1	45	4	90	1	1	18	2	4	4	2	4	6	2	2	2	8	5	2
7863	HIDESCRAPER	27	14	5	-	1	45	4	88	1	1	18	2	3	3	2	4	6	2	2	3	9	2	2
7916	HIDESCRAPER	17	17	4	-	1	45	4	70	1	1	18	2	4	4	2	4	6	2	2	2	8	2	2
5268	HIDESCRAPER	32	24	13	-	1	45	4	50	1	1	18	2	3	3	2	3	6	2	2	2	8	5	2
6342	HIDESCRAPER	25	23	8	-	1	45	4	52	1	1	18	2	3	3	2	4	6	2	2	3	8	2	2
7871	HIDESCRAPER	18	18	5	-	1	3456	4	86	1	1	18	2	3	8	2	4	6	2	2	2	8	2	2
1205	PLANTCUTTER	23	13	9	13	1	34	4	25	1	1	18	3	4	4	3	3	2	5	2	3	8	5	3
44134	WOODGRAVER	33	16	9	4	1	4	1	80	5	4	6	3	1	1	1	1	1	1	2	3	8	2	2
44170	WOODGRAVER	29	41	9	8	1	4	1	68	5	4	6	1	2	1	1	1	1	1	2	4	9	2	2
44170	WOODGRAVER	29	41	9	7	1	6	1	75	5	4	6	1	1	1	1	1	1	1	2	4	9	2	2
43228	WOODGRAVER	47	22	3	21	1	-	-	18	5	4	4	3	3	8	4	5	2	3	3	3	2	2	4
47145	WOODGRAVER	51	39	13	4	0	45	1	66	5	4	6	3	1	1	1	1	1	1	2	3	8	2	2
1200	WOODGRAVER	31	25	6	5	1	45	4	50	5	4	4	5	3	3	3	2	1	1	2	6	8	2	4
7256	WOODGRAVER	48	42	15	22	1	45	4	78	5	4	4	5	2	3	5	3	1	1	4	3	9	7	3
890	WOODGRAVER	41	14	5	4	1	45	4	50	5	4	4	4	3	3	2	2	1	1	2	2	8	2	3
7218	WOODGRAVER	35	12	6	10	1	5	4	67	5	4	4	5	2	3	5	3	6	2	4	4	9	2	4
9391	WOODGRAVER	20	11	3	11	1	2345	4	16	2	1	4	3	2	6	5	4	1	5	2	3	3	2	3
14246	WOODGRAVER	28	26	10	8	1	45	2	83	5	4	4	5	3	6	3	3	1	1	3	4	3	2	3
14248	WOODGRAVER	42	23	5	9	1	45	4	67	5	4	4	2	3	6	3	3	1	1	2	3	8	2	2
3817	WOODGRAVER	30	19	4	6	1	45	4	80	5	4	4	5	3	3	3	3	3	3	4	3	8	2	3
8590	WOODGRAVER	46	26	11	10	1	45	4	77	6	5	4	3	2	1	1	1	1	1	2	3	8	2	4
3891	WOODGRAVER	44	20	12	5	1	45	2	90	5	4	4	5	3	3	3	3	1	1	2	2	9	6	4
7410	WOODGRAVER	35	18	12	8	1	45	4	60	5	4	4	5	2	6	5	2	1	1	4	4	10	5	3
6335	WOODGRAVER	59	40	14	7	0	4	2	72	5	4	4	3	3	2	3	3	6	2	3	4	8	2	3
6545	WOODGRAVER	37	34	14	18	1	45	2	72	5	4	4	5	3	2	6	3	1	1	2	2	8	5	4
8079	WOODGRAVER	16	23	11	5	1	4	2	66	5	4	4	1	2	1	1	1	1	1	3	4	2	2	3
8052	WOODGRAVER	29	26	12	4	1	4	4	85	6	5	4	1	1	1	1	1	1	1	2	4	9	2	4
8037	WOODGRAVER	27	6	7	8	1	45	4	86	5	4	4	2	2	3	3	3	1	1	2	3	8	5	3
7917	WOODGRAVER	16	14	7	10	1	456	4	74	5	4	4	5	3	3	3	3	1	1	2	2	9	6	3
7887	WOODGRAVER	38	25	18	8	1	45	1	76	5	4	4	2	2	3	2	3	1	1	2	3	8	5	4
5642	WOODGRAVER	36	33	9	4	1	81	4	70	5	4	4	5	3	3	5	3	6	2	3	3	8	5	4
6516	WOODGRAVER	34	39	6	24	1	345	4	25	2	1	4	3	3	6	5	3	1	1	3	4	3	2	3
7917	WOODGRAVER	33	18	6	8	1	4	4	72	5	4	4	5	2	6	6	2	1	1	3	4	9	5	4
14924	WOODGRAVER	24	11	3	8	1	4	2	40	5	4	4	3	2	6	3	3	1	1	3	3	2	2	3
5419	WOODGRAVER	29	24	6	4	1	4	4	32	2	1	4	3	2	2	2	2	1	1	3	4	2	2	3
40097	WOODPERFORATOR	26	12	6	20	1	234567	2	70	4	6	4	3	6	6	3	6	2	5	3	9	2	2	3
42063	WOODPERFORATOR	34	9	4	39	0	234567	1	60	5	7	4	3	6	6	3	6	2	5	3	8	5	2	4
27147	WOODPERFORATOR	30	5	6	30	1	234567	3	44	5	7	4	2	2	3	2	1	1	3	4	2	2	4	3
992	WOODPERFORATOR	19	13	2	8	1	18	4	70	5	4	4	1	3	1	1	1	1	1	5	3	8	2	3

TABLE 16.
Usewear Variable States for 623 Utilized Elements, continued.

CAT	UEFUNC	L	W	TH	UL	RAW	LOC	MOD1	ANG	MOR1	MOR2	MOR3	ALC	DUL	POL	PIV	POC	STR	STL	MF1	MF2	MF3	MF4	TRJ
9196	WOODPERFORATOR	36	14	8	9	1	45	-	54	5	7	4	3	6	6	3	6	2	5	3	8	5	2	3
9124	WOODPERFORATOR	27	16	8	18	1	45	4	77	6	5	4	5	2	2	5	2	1	1	5	3	8	2	4
4430	WOODPERFORATOR	32	9	8	21	1	3456	4	42	6	5	4	5	3	3	6	3	1	1	3	3	8	2	4
4646	WOODPERFORATOR	51	8	6	62	1	234567	4	83	6	5	4	5	3	3	5	3	1	1	6	3	8	5	3
7480	WOODPERFORATOR	37	15	6	26	1	3456	4	67	5	4	4	5	3	3	6	3	6	2	5	4	8	5	4
44101	WOODSAW	43	28	7	33	1	5678	1	22	2	1	1	3	3	6	5	3	2	4	3	3	9	6	3
44273	WOODSAW	20	32	7	17	1	234	1	36	2	1	1	3	3	3	2	3	1	1	3	3	8	2	4
44281	WOODSAW	36	43	12	32	3	45	1	40	1	1	1	1	2	1	1	1	2	2	3	4	6	6	3
43150	WOODSAW	48	37	13	13	0	1	3	45	1	1	1	3	3	2	6	3	1	1	3	3	8	5	4
21065	WOODSAW	66	43	13	45	2	1234	2	36	2	1	1	2	2	2	4	3	2	3	2	7	10	7	2
50	WOODSAW	17	24	5	16	0	5678	-	40	1	1	1	1	2	1	1	1	2	2	3	4	6	6	2
47066	WOODSAW	65	25	10	28	0	234	1	44	2	1	1	3	3	6	5	2	1	1	3	3	8	5	4
47116	WOODSAW	41	54	10	28	0	4	2	35	1	3	1	3	3	6	5	3	1	1	3	3	8	5	4
47119	WOODSAW	56	56	10	50	0	45	1	46	2	3	1	3	3	5	2	2	2	2	3	3	8	7	4
47119	WOODSAW	56	56	10	30	0	5678	2	53	2	2	1	3	6	5	2	2	2	3	3	3	8	7	4
47119	WOODSAW	56	56	10	42	0	1234	1	61	2	1	1	3	3	6	5	2	2	2	3	3	8	6	4
47175	WOODSAW	43	50	17	26	0	-	1	43	1	1	1	3	2	6	3	2	2	1	3	3	8	5	4
47174	WOODSAW	33	49	9	41	0	45	1	38	2	3	1	3	4	6	5	2	1	1	3	3	9	6	4
26140	WOODSAW	38	23	18	20	1	234	1	40	2	1	1	3	2	2	3	2	1	1	3	4	8	5	4
1158	WOODSAW	30	26	13	13	1	678	4	25	2	1	4	1	1	2	2	2	1	1	3	5	2	2	4
852	WOODSAW	34	48	7	38	1	45	4	28	4	1	4	3	3	3	4	3	2	3	3	3	9	6	4
1006	WOODSAW	37	20	7	27	1	567	4	30	1	1	4	1	2	1	1	1	2	2	3	2	3	5	3
7382	WOODSAW	29	16	6	17	1	234	4	44	4	3	4	3	3	3	5	2	1	1	3	3	8	2	4
7372	WOODSAW	22	14	5	21	1	4567	4	49	4	3	4	3	3	3	5	3	1	1	3	4	9	5	3
14233	WOODSAW	18	12	5	14	1	5678	2	61	2	1	4	1	2	1	1	1	1	1	3	4	8	2	4
14912	WOODSAW	29	23	6	18	1	567	2	39	2	1	4	3	3	6	4	2	2	5	3	4	8	2	4
3856	WOODSAW	59	40	12	13	1	12	4	28	1	1	4	3	2	2	3	3	1	1	3	2	9	5	4
8487	WOODSAW	50	46	10	25	1	1234	4	43	2	3	4	1	1	1	1	1	1	1	3	3	10	6	3
4682	WOODSAW	42	23	6	34	1	234	4	38	2	3	4	3	4	3	6	4	2	3	3	2	10	5	4
7417	WOODSAW	36	40	7	23	1	678	4	49	4	3	4	1	2	6	3	3	1	1	3	4	10	7	3
6096	WOODSAW	27	16	7	20	1	45	4	33	2	1	4	3	3	2	3	2	1	1	3	4	8	2	4
7865	WOODSAW	36	26	9	26	1	45	4	44	1	1	4	3	3	6	6	3	1	1	3	4	9	5	3
6255	WOODSAW	29	23	7	19	1	45	4	44	2	1	4	2	2	3	5	3	1	1	3	4	8	5	4
5642	WOODSAW	36	33	9	8	1	78	4	24	2	3	4	3	3	2	6	3	3	2	3	4	2	2	4
44225	WOODSCRAPER	35	37	10	22	1	56	1	66	2	1	1	1	2	1	1	1	1	1	3	4	2	5	2
44253	WOODSCRAPER	31	28	18	13	1	67	1	64	3	1	1	2	3	3	2	4	1	1	2	3	8	2	4
43110	WOODSCRAPER	34	22	11	21	1	1234	1	45	2	1	1	2	3	6	2	2	1	1	2	3	8	2	2
42002	WOODSCRAPER	21	18	3	33	0	-	1	80	2	1	1	1	2	1	1	1	1	1	3	4	2	5	2
42011	WOODSCRAPER	48	31	10	38	0	123	4	45	2	2	1	2	3	2	2	1	1	2	3	4	2	5	2

TABLE 16.
Usewear Variable States for 623 Utilized Elements, continued.

CAT	UEFUNC	L	W	TH	UL	RAW	LOC	MOD1	ANG	MOR1	MOR2	MOR3	ALC	DUL	POL	PIV	POC	STR	STL	MF1	MF2	MF3	MF4	TRJ
42126	WOODSCRAPER	66	31	14	30	0	678	-	70	2	1	1	2	3	6	3	3	6	1	2	2	8	6	4
49009	WOODSCRAPER	33	23	9	11	1	45	1	47	2	1	1	1	2	1	1	1	1	1	2	2	2	2	2
47116	WOODSCRAPER	41	54	10	26	0	5	2	56	2	1	1	2	3	2	2	2	1	1	2	3	8	5	4
26094	WOODSCRAPER	24	22	6	20	1	5678	1	55	2	1	1	2	2	2	2	2	1	1	2	3	8	2	2
51024	WOODSCRAPER	25	22	7	18	1	1234	1	30	2	1	1	2	2	3	3	3	3	3	3	8	3	3	4
51030	WOODSCRAPER	39	30	11	25	1	678	2	45	1	1	1	2	3	3	2	3	6	3	2	3	8	3	2
1157	WOODSCRAPER	37	20	5	19	1	23	4	30	3	1	4	1	1	1	1	1	1	1	3	3	8	5	2
1204	WOODSCRAPER	30	18	7	15	1	2	4	50	2	1	4	1	3	1	1	1	1	1	2	3	9	3	2
7248	WOODSCRAPER	17	28	6	24	1	1234	2	67	2	1	4	2	2	3	2	3	1	1	2	4	2	5	2
7353	WOODSCRAPER	19	12	8	11	1	56	2	45	2	1	4	2	3	6	2	2	1	1	2	4	9	2	2
4473	WOODSCRAPER	72	12	8	16	1	45	4	75	2	1	4	2	4	3	2	2	8	2	2	3	8	5	2
4473	WOODSCRAPER	72	12	8	18	1	67	4	90	2	1	4	2	4	3	2	4	8	2	2	3	10	6	2
3640	WOODSCRAPER	46	20	6	38	1	1234	4	90	2	1	4	2	3	3	2	3	1	1	2	3	5	6	2
4473	WOODSCRAPER	72	12	8	21	1	234	4	88	2	1	4	2	4	3	2	2	8	2	2	3	8	5	2
4970	WOODSCRAPER	34	23	12	21	1	234	4	33	2	1	4	2	3	3	2	2	1	1	2	3	8	5	2
7464	WOODSCRAPER	36	17	11	12	1	45	4	42	2	1	4	2	3	3	3	4	6	2	2	3	8	5	2
7464	WOODSCRAPER	36	17	11	12	1	58	4	42	2	1	4	2	3	3	3	4	6	2	2	3	8	5	2
5816	WOODSCRAPER	58	46	6	31	1	67	4	55	3	1	4	2	3	6	2	3	1	1	2	2	9	5	2
7865	WOODSCRAPER	36	26	9	25	1	5678	4	90	3	1	4	2	3	3	3	3	1	1	2	5	9	5	2
5268	WOODSCRAPER	32	24	13	20	1	67	4	50	2	1	4	2	3	3	2	3	6	2	2	2	8	2	2
978	WOODSHAVER	37	31	8	17	1	234	1	25	1	1	1	1	3	1	1	1	1	1	3	3	2	5	4
16120	WOODSHAVER	20	19	7	16	1	1234	2	36	2	1	1	2	2	6	3	3	1	1	3	4	8	2	2
16159	WOODSHAVER	44	28	8	14	1	1234	1	37	1	2	1	3	2	6	3	3	1	1	3	3	8	2	4
16159	WOODSHAVER	44	28	8	14	1	678	1	40	1	2	1	3	2	6	3	3	1	1	3	3	8	2	4
44140	WOODSHAVER	18	10	3	16	1	45	1	80	2	1	1	3	3	6	2	3	1	1	3	3	8	5	4
44170	WOODSHAVER	21	41	9	18	1	45	1	68	2	1	1	1	2	1	1	1	1	1	2	3	9	2	2
44025	WOODSHAVER	35	23	6	14	1	4	1	10	2	1	1	3	3	2	2	2	3	3	3	4	2	5	4
44129	WOODSHAVER	46	36	10	29	1	56	1	34	3	2	1	3	2	6	3	3	1	1	3	4	2	5	2
44170	WOODSHAVER	29	41	9	13	1	45	1	20	2	1	1	1	2	1	1	1	1	1	3	4	8	5	4
44170	WOODSHAVER	29	41	9	17	1	123	1	36	2	1	1	1	3	1	1	1	1	1	3	4	8	5	4
44209	WOODSHAVER	54	33	10	19	1	567	1	39	2	1	1	3	3	6	3	3	3	2	3	4	2	5	4
44209	WOODSHAVER	54	33	10	27	1	567	1	28	2	1	1	3	3	6	3	3	3	2	3	4	2	5	4
44221	WOODSHAVER	32	33	7	18	0	567	1	28	2	1	1	1	1	1	1	1	1	1	2	4	2	5	4
44235	WOODSHAVER	22	19	9	19	1	45	1	38	3	2	1	2	3	2	4	3	1	1	3	4	8	5	4
44244	WOODSHAVER	20	28	5	21	1	45	2	22	2	1	1	1	2	1	1	1	1	1	3	3	8	2	4
43161	WOODSHAVER	45	20	9	29	1	123	1	64	1	1	1	1	3	1	1	1	2	2	3	3	10	3	2
40295	WOODSHAVER	21	17	4	13	1	678	1	20	3	1	1	2	2	2	2	3	1	1	3	3	9	5	2
43097	WOODSHAVER	25	24	10	19	1	1234	2	67	2	2	1	2	3	6	3	3	8	2	3	3	8	5	4
43129	WOODSHAVER	42	49	10	28	1	45	1	36	3	1	1	1	3	1	1	1	1	1	3	4	8	5	2

TABLE 16.
Usewear Variable States for 623 Utilized Elements, continued.

CAT	UEFUNC	L	W	TH	UL	RAW	LOC	MOD1	ANG	MOR1	MOR2	MOR3	ALC	DUL	POL	PIV	POC	STR	STL	MF1	MF2	MF3	MF4	TRJ
43129	WOODSHAVER	42	49	10	22	1	123	1	37	3	1	1	1	3	1	1	1	1	1	3	4	8	5	2
43150	WOODSHAVER	48	37	13	14	0	78	1	46	2	1	1	2	3	6	3	3	3	2	3	4	2	5	2
43156	WOODSHAVER	39	16	14	13	1	34	1	66	3	1	1	2	3	2	3	3	1	1	2	3	2	2	2
43177	WOODSHAVER	19	26	11	19	1	1234	1	42	2	1	1	1	2	1	1	1	1	1	3	4	8	5	2
43184	WOODSHAVER	29	16	6	15	1	234	1	70	2	1	1	2	3	6	4	3	3	2	3	3	8	2	4
43186	WOODSHAVER	36	18	9	14	1	34	2	45	2	1	1	2	3	6	4	3	1	1	3	3	8	5	4
43190	WOODSHAVER	24	26	10	8	1	5	1	44	3	1	1	1	3	1	1	1	1	1	3	3	8	5	4
43190	WOODSHAVER	24	26	10	15	1	678	1	35	3	1	1	1	3	1	1	1	1	1	3	3	8	5	4
43193	WOODSHAVER	45	118	6	15	1	234	1	38	3	1	1	3	2	6	6	3	1	1	3	3	8	2	4
43193	WOODSHAVER	45	118	6	26	1	567	1	26	3	1	1	3	2	6	6	3	1	1	3	3	8	2	4
43218	WOODSHAVER	30	21	6	11	1	78	1	30	2	1	1	2	3	6	3	2	1	1	3	3	8	5	2
43229	WOODSHAVER	26	18	4	16	1	678	1	23	2	1	1	3	2	6	5	3	1	1	3	3	2	5	4
43161	WOODSHAVER	45	20	9	14	1	78	1	58	3	1	1	1	3	1	1	1	1	1	3	3	10	3	2
40386	WOODSHAVER	39	19	9	22	0	678	1	85	1	1	4	1	3	1	1	1	6	2	2	3	8	2	2
42249	WOODSHAVER	53	21	6	21	0	78	2	45	2	1	1	2	2	2	3	2	1	3	4	3	5	4	4
42279	WOODSHAVER	27	28	10	12	0	45	1	45	3	1	1	2	2	2	3	2	1	1	3	4	2	5	4
42088	WOODSHAVER	19	20	6	13	0	5678	1	35	2	1	1	2	2	6	3	3	1	1	3	3	8	5	4
42279	WOODSHAVER	27	28	10	20	0	678	1	43	2	1	1	2	2	2	3	2	1	3	4	2	5	4	4
42262	WOODSHAVER	11	13	4	11	0	1234	2	60	3	1	1	2	2	2	3	2	1	1	3	4	2	5	4
42141	WOODSHAVER	20	19	4	13	0	567	1	35	2	1	1	1	1	1	1	1	1	1	3	3	8	2	4
42182	WOODSHAVER	20	20	8	18	0	1234	1	39	2	1	1	2	3	3	3	3	3	2	3	3	2	2	4
42182	WOODSHAVER	20	20	8	13	0	5678	2	33	2	1	1	2	3	3	3	3	3	2	3	3	2	2	4
19058	WOODSHAVER	31	21	7	24	1	123	2	36	2	1	1	2	2	2	3	2	1	1	3	3	9	2	4
45075	WOODSHAVER	31	14	4	19	1	23	2	44	2	1	1	2	3	2	2	2	1	1	3	4	8	2	4
45086	WOODSHAVER	63	54	18	32	1	56	1	35	3	1	1	2	2	2	3	2	1	1	3	4	2	5	4
45094	WOODSHAVER	21	25	6	16	1	34	2	75	4	1	1	2	2	6	2	2	1	1	2	3	8	5	2
49012	WOODSHAVER	23	30	9	19	1	45	1	28	1	1	1	2	2	2	3	3	1	1	3	3	2	2	2
49019	WOODSHAVER	49	39	15	23	1	234	1	36	2	1	1	3	2	6	3	3	1	1	3	3	2	5	4
49034	WOODSHAVER	25	27	10	19	1	123	1	68	2	1	1	3	3	6	3	3	1	1	3	4	8	2	2
49063	WOODSHAVER	22	16	6	9	1	6	1	40	2	1	1	3	2	2	3	3	1	1	3	4	2	2	2
49210	WOODSHAVER	29	31	12	14	1	34	1	37	1	1	1	3	2	2	4	3	1	1	3	4	2	2	4
49954	WOODSHAVER	43	27	4	26	1	5678	2	33	3	1	1	3	3	8	4	3	3	2	3	3	8	2	2
47031	WOODSHAVER	39	47	15	22	0	45	1	19	3	1	1	3	3	8	4	3	3	2	3	3	8	2	2
47098	WOODSHAVER	32	31	7	23	0	234	1	36	2	1	1	3	3	6	3	3	1	1	3	3	2	2	2
47098	WOODSHAVER	32	31	7	15	0	78	1	22	2	2	1	1	2	1	1	1	1	1	3	4	8	5	4
47069	WOODSHAVER	27	28	7	20	0	-	1	32	1	1	1	2	2	6	3	3	1	1	3	4	8	2	4
47201	WOODSHAVER	19	22	4	19	1	456	1	22	2	1	1	3	3	6	4	3	1	1	3	3	9	2	4
48029	WOODSHAVER	30	24	7	15	1	234	1	53	2	1	1	3	3	2	3	3	1	1	3	4	8	2	2
26008	WOODSHAVER	15	17	6	10	1	56	1	39	2	1	1	2	1	2	2	2	1	1	3	4	2	5	4

TABLE 16.
Usewear Variable States for 623 Utilized Elements, continued.

CAT	UEFUNC	L	W	TH	UL	RAW	LOC	MOD1	ANG	MOR1	MOR2	MOR3	ALC	DUL	POL	PIV	POC	STR	STL	MF1	MF2	MF3	MF4	TRJ
26097	WOODSHAVER	20	20	7	13	1	23	1	28	4	2	1	1	2	1	1	1	1	1	3	4	2	2	4
26097	WOODSHAVER	20	20	7	12	1	45	1	30	4	1	1	1	2	1	1	1	1	1	3	4	2	2	4
34233	WOODSHAVER	3	23	9	16	1	34	1	62	1	1	1	2	2	2	3	2	6	3	3	3	2	5	4
34274	WOODSHAVER	31	24	8	8	1	45	1	43	2	1	1	2	2	2	3	3	1	1	2	3	2	2	3
33056	WOODSHAVER	29	28	6	13	1	678	2	55	1	1	1	3	2	6	3	3	1	1	3	4	2	2	2
33098	WOODSHAVER	40	34	7	20	1	123	1	22	2	1	1	3	3	6	3	3	1	1	3	4	2	2	4
33098	WOODSHAVER	40	34	7	35	1	5678	1	33	2	1	1	3	3	6	3	4	1	1	3	4	2	2	4
32144	WOODSHAVER	20	18	6	11	1	345	1	62	2	1	1	3	2	2	3	3	1	1	3	4	2	2	4
52112	WOODSHAVER	24	23	3	16	0	-	-	77	2	1	1	3	3	6	4	3	1	1	3	4	8	2	2
52112	WOODSHAVER	24	23	3	10	0	-	-	72	2	1	1	3	3	2	4	3	1	1	3	4	8	2	2
51031	WOODSHAVER	16	18	6	16	1	1234	1	26	2	1	1	3	3	6	4	3	1	1	3	4	2	2	2
51064	WOODSHAVER	43	27	6	27	1	678	2	40	2	1	1	3	2	2	4	3	1	1	3	4	2	2	4
9113	WOODSHAVER	15	17	6	10	1	1234	1	42	2	1	1	3	3	2	2	2	3	3	3	4	2	5	4
7289	WOODSHAVER	42	21	9	24	1	678	4	42	2	3	4	3	4	3	5	3	1	1	3	3	10	7	2
7488	WOODSHAVER	33	26	10	24	1	18	4	25	1	1	4	2	3	3	4	3	3	2	2	3	9	2	4
7506	WOODSHAVER	33	31	10	22	1	18	4	28	1	1	4	2	3	3	4	3	1	1	2	3	8	2	2
7506	WOODSHAVER	33	31	10	37	1	456	4	37	1	1	4	2	3	3	4	3	1	1	2	3	8	2	2
1165	WOODSHAVER	23	14	4	12	1	56	4	20	2	1	4	2	3	3	3	3	3	2	3	3	8	5	4
1158	WOODSHAVER	30	26	13	11	1	12	4	42	2	1	4	3	3	3	4	3	3	3	3	3	8	5	2
1031	WOODSHAVER	37	29	4	20	1	4	4	30	2	1	4	2	3	3	3	3	3	2	3	3	8	5	2
14293	WOODSHAVER	49	61	16	24	1	12	4	68	3	1	4	2	3	3	4	3	1	1	2	3	8	2	2
7221	WOODSHAVER	46	28	4	23	1	45	4	18	2	1	4	3	2	3	3	3	1	1	2	4	2	5	2
7371	WOODSHAVER	33	24	12	13	1	23	4	27	3	1	4	3	2	6	4	3	1	1	3	4	8	2	4
1031	WOODSHAVER	37	29	4	9	1	4	4	30	2	1	4	3	3	3	3	3	5	3	3	2	8	5	4
162	WOODSHAVER	24	23	3	10	1	78	2	72	2	1	4	3	3	2	4	3	1	1	3	4	8	2	4
10001	WOODSHAVER	25	25	8	17	1	5	4	66	2	1	4	3	3	6	4	3	3	4	2	3	8	2	4
10599	WOODSHAVER	19	13	6	14	1	56	4	60	2	1	4	3	2	6	3	3	8	3	3	3	3	2	4
8880	WOODSHAVER	31	16	8	24	1	234	4	46	2	1	4	2	3	3	6	3	8	2	3	3	9	2	2
9130	WOODSHAVER	18	10	2	17	1	1234	4	66	2	1	4	2	3	6	3	3	1	1	2	3	3	2	2
8694	WOODSHAVER	30	20	5	20	1	678	4	36	2	1	4	3	2	3	4	3	1	1	3	4	8	5	2
8694	WOODSHAVER	30	20	5	22	1	1234	4	33	2	1	4	2	3	6	4	3	1	1	3	3	8	2	4
14353	WOODSHAVER	20	19	6	18	1	5678	4	38	1	1	4	3	2	3	3	3	1	1	3	4	3	2	4
14246	WOODSHAVER	28	26	10	10	1	45	2	74	5	4	4	5	3	3	3	3	6	2	3	3	8	2	4
14246	WOODSHAVER	28	26	10	21	1	234	2	82	3	1	4	3	3	3	4	3	3	2	3	3	2	5	4
14199	WOODSHAVER	30	16	8	10	1	3	4	42	3	1	4	2	2	6	3	3	1	1	3	4	8	2	2
14232	WOODSHAVER	33	27	6	16	1	45	4	45	2	1	4	2	2	3	3	4	1	1	3	3	8	2	2
14231	WOODSHAVER	29	19	5	13	1	567	4	46	3	1	4	2	2	6	2	3	1	1	2	3	2	2	4
14232	WOODSHAVER	33	27	6	12	1	678	4	38	2	1	4	2	2	3	3	3	1	1	2	4	8	2	2
14248	WOODSHAVER	42	23	5	27	1	5678	4	59	2	1	4	2	3	6	4	4	1	1	3	3	8	2	2

TABLE 16.
Usewear Variable States for 623 Utilized Elements, continued.

CAT	UEFUNC	L	W	TH	UL	RAW	LOC	MOD1	ANG	MOR1	MOR2	MOR3	ALC	DUL	POL	PIV	POC	STR	STL	MF1	MF2	MF3	MF4	TRJ
14797	WOODSHAVER	23	25	5	16	1	45	4	44	2	1	4	3	3	6	3	3	1	1	3	4	8	5	4
14797	WOODSHAVER	23	25	5	12	1	5678	4	40	2	1	4	3	3	6	3	3	1	1	3	3	8	5	4
14797	WOODSHAVER	23	25	5	11	1	5678	4	56	2	1	4	3	3	6	3	3	1	1	3	3	9	5	2
14684	WOODSHAVER	23	14	6	16	1	567	4	40	2	1	4	1	2	1	1	1	1	1	3	4	2	2	2
8490	WOODSHAVER	15	13	3	11	1	1234	4	84	2	1	4	3	2	6	4	4	1	1	2	3	8	5	4
8490	WOODSHAVER	15	13	3	12	1	5678	4	66	2	1	4	3	2	6	4	4	1	1	2	3	8	5	2
3231	WOODSHAVER	24	19	9	10	1	567	4	40	2	1	4	3	3	3	3	3	1	1	3	3	8	2	2
7953	WOODSHAVER	26	11	6	24	1	5678	4	39	2	1	4	3	3	6	6	3	1	1	3	4	8	2	4
8486	WOODSHAVER	53	39	4	40	1	5678	4	18	2	1	4	3	3	6	3	3	1	1	3	4	8	2	2
13968	WOODSHAVER	44	9	2	33	1	1234	4	40	2	1	4	2	2	2	3	2	1	1	2	2	8	2	2
13968	WOODSHAVER	44	9	2	36	1	5678	4	55	2	1	4	2	2	2	3	2	1	1	2	3	8	2	2
7625	WOODSHAVER	30	35	7	18	1	4	4	33	2	1	4	3	4	8	6	3	3	2	3	3	8	5	4
7633	WOODSHAVER	29	39	6	24	1	45	4	39	1	1	4	3	3	8	3	3	1	1	3	3	9	5	4
4422	WOODSHAVER	23	28	6	14	1	56	4	26	2	1	4	3	3	2	3	2	1	1	6	3	8	2	4
3816	WOODSHAVER	28	16	4	11	1	23	4	21	2	1	4	3	3	1	1	1	1	1	2	4	8	5	4
7647	WOODSHAVER	26	24	5	19	1	1234	4	33	2	1	4	3	2	2	3	3	1	1	3	4	3	5	4
3818	WOODSHAVER	27	25	6	6	1	7	4	40	2	1	4	3	3	3	6	3	1	1	3	3	8	5	4
7641	WOODSHAVER	29	23	5	22	1	1234	4	48	2	1	4	3	3	6	6	3	3	2	3	3	9	6	2
7439	WOODSHAVER	22	31	8	18	1	1234	4	34	1	1	4	3	3	8	6	3	1	1	3	4	9	2	2
7466	WOODSHAVER	26	25	10	21	1	123	4	37	2	2	4	2	3	3	3	3	3	3	3	4	8	2	4
7635	WOODSHAVER	34	24	9	16	1	56	4	36	3	1	4	3	3	6	4	3	1	1	3	4	9	5	2
7641	WOODSHAVER	29	23	5	18	1	5678	4	36	2	1	4	3	2	3	4	3	3	2	3	4	9	5	4
7668	WOODSHAVER	33	25	10	17	1	567	4	48	2	1	4	3	3	6	4	3	1	1	3	4	8	5	2
4770	WOODSHAVER	19	16	3	15	1	1234	4	25	2	1	4	2	3	3	4	3	1	1	2	4	3	3	2
5675	WOODSHAVER	30	22	17	7	1	23	4	55	3	1	4	2	2	3	2	3	1	1	2	2	10	5	4
5586	WOODSHAVER	17	24	9	12	1	23	4	16	2	1	4	3	3	2	3	2	1	1	3	4	8	5	2
8031	WOODSHAVER	22	24	54	19	1	45	4	46	2	1	4	2	2	2	4	4	1	1	3	4	2	2	2
8031	WOODSHAVER	22	24	54	18	1	5678	4	46	2	1	4	2	2	2	4	4	1	1	3	4	2	2	4
8041	WOODSHAVER	29	37	7	22	1	567	4	28	3	1	4	3	2	6	2	2	1	1	3	3	2	2	2
5649	WOODSHAVER	32	23	6	27	1	567	4	26	2	1	4	3	3	3	6	3	1	1	2	4	8	2	2
7828	WOODSHAVER	34	22	9	19	1	56	4	45	2	1	4	3	2	6	3	3	1	1	3	4	8	2	2
7828	WOODSHAVER	34	22	9	17	1	78	4	47	2	1	4	3	2	6	3	3	1	1	3	4	8	2	2
7844	WOODSHAVER	28	28	6	19	1	1234	4	28	2	1	4	3	3	3	6	3	1	1	2	3	8	2	2
7826	WOODSHAVER	33	36	15	28	1	1234	4	45	2	1	4	3	3	3	4	3	1	1	3	4	8	5	4
7828	WOODSHAVER	34	22	9	12	1	4	4	47	2	1	4	3	3	6	6	3	1	1	3	3	8	5	2
7861	WOODSHAVER	28	33	10	16	1	1234	4	52	2	1	4	3	3	3	4	3	3	2	3	4	8	5	2
7881	WOODSHAVER	30	11	4	18	1	5678	4	44	2	1	4	2	3	3	2	3	1	1	2	3	8	5	2
7891	WOODSHAVER	34	18	5	21	1	678	4	36	1	1	4	3	2	3	2	4	1	1	3	3	8	2	2
7926	WOODSHAVER	25	22	3	19	1	45	4	48	3	1	4	3	3	3	2	3	1	1	2	3	3	2	2
7864	WOODSHAVER	33	23	7	20	1	678	4	38	2	1	4	3	3	2	3	3	1	1	3	4	9	2	4
5754	WOODSHAVER	34	22	8	17	1	567	4	18	3	1	4	1	3	1	1	1	1	1	2	3	9	5	4
7918	WOODSHAVER	21	19	5	5	1	8	4	82	3	1	4	2	2	3	2	2	1	1	2	3	8	5	4
7918	WOODSHAVER	21	19	5	9	1	78	4	86	3	1	4	2	2	3	2	2	1	1	2	3	8	5	4
7891	WOODSHAVER	34	18	5	9	1	23	2	90	3	1	4	2	3	3	2	3	1	1	2	2	8	2	4
7935	WOODSHAVER	24	16	8	9	1	12	4	30	3	1	4	3	2	2	2	2	1	1	2	4	3	2	4

TABLE 16.
Usewear Variable States for 623 Utilized Elements, continued.

CAT = Artifact Catalog Number

UEFUNC = Utilized Element Functional Category

L = Length (mm)

W = Width (mm)

Th = Thickness (mm)

UL = Utilized Element Length (mm)

See Chapter 4 for code information on variables MOR1 to TRJ

TABLE 16, continued.
Usewear Variable States for 623 Utilized Elements, continued.
Key to Usewear Variable States.

TYPE	n	MOD1	ANG	MOR1	MOR2	MOR3	ALC	DUL	POL	PIV	POC	STR	MF1	MF2	MF3	MF4	TRJ
BAGRAVER	9	4	70	5	4	6	5	3	3	5	3	3	3	3	9	5	2
BAPERFORATOR	7	2	NA	6	5	7	5	3	3	3	6	6	3	3	9	5	2
BASAW	6	4	34	4	1	4	3	4	3	5	3	1	3	3	10	5	2
BASCRAPER	32	4	50	2	1	4	2	3	3	2	3	1	2	3	8	5	2
BASHAVER	5	4	77	3	1	4	2	2	3	4	2	1	2	3	9	5	3
BAWEDGE	3	1	NA	2	1	1	3	4	5	5	NA	1	3	3	7	5	2
BUTCHERY	105	4	25	2	1	4	3	2	2	1	3	1	3	4	2	2	3
HIDECUTTER	19	4	21	2	1	4	3	3	3	3	3	1	3	3	8	2	3
HIDEPERFORATOR	1	3	60	6	5	7	5	3	3	2	2	1	3	4	2	2	4
HIDESCRAPER	199	4	90	1	1	1	2	3	3	2	3	1	2	3	8	2	2
PLANTCUTTER	1	4	25	1	1	18	3	4	4	3	3	2	2	3	8	5	3
WOODGRAVER	28	4	72	5	4	4	5	2	3	3	3	1	2	3	8	2	3
WOODPERFORATOR	9	4	70	5	4	6	5	3	3	3	6	1	3	3	8	2	3
WOODSAW	29	4	44	2	1	4	3	3	5	5	3	1	3	3	8	5	4
WOODSCRAPER	25	4	45	2	1	4	2	3	3	2	3	1	2	3	8	5	2
WOODSHAVER	142	4	36	2	1	4	3	3	5	3	3	1	3	3	8	2	4
MODE OF MODES:		**4**	**70**	**2**	**1**	**4**	**3**	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**8**	**5**	**2**

TABLE 17.
Usewear Code Modes.

GROUP	VARIABLE	ARTIFACT / UE CLASS MEMBERS	HOUSE SUM	HOUSE UNIT AVERAGE
	SAMPLE	n of items examined in usewear study (all non-projectile point fine-grained chipped lithic items)	1794	199
	UE	lithic item bearing at least one UE	534	59
	INDET	lithic item in examined sample too small and/or fragmentary to be diagnosed with respect to UE presence/function	626	30
1	**UU**	lithic item shaped for use, but unused	146	16
	BPC	bipolar core identified in usewear examination (added to artifact counts, but not catalog)	108	5
	CORE	bipolar core identified in usewear examination (added to artifact counts, but not catalog)	19	1
	PF	Lithic Projectile Point, fragment (small bifacial item of size and shape of points; often tip, corner, or stem)	361	4
	BAGRAV	UE's assigned to bone/antler graving.	7	0.7
	BAPERF	UE's assigned to bone/antler perforation.	4	0.4
	BASAW	UE's assigned to bone/antler sawing.	8	0.4
	BASCR	UE's assigned to bone/antler scraping.	31	3.4
	BASHAV	UE's assigned to bone/antler shaving.	4	0.4
	BAWEG	UE's assigned to bone/antler wedging.	3	0.3
	BUTCH	UE's assigned to butchery.	90	10
2	**HIDECUT**	UE's assigned to hide cutting.	20	2
	HIDESCR	UE's assigned to hide scraping.	167	18
	HIDEPERF	UE's assigned to hide perforation.	1	0.1
	PLANTCUT	UE's assigned to vegetal cutting.	0	0
	WOODGRAV	UE's assigned to wood graving.	25	2.7
	WOODPERF	UE's assigned to wood perforation.	9	1
	WOODSAW	UE's assigned to wood sawing.	23	2.5
	WOODSCR	UE's assigned to wood scraping.	19	2.1
	WOODSHAV	UE's assigned to wood shaving.	123	13
	GRAVE	UE's assigned to graving.	32	4
	PERF	UE's assigned to perforation.	14	2
	SAW	UE's assigned to sawing.	31	3
3	**SCRAPE**	UE's assigned to scraping.	217	24
	SHAVE	UE's assigned to shaving.	127	14
	WEDGE	UE's assigned to wedging.	3	0.3
	CUT	UE's assigned to cutting.	110	12
	LIT STOR	Lithic Manuport, Lithic Raw, Lithic Core (viable freehand)	781	87
	LIT RED 1	Lithic Anvil, Lithic Hammer (sizes 3 and 4)	110	12
	LIT RED 2	Lithic Hammer (sizes 1 and 2), Lithic Core (viable bipolar)	1108	123
	LIT USE	All lithic toolstone items	1794	199
	LIT END	Lithic Core (exhausted freehand and exhausted bipolar)	592	66
	BASTOR	Bone / Antler raw material and indet items, e.g. metapodials & ulnae	134	15
4	**BARED1**	Lithic Wedge, Bone / Antler Worked Item	8	1
	BARED2	Lithic Abrader, all BONE / ANTLER UE's	270	30
	BAUSE	All Bone/ Antler Tools	57	6
	WOOD RED1	Bone/Antler Wedges	13	1
	WOOD RED2	Bone/Antler Chisels, WOOD UE's	191	21
	HIDE STOR	Lithic Projectile Point	719	80
	HIDE RED 1	HIDE-SCRAPING UE's	167	18
	HIDE RED 2	Bone / Antler Perforators, Lithic HIDE-PERFORATION and HIDE-CUTTING UE's	25	3

TABLE 18.
Variable Membership of Nine Data Groups for Spatial Analysis.

GROUP	VARIABLE	ARTIFACT / UE CLASS MEMBERS	HOUSE SUM	HOUSE UNIT AVERAGE
	MANUPORT	Lithic Manuport, Lithic Raw	178	20
	VIABLE CORE	Lithic Core, not exhausted (flakes >3cm may still be removed)	603	67
	EX CORE	Lithic Core, exhausted (flakes >3cm can no longer be removed)	128	14
	FREE CORE	Lithic Core, freehand (no sign of bipolar percussion)	603	67
	BIPOLAR CORE	Lithic Core, bipolar (clear evidence of bipolar percussion)	216	24
5	**WHOLE POINT**	Lithic Projectile Point (intact)	719	80
	POINT FAILURE	Lithic Projectile Point (missing tip, stem and/or corners)	361	40
	BROKEN POINT	Lithic Projectile Point (lateral snap near midline)	404	45
	SMALL HAMMER	Lithic Hammer <8 cm in maximum dimension	127	14
	LARGE HAMMER	Lithic Hammer >8 cm in maximum dimension	77	9
	USED LITHIC	lithic item bearing at least one UE	534	59
	UNUSED LITHIC	lithic item shaped for use, but unused	146	16
	DEBITAGE	Lithic Debitage Item	26706	2967
	G1	Lithic Debitage Item (>1-inch in maximum dimension)	221	25
6	**G2**	Lithic Debitage Item (<1-inch, >1/2-inch in maximum dimension)	4175	464
	G3	Lithic Debitage Item (<1/2-inch, >1/8-inch in maximum dimension)	16150	1794
	G4	Lithic Debitage Item (<1/8-inch in maximum dimension)	6161	685
	STONE 1	Lithic Manuport, Lithic Raw	178	20
	STONE 2	Lithic Anvil, Lithic Hammer (size 3), Lithic Hammer (size 4), Lithic Whole Core	694	77
	STONE 3	Lithic Hammer (size 1), Lithic Hammer (size 2), Lithic Broken Point	531	59
	WOOD 1	NA	NA	NA
	WOOD 2	Antler Wedge, Bone Wedge	18	2
7	**WOOD 3**	Antler Chisel, Bone Chisel, Lithic Abrader, Lithic Adze/Celt, all WOOD UE's, Unused Shavers	409	45
	BA 1	NA	NA	NA
	BA 2	Lithic Wedge and Lithic Unused Wedge	7	1
	BA 3	Lithic Abrader, all BONE / ANTLER UE's	241	27
	HIDE 1	Lithic Projectile Point	719	80
	HIDE 2	HIDESCRAPING UE's	167	19
	HIDE 3	Bone / Antler Perforators, Lithic HIDE-PERFORATION and HIDE-CUTTING UE's, unused HIDE-WORKING implements	113	13
	BONE / ANTLER	All Bone /Antler UE's	57	6
	WOOD	All Woood UE's	199	22
8	**HIDE**	All Hide UE's	188	21
	STONE	Any Lithic Item	1747	194
	FLESH	All Flesh UE's	90	10
	LINEFISH	Antler Point, Bone Point	14	2
9	**NETFISH**	Lithic Net Weight	29	3
	TERRHUNT	Lithic Projectile Point	719	80
	AQMAMM	Antler Harpoon Valve, Bone Harpoon Valve	2	0.22

TABLE 18.
Variable Membership of Nine Data Groups for Spatial Analysis, continued.

TABLE 19.

Variable Membership of Chaine-Operatoire Stages.

	Gathering / Storage	**Reduction Stage I**	**Reduction Stage II**	**Use of Produced Items**	**End Use / Discard of Produced Items**
Lithic Artifacts	CCS manuports & untested raw material	Anvils, large hammerstones (sizes 3&4), G1 and G2 debitage, opened, viable CCS cores	Small hammerstones (sizes 1&2), G3 and G4 debitage, bipolar cores, lithic projectile point failures.	Count of all UEs on lithic tools.	Exhausted CCS cores, exhausted hide scrapers, broken lithic projectile points.
Bone / Antler Artifacts	Lithic projectile points, bone and antler indet items, non-butchery-marked heavy faunal elements	Lithic wedges, bone/antler wedgeing usewear, lithic gravers, worked bone/antler indet items.	Lithic abraders, CCS UEs assigned to bone/antler.	N/A	N/A
Wooden Artifacts	N/A	Bone and antler wedges.	Bone and antler chisels, lithic abraders, CCS UEs assigned to woodworking.	N/A	N/A
Hides	Lithic projectile points.	Lithic hidescrapers.	Lithic hide cutting usewear, bone and antler perforators.	N/A	Exhausted hide-scrapers.

GROUP	VARIABLE	MEIER / CATHALAPOTLE	*p*	COMMENT
	SAMPLE	223.77	<.0005	51% (n=296) more than expected at Meier
	UE	333.18	<.0005	178% (n=162) more than expected at Meier
	INDET	101.22	<.0005	58% (n=117) more than expected at Meier
1	**UU**	6.29	0.0200	14% (n=14) more than expected at Cathlapotle
	BPC	1.10	>.2500	No significant difference.
	CORE	11.33	0.0010	111% (n=7) more than expected at Meier
	PF	127.55	<.0005	86% (n=100) more than expected at Meier
	BAGRAV	-	-	Disqualified for low counts
	BAPERF	-	-	Disqualified for low counts
	BASAW	-	-	Disqualified for low counts
	BASCR	9.40	0.0025	79% (n=7) more than expected at Meier
	BASHAV	-	-	Disqualified for low counts
	BAWEG	-	-	Disqualified for low counts
	BUTCH	31.55	<.0005	85% (n=24) more than expected at Meier
2	**HIDECUT**	-	-	Disqualified for low counts
	HIDESCR	3.29	0.1000	No significant difference (10% or 11 items more than expected at Cathlapotle)
	HIDEPERF	-	-	Disqualified for low counts
	PLANTCUT	-	-	Disqualified for low counts
	WOODGRAV	26.00	<.0005	147% (n=12) more than expected at Meier
	WOODPERF	-	-	Disqualified for low counts
	WOODSAW	0.49	>.2500	No significant difference.
	WOODSCR	3.59	0.1000	62% (n=3) more than expected at Meier
	WOODSHAV	13.78	<.0005	48% (n=19) more than expected at Meier
	GRAVE	30.71	<.0005	141% (n=14) more than expected at Meier
	PERF	3.95	0.0500	76% (n=3) more than expected at Meier
	SAW	2.34	>.2000	No significant difference.
3	**SCRAPE**	0.02	>.2500	No significant difference.
	SHAVE	17.37	<.0005	53% (n=21) more than expected at Meier
	WEDGE	-	-	Disqualified for low counts
	CUT	55.24	<.0005	102% (n=36) more than expected at Meier
	LIT STOR	373.67	<.0005	100% (n=252) more than expected at Meier
	LIT RED 1	5.45	0.0250	32% (n=11) more than expected at Meier
	LIT RED 2	264.09	<.0005	70% (n=253) more than expected at Meier
	LIT USE	223.77	<.0005	51% (n=296) more than expected at Meier
	LIT END	184.86	<.0005	80% (n=154) more than expected at Meier
	BASTOR	65.17	<.0005	100% (n=43) more than expected at Meier
4	**BARED1**	-	-	Disqualified for low counts
	BARED2	165.16	<.0005	113% (n=99) more than expected at Meier
	BAUSE	19.48	<.0005	84% (n=16) more than expected at Meier
	WOOD RED1	-	-	Disqualified for low counts
	WOOD RED2	53.52	<.0005	76% (n=47) more than expected at Meier
	HIDE STOR	89.56	<.0005	51% (n=118) more than expected at Meier
	HIDE RED 1	3.29	0.1000	No significant difference (10% or 11 items more than expected at Cathlapotle)
	HIDE RED 2	1.73	0.2000	No significant difference.

TABLE 20.
Chi-Squared Battery: Meier and Cathlapote Sites.

GROUP	VARIABLE	MEIER / CATHALAPOTLE	*p*	COMMENT
	MANUPORT	116.98	<.0005	117% (n=67) more than expected at Meier
	VIABLE CORE	259.95	<.0005	95% (n=185) more than expected at Meier
	EX CORE	178.25	<.0005	70% (n=70) more than expected at Meier
	FREE CORE	259.95	<.0005	95% (n=185) more than expected at Meier
	BIPOLAR CORE	11.40	0.0010	33% (n=23) more than expected at Meier
5	**WHOLE POINT**	89.56	<.0005	51% (n=118) more than expected at Meier
	POINT FAILURE	127.55	<.0005	86% (n=100) more than expected at Meier
	BROKEN POINT	103.13	<.0005	73% (n=85) more than expected at Meier
	SMALL HAMMER	41.53	<.0005	82% (n=33) more than expected at Meier
	LARGE HAMMER	0.00	>.2500	No significant difference.
	USED LITHIC	55.42	<.0005	46% (n=80) more than expected at Meier
	UNUSED LITHIC	6.29	0.0200	30% (n=14) more than expected at Cathlapotle
	DEBITAGE	10621.53	<.0005	91% (n=7877) more than expected at Meier
	G1	7.01	0.0100	25% (n=18) more than expected at Meier
6	**G2**	530.05	<.0005	51% (n=695) more than expected at Meier
	G3	6014.69	<.0005	88% (n=8609) more than expected at Meier
	G4	4838.22	<.0005	128% (n=1553) more than expected at Meier
	STONE 1	116.98	<.0005	117% (n=67) more than expected at Meier
	STONE 2	237.22	<.0005	84% (n=189) more than expected at Meier
	STONE 3	144.23	<.0005	75% (n=129) more than expected at Meier
	WOOD 1	-	-	Disqualified for low counts
	WOOD 2	-	-	Disqualified for low counts
7	**WOOD 3**	78.58	<.0005	63% (n=84) more than expected at Meier
	BA 1	-	-	Disqualified for low counts
	BA 2	-	-	Disqualified for low counts
	BA 3	64.10	<.0005	74% (n=58) more than expected at Meier
	HIDE 1	89.56	<.0005	51% (n=118) more than expected at Meier: note this is same as WHOLEPOINT
	HIDE 2	3.29	0.1000	No significant difference.
	HIDE 3	206.79	<.0005	10% (n=11) more than expected at Cathlapotle
	BONE / ANTLER	19.48	<.0005	84% (n=15) more than expected at Meier
	WOOD	36.21	<.0005	61% (n=40) more than expected at Meier
8	**HIDE**	0.00	>.2500	No significant difference.
	STONE	604.27	<.0005	85% (n=480) more than expected at Meier
	FLESH	31.55	<.0005	85% (n=14) more than expected at Meier
	LINEFISH	3.95	0.0500	76% (n=3) more than expected at Meier
9	**NETFISH**	9.18	0.0025	81% (n=7) more than expected at Meier
	TERRHUNT	89.56	<.0005	51% (n=118) more than expected at Meier
	AQMAMM	-	-	Disqualified for low counts

TABLE 20.
Chi-Squared Battery: Meier and Cathlapotle Sites, continued.

GROUP	VARIABLE	MEIER N,C,S	*p*	COMMENT
	SAMPLE	22.14	0.0005	23% (n=52) less than expected in North and 17% (n=54) more than expected in Center
	UE	7.06	0.0500	21% (n=19) more than expected in Center and 20% (n=12) less than expected in North
	INDET	7.41	0.0200	24% (n=20) less than expected in North
1	**UU**	0.37	>.25	No significant difference.
	BPC	-	-	Disqualified for low counts; note however that they are EXTREMELY RARE in the N
	CORE	-	-	Disqualified for low counts
	PF	4.31	0.1500	No significant difference.
	BAGRAV	-	-	Disqualified for low counts
	BAPERF	-	-	Disqualified for low counts
	BASAW	-	-	Disqualified for low counts
	BASCR	-	-	Disqualified for low counts
	BASHAV	-	-	Disqualified for low counts
	BAWEG	-	-	Disqualified for low counts
	BUTCH	6.96	0.0500	42% (n=5) less than expected in North and 46% (n=8) more than expected in Center
2	**HIDECUT**	-	-	Disqualified for low counts
	HIDESCR	2.32	>.25	No significant difference.
	HIDEPERF	-	-	Disqualified for low counts
	PLANTCUT	-	-	Disqualified for low counts
	WOODGRAV	-	-	Disqualified for low counts
	WOODPERF	-	-	Disqualified for low counts
	WOODSAW	-	-	Disqualified for low counts
	WOODSCR	-	-	Disqualified for low counts
	WOODSHAV	0.39	>.25	No significant difference.
	GRAVE	-	-	Disqualified for low counts
	PERF	-	-	Disqualified for low counts
	SAW	-	-	Disqualified for low counts
3	**SCRAPE**	0.77	>.25	No significant difference.
	SHAVE	0.82	>.25	No significant difference.
	WEDGE	-	-	Disqualified for low counts
	CUT	6.65	0.0250	36% (n=9) more than expected in Center and 40% (n=7) less than expected in North
	LIT STOR	50.25	0.0005	36% (n=64) more than expected in Center
	LIT RED 1	8.92	0.0200	74% (n=9) more than expected in North
	LIT RED 2	10.68	0.0050	11% (n=26) more than expected in Center
	LIT USE	22.14	0.0005	17% (n=54) more than expected in Center
	LIT END	15.67	0.0005	21% (n=26) more than expected in Center
	BASTOR	0.49	>.25	No significant difference.
4	**BARED1**	-	-	Disqualified for low counts
	BARED2	16.19	0.0005	42% (n=20) more than expected in North
	BAUSE	2.26	>.25	No significant difference.
	WOOD RED1	-	-	Disqualified for low counts
	WOOD RED2	22.66	0.0005	75% (n=21) more than expected in North
	HIDE STOR	2.32	>.25	No significant difference.
	HIDE RED 1	2.32	>.25	No significant difference.
	HIDE RED 2	-	-	Disqualified for low counts

TABLE 21.
Chi-Squared Battery: Meier Site North, Central and South Zones.

GROUP	VARIABLE	MEIER N,C,S	*p*	COMMENT
	MANUPORT	22.38	0.0005	52% (n=25) less than expected in S, and 39% (n=17) more than expected in Center
	VIABLE CORE	31.10	0.0005	34% (n=47) more than expected in Center
	EX CORE	13.34	0.0025	40% (n=16) more than expected in Center
	FREE CORE	31.10	0.0005	34% (n=47) more than expected in Center and 31% (n=46) less than expected in South
	BIPOLAR CORE	-	-	Disqualified for low counts
5	**WHOLE POINT**	2.19	>.25	No significant difference.
	POINT FAILURE	4.31	0.1500	No significant difference.
	BROKEN POINT	4.65	0.1000	No significant difference.
	SMALL HAMMER	17.88	0.0005	71% (n=13) more than expected in North and 54% (n=14) more than expected in Center
	LARGE HAMMER	2.84	0.2500	No significant difference.
	USED LITHIC	7.06	0.0500	21% (n=19) more than expected in Center and 19% (n=12) less than expected in North
	UNUSED LITHIC	0.37	>.25	No significant difference.
	DEBITAGE	243.30	0.0005	20% (n=841) more than expected in North
	G1	19.11	0.0005	55% (n=19) less than expected in South and 50% (n=15) more than expected in Center
6	**G2**	108.97	0.0005	32% (n=132) more than expected in North and 25% (n=105) less than expected in South
	G3	246.34	0.0005	26% (n=660) more than expected in North
	G4	54.57	0.0005	11% (n=205) more than expected in South and 13% (n=218) less than expected in Center
	STONE 1	22.38	0.0005	52% (n=25) less than expected in S, and 39% (n=17) more than expected in Center
	STONE 2	32.46	0.0005	33% (n=53) less than expected in S and 30% (n=44) more than expected in Center
	STONE 3	0.65	>.25	No significant difference.
	WOOD 1	-	-	Disqualified for low counts
	WOOD 2	-	-	Disqualified for low counts
7	**WOOD 3**	10.94	0.0050	33% (n=18) more than expected in North and 23% (n=19) less than expected in South
	BA 1	NA	NA	Disqualified for low counts
	BA 2	-	-	Disqualified for low counts
	BA 3	8.44	0.0200	40% (n=18) more than expected in North
	HIDE 1	2.19	>.25	No significant difference.
	HIDE 2	2.32	>.25	No significant difference.
	HIDE 3	1.21	>.25	No significant difference.
	BONE / ANTLER	2.26	>.25	No significant difference.
	WOOD	1.11	>.25	No significant difference.
8	**HIDE**	1.47	>.25	No significant difference.
	STONE	38.06	0.0005	25% (n=92) more than expected in Center
	FLESH	6.96	0.0500	46% (n=8) more than expected in Center and 42% (n=6) less than expected in North
	LINEFISH	-	-	Disqualified for low counts
9	**NETFISH**	-	-	Disqualified for low counts
	TERRHUNT	2.19	>.25	Not significant, but note that projectile point % of C and S assbs is 14-15% higher than N
	AQMAMM	-	-	Disqualified for low counts

TABLE 21.
Chi-Squared Battery: Meier Site North, Central and South Zones, continued.

GROUP	VARIABLE	CATH 1 N,C,S	*p*	COMMENT
	SAMPLE	23.34	0.0005	25% (n=59) more than expected in S
	UE	17.03	0.0005	35% (n=28) more than expected in S, 31% (n=19) less than expected in C
	INDET	19.62	0.0005	39% (n=28) more than expected in S, 31% (n=25) less than expected in N
1	**UU**	3.68	0.2000	No significant difference.
	BPC	-	-	Disqualified for low counts
	CORE	-	-	Disqualified for low counts
	PF	5.09	0.1000	No significant difference.
	BAGRAV	-	-	Disqualified for low counts
	BAPERF	-	-	Disqualified for low counts
	BASAW	-	-	Disqualified for low counts
	BASCR	-	-	Disqualified for low counts
	BASHAV	-	-	Disqualified for low counts
	BAWEG	-	-	Disqualified for low counts
	BUTCH	2.41	>.2500	No significant difference.
2	**HIDECUT**	-	-	Disqualified for low counts
	HIDESCR	0.60	>.2500	No significant difference.
	HIDEPERF	-	-	Disqualified for low counts
	PLANTCUT	-	-	Disqualified for low counts
	WOODGRAV	-	-	Disqualified for low counts
	WOODPERF	-	-	Disqualified for low counts
	WOODSAW	-	-	Disqualified for low counts
	WOODSCR	-	-	Disqualified for low counts
	WOODSHAV	10.81	0.0050	60% (n=11) more than expected in S, 39% (n=5) less than expected in C and 26% (n=5) less than expected in N
	GRAVE	-	-	Disqualified for low counts
	PERF	-	-	Disqualified for low counts
	SAW	-	-	Disqualified for low counts
3	**SCRAPE**	4.62	0.1000	No significant difference.
	SHAVE	10.81	0.0050	60% (n=11) more than expected in S, 39% (n=5) less than expected in C and 26% (n=5) less than expected in N
	WEDGE	-	-	Disqualified for low counts
	CUT	2.84	0.2500	No significant difference.
	LIT STOR	29.50	0.0005	50% (n=36) more than expected in S, 34% (n=28) less than expected in N
	LIT RED 1	9.42	0.0100	67% (n=10) less than expected in N
	LIT RED 2	3.51	0.2000	No significant difference.
	LIT USE	23.34	0.0005	25% (n=59) more than expected in S
	LIT END	15.02	0.0001	37% (n=25) more than expected in S
	BASTOR	11.74	0.0050	68% (n=10) more than expected in N, 54% (n=7) less than expected in S
4	**BARED1**	-	-	Disqualified for low counts
	BARED2	5.49	0.1000	No significant difference.
	BAUSE	-	-	Disqualified for low counts
	WOOD RED1	-	-	Disqualified for low counts
	WOOD RED2	5.36	0.1000	No significant difference.
	HIDE STOR	11.05	0.0050	26% (n=24) more than expected in S, 20% (n=21) less than expected in C
	HIDERED1	0.60	>.2500	No significant difference.
	HIDERED2	-	-	Disqualified for low counts

TABLE 22.
Chi-Squared Battery: Cathlapotle House I North, Central and South Zones.

GROUP	VARIABLE	CATH 1 N,C,S	*p*	COMMENT
	MANUPORT	-	-	Disqualified for low counts
	VIABLE COR	19.53	0.0005	42% (n=26) more than expected in S, 34% (n=23) less than expected in N
	EX CORE	-	-	Disqualified for low counts
	FREE CORE	19.53	0.0005	42% (n=26) more than expected in S, 34% (n=23) less than expected in N
	BIPOLAR CO	11.04	0.0050	54% (n=12) more than expected in N, 35% (n=7) less than expected in S
5	**WHOLE POIN**	11.05	0.0050	26% (n=24) more than expected in S, 20% (n=21) less than expected in C
	POINT FAILU	5.09	0.1000	No significant difference.
	BROKEN POI	14.18	0.0001	40% (n=20) more than expected in S, 31% (n=18) less than expected in N
	SMALL HAM	3.21	0.2500	No significant difference.
	LARGE HAM	-	-	Disqualified for low counts
	USED LITHIC	17.03	0.0005	35% (n=28) more than expected in S, 31% (n=19) less than expected in C
	UNUSED LIT	3.68	0.2000	No significant difference.
	DEBITAGE	771.17	0.0005	43% (n=1146) more than expected in S, 29% (n=592) less than expected in C
	G1	-	-	Disqualified for low counts
6	**G2**	196.76	0.0005	47% (n=269) more than expected in S, 29% (n=126) less than expected in C
	G3	545.57	0.0005	46% (n=758) more than expected in S, 27% (n=340) less than expected in C
	G4	59.32	0.0005	25% (n=110) more than expected in S, 30% (n=100) less than expected in C
	STONE 1	-	-	Disqualified for low counts
	STONE 2	22.56	0.0005	38% (n=31) less than expected in N, 36% (n=26) more than expected in S
	STONE 3	9.90	0.0100	27% (n=17) less than expected in N, 27% (n=18) more than expected in S
	WOOD 1	NA	NA	NA
	WOOD 2	-	-	Disqualified for low counts
7	**WOOD 3**	19.42	0.0005	48% (n=25) more than expected in N, 36% (n=14) less than expected in C
	BA 1	NA	NA	NA
	BA 2	-	-	Disqualified for low counts
	BA 3	12.08	0.0025	56% (n=13) more than expected in S, 34% (n=6) less than expected in C
	HIDE 1	11.05	0.0050	26% (n=24) more than expected in S, 20% (n=21) less than expected in S
	HIDE 2	0.60	>.2500	No significant difference.
	HIDE 3	-	-	Disqualified for low counts
	BONE / ANTL	-	-	Disqualified for low counts
	WOOD	11.92	0.0050	50% (n=14) more than expected in S, 38% (n=28) less than expected in C
8	**HIDE**	0.68	>.2500	No significant difference.
	STONE	21.99	0.0005	27% (n=47) more than expected in S, 21% (n=40) less than expected in N
	FLESH	2.41	>.2500	No significant difference.
	LINEFISH	-	-	Disqualified for low counts
9	**NETFISH**	-	-	Disqualified for low counts
	TERRHUNT	11.05	0.0050	26% (n=24) more than expected in S, 20% (n=21) less than expected in S
	AQMAMM	-	-	Disqualified for low counts

TABLE 22.
Chi-Squared Battery: Cathlapotle House I North, Central and South Zones, continued.

GROUP	VARIABLE	CATH 4 N,C,S	*p*	COMMENT
	SAMPLE	42.62	0.0005	45% (n=50) more than expected in S, 44% (n=30) less than expected in C and 32% (n=20) less than expected in N
	UE	-	-	Disqualified for low counts.
	INDET	10.52	0.0100	43% (n=10) less than expected in N and 33% (n=15) more than expected in S
1	**UU**	-	-	Disqualified for low counts.
	BPC	-	-	Disqualified for low counts.
	CORE	-	-	Disqualified for low counts.
	PF	-	-	Disqualified for low counts.
	BAGRAV	-	-	Disqualified for low counts.
	BAPERF	-	-	Disqualified for low counts.
	BASAW	-	-	Disqualified for low counts.
	BASCR	-	-	Disqualified for low counts.
	BASHAV	-	-	Disqualified for low counts.
	BAWEG	-	-	Disqualified for low counts.
	BUTCH	-	-	Disqualified for low counts.
2	**HIDECUT**	-	-	Disqualified for low counts.
	HIDESCR	-	-	Disqualified for low counts.
	HIDEPERF	-	-	Disqualified for low counts.
	PLANTCUT	-	-	Disqualified for low counts.
	WOODGRAV	-	-	Disqualified for low counts.
	WOODPERF	-	-	Disqualified for low counts.
	WOODSAW	-	-	Disqualified for low counts.
	WOODSCR	-	-	Disqualified for low counts.
	WOODSHAV	-	-	Disqualified for low counts.
	GRAVE	-	-	Disqualified for low counts.
	PERF	-	-	Disqualified for low counts.
	SAW	-	-	Disqualified for low counts.
3	**SCRAPE**	-	-	Disqualified for low counts.
	SHAVE	-	-	Disqualified for low counts.
	WEDGE	-	-	Disqualified for low counts.
	CUT	-	-	Disqualified for low counts.
	LIT STOR	2.82	0.2500	No significant difference.
	LIT RED 1	0.69	>.2500	No significant difference.
	LIT RED 2	10.71	0.0050	26% (n=19) more than expected in S
	LIT USE	42.62	0.0005	45% (n=50) more than expected in S and 44% (n=30) less than expected in C
	LIT END	1.01	>.2500	No significant difference.
	BASTOR	-	-	Disqualified for low counts.
4	**BARED1**	-	-	Disqualified for low counts.
	BARED2	-	-	Disqualified for low counts.
	BAUSE	-	-	Disqualified for low counts.
	WOOD RED1	-	-	Disqualified for low counts.
	WOOD RED2	-	-	Disqualified for low counts.
	HIDE STOR	1.45	>.2500	No significant difference.
	HIDE RED 1	-	-	Disqualified for low counts.
	HIDE RED 2	-	-	Disqualified for low counts.

TABLE 23.
Chi-Squared Battery: Cathlapotle House IV North, Central and South Zones.

GROUP		CATH 4 N,C,S	*p*	COMMENT
	MANUPORT	-	-	Disqualified for low counts.
	VIABLE CORE	2.43	>.2500	No significant difference.
	EX CORE	-	-	Disqualified for low counts.
	FREE CORE	2.43	>.2500	No significant difference.
	BIPOLAR CORE	14.64	0.0010	49% (n=14) more than expected in S and 56% (n=10) less than expected in C
5	**WHOLE POINT**	1.45	>.2500	No significant difference.
	POINT FAILURE	-	-	Disqualified for low counts.
	BROKEN POINT	4.37	0.1500	No significant difference.
	SMALL HAMMER	-	-	Disqualified for low counts.
	LARGE HAMMER	0.25	>.2500	No significant difference.
	USED LITHIC	-	-	Disqualified for low counts.
	UNUSED LITHIC	-	-	Disqualified for low counts.
	DEBITAGE	76.62	0.0005	24% (n=173) less than expected in C and 23% (n=147) more than expected in N
	G1	2.08	>.2500	No significant difference.
6	**G2**	57.55	0.0005	51% (n=71) less than expected in C and 29% (n=67) more than expected in S
	G3	65.05	0.0005	28% (n=132) less than expected in C and 25% (n=105) more than expected in N
	G4	48.50	0.0005	38% (n=65) less than expected in S and 41% (n=38) more than expected in N
	STONE 1	-	-	Disqualified for low counts.
	STONE 2	2.27	>.2500	No significant difference.
	STONE 3	0.65	>.2500	No significant difference.
	WOOD 1	-	-	Disqualified for low counts.
	WOOD 2	-	-	Disqualified for low counts.
7	**WOOD 3**	7.89	0.0200	46% (n=9) more than expected in S
	BA 1	NA	NA	NA
	BA 2	-	-	Disqualified for low counts.
	BA 3	7.36	0.0500	55% (n=4) less than expected in N and 48% (n=7) more than expeted in South
	HIDE 1	1.45	>.2500	No significant difference.
	HIDE 2	-	-	Disqualified for low counts.
	HIDE 3	-	-	Disqualified for low counts.
	BONE / ANTLER	-	-	Disqualified for low counts.
	WOOD	-	-	Disqualified for low counts.
8	**HIDE**	9.00	0.0100	74% (n=8) less than expected in S, 34% (n=3) more than expected in N and 26% (n=5) nore than expected in S
	STONE	6.50	0.0500	23% 9n=14) less than expected in C and 17% (n=16) more than expected in S
	FLESH	-	-	Disqualified for low counts.
	LINEFISH	-	-	Disqualified for low counts.
9	**NETFISH**	-	-	Disqualified for low counts.
	TERRHUNT	1.45	>.2500	No significant difference.
	AQMAMM	-	-	Disqualified for low counts.

TABLE 23.
Chi-Squared Battery: Cathlapotle House IV North, Central and South Zones, continued.

CONTEXT	LINE FISH	NET FISH	TERR HUNT	BUTCHERY	STONEWORK	HIDEWORK	BAWORK	WOODWORK	SUM
CATHLAPOTLE 1 NORTH	0	3	82	13	107	67	25	26	**323**
CATHLAPOTLE 1 CENTER	0	3	67	11	118	27	7	13	**246**
CATHLAPOTLE 1 SOUTH	0	3	116	24	166	54	7	57	**427**
CATHLAPOTLE 4 NORTH	0	0	22	1	36	19	0	2	**80**
CATHLAPOTLE 4 CENTER	0	0	34	0	27	6	3	2	**72**
CATHLAPOTLE 4 SOUTH	0	2	47	11	98	36	6	10	**210**
MEIER NORTH	2	13	78	12	244	37	56	40	**482**
MEIER CENTER	13	2	131	25	410	62	71	47	**761**
MEIER SOUTH	8	2	142	20	326	60	55	37	**650**
CATHLAPOTLE 6	0	1	13	0	38	2	8	2	**64**
CATHLAPOTLE SHEET MIDDEN	0	0	53	4	48	25	3	4	**137**
MEIER MIDDEN	7	0	36	2	97	17	53	13	**225**
MEIER EXTERIOR	3	0	14	11	99	5	10	12	**154**
SUM	**33**	**29**	**835**	**134**	**1814**	**417**	**304**	**265**	**3831**

(a) Raw Counts (artifacts assigned to each of eight activity classes per analytical unit)

CONTEXT	LINE FISH	NET FISH	TERR HUNT	BUTCHERY	STONEWORK	HIDEWORK	BAWORK	WOODWORK	SUM
CATHLAPOTLE 1 NORTH	0.0	0.9	25.4	4.0	33.1	20.7	7.7	8.0	**100**
CATHLAPOTLE 1 CENTER	0.0	1.2	27.2	4.5	48.0	11.0	2.8	5.3	**100**
CATHLAPOTLE 1 SOUTH	0.0	0.7	27.2	5.6	38.9	12.6	1.6	13.3	**100**
CATHLAPOTLE 4 NORTH	0.0	0.0	27.5	1.3	45.0	23.8	0.0	2.5	**100**
CATHLAPOTLE 4 CENTER	0.0	0.0	47.2	0.0	37.5	8.3	4.2	2.8	**100**
CATHLAPOTLE 4 SOUTH	0.0	1.0	22.4	5.2	46.7	17.1	2.9	4.8	**100**
MEIER NORTH	0.4	2.7	16.2	2.5	50.6	7.7	11.6	8.3	**100**
MEIER CENTER	1.7	0.3	17.2	3.3	53.9	8.1	9.3	6.2	**100**
MEIER SOUTH	1.2	0.3	21.8	3.1	50.2	9.2	8.5	5.7	**100**
CATHLAPOTLE 6	0.0	1.6	20.3	0.0	59.4	3.1	12.5	3.1	**100**
CATHLAPOTLE SHEET MIDDEN	0.0	0.0	38.7	2.9	35.0	18.2	2.2	2.9	**100**
MEIER MIDDEN	3.1	0.0	16.0	0.9	43.1	7.6	23.6	5.8	**100**
MEIER EXTERIOR	1.9	0.0	9.1	7.1	64.3	3.2	6.5	7.8	**100**
	0.9	**0.8**	**21.8**	**3.5**	**47.4**	**10.9**	**7.9**	**6.9**	**100**

(b) Percentages (of analytical unit's eight activity class material correlates)

CONTEXT	LINE FISH	NET FISH	TERR HUNT	BUTCHERY	STONEWORK	HIDEWORK	BAWORK	WOODWORK
CATHLAPOTLE 1 NORTH	0	0.2	4.7	0.7	6.1	3.8	1.4	1.5
CATHLAPOTLE 1 CENTER	0	0.3	5.7	0.9	10	2.3	0.6	1.1
CATHLAPOTLE 1 SOUTH	0	0.2	7.5	1.6	10.7	3.5	0.5	3.7
CATHLAPOTLE 4 NORTH	0	0	4.7	0.2	7.7	4.1	0	0.4
CATHLAPOTLE 4 CENTER	0	0	6.5	0	5.2	1.1	0.6	0.4
CATHLAPOTLE 4 SOUTH	0	0.2	5.5	1.3	11.5	4.2	0.7	1.2
MEIER NORTH	0.3	2	11.7	1.8	36.7	5.6	8.4	6
MEIER CENTER	1.4	0.2	14.2	2.7	44.6	6.7	7.7	5.1
MEIER SOUTH	0.8	0.2	14.1	2	32.4	6	5.5	3.7
CATHLAPOTLE 6	0	0.2	2.6	0	7.5	0.4	1.6	0.4
CATHLAPOTLE SHEET MIDDEN	0	0	8.3	0.6	7.5	3.9	0.5	0.6
MEIER MIDDEN	1.6	0	8.3	0.5	22.4	3.9	12.2	3
MEIER EXTERIOR	0.6	0	2.6	2	18.3	0.9	1.9	2.2

(c) Densities (count per cubic meter excavated)

TABLE 24.
Counts, Percentages and Densities for Eight Activity Classes Per Plank House.

	Meier			Cathlapotle I			Cathlapotle IV		
	Elite	**Middle Commoner**	**Low Commoner**	**Elite**	**Middle Commoner**	**Low Commoner**	**Elite**	**Middle Commoner**	**Low Commoner**
Production	Net Fishing	Stone-Working	Land Hunting	Stone-Working	Stone-Working	Hide- & Bone/Antler-Working	Net Fishing & Butchery	Land Hunting	Wood-Working
Distribution	na	na	na	na	na	na	na	na	na
Consumption	na	na	na	na	na	na	na	na	na
Transmission	not visible	not visible	not visible	not visible	not visible	not visible	not visible	not visible	not visible
Reproduction	not visible	not visible	not visible	not visible	not visible	not visible	not visible	not visible	not visible

TABLE 25.
Summary of Household Function Participation by Social Rank in the Sampled Plank Houses.
na = no distinction archaeologically apparent.

FIGURES