Formation Processes of a Lower-Columbia Plankhouse Site

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Most archaeological research includes some type of spatial analysis: *how much, of a given type, do we find in certain places?* This is because we know that people generally use space differentially, not uniformly. Consequently, the spatial distribution of artifacts and features should inform us about ancient, spatially-expressed social behavior.

We also know that artifacts and features are commonly moved and/or transformed between the time of deposition and the time of excavation by a variety of agents. The 'Pompeii Premise' (the assumption that artifacts and/or features are found precisely where they were used and/or deposited: see Binford 1981a) has been recognized as a portal to analytical disaster. Therefore, archaeologists have undertaken the study of site-formation processes to identify how archaeological phenomena were formed and transformed prior to analysis.

Site-formation processes take place on many scales, and different processes affect different types of artifacts and features. Each archaeological site, then, is the product of a unique set of formation processes that must be understood before spatial distribution analysis is considered. The most common (and correct) way to control for the effects of site formation processes is to match the scales of our analytical units with the scales of the formation processes.

These facts indicate that we must understand the full range of a site's formation processes before we infer past social behavior from spatial distributions of artifacts and features.

On the Northwest Coast, spatial distribution analyses are commonly used to understand the social organization of production within and among the remains of the large, multi-family domestic structures referred to as 'plankhouses' (for Northwest Coast natives, plankhouses and their inhabitants were the most important social and economic units, even more so than villages, which were clusters of plankhouses) (e.g. Coupland this volume; Grier this volume; Martindale this volume; Sobel this volume). This is because documentary evidence indicates that throughout the Northwest Coast at the time of European contact, populations were divided into at least three main social groups (elites, commoners [of higher and lower status], and slaves), and that members of these groups occupied different areas within the plankhouses. Social ranking extends millennia into the precontact period on the Northwest Coast (Ames and Maschner 1999; Matson and Coupland 1995), and spatial distribution analysis is widely expected to be the key to understanding the organization of labor in the precontact era. Most of this research is conducted as some form of 'household archaeology' (Wilk and Rathje 1982, Hayden and Cannon 1982), in which production is a structuring variable of social organization.

Portland State University's Wapato Valley Archaeology Project (WVAP) has excavated the remains of a plankhouse (occupied from roughly 1400 AD to roughly 1830's AD) at the Meier site (35CO5) located in the Lower Columbia River Valley near Portland, Oregon (Figure 1 also identifies the nearby and contemporaneous Cathlapotle village site, 45CL1 [Ames et al 1999]). Based on multiple lines of evidence from this site, the WVAP hypothesizes that elites occupied the north end of the plankhouse, and that commoners of middle and lower status (and perhaps slaves) resided in the center and southern areas, respectively. At Meier, then, we have the opportunity to examine the social organization of production by examining the spatial distribution of artifacts and features related to production in the north, central, and south areas of the plankhouse.

Of course, as noted above, spatial distribution analysis cannot proceed before site-formation processes are understood. At Meier, where the plankhouse stood for about four centuries, site-formation processes were particularly complex. This is because there was no discrete 'occupation floor', or even a series of floors, that collected artifacts over time. Rather, most artifacts were recovered from matrix composing large (often barrel-sized) pit features which originally composed subterranean storage facilities beneath plank floors. These are the most extensive archaeologically-identified storage facilities known on the Northwest Coast, and perhaps among foragers worldwide. How artifacts were introduced to the pits, and were moved and/or transformed within them, and how artifacts were removed from them, are all critical points if we are to understand the social organization of production via the spatial distribution of production-related artifacts and features.

In short, the four-century occupation of the Meier plankhouse generated a complex palimpsest (Binford 1983), and palimpsests can be very difficult to interpret (Binford 1987: 504-507; Carr 1984, 1987). The site-formation processes at Meier, then, must be carefully examined.

I have three goals in this paper. The first is to determine which of a range of possible site-formation processes generated and conditioned the Meier assemblage of material correlates that inform us of the social organization of production, the focus of my work in the Wapato Valley Archaeology Project (Smith 1996, 2004, 2005). The second goal is to identify (a) the scales, and (b) the directions that production-related artifacts were moved by the identified formation processes. I address these goals by evaluating the likelihood that 15 specific site-formation processes conditioned the assemblage, and by identifying how and on what scales they moved artifacts. Throughout my examination of these issues, I evaluate the use of 10 m-long analytical units to divide the Meier plankhouse interior assemblage into assemblages reflecting the activities of the elite, commoners of higher status, and commoners of lower status. My third goal is to construct a model of the essential flow of artifacts through the Meier plankhouse, based on facts that are demonstrated in the site-formation process evaluation. Such a model will be of considerable use in future analyses of Lower Columbia plankhouse remains, and may be of use in other archaeological contexts. I conclude the paper with a number of research implications derived from this model.

The Meier Site

Background

The Meier Site (35C05) is a southern Northwest Coast plankhouse site excavated by Portland State University's WVAP from 1987 to 1991 (Ames et al. 1992). The WVAP addresses the archaeology of the relatively sedentary pre- and post-contact foragers of the Greater Lower Columbia River Region, collectively known as Chinookans (Ames et al. 1999; Silverstein 1990) (Figure 1). The Meier excavations yielded a large and varied corpus of artifact and feature data representing a Chinookan plankhouse and an adjacent midden. Radiocarbon dating established that the 30 m x 12 m domestic structure was occupied between roughly 1400 A.D. and 1830 A.D. (Ames et al. 1992), thereby straddling the most conservative European contact date of 1792 A.D. The site is on a slough with easy access to the Columbia River. Roughly 35% of the plankhouse interior was exposed in this excavation, which was primarily research-oriented but did include a significant salvage component because the eastern half of the site had been extensively pothunted. Figure 2 indicates the layout of excavation units and features encountered.

One goal of archaeological research at Meier is to understand the social organization of labor within the plankhouse. Consequently, excavations sampled the long axis of the plankhouse. Historically, the long axis of Chinookan domestic plankhouses served a proxemic function, signaling (to visitors) and reiterating (to residents) the social status of the residents. At the time of European contact, the typical Chinookan plankhouse housed members of two or all three social statuses: elites, commoners, and sometimes slaves. Elites resided at the end of the plankhouse most distant from the common door, and therefore were physically segregated from the commoners (and sometimes slaves) residing closer to the other end of the structure (Sobel 2004). By sampling the long axis of the Meier plankhouse, the living areas of elites, commoners (of higher and lower status), and perhaps slaves can sampled and compared.

By the time of the first occupation at Meier, social ranking was clearly embedded as an aboriginal institution of some millennia on the Northwest Coast, and it is not unreasonable to project the historically-documented basic ranks of elite, commoner, and slave into the pre-contact period. Such a projection is reasonable not only for the Northwest Coast as a whole, but also for the Meier site specifically, given the long-term continuity in Meier plankhouse architecture discussed below.

Combining this projection with archaeological evidence indicating that the common door of the Meier plankhouse was at the south end, Meier site researchers hypothesize that the north end of the Meier plankhouse was occupied by the elites, the central portion by commoners of middle status, and the south end by commoners of the lowest status (Ames 1995; Smith 2004). Thus, in order to explore social hierarchy within the Meier household, analytical units representing the northern, central and southern 10 m sections of the 30 m long plankhouse have been developed; archaeological deposits from the northern 10 m of the plankhouse are used as evidence of behavior by elites, deposits from the central 10 m are used as evidence of behavior by commoners of middle status, and deposits from the southern 10 m are used as evidence of behavior by commoners of lowest status within the Meier household.

In this paper, I do not directly address the social and economic behaviors indicated by the assemblages from the three analytical units (see Smith 2004). Rather, I explore the site formation processes that generated and transformed the portions of the assemblage -- those related to production -- that reflect economic behavior.

Before evaluating a range of site-formation processes, it is necessary to introduce the basic architecture of the plankhouse, as that architecture structured (a) the activities of the plankhouse inhabitants, (b) field decisions made regarding excavation unit placement, and (c) the delineation of the north, central, and south analytical units.

Architecture of the Meier Site Plankhouse

Extensive feature evidence provides a detailed understanding of the Meier plankhouse architecture. Three major architectural facility types composed the interior architecture (Figure 3), each designed for different activities.

Benches, 1 m to 2 m wide, bordered the walls of the plankhouse, like benches shown in 19th-century illustrations of Lower Columbia dwelling interiors (Nabokov and Easton 1990:237); Chinookans used these benches for sleeping and storage of personal items. Each bench was composed of a wooden structure above the earthen floor. Space under the bench served as a storage area. At Meier, archaeological bench remains were composed simply of the earthen floor that was once covered by the wooden structure (see Figure 4), and were characterized by low artifact densities (in sum, 62 per cubic meter excavated) and a lack of depositional stratification.

Between the bench and the central hearth area was an extensive complex of pits excavated by the inhabitants, aligned roughly with the long axis of the plankhouse. Collectively, this row of closely-spaced pits is termed the cellar. Cellars are not mentioned in early-historic documents (Hajda 1994; Sobel 2004), nor are they found in illustrations of Lower Columbia plankhouses (Nabokov and Easton 1990). This is not surprising, however, as many historic Chinookan houses were equipped with floorboards, sometimes seen in historic illustrations. Given the size and placement of the cellar pits, and the distance between the bench and central hearth area, only a plank floor covering the cellar could prevent a mandatory two-meter broad jump from bed to hearth. Thus, we can be certain that the Meier house had a plank floor. Archaeologically, cellars invariably contained deposits of dark, organic matrix rich with artifacts (overall, 99 per cubic meter excavated). Some cellars preserved stratigraphic detail (Figure 5) while others were very turbated.

A series of hearths was aligned with the plankhouse long axis, down the middle of the plankhouse. Hearths were separated from one another whereas benches were continuous along the sides of the plankhouse. Thus, the spaces surrounding hearths were necessarily work areas (as is commonly encountered with domestic hearth facilities) and conduits of foot traffic. For this paper, I lump hearths with the surrounding matrix and refer to these complexes as ‘hearth/periphery’ facilities. Each hearth complex was characterized by multiple sand-lined, clay bowls (Figure 6). Archaeological features show that each hearth was bounded by a frame of wooden planks that formed a 'hearth box' (Figure 2). Hearth peripheries contained significantly more artifacts than benches, but significantly fewer artifacts than cellars (overall, 72 per cubic meter excavated). The area just outside each hearth box contained numerous peg- and postmolds for structures associated with the hearth.

The bench, cellar and hearth/periphery facilities were essentially identical in the north, central, and south areas of the plankhouse (although there is some important size variation among them). They are also regularly spaced along the entire plankhouse long axis. These facts indicate that the interior of the plankhouse had one essential plan, reiterated in the north, central, and south; the areas near the walls were for sleeping and storage, the cellars under the floorboards were for storage, and the hearth/periphery areas were for production-related activities. The implications of this architectural redundancy are discussed below.

A heuristic reconstruction of the Meier plankhouse, based on ethnohistoric data from the Lower Columbia and archaeological data from the Meier site, is presented in

Figure 3. It is encouraging that the ethnohistoric reports of Lower-Columbia house form, written by eye-witnesses from the time of Lewis & Clark (1805 and 1806) through the 1850's (Hajda 1994; Sobel 2004), are in accordance with what was found in the Meier excavations (Ames et al. 1992; Ames et al. 1999).

The architectural facilities described above conditioned the behavior of the plankhouse inhabitants. Different areas of the plankhouse interior had different functions: the hearth/periphery was not for storage of bulk items, the cellar pits were not for cooking, and the bench areas were not for bulk storage of large items.

Analytical Units Applied in Archaeological Analysis

Wapato Valley Archaeology Project investigators have divided the plankhouse interior into roughly 10 m-long north, central, and south analytical units for comparison of the assemblages of these portions of the plankhouse (e.g. Smith 1996, 2004). In the following discussion, I present the main rationale for using these 10 m-long units. Later in this paper, I return to them, when I evaluate whether or not the identified formation processes moved artifacts related to production *on scales or in directions significant to* these 10 m-long analytical units.

Spatial and Temporal Rationale for North, Central and South Analytical Units

The north, central and south analytical units may be used to compare activities in these areas of the plankhouse only if it is demonstrated that (a) architectural facilities in the north, central, and south of the house had the same general functions (spatial rationale) and (b) that each analytical unit was contemporaneously occupied, and basic activities in each unit were continuous through time (temporal rationale).

Spatial rationale for these unit is supported when we note that the north, central, and south analytical units each sample the same architectural facilities, but in different areas of the plankhouse. If different areas of the plankhouse had been used for different activities (e.g. the north for ceremonies only, or the south exclusively for production), we would not be justified in comparing their artifacts as representatives of basic production activities in each area. But, an examination of the features indicates that each area had benches, cellars, and hearths, and that in each area, these facilities were used for the same purposes (evidence for this is elaborated below). The north, central, and south analytical units therefore adequately sample the use of such facilities by the hypothesized socially-ranked groups.

Temporal rationale must also be demonstrated. For example, if a certain area of the plankhouse was abandoned for some period, and used as a refuse storage area before being refurbished and reused as a domestic dwelling area, such information would have to be considered before conducting a spatial analysis. We must also know whether or not regular maintenance or large-scale reorganization profoundly altered the use of space in the plankhouse.

A structure may be subject to at least two processes which may transform the building site, and associated archaeological deposits. Maintenance is the rejuvenation of worn or stressed elements, in order to keep the existing structure viable. Reorganization is the spatial rearrangement of architectural elements, and/or the introduction of new architectural elements or elimination of old elements.

The wooden Meier plankhouse, as with any domestic structure continually inhabited by a large number of people for four centuries, required extensive maintenance. I envision a continual replacement of minor elements, and occasional replacement of large elements, when considering the assemblage formation and transformation processes. Such activities could conceivably move artifacts from one area of the plankhouse to another (for example, from areas occupied by lower-ranked commoners to areas occupied by elites), and must be considered.

House Maintenance and Reorganization

Maintenance Features at Meier indicate that the plankhouse was continually refurbished and perhaps entirely reconstructed several times (Ames et al. 1992). Reconstruction, or at least large-scale maintenance of the structure, is evidenced by numerous resettings of structural features such as central roof supports, wall planks and posts, and corner posts. Maintenance is also indicated by intact lenses of hearth material ('hearth-dumps') in the midden deposit roughly 10m east of the plankhouse (Figure 7), multiple overlapping pit features (Figures 2 and 5), and a multitude of overlapping, non-structural postmolds around the hearth deposits (Figure 2). The nature and possible effects of these various maintenance activities are examined in detail in this paper, as they are very likely to have moved artifacts. The critical questions regard the directions and scale of this movement.

Reorganization Social information is frequently (and perhaps inevitably) encoded in the human material environment, at scales ranging from domestic architecture (Kent 1990; Rapoport 1980, 1990) to culturally-modified landscapes (Earle 2001). For the purposes of this paper, I am less concerned with the specific meanings encoded in Lower Columbia plankhouse architecture than I am with the hypothesis that large-scale, radical social change in Chinookan society would in some way be manifest in plankhouse architecture. In other words, if no major architectural change is noted in the uselife of the plankhouse, then I am more justified in proposing long-term social continuity at Meier than if, for example, there were major architectural changes. Architectural changes may or may not be the result of social reorganization, but, essentially, the absence of architectural change fortifies an hypothesis of social continuity through time.

Meier feature data indicate that two plankhouse modifications were made which might suggest substantial social change. First, at a time roughly half-way through the occupation, the orientation of the long axis of the plankhouse was changed by a few degrees (Ames et al. 1992). However, because this change was so slight, and is unaccompanied by any structural reorganization of the use of space within the plankhouse (see below), this was most likely an unintentional byproduct of rebuilding the entire plankhouse rather than a fundamental restructuring of the plankhouse alignment with, for example, a landscape or other symbolic feature. I conclude that the single rebuilding episode which resulted in a few degrees of axial orientation change at Meier does not reflect significant social reorganization.

The second possibly significant modification was shortening of the plankhouse, at an unknown date, but somewhat late in the occupation. The 'rear', northernmost wall of the plankhouse was moved at least one meter south of its original position. The short distance over which this wall was moved (Figure 2) appears to have been more a structural concern than a result of social reorganization, or even population change within the plankhouse.

In short, insofar as architectural continuity over time is a surrogate of social continuity over time, the feature data do not suggest radical social change during uselife of the Meier plankhouse. Rather, conservatism is apparent. Throughout the 400 year occupation (or roughly 16, 25-year human generations) a single architectural ideal, incorporating both utilitarian and social aspects (a sort of social/utilitarian 'bauplan' [Gould and Lewontin 1979]), was maintained. Changes to plankhouse architecture seem to have been related to maintenance only: the walls did not move much laterally or more than a few degrees in orientation; the hearths were stacked one upon the other in discrete, spatially-constrained hearth boxes made of planks; cellar pits were not allowed to substantially intrude into the bench areas; the plankhouse did not substantially change in size. All of this was the case for four centuries.

In sum, archaeological features provide little if any evidence of radical social change in the Meier household. This in turn implies a lack of major change in the social organization of production within the dwelling. Preliminary artifact analyses also point to a lack of fundamental change over time (Davis 1998; Hamilton 1994; Smith 1996; Wolf 1994). Thus, I suggest that a single social ranking system was maintained at the Meier site from initial to final occupation from 1400 AD to shortly after 1830 AD.

In this section, I have shown that the analytical units representing the north, central, and south areas of the plankhouse, hypothesized to have been occupied by groups of different social statuses, are both spatially and temporally acceptable. Below, in the heart of this paper, I examine a range of possible site-formation processes and evaluate whether or not they would have moved artifacts related to domestic production on scales relevant to these analytical units.

A Note on the Artifact Assemblage

Over 14,000 non-debitage artifacts (and over 78,000 lithic, bone, and antler debitage items) were recovered at Meier. Of this assemblage, more than 10,000 items were found within the plankhouse feature, and in sum they constitute a palimpsest of material remains representing the activities of an evolving, quite sedentary hunter-gatherer-forager population. It is a palimpsest because of the general lack of discrete stratigraphic units at Meier.

This palimpsest includes many artifacts that are material correlates of the domestic production activities that are the focus of my research. Before commenting on the way that various site-formation processes might have altered and/or moved these artifacts, I characterize the composition of the palimpsest assemblage. Because my interest is in production activity, I investigate the stages of production (from raw material acquisition to use and discard) represented by the Meier chipped stone, ground stone, and bone/antler palimpsest assemblage.

A generalized model of the Meier site tool productive system (raw material acquisition, processing, use, recycling, loss, and discard) is presented in Table 1, identifying material correlates of different stages of the system for the most common chipped lithic, ground lithic and bone/antler artifact classes at the Meier site (note that procurement, pre-processing and transport of raw materials, preforms and/or finished artifacts are not represented in Table 1).

It is evident from Table 1 that a wide variety of material correlates are potentially visible in the archaeological record at Meier. That items representing all stages of the productive system are found within the plankhouse indicates that the structure was 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 available in at least one class of raw material, indicating that it is possible to track production activity within the plankhouse.

In the sections above, I have demonstrated that the Meier site contains a complex plankhouse feature with several architectural facilities and large artifact, faunal, and floral assemblages. The house was built as a single structure that was maintained for four centuries. Within the plankhouse, all manner of activities were carried out and the artifacts representing those activities were presumably subject to a variety of transforming agents; maintenance activities are especially likely to have moved them. I now turn to an examination of the potential site-formation processes, and how these processes affected the assemblage.

Evaluation of 15 Possible Site Formation Processes

When modeling formation processes of a palimpsest, we should consider the activities of past peoples, the material correlates of those activities, and the various movements of those material correlates by a variety of taphonomic agents. My approach is to evaluate a range of cultural and natural processes (sensu Schiffer 1987) with the ability to affect 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; in this paper, that scale is the 10-meter long north, central, and south analytical units of the Meier plankhouse.

I follow Schiffer (1987) in general and Carr (1985) in particular, identifying and evaluating 15 formation processes that may have been responsible for the absence of artifact types from (a) events and/or (b) deposits. I also consider processes that may have moved artifacts in (a) systemic context (before or during deposition) and/or (b) archaeological context (after deposition). I closely follow Carr (1985:349-350) 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 Processes in Systemic Context: Processes Responsible for Absences of Artifact Types from Events in Which Their Use Might Be Expected

1. Several Alternative Tool Types May be Used to Accomplish the Same Task. This issue is concerned with multifunctionality; a single functional 'type' may have been used for several tasks, or several different 'types' may have been used for the same task. Thus, the absence of an artifact type that we expect to have been used for a given task may not represent the absence of that task. To reconstruct such a task, the analyst is best served by largely unifunctional tool types, if such unifunctionality existed. If many tools were multifunctional, then the analyst may have to analytically discard those implements with multiple functions. Classification of tool function, then, is a key issue in determining if and how a given task was carried out at a site. The classification system that I used for the Meier site analysis is shown in Table 2.

1.1. Chipped Lithic Artifacts. I classify chipped lithics from the Meier site using a functional typology of largely mutually-exclusive types. While a few chipped lithics were multifunctional, two usewear studies indicate that most chipped lithics were used for a single work action (such as scraping or perforating), though they occasionally exhibit wear from other, incidental uses (Smith 1996, 2004). 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) and pounding (use of the butt of the handle for a variety of tasks) would be evident. Likewise, the typical Meier site chipped stone tool was shaped for one primary task, and most usewear reflects this task, but other usewear is also occasionally present. This inference is based on one usewear analysis focusing on 'utilized elements per lithic item' (number of utilized edges per lithic item) and one focusing on 'function per item' (which assumes a single function per lithic item); both analyses support the conclusion that most Meier chipped lithics had one utilized element (Smith 2004:112). Hence, for current purposes I am confident that (a) most Meier chipped lithics were largely unifunctional and (b) my classification of tool function reflects such unifunctionality.

1.2. Bone and Antler Artifacts. The bone and antler typology developed for the Meier site by Davis (1998) is based on a large body of ethnographic data regarding the function of bone and antler tools on the Northwest Coast as well as on a typology developed for a functionally analogous assemblage (Ames 1976). 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). Northwest Coast peoples used wedges in a variety of activities, from plank production to firewood splitting (Ray 1938), and it is therefore difficult to assign wedges to one specific activity. Adzes and chisels, however, are more diagnostic, representing the later (i.e. 'post-roughout') stages of woodworking.

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. 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.

Lower Columbia ethnographic and historical sources document native use of bone and antler points and bipoints for aquatic hunting (including capture of fish and mammals), and use of bone and antler harpoon valves for sea-mammal hunting (Ray 1938).

1.3. Ground Stone Artifacts. This category 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, Northwest Coast ethnographic and ethnohistorical research has clearly determined the general function of most ground stone items recovered from Meier (e.g. net weights, mortars, bowls, adze bits). Again, multifunctionality seems unlikely in most categories, though some items such as those assigned to the type "maul" exhibit scarring consistent with use not only as percussors but also as anvils for bipolar reduction of small lithic cores.

These considerations, and Table 2 (a listing of artifact types, work actions and worked materials, and inferred activities for a sample of artifacts drawn from the north, central and south analytical units within the plankhouse), indicate that the 17 major functional artifact types used in the Meier analysis do indeed reflect gross function. The tool types are further discussed in Smith (2004).

II Processes in Archaeological Context: Processes Responsible for Absences of Artifact Types from Deposits in Which They Might Be Expected

2. Artifact types related to the same activity may enter the archaeological context as subsets, dispersed among locations of manufacture, use, storage or discard, none of which need coincide. This point addresses site occupants' behaviors that generate archaeological deposits and that affect these archaeological matrices. Such behaviors at the Meier site include (a) reworking of matrix containing deposited artifacts and (b) the variety of behaviors in different stages of the productive system.

Movement of Archaeological Deposits by Meier Plankhouse Inhabitants. Matrix containing artifacts was sometimes moved from the point of deposition by a number of reconstruction and maintenance activities. Such activities can be broadly divided into digging out matrix, packing in matrix and clearing of high-traffic areas. Each of these activity types may be addressed for each architectural facility (bench, cellar, hearth/periphery) in an attempt to identify the effects of maintenance on artifact distributions.

2.1. Bench maintenance. Figure 4 represents typical bench deposits. The massive, non-stratified composition of bench features suggests that maintenance of the bench facility did not involve a great deal of digging. Sandy floor surfaces beneath benches may have been swept and packed as part of bench maintenance, although this would have been quite limited considering the house's plank floor. Feature data indicate that Meier inhabitants reset bench supports, but not as frequently as they reset pegs and posts around the hearth facilities. The sandy substrate of the bench area likely required little maintenance, as documentary sources indicate that the bench surface would have been covered with mats and/or planks (Sobel 2004). If the site was abandoned for periods of seasons or years it may have been necessary for returning inhabitants to remove vegetation from the bench deposits. This was probably not a frequent or large scale event, however, since root casts were uncommon and palaeosols were not encountered during excavation of bench deposits.

The ethnohistoric data indicate that floor space under bench platforms was often used to store boxes and other containers (Vastokas 1966). Such personal items and valuables were likely removed from the site at times of planned abandonment, leaving only a bare surface with few artifacts to be affected by water or other taphonomic agents.

One aspect of plankhouse maintenance, the resetting of wall planks, may have disturbed bench deposits closest to the wall. Small, lost, or discarded artifacts previously located in those bench deposits may have fallen into the wall trench or gaps between wall planks and their supporting matrix. If so, then when excavated these artifacts should represent items stored on a given 10 m stretch of bench area rather than items stored in some other 10 m portion of the plankhouse. Hayden & Cannon (1983) suggest that items in such peripheral areas of dwellings (in the dark, under wooden benches, next to wall planks) would likely consist of low-value refuse, a point also noted by Samuels (this volume).

In sum, bench facility maintenance appears to have been minimal. Bench deposits do not show the stratification that substantial maintenance would have produced. Maintenance that did occur apparently moved discarded bench deposits into the adjacent cellar and/or the exterior midden. Hence, there is no evidence that production items (e.g. tools and debris) from bench deposits were systematically moved, conveyor-like, from one end of the plankhouse to another, from areas (hypothetically) occupied by elites to areas occupied by people of distinctly lower social rank.

2.2. Cellar maintenance. Meier cellar deposits 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 after final abandonment and very likely during periodic, short-term abandonments. Figure 5 illustrates typical cellar deposits. The dark, greasy matrices composing cellar deposits indicate that cellar pits, over time, filled in with a variety of decaying organics (e.g., basketry, planks lining pits, bone/antler artifacts), soil (possibly shaken from vegetation, hides and clothing), decaying floorboard undersurfaces (cedar), ashes, and charcoal. As explained below, the pits contained useable (e.g. non-exhausted) artifacts, caches of valued items, and foodstuffs.

At least three times at Meier, this accumulation of detritus in the cellars was dug out, leaving the plankhouse with clean, new pits which in turn eventually filled in; this is evidenced by a repeated pattern, seen in profiles, of pit 'cleanout' and reconstruction activities (Smith 2004). The critical question, of course, is where the matrix dug out of these pits was deposited, because artifacts would have been moved with this matrix. The rather uniform, sandy bench and hearth/periphery deposits indicate that dug-out cellar fill was not dumped in these areas. It is inconceivable that cellar waste deposits would simply be dumped on the high-traffic plank floor areas above the pits, which would defeat the basic objective of the cleaning procedure. Nor was it deposited in the cleaned, orderly hearth/periphery areas. Clearly, cellar matrix was either taken outside (possibly to the midden, or, perhaps, to wall and structural support foundations to be used as buttressing) or dumped into other pit depressions within the plankhouse.

2.3 Dumping pitfill in the midden. If cellar fill was dumped on the midden, then the relatively uniform cellar matrix color and texture probably make it indistinguishable from the similarly highly-organic midden fill. Dumping cellar fill in the midden would of course move artifacts from the cellar to the midden. A cursory analysis has revealed that in terms of chipped lithic assemblage structure, house and midden deposits are largely similar (Smith 1996). This may reflect precisely the hypothesized movement of matrix from cellar deposits to the midden, and it is my working hypothesis that the midden is to a degree composed of cellar matrix or 'pit fill' which originated within the plankhouse. Figure 7 shows typical midden deposits.

2.4 Dumping pitfill in the toft. Cellar fill may have been dumped outside the plankhouse as buttressing (toft) for wall planks. Consequently, deposits from the house toft could contain items from nearly any area of the plankhouse interior, and should be excluded from analysis. Since there is little wall buttressing and little discrete toft at the Meier site, this is not a major analytical problem.

2.5 Dumping pitfill into other pits within the plankhouse. Figure 2 displays all pits at Meier, but does not attempt to identify which pits are contemporaneous; overlapping pit outlines indicate pits of different ages because Meier pits are, as a rule, circular in plan view. Figure 8 clarifies the situation: this plot only displays pits with upper elevations (indicating, basically, the time of pit construction) between 90 and 120 cm BSD (below site datum), the depth at which most pits were encountered. The majority of these features do not overlap, but are constructed next to one another, often with rims separated by roughly 10cm or more of matrix. Meier inhabitants, then, built pits as separate facilities, and used them along the entire plankhouse long axis contemporaneously. While there is evidence that pitfill was occasionally used to buttress pit interior surfaces, many pits appear to have been sturdy bases for baskets and are not buttressed; it appears that some pits were even buttressed with planking in the form of a barrel (see reconstruction in Figure 3).

What may we conclude, then, about the destination of the 'scooped-out-pitfill' that was occasionally dug out of the plankhouse? In short, there is no good evidence that the pitfill scooped out of, say, northern pits was dumped in central or southern pits, or vice-versa: residents of all areas were using pits at the same time (Figure 8). Also, as noted above, there is no stratigraphic or topographic evidence for a discrete, built-up toft buttressing the exterior (or interior) of plankhouse walls. There is, however, a discrete midden facility centered roughly 10 m east of the plankhouse. Not only these considerations, but also lithic analyses suggest that cellar maintenance affected artifact spatial distributions mainly by moving artifacts from cellar pits, used as secondary refuse facilities, to the final, tertiary midden deposits (Smith 2005). The lithic analyses imply differential treatment of Meier lithic debitage between the domestic living space and the midden. Figure 9a displays boxplots of lithic debitage density in the plankhouse and midden contexts. While there is more score variation within the plankhouse, the central tendencies are similar. The central tendency in the plankhouse is largely a function of the cellar deposits, with rich debitage loads. Lower scores in the plankhouse are invariably found in the benches. These observations indicate differential treatment of lithic debitage between the living (bench) and secondary-deposit and storage (cellar) facilities, with tertiary deposits of cellar-derived artifacts in the midden, in densities similar to those in the cellars.

Figure 9b indicates differential treatment of non-debris artifacts by context. In the cellars, non-debris (whole, non-exhausted) artifacts are found in clearly higher densities than in the midden. Whole and serviceable artifacts were moved to the midden on occasion, probably accidentally as a consequence of maintenance inside the plankhouse, but were curated in higher densities within the plankhouse cellar pits. Exhausted and broken artifacts (not discussed extensively here; see Smith 2005) are far more common in the midden, again suggesting use of the midden as a tertiary refuse deposit.

These data (see also Smith 2004) indicate that cellars were both secondary refuse deposits in which discarded items destined for the midden were stored (Figure 9a) as well as storage facilities for valued, useable artifacts (Figure 9b). Cellars contained high densities of completely serviceable items such as untested fine-grained lithic nodules, finely-flaked projectile points with no signs of use or resharpening, and rare, large bifacial knives representing substantial labor investment. They also contained caches of useful tools and raw material. Faunal material representing stored meat was also recovered from the Meier cellars (Lyman 1990), thus indicating that these extraordinary features contained stored foodstuffs as well as refuse and intact, valued tools.

Clearly, both products and tools of production were stored within the cellars. As mentioned above, and illustrated in Figure 8, these cellars appear to have been used contemporaneously throughout the life of the plankhouse; Figures 9a and 9b suggest that cellar deposits were not moved to other pits or to the benches, hearth/periphery, toft or high-traffic plankhouse floorboards, but rather were moved to, and formed the bulk of, the midden.

Movement of artifacts from cellars to the midden would not have systematically moved artifacts along the long axis of the plankhouse, but it would have occasionally depleted artifact frequencies in the plankhouse. I suggest that after cellar maintenance (i.e. cleaning by removing matrix to midden), a renewed use replenished the artifact load of a given cellar area, effectively duplicating the pre-maintenance cellar deposit. Because pit clean-out episodes often appear to have left old pit contents partially intact, but also partially disturbed, without many discrete strata, the cellar assemblage must be recognized as a palimpsest generated over four centuries. This palimpsest conflates time periods, but does not appear, importantly, to have conflated the artifact assemblages of the north, central, and south analytical zones of the plankhouse.

In short, cellar maintenance does not seem to have been as disruptive to the Meier plankhouse feature as it may superficially appear; it moved artifacts away from the plankhouse, but not substantially along the long axis of the plankhouse sampled by the north, central, and south analytical units.

2.6 Hearth/periphery maintenance. Ethnohistorically, hearths are documented more often than pits, which are mentioned only in passing. Minimally, Lower Columbia peoples used plankhouse hearths for cooking on personal, family, household, and supra-household scales. They also used hearths as light sources, as heat and smoke sources for processing meat (arrayed on racks above the hearths), as heat sources to maintain a comfortable temperature in winter, and as lithic raw material 'ovens' (Ray 1938). Hearths at Meier were rather standardized in form and composition; indurated ash and small fragments of shell and bone (often <.5cm in maximum dimension) were found in a compact, orange-colored aggregate, often 1m in diameter, circular in plan view and ovate in section view. This matrix only very rarely contained artifacts. Fire-cracked rocks occured in the hearth periphery, but never in the hearth matrix proper; this appears to have been meticulously maintained in order to be rock-free. This lack of rock suggests a high degree of concern with temperature control. Such control is required for heat-treatment of lithic raw material, which was common at Meier (Hamilton 1994). The condition of bone in the hearths suggests a hot, oxidizing atmosphere (Ames et al. 1992:283). Figure 6 depicts typical hearth deposits. Clearly, when maintaining hearths, Meier residents were mainly concerned with removing rocks and periodically cleaning out the hearth bowls in order to maintain an orderly, controlled heat source for a variety of consumption and production activities. Intact lenses of hearth matrix in the midden reflect episodic hearth bowl clean-out. Ongoing cleanout probably occurred as well. This removal of hearth matrix would not have moved significant numbers of artifacts from the house.

Meier inhabitants' frequent excavation of peg- and postholes around hearths (possibly to build drying racks as suggested for Ozette [Samuels 1989]) probably continually moved sediment within the house. However, we can assume that few artifacts were moved around the house during this process, since hearth/periphery deposits exhibit a low artifact density when compared with the rich cellar deposits (but a high density of artifacts compared with the bench deposits) (Smith 2004). This difference in artifact density is generally in accordance with maintenance theory, which states that intensely-used, high-traffic areas should be those areas most commonly and attentively cleaned (Keeley 1982, 1991), certainly in dwellings (Hayden and Cannon 1983) and particularly in dwellings like the Meier plankhouse – the relatively permanent dwelling of sedentary or semi-sedentary people (Murray 1980).

Fire-cracked rocks 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 almost 40,000 kg of fire-cracked rock (FCR) recovered from Meier were used to line pits, likely to facilitate draining, and to serve as draining footings beneath posts, though FCR was not found beneath the largest structural posts, which were occasionally footed with boulders. Much FCR, however, was simply refuse that was dumped into the midden; excavation units in the midden contained the second-highest FCR densities, site-wide (the midden contained 301 kg of FCR per cubic meter excavated, only slightly less than the 353 kg / cubic meter excavated in the cellars).

I suggest that artifacts in the hearth/periphery were not significantly moved with fire-cracked rock or hearth matrix, the main 'targets' during maintenance of these facilities. Artifacts moved from the hearth/periphery area in order to keep it free of hindrance were most likely stored handily nearby, in adjacent cellar pits. Items remaining in the hearth area may have been used there frequently, stored above ground on racks, or stored in boxes or other containers. (One feature excavated immediately adjacent to a hearth appears to have been a storage box). In sum, artifact movement from the hearth/periphery area seems negligible. Moreover, when artifacts were moved from the hearth/periphery to other parts of the house, they were most likely moved to adjacent cellar and bench areas rather than transported a substantial distance north or south in the dwelling.

Summary of Maintenance Activity Effects In the course of house maintenance, artifact-rich matrix was moved primarily from cellar deposits to the midden. Rocks and hearth matrix were moved from the hearth/periphery area to the adjacent cellars, and then to the midden. Artifacts removed from hearth areas were probably stored conveniently nearby in adjacent cellars, on benches, or above benches. Bench areas were used to store artifacts, but were not the site of significant refuse disposal or storage.

Importantly, as discussed above, none of the movements of matrix reconstructed or proposed above would have systematically moved artifacts from one end of the plankhouse interior to the other, along the socially meaningful long axis of the plankhouse. Also, it is clear that each area of the plankhouse, north, central, and south, had its own facilities for production, storage of the means (tools) and products of production, and storage of the detritus resulting from production. Further, these areas were all inhabited contemporaneously, with functionally identical architectural facilities, and I suggest that residents of each plankhouse area (north, central, and south) stored and disposed of their refuse in similar ways, preserving material correlates of activities carried out within those areas (rather than other areas), to the extent that a given material correlate was preserved within the plankhouse.

Based on this understanding of activities in the plankhouse, Figure 10 reconstructs the general spatial trajectory of a generic artifact from production through final discard.

3. *'Mining' of Abandoned Parts of a Site or an Abandoned Site by Prehistoric Individuals or Contemporary Artifact Collectors.* In the historic era, some Chinookans regularly moved their house planks from one site to another for a number of seasons or years; on such occasions the plankhouse frame may have been left largely intact, or elements of it may have been submerged in nearby bodies of water for preservation (Hajda 1984). Pilot floral and faunal analyses have independently concluded that the Meier folk were fully sedentary (Lyman 1990; Saleeby 1983). If those interpretations are incorrect, and the plankhouse was ever abandoned for substantial periods of time (perhaps as part of an unrecognized seasonal round), the plankhouse interior would have been physically unprotected and therefore subject to scavenging or mining. 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 Chinookan contemporaries. There are good reasons to suspect that such scavenging probably did not occur, and that if it did occur, it did not remove from the site most artifact types related to production.

In the first case, planning to move the bulk or entirety of the plankhouse 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 (Stevenson 1982). Such planning certainly would have included transport of the means of production critical to the subsistence economy as well as items constituting and indicating wealth (Hayden's [1998] practical and prestige technologies). Items left in situ at the 'abandoned' plankhouse 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; note that 98% of the Meier lithic tools are made of unremarkable, locally-abundant crypto-crystalline silicates (Hamilton 1994) or basalts (Wolf 1994), and bone and antler raw material would have been similarly abundant in the Wapato Valley (Ames et al. 1999; Saleeby 1983). Hence Chinookan contemporaries, likely knowing the mode of seasonal abandonment in terms of items left behind and items taken away, would have had little to gain by systematically mining out old pit deposits.

If such scavenging did occur, it probably targeted either house timbers or buried artifacts. The removal of timbers would not have dramatically affected the distribution of artifacts buried in pit deposits, as the largest and most valuable timbers would have stood at house corners, along walls and between hearths, where few pit features were located.

Stratigraphic traces of scavenging during temporary house abandonment may have been obliterated after reoccupation of the plankhouse. In this case, however, I assume a resumption of activity within the plankhouse and hence the renewed deposition of artifacts in the newly re-excavated pits. These considerations imply that neither mining nor scavenging were significant site formation processes at Meier.

4. *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 1995:804; Samuels, this volume; Stevenson 1991; Yellen 1977:103); it may also affect and mimic usewear traces (Shea and Klenck 1993) and thereby affect functional classifications. As mentioned above, the Meier house necessarily had a plank floor. It is difficult to imagine the Chinookan plankhouse inhabitants, likely with bare feet (Silverstein 1990:540), trampling sharp chips of lithic, bone and antler debitage into the hard plank flooring of the Meier house; it is much more likely that such hindering and dangerous refuse types were carefully controlled, cleared from or infrequently deposited in high-traffic areas. Such careful handling of debris in nonindustrial household contexts is noted ethnographically by numerous workers (e.g. Clark 1991; Hayden and Cannon 1983). These data imply that trampling caused minimal artifact usewear modification and rarely moved artifacts between the 10m north, central, and south analytical units.

5. *Carnivore Activity.* Ethnohistorically, domesticated dogs were common in Chinookan plankhouses (Ray 1938). Therefore, dogs are a possible site-formation agent in terms of the Meier faunal assemblage, including bone and antler tools. The main reason canids move bones and other organics is to bury them for later or immediate use (eating, gnawing, etc.) (Binford 1981b). In either case, bone and antler items gnawed by dogs should exhibit 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 Meier bone and antler artifacts (Davis 1998; personal observation). Hence, it is unlikely that dogs significantly altered the spatial distributions of bone and antler artifacts within the Meier plankhouse. (In contrast, non-artifact faunal remains from Meier do exhibit some carnivore damage [Lyman 1990]).

6. *Water Washing and Wind Sorting.* Wind sorting is discounted as an important site-formation agent; only the uppermost deposits would have been affected at any given time, yet most artifacts were found in the relatively low elevation cellar deposits. Moreover, the National Weather Service reports a fairly low Annual Average Wind Speed of 7.9 mph for the nearby town of Scappoose, Oregon.

The Meier site is situated just above the elevation of both modern and pre-dam flood levels. High-energy flood deposits were never encountered during excavations at Meier, either within the plankhouse boundaries, or in units placed outside the plankhouse. Nor was evidence of erosion observed. Sediments forming the plowzone capping the bulk of the occupation deposits are largely low-energy overbank deposits deriving from the Columbia River. These data imply a lack of flooding at Meier. This in turn may account for the evidence of relatively continuous occupation in contrast to the regular site abandonment and resettlement (due to flooding) seen at the nearby, and largely contemporaneous, Cathlapotle village site (Ames et al. 1999).

The water action at Meier was very low energy, transporting only silt-sized particles to the site. The effect of such low energy water action on the distribution of stone, bone and antler artifacts of the sizes addressed in the study of the social organization of production was negligible; most artifacts dealt with in this study are between 2 cm and 10 cm in maximum dimension (Smith 2004).

7. *Biologically Caused Soil Movements: Burrowing Mammals, Insects and Earthworms.* Rodent activity at Meier was evident and occasionally extensive in the organic-rich cellar deposits. Bench and hearth/periphery deposits, containing less organic matter and often largely composed of a sandy and ashy matrix, were not commonly disturbed by rodents. We can expect that movement of artifacts in the rodent-disturbed cellar deposits affected 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, 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 stone tools) on the long axis of the plankhouse. Bocek (1986) found that artifacts were moved up to 1.5 m by rodents before ejection to the surface. This is a negligible distance considering the 10-meter long analytical units hypothesized to sample the living areas of plankhouse inhabitants of different social status. On the other hand, colonial burrows of the California ground squirrel (a species found in Oregon) may include up to 700 feet of tunnels (Burt and Grossenheider 1976). However, no evidence of such a colony was observed at Meier. An exhaustive examination of fieldworkers' notes and drawings, as well as photographs and profiles, and consideration of the conditions encountered in the field, indicated that rodent burrows at Meier were normally less than two meters long.

Therefore, while burrowing mammals may well have moved artifacts at Meier, such horizontal movement affected only those artifacts less than 5 cm or so in maximum dimension. Many chipped lithics fall into this category. The average maximum dimension of a spatially-stratified sample of the Meier chipped lithic tools is 2.4 cm (Smith 2004). Such artifacts that were moved are unlikely to have traveled more than a meter or so, a distance of little consequence to the proposed analytical units. Where excavation units are immediately adjacent, but are assigned to different analytical units, we must accept the possibility of some displacement which could effect observed distributions. In such cases rodent activity is common only in the highly-organic (and rodent-favored) cellar units; substantial horizontal displacement from such units to the adjacent sandy, less-favored bench and hearth/periphery units is very unlikely. Most bone, antler and ground stone artifacts are all far too large to have been moved horizontally to any great degree.

Similarly, artifact displacement by earthworm activity is likely restricted to small vertical movements. Earthworms may be responsible for the occasional lack of clear stratigraphy at the site, as found by Stein (1983). Because earthworms normally only move sediments 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.

8. *Geologically- and Meteorologically-Caused Soil Movements.* Solifluction and cryoturbation are both ruled out as major agents of site formation at Meier. While infrequent seasonal freezing of the upper (plowzone) sediments may have occurred, it would have been rare given the annual temperature range in the Wapato Valley. Using more than 130 years of weather records for Portland, the National Oceanic and Atmospheric Association reports that freezing episodes sufficient to freeze soils are rare and limited in duration and frost does not normally penetrate more than about 10 cm. Such infrequent frosts could not conceivably systematically alter the deposits at Meier.

Artifacts can be moved by soil creep, essentially driven by gravity and vitiated by water action. Due to the flat topography at Meier, the only possibly significant soil creep would have moved midden deposits westward toward the eastern exterior house wall. I must emphasize, however, that this scenario is unlikely, since on average, the midden is just a few centimeters higher in elevation than the plankhouse feature area. Occasional thin and well-stratified lenses of shell as well as hearth matrix dump deposits were found intact in the midden deposits, further suggesting little or no creep from the midden towards the plankhouse despite the rainy environment. Moreover, it is possible that the organic-rich midden was largely overgrown at the time of occupation, with roots retarding erosion. In the unlikely event that soil creep took place, significant deposits probably did not encroach on the plankhouse interior; they would have been 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 plankhouse interior, but no evidence of such creep is seen in the stratigraphy of the relevant excavation unit. Regardless, refurbishing of the plankhouse at the time of re-occupation probably would have cleared off any encroaching deposits. Finally, any 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 plankhouse. Most of these excavation units are roughly 12-15 m east of the midden centrum (Figure 2). Therefore, I conclude with confidence that creep did not significantly affect the Meier assemblage.

9. *Differential Preservation.* Of the lithic raw materials recovered at Meier (mostly basalt, crypto-crystalline silicates, rhyolite, sandstone, pumice and slate [Hamilton 1994; Wolf 1994]), only pumice artifacts exhibit macroscopic decay possibly attributable to chemical processes. Pumice artifacts are occasionally rather friable. 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. Pre-excavation breakage is not common (Wolf 1994).

Bone and antler artifacts are of course more liable to differential preservation. One indicator of the good organic preservation conditions at Meier is the presence of thousands of fish vertebrae and ribs (Butler 1999), 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; Davis 1998). Differential preservation of bone and antler items between facilities (sandy bench deposits, highly organic cellar deposits, and sandy hearth/periphery deposits) also seems relatively trivial, as perforators, the most common slender bone and antler tools, are not differentially distributed between these facilities within the plankhouse.

10. *Site Alteration by Non-Native Peoples: Scavenging and Looting* Oral tradition recounted by the Meier site landowner suggests that a house frame may have stood on the Meier site in the mid- to late-19th Century A.D. It is also locally rumored that a military man, perhaps stationed at nearby Fort Vancouver (occupied from A.D. 1825 into the 20th century), visited the site and removed from it an unspecified number of artifacts. However, there is no stratigraphic evidence for intrusive excavations in the sampled deposits. Nevertheless, both traditions indicate that the site was known to Euroamericans in the 19th Century, well after the 1792 contact date and shortly after the most sweeping depopulation of the Chinook due to European disease in 1833 A.D. (Boyd 1999). The site may well have attracted pothunters as well as scavengers; if the entire house stood at the time of abandonment in the early 1800s, roughly 40,000-55,000 board-feet (Ames et al. 1992) of free, processed lumber would have been a very attractive target for local European landowners.

Removal of such lumber may have simply consisted of picking it up and carting it away. Plankmolds and postmolds indicate that only the corner posts and other major structural supports were substantially imbedded in the ground; everything else would have been easy to remove from the site. If larger corner posts (a meter or more in diameter) were cut down before being hauled away, artifacts would not have been moved appreciably. Considering the work involved, however, 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, where corner posts appear as well-defined, circular features, rather than the ovate or oblong and less distinct features one would expect had these supports been dug out. There is little evidence, then, to suggest that scavenging of lumber at the site substantially affected the assemblage.

Pothunter excavations, some of unknown date (but all cutting into the plowzone deposits, and thus all relatively recent) were clearly evident along portions of the eastern interior of the plankhouse. Damage here was controlled for by focusing excavations on the western half of the plankhouse interior. Some pothunter damage also occurred during the Portland State University excavations, over a weekend. Artifacts recovered from pothunter-damaged areas are eliminated from spatial analyses, as these artifacts easily may have been moved tens of meters by the pothunters.

11. *Site Alteration by Non-Native Peoples: Plowing* Historically, the Meier site was plowed extensively by mechanical means. Ploughing can have a variety of effects, but at the least it moves artifacts similar in size to those at the Meier site on a scale of several meters (Boismer 1997; Orton 2000:57-66). Therefore, artifacts in the stratigraphically distinct plow-zone, approximately 30 cm in depth, should be eliminated from spatial analyses using the noted 10 m analytical units, since plowing may have moved artifacts between the north, central, and south 10 m units.

12. *Misclassification of Artifact Function*, 13. *Use of an Overly-Divisive Functional Classification Scheme* and 14. *Use of a Non-Functional Artifact Classification Scheme.*

The artifact classification scheme applied in this analysis has been described above. This typology, summarized in Table 2, is functional, conservative and reflective of the gross production activities that were the focus of my recent study of the social organization of production (Smith 2004).

15. *Temporal Variation in Behavior.*

All of the processes reviewed above address the artifacts and other material correlates of production activities that are the focus of much of my work. Earlier in this paper, I noted that most of these artifacts were excavated from voluminous pit features, and that the floor of the plankhouse was planked. Therefore, most artifacts were not derived from discrete strata, but from a complex conglomerate of matrix that formed beneath the plankhouse flooring. For this reason, most Meier site analyses focus on the density of a given artifact type *per excavation unit* rather than *per level of a given excavation unit*. If activities within the plankhouse changed radically through time, or there were significant occupational hiatuses in any particular area of the plankhouse, analysts may misread the significance of horizontal spatial variation of artifact presence, absence, or frequency. Therefore, it is necessary to identify whether or not artifacts were introduced to the matrix on a continual or punctuated basis, and whether, over time, activities varied greatly within the plankhouse. I do this by examining what call ‘modes of deposition’ to characterize the Meier site plankhouse deposits in terms of temporal continuity.

15.1 Depositional Mode History The assemblage that was generated and sampled within the Meier plankhouse represents a 400-year occupation. Figure 5 typifies the unfortunate lack of clear stratigraphy within the plankhouse feature, due to maintenance activities outlined above. The lack of clear stratigraphy within the plankhouse presents us with what I call a 'vertical palimpsest'. The horizontal component of the assemblage, however, does not appear to be a palimpsest; as shown above, there is little evidence for significant movement of artifacts related to production between the 10 m north, central, and south analytical units.

One way to understand this 'vertical palimpsest' is to identify the history of the depositional modes responsible for the assemblage. Broadly speaking, I view depositional modes as either continuous or punctuated. In continuous deposition, artifacts are regularly deposited through time, though nothing is implied here about the rate or density of deposition. Punctuated deposition introduces artifacts sporadically; episodic frequencies may or may not be time-redundant. Depositional mode may be investigated only by considering vertical distribution by arbitrary or natural excavation level.

Although most deposits at Meier cannot be assigned to a discrete 'occupation level', vertical patterning is visible. Figures 5 and 6, for example, reflect a gradual vertical accumulation of pit and hearth features through time. Below, I examine artifact vertical distribution in order to characterize depositional mode. I observe depositional mode in the bench, cellar, and hearth architectural facilities, and in the 10 m north, central, and south analytical units. I then examine depositional mode with regard to artifact type in order to evaluate the possibility of change over time in activities carried out by plankhouse residents.

15.1.1 Deposition by Architectural Facility and Plankhouse Area If there were radical differences in artifact load through time in the bench, cellar, and hearth/periphery facilities, comparisons of artifact frequencies in excavation units that sampled these architectural facilities could be misinterpreted. For example, a low frequency of artifacts in a cellar pit might be misinterpreted to indicate that less production was carried out in its vicinity, but it may simply reflect the abandonment of that cellar area for some time. In the same way, high frequencies of some artifact type observed in the north analytical unit may indicate that such artifacts were more commonly used there, or they may simply reflect the fact that that area of the plankhouse was used throughout the history of occupation, with the southern end (to continue the example) sealed off for some time, without artifact deposition. Such possibilities may be examined in plots of artifact elevations in separate architectural facilities and plankhouse areas.

Assemblage deposition by zone and architectural facility is displayed in Figure 11, which represents 8,462 antler, bone and lithic artifacts excavated from within the plankhouse and attributable to a specific architectural facility and zone. Figure 11a indicates several important points: first, there are clearly more artifacts in the south analytical unit than in the north or central units, though this reflects, largely, the greater numbers of excavation units and pit features in the south. More important is the general pattern seen in the breakdown by facility: in each analytical unit (north, central, and south), cellars have relatively high frequencies of artifacts, indicating a similarity across analytical units in cellar function as a general 'trap' for a wide variety of artifacts. Also, although there are occasional gaps, artifacts were generally deposited throughout the occupation relatively continuously. Therefore, it is analytically reasonable to compare cellars of the north, central, and south analytical units, as in each area they were used continuously, and had essentially the same functions (discussed above).

As noted above (section 2.5), it is also important to determine whether the north, central, and south analytical units were occupied continuously and for the life of the plankhouse. To evaluate this aspect of deposition, Figure 11b displays quantile plots for artifact frequency in the north, central, and south analytical unit assemblages, regardless of architectural facility. Here we see that the general accumulation of artifacts through time (vertical position) is rather constant, depicted by the relatively smooth quantile curves. The ‘steps’ evident in the north zone and, to a lesser extent, the central zone, represent both lower numbers of artifacts (due to fewer excavation units) spread across the quantile plot, and also possible differences in cleaning behavior (e.g. Samuels, this volume). There is no clear evidence for an appreciable occupational hiatus in the north, central, or south 10 m analytical units. A substantial occupational hiatus in any of these areas would presumably be manifest as a significant ‘step’ in the quantile plots, and a significant ‘gap’ in the stripe plots, but few such steps and gaps are present. When I investigated those that do exist, by reviewing field conditions, excavation notebooks, and feature evidence, I found that the few ‘steps’ evident in Figure 11 are the result of excavation methods rather than punctuated deposition.

In sum, so far as elevation is a surrogate of age, Figure 11 indicates that each plankhouse zone (north, central, and south) was used from the earliest to the latest periods. In other words, the entire house interior was occupied from initial construction to final abandonment. Also, there do not appear to be significant stratigraphic breaks that would indicate complete abandonment of the plankhouse for appreciable time periods.

Another line of evidence may be examined for information on the temporal nature of the Meier site deposits. Figure 12 plots pit feature volume against pit feature upper elevation; the latter is used to indicate the relative point in time of the excavation of a given pit feature by plankhouse inhabitants. The plots indicate that the average pit volume was around 1.2 cubic meters, and we see that pits were used throughout the life of the plankhouse, with pits having been dug mainly between the 60 and 130 cm BSD (below site datum). There are two main observations to note here.

First, the absence of discrete horizontal 'stripes' representing pit feature elevations is further evidence of the lack of discrete occupation levels and the lack of punctuated deposition; both of these facts demand non-traditional analyses to understand this palimpsest.

Second, all of the larger pits (those greater than about two cubic meters in volume) have upper elevations less than 100 cm BSD, and hence were dug rather late in the plankhouse occupation. Almost all of these large pits were excavated in the southern zone of the plankhouse. This phenomenon suggests that some temporal information *is* preserved in the feature data at Meier. It suggests that the largest pits at Meier were in the south, and that these were constructed some appreciable time after initial construction of the plankhouse. This is an important observation that will have to be considered in future analyses of production in the north, central, and south analytical units.

<u>15.2 Activity Continuity</u> The evidence for continuous deposition of Meier assemblage elements raises the question of whether there was similar continuity, through time, in the activities carried out within the plankhouse. In other words, what activities were represented by material correlates at the beginning of occupation, and did these activities persist or change through time? If basic aspects of production changed radically through time, and this is not identified, spatial variation in artifacts relating to production could easily be misinterpreted as variation related to rank-based production. For this reason, it is important to establish the degree of activity continuity at the site.

Figure 13 displays the frequency of a given artifact type per excavation level for a sample of 10,104 non-debitage artifacts recovered within the plankhouse, provenienced to excavation level and assigned to one of 62 artifact types (including both the production-related types in Tables 1 and 2, as well as non-production-related artifact types). Note that most excavation units went sterile around levels 14 to 15, but some lower levels with very few artifacts were encountered; these lower levels should be considered anomalies, and levels 13 and 14 should be viewed as evidencing the beginning of occupation.

Figure 13 demonstrates that most of the 62 artifact types were deposited, and hence used, throughout the life of the plankhouse. From the very start, people were using scrapers, making lithic tools, perforating all variety of materials, hunting land animals, fishing with net weights, and so on. This wide range of behaviors continued until abandonment of the plankhouse. The most numerous artifact classes (such as lithic projectile points) are clearly represented without punctuation. My recent usewear study fortifies these results, finding essentially the same pattern in more specific activities such as woodworking and butchery (Smith 2004).

<u>15.3 Summary of Modes of Deposition and Activity Continuity</u> Several themes resound from the examination of depositional mode. First, artifacts were deposited in all areas of the plankhouse from beginning to end of occupation. Second, the functions of

the architectural facilities did not change radically through time. For example, throughout occupation, relatively few artifacts were deposited in benches whereas high amounts of artifacts were deposited in cellars. Third, the full range of archaeologically visible basic extractive and maintenance tools (those related to production), such as scrapers, projectile points, and woodworking tools, were deposited throughout plankhouse occupation; there is no evidence of radical changes in plankhouse productive economy through time. Fourth, these phenomena are essentially the same in the 10 m north, central, and south analytical units, and we may consider them analytically comparable.

Summary of Site-Formation Process Evaluations

The site formation processes reviewed here include behaviors that generated and could have affected the original Meier assemblage and its characteristics, as well as Cultural and Natural transforms that could have affected the site as an archaeological phenomenon.

Artifacts were deposited within the plankhouse at all stages of post-transport production, including processing, discard, and loss. Artifacts were deposited and curated differentially, according to architectural facility. The most substantial movement of artifacts took place via transport of cellar deposits to the midden. No identified artifact movement, in systemic or archaeological context, moved items significantly or systematically on the crucial long axis of the plankhouse. No evidence was found for site-formation processes that would preclude the use of 10 m north, central and south analytical units that arguably sample residences of people of different social statuses: elites, commoners of middle status, and commoners of lower status, respectively.

Discussion

Generation and Transformation of the Meier Assemblage

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

All varieties of raw material, in the form of cobbles, antler tines and beams, metapodials, and so on, were transported into the plankhouse. Here, they were sometimes stored in cellar pits (occasionally manifested archaeologically as discrete caches of intact, usable items, such as 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 in the plankhouse, 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 the plankhouse floorboards. Also stored in the sub-floor cellar pits were foodstuffs, archaeologically evidenced by the extensive faunal remains, and large amounts of fire-cracked rock that residents had cleared from the orderly hearth boxes. The cellars also contained all manner of baskets, boxes and bags containing the intact, usable artifacts found there archaeologically. Some cellar pits were carefully lined with rock floors, or 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 for simple refuse pits. Pits had multiple functions.

Over time, decaying organics and slumping pit walls filled in or deformed these cellar pits. Therefore, to maintain the cellar, it was necessary to dig out these in-filling pits. The excavated fill was not dumped in the bench areas, nor near the hearth areas; it was dumped on the midden heap roughly 10 m east of the plankhouse, where the Meier site's highest densities of exhausted and broken tools were encountered. Hearth material cleaned from inside the hearth boxes (fire-cracked rock, ash, and indurated bone) was also dumped on the midden, either immediately after being cleaned from the hearth, or after being first stored in refuse pits in the cellar.

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. Table 3 summarizes the distribution of a variety of the material correlates of this production and disposal system among the main architectural facilities at Meier.

All of this activity was time-redundant, in that the plankhouse was built early on as a single, large structure with a discrete long axis orientation and architectural facility arrangement. These were diligently maintained for four centuries. No major additions were annexed to the plankhouse, and no areas were sealed off to be used, for example, as temporary middens or other special-use areas.

Social information about the built environment was similarly conserved over a long period. This was done by socially transmitting the same ideals for roughly 16 generations through conservative maintenance of the structure's 'bauplan' (Gould and Lewontin 1979).

During the historic period, elites would have lived at the far (north) end of the plankhouse. I feel comfortable projecting this status-based spatial arrangement into the past, to the origin of the Meier plankhouse, at least as a working hypothesis, based on the notation of such behavior in the historical record, the noted stability of the plankhouse architecture through occupation, and the distribution (unreported and unquantified at this time) of certain high value art and trade goods (and other high cost items) that are more commonly (and sometimes exclusively) found in the north end of the plankhouse.

After deposition, which has been detailed in the discussions above, production-related artifacts were affected by various site formation processes. This study has demonstrated several aspects of those post-depositional processes:

- Most artifact movement at Meier was a result of Cultural site-formation processes rather than Natural site-formation processes. Thus, much of this movement is potentially comprehensible as a result of patterned behavior (Ascher 1968). Generally speaking, 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.

- Artifacts were continually moved from the hearth area to the bench, and then to the cellar before being moved to the midden (Figure 10). Artifact density in a given deposit ultimately must be understood in terms of the number of episodes represented in such a deposit. For example, unstratified bench deposits may preserve largely the remnants of the last few activities at the site, and may not be suitable for comparison with cellar deposits. This problem may be addressed by modeling the number of deposited artifacts expected per behavioral episode, but this is a difficult endeavor and must be carried out with caution.

- No evidence has been found for systematic, large-scale movement of deposits between the north, central, and south analytical units expected to represent the residences of different status groups: elites, commoners of middle status, and commoners of low status, respectively. Each of these populations maintained their own facilities for processing and storing a wide variety of artifacts in all stages of production. More than the other architectural facilities, cellars of the north, central, and south analytical units should reflect activities carried out in those parts of the plankhouse.

- Plankhouse architecture did not change appreciably during the course of occupation, suggesting long-term continuity of this spatial segregation of social ranks through time. This continuity further suggests the viability of the north, central, and south analytical units for understanding rank-based production in the Meier plankhouse.

- Sensitive research design can control for all identified formation processes.

Implications for Future Spatial Distribution Analysis Research Design Spatial distribution analyses can broadly be divided into studies of either point distributions or cell-frequencies (Johnson 1984). At Meier, the finest scale at which artifacts were provenienced was the three-point centimeter scale. The variety of formation processes that affected Meier deposits, however, probably make centimeter-scale location data largely irrelevant; sweeping, trampling, bioturbation, and cellar-matrix reworking during cellar maintenance are all likely to have moved any artifact on a scale of centimeters. Thus, point-pattern analysis is unlikely to be a fruitful avenue of research in most contexts at Meier, or other, similarly-formed plankhouse sites on the Lower Columbia River. Keeley (1991) makes a similar case in his analysis of an open-air site in the Paris basin, where he suggests that the assumptions of point-pattern analysis are too great and that multiple analytical methods including cell-frequency analysis are more suitable.

In contrast, cell-frequency analyses are promising. One scale of data recording at Meier was the 2 x 2 m (and sometimes 1 x 4 m) excavation unit. Since Chinookan inhabitants moved artifacts among clearly differentiated architectural facilities within the house, and since the typical excavation unit samples only one architectural facility, the 2 x 2 m excavation unit or 'cell' is an important analytical unit. Activities in the north, central, and south areas of the plankhouse can and should be studied by stratifying samples by bench, cellar, and hearth/periphery facility deposits.

Despite the complexities, I agree with Ferring that it is possible to achieve many of the goals of spatial analysis with sensitive, problem-driven research design (Ferring 1984). Future Meier analyses of rank-specific production should be carried out by cell-frequency analysis of production tool density differences among rank-specific areas of the plankhouse interior, stratified by architectural facility.

Conclusions

Exhaustive site-formation investigations may lead full circle, from the original optimistic assumption that artifact location reflects some aspect of behavior with high fidelity, to a low point where one suspects that nothing may be learned from spatial analyses, and back to the original proposition that spatial distributions may indeed be effectively investigated with properly scaled analytical units. The success of the analysis depends largely on coordinating the scale of the analytical units (such as artifact classes or zones of deposition) with the scale of various formation process effects (such as the movement of certain artifacts by meters or centimeters in specified directions). Such scales may affect different artifact and feature types in different ways. The absence or presence of such processes must be demonstrated rather than assumed. Studies that do not demonstrate formation processes (e.g. Chatters 1989) may indeed observe meaningful patterning, but can be substantially fortified by explication of formation processes.

Fundamental issues on the Northwest Coast, such as the evolution of social ranking and post-contact culture change, may well be comprehensible via analyses of the social dimension of labor control. This, in turn, may be understood via spatial distribution analyses of plankhouse interiors. Considering the largely similar types and scales of architectural facilities in Northwest Coast plankhouses (see Figures 14 and 15, other papers in this volume, and Ames et al. 1999), cell-frequency analysis is likely sufficient and necessary for such spatial analyses of plankhouse remains throughout the Coast. A similar redundancy in the presence (but not necessarily exact configuration) of rank-based spatial segregation within and among plankhouses is also present all along the Coast (e.g. Coupland, this volume; Grier, this volume; Marshall 1989; Martindale, this volume; Sobel, this volume), further supporting the use of cell-frequency analyses in archaeological studies of the social dimension of household labor organization on the Northwest Coast. As this study shows, we can most effectively use cell-frequency analyses to examine household labor organization if we begin by identifying site formation processes.

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FIGURES

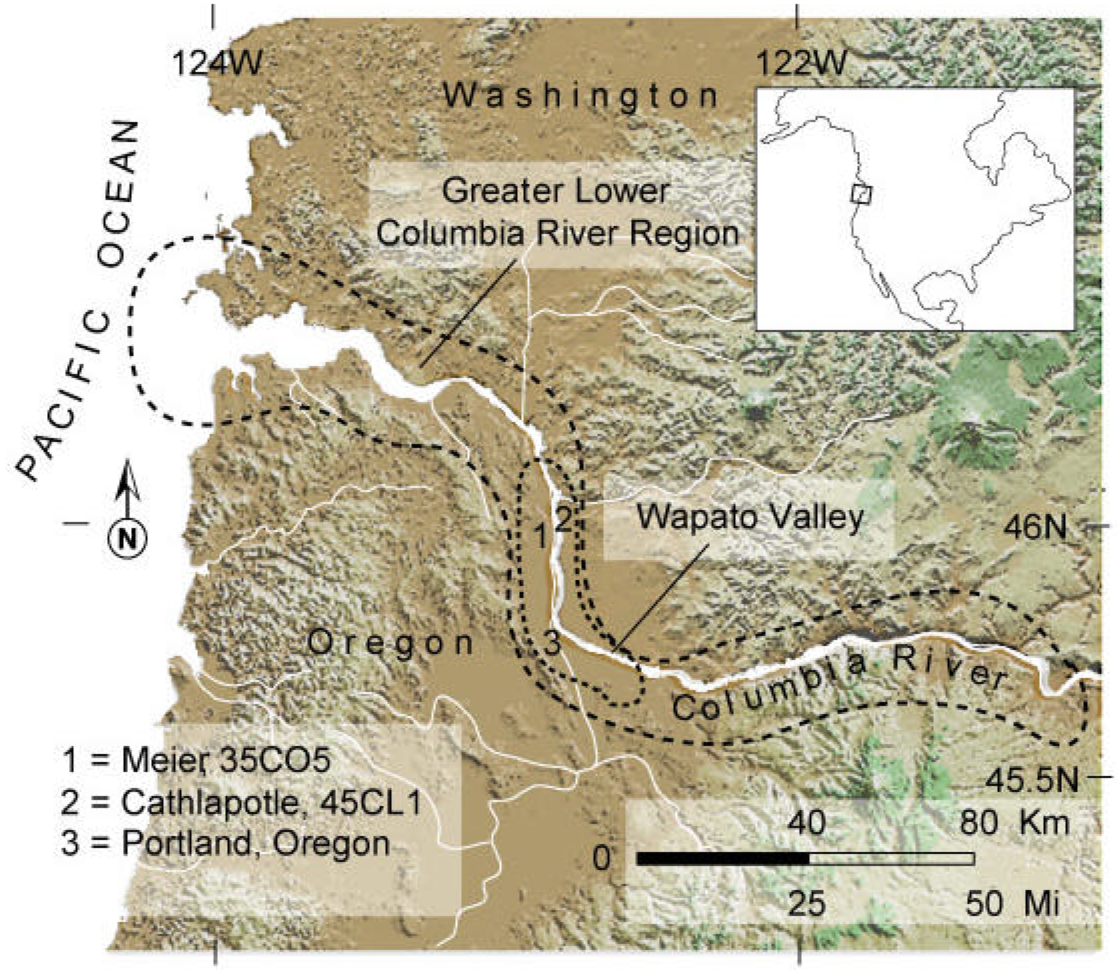


FIGURE 1.
Study Area.

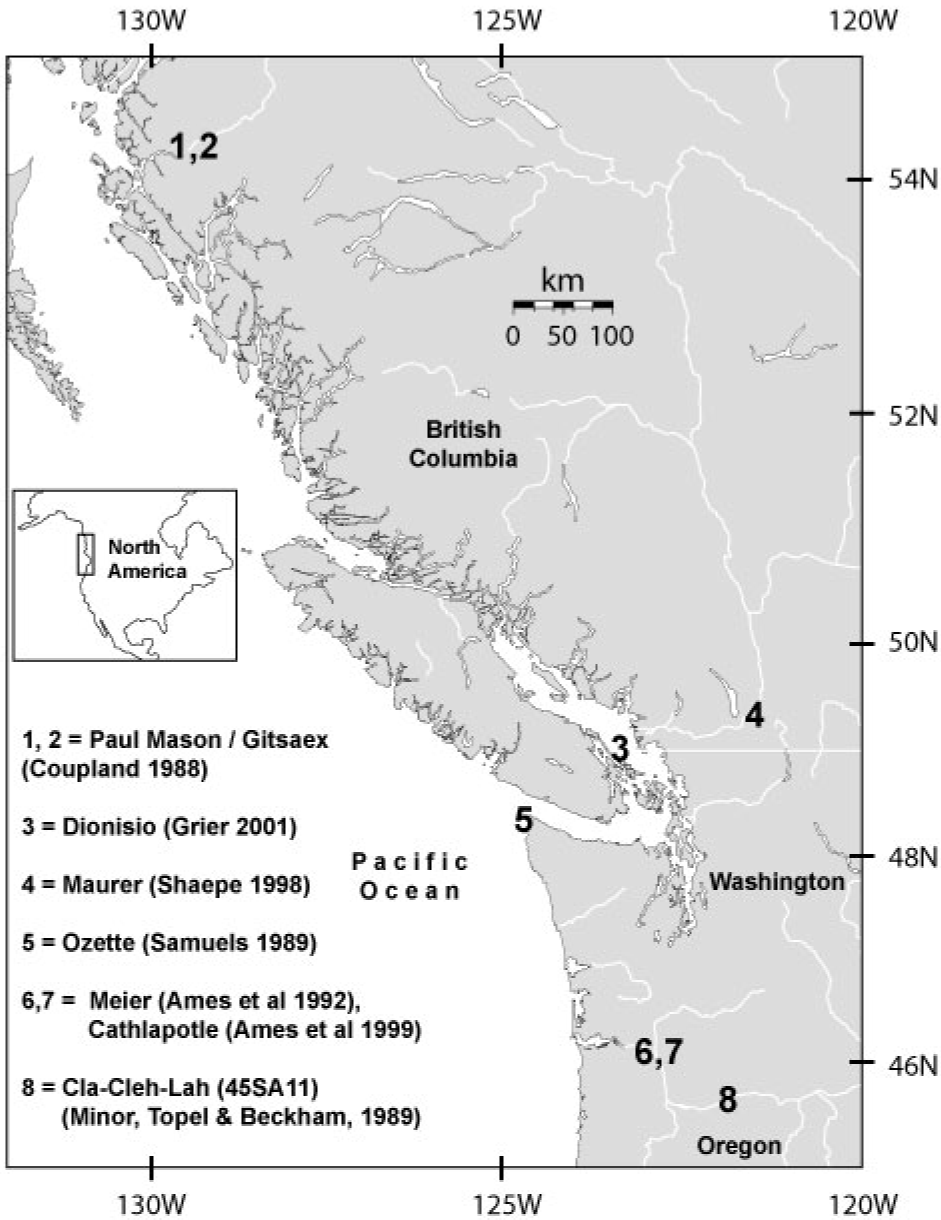


FIGURE 15.
Location of Plankhouse Sites
Indicated in Figure 14.

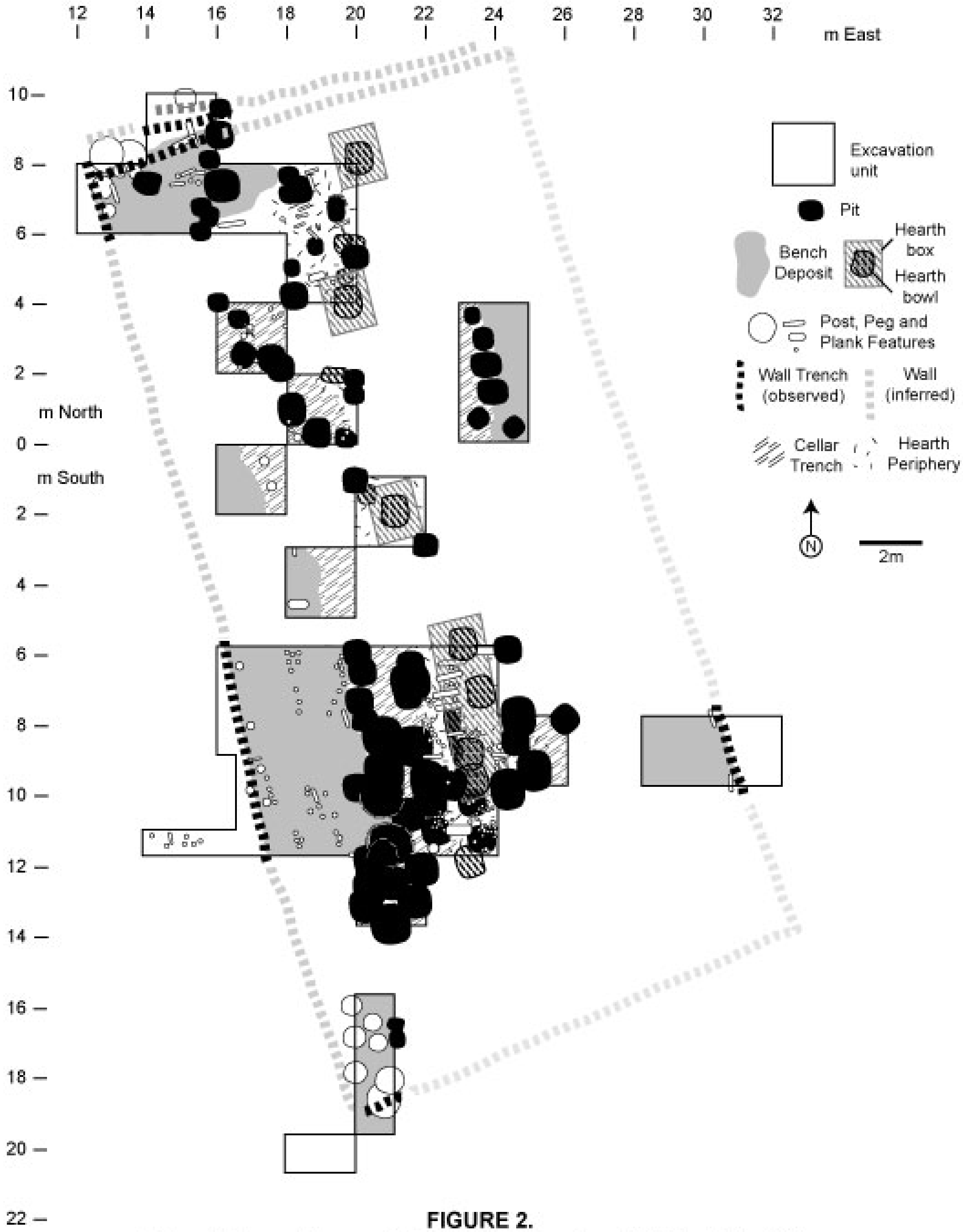


FIGURE 2.
Plan of Excavations and Features Encountered at the Meier Site.
Midden and other extra-plankhouse excavations not shown.

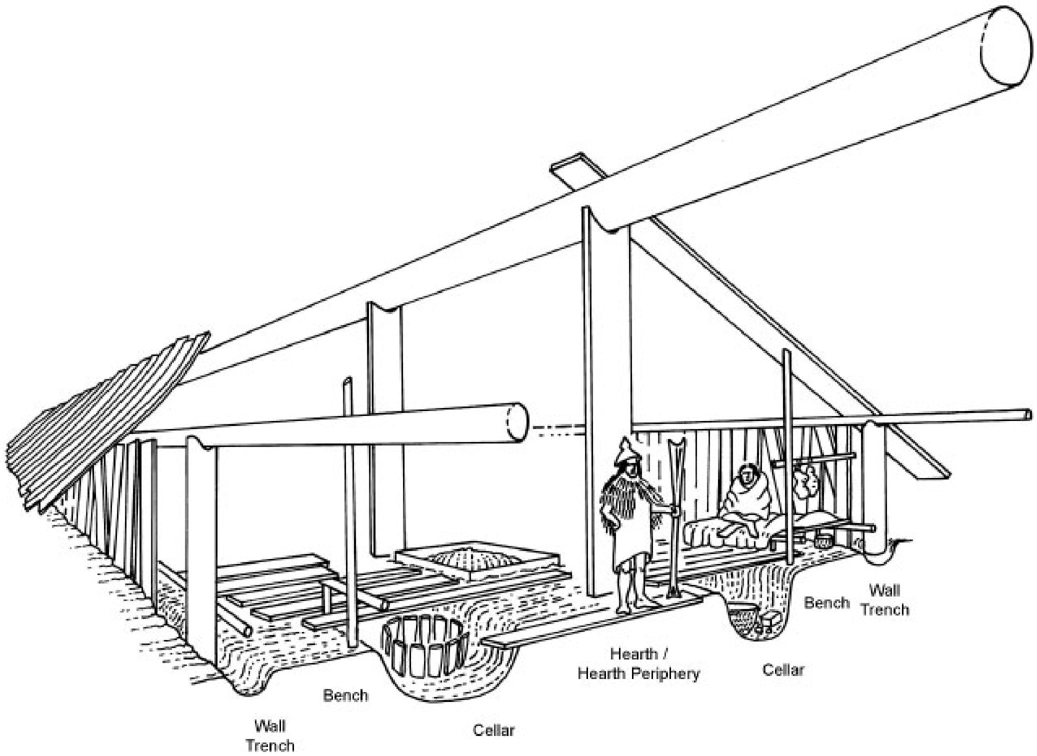


FIGURE 3.
Author's Reconstruction of Meier Plankhouse Architecture.

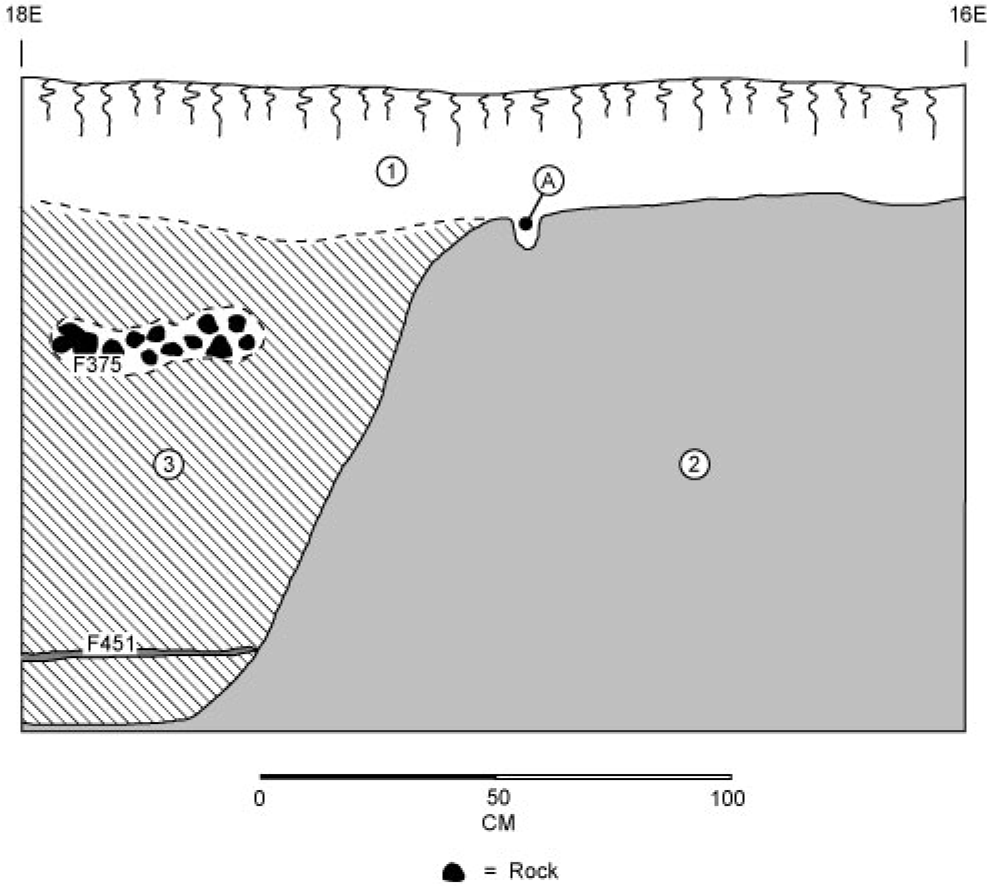


FIGURE 4.
Unit S0-2 E16-18 South Profile Illustrating Typical Bench and Cellar Deposits.

1= A horizon soil. 2= Bench: massive nonstratified sandy clay.
3= Cellar: turbated nonstratified silty loam with high organic and artifact content.
Feature 375 = fire-cracked rock concentration (not in-situ hearth).
Feature 451 = clay path. A = post feature, probably for support of floor or bench planks.

Elevation at excavation floor=120 cm Below Site Datum.

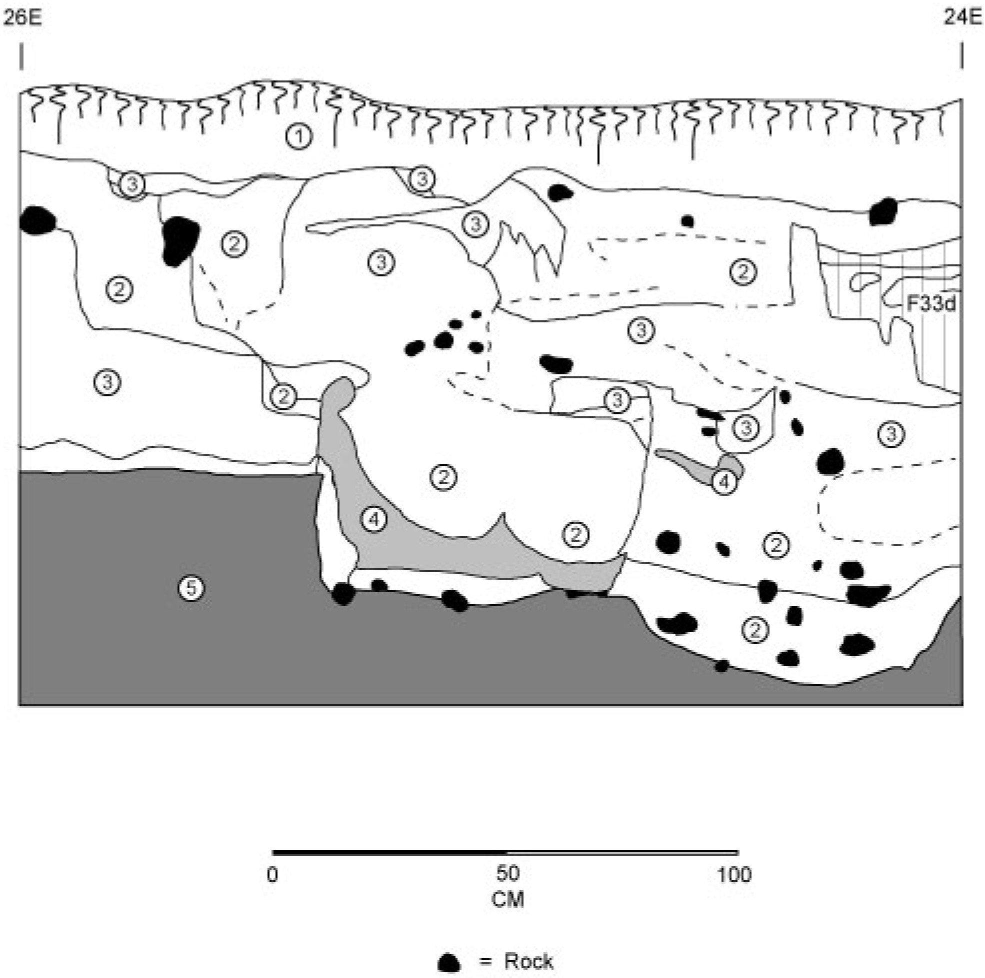


FIGURE 5.
Unit S8-10 E24-26 South Profile Illustrating Typical Pit Deposits.

1= A horizon soil. 2 = Pit: each occurence is a distinct pit feature, characterized by a highly organic silty loam matrix and a high density of artifacts.
3 = Undifferentiated, highly turbated pit deposit, likely construction fill.
4 = Pit buttressing rim constructed from plaster-like clay, sand and pitfill mixture.
5 = Sterile parent clay.
Feature 33d is a hearth.

Elevation at excavation floor=130 cm Below Site Datum.

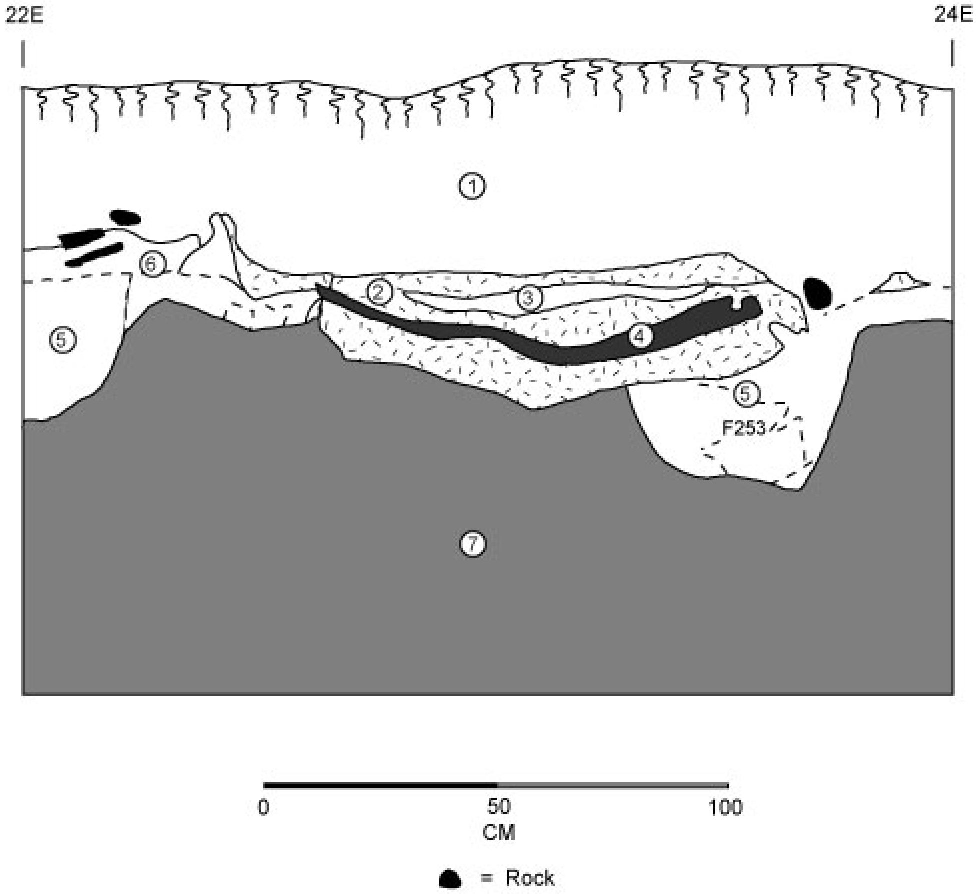


FIGURE 6.
Unit S6-8 E22-24 North Profile Illustrating Typical Hearth Deposits.

1= A horizon soil. 2 = Hearth matrix of indurated ash and small bone fragments.
3 = Lens of pure, white ash. 4 = 'Hearth Bowl' of massive, unsorted pure beach sand.
5 = Undifferentiated, highly turbated pit deposits (silty loam), with
high organic and artifact content.
6 = 'Construction Fill' of reworked pit matrix.
7= Sterile parent matrix.
Feature 253 = pit.

Note lack of fire-cracked rock in the hearth matrix, which was
kept meticulously clear of this debris.

Elevation at excavation floor=130 cm Below Site Datum.

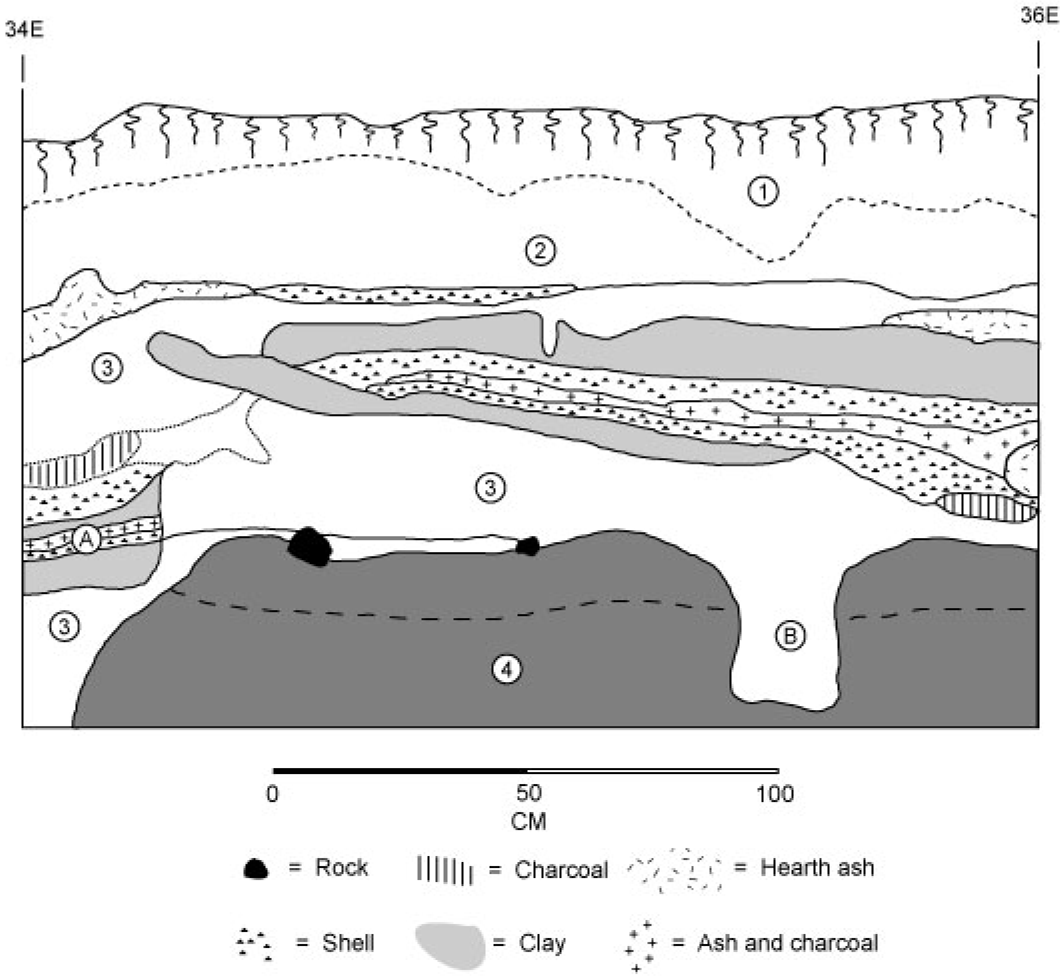


FIGURE 7.
Unit S8-10 E34-36 North Profile Illustrating Typical Midden Deposits.

1= A horizon soil. 2= B horizon soil & cultural deposits.
3 = Turbated, highly organic sandy silt with high artifact density
(same matrix as that found in plankhouse pit features).
4 = Sterile parent clay. A and B are pit features (rare in the midden).

Elevation at excavation floor=120 cm Below Site Datum.

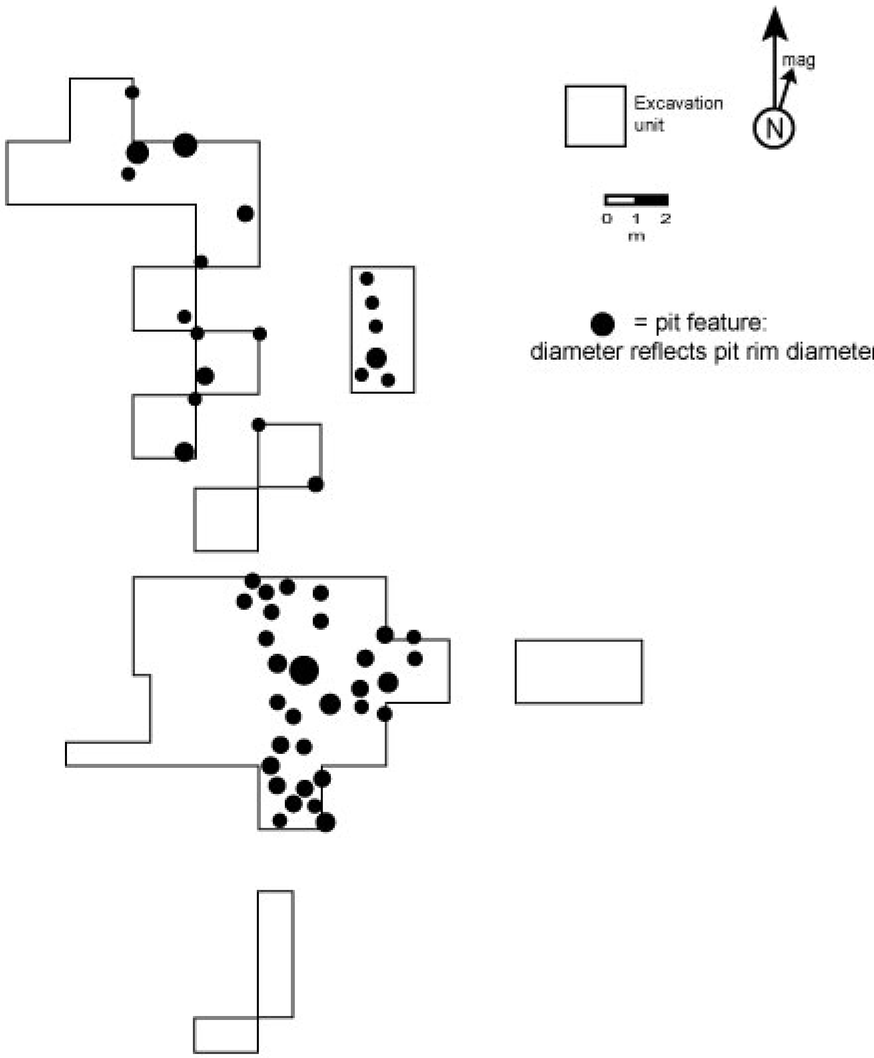


FIGURE 8.
Pit Features With Upper Elevations (rims)
Between 90 and 120 cm Below Site Datum.

9a

9b

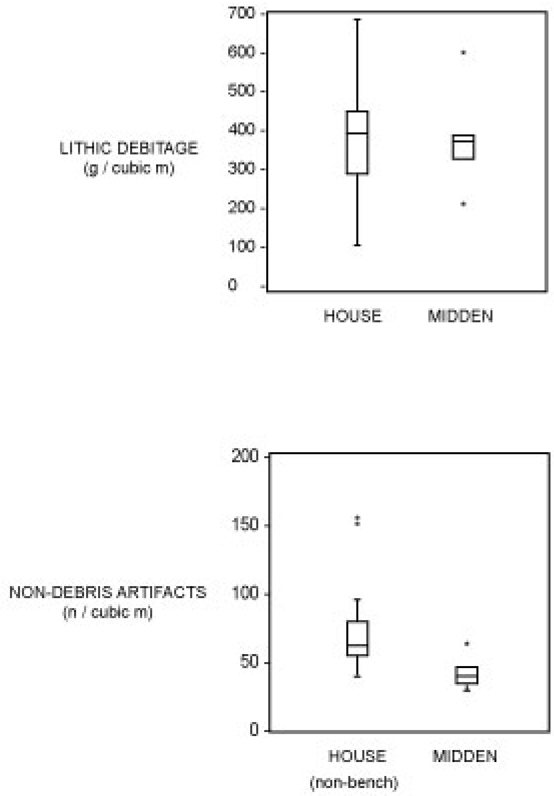


FIGURE 9.
Comparison of House and Midden Deposits.

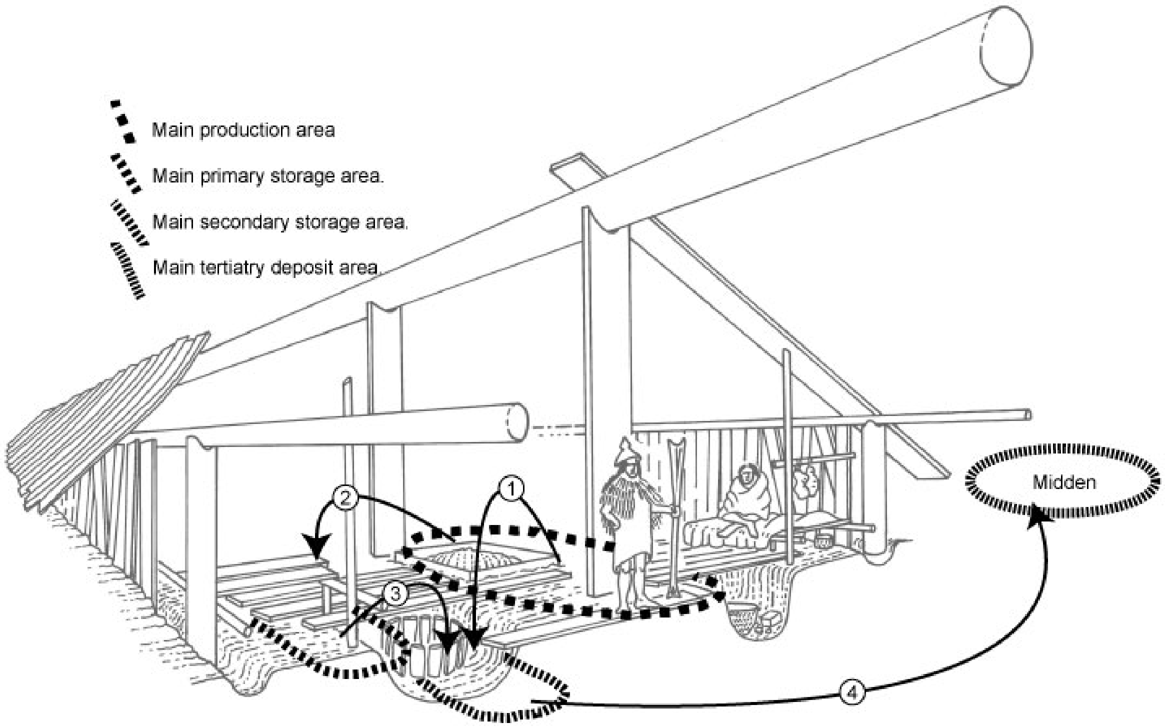
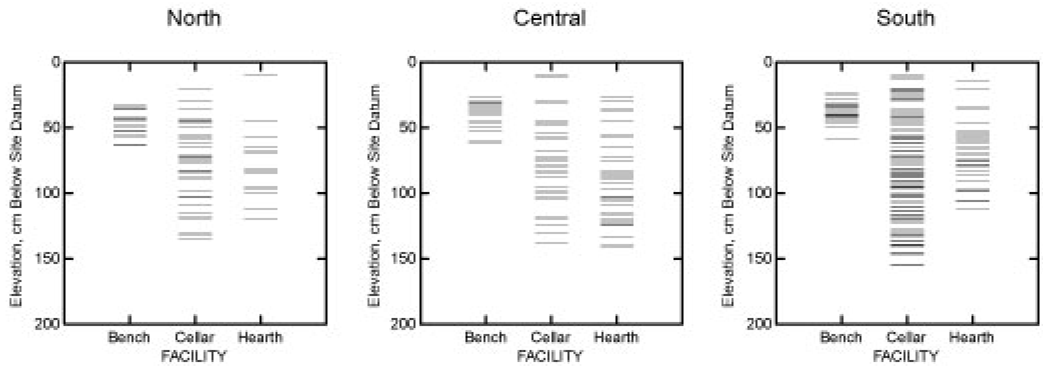


FIGURE 10.
Reconstruction of Generic Artifact Trajectory from Production to Discard.

1= Production in Hearth/Periphery, immediate storage in Cellar (debris & non-debris items).
2= Production in Hearth/Periphery, storage in Bench (non-debris items).
3= Production (limited), use and/or tool exhaustion in Bench, with debris & nondebris deposit in Cellar.
4= Cellar (secondary storage site) clean-out, with matrix deposition in Midden.

11a



11b

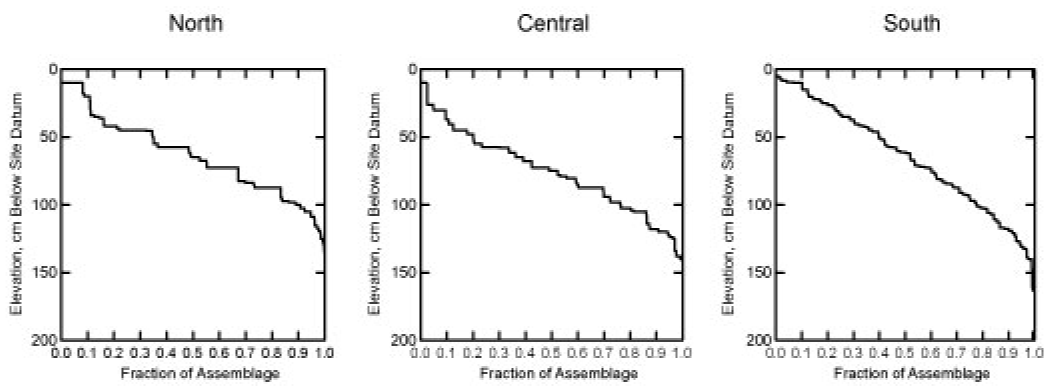


FIGURE 11.
Elevation Data for 8,462 Artifacts Recovered from Within the Plankhouse.

11a Stripe Diagrams of Artifact Mean Elevation (cm Below Site Datum) for North, Central and South Bench, Cellar and Hearth Facilities. Each stripe represents an artifact. Vertical compression and artifacts with same elevations often result in single stripes representing multiple artifacts. Dark, fat stripes indicate concentrations of artifacts in the vertical dimension.

11b Quantile Plots of Artifact Mean Elevation for North, Central and South Zone Assemblages.

Sample sizes: North, n= 2,151 artifacts; Central, n=2,186 artifacts; South, n=4,125 artifacts.

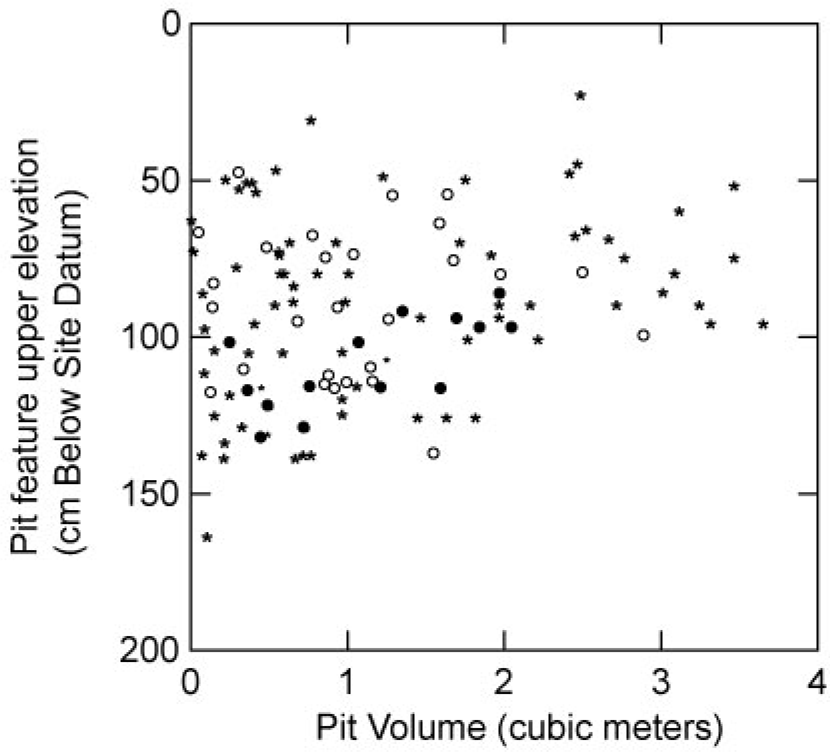


FIGURE 12.
Volume and Upper Elevation of Pit Features.

n=119 pits

- ○ Pit in North analytical unit
- ● Pit in Central analytical unit
- * Pit in South analytical unit

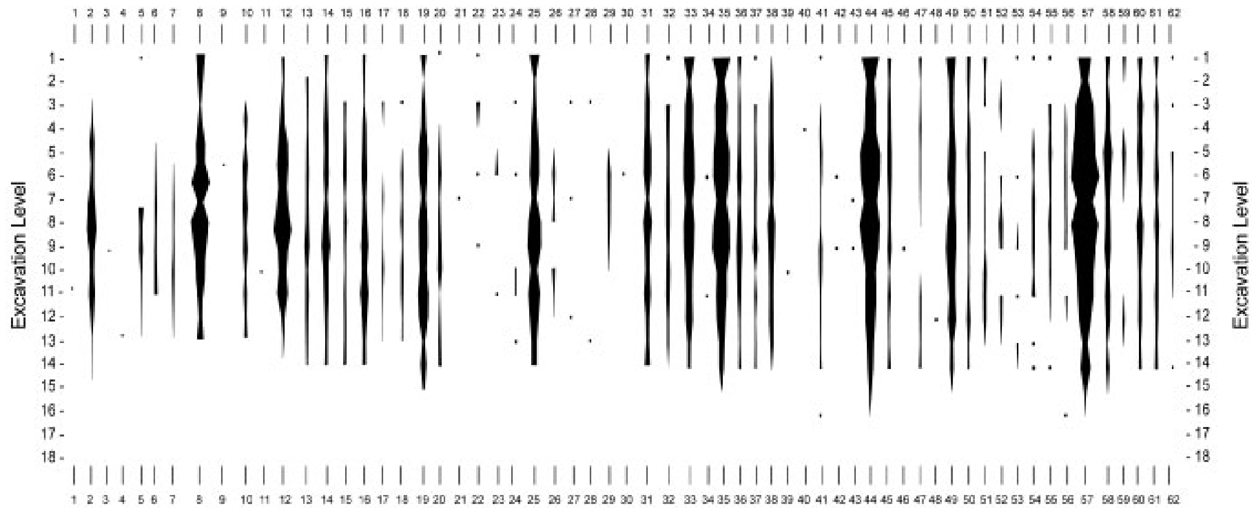


Figure 13.
Artifact Frequency by Standardized Excavation Level for 10,401 Common Bone, Antler and Stone Artifacts Recovered from Within the Plankhouse.

Width of graphic represents frequency (count, not %) of items of a given artifact type found at a given excavation level. See text for important details.

Artifact types: 1, antler chisel, 2, antler debitage, 3, decorated antler, 4, antler handle, 5, antler harpoon valve, 6, indeterminate antler, 7, antler perforator, 8, antler raw material, 9, antler tine end, 10, antler wedge, 11, antler wedge/chisel, 12, antler worked item, 13, bone bead, 14, beaver incisor, 15, bone bipoint, 16, butcher-marked bone, 17, bone chisel, 18, bone chisel/wedge, 19, bone debitage, 20, decorated bone, 21, bone harpoon valve, 22, indet bone artifact, 23, modified bone, 24, bone pendant, 25, bone perforator, 26, rodent incisor, 27, sea lion canine, 28, shark tooth, 29, bone wedge, 30, bone wedge/chisel 31, bone worked item, 32, bipolar core item, 33, RUM* flake, 34, RUM FCR**, 35, RUM biface, 36, flaked cobble, 37, RUM uniface, 38, lithic abrader, 39, lithic adze, 40, lithic adze/celt, 41, lithic anvil, 42, lithic bowl, 43, lithic club, 44, lithic core, 45, lithic cutter, 46, decorated lithic, 47, lithic graver, 48, gun flint, 49, hamerstone, 50, indet chipped lithic, 51, indet ground lithic, 52, lithic maul/pestle, 53, lithic mortar/bowl, 54, lithic net weight, 55, lithic perforator, 56, lithic pigment, 57, lithic projectile point, 58, lithic raw material, 59, lithic saw, 60, lithic scraper, 61, lithic shaver, 62, lithic wedge. * RUM = Retouched, Utilized or otherwise Modified lithic item. ** FCR = fire-cracked rock.

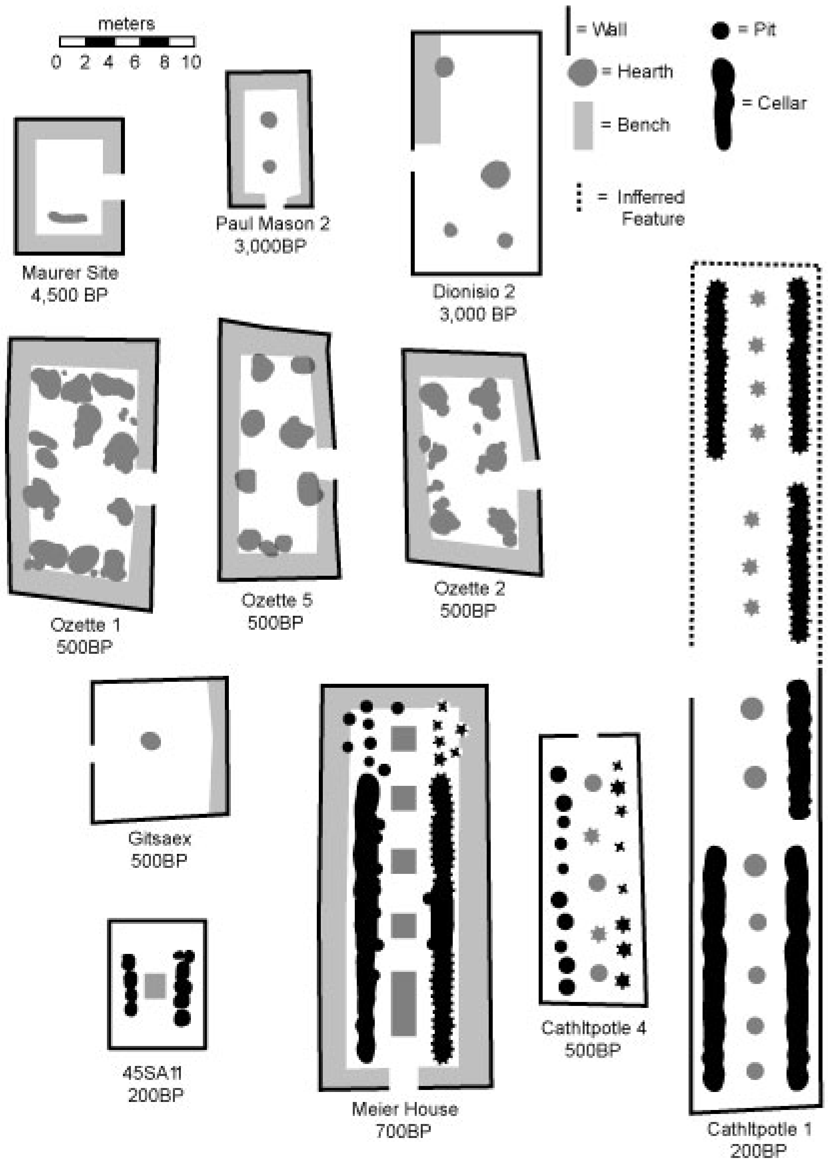


FIGURE 14.
Schematic Illustration of
Excavated Plankhouses on the Northwest Coast.
Sources are found in Figure 15.

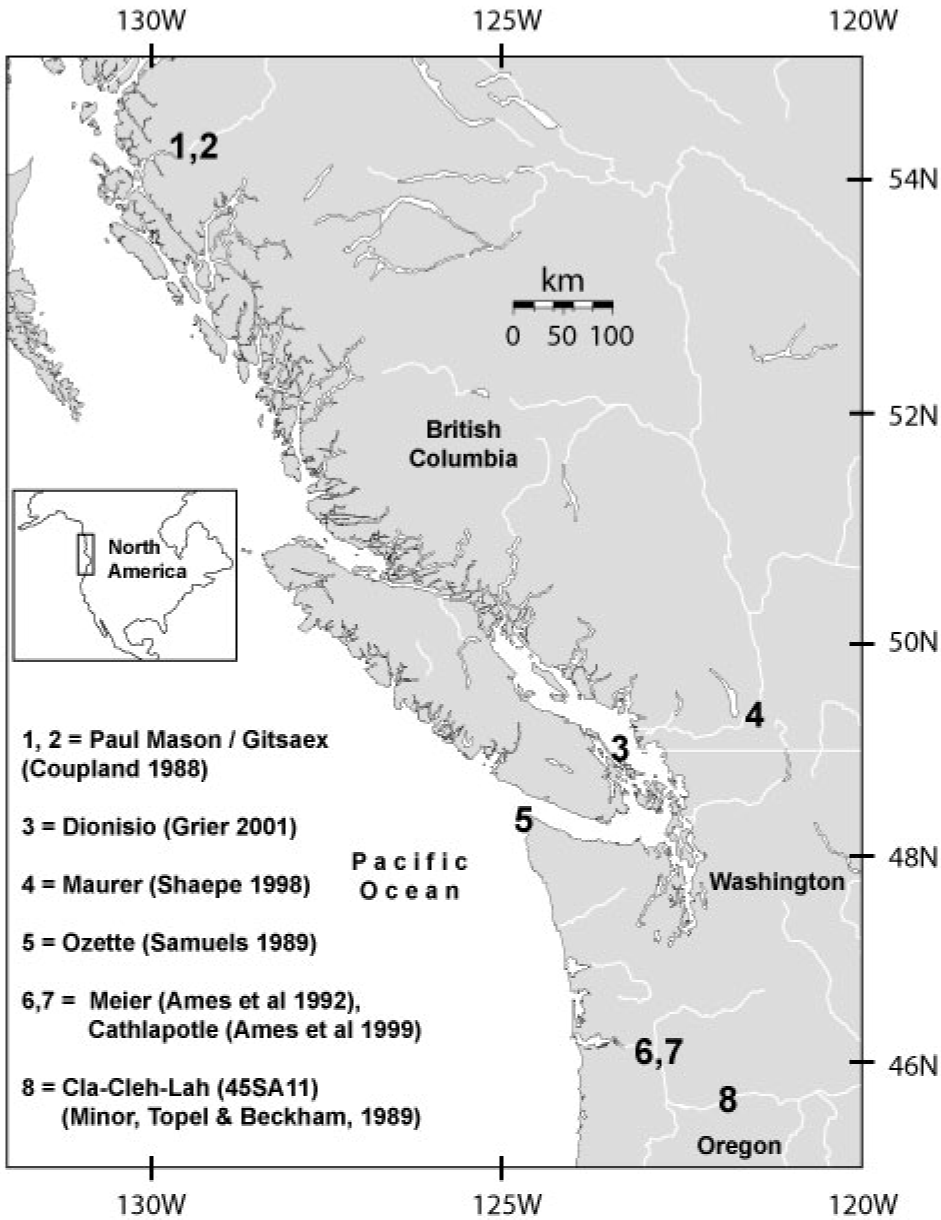


FIGURE 15.
Location of Plankhouse Sites
Indicated in Figure 14.

TABLES

Table 1.
Evaluation of Production Stages and Presence/Absence of Material Correlates of Such Within the Meier Site Plankhouse Boundaries.

Production System	Material Correlate	Present Within the Meier Plankhouse Boundaries?
Chipped Lithic		
	Unused fine-grained cobbles (non-local manuports).	Yes
Raw material import.	Fine-grained cobbles with single assay strikes.	Yes
	Debitage >1/2" in max dimension.	Yes
Initial core reduction.	Hammerstones >15cm max dimension.	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 tools.	Yes
Flake production.	Much debitage of 1/2"-1/8" max dimension.	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 debitage of <1/8” max dimension.	Yes
	Antler flaking tines.	Yes
	Hammerstones <10cm max dimension.	Yes

Table 1, continued…

Production System	**Material Correlate**	**Present Within the Meier Plankhouse Boundaries?**
Tool use.	Usewear.	Yes
Core & tool curation / storage.	Core and tool caches.	Yes
	Useable tool presence in discrete pits.	Yes
Tool recycling.	Tool reshaping for new use.	Rare
	Use of exhausted bipolar cores as wedges.	Yes
Tool modification for reuse.	Tool resharpening over usewear traces.	Yes
	Post-use thermal alteration evident on finished tools	Rare

	(crazing, potlidding, discoloration, etc.)	
Tool exhaustion.	Extreme blunting of use elements.	Yes
	Rework of tools to very small size.	Yes
	Broken tools (usewear terminated by break).	Yes
Core exhaustion.	Core reduction to state where no more flakes may be reasonably removed.	Yes
	Some bipolar cores.	Yes
Core discard.	Cores in midden deposits.	Yes
Tool discard.	Tools in midden deposits.	Yes
Core and tool loss.	Useable tools in toft and/or wall trench.	Yes

Table 1, continued…

Production System	Material Correlate	Present Within the Meier Plankhouse Boundaries?
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.	Yes
	Ground-stone production tools.	Yes
Final shaping.	Finished ground/percussed tools (assumed not imported).	Yes
Tool use.	Usewear.	Yes
Tool curation / storage.	Tool caches.	Yes
	Useable tools in discrete pits.	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.	Yes
	Broken tools (uswear terminated by break).	Yes
Tool discard.	Tools in midden deposits.	Rare
Tool loss.	Useable tools in toft and/or wall trench.	Yes

Table 1, continued…

Production System	Material Correlate	Present Within the Meier Plankhouse Boundaries?
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
Final shaping.	Presence of lithic abraders with wear grooves.	Yes
	Presence of finished tools (e.g. unused items).	Yes
Tool use.	Usewear.	Yes
Tool curation/storage.	Tool caches.	Yes
	Useable tools in discrete pits.	Yes

Tool re-use and/or recycling.	Presence of usewear on previously broken elements.	Rare.
Tool exhaustion.	Thermal alteration of fragm ents of ground/percussed tools.	Rare
	Broken tools (uswear terminated by break).	Rare

Table 1, continued…

Production System	**Material Correlate**	**Present Within the Meier Plankhouse Boundaries?**
Tool discard.	Tools in midden deposits.	Yes
Tool loss.	Useable tools in toft and/or wall trench.	Yes

(End of Table 1)

Table 2.

Functional Classes, Work Actions, Worked Materials and Inferred Activities for 17 Artifact Types.

Type	Work Action and Worked Material	Inferred Activity
Lithic Cutter (n=123)	Incise relatively yielding materials, including meat, hide, vegetal matter.	Multipurpose tool.
Lithic Graver (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 Perforator (n=44)	Perforate resistant materials , such as wood, bone and antler	Perforation of antler, bone and wood for a wide variety of tasks.
Lithic Scraper (n=205)	Scrape medium-hard materials, such as hide, wood, bone and antler (hide scrapers are discussed in the text).	General-purpose scraping.
Lithic Shaver (n=110)	Shave 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 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 there are bone/antler wedges of appropriate

size.

Table 2, Continued…

Type	Work Action and Worked Material	Inferred Activity
Lithic Saw (n=4)	Cut 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, most likely mammals.	Terrestrial hunting.
Lithic Abrader (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, and are discussed in the text.	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 extractive and maintenance activities.
Lithic Maul/Pestle (n=32)	Percuss a variety of non-lithic materials.	Wide variety of uses in woodworking (mauls) and, in conjunction with mortars (pestles), activities such as food processing.

Lithic Net Weight (n=33)	Sink fishing net weights.	Fishing, likely for salmon or sturgeon.

Table 2, Continued…

Type	Work Action and Worked Material	Inferred Activity
Bone/Antler Point and Bipoint (n=55)	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=16)	Puncture + Apprehend aquatic mammals.	Sea mammal hunting, primarily.
Bone/Antler Wedge and Adze (n=76)	Wedge + Adze moderately 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, as for pressure-flaking.	Probably mostly representing hide-working and basketry construction. Some few items may be pressure flakers, though this is unlikely.

Table 3.
Summary of Debris and Non-Debris Distributions Among the House and Midden Contexts.

Context	*Debris* small (debitage)	*Debris* large (FCR)	*Non-Debris* somewhat valued items	Uselife useable	Uselife exhausted
Bench	-	-	-	+[1]	-
Cellar	+	+	+	+	+
	+	+	+	+	+
Hearth					
Midden	+	+	-	-	+[2]

+ = more common
- = less common
[1] serviceable lithic cores
[2] exhausted lithic end scrapers