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Household Archaeology of a Southern Northwest Coast Plank House

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Five seasons of excavation at the Meier site, near Portland, Oregon, have exposed portions of a very large (14 m × 35 m) plank house dating to late prehistoric times. The Meier house is unusual not only because of its size but because it is part of a Northwest Coast residential site that is not a deep shell midden. Detailed information about the frequency of repair and modification of the house indicates the great extent to which the site's occupants recycled deposits associated with the dwelling for construction and maintenance purposes, and supports the inference that the Meier house and other, similar structures represent, over their use lives, several hundred thousand board feet of lumber and a major labor investment by the occupying household. The vast majority of other Northwest Coast residential sites are incorporated into large shell middens and the Meier excavations suggest that their stratigraphy must be the result of deliberate construction activities as well as dumping.

Introduction

On the Northwest Coast of native North America, the household was the central and fundamental social, political, and economic institution and the house itself was one of the most spectacular objects in the region's material culture. This paper reports on the household archaeology (see Wilk and Rathje 1982: 617) of a residential site on the southern Northwest Coast. Our present concerns, beyond summarizing the results of the excavation, are twofold: to discuss the household as the primary taphonomic agent shaping and structuring the site's deposits; and to assess the costs in labor and time of building and maintaining a Northwest Coast house.

The Meier site (Smithsonian site number 35CO5) is located on rich bottom lands near the confluence of the Willamette and Columbia rivers (FIG. 1) within the metropolitan area of Portland, Oregon. The Portland State University (PSU) field school has conducted excavations there since 1987. The site contains the remains of a large, rectangular plank house, and its associated features and cultural debris. We have recovered evidence of two major construction phases and multiple lesser episodes of alteration and repair of the house. The dwelling, dating from the 14th to 18th centuries A.C., was 14 m wide and 35 m long.

The site, on the NW bank of Jackson Creek west of Scappoose, Oregon, is 2–3 m above the creek on a structural terrace composed of an openwork gravel capped by a thick silt-clay. The site is about 130 m in length and up to 60 m in width; the cultural materials are generally within the top 70–100 cm. The creek flows along the western edge of what was a shallow, marshy lake before the area was drained and diked.

Prior to our excavations, two previous projects established the site's general boundaries and depth (Pettigrew 1981; Ellis n.d.). Vandals have destroyed about 30% of the site; the land owner has extensively modified other portions. We estimate that no more than 50% of the original site survives. Our work was intended in part to salvage information before the remainder of the site was destroyed.

The household is, for most of the world's people, the fundamental unit of production, consumption, and social and biological reproduction (Wilk and Rathje 1982: 618). This was particularly so on the Northwest Coast (Mitchell and Donald 1988). It is clear from work such as that summarized by Mitchell and Donald (1988) (see also citations in Isaac 1988; Suttles 1990) that an understanding of the long-term social and economic history of affluent foragers in NW North America (e.g., Ames 1985)

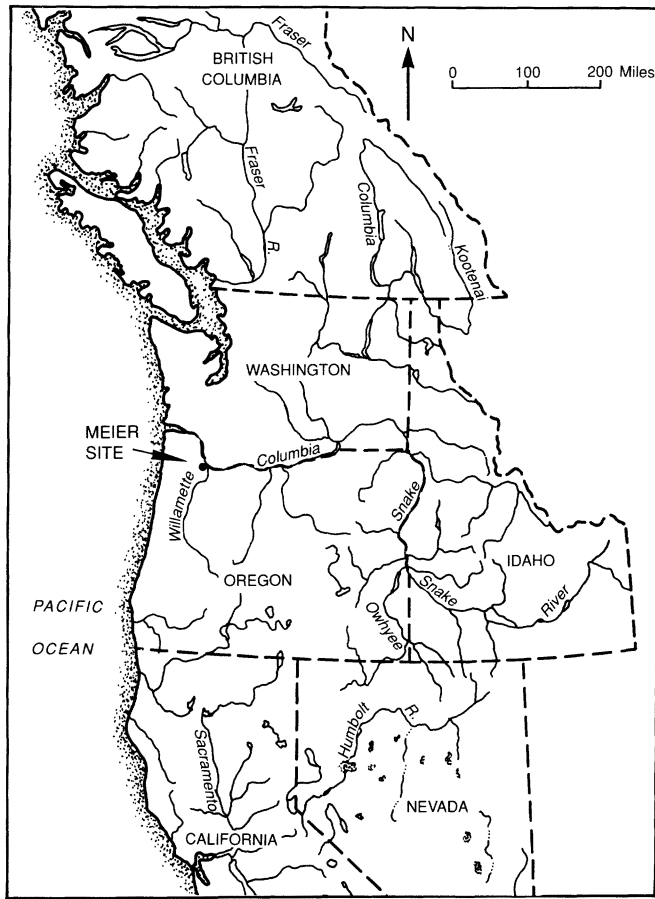


Figure 1. Western North America and the location of the Meier site.

requires knowledge of the relationships among household organization (as measured by house form), residential mobility (specifically, variations in sedentism and semi-sedentism), and the organization of production, including storage and subsistence changes (e.g., Ames 1991).

A central aspect of these issues is how the household is physically reproduced in the form of the dwelling itself, and how much labor and time are required to maintain the structure. The Meier excavations have also produced valuable data on the depositional history and taphonomy of plank houses. We are able to trace out and establish stratigraphic relationships and episodes of construction using site sediments that would have been extremely difficult to recognize in a shell midden. Our results suggest that the formation of residential shell middens may have been more complex than is commonly appreciated.

Northwest Coast Household Archaeology

The Meier site is located in the southern portion of the Northwest Coast culture area of native North America (Suttles 1990). Villages of large, permanent rectangular

houses were a central cultural trait of the area. Construction details varied, but the houses were built by erecting a frame of heavy posts and beams, and then sheathing the frame with planking. The frame was the permanent element of these structures. Until quite recently, standing house-frames still marked the locations of long-abandoned villages (e.g., MacDonald 1983). Households commonly possessed house-frames at two or more places, moving their planking from frame to frame during an annual cycle. When not in use, the planking was sometimes stored immersed in swamps or ponds to preserve the wood and drown any vermin in the planks. The household living in the plank house was the basic social unit of the entire area in the 18th and 19th centuries (Suttles 1990).

Household archaeology on the coast emphasizes the social and economic implications of variations in plank house size and internal organization (Coupland 1985a, 1985b; Chatters 1989; Ames 1991). The methodological issues in excavating and analyzing these complex residential features have also been addressed (e.g., Fladmark 1973; Mauger 1978; Samuels 1983). One of us (Ames 1991: 119–132) was recently able to outline changes in house form over the past 5500 years in the Plateau culture area (immediately east of the southern Northwest Coast), using data from almost 300 excavated houses, and some 120 radiocarbon dates. Unfortunately, equivalent data do not exist for the Northwest Coast.

Recognizing the remains of houses in the large shell midden sites on the coast is extremely difficult. Evidence of houses within the middens includes the arrangements of prepared hearths (e.g., Dewhurst 1980; Chatters, Rhode, and Hoover 1990), post- and plankmolds, “floor” deposits (MacDonald and Inglis 1981), and other features. Occasionally, actual structural members such as posts and planks are found. We are aware of very few midden excavations where major portions of a buried house were recognized and exposed (e.g., Carlson 1972). The complexity of middens is formidable, and excavations are usually not designed to retrieve features, but faunal and artifact samples instead. Lyman (1991) has shown that, in shell middens along the Oregon coast, at least 100 cu m must be excavated to even find evidence for the presence of houses.

It is not surprising that two of the oldest, best documented structures on the Northwest Coast are not actually on the sea, but upstream on the Skeena River at the Paul Mason site in Kitselas Canyon (Coupland 1985a, 1985b) and on the Fraser River at the Mauer site (LeClair 1976). Neither of these are shell midden sites. The Paul Mason site contains two rows of small, rectangular depressions that represent houses dating 2800–3200 b.p. (Coupland

1985a). The Mauer site contains a large, rectangular depression dating several hundred years earlier (LeClair 1976: 41).

The famous Ozette excavations are the most extensive ones of Northwest Coast houses (Mauger 1978; Wessen 1982; Samuels 1983; Huelsbeck 1983, with references). The structures there are associated with midden deposits, but were sealed under massive, catastrophic mud slides that preserved their structural members and fittings in the resulting anaerobic environment. Other excavated plank houses include Old Man House (Snyder 1956; Gaston and Jermann 1975); 45KI159 and 45KI151 (Chatters 1981, 1988, 1989; Chatters, Rhode, and Hoover 1990; Butler 1990); Meier; and 45SA11 (Minor, Toepel, and Beckham 1989).

Blukis Onat (1985) believes that households and their domiciles were one of the major agencies in the formation and organization of shell middens on the coast. Recent work by Stein focuses on individual facies within the shell strata of a midden (Julie Stein, personal communication, 1988), but much more work is needed, particularly in light of our conclusions that deposits associated with residential sites did not accumulate haphazardly, and that even the texture of strata can be the result of the deliberate, planned actions of residents when working on their houses.

Regional Background

The Meier site is located in the Wapato Valley¹ portion of the Lower Columbia River (that part of the river from Celilo, Oregon, to the river's mouth). The Wapato Valley is a broad, fertile valley extending from the Sandy River downstream to the mouth of the Cowlitz River at Longview, Washington. The valley floor is a flat alluvial bottom, with extensive wetlands and waterways prior to diking and draining. It is flanked by higher ridges, small volcanic cones, and low, dissected plateaus.

When the first Euroamericans entered the area, the Lower Columbia River was home to speakers of Chinookan languages (Silverstein 1990), who were densely settled along both banks of the river and adjacent parts of the Pacific Coast. (Hajda [1984] provides the most thorough recent description of Chinookan society and economy.) The Wapato Valley was very thickly populated (Boyd 1985; Boyd and Hajda 1987) and was occupied by people who were exclusively hunter-gatherers. It has recently been suggested that the inhabitants were none-

theless fully sedentary (Saleeby 1983), an issue being investigated at the Meier site.

The inhabitants lived in a very rich environment and depended on a wide array of resources, though emphasizing a relatively few plentiful ones, including the five species of pacific salmon (*Oncorhynchus* sp.), white sturgeon (*Acipenser transmontanus*), elk, or wapiti (*Cervus canadensis*), deer (*Odocoileus*), harbor seal (*Phoca vitulina*), wapato (*Sagittaria latifolia*), and camas bulbs (*Camassia quamash*). Other significant resources included a variety of migratory and resident water birds. Detailed reconstructions of the distributions of plant communities within the valley using records from the mid-19th century (Saleeby 1983; Hamilton 1990) indicate that most plants utilized for food and technology would have been found within the standard-sized (6 km) catchment radius of a Wapato Valley site.

There have been numerous surveys but only very limited excavations in the Wapato Valley itself, for which Pettigrew's dissertation (1981) is the basic document. He tested seven sites, including the Meier site, in the valley in 1973, surface-collected three others, and examined local collections. His tests were limited, usually three 2 m × 2 m pits aligned as a trench. His 25 radiocarbon dates form the basis of a two-phase chronology spanning the last 2800 radiocarbon years. The oldest reported date from the valley floor is 3519 ± 100 b.p. (Wessen 1983). Older sites occur in the surrounding uplands, and may exist in the valley. Very early sites (>9000 b.p.) have been excavated at the upstream end of the gorge (Cressman et al. 1960).

Reconstructing the Meier House

Our work at the Meier site (FIG. 2) uses a generalized model of the "typical" Chinookan plank house, with reconstruction of interior and exterior spaces derived from a variety of sources, including ethnographic and ethnohistoric evidence (Ray 1938; Vastokas 1966; Hajda 1984, n.d.), archaeological data (Minor, Toepel, and Beckham 1989) and the features present within the Meier structure. The ethnographic descriptions are supplemented by three 19th-century illustrations of Chinookan dwellings by Swan (1972), Kane (FIG. 3), and Wilkins (Ray 1938). Our approach is adopted from that used to analyze the Ozette houses (Mauger 1978; Samuels 1983).

Ethnohistoric and Ethnographic Evidence

There was considerable variability in plank house size along the Lower Columbia (Hajda n.d.), including extremely large houses, 60–137 m in length. The typical range was 4.5–9 m in width and 6–15 m in length, with

1. This valley has no consistently applied local name. It has been called the Columbian Valley, the Portland Basin, and the Wapato Valley (*wapato* is the local name for *Sagittaria latifolia*, or "Indian potato"). We use the last.

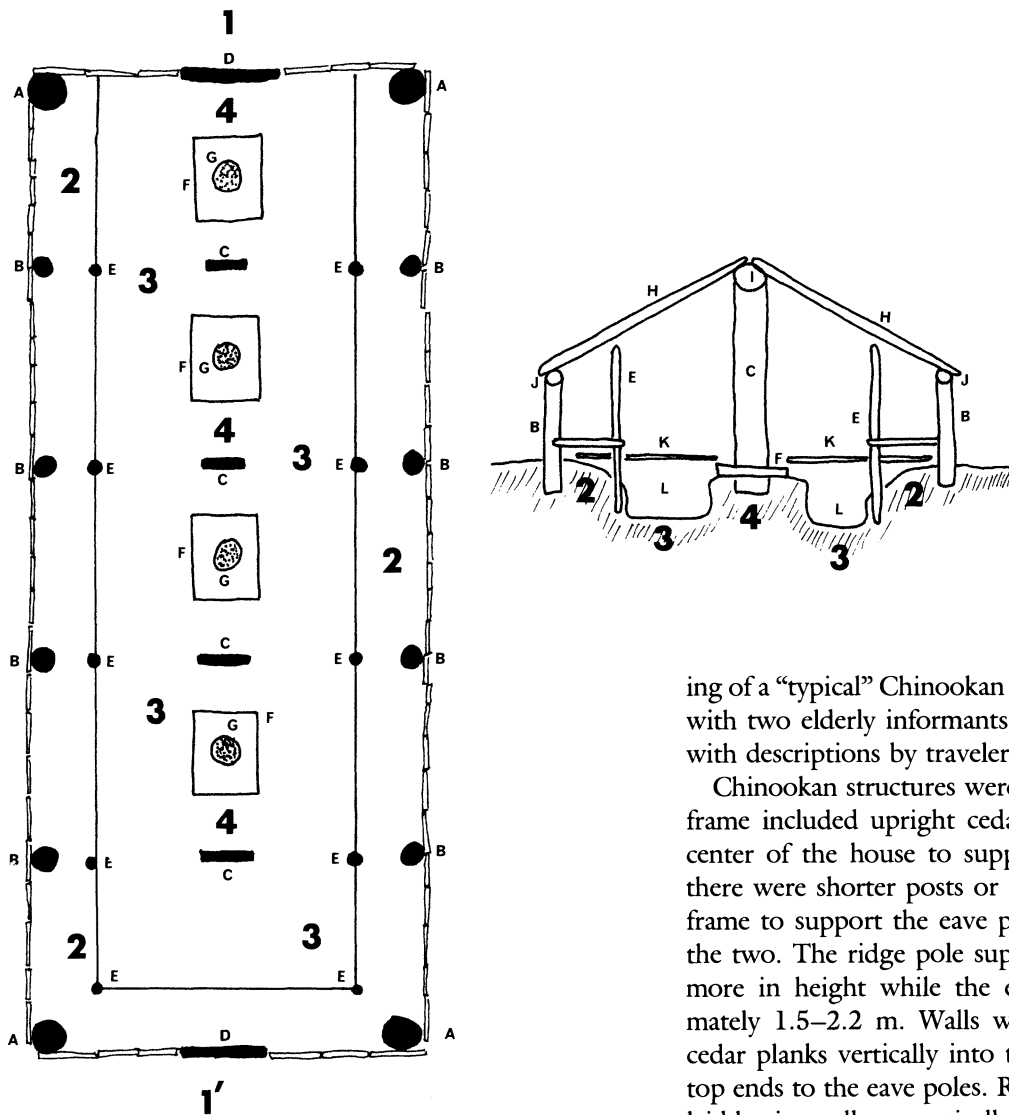


Figure 2. Plan view and cross section of our working model of a "typical" large Chinookan house. The structure in the drawing is 12 m × 30 m. Key: 1) the front end, with a door cut through the large end plank; 1') the back end of the house; 2) platform area; 3) corridor; and 4) central area. A) corner posts; B) eave supports; C) ridge beam supports; D) end planks; E) platform support posts; F) hearth box; G) hearth bowl; H) rafter; I) ridge beam; J) eave pole; K) floor; and L) corridor pit trench. The height of the platform support posts is speculative. We have no information on how a plank floor would have been suspended.

some houses as long as 30 m. The Meier structure is somewhat larger in size than the typical houses (Ray 1938: 124; Silverstein 1990). Hajda has little data on the manner in which the extremely large structures were built. Ray (1938) gives the most complete description of the build-

ing of a "typical" Chinookan house, based upon interviews with two elderly informants in the 1930s, supplemented with descriptions by travelers in the early 19th century.

Chinookan structures were gabled (FIG. 2). The house-frame included upright cedar posts or planks along the center of the house to support the central ridge beam; there were shorter posts or planks along the sides of the frame to support the eave poles. Rafter poles connected the two. The ridge pole supports were 4 m to 5.5 m or more in height while the eave supports were approximately 1.5–2.2 m. Walls were formed by butting split cedar planks vertically into the ground and lashing their top ends to the eave poles. Roofs consisted of thin planks laid horizontally or vertically, or both, sometimes covered with cedar bark. Floors were either dirt (sometimes covered with cedar mats) or planked. Hearths were placed at the center of the house (or in a row down the center) about 30 cm below floor level, and inside framed boxes 2.5–3 m square. Platforms (for sleeping and other activities) ran along at least two sides of the house, and goods were stored on and under these. Sometimes the platforms were vertically doubled, like bunk beds. Posts supporting the platforms paralleled the eave and ridge beam supports along the inside of the house, and were secured to the eave supports by poles. Kane's painting shows other interior pole frames as well (FIG. 3), features attested by other sources (Lewis and Clark, in Thwaites 1904–1905; Ray 1938; Silverstein 1990; Hajda n.d.). Our model divides the interior space of the house into five areas: end, benches, central zone, corridors, and walls (FIG. 2).

Silverstein (1990) states that large structures (such as

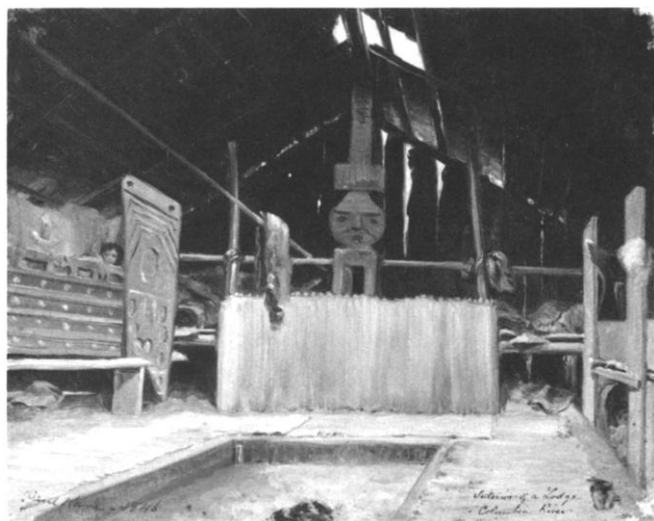


Figure 3. "Interior of Ceremonial Lodge, Columbia River." Despite its title, Paul Kane's eyewitness painting shows the interior of a Chinookan residence that was probably located near Fort Vancouver. Note the interior pole frames and decoration. The painting, oil on paper, 24.1 cm × 29.2 cm, is dated 1846. Courtesy Stark Museum of Art, Orange, Texas.

that at Meier) housed one or more high-status families.² The rear of each structure was reserved for the highest-ranking family in the house, and in some cases was set off by a screen and carved and painted figures of wood and stone. The exterior ends of houses were apparently painted with anthropomorphic designs.

Archaeological Evidence

Our excavations and those at 45SA11 (Minor, Toepel, and Beckham 1989), Ozette (Mauger 1978; Samuels 1983), and elsewhere on the southern Northwest Coast

2. The ethnohistoric and ethnographic sources for the Chinookans indicate that in a large dwelling, like the Meier house, two families shared a hearth. We have reconstructed the Meier house with four hearths, leaving an open space at the rear. The sources do not clarify whether the rear, or high status end, had a hearth or not. While that seems likely, we elected not to show a hearth there since the reconstruction is based only on arrangements for which we have firm evidence. In any case, the Meier structure could have housed 8–11 families, with the highest status families occupying the platform along the back wall and the adjacent side walls. On the Northwest Coast generally, the door end of the house was the low-status end, occupied, for example, by slaves owned by the house chief, while the back wall was reserved for the highest status members, including the house chief and his family. The Chinookans appear to have followed this practice in their larger dwellings at least.

We have estimated the household size of the Meier structure to have been 60 people using Cook's formula for calculating population size from living area (Hassan 1981: 122). One of us has found that this formula provides quite good estimates for Northwest Coast household sizes (Ames 1991).

(Snyder 1956; Gaston and Jermann 1975; Chatters 1981, 1988, 1989; Chatters, Rhode and Hoover 1990; Butler 1990) provide significant information on the archaeological features representing the structural elements described above. In the Meier house, as elsewhere, postholes and postmolds are the most common structural features, ranging from 5 cm to 30 cm in diameter, with a few as large as 1 m. The smallest were probably for the cedar pegs used widely in native construction on the coast. The flat bottoms and/or walls of the larger postholes and postmolds are commonly packed with stones and fire-cracked rock. Most had been filled and redug several times during the use-life of the structure.

Plankmolds, representing the planks and rectangular timbers used in the structure, have three size ranges at the Meier site. Small plankmolds are rectangular; about 3 cm wide and 5–10 cm long. They are commonly, but not exclusively, found encircling the floors of large pit features (see below). Medium plankmolds, 2–6 cm wide and 30–100 cm long, were produced by the planks used in the walls and elsewhere in the house. Large plankmolds, 10–20 cm wide and 30–100 cm long, are assumed to represent ridge pole and eave supports, given their locations within the dwelling. In cross-section, plankmolds are rectangular; medium and large ones can be 10–30 cm deep. Plankmolds can be shallow stains on earthen surfaces or highly visible, substantial features. Large plankmolds frequently have fire-cracked rock packed against their walls, but never at their bottoms.

While large plankmolds and postholes are easily recognizable under almost any soil moisture conditions, the visibility of small and medium plankmolds and postmolds is affected by varying moisture conditions. At the Meier site, plankmolds are sometimes clearest in wet or drying soil, postmolds in completely dry soil. An additional problem in recognizing these features is that burrowing animals sometimes incorporate them into their tunnels.

Defining plank houses archaeologically frequently depends on locating their walls and/or floors. Walls are indicated by features caused by the house-frame and plank sheathing. The house-frame will produce large postholes, postmolds, and plankmolds. The sheathing can produce "wall trenches," which essentially are long rows of plankmolds individually as much as 30 cm deep (e.g., Minor, Toepel, and Beckham 1989). Some methods of sheathing a house can also produce long lines of small postholes (Mauger 1978). These features are rare at the Meier site, which has a plow zone 24 cm thick. We have depended upon identifying occasional plankmolds and multiple postholes related to the frame (described below).

At Ozette, the earthen floor was a midden composed

of multiple “thin (<1 cm), hard, parallel laminae” (Samuels 1983: 30). Chatters, Rhode, and Hoover (1990) mention such laminae in the earthen floor of a plank house they excavated in the southern Puget Sound area. Excavated earthen floors on the Oregon coast and at least one plank house in the Wapato Valley were covered with a thin hard layer of clay.

Prepared hearths are also used as markers of floors. At Meier, hearth deposits include the prepared hearths, the contents of these hearths, and ash lenses related to the hearth boxes described above. The hearths are shallow clay bowls built on underlying sediments. These are about 50 cm in diameter, 10 cm deep, and lined with clean beach sand. The heat of the fires baked the clay hard, and to a bright terra-cotta color. The hearths themselves contain virtually no fire-cracked rock, but rather an indurated, white or yellow compound of plentiful calcined bone, charred shell fragments, and wood ash. Thick deposits of multiple, very thin ash lenses sometimes extend out from the bowls (covering earlier ones) 1–2 m, and end abruptly. The edges of these ash deposits are straight, with square corners—representing the hearth boxes.

Establishing the presence of the wooden sleeping platforms is important to understanding the distribution of cultural debris and features within these structures (e.g., Samuels 1983). At Ozette, the planks of the sleeping platforms were still present, permitting Samuels to demonstrate that the front of the platform was associated with dense, linear concentrations of small and medium postholes, representing the platform supports. The location and size of the platforms at Meier are indicated by similar concentrations of postholes and by a hard, earthen bench described below.

There are much less data on what to expect outside these structures. At 45SA11, a village of seven small plank houses in two rows fronting on the Columbia River that dates to the early and middle portions of the 18th century, there was a large “river bank activity area” containing evidence of varied maintenance, manufacturing, and food processing tasks, but it is not described in detail (Minor, Toepel, and Beckham 1989: 212).

Excavation Results

We have opened 160 sq m to an average depth of about 1 m. Excavations extend down to and into the culturally sterile gravels underlying the site. Seventy-three auger holes helped locate the boundaries of the house and the distribution of the associated deposits.

The deposits are classed into house interior and house exterior deposits; the latter are analogous to the river front activity area at 45SA11, and are separated into midden

and “yard” deposits. The midden deposits consist of thin strata of bivalve shells interbedded with thicker strata of ash, burnt clay, and earth with a high organic content. The yard deposits are exterior deposits that are not midden. The dimensions we have established for the structure are for the final construction phase and were stable for an appreciable period of time.

The House

A major part of the western half of the house (FIG. 4) was excavated, including postholes representing the sw corner-post of the house-frame, 6.3 m of the west wall, and a large portion of the NW corner. A 2 m section of the east wall was also exposed. The east side of the house, which abuts the midden, was partially disturbed by relic hunters. We have therefore focused almost exclusively on the west side of the house. Our exposures are laid out to stratigraphically link the structure with the midden and the yard. Areas within the house are recognized on the basis of the ethnographic model and the archaeological features described above.

ENDS AND WALLS

We have exposed a portion of the sw corner of the house including large postholes (D. 1 m) for the corner posts and a section of the wall. Each posthole contained a large boulder weighing over 100 lb. One hole had been subsequently used as a dump, and was filled with ash, shell, and salmon bones, while the other was filled with hard-packed earth and fire-cracked rock. This kind of activity is typical of the Meier deposits.

The stones frequently found at the bottom of postholes at the site reduced the amount of dirt in contact with the timbers (of western redcedar), prolonging their use life. The large rocks in the corner postholes were much larger than other “post stones” in this structure.

We have established the position of the west wall in three exposures, and 2 m of the east wall in a single exposure. A surviving fragment of the wall-trench extends north from the large postholes at the house’s sw corner. A 6.3 m section is exposed 7 m north of the wall trench. This part of the wall is marked by scattered plankmolds and clusters of superimposed postmolds extending along a straight line 15° W of magnetic N, scattered medium plankmolds with long axes parallel to that line, and occasional large plankmolds at right angles to the dominant axis. The superimposed postholes, with diameters of 30–50 cm, represent the eave support timbers. Each cluster contains at least three to five overlapping holes. Many of these features were filled in, and then re-excavated nu-



Figure 4. The excavation at the end of 1988. All of the pit rims and surfaces at the bottom of the trench are constructed of reworked fill.

merous times, but yielded artifacts, ecofacts, and other objects. Commonly, fire-cracked rock and large broken stone artifacts were packed in around the edges of the holes, probably to help secure the post. A 2 m portion of the west wall was also exposed near the NW corner of the house. This section contained plankmolds and postholes.

The east wall is indicated by medium plankmolds with midden to the east and an earthen bench to the west. The midden deposits terminate against the plankmolds.

A 4 m portion of the north wall was exposed in 1991. Its position is marked by plankmolds, large postholes, and a section of a wall trench.

BENCH

The bench is the earthen surface below the wooden platforms along the house walls. Early observers described these platforms as being 1.2–2 m wide. In the last and best-documented building phase of the Meier house, the earthen benches are 2–2.5 m wide, flat, usually very hard, with small postholes (<10 cm D.) and plankmolds preserved on the top. The top surface of the earthen bench slopes down into the massive pit features flanking the central hearths. The sloping pit walls have linear concentrations of multiple postholes with diameters ranging from



Figure 5. The main excavation area at the end of 1989.

3 to 30 cm. The surface of the earthen bench has relatively few artifacts or ecofacts.

CORRIDOR

The corridor, the space between the bench and the central zone, has floor laminae and large pits as archaeological features. In the 1990 and 1991 excavations, we encountered both floor laminae and a thin clay floor in the northern half of the house. The laminae are not hard, but are thin, flat lenses high in ash content encountered in areas that lacked recurring pit excavation (see below). The clay floor appears to have been laid in an effort to create a stable, firm surface above a series of pits with very soft fill. There is also negative evidence, discussed below, that all or parts of the floor was sometimes planked.

The corridor pits, the most spectacular and distinctive features associated with the house, contain the great bulk of recovered faunal and floral remains as well as large artifacts. These pits are very consistent in shape: straight walled, flat bottomed, about 1 m in depth and with a mean diameter of 86 cm. The pits extend to a depth of 1.5 m in places. Typically, they were dug 20 to 50 cm into the underlying, sterile silt-clays. Their walls are hard

(the matrix is usually soft), either through use or deliberate intent. In many cases, pit walls and rims were built up out of a mix of pit fill and sterile dirt (FIG. 5). In several instances small plankmolds and postholes occur around the perimeter of the pit, which is otherwise so shallow as to hardly merit the term. These last occur where native excavation was very extensive and there was probably no dirt to form conventional pits.

These features, in the past, were excavated and re-excavated many times. In one 2 m × 2 m unit we discerned the rims and sides of 17 overlapping pits. While in some cases we recognized discrete pits, collectively they produced trenches 2–3 m wide and 1.5–1.9 m in depth, flanking the central zone. In the northern half of the house, a hard, 1 m wide surface separates the pits from the base of the bench. This surface appears to be a path.

The pit-fill is very dark and greasy when moist. Individual pits held hundreds of pieces of fire-cracked rock, some of which were scattered through the fill while others occurred in concentrations. The volume of rock and the ash-rich deposits show the intensity of heating and food processing. The hearths themselves contained virtually no fire-cracked rock. The condition of the bone suggests a hot,

oxidizing environment (Bowman 1990). The pits lacked the thick charcoal deposits produced in the low oxygen-reducing atmosphere of earth ovens (Thoms 1989).

The pits also contained plentiful remains of elk, salmon, sturgeon, and many other animals (see below). Sometimes elk limbs and salmon vertebrae were fully articulated. There were concentrations of very small fish bones that may have been contained within a basket, and carefully cached elk-antler tines.

The use of these pits and the origins of their contents present something of a problem. It appears that initially, the pit trenches (for want of a better phrase) were open, dirt free, then began filling in. There are three episodes of trench filling; the final one ended by the clay floor. While some of the earth in the trenches probably resulted from flooding, much of the dirt represents backfilling by the site's occupants.

Some archaeologists, on the basis of the only partially-butchered animal remains and great quantities of fire-cracked rock in the pits, have suggested to us that these pits must have stood open and been used as dumps during periods when the house was abandoned. While that is a possibility, we cite evidence below from adjacent coastal areas that butchering and disposal of carcasses occurred inside houses during occupation. The pits themselves, in any event, were clearly dug originally as part of the fittings for the house.

There are two lines of evidence indicating the house initially had a plank floor. The construction of pit rims of earth or planks suggests the need to reinforce the sides of whatever was placed below the ground surface—probably baskets. If there had been an adequate depth of earth, such reinforcement would seem unnecessary. There is one area, ca. 6 m long, 2 m wide, and 1.5–1.9 m deep where these rims and small plankmolds are concentrated. If these features, or any portion of them, were exposed when the house was occupied, some sort of plank flooring would have been an absolute requirement. The path-like surface mentioned above is at least 12 m long. In cross-section, it is very like the crawl-spaces under modern houses without basements. The surface, which is extremely hard, is part of the original fittings of the house and appears to have been used for some time before being covered with dirt. This also suggests a plank floor.

Deposits with no clear evidence of a floor but at the right elevation relative to the hearths are termed the floor zone. This artifact-rich zone is 20–40 cm thick and yielded 100+ artifacts/cu m in contrast to 40–50/cu m in the pit fill. There are other contrasts in the vertical distribution of artifacts. For example, most projectile points come from the floor zone, and almost all large ground stone artifacts

from the pits. The floor zone includes ash and charcoal, but is not as rich in other organics as is the pit fill.

CENTRAL ZONE

The central zone contains floor deposits, the hearth boxes, ridge support timbers, and associated surfaces. It appears archaeologically as an earthen platform between the flanking rows of deep corridor pits. This platform was originally created when the pits were dug beside it, but it was maintained as a platform by filling and packing older surfaces and features with reworked fill. Thus, the areas carrying the central hearths and ridge support beams were partially to fully constructed of fill. Hearth features include the hearths themselves, the ash lenses, and indurated hearth contents. In 1989, we exposed 10 of these within a 2 m × 4.5 m area.

Plankmolds and postmolds were found in positions indicating they held the timbers supporting the ridge beams. There were also multiple postmolds about 5 cm in diameter. One 2 m × 2 m surface had 183 of these peg holes. Samuels (1983) argues that the distribution of these features at Ozette reflects the location of processing activities in the houses.

Midden

The midden is east and north of the structure. Extensive portions of it have been destroyed by collectors and recent livestock burials. We have found and sampled areas of midden deposit, and Pettigrew's earlier test was in undamaged midden. The midden's basal portion, which lies directly on the silt-clays, is usually a series of shallow to moderately deep saucer- and bowl-shaped pits, though straight-walled pits occur. These are commonly rich in cultural debris. Overlying them are thin, sheet-like lenses of shell (complete or crushed valves), alternating with thicker lenses of burnt clay, indurated hearth fill, charcoal, wood ash, and dark silt-clay with high organic content. These thick lenses probably represent extensive hearth cleaning. The midden is extremely rich in fauna, fire-cracked rock, and artifacts.

The shell lenses, quite fragile and easily destroyed, are identical wherever encountered: sheets of molluscan valves 3–5 cm thick. The lenses are discontinuous across the site, and their topology is very irregular. They were probably rapidly laid down and buried, and are not like the thick shell strata sometimes seen in coastal middens.

Hearths in the midden always occur singly, unlike interior hearths. But like interior hearths, these were prepared by constructing a clay bowl and lining it with sand.

Yard Deposits

This term refers to areas that are neither parts of the house nor of the midden. This class of deposits, contained within a churned and mixed stratum of the basal silt-clays, comprises our smallest areal sample. The matrix lacks both the organic content of the pit fill and the ash and charcoal of the floor zone. Yard deposits contain pits, but these are usually cone-shaped rather than straight walled, and their sides are soft like the surrounding matrix, sometimes making them difficult to excavate. These pits frequently contain nothing but earth, but some have charred acorns and hazelnuts, items rarely found in the house. Like the interior corridor pits, these exterior ones have been dug, filled, and redug. There are also features, such as plank- and postmolds, that could represent small structures associated with the larger dwelling.

Artifacts and Ecofacts

We have recovered over 12,500 shaped tools, about 67/cu m, and more than 30,000 pieces of lithic debitage. The types are similar to those reported by Pettigrew, and include wedges, harpoon valves, barbs, foreshafts, needles, mauls, pestles, stone bowls, net weights, projectile points,

burins, drills, figurines, dentalia, shell blades, copper—including copper projectile points—and trade beads. As noted above, different classes of artifacts and debris have contrasting distributions in relation to the various classes of deposition and feature. Some of these differences may reflect varying preservation conditions; others are probably the result of curation.

The faunal remains are similar to those described for the region by Saleeby (1983). The bulk of our fauna appears to be elk, deer, salmon, and sturgeon, and we estimate we have between 90,000 and 220,000 specimens. The density and diversity of fauna from the interior of the house is not atypical of Northwest Coast houses (Huelsbeck 1983; Chatters, Rhode, and Hoover 1990). Macrobotanical remains include wood and bark from Western redcedar (*Thuja plicata*), unidentified sections of twigs and twinning, charred acorns (*Quercus* sp.), and hazelnuts (*Corylus cornuta*).

Building Sequence and Chronology

The features described above are assigned to two phases of house construction and rebuilding. While these phases were not completely separate events, one end of the house-

Figure 6. Plankmolds and adjacent hearth bowls of House 1B, exposed during excavation.



Table 1. Radiocarbon dates from the Meier site.

Lab #	Date (b.p.)	House	Association	Calibrated range*	Probability†
TX6710	130 ± 60	1B	corridor pit	1671–1952	1.00
TX6711	240 ± 70	1B	corridor pit	1489–1858	.89
TX6712	500 ± 120	1B	midden	1260–1640	1.00
TX6713	510 ± 90	Unknown	—	1280–1595	.96
TX6714	510 ± 90	1B	corridor pit	1280–1595	.96
GAK5568	720 ± 70	Unknown	midden	1174–1389	1.00

* Two-sigma calibrated age range calculated using the University of Washington's Quaternary Isotope Lab's radiocarbon calibration program 1987, revision 2.0, calibration file ATM10.14C.

† Probability represents relative area of the date range under the probability curve, calculated using the University of Washington's Quaternary Isotope Lab's radiocarbon calibration program 1987, revision 2.0.

frame was shifted several degrees from its original position in the second phase. The earlier phase is called House 1A (H1A) while the later phase is House 1B (H1B).

Our best indications of the building sequence are two sets of plankmolds for the ridge beam support in the central zone area (FIG. 6), changes in the eave supports, and the sequence revealed in a massive hearth complex. The two sets of plankmolds can be separated by their orientation. In one, the beam they supported was oriented directly on grid (magnetic) N–S (H1A), while the second was oriented 10° to 15° west of magnetic north (H1B). Eave supports for H1A were thick vertical planks, while those of H1B were posts about 30 cm in diameter. The H1A and H1B corridor pit trenches also follow their respective orientations, with that of H1A being stratigraphically earlier. The distribution of hearths generally follows the H1B orientation. As a result, remains of the two phases almost completely overlap at the structure's southern end, while diverging to the north at a decided angle. The relationships among the 10 hearths in the excavated hearth complex and the H1A and H1B plankmolds suggest that the hearth boxes and interior timbers were repositioned several times.

Almost all of the post- and plankmolds representing frame members occur in tight clusters of overlapping features, and virtually all of them appear to have been filled and re-excavated several times, indicating replacement of frame members. We have already commented on the clustering of eave supports along the H1B west wall. The H1A ridge-beam support post, by conservative estimate, was reset 5 to 8 times; and the H1B post 7 to 10 times. These estimates hold for the other identified frame members as well.

Interior hearths are usually placed on top of earlier ones, and are complexly interbedded and filled with indurated ash, shell, and bone. Hearth boxes may not have been cleaned until filled with debris. The thick lenses of such debris in the midden probably represent major hearth-

cleaning activities, perhaps associated with repositioning interior spaces.

There was a continual reshaping of the earthen surfaces under and around the structure, as well as the refilling and re-excavation of the corridor pits. Pits, postholes, and surfaces were filled, covered, and reshaped by applying a mix of earth and fire-cracked rock. The earth was usually, but not always, the sterile silt-clay under the house. We term this mixture "reworked fill." In some cases, entire corridor pits were packed solid with the mixture. The central zone of H1B was partially constructed by filling in corridor pits from H1A or by using a thin layer of reworked fill to cover complexes of small postholes and to provide anchors for new sets. We have encountered very few surfaces or features directly associated with the dwellings that are not extensively reworked and shaped to fit the needs of the residents.

Lastly, there is one set of these pits—the first we encountered—which cannot be easily accommodated in House 1. These may indicate the presence of another, separate structure between House 1 and the creek, but there is little room in that space, given the size of House 1. These pits are close to Pettigrew's test excavation and other areas which have been extensively disturbed, so the issue may be unresolvable.

Six radiocarbon dates provide a chronological framework (TABLE 1). The GAK date is Pettigrew's; the TX dates are from the PSU project. These are all maximum ages, based on samples from the bottoms of excavation units and pit features. The extensive re-excavation of pits, however, and the continual rebuilding and repair of the plank house, means that a given date may not reflect the initial use of the feature from which it was derived. Additionally, the heartwood of the Western redcedar, a tree that can live for several centuries, was the most popular for planks (Friedman 1975). Thus, radiocarbon dates could be several hundred years too old—the "old wood" problem. The PSU samples were selected from clearly

identified and bounded features—they are not aggregate samples—but they are all charcoal too carbonized to permit identification of the wood.

The TX 6710 date and the few European trade goods we have recovered clearly indicate an occupation during the 18th and perhaps early 19th centuries. There are a very few trade beads and clay pipe fragments, but little evidence of prolonged contact with Europeans. We believe the site was essentially abandoned by the very early 19th century, and perhaps earlier. The landowner mentioned a local oral tradition that a house-frame may have stood on the site until sometime in the middle to late 19th century. The GAK date cannot be directly linked to the PSU exposures, and since the area between Pettigrew's trench and our units is disturbed, a connection cannot be made.

The data do suggest an early occupation during the 12th to 14th centuries A.C. TX 6713 is from the pit features that may belong to another house and may imply another structure contemporary with H1B. The TX 6712 sample was recovered from a pit capped by midden abutting the east wall of H1B. TX 6714 was collected from the bottom of a deep corridor pit that was clearly part of the corridor trench row of H1B. TX 6711 was collected near the bottom of that same trench row, 5 m north of TX 6714. The calibrated 2-sigma ranges of these dates indicate an age range for H1B between the 14th and the 20th centuries.

For present purposes, it seems safest to date the deposits associated with House 1 to 1400–1800 A.C. That span probably includes both the 1A and 1B house-frames. Given the clear evidence for continual mixing of corridor pit fill, there is no way to separate H1A and H1B deposits in that period, although H1A features are stratigraphically earlier.

House-frame and Planking Replacement and Repair

The extensive renovation documented for the house at Meier raises two important questions: how much wood was required to build the structure, and how much to maintain it. The estimates used here are based on contemporary lumbering practices, and provide interesting parameters for H1B. The board foot (12 in × 12 in × 1 in) is the standard measure for estimating the amount of wood in a modern building in the United States. We calculate the 1B house to have been 14 m × 35 m, with side walls 2.4 m high, and to have had a 6.1 m-high ridge beam and a single 2 m-wide sleeping platform along each side wall, plus the ridge beam itself, six ridge support planks, and the eave supports. The estimate does not at-

tempt to include the posts supporting the sleeping platforms, and any of the other wood in the house. Therefore, it errs on the conservative side.

Without a planked floor, the Meier 1B house, including roof, would have required ca. 40,000 board feet of lumber; with a plank floor, ca. 55,000 board feet. For comparison, a modern, three-bedroom American house uses some 10,000 to 12,000 board feet.

With respect to planking the floor,³ it was probably much less costly to refill the corridor pits with dirt than to lay a wooden floor. Thus, whether the floor was planked or not may have depended both on what was kept in the pits, and the labor available to make the planks. The roof required ca. 15,000 to 17,000 board feet of lumber for only a single course of planks; some Northwest Coast houses had double courses (Silverstein 1990).

According to one standard formula (Robert Hostetter, personal communication, 1990), there are 1150 board feet in a log 36 in diameter and 20 ft long (approximately 1 m × 6 m). Using this figure, the Meier house represents 38 to 52 such logs. On other parts of the coast, the people did not always fell large logs for building, but split planks from prepared, standing trees or from downed logs.

The house was built of Western redcedar, an extremely durable wood, and the site's deposits are rich in identifiable fragments of it. Redcedar fence posts, untreated by any preservatives and in direct contact with the ground, can be expected to last about 12 years (Robert Hostetter, personal communication, 1990). Redcedar shakes and shingles, which may be only an inch thick, can last from 15 to 20 years if there is no contact with the ground. Placing stones under and around posts and planks to minimize their contact with soil will increase their durability.

The large postholes (D. 1 m) at the house's sw corner have massive boulders in them and would have lasted a long time. We also have encountered smaller, interior postholes with stone-lined bottoms. Plank holes and molds frequently have fire-cracked rock packed around their perimeters, perhaps to both shield the plank from the surrounding dirt and to stabilize it. The bottoms of plank-molds are not stone-lined, however.

This structure required a tremendous amount of wood over its use-life, particularly given the available technology, which included stone mauls and splitting wedges

3. The presence of a planked floor will be difficult to establish directly. There are a variety of indicators that a floor was not planked, including floor midden laminae, but their absence does not prove the floor was planked. In most areas of the Northwest Coast, they were not. The use of planked floors by the Chinookans may be the result of their use of the corridor pits for storage.

made of antler—very common items at Meier. In fact, elk antler was very carefully curated, and caches of antler wedges occur regularly in the site. We have recovered only two stone woodworking blades (celts or adzes): one is completely exhausted and the other sharpened and re-sharpened until it was probably too small to re-haft.

Frame members had to be replaced several times over the life of the house; conservatively, a minimum of 5–11 times per feature cluster, and the H1B frame could have existed for perhaps 400 years. Given the life span of red-cedar, we might estimate almost total replacement of frame members every 20 years or so, or 20 times over that period. We have evidence of the ridge beam support planks—taking H1A and H1B together—having been replaced perhaps 12–18 times. While we have not recovered a complete sample either of ridge beam supports or replacement episodes, perhaps half to two-thirds of these episodes have been identified. The evidence, therefore, indicates a need for something like 0.48 to 1.1 million board feet of lumber over four centuries to maintain this one structure. While corner posts might have needed only occasional replacement, it is likely that the thin wall planks and small posts and pegs had to be regularly replaced.

Our data also suggest that H1B burned at least once. Fire was no doubt a constant hazard, and sometimes likely accelerated the repair schedule of a house and its frame.

Discussion and Conclusions

Two issues were raised in the introduction: the amount of labor required to build and maintain a Northwest Coast plank house; and the taphonomy of plank house deposits, particularly those in shell middens. Meier House 1B, the one we understand the best, required a great deal of effort. We have shown that the level of investment in the house ranged from regularly acquiring large amounts of lumber to actively filling and re-excavating the corridor pits, and shaping and reshaping the earthen surfaces in the house with reworked fill. Noting that most considerations of household economy on the coast have been heavily focused on subsistence (Mitchell and Donald 1988), we suggest that further work needs to expand these considerations to include the house and other aspects of household material culture. These suggestions are not limited to the Northwest Coast but extend to other so-called affluent foragers, such as the Jōmon people of Japan and the Natufians of sw Asia.

The interior house deposits and exterior yard deposits were frequently reworked by pit excavation and incorporated into construction as reworked fill. Only the midden deposits appear to be primary, in the sense that they were

not reworked once becoming part of the midden.

These relationships have been difficult enough to glean in non-midden deposits. Reworked fill can be an archaeologist's nightmare, particularly when it is black pit-fill packed into a pit dug into older black pit-fill, or a posthole dug into tan sterile silt-clay that has then been packed with the same material. Identifying these relationships in a shell midden settlement will be much more difficult.

The way in which the Meier occupants used and modified the deposits for construction and repair purposes was perhaps typical for plank house village sites of the Northwest Coast. While the corridor pits may be distinctive features of Wapato Valley plank houses, the level of house repair and construction documented at Meier very likely is not unique to this valley. Mauger's (1978) discussion of the history of Old Man House, a large plank dwelling located in the Puget Sound area, is instructive. He notes that the house may have increased in length by almost 108 m in a 14-year period, from 52 m to 160 m. Such a change in dimension would be accompanied by a major shift in interior arrangements as well. On the other hand, Samuels (1983) notes plank repair at Ozette, and the resetting of one wall, but describes nothing like what we have seen at Meier. It may be that the Ozette houses were not occupied long enough, before their burial, for extensive renovation and repair to take place, but it follows from our assumption that Meier is typical that the shell midden sediments associated with plank houses and plank house villages will be at least as complex as those described from this site. Building and maintaining a Northwest Coast plank house was a labor intensive activity. One consequence of that labor was the extensive and continual modification of deposits associated with the house through use in house construction and repair. As a result, it must be assumed that sediments associated with these structures have had long and complex histories and that these midden sediments represent deliberate construction activities (cf. Blukis Onat 1985), rather than haphazard dumping. They must be seen as reworked fill. Viewed in a positive light, this means that shell deposits can yield information on household construction, given the right methods.

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