THE FLANAGAN SITE: 6,000 YEARS OF OCCUPATION IN THE UPPER WILLAMETTE VALLEY, OREGON

by

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A DISSERTATION

Presented to the Department of Anthropology
and the Graduate School of the University of Oregon
in partial fulfillment of the requirements
for the degree of
Doctor of Philosophy

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APPROVED: [redacted]

Dr. Don E. Dumond

An Abstract of the Dissertation of

Kathryn Anne Toepel for the degree of Doctor of Philosophy

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The culture of the Kalapuya Indians of the Willamette Valley, the largest interior valley in western Oregon, does not neatly fit within the culture area schemes devised by anthropologists for native North America. Anthropologists have assigned the Willamette Valley to both the Northwest Coast and the Interior Columbia Plateau culture areas. The Willamette Valley culture, however, is lacking the substantial anadromous fish runs which played such an important role in the subsistence economies of most of the native peoples of the Pacific Northwest. As a result, the Kalapuya and their ancestors relied on hunting and gathering rather than fishing as their primary means of subsistence.

Because of the limited material culture generally associated with the prehistoric hunter-gatherers of the Willamette Valley, relatively few comprehensive archaeological studies have been conducted in the region. As a result, many of the basic questions regarding prehistoric occupation in the Willamette Valley remain partially or wholly

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Because of the limited material culture generally associated with the prehistoric hunter-gatherers of the Willamette Valley, relatively few comprehensive archaeological studies have been conducted in the region. As a result, many of the basic questions concerning prehistoric occupation in the Willamette Valley remain partially or wholly unanswered. The present study is focused primarily on refining the chronology of prehistoric occupation in this region, a basic prerequisite for approaching Willamette Valley prehistory on a regional basis.

This study is based on the chronological patterns evident in the 6,000-year-old cultural sequence investigated at the Flanagan site, a task-specific seasonal camp in the Long Tom Sub-basin of the Upper Willamette Valley. The Flanagan site assemblage, representing the longest continuous occupation documented in the Willamette Valley to date, is used to define a temporally-significant projectile point typology. Changes in projectile point types as well as the frequency and distribution of other tools are used to define three cultural components at the Flanagan site.

The major change in site use appears to correlate with the transition from the Hypsithermal to the Late Postglacial climatic interval. The Flanagan components are in turn related to three of the chronological phases proposed for the Upper Willamette Valley. The archaeological record from the Flanagan site provides a long-term perspective on the hunter-gatherer adaptations in the Willamette Valley which culminated in the ethnographically-known culture of the Kalapuya Indians.

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1983 Patterns of aboriginal land use in the southern Oregon coastal region. In Prehistoric places on the southern Northwest Coast, edited by Robert E. Greengo, pp. 225-253. Thomas Burke Memorial Washington State Museum.

1984 Lava Island Rockshelter: an early hunting camp in central Oregon. Occasional Papers of the Idaho Museum of Natural History 34.

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Toepel, Kathryn Anne, Rick Minor, and William F. Willingham
1980 Cultural resource overview of BLM lands in north-central Oregon: ethnography, archaeology and history. University of Oregon Anthropological Papers 17.

Toepel, Kathryn Anne, and Robert Lee Sappington
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David Dodson
Julie Hallenbeck
Kirk Johnson
Susan Leffingwell
Connie Nosbisch
Lisa Saichek
Jackie Scott
Carol Snyder
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The final season of fieldwork in 1978 was directed by Rick Minor and the author. Students including the following:

Richard Cheatham
Brad A. Coutant
Heide Didwiszus
James Earl
Julie Marsalek
Jon Silvermoon
David Smithson
Lois Stanford
Grace Zilverberg

A number of others were involved in the analysis of various aspects of the collection, including Donald K. Grayson, Ruth L. Greenspan, Rick Minor, Christine Pickett and Robert Lee Sappington, as indicated in the appendices. Marion Smith conducted the initial computer studies of the distribution of surface materials from the site. Others consulted during the course of this project included David L. Cole, Laurence R. Kittleman, and Dave Wagner. The artifact collections and laboratory notes, as well as the field notes from all three seasons of excavation, are housed at the Oregon State Museum of Anthropology under Accession 411.

I am most grateful to Marjorie (Flanagan) Edwards and Vernon Flanagan, owners of the Flanagan site property, for granting permission to carry out this project. Their full cooperation in allowing the nomination and excavation of one of the few archaeological sites in Oregon currently listed on the National Register is truly appreciated. Our knowledge of Willamette Valley prehistory has been considerably broadened as a result of their support.

Finally, I am indebted both to my parents and to my husband Rick Minor for their support in countless ways throughout my graduate career. In addition to playing a major role in the fieldwork and laboratory analysis of the Flanagan collection, Rick provided a steady source of inspiration, advice and encouragement over the years. His invaluable assistance, as mentor and colleague, are most gratefully acknowledged.

To Rick, my best friend

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CHAPTER I

INTRODUCTION

It has long been recognized that the way of life practiced by the Kalapuya Indians who inhabited the Willamette Valley of western Oregon at the time of historic contact does not easily fit within the culture area classification systems developed by anthropologists. Initially, this region was placed within the Northwest Coast Culture Area (Wissler 1917, Kroeber 1920). Later, however, the Willamette Valley was distinguished as a separate subarea of the Northwest Coast Culture Area in recognition of the fact that the Kalapuya represented "the only interior culture in the Northwest region" (Kroeber 1939:30).

The assignment of the Willamette Valley to the Northwest Coast Culture Area went unchallenged until the first synthesis of anthropological information on the Kalapuya appeared in 1951. As a result of the comparison of the material culture of the Kalapuya (based on both ethnohistoric accounts and archaeological collections) with that of neighboring aboriginal groups, it was concluded that the Kalapuya were more closely related to the peoples of the Columbia Plateau than to those of the Northwest Coast (Collins 1951:139-146). Despite Collins' conclusion about the interior affiliation of the Kalapuya, the idea that the prehistoric inhabitants of the Willamette Valley were more closely affiliated with Northwest Coast peoples has continued to persist (Aikens 1975:iii; White 1975a:21, 100).

It is important to point out, however, that the lifeways of the Kalapuya and their ancestors differed in at least one very important respect from those of the native peoples of the Northwest Coast and Columbia Plateau. The salmon "harvest," so important in the economies of the native peoples living elsewhere in the Pacific Northwest, was for the most part not available to the Kalapuya, as the presence of Willamette Falls on the lower Willamette River apparently formed a substantial barrier to the upstream migration of anadromous fish into the main Willamette Valley. As a result, Kalapuyan subsistence depended more heavily on hunting and gathering than on fishing (Zenk 1976:30-37). Archaeological research has established that the basic lifeway developed by the ancestors of the Kalapuya has a long time depth in this region, and the bulk of the evidence obtained so far supports the interpretation of much closer affiliations with peoples of the interior Columbia Plateau rather than with the inhabitants of the Northwest Coast throughout most of the prehistoric past.

Within this frame of reference, the present study focuses on the refinement of cultural chronology within the area occupied by Kalapuyan peoples, one of the major research topics which must be addressed before establishing the position of the Willamette Valley within the context of the prehistory of the Pacific Northwest as a whole. The objective of this study is to examine the chronological patterns evident in the 6,000-year-old cultural sequence preserved at the Flanagan site, a task-specific seasonal camp in the Long Tom Sub-basin of the Upper Willamette Valley. The Flanagan site contains the longest continuous occupational sequence documented in the Willamette Valley to date. The Flanagan site occupation reflects changes in prehistoric lifeways which can be traced over time through an examination of the differences in the functional and technological attributes of the artifacts recovered. The present study is intended as a contribution toward a more explicitly defined cultural sequence which provides a framework for the recognition of the cultural diversification which was apparent among the native inhabitants of the Willamette Valley at the time of historic contact.

Ethnographic Inhabitants

At the time of historic contact, the Kalapuya occupied the greater portion of the Willamette Basin as well as part of the Umpqua Basin directly south of the Calapooya Mountains which separate the Willamette and Umpqua rivers. The only non-Kalapuya groups within the Willamette Basin were the Chinook who lived along a short stretch of the river in the lower valley below Willamette Falls, and the Molala, who inhabited the slopes of the Cascades Range on the east edge of the valley (Figure 1).

The languages spoken by these valley inhabitants have been posited to be distantly related to the languages spoken by the aboriginal inhabitants of the Southern Columbia Plateau. These languages have been identified by linguists as belonging to a single language phylum known as Penutian. Such a grouping indicates that there are some resemblances between the member languages which may indicate a common origin thousands of years in the past.

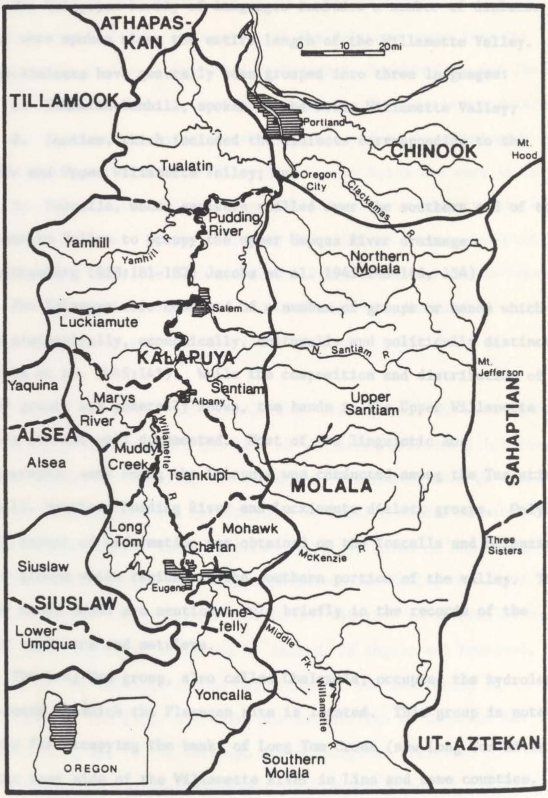


FIGURE 1. Distribution of Indian groups in northwestern Oregon in relation to major Willamette Basin drainages (adapted from Beckham 1976:7).

The Kalapuyan Family of languages includes a number of dialects which were spoken along the entire length of the Willamette Valley. These dialects have generally been grouped into three languages:

1. Tualatin-Yamhill, spoken in the Lower Willamette Valley;

2. Santiam, which included the dialects corresponding to the Middle and Upper Willamette Valley; and

3. Yoncalla, whose speakers spilled over the southern end of the Willamette Valley to occupy the upper Umpqua River drainage (Frachtenberg 1918:181-182; Jacobs et al. 1945:145-146, 154).

The Kalapuya were composed of a number of groups or bands which were dialectically, economically, culturally and politically distinct (Jacobs et al. 1945:145). While the composition and distribution of these groups are generally known, the bands in the Upper Willamette Valley are not well documented. Most of the linguistic and ethnographic work among the Kalapuya was conducted among the Tualatin, Yamhill, Santiam, Pudding River and Luckiamute dialect groups. Only a small amount of information was obtained on the Yoncalla and McKenzie River groups which resided in the southern portion of the valley. The other known bands are mentioned only briefly in the records of the early explorers and settlers.

The Long Tom group, also called Chelamela, occupied the hydrologic sub-basin in which the Flanagan site is located. This group is noted simply for occupying the banks of Long Tom Creek (now Long Tom River) on the west side of the Willamette River in Linn and Lane counties. Berreman (1937:22) was inclined to consider them another band of the Calapuya proper. The sources which mention this group as distinct are

Hodge (1907:242) and the treaty of 1855 (Belden 1855).

The most reliable information on the Kalapuya comes from the ethnographic fieldwork conducted by Gatschet, Frachtenberg and Jacobs. The first fieldwork to be conducted among the Kalapuya was carried out in 1877 by Albert S. Gatschet, who was employed as an ethnologist with the U.S. government. Gatschet collected myth texts and word lists from the Lower Willamette Valley groups who were then residing on the Grand Ronde Reservation. Between 1913 and 1916, Leo J. Frachtenberg collected data from Kalapuyan speakers on the Grand Ronde and Yakima reservations. Frachtenberg was concerned with verifying Gatschet's earlier transcriptions as well as with collecting additional linguistic information.

During the 1930s, Melville Jacobs, drawing upon the work of his two predecessors, assumed the task of gathering additional information from informants, compiling the texts, and publishing them as a collection of ethnographic and mythological material (Jacobs, Gatschet and Frachtenberg 1945). Two of Jacobs' students, Jaime de Angulo and L.S. Freeland, also worked with Kalapuyan informants during the 1930s (Jacobs 1941). Considerable unpublished material on several of the Kalapuyan subgroups, collected by Jacobs, de Angulo and Freeland, are housed in the Melville Jacobs Collection at the University of Washington. The field notebooks and manuscripts of Gatschet and Frachtenberg are in the National Anthropological Archives.

One of the earliest anthropological descriptions of the Kalapuya appeared in the <u>Handbook of American Indians North of Mexico</u> (Hodge 1907). The next description of substance was presented by Berreman

(1937), who compiled the historic and ethnographic evidence pertaining to Oregon Indian groups, including the Kalapuya. More recently, Collins (1951) and Mackey (1974) have addressed themselves specifically to the Kalapuya and have compiled miscellaneous sources on the group. The most complete summary of any single Kalapuyan group is that prepared by Zenk (1976) for the Tualatin. Additional manuscript research directed primarily at obtaining information on Upper Willamette Valley groups was conducted by the author as a part of this study and has been previously presented (Toepel and Beckham 1981:41-81; 1982:118-142; Beckham et al. 1984:57-77).

Previous Archaeological Research in the Willamette Valley

The history of archaeological research in the Willamette Basin has been reviewed in a number of publications, most recently by Minor and Toepel (1981:117-124). Previous investigations have been primarily concentrated on the floor of the Upper Willamette Valley, where the two major state universities are located. The bulk of this fieldwork, including most of the major investigations, has been carried out by the University of Oregon, which has sponsored an ongoing archaeological field school program in this area since 1965.

The other major impetus for archaeological investigations in the Willamette Valley has been federal cultural resource legislation requiring surveys and excavations of sites threatened by projects on lands administered by federal agencies or involving the use of federal funds. Archaeological research stemming from this legislation has been carried out in connection with water-control projects funded by the

National Park Service and the Soil Conservation Service, and also conducted on federal lands in the foothills and mountains on the periphery of the Willamette Valley administered by the Bureau of Land Management and the Forest Service. Although most of these investigations have been rather limited in scope, these projects account for most of the information about regional prehistory so far obtained outside the local Upper Willamette Valley floor.

By the mid-1970s when fieldwork began at the Flanagan site, more than a dozen major sites had been excavated and reported for the Willamette Valley floor and, in addition, at least some information was also available from a large number of other sites in the region (refer to Table 1 and Figure 2). A regional chronology and a subsistence-settlement model had been proposed for the region (White 1975a). In short, the beginnings of a framework had been developed within which archaeologists could begin organizing their data and testing the utility of the proposed chronology and settlement pattern.

Recent Developments in Willamette Valley Archaeology

The Flanagan site investigations began in 1975 with very modest goals, primarily focusing on an adequate sampling of the site to recover a "representative" assemblage of tools from throughout the cultural deposits. Because of the various ways in which previous Willamette Valley excavations had been conducted, the investigators were particularly concerned with employing rigorous and standardized excavation and recording methods at the site. There was little hint that the small campsite near the Eugene airport would produce the

TABLE 1. Major archaeological sites in the Willamette Basin.

Map Reference Number	Site	References
1	Scoggin Creek Site	Davis 1970a
2	Geertz Site	Woodward 1972
3	Lynch Site	Sanford 1975
4	Davidson Site	Davis et al. 1973
5	Spurland and Miller Mounds	Laughlin 1941
6	Halsey and Shedd Mounds	Laughlin 1941
7	Kropf, Simrock and Miller Farm Sites	Davis 1970b
8	Cascadia Cave	Newman 1966
9	Fuller and Fanning Mounds	Laughlin 1943
10	Hager's Grove Sites	Pettigrew 1980
11	Lebanon Site	Cressman and Laughlin 1941
12	Tangent Site	Cressman 1947
13	Luckiamute Hearth	Reckendorf and Parsons 1966
14	Simons Site	Pettigrew 1975
15	Gettings Creek Sites	White 1975a
16	Fall Creek Sites	Cole 1968
17	Baby Rockshelter	Olsen 1975
18	Hurd Site	White 1974, 1975b
19	Halverson Site	Minor and Toepel 1980, 1982
20	Beebe Site	Follansbee 1975
21	Indian Ridge Site	Henn 1975
22	Lingo Site	Cordell 1967, 1975
23	Benjamin Sites	Miller 1970, 1975
24	Clovis Find	Allely 1975
25	Flanagan Site	Toepel and Minor 1980
26	Rigdon's Horse Pasture Cave	Baxter et al. 1983
27	Fern Ridge Sites	Cheatham 1984

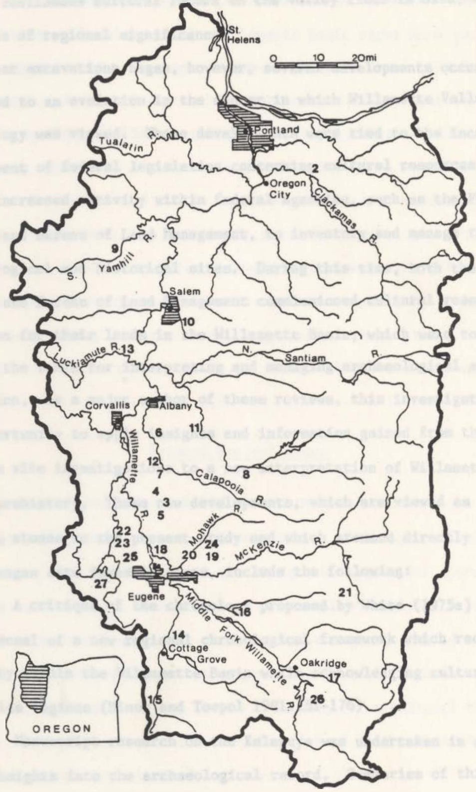


FIGURE 2. Location of major archaeological sites in the Willamette Basin (key, Table 1).

longest continuous cultural record on the valley floor to date, making it a site of regional significance.

After excavations began, however, several developments occurred which led to an evolution in the manner in which Willamette Valley archaeology was viewed. These developments were tied to the increased enforcement of federal legislation concerning cultural resources, leading to increased activity within federal agencies, such as the Forest Service and Bureau of Land Management, to inventory and manage their archaeological and historical sites. During this time, both the Forest Service and Bureau of Land Management commissioned cultural resource overviews for their lands in the Willamette Basin, which were to be used as the basis for interpreting and managing archaeological sites in the region. As a major author of these reviews, this investigator had the opportunity to apply insights and information gained from the Flanagan site investigations to a new interpretation of Willamette Valley prehistory. These new developments, which are viewed as stepping stones to the present study and which stemmed directly from the Flanagan site investigations, include the following:

1. A critique of the chronology proposed by White (1975a) led to the proposal of a new regional chronological framework which recognizes diversity within the Willamette Basin while acknowledging cultural ties to outside regions (Minor and Toepel 1981:151-176).

2. Manuscript research on the Kalapuya was undertaken in order to glean insights into the archaeological record. Summaries of this research have been presented in several volumes (Toepel and Beckham 1981:41-81; 1982:118-142; Beckham et al. 1984:57-77).

3. As a result of the ethnographic research, this investigator proposed that archaeology in the Willamette Basin might more profitably be approached by using the natural sub-basins as a frame of reference for research and comparisons rather than the pan-valley approach advocated by White (1975a) (see Minor and Toepel 1981:142-149).

4. An assessment of the status of archaeological research in the Willamette Valley has led to the formulation of a number of research objectives which have been previously posed (Beckham et al. 1981:281-287; Minor et al. 1982:33-56). Although work remains on refining both the regional chronology and sub-basin settlement approach, these new developments, along with the research goals, have begun to be applied by others working in the region (e.g., Baxter et al. 1983; Cheatham 1984).

Present Project Focus

The present study is intended as a further contribution to the recent accomplishments already outlined above. Although archaeological studies have been carried out in the Willamette Valley for approximately a half-century, archaeologists are still struggling to bring a basic order to the prehistoric record in this region. One of the major and most elementary problems not yet adequately dealt with in Willamette Valley archaeology is the refinement of a cultural chronology for the region and an explicit definition of cultural indicators for the proposed chronological periods.

Because interpretations of prehistory necessarily rely heavily on a well-defined chronology, the primary focus of this study is on an examination of the chronological patterns evident in the 6000-year-old cultural sequence preserved at the Flanagan site. A temporally-significant projectile point typology, based on explicit criteria, is proposed on the basis of the site assemblage. Changes in projectile point types as well as the frequency and distribution of other tools are used to define three cultural components at the Flanagan site, which are related in turn to the various chronological periods presented in a revised chronological framework for the region.

Differences observed in the three components defined at the Flanagan site can be traced to changes in both technology and the paleoenvironment. The technological changes are related to the transition from use of the atlatl-dart to the bow-and-arrow weapons systems. Shifts in the frequency and distribution of other tools over time indicate a change in the basic use of the site over the course of its 6000 years of occupation. The major change in site use appears to correlate with the transition from the Hypsithermal to the Late Postglacial climatic interval, which resulted in vegetational changes on the valley floor.

In the following chapter, the natural environment of the Willamette Valley is briefly described in order to establish the setting in which the prehistoric inhabitants existed. Chapter III provides background information on the methods and results of excavations at the Flanagan site. Chapter IV reviews the artifact assemblage from a functional perspective, while a temporally-significant projectile point typology is described in Chapter V. The site's components are defined and interpreted in Chapter VI, which includes an application of the projectile point typology and an interpretation of site function over time. In Chapter VII, the new information obtained from the Flanagan site investigations is used to refine the cultural chronology for the region. The concluding chapter summarizes the results of this study and its implications for placement of the Willamette Valley within the broader framework of Pacific Northwest prehistory as a whole.

CHAPTER II

ENVIRONMENTAL BACKGROUND

Located approximately 65 km inland from the Pacific Ocean, the Willamette Valley is the largest interior valley in western Oregon. It extends southward from the Columbia River more than 200 km and is bounded on the west by the Coast Range, on the east by the Cascade Range, and on the south by the Calapooya Mountains. The valley is irregular in shape, averaging 40 to 65 km in width. The valley itself is distinguished from the surrounding mountains as that area below an elevation of roughly 150 meters above mean sea level.

Geology

The Coast Range bordering the Willamette Valley on the west is composed of sedimentary and volcanic rocks of Eocene age. In the southern portions of the valley these Eocene rock formations probably extend under alluvial deposits to the margin of the Cascade Range (Franklin and Dyrness 1973:16). The Cascade Range foothills along the eastern side of the valley are predominantly Columbia River basalts of Miocene age (Baldwin 1976:41). Similar early Miocene basalt flows occur in the Eugene area in the form of the Coburg Hills (Peck et al. 1964). The floor of the valley is covered by thick gravel, sand, and silt deposits of Pliocene-Pleistocene age deposited during various stages of alluviation by the Willamette River and its tributaries.

Geography

The Willamette Valley is a structural depression which has been tranformed into an alluvial plain as a result of the deposition of enormous quantities of sediments brought in by tributary streams (Dicken 1973:24). Groups of low hills occur at intervals and separate the broad alluvial flats into a number of hydrologic sub-basins. The floor of the valley has a very gentle, north-facing slope which gradually rises from 50 meters near Salem to 129 meters at Eugene. As a result, the Willamette River is a meandering stream with braided or multi-channel features, especially along the section from Eugene north to Oregon City (Franklin and Dyrness 1973:16).

Hydrology

The Willamette River has a length of about 300 km from the confluence of the Coast and Middle Forks near Eugene to where it empties into the Columbia River at Portland. The total area drained by the Willamette River and its tributaries is more than 30,000 square kilometers. Hydrologically, the Willamette River drainage system is divided into three areas, referred to as the Upper, Middle, and Lower Basins (Oregon State Water Resources Board 1967). The Willamette River drainage is further subdivided into eleven sub-basins containing 49 separate stream systems (Figure 3; Table 2).

Geomorphology

The Quaternary history of the alluvial flood plains of the Willamette River has been reconstructed by Balster and Parsons (1968), who recognized nine major and four minor geomorphic surfaces. The five surfaces of greatest extent in the Upper Willamette Valley are the Horseshoe, Ingram, Winkle, Calapooyia, and Senecal Units.

The Horseshoe Unit represents the present channel and active point-bar deposits of the Willamette River and is the youngest geomorphic surface in the valley. The Ingram and Winkle Units represent successively higher and therefore earlier flood plains of the Willamette River and its tributaries. These units occur most extensively in the area between Eugene and Albany, west of the present course of the Willamette River. The change in the stream system that caused abandonment of the Winkle surface as a flood plain is estimated on the basis of radiocarbon dates to have occurred between 3290 and 5250 years ago, while the abandonment of the Ingram surface occurred within the last 500 years (Balster and Parsons (1968:9).

The Calapooyia and Senecal units represent still older geomorphic surfaces which are most extensive east of the Willamette River, especially in the Salem vicinity. The age of the Calapooyia and Senecal units has not been established, but the development of these geomorphic surfaces is thought to date to the Late Pleistocene (Balster and Parsons 1968:6-8).

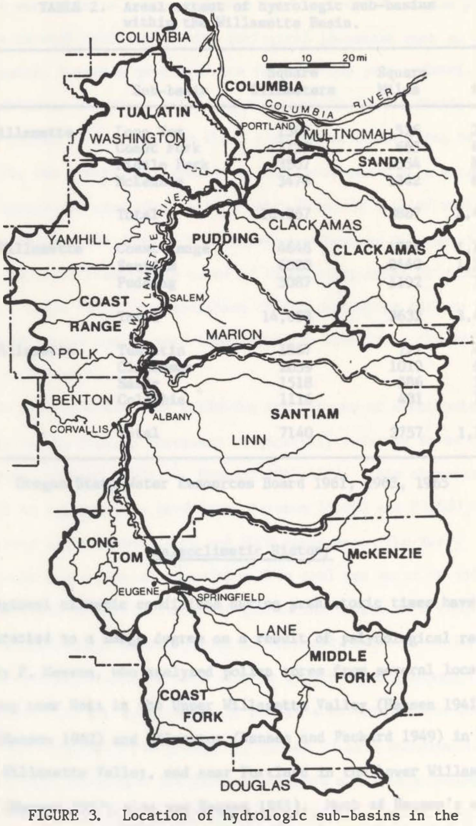


FIGURE 3. Location of hydrologic sub-basins in the Willamette Basin (from Oregon State Water Resources Board 1967:8).

TABLE 2. Areal extent of hydrologic sub-basins within the Willamette Basin.

Basin	Sub-basin	Square Kilometers	Square Miles	Area in Acres
Upper Willamette	Long Tom	1362	526	336,600
	Coast Fork	1722	665	425,600
	Middle Fork	3507	1354	866,600
	McKenzie	3476	1342	858,900
	Total	10,067	3887	2,487,700
Middle Willamette	Coast Range	4646	1794	1,148,200
	Santiam	6320	2440	1,561,600
	Pudding	3087	1192	762,900
	Total	14,053	3632	3,472,700
Lower Willamette	Tualatin	1867	721	448,000
	Clackamas	2639	1019	653,300
	Sandy	1518	586	373,400
	Columbia	1116	431	274,100
	Total	7140	2757	1,748,800

Source: Oregon State Water Resources Board 1961, 1963, 1965

Paleoclimatic History

Regional climatic conditions during prehistoric times have been reconstructed to a large degree as a result of palynological research by Henry P. Hansen, who analyzed pollen cores from several locations, including near Noti in the Upper Willamette Valley (Hansen 1941), near Salem (Hansen 1942) and Silverton (Hansen and Packard 1949) in the Middle Willamette Valley, and near Portland in the Lower Willamette Valley (Hansen 1947; also see Hansen 1961). Much of Hansen's work was carried out before the development of radiocarbon dating. Although attempts were made to assign relative ages to sections of the pollen profiles through correlation with geological phenomena such as volcanic ash deposits, Hansen's profiles were for the most part undated.

Additional important palynological research in the Pacific Northwest by Calvin J. Heusser, for which a series of radiocarbon dates is available, has contributed greatly to the development of a general phytogeographical chronology within which Hansen's earlier work can be interpreted (Heusser 1960). Both Hansen and Heusser discuss the results of their research in terms of three postglacial climatic periods. While their interpretation of the chronology differs somewhat, both Hansen and Heusser documented the same basic climatic sequence (Figure 4).

The period immediately following the retreat of continental glaciers in the Pacific Northwest is generally referred to as the Early Postglacial (Hansen 1947:113; Heusser 1960:183). This climatic interval is estimated to have begun between 15,000 and 10,500 years ago and to have ended between 8500 and 8000 years ago. The Early Postglacial was a time of transition from cool and moist to warm and dry conditions as the influence of glaciation became more remote.

The following climatic period is variously referred to as the Middle Postglacial (Hansen 1947:116) or Hypsithermal (Heusser 1960:184). This was an interval of accelerated warming and drying. The Middle Postglacial is thought by Hansen to have occurred between 8000 and 4000 years ago, but Heusser suggests a slightly longer span from 8500 to 3000 years ago for this interval.

The final climatic period, which began between 3000 and 4000 years

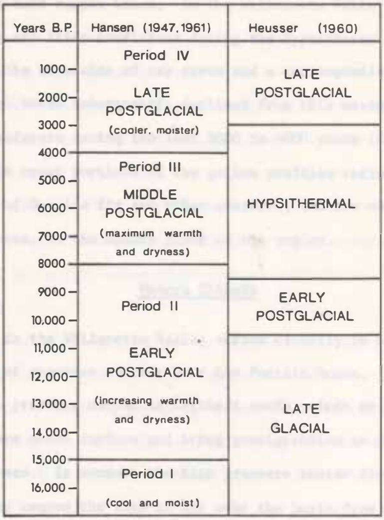


FIGURE 4. Post-Pleistocene climatic sequences in the Pacific Northwest.

ago, is known as the Late Postglacial (Hansen 1947:118; Heusser 1960: 186). This period saw the onset of cooler and moister climatic conditions characteristic of the Pacific Northwest at the present time.

In summary, analyses of pollen profiles located in several different areas indicates a consistent paleoclimatic sequence in the Willamette Valley. In general, the pollen profiles indicate increasing warmth and dryness to a maximum and then a return to cooler and moister conditions in more recent times. In the Willamette Valley, the onset of the warmer and drier conditions during the Hypsithermal was strongly reflected in the expansion of oak trees and a corresponding decrease in conifers. Oak trees subsequently declined from this maximum with the increase in moisture during the last 3000 to 4000 years (Hansen 1947: 86, 117). The upper portions of the pollen profiles reflect the predominance of Douglas fir and other conifers, and the much reduced presence of oaks, in the modern flora of the region.

Modern Climate

Weather in the Willamette Valley varies directly in relation to the location of pressure centers over the Pacific Ocean. In winter, when the high pressure center is farthest south, winds move over the relatively warm ocean surface and bring precipitation to the valley and contiguous areas. In summer, the high pressure center lies near the west coast and causes the flow of air over the basin from a northerly direction. This condition decreases relative humidity and reduces the amount of cloudiness and precipitation over the entire area (Oregon State Water Resources Board 1961:3).

Annual precipitation in the Coast Range and Calapooya Mountains is relatively high, reaching values in excess of 150 cm and 200 cm in each of these areas, respectively. The floor of the Willamette Valley lies for the most part in the rain shadow of these mountain ranges, and as a result annual precipitation declines to 100 cm to 125 cm. Annual precipitation increases on the windward side of the Cascades, reaching maximum values of over 250 cm on the Cascade Summit (Oregon State Water

Resources Board 1961:3).

An outstanding characteristic of the seasonal distribution of precipitation is the high proportion of the annual amount that occurs during the winter season. About 70% of the annual precipitation normally falls during the five months from November through March, while only about 1% occurs during each of the two midsummer months of July and August (Willamette Basin Task Force 1969:21). At low elevations most precipitation occurs as rain, with mean annual snowfall averaging only about 12 cm on the valley floor (Oregon State Water Resources Board 1961:4).

Because the Willamette Valley is largely dominated by marine air from the Pacific Ocean, both annual and diurnal temperature ranges are relatively small. Mean annual temperatures in Eugene range between 40° F and 66° F, with the variation between average minimum and maximums ranging from 32° F in January to 81° F in July (U.S. Weather Bureau 1936:33-34).

Vegetation

The floor of the Willamette Valley contains a vegetational mosaic consisting of coniferous forests, oak woodlands, and prairie grasslands. The species comprising this mosaic occur in the lowlands where it is too warm and dry for the mesic species like western hemlock (*Tsuga heterophylla*), Pacific silver fir (*Abies amabilis*), and mountain hemlock (*T. mertensiana*) found on the adjacent mountain slopes of the Coast and Cascade Ranges (Franklin and Dyrness 1973:116).

Conifer forests occur along the foothills of the Willamette

Valley. Douglas fir is the dominant species, but grand fir (Abies grandis), ponderosa pine (Pinus ponderosa), and incense-cedar (Libocedrus decurrens) are also present, especially in the southern Willamette Valley (Sprague and Hansen 1946).

In the oak woodlands of the Willamette Valley, Oregon white oak (Quercus garryana) is often the sole dominant species, although California black oak (Q. kellogii) is also found in the southern portion of the valley. Bigleaf maple (Acer macrophyllum), Douglas fir (Pseudotsuga menziesii), and Pacific madrone (Arbutus menziesii) also may be present (Thilenius 1968).

Climatic conditions over the last few thousand years have been slightly more favorable for Douglas fir. The oak woodlands are generally interpreted to represent relict colonies marking an earlier widespread range during the warmer and drier Hypsithermal interval of what is now a retreating flora. At the present time, oak woodland maintains itself as climax vegetation only in the most xeric habitants, Douglas fir in more mesic regions, and big-leaf maple or a mixture of maple and fir in the wettest areas (Towle 1974:25-27).

At the time of historic contact the floor of the Willamette Valley was covered by extensive prairie grasslands (for historical descriptions of these grasslands, see Towle 1974:27-39). These grasslands are believed to have been created and maintained by annual fires set by the aboriginal inhabitants as a means of vegetation and game management (Morris 1934; Johannessen et al. 1971; Towle 1974:36-39).

Because of the high proportion of non-native species introduced as a result of agriculture, less is known about the composition of the

Willamette Valley grasslands. These grasslands were presumably bunchgrass-needlegrass types similar to those of the interior valleys of California (Towle 1974:34). Vegetable resources apparently accounted for the major portion of Kalapuyan subsistence, and most of the plants were associated with the grasslands. Among the species specifically mentioned in historical accounts as found on the grasslands, tarweed (Madia sp.), strawberry (Fragaria sp.), and especially camas (Camassia quamash) are known to have been important in aboriginal subsistence practices (Towle 1974:35-36; Zenk 1976:82-84).

The nature and distribution of the native vegetation in various areas of the Willamette Valley at the time of historic contact have been reconstructed in two studies which were based on the records of the General Land Office (GLO) surveys carried out during the 1850s (Habeck 1961; Johannessen et al. 1971). Vegetation patterns in the area around the Flanagan site immediately northwest of the city of Eugene in the Upper Willamette Valley are shown in a map prepared by Johannessen and others (1971) (Figure 5).

Fauna

Fishing was not a major subsistence activity for most of the Kalapuyan peoples of the Willamette Valley, because anadromous fish were largely blocked from migrating upstream into the Middle and Upper Willamette River basins by the falls at present day Oregon City (cf. McKinney 1984). With the exception of limited fishing activities mostly for non-anadromous fish, then, the subsistence practices of the Kalapuya were closely linked to the prairie and open woodland

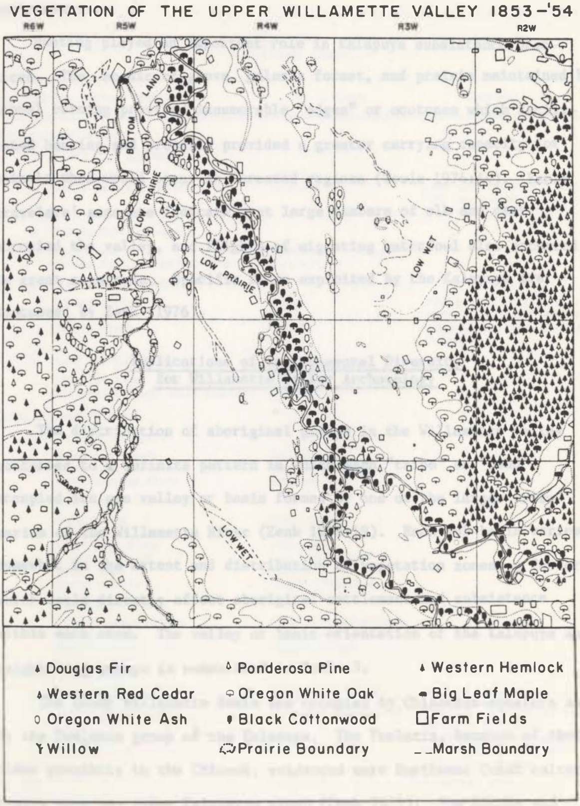


FIGURE 5. Vegetation of the Upper Willamette Valley as reconstructed from General Land Office Survey records (from Johannessen et al. 1971:293).

environments.

Hunting played an important role in Kalapuya subsistence practices. The mosaic of grove, galeria forest, and prairie maintained by annual burning provided innumerable "edges" or ecotones which facilitated hunting and probably provided a greater carrying capacity for animals than would occur in forested regions (Towle 1974:44). Early travelers' accounts indicate that large numbers of elk and deer occupied the valley, and flights of migrating waterfowl also occurred in great magnitude. Specific fauna exploited by the Kalapuya are discussed by Zenk (1976).

Implications of Environmental Diversity for Willamette Valley Archaeology

The distribution of aboriginal groups in the Willamette Valley conformed to a definite pattern in which each "tribe" or "band" occupied its own valley or basin formed by one of the larger tributaries of the Willamette River (Zenk 1976:18). Each sub-basin varies somewhat in the extent and distribution of vegetation zones, a factor which would directly affect aboriginal settlement and subsistence within each area. The valley or basin orientation of the Kalapuya and neighboring groups is summarized in Table 3.

The Lower Willamette Basin was occupied by Chinookan-speakers and by the Tualatin group of the Kalapuya. The Tualatin, because of their close proximity to the Chinook, evidenced more Northwest Coast culture traits than any other Kalapuyan group (Zenk 1976). The Middle and Upper Willamette basins, as well as the northern Umpqua Basin, were

TABLE 3. Summary of Willamette Valley band locations by drainage basin.

Basin/Sub-Basin/River Drainage	Ethnic Group	Comments
UPPER WILLAMETTE BASIN		
1. Coast Fork Sub-basin		
Row River	Yoncalla	
Coast Fork Willamette River	Yoncalla	Lower portion of the Coast Fork was shared by the Long Tom and Winefelly bands
2. Middle Fork Sub-basin		
Fall Creek	Winefelly	
Middle Fork Willamette River	Winefelly	
3. McKenzie Sub-basin		
McKenzie River	Chafan	Chafan occupied the lower McKenzie drainage; Mohawk occupied the upper McKenzie drainage
Mohawk River	Mohawk	
4. Long Tom Sub-basin		
Long Tom River	Long Tom	
Willamette River (main channel)	Long Tom	
MIDDLE WILLAMETTE BASIN		
5. Santiam Sub-basin		
Calapooia River	Tsankupi	
South Santiam River	Tsankupi/Santiam	
North Santiam River	Santiam	
6. Coast Range Sub-basin		
Muddy Creek	Muddy Creek	
Marys River	Marys River	
Luckiamute River	Luckiamute	
Rickreall Creek	Luckiamute/Yamhill	
South Yamhill	Yamhill	
North Yamhill	Yamhill/Tualatin	
7. Pudding Sub-basin		
Mill-Champoeg Creeks	Santiam/Pudding River	
Molalla River	Pudding River	
Pudding River	Pudding River	
LOWER WILLAMETTE BASIN		
8. Tualatin Sub-basin	Tualatin	
9. Clackamas Sub-basin	Clackamas/Clowewalla	With the exception of the Tualatin, the Lower Willamette Basin was occupied by Chinookan, not Kalapuyan, groups
10. Columbia	Multnomah	Chinookan group
11. Sandy	Cascades	Chinookan group

occupied by Kalapuyan groups. The upper reaches of the eastern sub-basins on the western side of the Cascade Range were apparently used by the Molala.

The correspondence of the hydrologic basins with the Kalapuyan languages and the sub-basins with Kalapuyan dialects strongly suggests that it may be profitable to use the basin/sub-basin distinctions as natural units of study in Willamette Valley archaeology. Archaeological patterns--functional, temporal, and cultural (or ethnic)--may be defined in each sub-basin, and these patterns can then be compared with those observed in other sub-basins in developing a picture of the archaeological record within the region as a whole.

CHAPTER III

DESCRIPTIVE ARCHAEOLOGY OF THE FLANAGAN SITE

The Flanagan site is located on the Willamette River flood plain approximately 3.2 km northwest of Eugene, Oregon. The site is about 6 km west of the present channel of the Willamette River, and about 8 km northwest of the confluence of the Willamette and McKenzie Rivers.

Local Setting

The Flanagan site is situated on the geomorphic surface known as the Winkle Unit. This surface is only slightly higher in elevation than the adjacent Ingram Unit, which is the current flood plain of the Willamette River (Balster and Parson 1968). According to local residents of the area, the Flanagan site was reportedly inundated during the wetter seasons of the year before the implementation of flood control measures in historic times. On the basis of available radiocarbon dates, Balster and Parsons (1968:9) suggest that the Winkle Unit ceased to be an active flood plain of the Willamette River between 5250 and 3300 years ago.

The earliest description of the local environment around the Flanagan site can be found in the map and fieldnotes prepared by the Government Land Office surveyors which date to January 6, 1853 (Figure 6). In describing the area around the Flanagan site, the surveyors

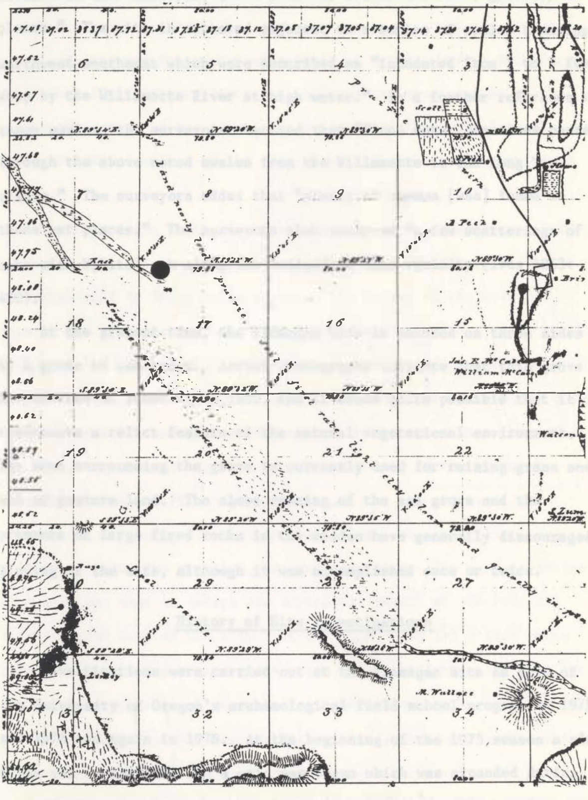


FIGURE 6. General Land Office Survey map, T17S, R4W, showing setting of Flanagan site in 1853.

noted that the "land [is] level prairie, soil first rate, gravelly in places." The site is situated adjacent to a series of swales trending northwest-southeast which were described as "inundated from 1 to 3 feet deep by the Willamette River at high water." In a further reference to these swales, the surveyors observed that "flood water sometimes passes through the above noted swales from the Willamette to the Long Tom rivers." The surveyors added that "plenty of cammus [was] found in these wet places." The surveyors also observed "a few scatterings of oaks with W[hite] ash along the swales" in this vicinity (Ives 1853: 420).

At the present time, the Flanagan site is bounded on three sides by a grove of ash trees. Aerial photographs indicate that this grove has existed at least since 1936, and it seems quite possible that it represents a relict feature of the natural vegetational environment. The area surrounding the grove is currently used for raising grass seed and as pasture land. The close spacing of the ash grove and the presence of large fired rocks in the midden have generally discouraged plowing of the site, although it was accomplished once or twice.

History of Site Investigations

Investigations were carried out at the Flanagan site as part of the University of Oregon's archaeological field school program in 1975 and 1976 and again in 1978. At the beginning of the 1975 season a site datum was established and a grid was begun which was expanded during subsequent seasons of investigation. A controlled surface collection was initiated in the southeast corner of the site, with forty 2x2 m units collected in 1975.

Excavations in 1975 began with the use of 5-cm levels, with the intent of exposing the entire site level by level. During this first eight-week field season, sixty-one 1x1 m units, concentrated in the southeast portion of the site, were stripped of the upper 5 cm of fill. A limited number of the units were excavated to a depth of 10 cm.

Testing of the depth of the cultural deposit was attempted only in two units. The first test pit was a 1x2 m unit (OE/OF) which was excavated only to 30 cm below surface; the bottom of the cultural deposit was not reached. The second test pit was a 1x2 m unit near the center of the site (KL/LL), the excavation of which was carried to 110 cm below surface, which as subsequent work showed was reasonably close to the bottom of the cultural deposit in this area of the site. These two units represented the only vertical sampling of the cultural deposits during the first season's work.

At the beginning of the 1976 field season the controlled surface collection begun the previous year was completed. The surface collection data was used to define the horizontal extent of the cultural deposits over most of the site. In addition, five 1x1 m test units were placed on the northern and western site peripheries to check for the presence of cultural deposits in those areas. As a result of these procedures the site was determined to extend approximately 25 meters in diameter horizontally and more than one meter vertically.

With the completion of the surface collection, the surface distributions of the cultural materials were analyzed, and a stratified

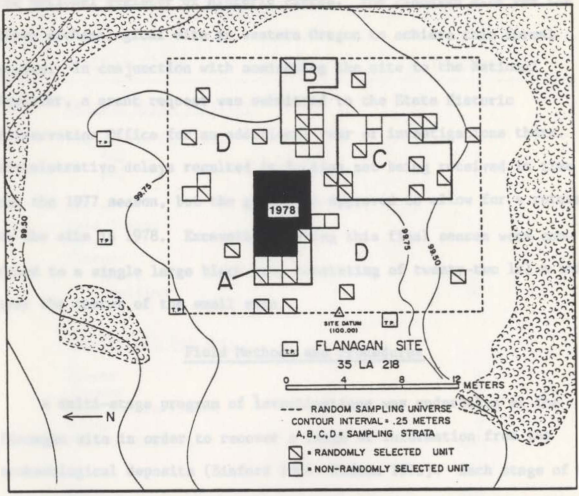


FIGURE 7. Location of units excavated during the 1975 and 1976 field seasons as well as the 1978 block excavation.

random sample was selected for excavation. A total of twenty-eight 1x1 m units was excavated to the bottom of the cultural deposit during this random sampling phase. Excavations were pursued in 11 additional 1x1 m units located adjacent to the randomly selected units so that features discovered in these units could be further exposed. In all, forty-four 1x1 m units were excavated during the 1976 field season (Figure 7).

At the end of the 1976 excavations, the significance of the Flanagan site was realized and procedures were followed to place it on the National Register of Historic Places. The Flanagan site was the first archaeological site in western Oregon to achieve this formal status. In conjunction with nominating the site to the National Register, a grant request was submitted to the State Historic Preservation Office for an additional year of investigations there. Administrative delays resulted in funding not being received in time for the 1977 season, but the grant was approved to allow for a return to the site in 1978. Excavations during this final season were confined to a single large block area consisting of twenty-two 1x1 m units near the center of the small site.

Field Methods and Procedures

A multi-stage program of investigations was undertaken at the Flanagan site in order to recover a range of information from the archaeological deposits (Binford 1964; Redman 1973). Each stage of the investigations in 1976 and 1978 was designed to recover information about a different aspect of the site.

Surface Collection

The initial task of defining the boundaries of the cultural deposit was accomplished by means of a controlled surface collection which was initiated in 1975 and completed in 1976 (Table 4). A grid consisting of squares two meters on a side was established and all

TABLE 4. Artifacts recovered during controlled surface collection in 1975 and 1976.

Artifact Class	Frequency
Chipped Stone Industry	
Projectile Points:	
SS2	1
NN2	4
Graver	1
Used Flakes	13
Cores	4
Flakes:	
Chert	205
Obsidian	108
Cobble Tool Industry	
Hammer	1
Chopper	5
Used Cobble Flakes	7
Cores	2
Flakes (Basalt)	139
TOTAL	490

exposed cultural materials in each square were then collected and bagged separately. The frequency of chipped stone items and the weight of fire-cracked rock were plotted by grid square using the SYMAP computer program (Figure 8). The surface distribution of cultural materials was found to be largely confined to an area 22 m north-south by 18 meters east-west. With the exception of test pits located around the periphery of the midden, all subsequent excavations were conducted within this area (Figure 7).

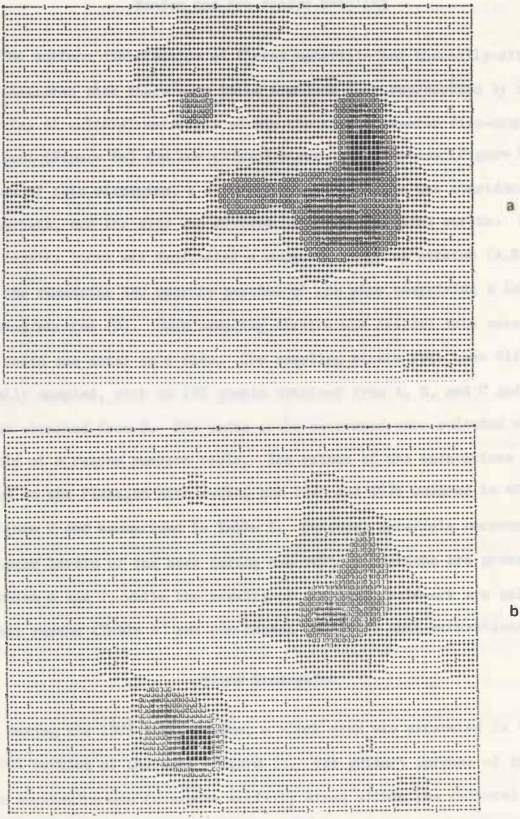


FIGURE 8. SYMAP plots of surface density of chipped stone (a) and fire-cracked rock (b) at the Flanagan site.

Random and Non-random Sampling

The surface distribution of flaked materials and thermally-altered rock indicated that there were three distinct loci represented by heavy densities of cultural materials within the site area—two fire-cracked rock loci (Figure 8a) and one chipped stone concentration (Figure 8b). In view of this situation, a stratified random sample was considered appropriate, and the site was divided into four sampling strata. Each high density locus was designated a separate sampling stratum (A,B,C) with the remaining low density portion of the site comprising a fourth sampling stratum (D). Each sampling stratum was divided into excavation units one meter on a side. The sampling strata were then differentially sampled, with an 18% sample obtained from A, B, and C and a 4% sample obtained from D. The units to be excavated were selected with the aid of a random numbers table. The extent of the excavations conducted at the Flanagan site during the 1975 and 1976 seasons is shown in Figure 7 and summarized in Table 5. Cultural materials recovered in the upper levels of the site during the 1975 excavations are presented in Tables 6 and 7, while the results of the 1976 fieldwork are tallied by both random (Table 8) and non-random (Table 9) unit excavations.

Block Excavation

During the 1978 field season, a block area was excavated in the central portion of the site (Figure 7). The primary purpose of this block excavation was to expose activity areas within the cultural deposits. A secondary objective was to obtain a larger sample of

TABLE 5. Summary of excavation program at the Flanagan site.

	Sampling Stratum				
	A	B	C	D	Totals
Number of Units in Stratum	16	16	44	320	396
Randomly Selected Units (1976)	3 (18%)	3 (18%)	8 (18%)	13 (4%)	27
Non-randomly Selected Units					
1975	0	0	2	2	4
1976	4	1	0	6	11
Test Units (1976)	0	0	0	5	5
Block Excavation Units (1978)	6	0	0	16	22
Total Units Excavated	13	4	10	42	69
% of Sampling Strata Excavated	81%	25%	23%	13%	17½%

Note: Inclusion of 1975 excavation units is limited to two 1x2 m units which were the only units excavated below Level 1.

cultural materials from all levels (Table 10) in order to be better able to elucidate human use patterns over time.

The block area consisted of twenty-two 1 x 1 m units (Figure 8). Unfortunately, the block area was not completely excavated before the end of the field season. All 22 units were excavated to the bottom of Level 8. Only nine units in the western half of the block, however, were dug to culturally sterile soil at Level 12.

All of the excavations at the Flanagan site in 1976 and 1978 were carried out in 1x1 m units, corresponding to the X/Y grid established in 1975. During laboratory analysis, the more lengthy grid numbering

TABLE 6. Artifacts recovered during 1975 excavations.

Artifact Class	Excavation Level 1	2	3	Totals
Chipped Stone Industry				
Projectile Points				
SS1	1			1
SS2	1		1	2
SS3	1			1
NN2	18			18
NN3	2	1		3
NN Unident.	4			4
Fragments	6			6
Knife	1			1
Drills	5			5
Bifaces	2			2
Used Flakes	15	1		16
Cores	4		1	5
Flakes:				
Chert	1986	76	64	2126
Obsidian	1313	38	36	1387
Manuport	1			1
Cobble Tool Industry				
Hammer	1			1
Choppers	3	1		4
Cobble Flake Knife		1		1
Cobble Flake Scraper		1		1
Used Cobble Flakes	28	1	1	30
Cores	4	1		5
Flakes (Basalt)	886	21	13	920
TOTALS	4282	142	116	4530

TABLE 7. Artifact inventory from 1975 test unit (KL/LL).

	Excavation Level											
Artifact Class	1	2	3	4	5	6	7	8	9	10	11	Total
<u>Chipped Stone Industry</u>												
Projectile Points:												
NN2			1		1							2
NN3			2									2
MB series						1						1
Fragments		1				1						2
Knife					1							1
Bifaces			1		2							3
Used Flakes		2	8		2	1		1	2		1	17
Cores				2				1	1		2	6
Flakes:												
Chert	45	33	29	28	28	49	16	15	25	25	22	315
Obsidian	19	29	21	22	10	12	1	2	3	1	8	128
<u>Cobble Tool Industry</u>												
Hammer				1								1
Chopper			1									1
Cobble Flake Scraper			1									1
Used Cobble Flakes	2	5	2		1	1	1			2	2	16
Flakes (Basalt)	22	17	9	9	10	8	2	1	4	4	3	89
Pestle										1		1
TOTALS	88	87	75	62	65	73	20	20	35	33	38	586

system was translated into a letter code which was used for designating the excavated units and cataloguing the artifacts (Figure F-1). Because of the lack of easily discernible stratigraphy, vertical control was maintained by digging in arbitrary 10 cm levels. The cultural deposit was removed with shovels and trowels and passed

TABLE 8. Artifacts recovered from 1976 random sample.

	Excavation Level											
Artifact Class	1	2	3	4	5	6	7	8	9	10	11	Total
Chipped Stone Industry												
Projectile Points:												
SS1	1	1		2		1	1					6
SS2	3			3			1					7
NN2	4	5	6	6	2	1	2					26
NN3	1	1	1	3				1				7
NN Unident.			2									2
MB/HB1		1										1
MB2	1							1				2
MB3		1					1					2
HB2			1		1	1		1		2		6
HB3					1							1
HB Unident.											1	1
HS 3						2		1				3
Fragments	3	3	2	2		3		1				14
Knives		3										3
Drill		1										1
Bifaces	1	5	7	1		1						15
Flake Scrapers	1	1	1	1			1					5
Flake Knives	2	3	1			1			1			8
Gravers	1	1	3		1		4		2	2		14
Spokeshaves			1			1	1					3
Used Flakes	16	11	10	7	9	7	5	7	5	2	2	81
Cores		2	1	2	2	5	5	3	3	1	3	27
Flakes:												
Chert	540	507	390	320	221	178	271	194	129	68	37	2856
Obsidian	271	201	137	90	58	32	41	34	21	12	11	908
Manuport						1						1
Cobble Tool Industry												
Hammers						1		1				2
Choppers			2	8	3	6	3	2		3		27
Cobble Flake Knives	2	3	2		1	1		1				10
Cobble Flake Scrapers	1		2			2		2				7
Cobble Flake Gravers	1	1			2							4
Cobble Flake Spokeshaves			1	1				1				3
Used Cobble Flakes	10	16	10	5	11	6	5	3	3	5		74
Cores	1			1	2		1					5
Flakes (Basalt)	176	218	167	101	58	36	40	32	11	8	8	855
Mortar						1			1			2
TOTALS	1036	985	747	553	372	288	381	285	176	103	62	4988

TABLE 9. Artifacts recovered from 1976 non-random sample.

Artifact Class	1	2	3	4	5	6	7	8	9	10	11	12	Total
	Excavation Level												
<u>Chipped Stone Industry</u>													
Projectile Points:													
SS1	1												1
SS2		2	1										3
NN2	6	4	4	4			1	2	1				22
NN3		2	1										3
NN Unident.	3				1	1							5
MB2								1					1
MB Unident.			1										1
HB2		1											1
HS3					1								1
Fragments		2	2	2	1								7
Drill	1												1
Bifaces	1	1	1	3				1	1		2		10
Flake Knives	1			1			1						3
Flake Scrapers			1				2						3
Gravers	2	2	1	1			1						7
Spokeshaves		1	1				1						3
Used Flakes	6	15	4	7	9	7	3	6	4		2	2	65
Cores	1	3	1	2	2	1	5	1	3		3	1	23
Flakes:													
Chert	228	299	192	146	163	137	141	104	69	30	27	7	1543
Obsidian	99	103	80	69	54	35	33	24	9	5	8		519
<u>Cobble Tool Industry</u>													
Hammers				1		1							2
Choppers	1	1	7	2	3	2	3	1	1				21
Cobble Flake Knives	2	1	1			1		1					6
Cobble Flake Biface										1			1
Cobble Flake Scraper		1		1		1	1						4
Cobble Flake Graver		1											1
Used Cobble Flakes	10	13	11	5	10	4	5	2	1	1	1	1	64
Cores	1	2			1								4
Flakes (Basalt)	113	132	87	61	64	33	23	18	7	2	4	2	546
Mortar										1			1
Pestle											1		1
TOTALS	476	586	396	305	309	223	220	161	96	40	48	13	1873

TABLE 10. Inventory of artifacts from the 1978 block excavation.

	Excavation Level												
Artifact Class	1	2	3	4	5	6	7	8	9	10	11	12	Total
Chipped Stone Industry													
Projectile Points:													
SS1	2	2	1		1								6
SS2		1	1	3			2						7
NN2	6	17	5	6	4	5	1		1				45
NN3		1	2	3	2		1						9
NN Unident.	1	2	2		1		1						7
MB/HB1										1			1
MB2						1					1		2
MB3							1	1					2
HB2								1			2	1	4
HB3										1			1
HS2								1					1
HS3						1			2				3
Fragments	3	8	6	7	2	3	2	2					33
Knives		2											2
Drills		1	1				1	1					4
Bifaces	1		1	1	2			1					6
Flake Scrapers			2			1		2					5
Flake Knives	1	3	1	1	1	1	2		1	1	1	1	14
Gravers	3	6	4	2	2	1	5	2	1	1			27
Spokeshaves		1	1	1	2	1		1	2				9
Used Flakes	7	27	23	13	13	10	15	13	4	7	5		137
Cores	5	19	14	9	10	15	20	12	5	2	6	3	120
Flakes:													
Chert	248	485	360	350	270	249	439	417	146	69	79	27	3139
Obsidian	139	258	221	172	119	70	73	84	26	15	10	5	1192
Manuports			2						1			1	4
Cobble Tool Industry													
Hammers			1	3	1	1		1		1	1		9
Choppers			6	4	12	7	3	14	2			1	49
Cobble Flake Knives		1	2	1	2	2	1	2		1	1		13
Cobble Flake Bifaces					1			1	1				3
Cobble Flake Scrapers		1	2	2				1			2	1	9
Cobble Flake Gravers		1	4							1		1	7

TABLE 10 (continued)

Artifact Class	Excavation Level 1	2	3	4	5	6	7	8	9	10	11	12	Total
Used Cobble Flakes	6	5	7	6	4	5	4	7	3		2	2	51
Cores			2	2		1	1	1					7
Flakes (Basalt)	136	270	215	252	162	131	131	137	70	39	34	1	1578
Mortars							1	1					2
Pestles						2		1	1		1		5
Milling Stones					1				1				2
Cobble Celt									1				1
Edge-Ground Cobble									1				1
Abraders					1	1			1				3
TOTALS	558	1111	886	838	613	508	704	704	270	139	145	44	6520

Note: All 22 units in the block area were excavated to the bottom of Level 8; nine were excavated to the bottom of Level 12.

through 1/4-inch mesh screen. All whole and fractured rocks were left in place to be mapped and then removed at the completion of each block level. All rock fill was then weighed for each unit/level and discarded. At the completion of the excavations, stratigraphic profiles of the exposed walls were drawn and described. Soil samples were also collected for subsequent laboratory analysis.

Description of the Deposit

The soils of the Winkle geomorphic surface on which the Flanagan site is located are Pachic Ultic Argixerolls (Balster and Parsons 1968:14, 28). In their upper levels these soils are very dark brown silty loam and in depth they grow lighter in color and more clayey, finally ending in a gravel bar several feet thick. The site itself is situated on a soil referred to by the Soil Conservation Service as Bashaw Clay (Soil 60A), which as the name indicates has a high clay content and is very poorly drained.

The sediments at the Flanagan site were moist and very compact and, during the excavations, appeared to be homogeneous in color and texture. However, once allowed to dry three basic strata were discernible in the exposed walls of the excavation units (Figure 9).

Stratum 1, the upper layer of the cultural deposit, is a dark brown clay loam. In the levels immediately below the ground surface. bisque is scarce (Stratum 1a). The lower levels of this stratigraphic unit, however, are flecked with bisque (Stratum 1b).

Stratum 2, the lower layer of the cultural deposit, is a gray clay loam. This stratum is also flecked with bisque.

Stratum 3, which underlies the cultural deposit, is also a gray clay loam. This stratum is distinguished from the overlying cultural deposit in Stratum 2 by its greater compactness, slightly lighter color, and by an absence of evidence of aboriginal occupation.

Artifacts and cultural features occur throughout Strata 1 and 2. In addition, small pieces of light-orange fired clay, locally referred to as "bisque," occur in the lower portion of Stratum 1 and throughout Stratum 2. This material is ubiquitous in archaeological sites in the Willamette Valley and is thought to be the result of the firing of midden soil in association with aboriginal hearths or ovens (Sanford 1975:237).

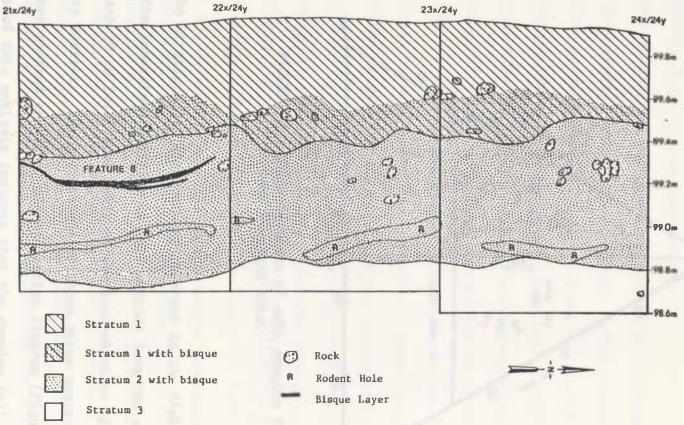


FIGURE 9. Stratigraphic profile of west wall of block excavation area at the Flanagan site.

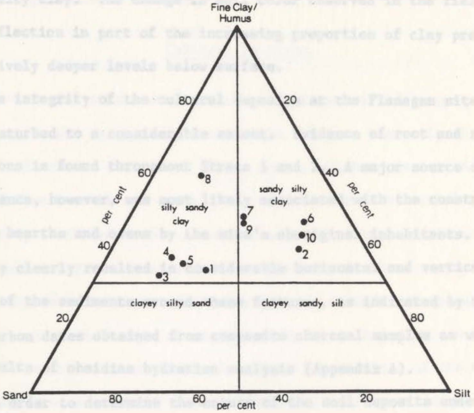


FIGURE 10. Classification of soil samples from the Flanagan site.

The stratigraphic distinctions observed in the field also showed up in the laboratory analysis of soil samples from the site. Samples from each 10 cm level were analyzed for determination of sand, silt, and clay content. The proportions of these three grain-size fractions were then plotted on a soil classification diagram (Figure 10). The results of this analysis indicate that the samples fall into two closely-related grain-size categories. With only one exception, soil samples from the upper levels of the deposit are identified as silty sandy clay, while soil samples from the lower levels are identified as sandy silty clay. The change in soil color observed in the field may be a reflection in part of the increasing proportion of clay present at successively deeper levels below surface.

The integrity of the cultural deposits at the Flanagan site has been disturbed to a considerable extent. Evidence of root and rodent intrusions is found throughout Strata 1 and 2. A major source of disturbance, however, was most likely associated with the construction of fire hearths and ovens by the site's aboriginal inhabitants. This activity clearly resulted in considerable horizontal and vertical mixing of the sediments around these features, as indicated by the radiocarbon dates obtained from composite charcoal samples as well as the results of obsidian hydration analysis (Appendix A).

In order to determine the nature of the soil deposits underlying the aboriginal occupation, an auger hole was excavated at the bottom of the floor of the lowest units in the block excavation area where Stratum 3 was exposed. The auger hole began at a depth of approximately 130 cm below surface. Several changes were noted in the color and texture of the clay at various intervals, but no further evidence of aboriginal occupation was encountered. At approximately 280 cm below surface, water was encountered within a matrix of yellow sandy clay containing water-worn basalt pebbles. This layer presumably corresponds with the gravel bar which underlies the Winkle Unit (Balster and Parsons 1968:14, 28). A gravel deposit, presumably related to the gravel bar underlying the Flanagan site, is exposed in the banks of Flat Creek approximately 200 m south of the site. This gravel deposit probably served as a source of raw lithic material for the site's prehistoric inhabitants.

Cultural Features

The cultural strata at the Flanagan site contained large quantities of whole and fragmentary rocks which had been thermally-altered as a result of contact with fire. These rocks, which represent the remains of fire hearths and camas ovens made by the site's inhabitants, were widely distributed throughout the cultural deposits. In seven cases, however, rocks encountered during the excavations occurred in obvious concentrations warranting designation as cultural features. The only other evidence of aboriginal occupation designated as a cultural feature was a small shallow pit. Descriptions of the eight cultural features recorded at the Flanagan site are provided below and are summarized in Table 11.

Feature 1

A shallow pit was encountered in one of the units (TI) on the southern margin of the site excavated during the 1976 field season. This pit, which varied between 30-40 cm in diameter, began at 42 cm and ended at 65 cm below surface. The pit fill, which consisted of dark brown silty clay containing bisque and charcoal, was clearly distinguishable from the surrounding compact gray clay. The contents of the pit included a few flakes, a few pieces of fire-cracked rock, and a 20 cm-long piece of decaying wood. The only tools recovered from the levels around this pit were one graver and two used cobble flakes. In view of the presence of wood, it seems possible that this pit represents a posthole dug by the site's aboriginal inhabitants. Charcoal from this feature produced a date of 1720 ± 100 radiocarbon years: A.D. 230 (GaK-8371). This date is consistent with the finding of two narrow-necked projectile points (1 NN2 and 1 NN3) in the levels above the feature.

Feature 2

A dispersed cluster of whole and fragmentary thermally-altered cobbles with scattered charcoal was encountered in the eastern portion of the site (Units JF, JG, KF, KG) during the 1976 season. The cobbles covered an area 85 cm by 137 cm and extended from 16–33 cm below surface. A large number of artifacts were recovered in the levels around this feature. Chipped stone tools included three projectile points (1 SS1, 1 HB2, and 1 MB series), one flake knife, two bifaces, a graver, a core, and four used flakes. Cobble tools included one chopper, one cobble flake knife and five used cobble flakes. This feature remains undated.

Feature 3

A more concentrated and at the same time more extensive cluster of whole and fragmentary thermally-altered cobbles was encountered in the western portion of the site (Units IP, IR, HO, HP, GO, GP) during the 1976 season. The cobbles covered an area 140 cm by 170 cm and were situated 25–40 cm below the surface. A very large number of artifacts as well as bone pieces were recovered in the levels around this feature. These included seven projectile points (1 SS2, 5 NN2, 1 NN3)

TABLE 11. Summary of recorded features.

Feature Number	Description	Units	Depth Below Surface	Horizontal Extent	Radiocarbon Date	Projectile Points	Associated Artifacts: Chipped Stone	Associated Artifacts: Cobble Tools
1	pit (posthole?)	TI	42-65 cm	30 x 40 cm	1720 ± 100 (A.D. 230) (Level 5)	1 NN2 1 NN3		
2	rock hearth	KF JF KG JG	16-33 cm	137 x 85 cm	undated	1 SS1 1 MB 1 HB2	1 flake knife 2 bifaces 1 graver 1 core 4 used flakes	1 chopper 1 cobble flake knife 5 used cobble flakes
3	rock hearth	GO GP HO HP IO IP	25-40 cm	140 x 170 cm	460 ± 80 (A.D. 1490) (Levels 3-4)	1 SS2 5 NN2 1 NN3	4 bifaces 1 graver 8 used flakes 2 cores 1 point fragment	5 choppers 1 hammer 2 cobble flake knives 1 cobble flake scraper 6 used cobble flakes
4	rock hearth	KF JF KG JG	35-50 cm	130 x 95 cm	undated	1 NN2	1 point fragment 1 knife 3 used flakes	4 choppers 1 cobble flake graver 10 used cobble flakes
5	rock hearth	JD KD JE KE	55-70 cm	108 x 90 cm	3300 ± 220 (1350 B.C.) (Level 6)	none	1 graver 1 used flake	2 choppers 1 hammer 1 hammer/chopper 1 cobble flake knife 1 cobble flake scraper 2 used cobble flakes
6	rock hearth	BJ CI CJ	12-30 cm	103 x 123 cm	undated	2 NN2	1 point fragment 1 spokeshave 1 core 6 used flakes	3 used cobble flakes
7	camas oven	HI II HJ IJ	30-70 cm	200 x 150+ cm	3230 ± 150 (1280 B.C.) (Level 6)	1 SS2 3 NN 1 NN2 1 NN3 1 MB2	4 point fragments 1 biface 1 flake knife 4 gravers 4 used flakes 8 cores	5 choppers 2 pestle fragments 1 used cobble flake
8	rock hearth	IN	50-70 cm	95 x 50+ cm	960 ± 100 (A.D. 990) (Level 7)	none	1 drill 1 used flake	1 used cobble flake

and one point fragment. Other chipped stone tools included four bifaces, one graver, eight used flakes, and two cores. Cobble tools included one hammer, five choppers, two cobble flake knives, a cobble flake scraper, and six used cobble flakes. A sample composed of charcoal pieces recovered from levels 3 and 4 within this feature produced a date of 460 ± 80 radiocarbon years: A.D. 1490 (GaK-6574).

Feature 4

This relatively tight concentration of thermally-altered cobbles was situated below Feature 2 (Units JF, JG, KF, KG). It covered a 130 cm by 95 cm area, and extended between 35-50 cm below the surface. Chipped stone artifacts recovered from levels around this feature included one classifiable projectile point (NN2), one projectile point fragment, one knife, and three used flakes. Cobble tools included four choppers, one cobble flake graver, and ten used cobble flakes. This feature remains undated.

Feature 5

This tight concentration of thermally-altered cobbles was situated below and about one meter to the east of Features 2 and 4 (Units JD, JE, KD, KE). Feature 5 covered a 90 by 108 cm area, and extended from 55-70 cm below the surface. Chipped stone artifacts recovered from levels around this feature included one graver and one used flake. Cobble tools included one hammer, two choppers, one hammer/chopper, one cobble flake knife, one cobble flake scraper, and two used cobble flakes. Charcoal recovered from Feature 5 produced a date of 3300 ±

220 radiocarbon years: 1350 B.C. (GaK-8369).

Feature 6

This concentration of thermally-altered cobbles was discovered in the northern portion of the site (Units BJ, CJ, CI) during the 1976 season. It covered a 103 cm by 123 cm area, and extended from 12 cm to 30 cm below surface. Chipped stones recovered from the levels around this feature included two projectile points (both NN2), one point fragment, one spokeshave, one core, and six used flakes. Cobble tools included three used cobble flakes. This feature remains undated.

Feature 7

A very large and deep concentration of thermally-altered cobbles was encountered in the central portion of the site (Units HI, HJ, II, IJ) during the 1978 season. This feature, a cross-section of which was exposed in the east wall of the block area, was only partially uncovered and extends farther east into an unexcavated area of the site. This cobble concentration first emerged between 30-40 cm below surface and continued to 60-70 cm below surface. The maximum horizontal extent of this feature occurred between 50-60 cm where it covered a 150 cm by 200 cm area. The feature's greatest density also occurred in Level 6 where over 400 pounds of fire-cracked rock were recovered from a single unit/level. The portion of the feature excavated in the block area was composed of approximately 1500 pounds of cobbles, making it one of the largest, if not the largest, camas ovens excavated to date in the Willamette Valley. The extensive nature of the oven greatly over-

TABLE 12. Weight of non-artifactual rock by excavation level for the 1978 block excavations.

Excavation Level	Weight in Pounds
Surface	7.20
1	119.75
2	255.00
3	325.75
4	589.50
5	870.50
6	1274.50
7	325.50
8	324.75
9 *	98.50
10 *	34.00
11 *	26.75
12 *	14.50
Total Rock, 1978	4266.20

* Levels 9-12 included only a 3x3 m area, constituting 41% of the block area.

shadowed the other features recorded during the 1978 excavations, as indicated by the distribution of fire-cracked rock for the entire block area, which primarily mirrors the distribution of rock from Feature 7 (Table 12).

Chipped stone tools recovered from the levels around Feature 7 included seven projectile points (1 SS2, 1 NN2, 1 NN3, 3 NN series, and 1 MB2), four point fragments, one biface, one flake knife, four gravers, four used flakes, and eight cores. Cobble tools included two pestle fragments, five choppers, and one used cobble flake.

Considering the size and nature of this feature, it seems reasonable to interpret it as a camas baking oven. A few charred bulbs, identified mostly as wild onion (Allium sp.) but possibly also including some camas, were retrieved from Feature 7. Charcoal obtained from Level 6 within Feature 7 produced a date of 3230 ± 150 radiocarbon years: 1280 B.C. (GaK-8368).

A small fire hearth was encountered in the southwest corner of the block area (Unit IN) during the 1978 season. The hearth consisted of a concentration of thermally-altered cobbles less than 20 cm in thickness occupying an area less than one meter in diameter. This feature was situated between 50-70 cm below surface. An increase in charcoal flecks was noted in the deposit around this feature. A thin but distinct layer of fired clay was observed underlying the hearth; this layer was clearly evident in the western wall of the block excavation after the rocks were removed. The only artifacts recovered in the levels around this feature were one drill, one used flake, and one used cobble flake. In the absence of well-preserved charcoal chunks, a composite sample of numerous charcoal bits was collected from Level 7 in the unit containing this feature. This sample yielded a date of 960 ± 100 radiocarbon years: A.D. 990 (GaK-8364).

CHAPTER IV

DESCRIPTION OF ARTIFACTS

The artifact collection from the Flanagan site consists entirely of stone tools and debitage, as no artifacts made from other materials (e.g., bone, antler, wood, clay or historic materials) were recovered. Classification and description of the artifact collection involved the recognition of increasingly more specific artifact sets, referred to here as industries, series, classes, and types (Table 13).

Classification began by recognizing that the tools in the collection represented two major categories: the Chipped Stone and Cobble Tool Industries. These industries are most easily delineated on the basis of raw materials, variations in which are interpreted to have functional implications. The Chipped Stone Industry is composed primarily of artifacts made of glassy or finer-grained lithic materials such as obsidian and various cryptocrystalline silicas, while the artifacts in the Cobble Tool Industry are made of coarser-grained lithic materials, primarily basalts.

The tools within the Chipped Stone and Cobble Tools Industries were then assigned on technological grounds to different series; for example the bifacial series within the Chipped Stone Industry or the pecked and ground series within the Cobble Tool Industry. Within each series, the basic artifact category is the class. Classes are

TABLE 13. Inventory of artifacts from the Flanagan Site.

		Excavation Level												
Artifact Class	Surface	1	2	3	4	5	6	7	8	9	10	11	12	Total
CHIPPED STONE INDUSTRY														
Bifacial Series														
Projectile Points:														
SS1		5	3	1	2	1	1	1						14
SS2	1	4	3	2	6			3						19
SS3		1												1
NN2	4	32	27	16	16	8	6	4	2	2				117
NN3		3	4	6	6	2		1	1					23
NN Unident.		7	2	4		2	1	1						17
MB/HB1			1								1			2
MB2		1					1		2			1		5
MB3			1					2	1					4
MB Unident.				1			1							2
HB2			1	1		1	1		2		2	2	1	11
HB3						1					1			2
HB Unident.												1		1
HS2									1					1
HS3						1	3		1	2				7
Fragments		6	14	10	11	3	7	2	3					56
Knives			5			1								6
Drills		6	2	1				1	1					11
Bifaces		5	6	10	4	4	1		2	1		2		35
Marginally Modified Series														
Flake Knives		4	6	2	2	1	2	3		2	1	1	1	25
Flake Scrapers		1	1	4	1		1	3	2					13
Gravers	1	6	9	8	3	3	1	10	2	3	3			49
Spokeshaves			2	3	1	2	2	2	1	2				15
Used Flakes	13	44	56	45	27	33	25	23	27	15	9	10	2	329
Core and Flake Series														
Cores:														
Chert	3	6	15	10	15	11	17	25	14	10	3	13	3	145
Obsidian	1	4	9	7		3	4	5	3	2		1	1	40
Flakes:														
Chert	205	3047	1400	1035	844	682	613	867	730	369	192	165	40	10,189
Obsidian	108	1841	629	495	353	241	149	148	144	59	33	37	8	4245
Manuports (Chert)		1		2			1			1			1	6
COBBLE TOOL INDUSTRY														
Unmodified Series														
Hammers	1	1		1	5	1	3		2		1	1		16

TABLE 13 (continued)

Artifact Class							Excavation Level							
	Surface	1	2	3	4	5	6	7	8	9	10	11	12	Total
COBBLE TOOL INDUSTRY (continued)														
<u>Flaked Series</u>														
Choppers	5	4	2	16	14	18	15	9	17	3	3		1	107
Cobble Flake Knives		4	6	5	1	3	4	1	4		1	1		30
Cobble Flake Bifaces						1			1	1	1			4
Cobble Flake Scrapers		1	3	5	3		3	1	3			2	1	22
Cobble Flake Gravers		1	3	4		2					1		1	12
Cobble Flake Spoke-shaves				1	1				1					3
Used Cobble Flakes	7	56	40	31	16	26	16	15	12	7	8	5	3	242
<u>Core and Flake Series</u>														
Basalt Cores	2	6	3	2	3	3	1	2	1					23
Basalt Flakes	139	1333	658	491	423	294	208	196	188	92	53	49	5	4129
<u>Pecked and Ground Series</u>														
Mortars							1	1	1	1	1			5
Pestles							2		1	1	1	2		7
Milling Stones						1				1				2
Cobble Celt										1				1
Edge-ground Cobble										1				1
<u>Abrader Series</u>														
Basalt Abraders						1				1				2
Sandstone Abraders		1					1							2

generally distinguished from one another on functional grounds. Commonly used terms, such as projectile point, knife, scraper, etc., are employed here to reflect the assumed function of various artifacts, but with the understanding that the actual function of each individual specimen may not be fully delimited by any one particular term.

Finally, when an artifact class was considered to include significant variation, the specimens within it were further distinguished as separate types. The only artifact class in the Flanagan site collection which exhibited such variation was the projectile point class.

An inventory of all of the artifact classes, their frequency, and their vertical distribution is presented in Table 13.

Chipped Stone Industry

The glassy obsidian and fine-grained cryptocrystalline silicas almost solely used for the making of artifacts in the Chipped Stone Industry are easily-worked lithic materials which were highly suitable for the manufacture of the small, delicate tools characteristic of this industry. These artifacts were fashioned by careful percussion flaking; many were further refined by detailed percussion flaking as well. Only a few artifacts made of basalt, all of which are projectile points, exhibit a similar degree of workmanship and have been included within the Chipped Stone Industry.

Cryptocrystalline silica materials found at the Flanagan site primarily consist of various grades of chert, chalcedony, and jasper; quartzite and petrified wood are also present in very low frequencies. Because of the difficulty of distinguishing these materials, and considering that there is no discernible difference in the way in which they were used by native peoples, all of the cryptocrystalline silica materials are considered together in this study under the generic term chert.

Most of the chert was apparently obtained in the form of pebbles from nearby streambeds, as many of the cores and flakes recovered at the site exhibited waterworn cortex. The use of pebble-size raw materials is also reflected in the small size of most of the cores and debitage recovered. The closest source may well have been a gravel deposit exposed in the banks of a creek approximately 200 m south of the site. Outcroppings of chert are also known to exist in the foothills of the Cascade Range to the east and probably occur in the Coast Range to the west as well.

The obsidian represented at the Flanagan site occurs exclusively in the form of water-worn pebbles. Obsidian pebbles which originate from sources in the Cascade Range are available in the gravels of the McKenzie River to the east. Obsidian pebbles also occur in streams draining into the Long Tom River from the Coast Range to the west. A sample of obsidian artifacts from the Flanagan site was submitted for source identification through x-ray fluorescence analysis. The results indicate that obsidian from both of these sources is represented at the Flanagan site (Appendix B).

Bifacial Series

Projectile Points

This is a traditional artifact class composed of symmetrical pointed bifaces with a sharp tip and a low edge angle on blade edges. Preparation for hafting is obvious in most cases. Because projectile points underwent technological changes over time, they are particularly useful as time markers in the archaeological record. For this reason, the projectile points from the Flanagan site were subjected to intensive analysis with the goal of developing a typology that was meaningful in a temporal sense. The classification of the projectile points from the Flanagan site is described in detail in the following chapter.

Knives

This class consists of well-made bifaces with well-defined working edges formed by careful percussion or pressure flaking. They are generally larger and/or thicker than artifacts classified as projectile points (Figure 11a-b).

Drills

This class includes tools that are characterized by a narrow, bifacially-flaked distal tip projecting from a broader proximal base (Figure 11c-e).

Bifaces

This class consists of bifacially-worked pieces without well-defined working edges and/or areas of use-wear on edges or faces. They tend to be thick and somewhat irregular in outline and frequently have obvious flaws in the lithic material which resulted in their never being completed.

Marginally Modified Series

Flake Knives

These tools have low-angled retouched edges, usually unifacially but sometimes bifacially flaked, which are generally straight or slightly convex in outline (Figure 11f).

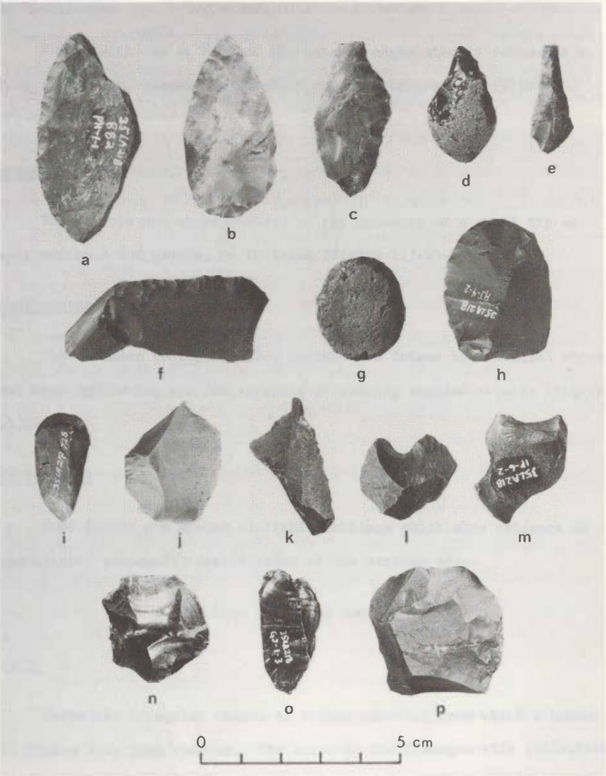


FIGURE 11. Artifacts from the Chipped Stone Industry at the Flanagan site: a-b, knives; c-e, drills; f, flake knife; g-i, flake scrapers; j-k, gravers; l-m, spokeshaves; n-p, cores.

Flake Scrapers

Flakes with one or both of the lateral edges steeply retouched to form a straight, convex, or slightly concave working edge (Figure 11g-i).

Gravers

These tools are characterized by the presence of a small tip or spur suitable for graving or incising (Figure 11j-k).

Spokeshaves

These flakes feature shallow concavities formed by unifacial shear and wear indicating use for scraping or shaving rounded objects (Figure 11,1-m).

Used Flakes

Used flakes are pieces of lithic debitage which show evidence of use without purposeful modification of the working edge.

Core and Flake Series

Cores

Cores are irregular chunks of lithic material from which a number of flakes have been removed. The cores in the Flanagan site collection differ somewhat in their characteristics and the way in which they were used by the site's inhabitants.

With only one exception, the chert cores are all in the pebble size range (less than 6.4 cm in length). The collection includes cores which were reduced by direct free-hand percussion as well as cores which were reduced by the bipolar method. While it is possible to distinguish examples of both kinds of cores, the majority of the specimens in the collection intergrade in terms of size and appearance and may have been reduced by either method. In view of this situation, no attempt has been made to establish the frequency of one kind of core versus the other. It appears, however, that the bipolar method was the preferred mode for the reduction of chert cores at the Flanagan site.

Likewise, the obsidian cores are also all within the pebble size range. Many of these specimens have been split in half and thus can provide reliable measurements on the original size of the pebbles. The majority of these fragments indicate the use of pebbles with a maximum size of 3-5 cm. Considering the small size of these pebbles and the nature of the fracture patterns, it can be said with reasonable assurance that the bipolar method was the exclusive mode of reduction for the obsidian cores at the Flanagan site.

Flakes

The residual material left over from the manufacture of stone tools consists of flakes or lithic debitage. The specimens in this class exhibit no evidence of modification or use as tools.

Manuports

Unmodified nodules of raw lithic material which have not been modified or used as tools fall into this class. Since these materials do not naturally occur at the site, they were presumably carried in for the purpose of stone tool manufacture. All six of the manuports are chert cobbles.

Cobble Tool Industry

As the name implies, the artifacts in the Cobble Tool Industry were made from flakes or nuclei obtained originally in the form of small- to medium-sized cobbles. Some of these cobbles were used without modification (e.g., as hammers), but most were modified for use either by flaking or by pecking, grinding, or abrasion. The flaked cobble tools in all cases have been crudely modified by the percussion method. These tools thus tend to be relatively large in size and crudely made, and were presumably used for somewhat different or at least heavier-duty tasks than their counterparts in the Chipped Stone Industry.

With the exception of two sandstone cobbles used as abraders, all of the artifacts in the Cobble Tool Industry were made of various grades of basalt. As was the case with the other lithic materials represented, basalt cobbles were available in nearby stream gravels. The inhabitants of the Flanagan site preferred cobbles composed of light grey basalt for making into choppers and some of the other heavy cobble tools, while a distinctive fine-grained black basalt was most commonly made into cobble flake tools. This high quality black basalt appears to correspond with material of a similar description which was widely used at the Hurd site on the McKenzie River near Coburg, Oregon

(White 1975b:171). Vesicular basalt is also represented in low frequency at the Flanagan site, where it was used exclusively in the making of tools in the Pecked and Ground Series. This material was presumably also obtained from nearby stream gravels.

Unmodified Series

Hammers

These tools are large pebbles or small cobbles which exhibit light to heavy pecking on an end or side (Figure 12a).

Flaked Series

Choppers

Choppers include cobbles which exhibit a chopping edge created by the removal of one or more flakes from an end or side (Figure 12b-c).

Cobble Flake Knives

These tools are large flakes struck from a cobble which exhibit low-angled retouched edges suitable for cutting (Figure 13a-b).

Cobble Flake Bifaces

These bifaces are large flakes struck from cobbles which have been bifacially worked but which lack well-defined working edges. The workmanship on these specimens is generally crude, and it is questionable as to whether they were ever actually used as tools.

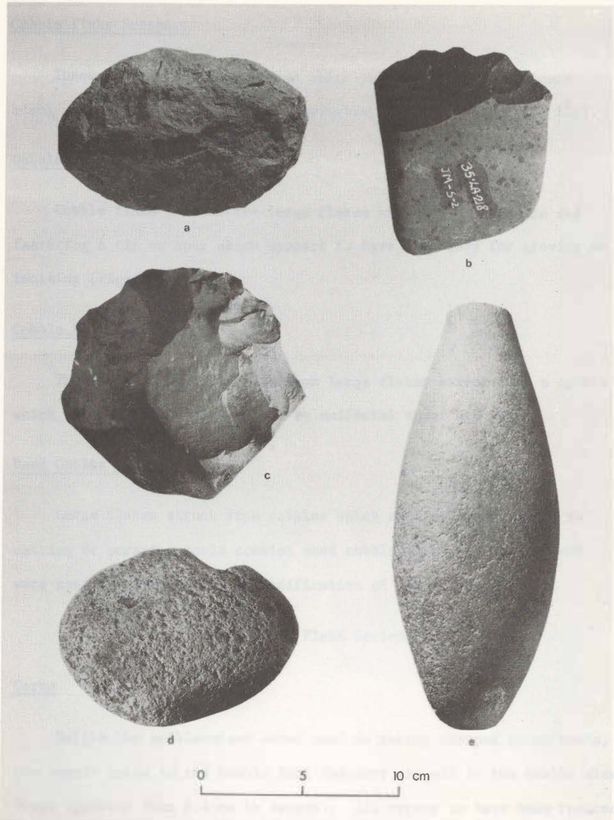


FIGURE 12. Miscellaneous artifacts from the Cobble Tool Industry at the Flanagan site: a, hammer; b-c, choppers; d, edge-ground cobble; e, cobble celt.

Cobble Flake Scrapers

These are large cobble flakes which exhibit unifacial retouch along a steep-angled working edge suitable for scraping (Figure 13c).

Cobble Flake Gravers

Cobble flake gravers are large flakes struck from a cobble and featuring a tip or spur which appears to have been used for graving or incising (Figure 13d).

Cobble Flake Spokeshaves

These spokeshaves are made from large flakes struck from a cobble which feature concavities formed by unifacial shear and wear.

Used Cobble Flakes

Large flakes struck from cobbles which show evidence of use as cutting or scraping tools consist used cobble flakes. These flakes were used without purposeful modification of the working edge.

Core and Flake Series

Cores

Unlike the pebble-sized cores used in making chipped stone tools, the basalt cores in the Cobble Tool Industry are all in the cobble size range (greater than 6.4 cm in length). All appear to have been reduced by direct free-hand percussion.

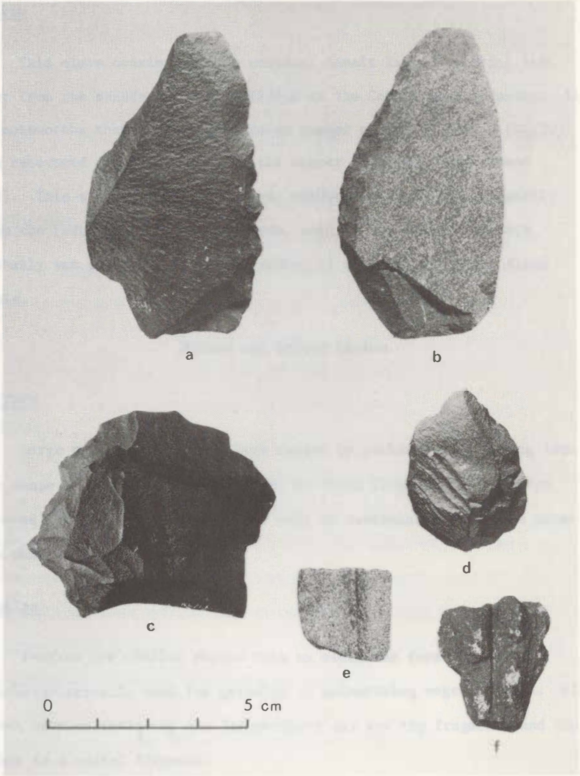


FIGURE 13. Artifacts from the Flaked Series and the Abrader Series in the Cobble Tool Industry from the Flanagan site: a-b, cobble flake knives; c, cobble flake scraper; d, cobble flake graver; e-f, abraders.

Flakes

This class consists of the residual basalt lithic material left over from the manufacture of artifacts in the Cobble Tool Industry. It is noteworthy that a relatively large number of basalt flakes (4,129) was recovered in comparison with the number of basalt cores found (23). This situation suggests that, rather than resulting primarily from the reduction of prepared cores, much of the basalt debitage probably was produced during the making of choppers and heavy flake tools.

Pecked and Ground Series

Mortars

Large cobbles which have been formed by pecking and grinding into the shape of a bowl. Fragments from at least five mortars were recovered. Four of the mortars were made of vesicular basalt; the other was made from vitreous basalt.

Pestles

Pestles are cobbles shaped into an elongated form which were characteristically used for grinding or pulverizing vegetal foods. All seven pestles recovered are fragmentary; six are tip fragments and the other is a medial fragment.

Milling Stones

These cobbles exhibit grinding wear on flat surfaces. Both specimens in this class are both made of vesicular basalt.

Cobble Celt

The single specimen is a large, elongate, rounded cobble with one end ground into a narrow bit and the other used as a hammer (Figure 12e).

Edge-ground Cobble

The single specimen is an ovoid water-worn cobble featuring a smoothly-ground facet along one edge (Figure 12d).

Abrader Series

Abraders

Abraders are tools which exhibit signs of abrasive wear indicating use for grinding, polishing, or sharpening other tools, such as implements made of wood, bone or antler. Of the four abraders recovered, two are of sandstone and two are of grainy basalt. The sandstone abraders both feature a grooved impression for smoothing shafts (Figure 13e-f). The basalt abraders exhibit evidence only of smoothing or polishing on rounded surfaces.

Characterization of Site Assemblage

The multi-phase program of investigations carried out over the three seasons of fieldwork produced a sizable artifact collection from which inferences concerning aboriginal use of the Flanagan site can be made. The vertical distribution of these artifacts within the cultural deposit are analyzed for chronological trends in Chapter 6. To conclude the present chapter, a few observations are offered on the function of the site as indicated by the range of artifacts and other archaeological remains represented.

The artifact assemblage contains a variety of artifact classes, a situation which suggests that a fairly wide range of activities was carried out at the Flanagan site. Among the most obvious of these activities were hunting, plant processing, wood working and hide scraping, and the manufacture of stone, and probably bone, tools. The fact that such a wide range of activities is in evidence suggests that the Flanagan site played an integral role in the yearly settlement-subsistence cycle of the aboriginal inhabitants of this area.

The high frequency of artifacts indicates rather intense use of the Flanagan site over most of the occupation span. The relatively small size of the site and its location on a low-lying section of the valley floor, however, suggest that this occupation was seasonal in nature. As indicated in the fieldnotes of the General Land Office surveyor, the area around the Flanagan site was very damp during the winter months (Ives 1853). Even after the implementation of flood control measures in historic times, conditions in the site area remain damp well into July. Use of the Flanagan site as a base camp during the warmer months of the late summer and fall thus seems indicated.

The conclusion that the Flanagan site was occupied during summer and fall is consistent with the seasonality of most of the plant macrofossils recovered (Appendix C). Processing of two plant foods known to have been staples of the Kalapuya Indians is in evidence at the site. Processing of acorns is indicated by both the recovery of charred acorn fragments and the presence of mortars and pestles which are generally associated with this activity. Likewise, harvesting and processing of camas are reflected in the recovery of some possible charred camas bulbs and, more importantly, by the presence of numerous fire-cracked rock features which conform to the description of camas ovens. Both acorns and camas processing were subsistence activities which primarily occurred in the late summer and fall (Zenk 1976:53-56; 60-61).

While not as reliable as a seasonal indicator, the small collection of faunal remains recovered from the Flanagan site also supports the idea of a late summer and fall occupation (Appendix D). Most of the faunal remains recovered seem to reflect the hunting of large mammals, especially deer, which would have been available in the site area more or less throughout the year. A few remains of waterfowl are also represented, however, and these birds would have been most available to the site's inhabitants during their migrations in the fall. The faunal remains from the site for the most part represent animals reported in the area at the time of historic contact. The only exceptions are the likely occurrence of bison in the earliest levels of the site (Appendix E), and the finding of a couple of elements from obviously introduced animals on or near the ground surface.

Many of the artifact classes represented at the Flanagan site appeared early in the occupation and continued to occur more or less throughout the occupation. Most of these are simple tools which involved little or no modification prior to use. The only artifacts from the Flanagan site which underwent demonstrable change over time are the projectile points. The typology developed for classifying these points is described in the following chapter. A discussion of the chronological patterning in the projectile points and other artifact classes represented at the Flanagan site is presented in Chapter VI.

CHAPTER V

PROJECTILE POINT CLASSIFICATION: A QUANTITATIVE APPROACH

One of the basic problems faced by archaeologists in reporting and interpreting projectile points recovered from sites and private collections in the Willamette Valley is that no typology has yet been explicitly defined which takes technological and functional factors into account and which is meaningful in a chronological sense. It is the intent of this chapter to present an easily applied, explicit typology for the classification of projectile points in the Upper Willamette Valley. The development of this typology, which is based on a limited number of attributes observed on points from the Flanagan site, is described in this chapter. The typology will be examined in the next chapter for its temporal sensitivity.

Existing Willamette Valley Point Typologies

One of the hindrances to the development of a meaningful projectile point typology has been the manner in which many of the Willamette Valley sites were excavated. A number of the sites investigated before 1975, which have produced some of the largest projectile point samples available, were excavated using highly variable field methods, so that the resulting provenience information is comparable in only a gross way. Several classes on statistical analysis in archaeology at the University of Oregon in the 1970s attempted classifications of projectile points from sites in the Willamette Valley, but the inexactness of the provenience data was a major source of frustration in attempting to validate the ordering of these collections in terms of site stratigraphy.

The published typologies for the Willamette Valley which emerged from this era of study (Sanford 1975; Henn, Mack and Sanford 1975; White 1975a) show a heavy emphasis on descriptive morphology mixed with an intuitive definition of point types. Types were most frequently defined on the basis of the presence or absence of various attributes based on dimensions such as size, blade outline, and hafting configuration. Once they were intuitively assembled into groups, points were often defined as types after the fact in an attempt to provide an "empirical" basis for their definition.

The typology which has subsequently been most used by archaeologists for reporting projectile points from the Willamette Valley is that devised by White (1975a). In this typology, which includes 16 major types and 26 subtypes, types are defined primarily on the basis of basic outline, with subtypes variously distinguished by size. Because consideration of the attributes of shape and size is not carried out in a systematic manner between types, the distinction between the earlier atlatl-and-dart and the later bow-and-arrow points is obscured. White, in fact, does not explicitly recognize that a reduction in size is a temporal trend; instead, large, thick projectile points were interpreted as indicative of large game hunting activities (White 1975a:43).

White assigned temporal significance to a number of his point types within the framework of his five-period cultural chronology for the Willamette Valley (White 1975a; 1979). The bases on which White defined his periods as well as the archaeological traits used to characterize them have been criticized on several grounds, however. Most of the traits listed as "commonly associated" with various periods are either items of rare occurrence or items which are known to occur in more than one period. In addition, the listing of a large number of traits which actually occur at only a few sites in one end of the valley effectively masks important differences in assemblages from different areas of the valley. Finally, White failed to be explicit in his rationale for choosing the dates used in defining the periods within the chronology (Minor and Toepel 1981:157ff).

In recognition of the shortcomings of White's chronology, a new system of periods and phases has recently been proposed for ordering archaeological manifestations in the Willamette Valley (Minor and Toepel 1981:161-176). In this theoretical framework, projectile points corresponding to these periods were grouped into three main subclasses —lanceolate, broad-necked and narrow-necked—with the understanding that further work was required in order to develop a more explicit and workable typology (Beckham et al. 1981:286). The projectile point assemblage from the Flanagan site, covering a documented 6,000-year span, provides a basis for developing such a typology.

Functional/Temporal Typological Approaches

Although previous approaches to projectile point classification in the Willamette Valley have generally followed the descriptive approach (e.g., after Binford 1963), studies focusing on the technological or functional aspects of projectile point attributes have been conducted elsewhere for at least the past 25 years. These studies are based on the assumption that dart tips will differ from arrow tips in one or more significant ways since the two technologies were very distinct. Such studies have included that of Fenega (1953), who concluded that gross weight is the single best indicator of the function of a projectile point; his study of 884 chipped stone points produced a bimodal pattern for weight which was interpreted to reflect the atlatl versus the bow-and-arrow technologies.

Others have focused on the hafting area (e.g., Forbis [1960] and Wyckoff [1964]) as the most important functional indicator, under the assumption that the larger dart shaft would be accompanied by a larger stone tip than the smaller arrow shaft. In a similar vein, Corliss (1972) used projectile point neck width as an operational indicator for the relative size of the hafting area. On the basis of a comparative study of 2712 specimens, larger points with neck widths of greater than 9 mm were interpreted as dart points while points with neck widths of 8 mm and less were considered arrow tips (Corliss 1972, Figure 3). Since the appearance of Corliss' study, archaeologists have begun to consider neck width as a major indicator for distinguishing dart from arrow points.

The first application of such a quantifiable functional attribute to the development of a regional point typology in the Pacific Northwest was undertaken for the Portland Basin area of the Lower Columbia

Valley by Pettigrew (1977, 1981). Pettigrew distinguished between broad- and narrow-necked points, defining the former as those points with neck widths of 8 mm and greater and the latter as those with neck widths of 7 mm or less (Pettigrew 1981:14). The remainder of his criteria, however, are based upon judgmental rather than metrically verifiable aspects of projectile points (e.g., on the presence or absence of barbing, shouldering, notching and diverging stem). Aside from the initial criterion of neck width, then, Pettigrew's typology is not based on metric aspects of projectile points.

The nominal fashion in which continuous variables (such as neck width) are treated in the Pettigrew classification has been criticized by Dunnell and Beck (1979:86-91). In addition, Dunnell and Beck rearrange Pettigrew's criteria and suggest that the typology in fact consists of a hafting dimension, including modes of (1) no haft, (2) diverging stem, (3) non-diverging stem, and (4) side notches, and a barbing dimension, including modes of (1) barbed and (2) unbarbed. They subsequently delete the barbing dimension from the classification on the grounds that barbs have a functional significance and are apparently arbitrary in the temporal dimension (Dunnell and Campbell 1977:175). They state that barbing values cluster at the threshold of Pettigrew's distinction rather than bimodally on either side of it (Dunnell and Beck 1979:88-89), indicating that it is not a profitable dimension on which to make typological distinctions. As a result, the typology as modified by Dunnell and Beck lumps the barbed and unbarbed types.

Dunnell and Beck provisionally accept neck width as an indication of size for Lower Columbia Valley points in the absence of "an explicit distinction between robust and unrobust points" (Dunnell and Beck 1979:88). They conclude by noting that "size, as measured in one or more different parameters, may in itself prove to be of chronological value...but exploitation of this aspect... will have to await the acquisition of a much larger number of assemblages with large numbers of points" (Dunnell and Beck 1979:89-91).

Other archaeologists have also continued to pursue a metric approach to the classification of projectile points. One of the most prolific investigators on this subject is Thomas (1970, 1978, 1981), whose research has included a study of 142 hafted arrow and dart tips. On the basis of a number of measurements (excluding weight which could not be determined for the hafted specimens), Thomas concluded that dart points could be distinguished from arrowheads. Two equations (based on specimen length, width, thickness and neck width) were derived to allow the classification of a given specimen as either a dart or an arrow point.

Following Thomas (1970), Tucker (1980) investigated the variables of size and haft for a collection of 70 projectile points in an effort to demonstrate objectively the reliability of intuitively-derived typological categories. Attributes assumed to relate to size included maximum length, axial length, maximum width, thickness and weight; haft attributes consisted of basal width, distal shoulder angle and proximal shoulder angle. Neck width was not considered an important variable in this study. Tucker concluded that dart points could be distinguished from arrowheads on the basis of the various attributes, but felt that attributes relating to size were more variable than those interpreted to be related to hafting methods (1980:5).

Thomas has since presented an updated typology of points from his study area, Monitor Valley, Nevada, which emphasizes "temporal types." This new typology relies primarily on basal width and proximal shoulder angle instead of length and weight which are considered more unstable characteristics. Although Thomas states that neck width (along with basal width) is a "particularly robust" attribute, it is worth noting that he does not use it to define any of his Monitor Valley point types (Thomas 1981:15). It is basically on the rationales presented in that study that the present undertaking is based.

A Consideration of Attributes

A perusal of typology keys for projectile points (e.g., Binford 1963; Thomas 1970) provides an overwhelming variety of attributes on which to base a typology. The intent of the typology presented here, however, is to reflect basic temporal patterns which may be found in the Flanagan site assemblage and which is intended to be tested for its applicability to the Long Tom Sub-basin and other Willamette Valley sub-basins. Accordingly, the following advice is employed: "When defining a temporal type, the wise archaeologist employs the simplest, most repeatable criteria available" (Thomas 1981:15). A number of attributes were considered in the course of determining those which were the simplest, yet most predictive, in developing the Flanagan site typology.

Because projectile points do appear to decrease in size over time in the Willamette Valley as well as elsewhere, an important dimension perceived by earlier investigators, and which is quite evident in the subtypes of White's (1975a) point typology, is size. White used the attributes of length, width and thickness to distinguish both types and subtypes that he labeled thick, thin, large and small. For reasons outlined by Thomas, however, greater consideration should be given to determining which attributes are most consistently indicative of gross size:

> Once a projectile point—whether spear point, arrowhead, or dart point—is manufactured, it is hafted and then used for the intended function. The point can suffer a number of fates during its use-life: simple breakage from impact, resharpening, edge attrition from use, burination, or conversion into an entirely different kind of tool, such as a drill or scraper. Each modification changes the morphology of the projectile point, and these changes serve only to confuse the temporal issue.
>
> But note that such attrition occurs primarily on the distal end of the projectile point. Use-life modification, in other words, is systematic: length, width and particularly weight, are systematically *reduced* during projectile point use-life, and they are thus relatively unstable attributes. Although thickness is generally unaffected by such attrition processes, it is also the least sensitive of the size variables.
>
> Basal attributes clearly provide the most stable variables for monitoring temporal change in projectile points. Particularly robust are *basal width* and *neck width*, and whenever possible, basal attributes are used to sort the various point types ~~through time;.~~..I deliberately avoid using gross size indicators such as weight and length (whenever possible) because of their unstable characteristics (Thomas 1981:14-15).

Following previous investigators, two basic dimensions were considered to be the most significant for defining temporal types: (1)

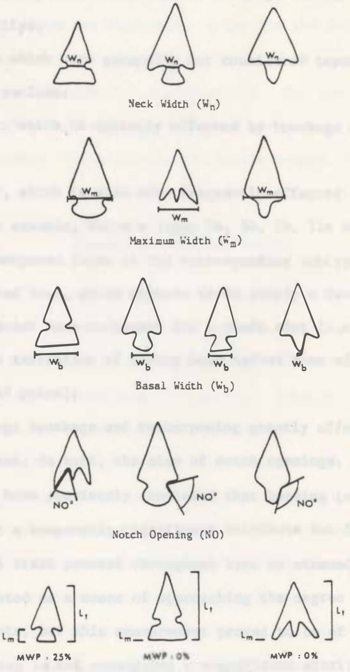
size (or "robustness"), and (2) hafting configuration.

Because basal attributes are assumed here to be the most reliable indicators of size, the attributes employed for this typology include: (1) neck width (W_n), (2) basal width (W_b), and (3) maximum specimen width (W_m) (Figure 14). A secondary size attribute, used primarily for the definition of stemless point types, is maximum thickness (T). A note of explanation should accompany Figure 14 for defining W_b: when any portion of the stem is wider than the neck (W_n), then W_b equals the widest portion of the stem; when the stem is narrower than the neck, W_b equals the measurement at the base of the stem.

The second dimension, hafting configuration, concerns those attributes affecting the manner in which a stone tip is attached to a foreshaft (e.g., socket versus slot hafting). Again, it is assumed for this study that the absence of a stem or the configuration of a stem (e.g., expanding or contracting) or stemless point base (e.g., straight, rounded or pointed) may be significant factors. This dimension was operationalized primarily through the use of the three size attributes mentioned above:

1. W_b-W_n is used as an indicator of expanding versus contracting stem; also, when $W_b-W_n = W_b$ (or $W_n = 0$), a point is classified as stemless. Another means of approaching the stem configuration is through the ratio (W_b/W_n).

2. W_b/W_m provides an indication of point shape for stemless points (triangular, teardrop or lanceolate), and is used to define notching categories (side-, corner-, and basal-notched) for the stemmed points.



Neck Width (W_n)

Maximum Width (W_m)

Basal Width (W_b)

Notch Opening (NO)

Maximum Width Position (MWP)

FIGURE 14. Projectile point attributes (after Thomas 1981:14).

3. For stemless points, T/W_m provides a relative index of rotundity, which may be a factor in the hafting technique used for stemless stone tips.

Attributes which were generally not considered important variables for this study include:

1. weight, which is directly affected by breakage and resharpening;

2. length, which is also more frequently affected by breakage and retouching (for example, White's Types 3b, 5b, 7b, 11a and 14a appear to include resharpened forms of the corresponding subtype);

3. indented base, which appears to be simply a function of adjusting the point base to better fit a shaft slot (i.e., an indented base is more an indication of having been hafted than of a particular type or style of point);

4. barbing; breakage and resharpening greatly affect barb configuration and, in turn, the size of notch openings. Dunnell and Beck (1979:88) have previously concluded that barbing (or degree of barbing) is not a temporally significant attribute but is better viewed as a functional trait present throughout time on stemmed points. (W_n/W_m) was tested as a means of approaching the degree of barbing on stemmed points, but this measurement proved to be of only limited utility. Barbing is not considered a significant attribute in this typology.

The Flanagan Site Typology

The projectile point sample from the Flanagan site includes 226 classifiable points and 39 unclassifiable fragments. In this section the criteria used in classifying these artifacts and the resulting projectile point types are described. A key for the definition of these types is presented in Figure 15. Metric data on which this typology is based are presented in Appendix F. For ease of description, the following discussion is presented in terms of three major point classes: (1) stemless, (2) narrow-necked, and (3) broad-necked.

Stemless Projectile Points

The class of stemless projectile points is defined as those specimens which have no apparent neck, and consequently $W_n = 0$. Another way to operationally determine whether neck width can be measured is through a measurement of the notch opening (NO); if the NO $> 180°$, then there is no measureable neck width.

A caution appropriately made by Thomas concerning stemless (or unshouldered) points is that it is very easy to confuse unfinished specimens from preliminary manufacturing stages with finished stemless points (Muto 1971; Thomas 1981:15). Consequently, care must be taken when assigning specimens to this class of artifacts.

This point class is further defined into two series: (1) the Small Stemless (SS) series, and (2) the Heavy Stemless (HS) series (Figure 16). Each series has three types based on the basal configuration of the points. Maximum width position (MWP) was considered for aiding in the definition of basal configuration (following Thomas 1981), but the serration of the majority of the points created

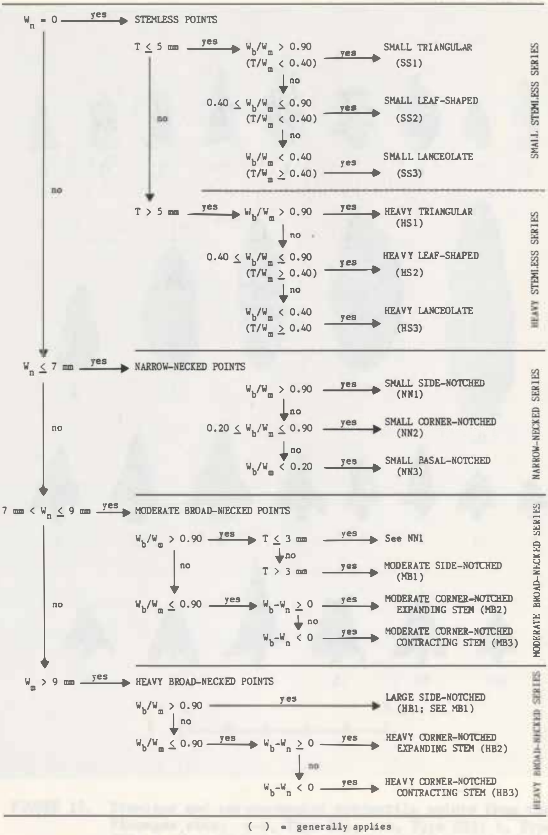


FIGURE 15. Key to Flanagan site projectile point types.

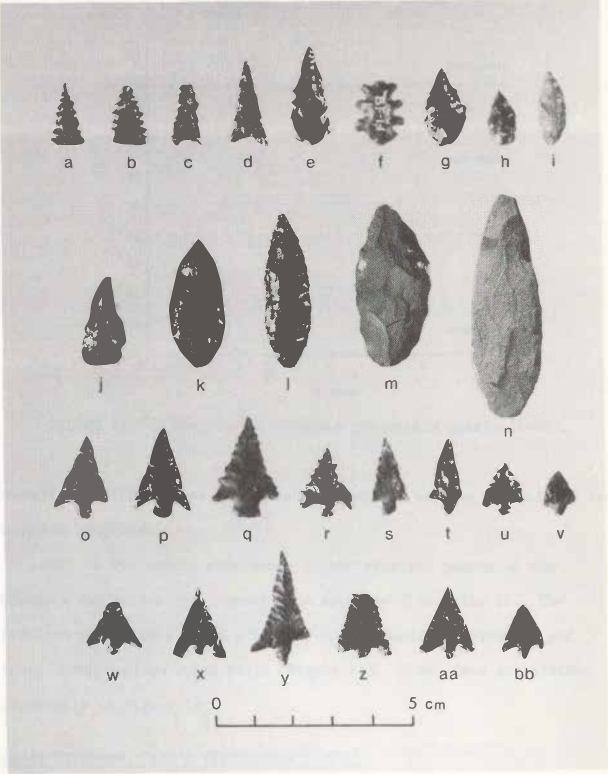


FIGURE 16. Stemless and narrow-necked projectile points from the Flanagan site: a-d, Type SS1; e-h, Type SS2; i, Type SS3; j, Type HS2; k-n, Type HS3; o-v, Type NN2; w-bb, Type NN3.

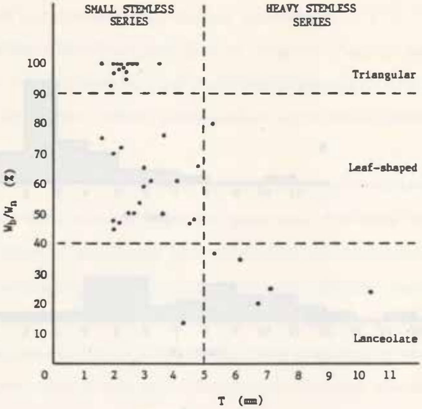


FIGURE 17. Definition of stemless projectile points (n=42).

operational difficulties with this measurement, voiding its utility for serrated specimens.

Data on the metric attributes of the stemless points in the Flanagan collection are presented in Appendix F in Table 27. The stemless points were typed primarily on the basis of thickness and basal width/maximum width ratio (Figure 17). These data are plotted separately in Figure 18.

Small Stemless, Type 1 (Triangular) (SS1)

Fourteen Type SS1 points were recovered during the Flanagan site excavations. These points are thin, unnotched, triangular projectile

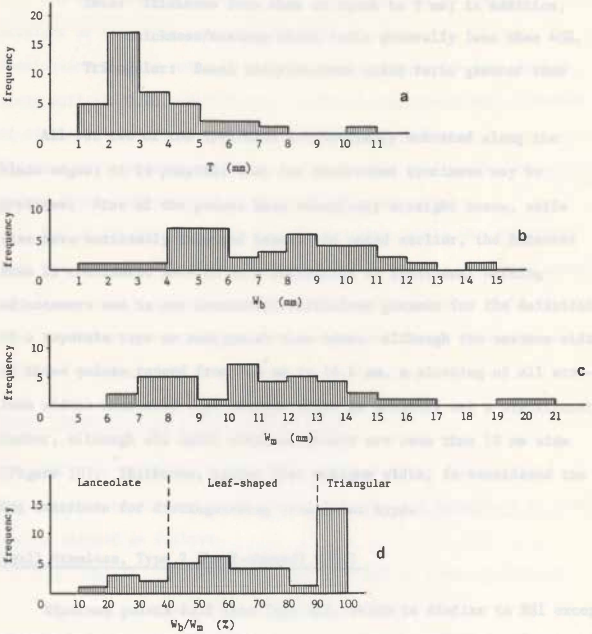


FIGURE 18. Plot of stemless point metric measurements: a, thickness (T); b, basal width (W_b); c, maximum width (W_m); d, W_b/W_m ratio.

points which are operationally defined as follows:

Thin: Thickness less than or equal to 5 mm; in addition, thickness/maximum width ratio generally less than 40%.

Triangular: Basal width/maximum width ratio greater than 0.90.

All but two of the specimens are obviously serrated along the blade edges; it is possible that the unserrated specimens may be preforms. Nine of the points have relatively straight bases, while five have noticeably indented bases. As noted earlier, the indented base is considered here to be a reflection of individual hafting adjustments and is not considered sufficient grounds for the definition of a separate type or subtype at this time. Although the maximum width of these points ranged from 7.3 mm to 14.1 mm, a plotting of all stemless widths indicated that maximum width is probably not a significant factor, although all small stemless points are less than 18 mm wide (Figure 18). Thickness, rather than maximum width, is considered the key attribute for distinguishing this point type.

Small Stemless, Type 2 (Leaf-shaped) (SS2)

Nineteen points fall into Type SS2, which is similar to SS1 except that the basal configuration is rounded instead of straight. These points are thin, unnotched and leaf-shaped in outline and are operationally defined as follows:

Thin: thickness less than or equal to 5 mm; thickness/ maximum width ratio generally less than 40%.

Leaf-shaped: Basal width-maximum width ratio less than or equal to 0.90 and greater than or equal to 0.40.

The implications for hafting of a rounded base as opposed to a straight or incurvate base are not clear at this time, but the distinction will be retained for now in the expectation that future study will elucidate whether this difference is significant. Because of similarities in sample size and vertical distribution within the Flanagan site, this investigator is inclined to believe that straight/convex basal configuration is not a significant factor.

Ten of the specimens are heavily serrated, while the unserrated ones may either be preforms or points which were retouched in a manner which removed any serrations. As with Type SS1, maximum width was not used to define subtypes within this group even though the points ranged from 6.3 mm to 16.0 mm.

Small Stemless, Type 3 (Lanceolate) (SS3)

Only one specimen of Type SS3 was found at the Flanagan site. This type is considered to be small, unnotched and lanceolate in form and is defined as follows:

Small: Thickness less than or equal to 5 mm; thickness/maximum width ratio greater than 0.40.

Lanceolate: Basal width/maximum width ratio less than 0.90.

Since only a single specimen was recovered from the Flanagan site, it is with reluctance that this type is proposed. Similar specimens have been noted in previously excavated site collections, although also in very small numbers, so this type is tentatively proposed until its utility can be established by further work.

Heavy Stemless, Type 1 (Triangular) (HS1)

This type, described as thick, unnotched and triangular, is also proposed with reservations because it is currently based on no specimens from the Flanagan site. It is the logical larger counterpart to Type SS1, but other collections may prove that such a type does not exist. Its use as a type must be tested on other Willamette Valley collections. The definition of Type HS1 is as follows:

Thick: Thickness greater than 5 mm; thickness/maximum width ratio greater than 30%.

Large: Maximum width greater than 9 mm.

Triangular: Basal width/maximum width ratio greater than 0.90.

Heavy Stemless, Type 2 (Leaf-shaped) (HS2)

Only one specimen is classified as Type HS2, which corresponds in form to Type SS2 with an increase in thickness and maximum width. These points are thick, unnotched and leaf-shaped in outline, fitting the following definitions:

Thick: Thickness greater than 3 mm; thickness/maximum width ratio generally greater than 30%.

Leaf-shaped: Basal width-maximum width ratio less than 0.90.

The single specimen is serrated and exceeds 12 mm in maximum width. This specimen fits closely with the larger specimens in Type

SS2 (Figure 17), and further testing of this type may indicate that the two types should be merged.

Heavy Stemless, Type 3 (Lanceolate) (HS3)

Five complete points and two fragments fall into this category, which is defined as thick, unnotched and lanceolate as follows:

Thick: Thickness greater than 5 mm; thickness/maximum width ratio generally greater than 0.40.

Lanceolate: Basal width/maximum width ratio less than or equal to 0.40.

This point type is somewhat akin to a form commonly referred to in the archaeological literature as the "Cascade point," which is generally considered to be an early time marker. Although the Flanagan sample is very small, all seven specimens are located in the lower portions of the site.

Narrow-necked Projectile Points

Three series of stemmed projectile points are recognized in the present typology. A plotting of the neck width measurements of the 182 stemmed points in the Flanagan collection indicated that the points fell into three neck-width categories (Figure 19a), with narrow-necked points being the series with the smallest neck widths (less than or equal to 7 mm). Maximum specimen width (Wm) was also plotted for all specimens, but this attribute showed less variability than the neck width measurements (Figure 19b).

The Narrow-necked Series is divided at this time into only three

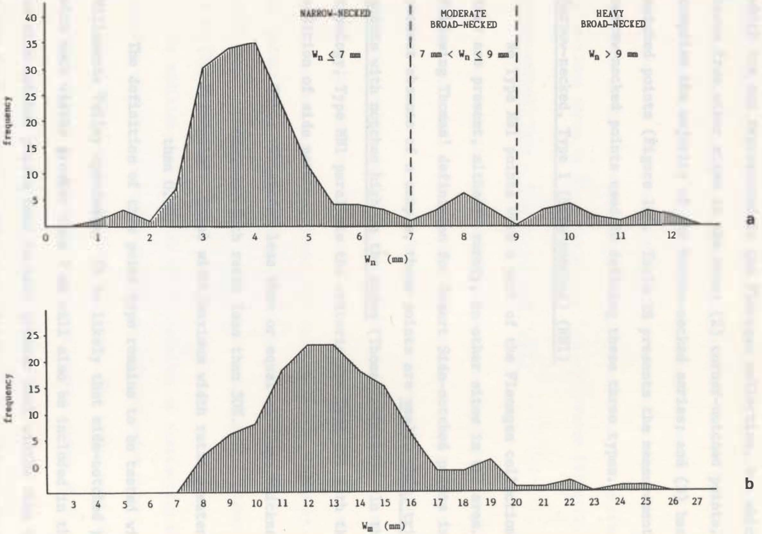


FIGURE 19. Neck width (a) and maximum width (b) frequencies for all stemmed projectile points from the Flanagan site (n=184).

types described on the basis of notching: (1) side-notched points, which are not represented in the Flanagan collection, but which are known from other sites in the area; (2) corner-notched points, which comprise the majority of the Narrow-necked series; and (3) basal-notched points (Figure 16). Table 28 presents the measurements of the narrow-necked points used in defining these three types.

Narrow-necked, Type 1 (Side-notched) (NN1)

No Type NN1 points were a part of the Flanagan collection, but they are present, although rarely, in other sites in the area. Following Thomas' definition for Desert Side-notched points in the present absence of a sample, these points are small, thin, triangular points with notches high on the sides (Thomas 1981:18). In this typology, Type NN1 parallels the criteria for Type SS1 with the addition of side notches:

Thin: Thickness less than or equal to 4 mm; thickness/maximum width ratio less than 30%.

Triangular: Basal width/maximum width ratio greater than 0.90.

The definition of this point type remains to be tested with Willamette Valley specimens. It is likely that side-notched points with neck widths greater than 7 mm will also be included in this type, as side-notched points tend to have greater neck widths than other notched points of comparable size. Consequently, side-notched points which fall into Type MB1 (described below) but which have a thickness of less than or equal to 4 mm will be included here in Type NN1.

Presumably, the distinction between NN1 and MB1 will be refined with a larger sample of side-notched points from the Willamette Valley.

This point type, frequently referred to as "Desert Side-notched," corresponds to White's Type 16, which he describes as "found in the upper levels of valley sites where it occurs only rarely. Not found at the Lingo or Hurd sites. Several specimens observed from surface collections taken in the extreme upper valley" (White 1975a:131).

Narrow-necked, Type 2 (Corner-notched) (NN2)

A vast majority (130 or 83%) of the narrow-necked points from the Flanagan site fall into this type. The narrow-necked points posed a problem in terms of typology because although some differences were observable within the sample, the extent of this variability appeared to be rather limited. In an effort to sort out types within this group, maximum width was plotted, but this offered no means by which the points could be subdivided; 152 of the 157 narrow-necked points (97%) with measurable maximum width formed a bell curve between 8 and 17 mm (Figure 20a).

In addition, the presence of an expanding or contracting stem, commonly used by other archaeologists in defining point types, does not seem to be significant for this collection. The points seem to cluster on either side of the straight stem configuration (where W_b-W_n = 0), with 105 of the 140 points (75%) with measurable neck and basal widths falling between +1 mm and -1 mm for (W_b-W_n) (Figure 20b). The same situation can be observed when neck width is plotted against basal width (Figure 21).

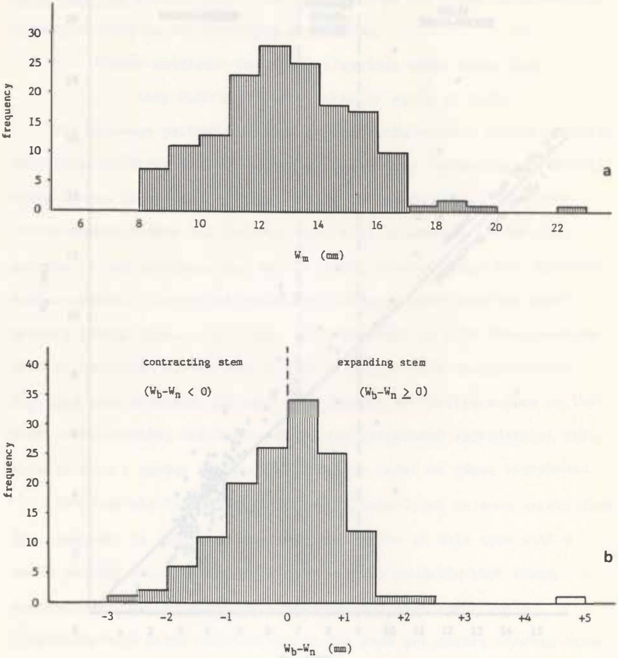


FIGURE 20. Frequency of maximum width (a) and expanding/contracting stem (b) configuration for narrow-necked points (n=157).

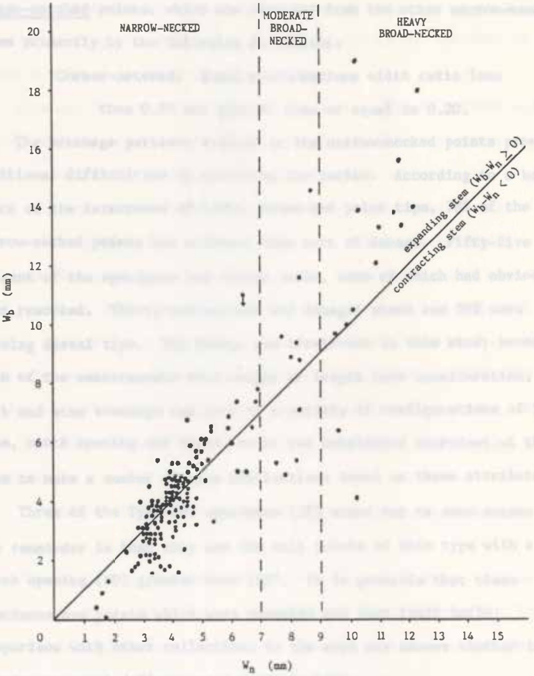


FIGURE 21. Distribution of stemmed projectile points by neck width and basal width (n=184).

The specimens which fall into Type NN2 are primarily narrow-necked corner-notched points, which are excluded from the other narrow-necked types primarily by the following definition:

Corner-notched: Basal width/maximum width ratio less than 0.90 and greater than or equal to 0.20.

The breakage patterns evident on the narrow-necked points provided additional difficulties in splitting the series. According to a brief check of the intactness of barbs, stems and point tips, 78% of the narrow-necked points had suffered some sort of damage. Fifty-five percent of the specimens had broken barbs, some of which had obviously been reworked. Thirty-two percent had damaged stems and 38% were missing distal tips. Tip damage was irrelevant in this study because none of the measurements take weight or length into consideration. Barb and stem breakage can lead to a variety of configurations of the stem, notch opening and barbs, so it was considered imprudent at this time to make a number of type distinctions based on these attributes.

Three of the Type NN2 specimens (2%) stand out to some extent from the remainder in that they are the only points of this type with a notch opening (NO) greater than 150°. It is possible that these specimens are points which were reworked and lost their barbs; comparison with other collections in the area may answer whether these points are worth defining as a separate type.

Narrow-necked, Type 3 (Basal-notched) (NN3)

This type includes a minority of the narrow-necked points (27 or 17%) which show clear evidence of basal notching as opposed to corner notching. It is likely that the membership of this type should be larger, but the slender stem characteristic of this type appears to be prone to breakage; once the stem is snapped, it is not possible to define a point as belonging to this type.

Although the graph for the ratio of basal width to maximum width (W_b/W_m) did not show any obvious breaks (Figure 22), a plotting of W_b/W_m against W_n/W_m indicated that all specimens with a W_b/W_m ratio of less than 20% were contracting stem points, while points with W_b/W_m ratios of 20% and greater included contracting and expanding stem specimens (Figure 23). Those points with a W_b/W_m ratio of less than 20% also include a range of basal-notched, barbed, contracting stem points, including those distinctive specimens with squared barbs. This type is tentatively proposed so that the utility of the basal- versus corner-notched distinction can be tested.

Type NN3 is defined to include basal-notched, narrow-necked points as follows:

> Basal-notched: Basal width/maximum width ratio less than 0.20.

This point type has been intuitively defined by other archaeologists in the Willamette Valley (e.g., Type 8 [White 1975a:126]; Type 11 [Sanford 1975:260]; Type XX [Miller 1975:328]; Types 5 and 11 [Henn et al. 1975:527]) and frequently includes a distinctively contracting stem and long barbs which are sometimes squared (indicative of basal notching on a triangular preform).

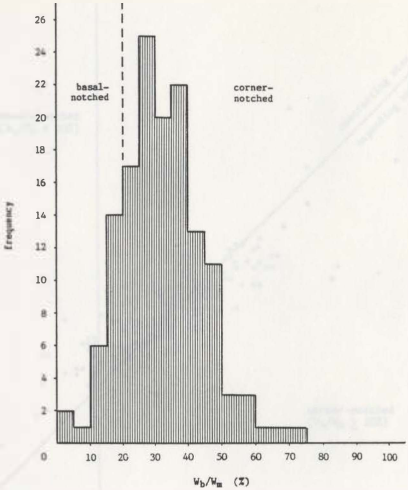


FIGURE 22. Distribution of narrow-necked projectile points by basal width/maximum width ratio (n=157).

Broad-necked Projectile Points

The class of broad-necked projectile points is defined as those specimens which have a neck width greater than 7 mm. This point class is further divided into two series: (1) Moderate Broad-necked (MB), which includes points with neck widths measuring greater than 7 mm and less than or equal to 9 mm; and (2) Heavy Broad-necked (HB), which

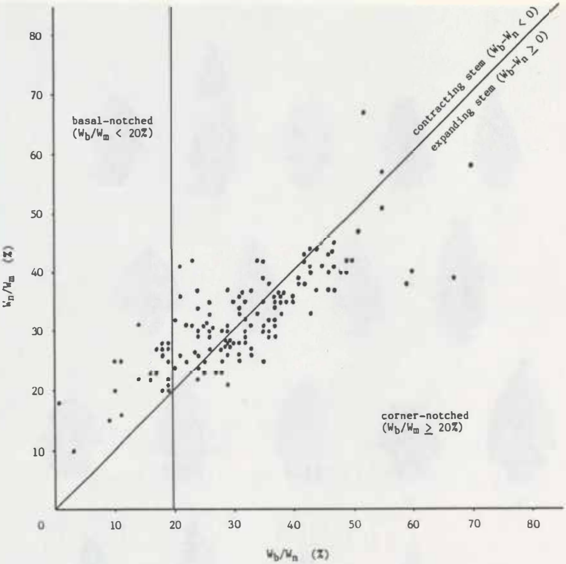


FIGURE 23. Plot of narrow-necked projectile points by neck width/ maximum width ratio and basal width/maximum width ratio (n=157).

includes points with neck widths greater than 9 mm. Each broad-necked series is further divided into three more types: (1) side-notched; (2) a corner-notched, expanding stem type, and (3) a corner-notched, contracting stem type (Figure 24). Because of a general lack of data on large side-notched points, the Moderate and Heavy side-notched points

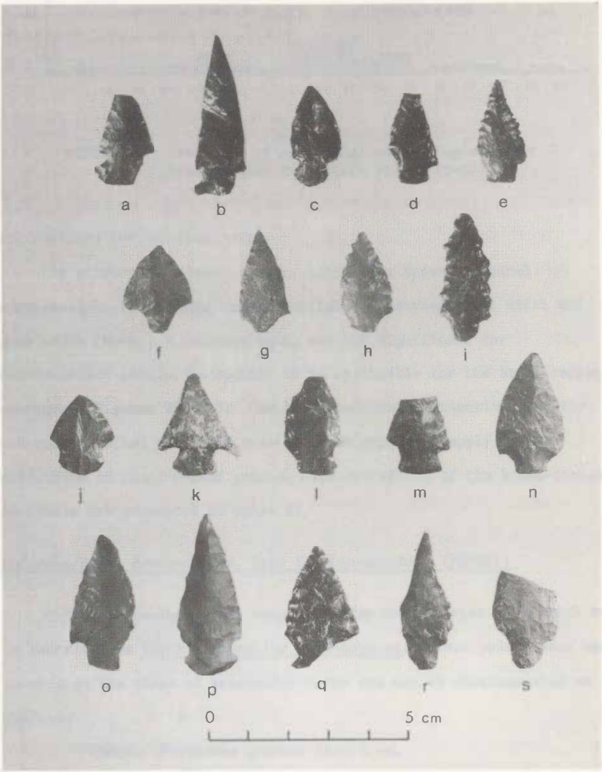


FIGURE 24. Broad-necked projectile points from the Flanagan site: a–b, Type MB/HB1; c–e, Type MB2; f–i, Type MB3; j–q, Type HB2; r–s, Type HB3.

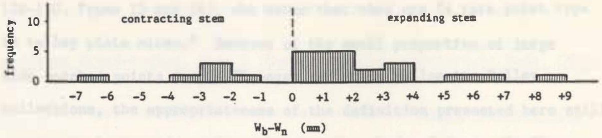


FIGURE 25. Frequency of expanding/contracting stem for broad-necked projectile points (n=27).

are combined for the time being.

The primary attributes used to define the types are basal width/maximum width ratio and the difference between basal width and neck width (W_b-W_n). Although W_b-W_n was not significant for narrow-necked points, it appears to be applicable for the broad-necked specimens (Figures 21, 25). The basal notching distinction used for the narrow-necked points in turn does not appear to apply to the definition of broad-necked points. The attributes of the broad-necked specimens are presented in Table 29.

Moderate/Heavy Broad-necked, Type 1 (Side-notched) (MB/HB1)

Only two specimens were recovered from the Flanagan site which can be described as thick, triangular side-notched. These points have been notched on the sides of triangular forms and can be distinguished as follows:

Thick: Thickness greater than 4 mm.

Triangular: Basal width/maximum width ratio greater than 0.90.

Large side-notched points have also been defined by White (1975a:

129-130, Types 13 and 14), who notes that they are "a rare point type in valley plain sites." Because of the small proportion of large side-notched points in the Flanagan and other Willamette Valley collections, the appropriateness of the definition presented here still remains to be tested. A few other broad-necked points in the Flanagan site collection could be described by some as side-notched as well; however, they are either fashioned on leaf-shaped forms or are rather shallowly notched, so that the W_b/W_m ratio is significantly less than 0.90. These specimens grade into the obviously corner-notched specimens in form. Thus far, it has not been possible to factor out these shallow side-notched points with narrower stems from the rest of the broad- necked expanding stem points through the use of width or thickness measurements, or through the use of other measurements such as proximal shoulder angle (as used by Thomas 1981:19), notch opening or maximum width position. It is possible that this marginal side-notching is not significant in either a functional or temporal sense. For now, these points are classified with the appropriate broad-necked, expanding stem type.

Moderate Broad-necked, Type 2 (Corner-notched, Expanding Stem) (MB2)

Five specimens are included in Type MB2, which are defined as corner-notched with expanding stem:

Corner-notched: Basal width/maximum width ratio less than or equal to 0.90.

Expanding stem: Basal width/neck width difference (W_b-W_n) greater than or equal to 0 (or basal width/

neck width ratio greater than or equal to 1.00).

Moderate Broad-necked, Type 3 (Corner-notched, Contracting Stem) (MB3)

This type includes four specimens which are corner-notched with contracting stem:

Corner-notched: Basal width/maximum width ratio less than or equal to 0.90.

Contracting stem: Basal width/neck width difference (W_b-W_n) less than 0 (or basal width/neck width ratio less than 1.00).

Heavy Broad-necked, Type 2 (Corner-notched, Expanding Stem) (HB2)

This type is the largest broad-necked point type including 12 specimens from the Flanagan site. Like Type MB2, this type is defined as corner-notched with expanding stem with neck widths greater than 9 mm:

Corner-notched: Basal width/maximum width ratio less than or equal to 0.90.

Expanding stem: Basal width/neck width difference (W_b-W_n) greater than or equal to 0 (or basal width/neck width ratio greater than or equal to 1.00).

Heavy Broad-necked, Type 3 (Corner-notched, Contracting Stem) (HB3)

Aside from the large side-notched points, this type is the smallest defined for the Flanagan site, represented with only two points. Comparable to Type MB3, this type is corner-notched with contracting stem:

Corner-notched: Basal width/maximum width ratio less than or equal to 0.90.

Contracting stem: Basal width/neck width difference (W_b-W_n) less than 0 (or basal width/neck width ratio less than 1.00).

Ordering of the Series

The preceding five series and their associated fourteen types are defined on the basis of gross size and hafting attributes, on the assumption that the larger, heavier points represent the earlier atlatl and dart technology, while the small, thin points are indicative of the later bow and arrow. It is also assumed that hafting techniques may have been altered along with the change in atlatl to bow technology; on the other hand, hafting techniques may be independent of atlatl or bow methods. In any event, the manner in which a projectile tip is hafted to a shaft is considered to be a possible temporal indicator along with the method used to propel the shaft.

Details on the vertical distribution and temporal significance of the various types defined in this typology will be presented in the following chapter. This section is concerned primarily with the increasing size and other trends associated with the various projectile point series, which are summarized and ordered in Table 14. The five series are ordered and reviewed by increasing size.

TABLE 14. Attribute ordering of projectile point series.

Series	Wn	Wm	T	W_b/W_m*	W_n/W_m*	% Obs.	% Serrated
SMALL STEMLESS	—	6-16 mm	<5 mm	40-100%	—	91%	68%
NARROW-NECKED	1-7 mm	8-17 mm	<5 mm	15-50%	20-45%	85%	45%
MODERATE BROAD-NECKED	7-9 mm	14-19 mm	3½-7½ mm	25-75%	40-60%	75%	50%
HEAVY BROAD-NECKED	9-13 mm	14-25 mm	9-13 mm	20-85%	40-70%	53%	13%
HEAVY STEMLESS	—	12-21 mm	5-11 mm	10-40%	—	38%	12%

* primary distribution range (Figure 21)

Small Stemless Series

This series is the second most frequent series at the Flanagan site. Sixty-eight percent of the Small Stemless points were heavily serrated along the blade edge, and more than 91% were made of obsidian. These points are characterized as thin (less than 5 mm, although most measure between 2-3 mm), suggesting that the specimens were probably slipped into a slot on the end of the shaft for hafting. Most of the Small Stemless points were leaf-shaped in form, but triangular points were also well represented. Small lanceolate forms appear to be rare.

Narrow-necked Series

The most abundant points are associated with the Narrow-necked Series. This series, in addition to having the narrowest neck widths of the stemmed points, is correspondingly smaller in other ways. These points are less than 18 mm in maximum width and have a thickness of less than 5 mm, like the Small Stemless points. They tend to have smaller stems in relation to their maximum width (W_n/W_m), and have a greater degree of basal notching (or stem contracting as indicated by W_b/W_m), in relation to the other stemmed points. Eighty-five percent of the Narrow-necked Series is made of obsidian, while 45% are serrated. The hafting method most frequently used was probably also the slotted method.

Moderate Broad-necked Series

This series appears to be a transitional series in that it falls between the Narrow-necked Series and the Heavy Broad-necked Series in all respects and overlaps with both of them to some extent. Most of the specimens are less than 18 mm in maximum width and are generally thicker than the Narrow-necked points. The stems are more stout as indicated by the W_n/W_m ratio. Approximately half of the points have expanding stems, and the thickness of the stem indicates that a notch, rather than a simple slot, would have been required for hafting. Seventy-five percent of the points are of obsidian; 50% are serrated.

Heavy Broad-necked Series

This series consistently contains the largest specimens recovered from the Flanagan site. The neck width, maximum width and thickness of this series are greater than any other. Like the Moderate Broad-necked Series, this series has rather stout stems indicated by a rather high W_n/W_m ratio. Nearly all of the examples of this series have thick expanding stems and may have been hafted into a notch in a shaft. Only 13% are serrated, and 53% are made of obsidian.

Heavy Stemless Series

The counterpart to the Small Stemless Series is not heavily represented at the Flanagan site, but a clear contrast can be drawn between the two stemless series. The sample available indicates that emphasis in form is quite different; the Heavy Stemless Series contains no triangular forms and only one leaf-shaped point. The bulk of the specimens are lanceolate in form. Only one specimen (12%) is serrated along the blade edge, and only three (38%) are made of obsidian. In contrast with the Small Stemless points, the Heavy Stemless specimens are thick (greater than 5 mm) with a rotundity ratio of more than 40%, suggesting that the socket method of hafting may have been used.

It is clear that this series is not transitional between the Small Stemless and Narrow-necked series. Instead, it appears that the Heavy Stemless Series belongs at the heavy end of the point scale in the company of the broad-necked points, although its lanceolate configuration and lack of a stem makes it difficult to place. This series exceeds the maximum width and thickness of the Moderate Broad-necked Series, but it generally runs a bit smaller than the Heavy Broad-necked types. For the time being, the Heavy Stemless Series will be placed at the end of the series size scale, although it should be considered to be roughly on a par with the Heavy Stemless Series in view of its low proportion of obsidian and serrated specimens. Additional research should clarify the position of this series in relation to the larger stemmed series.

Observations on the Use of the Flanagan Site Typology

The lack of a temporally-sensitive projectile point typology with explicit definitions has long hindered the ability of archaeologists to approach the reconstruction of Willamette Valley prehistory in a systematic way. The typology in use since 1975 has been variably applied by different archaeologists because of a lack of operationally defined attributes. For instance, some specimens have been often classified as side-notched points which are often indistinguishable from corner-notched points. The White typology depended on an intuitive definition of types, while the Flanagan site typology makes the critera for membership in a type explicit to allow for a more rigorous and repeatable analysis.

It should be stressed that this typology is intended to pick up general temporal trends occurring in the vicinity of the Flanagan site. As a result, the typology is applicable to collections of points, and not necessarily to individual specimens. In addition, the temporal ranges of most of the types can be defined at this time in only very general terms. This situation is primarily due to the generally disturbed nature of cultural deposits at sites on the valley floor and the lack of well-defined stratigraphic deposits at the sites investigated to date in the region. As well-controlled excavations at stratified sites proceed, we can expect the Flanagan site typology to be refined.

It should also be noted that the Flanagan site typology is not intended to define stylistic differences due to geographic location or differing band territories. Although the need exists for a stylistic typology as well (Beckham et al. 1981:286-287), it is anticipated that the Flanagan site typology will not be sufficient to account for stylistic variability which may be found in different sub-basins of the Willamette Valley. A stylistic typology should be based, however, on a typology of proven temporal significance such as the one presented here (see Chapter VI) in order to better trace variability over time and space.

The applicability of the point types defined here remains to be tested with other collections in the immediate vicinity, most preferably within the Long Tom Sub-basin. The need for certain types (e.g., NN1 and HS1) has been anticipated because these forms are reported from other sites, but their definitions remain to be refined and expanded as necessary. In addition, the distinction between the large and small side-notched points cannot be said to be well-defined on the basis of the two specimens from the Flanagan site, and the utility of Types SS3, HS2 and NN3 remain to be established. There is no doubt that the criteria used in developing the typology for the Flanagan site will be improved by subsequent research.

CHAPTER VI

CULTURAL STRATIGRAPHY AND COMPONENTS AT THE FLANAGAN SITE

The stratigraphic relationships between various classes of cultural data were investigated in order to define cultural components which relate to different periods of use at the Flanagan site. Brief descriptions of the trends observed in these classes of data are presented before the cultural assemblages and components derived from them are discussed.

Cultural Stratigraphy

The classes of cultural data which are summarized below in terms of their stratigraphic trends include: (1) frequencies of lithic debitage by raw material, (2) frequencies of cultural features, (3) projectile point types and series, (4) distribution of other artifact industries and classes, and (5) dating determinations.

Lithic Material Frequencies

General trends can be observed in the use of lithic materials over time at the Flanagan site as indicated by the 1978 data in Figure 26. The 1978 block excavation was chosen to represent the raw material use because the depth of the cultural deposit and the occurrence of the cultural strata were uniform in this portion of the site. As indicated

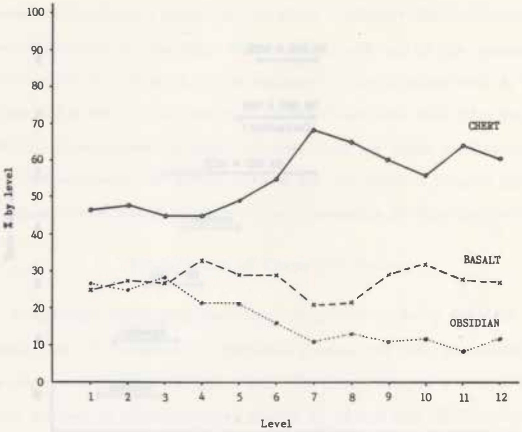


FIGURE 26. Percentage of debitage by raw material by level for 1978 block area excavations.

in Table 10, chert is used most frequently throughout the site occupation, but its use is highest in the earliest levels (56%-65%), peaking at Level 7 (68%) and then quickly declining to stabilize at 45% in the upper levels. Obsidian follows the reverse trend, comprising approximately 10% of the debitage for each level in the lower levels of the site and rising to more than 25% use in the upper levels. Basalt use falls between chert and obsidian, showing two peaks, one in the lowest levels at Level 10 (32%) and a second near the top of the site in Level 4 (33%). A dip in basalt frequency occurs in Levels 7 and 8 with 21% use represented.

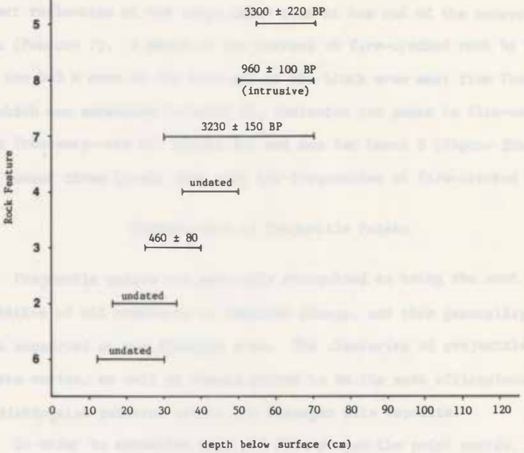


FIGURE 27. Subsurface distribution of rock features at the Flanagan site.

Feature Distributions

The subsurface distribution of site features as indicated in Figure 27 shows a definite concentration of rock hearths and ovens in the upper seven levels of the site, with no discrete features recorded below that level. Fire-cracked rock indicative of cooking activity occurred throughout the site, however, as indicated by Table 12. A plotting of the percent of fire-cracked rock by level for the 1978 excavations produces a major peak at Level 6 (Figure 28a), which is a direct reflection of the large camas oven at one end of the excavation area (Feature 7). A graph of the percent of fire-cracked rock by level for the 3x3 m area at the west end of the block area away from Feature 7, which was excavated to Level 12, indicates two peaks in fire-cracked rock frequency—one for levels 3-5 and one for Level 8 (Figure 28b). The lowest three levels show very low frequencies of fire-cracked rock.

Distribution of Projectile Points

Projectile points are generally recognized as being the most sensitive of all artifacts to temporal change, and this generality was also supported at the Flanagan site. The clustering of projectile points series, as well as types, proved to be the most efficacious way to distinguish patterns within the Flanagan site deposits.

In order to establish that the five projectile point series, as ordered by attribute in Table 14, had temporal validity, the vertical distributions were plotted for the eleven most frequent projectile point types defined in Chapter V. The types were plotted both for all units excavated through the majority of the cultural deposit (including the 1975 test pit, the 1976 units, and the 1978 block area) and for the 1978 block excavation area alone, which was presumed to have more internal consistency because the depth of the cultural deposit was less variable in this area than within the site as a whole. With the exception of the single test unit from 1975 (KL/LL), the remainder of the 1975 collection was not included in this portion of the study because it would have heavily skewed the distribution in favor of Level 1.

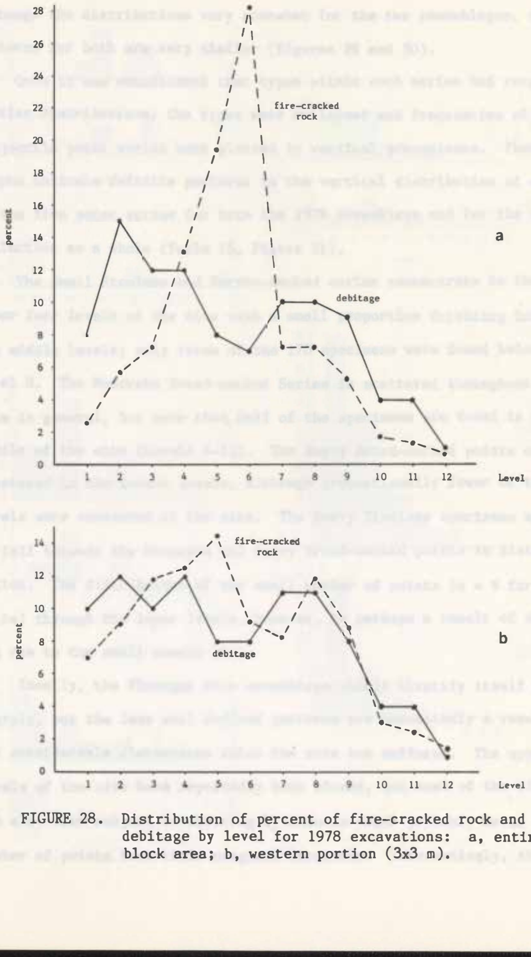


FIGURE 28. Distribution of percent of fire-cracked rock and debitage by level for 1978 excavations: a, entire block area; b, western portion (3x3 m).

Although the distributions vary somewhat for the two assemblages, the patterns for both are very similar (Figures 29 and 30).

Once it was established that types within each series had roughly similar distributions, the types were collapsed and frequencies of each projectile point series were plotted by vertical provenience. These graphs indicate definite patterns in the vertical distribution of each of the five point series for both the 1978 assemblage and for the total collection as a whole (Table 15, Figure 31).

The Small Stemless and Narrow-necked series concentrate in the upper four levels of the site with a small proportion dribbling into the middle levels; only three of the 170 specimens were found below Level 8. The Moderate Broad-necked Series is scattered throughout the site in general, but more than half of the specimens are found in the middle of the site (Levels 8-12). The Heavy Broad-necked points are clustered in the lowest levels, although proportionally fewer of these levels were excavated at the site. The Heavy Stemless specimens appear to fall between the Moderate and Heavy Broad-necked points in distribution. The distribution of the small number of points (n = 8 for all units) through the lower levels, however, is perhaps a result of skewing due to the small sample size.

Ideally, the Flanagan site assemblage should stratify itself more sharply, but the less well defined patterns are undoubtedly a result of the considerable disturbance which the site has suffered. The upper levels of the site have reportedly been plowed, but most of the site has also been subject to churning by rodents which probably moved a number of points from their original locations. Interestingly, the

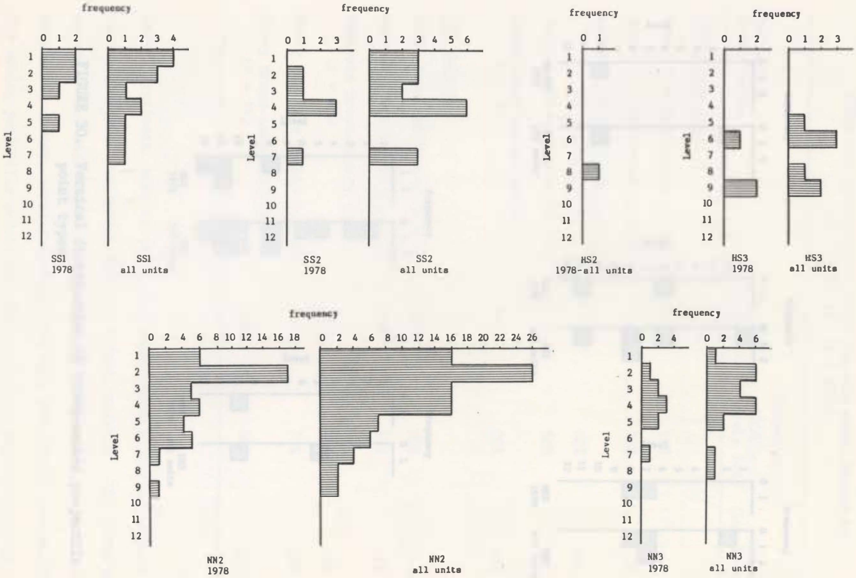


FIGURE 29. Vertical distribution of stemless and narrow-necked projectile point types.

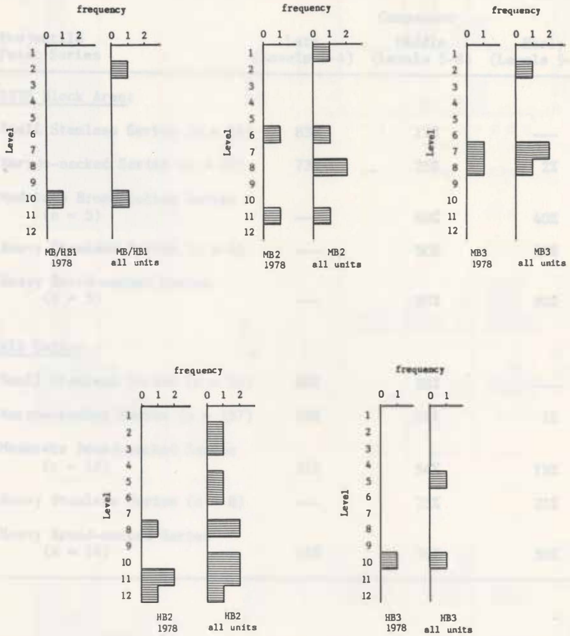


FIGURE 30. Vertical distribution of broad-necked projectile point types.

TABLE 15. Distribution of projectile point series by site component (n = 226).

Projectile Point Series	Component Late (Levels 1-4)	 Middle (Levels 5-8)	 Early (Levels 9-12)
1978 Block Area:			
Small Stemless Series (n = 14)	83%	17%	—
Narrow-necked Series (n = 62)	73%	25%	2%
Moderate Broad-necked Series (n = 5)	—	60%	40%
Heavy Stemless Series (n = 4)	—	50%	50%
Heavy Broad-necked Series (n = 5)	—	20%	80%
All Units:			
Small Stemless Series (n = 34)	80%	20%	—
Narrow-necked Series (n = 157)	78%	21%	1%
Moderate Broad-necked Series (n = 13)	31%	54%	15%
Heavy Stemless Series (n = 8)	—	75%	25%
Heavy Broad-necked Series (n = 14)	14%	36%	50%

larger artifacts, such as the ground stone, show a sharper pattern and were also items less easily moved by rodent activity. The disturbance caused to the site deposits by the aboriginal inhabitants should not be overlooked either, as this activity was also undoubtedly responsible for moving projectile points and other material, such as charcoal,

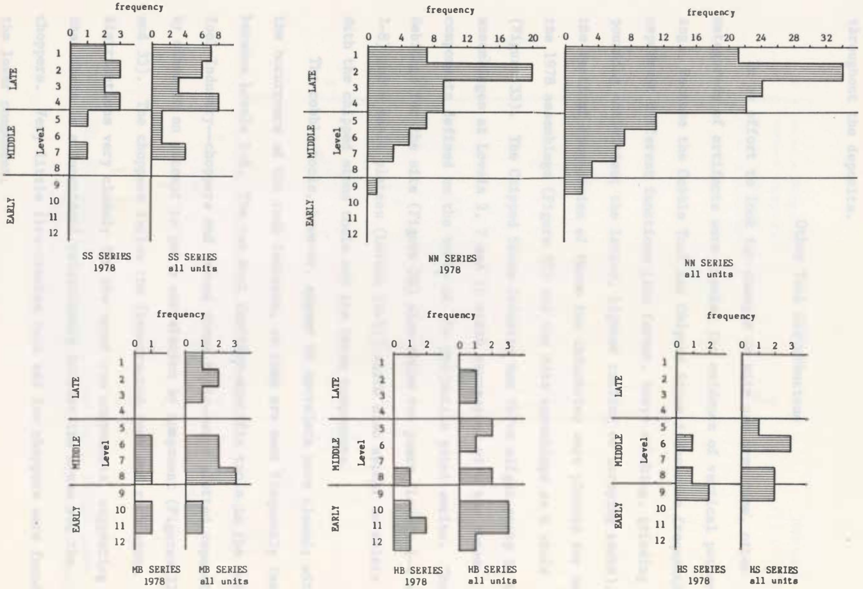


FIGURE 31. Distribution of projectile point series by excavation level and component.

throughout the deposits.

Other Tool Distributions

In an effort to look for changes in site use over time, other categories of artifacts were checked for evidence of vertical patterning. Because the Cobble Tool and Chipped Stone industries frequently represent different functions (the former, heavy crushing, grinding or pounding activities; the latter, lighter cutting or scraping tasks), the vertical frequencies of these two industries were plotted for both the 1978 assemblage (Figure 32) and the site assemblage as a whole (Figure 33). The Chipped Stone Industry has three slight peaks in both assemblages at Levels 2, 7 and 11 which correspond with the three components defined on the basis of the projectile point series. The debitage for the site (Figure 28) also shows two peaks (Levels 1-4 and 7-8) and a small plateau (Levels 10–11) which also appear to relate with the chipped stone tools and the three components.

The cobble tools, however, appear to correlate more closely with the occurrence of the rock features, as they are most frequently found between Levels 2-8. The two most function-specific tools in the Cobble Tool Industry—choppers and ground stone tools--were plotted separately by class in an attempt to get a correlation by component (Figures 32 and 33). The choppers follow the fire-cracked rock and rock oven distributions very closely for the upper two components, suggesting that there is a functional relationship between the ovens and the choppers. Very little fire-cracked rock and few choppers were found in the lower component.

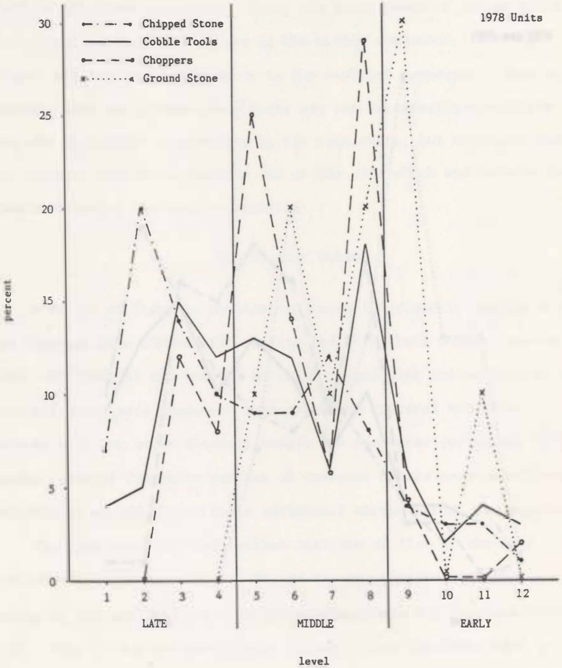


FIGURE 32. Distribution of chipped stone tools, cobble tools, choppers and ground stone tools by excavation level and component for 1978 units.

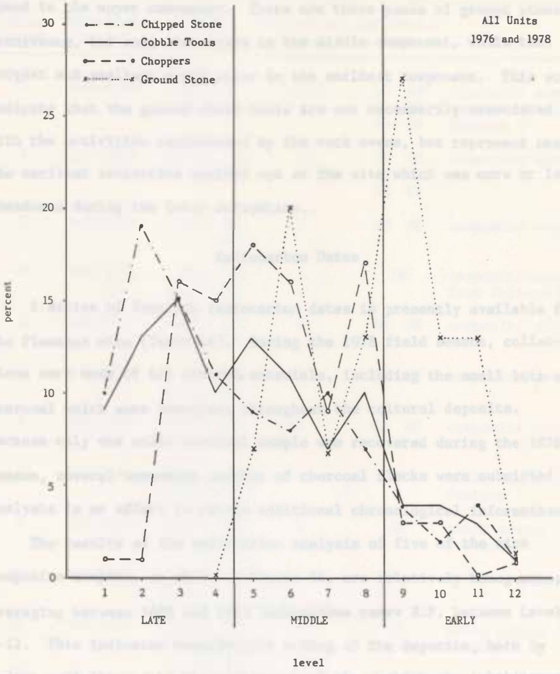


FIGURE 33. Distribution of chipped stone tools, cobble tools, choppers and ground stone tools by excavation level and component for 1976 and 1978 excavations.

The ground stone tools had a reverse pattern. No ground stone was found in the upper component. There are three peaks of ground stone occurrence, but only one occurs in the middle component, while the largest and smallest peaks occur in the earliest component. This would indicate that the ground stone tools are not necessarily associated with the activities represented by the rock ovens, but represent one of the earliest activities carried out at the site which was more or less abandoned during the later occupation.

Radiocarbon Dates

A series of fourteen radiocarbon dates is presently available from the Flanagan site (Table 16). During the 1978 field season, collections were made of all charred materials, including the small bits of charcoal which were prevalent throughout the cultural deposits. Because only one solid charcoal sample was recovered during the 1978 season, several composite samples of charcoal flecks were submitted for analysis in an effort to obtain additional chronological information.

The results of the radiocarbon analysis of five of the nine composite samples, as shown in Figure 34, are relatively homogeneous, averaging between 1680 and 1840 radiocarbon years B.P. between Levels 3-12. This indicates considerable mixing of the deposits, both by rodent activity and by the activities of the prehistoric inhabitants of the site.

Two of the composite dates (GaK-9219 and GaK-9220) from the central portion of the site stand out, however. These two dates--5570 and 5750 radiocarbon years B.P. from Levels 8 and 12 respectively—

TABLE 16. Radiocarbon dates from the Flanagan site.

Sample Number	Laboratory Number	Date Years B.P.	Excavation Level	Excavation Unit	Comments
1	GaK-6574	460 ± 80 (A.D. 1490)	3,4,5	GO GP HO HP IO IP	composite sample; associated with Feature 3
2	GaK-8362	1800 ± 110 (A.D. 150)	3	GM GN HM HL IM HN	composite sample
3	GaK-8363	1760 ± 100 (A.D. 190)	5	GN HN	composite sample
4	GaK-8364	960 ± 100 (A.D. 990)	7	IN	composite sample from Feature 8
5	GaK-8365	1680 ± 130 (A.D. 270)	8	GN HN	composite sample
6	GaK-8366	1780 ± 110 (A.D. 170)	10	GN HN	composite sample
7	GaK-8367	1840 ± 120 (A.D. 110)	12	GN HN	composite sample
8	GaK-8368	3230 ± 150 (1280 B.C.)	6	IJ	solid sample from Feature 7
9	GaK-8369	3300 ± 220 (1350 B.C.)	6	JE	solid sample from Feature 5
10	GaK-8370	840 ± 100 (A.D. 1110)	4	TP 4	solid sample
11	GaK-8371	1720 ± 100 (A.D. 230)	5	TI	solid sample from Feature 1
12	SI-3234	210 ± 55 (A.D. 1740)	11	IO	*Bos* bone sample
13	GaK-9219	5570 ± 180 (3620 B.C.)	8	IP	composite sample
14	GaK-9220	5750 ± 200 (3800 B.C.)	12	IM	composite sample

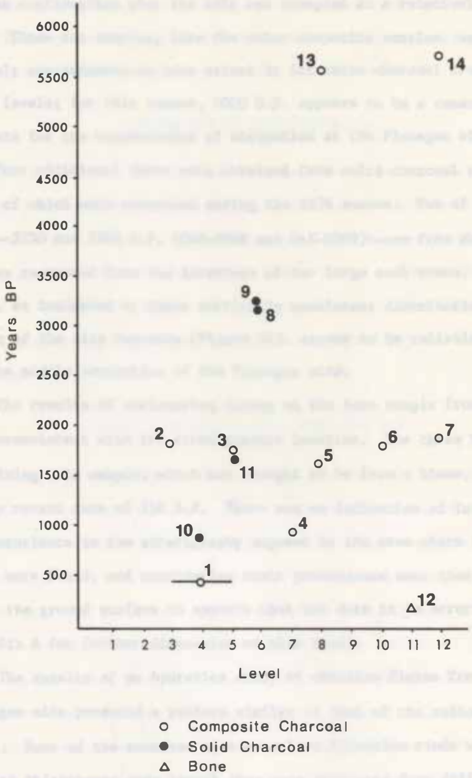


FIGURE 34. Results of radiocarbon dating at the Flanagan site.

provide confirmation that the site was occupied at a relatively early time. These two samples, like the other composite samples, were probably contaminated to some extent by intrusive charcoal from the later levels; for this reason, 6000 B.P. appears to be a reasonable estimate for the commencement of occupation at the Flanagan site.

Four additional dates were obtained from solid charcoal samples, three of which were recovered during the 1976 season. Two of these dates--3230 and 3300 B.P. (GaK-8368 and GaK-8369)--are from charcoal samples recovered from the interiors of two large rock ovens. These dates, as indicated by their vertically consistent distribution at the center of the site deposits (Figure 34), appear to be reliable dates for the middle occupation of the Flanagan site.

The results of radiocarbon dating on the bone sample from Level 11 are inconsistent with its stratigraphic location. The three bones comprising this sample, which are thought to be from a bison, produced a very recent date of 210 B.P. There was no indication of intrusions or disturbance in the stratigraphy exposed in the area where these bones were found, and considering their provenience more than a meter below the ground surface it appears that the date is in error (see Appendix E for further discussion of this find).

The results of an hydration study of obsidian flakes from the Flanagan site produced a pattern similar to that of the radiocarbon dates. Most of the measured specimens have hydration rinds with similar thicknesses even though they were recovered from different excavation levels. This situation obviously reflects mixing of the cultural deposit. At the same time, however, two obsidian specimens from the lower portion of the cultural deposit exhibit hydration rinds of sufficient size to support the radiocarbon dates indicating occupation as early as circa 6000 years ago (Appendix A).

Definition of Site Components

On the basis of the available radiocarbon dates and the chronological trends evident in the artifacts recovered, three cultural components can be defined at the Flanagan site (Figures 35-37). It should be noted that vertical disturbances in the cultural deposit have tended to obscure the differences between the components. The vertical breaks between components are therefore considered approximate rather than definite.

Early Component (circa 4000-6000 B.P.)

The early component at the Flanagan site is best represented by the lowest four levels (Levels 9-12) of the cultural deposit. Bracketing dates of 4000-6000 B.P. are suggested for this component in view of the date of 5750 B.P. at the bottom of the site and two reliable dates of 3230 and 3300 B.P. above this component. This timespan places the initial occupation of the site during the latter portion of the Hypsithermal climatic interval, when climatic conditions were warmer and drier than at present (Hansen 1947:116; Heusser 1960:184).

The timespan of the early component also coincides with the period when the Winkle geomorphic unit on which the site is situated was gradually being abandoned as part of the active floodplain (Balster and Parsons 1968:9). The warmer and drier climatic conditions prevalent at

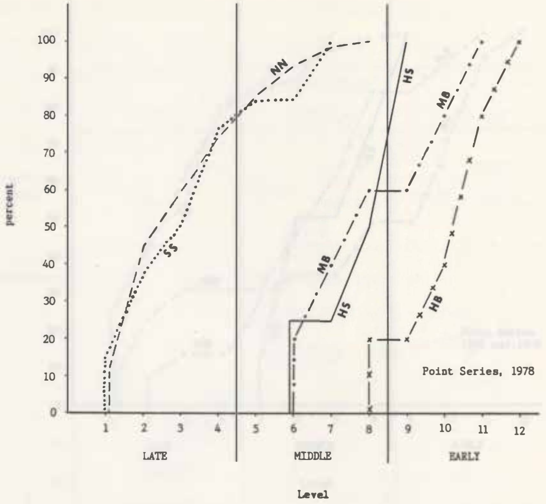


FIGURE 35. Projectile point trends by cumulative percentage for components at the Flanagan site, 1978 excavations.

this time resulted in an expansion of oak trees in the Willamette Valley. These trees were undoubtedly present, along with ash and maple trees, in the nearby site vicinity.

This early component is best characterized by the Heavy Broad-necked projectile point series which is predominant in these levels, but Heavy Stemless points may also be indicators of this temporal span (Figure 35). A small proportion of Moderate Broad-necked points also

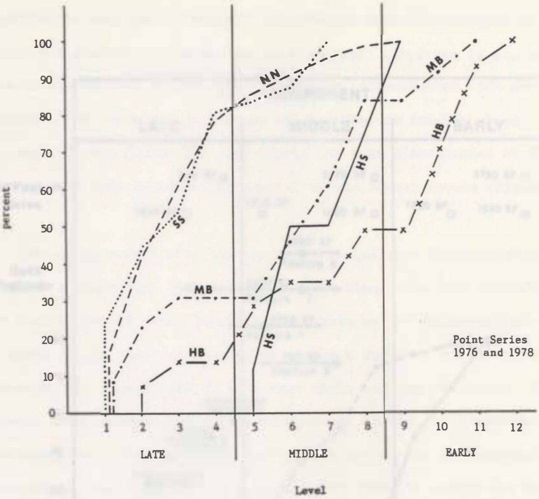


FIGURE 36. Projectile point trends by cumulative percentage for components at the Flanagan site, 1976 and 1978 excavations.

occur in these levels. These points indicate use of the atlatl and dart technology. The presence of these points suggests that hunting, perhaps of large mammals like the bison which is thought to be represented by bones recovered in the lowermost levels, was an important site activity.

Slightly more than half of the ground stone tool assemblage is also found in these lowermost levels, a pattern which gains more

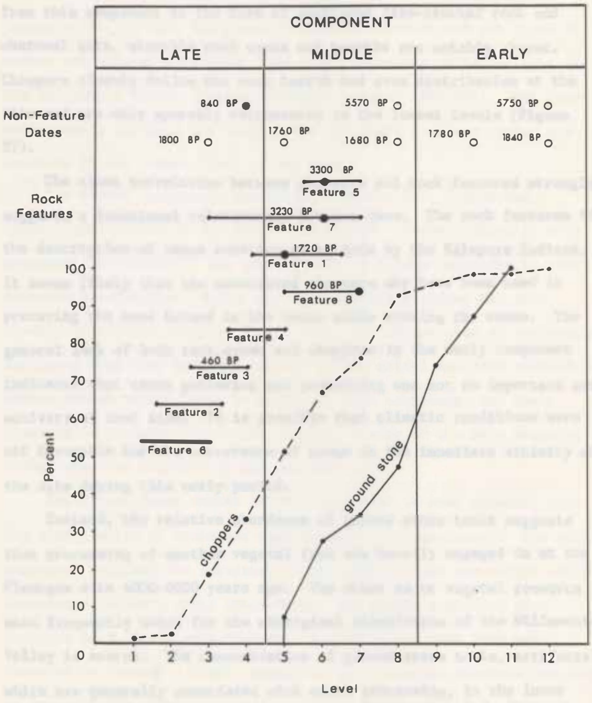


FIGURE 37. Distribution of choppers, ground stone tools, and cultural features for 1976 and 1978 assemblages.

significance when the correspondingly smaller excavation sample is taken into account. Although evidence of small campfires is available from this component in the form of scattered fire-cracked rock and charcoal bits, sizeable rock ovens and hearths are notably absent. Choppers closely follow the rock hearth and oven distribution at the site and are only sparsely represented in the lowest levels (Figure 37).

The close correlation between choppers and rock features strongly suggests a functional relationship between them. The rock features fit the description of camas roasting ovens made by the Kalapuya Indians. It seems likely that the associated choppers may have been used in procuring the wood burned in the ovens while cooking the camas. The general lack of both rock ovens and choppers in the early component indicates that camas gathering and processing was not an important site activity at that time. It is possible that climatic conditions were not favorable for the occurrence of camas in the immediate vicinity of the site during this early period.

Instead, the relative abundance of ground stone tools suggests that processing of another vegetal food was heavily engaged in at the Flanagan site 4000-6000 years ago. The other major vegetal resource most frequently noted for the aboriginal inhabitants of the Willamette Valley is acorns. The concentration of ground stone tools, artifacts which are generally associated with acorn processing, in the lower levels of the site coincides with the latter portion of the Hypsithermal climatic interval when oaks were at their maximum expansion in the Willamette Valley.

Middle Component (circa 2000-4000 B.P.)

The middle component at the Flanagan site coincides with the beginning of the Late Postglacial climatic interval and the onset of cooler and moister conditions like those presently characteristic of the Willamette Valley (Hansen 1947:118; Heusser 1960:186). Oak trees subsequently declined and Douglas fir and other conifers became predominant in the modern flora of the area.

The middle component, encompassing Levels 5-8, represents a transitional period in the site's occupation. Technologically, this component is defined by the predominance of points belonging to the Moderate Broad-necked Series, but Heavy Stemless points are also closely associated (Figures 35 and 36). The larger size of the points indicates that they are also related to the atlatl and dart technology. Narrow-necked points begin to appear in this component, but their presence is probably due to the internal mixing of the site deposits rather than the adoption of the bow and arrow.

The transitional nature of this component is most apparent when the distribution of tools and rock features are considered. The middle component contains the remainder of the ground stone assemblage which presumably reflects acorn processing. The middle component also contains half of the rock features, including the vast rock oven recorded as Feature 7 which represents the strongest evidence available at the site for camas processing. Again, there appears to be a correlation between the occurrence of rock features and the presence of choppers. The dates from Features 7 and 8 (3230 and 3300 B.P.) provide the earliest evidence for camas processing at the Flanagan site. In view of the new evidence for the processing of camas in addition to acorns, it is possible that the vegetation was changing in the immediate area around the Flanagan site. The exploitation of camas suggests that the area had become wetter, a condition which would be consistent with the onset of cooler and moister climatic conditions during the Late Postglacial. A moister climate would probably have increased the ponding of water on the valley floor, creating additional marsh environments suitable for camas.

The dating of the middle component relies heavily on the two dates of 3230 and 3300 B.P. from reliable contexts in the middle levels of the cultural deposit. A beginning date of 4000 B.P. is the best estimate to be proposed at this time, given the disturbance of the site and the lack of reliable dates between 3300 B.P. in this component and 5750 B.P. in the early component. Because of the transitional nature of the middle component, the separation between the early and middle components should not be seen as a definite break, but rather as a gradual shift in site emphasis as local conditions changed. The general lack of narrow-necked points suggests that an upper date of 2000 B.P. is appropriate for the middle component, as shortly after this time these small points become predominant at sites in this region.

Late Component (circa 2000 to 200 B.P.)

The late component, primarily Levels 1-4, is marked technologically by the overwhelming proportions of small points of the Small

Stemless and Narrow-necked series. These series, which follow almost identical frequency curves (Figures 35 and 36), are presumably related to the bow and arrow technology which is thought to have been commonly adopted by 2000 years ago. The Flanagan site is not a good site at which to examine the precise time at which the bow and arrow was introduced because of the internal disturbance apparent within its cultural deposits. It is clear that this event occurred at the site sometime between 840 B.P. and 3230 B.P. The bow and arrow technology was apparently well established by 1720 B.P., as indicated by the radiocarbon date from the small pit recorded as Feature 1. Only narrow-necked points were found in the unit containing this feature above the level from which this date was obtained.

The prevalence of radiocarbon dates in the 1700-1800 year B.P. range suggests there was an increase in the intensity with which the site was used by native peoples during that time. The site was occupied at least until 460 B.P., but was abandoned before the introduction of Euro-American trade items to the region around A.D. 1750.

The late component provides indirect evidence that the vegetation changes apparently in progress during the span of the middle component had been completed. No ground stone tools were recovered from the upper four levels of the cultural deposit, suggesting that acorn processing had not been an important site activity for the past 2000 years. Camas ovens continued to occur in these levels, and three of these features yielded radiocarbon dates falling within this late period of occupation. Choppers also continued to be found in this portion of the site.

The occurrence of both choppers and camas ovens dwindled in the upper two levels of the cultural deposit, however, indicating that use of the site for camas processing was beginning to decline. On the other hand, the relative proportion of projectile points and utilized flakes increases in these uppermost levels, perhaps indicating a shift in use of the site. Instead of use as a base camp where a variety of activities, including plant processing, were carried out, the artifacts recovered from the uppermost levels suggest that in its latest use the site was occupied primarily as a hunting camp.

CHAPTER VII

FLANAGAN SITE IN REGIONAL PERSPECTIVE

The results of the Flanagan site investigations make it possible to strengthen and refine the system of periods and phases recently proposed as an alternative to White's earlier cultural chronology for the Willamette Valley. In fact, the lower component at the Flanagan site represents a previously undocumented span of occupation on the Willamette Valley floor which seems to warrant recognition as a separate phase in the sequence. This chapter will briefly review the cultural sequence for the Willamette Valley (following Minor and Toepel 1981:161-176) with a view toward placing the Flanagan site in a regional perspective.

Organizational Basis

The cultural sequence is intended to serve on a regional scale, encompassing that portion of the Willamette Valley above the falls at Oregon City. Three geographic provinces are recognized in this region. An initial distinction is made between the Cascade uplands, occupied primarily by Molala-speakers, and the floor of the Willamette Valley, the home of the Kalapuya, at the time of historic contact.

The floor of the Willamette Valley is subdivided on the basis of drainage basins into two geographic provinces which correspond with the distribution of two of the Kalapuyan languages: (1) the Middle Willamette Valley, occupied by the Tualatin-Yamhill language group; and (2) the Upper Willamette Valley, occupied by the Santiam-McKenzie language speakers. The Tualatin River sub-basin, although usually assigned by geographers to the Lower Willamette Valley, is herein included within the Middle Willamette Valley, as archaeological research as well as ethnographic and linguistic distributions indicate that its cultural ties are with the Kalapuya of the Willamette Valley rather than with the Chinook of the Lower Columbia region (Davis 1970a; Zenk 1976). The speakers of the third Kalapuyan language, Yoncalla, primarily occupied portions of the Umpqua Basin south of the Willamette Valley which is not included in the present sequence.

The prehistoric sequence in the Willamette Valley consists of five main periods, beginning with the Paleo-Indian and ending with the Historic. The bulk of the archaeological record in this region relates to the Archaic culture stage, which is subdivided into Early, Middle, and Late periods. The chronology of these periods is based primarily on the estimated dates at which changes in projectile points—the most temporally-diagnostic artifacts found in this region--occurred.

The three Archaic periods are divided into six cultural phases, which have been named after the archaeological sites at which they are best represented. These phases have both temporal meaning and areal significance in terms of the geographic provinces within which they are defined (Figure 38). Assignment to the various phases of the major archaeological sites so far investigated in this region is summarized in Table 17.

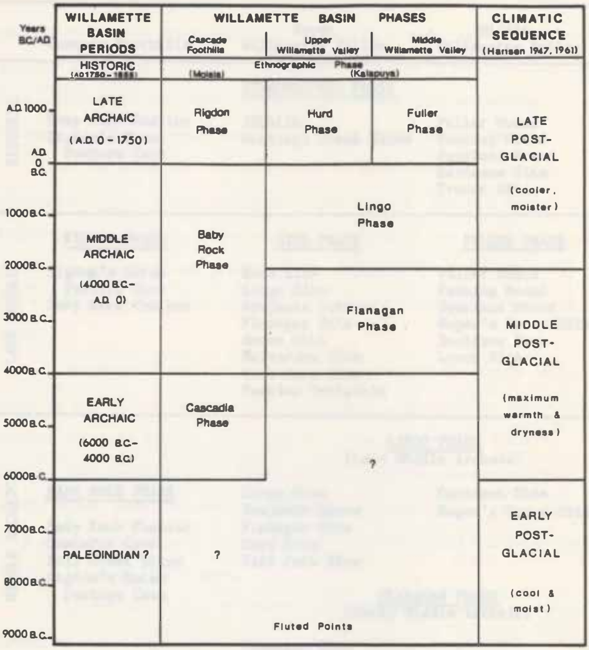


FIGURE 38. Revised cultural sequence for the Willamette Basin (after Minor and Toepel 1981:162).

Table 17. Archaeological sites representing cultural phases.

	Cascade Foothills	Upper Willamette Valley	Middle Willamette Valley
HISTORIC		ETHNOGRAPHIC PHASE	
	Baby Rock Shelter Rigdon's Horse Pasture Cave	35LA118 Gettings Creek Sites	Fuller Mound Fanning Mound Spurland Mound Davidson Site Tracer Site
LATE ARCHAIC	RIGDON PHASE	HURD PHASE	FULLER PHASE
	Rigdon's Horse Pasture Cave Baby Rock Shelter	Hurd Site Lingo Site Benjamin Sites Flanagan Site Beebe Site Halverson Site Kirk Park Site Perkins Peninsula	Fuller Mound Fanning Mound Spurland Mound Hager's Grove Sites Davidson Site Lynch Site
MIDDLE ARCHAIC	BABY ROCK PHASE	LINGO PHASE (Late Middle Archaic)	
	Baby Rock Shelter Cascadia Cave Fall Creek Sites Rigdon's Horse Pasture Cave	Lingo Site Benjamin Sites Flanagan Site Hurd Site Kirk Park Site	Davidson Site Hager's Grove Sites
		FLANAGAN PHASE (Early Middle Archaic)	
		Flanagan Site	
EARLY ARCHAIC	CASCADIA PHASE		
	Cascadia Cave Baby Rock Shelter		

Paleo-Indian Period

The Paleo-Indian period in North American prehistory is characterized by chipped stone artifacts reflecting a major emphasis on the hunting of big game, especially extinct megafauna. Finds relating to this period generally occur in environmental contexts suggesting climatic conditions cooler and moister than those of the present.

There is presently little evidence of human occupation in the Willamette Valley during the Paleo-Indian period. The only finds definitely attributable to Paleo-Indian occupation are a Clovis fluted point recovered from the gravels of the McKenzie River (Allely 1975) and a Folsom fluted point reportedly found near Cottage Grove (Minor 1985).

In the Great Plains and American Southwest, Clovis points often occur in kill sites with the bones of mammoth, giant bison, and other extinct big-game animals where they have been radiocarbon dated to between 9500 and 9000 B.C. Folsom points, generally associated with modern bison, date from 8000 to 9000 B.C. (Haynes 1980). It is generally assumed that fluted points found west of the Rocky Mountains have roughly the same time ranges.

It is not yet clear, of course, what kinds of game animals were hunted by Paleo-Indian peoples in western Oregon. It is worth noting, however, that suggestive, though not conclusive, finds of artifacts in association with mammoths have been reported in the Willamette Valley (Cressman and Laughlin 1941; Cressman 1947). These finds establish the presence in western Oregon of big-game animals of the kind hunted elsewhere by Paleo-Indian peoples.

Early Archaic (6000-4000 B.C.)

The Early Archaic in the Willamette Valley is viewed as a period of initial adaptation to the resources available in the region during the warm and dry conditions characteristic of the Middle Postglacial (Hansen 1947) or Hypsithermal (Heusser 1960) climatic interval. Although evidence of both camas and acorn processing is expected for the Early Archaic period on the flood plain, a greater emphasis on acorn gathering should be evident given the expansion of oaks as reported in pollen profiles from this period (Hansen 1947; Heusser 1960).

The hallmark artifact of the Early Archaic in the Pacific Northwest is the leaf-shaped projectile point, sometimes known as the "Cascade point" (Butler 1961). The Early Archaic in the Willamette Valley is assigned a time range from 6000 to 4000 B.C., based in part on the cross-dating of these leaf-shaped points with those found in other regions of the Pacific Northwest (Leonhardy and Rice 1970).

Evidence of Early Archaic occupation on the Willamette River flood plain is limited for the most part to finds of leaf-shaped points in undated surface contexts. A single feature found on the flood plain at the Hannavan Creek site, a camas oven containing hundreds of well-preserved camas bulbs, has produced a radiocarbon date of 5800 ± 90 B.C., falling within Early Archaic times. Although flakes were found with this feature, no diagnostic artifacts were associated (Cheatham 1984:102). Although this feature clearly indicates the presence of native peoples in the region, definition of a separate phase for occupation on the valley floor during the Early Archaic will have to await the recovery of a larger cultural assemblage which will adequately reflect the prehistoric lifeways during this time.

The Early Archaic in the Willamette Valley is currently represented by only a single phase, which has a geographic distribution limited to the Cascade foothills.

Cascadia Phase

The Cascadia Phase is named after Cascadia Cave, which contains the earliest radiocarbon dated occupation in the Willamette Valley at 5960 ± 280 B.C. (Newman 1966). Another site in the Cascades, Baby Rock Shelter, is also known to have been occupied during this phase (Olsen 1975). At the latter site a few artifacts were found below Mazama ash, the deposition of which is known to have occurred around 5000 B.C. (Randle, Goles and Kittleman 1971).

The cultural content of the Cascadia Phase is based almost entirely on the artifact assemblage from Cascadia Cave. Only limited excavations were carried out at Baby Rock Shelter, and none of the artifacts recovered can be considered culturally or temporally diagnostic. Unfortunately, detailed information on the stratigraphic distribution of artifacts at Cascadia Cave is not available. It is stated in the report, however, that 109 complete leaf-shaped "Cascade points" were recovered, that they were the only type represented in the lower levels of the cave, and that they were found throughout the cultural deposit (Newman 1966:11-13).

A small number of stemmed, broad-necked projectile points also were found in the upper levels of the cave (Newman 1966:14). These specimens relate to the subsequent Middle Archaic occupation of the site. Most of the remaining artifacts found at Cascadia Cave are of uncertain provenience. These include knives, scrapers, drills, modified flakes, hammers, manos and metates, and two edge-ground cobbles.

Fauna hunted by the inhabitants of Cascadia Cave included deer, elk, marmot, rabbit, weasel, and an unidentified species of bird (possibly grouse). The faunal remains suggest a spring or summer occupation. The only floral remains recovered were hazelnuts, which were found in the upper levels of the cultural deposit.

The archaeological remains at Cascadia Cave are interpreted to represent "a relatively simple hunting and gathering culture" (Newman 1966:27-28). The frequency of both artifacts and faunal remains increases from the bottom to the top of the cave's cultural deposit (Newman 1966:18), suggesting a gradual increase in use of the site by native peoples from Early to Middle Archaic times.

The radiocarbon date of 5960 ± 280 B.C. from the bottom of Cascadia Cave is used to place the beginning of the Cascadia Phase at 6000 B.C. An ending date of 4000 B.C. for this phase is tentatively suggested, as radiocarbon dates from sites on the Willamette River floodplain indicate that by this time leaf-shaped projectile points had been replaced by stemmed, broad-necked points as the predominant form in artifact assemblages in this region.

Middle Archaic (4000 B.C.-A.D. 0)

The Middle Archaic in the Willamette Valley is represented by a well-developed adaptation to the resources of the region, with most of the currently available evidence indicating relatively intense occupation on the floor of the Willamette River. Artifact assemblages from this period are characterized by stemmed, broad-necked projectile points, which are assumed to have been used with the atlatl and dart weapon system. Leaf-shaped points are sometimes present in low frequencies in sites dating from this time. Mortars and pestles also constitute an important part of Middle Archaic assemblages, suggesting that vegetal resources were now a significant part of the subsistence practices of the aboriginal inhabitants.

In the original formulation of this cultural chronology, the Middle Archaic was represented by two phases, one in the Cascade foothills and the other on the valley floor (Minor and Toepel 1981:167-169). The rationale for defining two concurrent phases in different geographic provinces was based on the suggestions by Cole (1968) and Grayson (1975) that the Cascade foothills and the valley floor had become separate cultural subareas by this time.

The results of investigations at the Flanagan site indicate that the Middle Archaic is now represented by three phases. One, the Baby Rock Phase, follows the Cascadia Phase in the Cascade foothills. The other two, the Flanagan and Lingo phases, represent early and late Middle Archaic occupation on the Willamette Valley floor.

Baby Rock Phase

The Baby Rock Phase is named after Baby Rock Shelter (Olsen 1975), where artifacts from the middle levels are considered characteristic of this phase. This phase is also represented at some of the sites in the Fall Creek reservoir area (Cole 1968), the upper levels at Cascadia Cave (Newman 1966), and at Rigdon's Horse Pasture Cave (Baxter et al. 1983).

In addition to stemmed, broad-necked projectile points, chipped stone artifacts include knives, scrapers, gravers, drills, and perforators. Cobble tools include choppers, mauls, hammers, manos and unidentified milling stone fragments.

The only radiocarbon date available for the Baby Rock Phase is a date of 500 ± 60 B.C. from the bottom of Rigdon's Horse Pasture Cave (Baxter et al. 1983:37). The chronology of this phase is thus based largely on the general cross-dating of broad-necked projectile points from the dated assemblages on the valley floor.

Flanagan Phase

The earliest established occupation on the valley floor is represented by the early component at the Flanagan site. This component forms the basis for the description of the Flanagan Phase, which is assigned a time range from 4000 to 2000 B.C. based on a radiocarbon date of 3800 ± 200 B.C. from the bottom of the site and dates of 1280 ± 150 and 1350 ± 220 B.C. above this component.

Technologically, the Flanagan Phase is characterized by the predominance of the Heavy Broad-necked point series, but Heavy Stemless (leaf-shaped) points as well as a few Moderate Broad-necked points also occur. Other artifacts unique to this component at the Flanagan site were a cobble celt and an edge-ground cobble.

Occupation during the early Middle Archaic coincided with the latter part of the Hypsithermal interval, when warmer and drier conditions prevailed in the Pacific Northwest (Hansen 1947; Heusser 1960). Pollen profiles indicate an expansion of oak trees in the Willamette Valley during this time. The earliest dated use of acorns in the Willamette Valley is documented at Luckiamute Hearth, which yielded a radiocarbon date of 3300 ± 270 B.C. (Reckendorf and Parsons 1966). The importance of the acorns provided by these oak trees in the subsistence practices of the native inhabitants is also reflected in the relative abundance of milling stones in the early component at the Flanagan site.

Since aboriginal use of camas in the Willamette Valley has now been dated back to Early Archaic times (Cheatham 1984:102), it is obvious that native peoples occupying the region during the Middle Archaic also exploited this resource. No evidence of camas exploitation was found in the lower component at the Flanagan site, however. In view of this situation, it is suggested that the warmer and drier conditions of the Hypsithermal interval may have restricted the extent of camas in the valley. While camas would certainly have still been available in the wetter areas closer to rivers, other resources such as acorns appear to have been of greater importance in drier locales on the valley floor like the Flanagan site. The predominant role that camas played in the subsistence practices of the historic Kalapuya Indians of the Willamette Valley may have developed only with the onset of cooler and moister conditions during the Late Postglacial interval.

Lingo Phase

The Lingo Phase is named after the Lingo site on the Long Tom River near Junction City (Cordell 1967, 1975). In the original formulation of this cultural chronology, the Lingo phase was said to begin by 4000 B.C. on the bases of radiocarbon dates associated with a comparable artifact assemblage at the Flanagan site (Minor and Toepel 1981:169). In view of the fact that the early component at the Flanagan site is now recognized as a separate phase, the dates of the Lingo phase must be revised. Accordingly, a time span from 2000 B.C. to A.D. 0 is now proposed for the Lingo Phase. This revised time span more accurately reflects the age of the sites with components assigned to this phase.

The Lingo Phase is represented in the lower components at the Benjamin sites (Miller 1970, 1975), the Hurd site (White 1975b), the Kirk Park site (Cheatham 1984), and the middle component at the Flanagan site in the Upper Willamette Valley, and the Davidson site (Davis et al. 1973) and the Hager's Grove sites (Pettigrew 1980) in the Middle Willamette Valley. Although minor differences exist between the artifact assemblages from sites in the Upper and Middle Willamette Valley, primarily in terms of varying projectile point type frequencies (Pettigrew 1980:76), the essential nature of the prehistoric lifeways appears to be the same in both geographic provinces. Until indicated otherwise, the Lingo phase is thus believed to have a valley-wide distribution encompassing archaeological manifestations on the valley floor during late Middle Archaic times.

The projectile point sequence at the Flanagan site indicates that the Moderate Broad-necked point series predominates during the time of the Lingo Phase, but Heavy Stemless points also occur. Other chipped stone tools found in Lingo Phase components include knives, drills, scrapers, gravers, reamers, and spokeshaves. Cobble tools include hammers, choppers, anvils, mortars and pestles, and abrading stones.

Unfortunately, faunal remains are poorly preserved at sites on the valley, and thus there is almost no direct evidence of the animals hunted during the Lingo Phase. The scanty evidence available suggests that elk, deer, and various species of small game were all part of the aboriginal diet.

In contrast, evidence of the use of vegetal resources is relatively abundant during the Lingo Phase. Acorns continued to be an important resource exploited at the Flanagan site, as indicated by the continued presence of mortars and pestles in the middle component. In addition, charred camas bulbs and associated ovens have produced radiocarbon dates of 1280 ± 150 B.C. from the Flanagan site, 370 ± 80 B.C. from the Benjamin site (Miller 1975:321), and 95 ± 120 B.C. from the Lingo site (Cordell 1975:283).

The only evidence of a prehistoric house in the Willamette Valley relates to this phase. At the Hurd site, evidence of a pithouse with associated postholes and central hearth was discovered. No artifacts were found within this structure, but the earliest radiocarbon dates from the Hurd site, 850 ± 110 B.C. and 870 ± 230 B.C., were associated with this feature (White 1975b:148-151).

The earliest evidence of mortuary practices in the Willamette Valley also dates to the Lingo Phase. Five burials recovered in the lower levels of the Lingo site are attributed to this phase. All five burials were flexed inhumations which occurred in simple pits. Body orientation was uniformly to the west or southwest. Interestingly, three of the five burials were covered with scattered pebbles. Only one of the burials had grave goods. Associated with an adult female were a pestle and a beaver mandible found near the pelvic region, and a fragment of a marine shell pendant found near the ribs (Cordell 1975: 283-287).

As previously indicated, the time span of the Lingo Phase has been revised, with the phase beginning at 2000 B.C. and ending at A.D. 0. The ending date, which had originally been proposed as A.D. 200, represents a slight revision of the initially proposed sequence; it is tentatively suggested based on the estimated date at which broad-necked projectile points were replaced by smaller narrow-necked points as the predominant form in artifact assemblages in this region.

Late Archaic (A.D. 0-1750)

The Late Archaic represents the culmination of the gradual development of the native cultures of the Willamette Valley. Building upon earlier cultural developments, the Late Archaic witnessed a considerable population growth (at least on the valley floor), an expansion of interregional contacts, and the emergence of a distinguishable regional traditon.

Artifact assemblages from Late Archaic sites are characterized by the presence of small projectile points with narrow neck-widths. Projectile points of this small size are generally assumed to have been used with the bow and arrow.

For the Late Archaic, a separate cultural phase is defined for each geographic province in the Willamette Valley, as archaeological evidence indicates that significant differences exist in the artifact inventories found at sites located in the different areas. All three phases are believed to end about A.D. 1750, which is thought to be about the earliest that Euro-American trade items might have been introduced into the region.

Ridgon Phase

Late Archaic occupation in the Cascade foothills is represented by the Rigdon Phase, which is named after Rigdon's Horse Pasture Cave, located about 30 km south of Oakridge in the Western Cascades (Baxter et al. 1983). This cave contains a sizable Late Archaic component. The uppermost levels of Baby Rock Shelter (Olsen 1975) also contain artifacts representative of this phase.

In addition to small narrow-necked points, other chipped stone tools recovered from Rigdon Phase components include knives, scrapers, and perforators. A stone bowl and several pestles were found in the upper levels of Baby Rock Shelter by relic collectors, and these artifacts can probably also be attributed to this phase.

There is considerable evidence to suggest increased contacts with aboriginal populations outside the Cascades during this phase. Two of the projectile point types found at Ridgon's Horse Pasture Cave and Baby Rock Shelter--Desert Side-notched and Cottonwood Triangular--represent styles common in the Great Basin to the east. Olivella shell beads were also recovered at both of these sites. These finds represent rare occurrences of marine shells in archaeological sites in the southern Willamette Valley.

Hurd Phase

The Hurd Phase is named after the Hurd site in the Upper Willamette Valley near Coburg (White 1975b). Components assigned to this phase are represented in the upper levels of the Lingo site (Cordell 1967, 1975), the Benjamin sites (Miller 1970, 1975), and the Flanagan site, and in all levels of the Beebe site (Follansbee 1975) and the Halverson site (Minor and Toepel 1980, 1982). The phase is also represented at a large number of less intensively investigated sites, resulting in the impression that the valley floor supported a dense aboriginal population in late prehistoric times. The geographic distribution of the Hurd Phase is limited to the Upper Willamette Valley, as the aboriginal inhabitants of the Middle Willamette Valley appear to have participated in a somewhat more elaborate cultural system during the Late Archaic.

The projectile point sequence from the Flanagan site indicates that the Small Stemless series and the Narrow-necked series were the predominant point types during the Hurd Phase. Aside from these small points, the artifact assemblages from components assigned to this phase contain basically the same artifacts as found during the preceding Lingo Phase. Chipped stone tools include knives, scrapers, gravers, spokeshaves, drills, and reamers. Cobble tools include choppers, hammers, anvils, and mortars and pestles.

The basic mortuary pattern observed during the preceding Lingo Phase, flexed inhumations in simple pits, continues to be the usual method of interment. Five burials found in the upper levels of the Lingo site (Cordell 1975:287-288), and single burials from the Hurd site (White 1975b:160) and Simons site (Pettigrew 1975:428) are attributed to this phase. All are flexed inhumations, with five placed on the right and two on the left side. Burial orientation is generally toward the north or west. Grave goods accompanied two of the seven burials. Olivella shell beads and an abalone shell pendant were found around the neck, and clam shells near the elbows and behind the legs of an adult female at the Lingo site (Cordell 1975:288). Six basalt choppers were found with a young adult (sex indeterminable) at the Hurd site (White 1975b:160).

Evidence of increased contacts with other regions during the Hurd Phase is found in the form of the Olivella, clam shells and abalone shell pendant associated with the burial at the Lingo site. In addition, projectile points of the Desert Side-notched type occur in small numbers at the Benjamin site, Site 35LA70, the Gettings Creek sites, and the Halverson site. A single occurrence of the Great Basin point type known as Surprise Valley split-stem was noted at Site 34LA118 (White 1975a:95-96). Although Desert Side-notched points are characteristic of the Great Basin, it should be noted that they are also found during protohistoric times in the Lower Columbia Valley (Pettigrew 1981), from where they could have been introduced into the Upper Willamette Valley.

Fuller Phase

The Fuller Phase is named after Fuller Mound on the South Yamhill River near McMinnville (Laughlin 1943). Components representative of this phase are found in the precontact levels at Fanning Mound (Laughlin 1943) and Spurland Mound (Laughlin 1941), and the upper levels of the Hager's Grove sites (Pettigrew 1980). The upper levels of the Davidson site (Davis et al. 1973) and all levels at the Lynch site (Sanford 1975) are also assigned to this phase, although it should be noted that their location on Little Muddy Creek is geographically transitional between the Upper and Middle Willamette Valley.

The same basic types of chipped stone and cobble tool artifacts representative of the Hurd Phase are also characteristic of the Fuller Phase. The important difference is that some of the sites assigned to the Fuller Phase (notably Fuller, Fanning and Spurland mounds) contain an abundance of antler and bone tools as well. Antler artifacts include digging stick handles, flakers, ear plugs, and fleshing tools. Artifacts made from bone include harpoon heads, projectile points, whalebone clubs, tubular beads, disc beads, poniards, and ear and nose plugs.

For the first time there is evidence of fishing by the prehistoric inhabitants of the Willamette Basin. The presence of fish vertebrae and grooved pebbles believed to be net or line weights at the Fuller and Fanning mounds on the South Yamhill River (Laughlin 1943:220) is consistent with the ethnographic reference that the Yamhill band of the Kalapuya Indians caught salmon in large numbers and prepared them for storage by drying (Coues 1897:811). This suggests that at least some salmon were making it over the falls at Oregon City and into the tributaries of the Willamette River. For the first time there is also evidence, though scanty, of the use of freshwater mussel as a food source (Laughlin 1941:151; 1943:225; Davis et al. 1973:13).

A total of 75 burials have been recovered from components assigned to the Fuller Phase: 41 from Fuller Mound and 18 from Fanning Mound (Laughlin 1943), four from Spurland and four from Miller Mound (Laughlin 1941), six from the Lynch site (Sanford 1975), and two from the Davidson site (Davis et al. 1973). Information on burial position is available in 29 cases, all of which were in flexed positions. In comparison with the Hurd Phase, the inclusion of grave goods with burials was more common during the Fuller Phase. Twenty-three of the 75 burials (31%) possessed accompanying grave goods. The most common items occurring with burials were marine shell beads and various types of antler artifacts. Less frequent were projectile points, mortars and pestles.

Coast-interior trade became intense during the Fuller Phase, most of it probably via the Columbia River. Ornaments manufactured from marine shells traded inland from the coast are almost nonexistent prior to this time. The most common items involved in the coast-interior trade were marine shells, including Dentalium, Olivella, Littorina, Glycymeris, Pelecypod, Acmae, Paphia staminea, Haliotis, Ipitonium, and Turitella. These shells usually occur in the form of necklaces, bracelets and anklets. Other items associated with coast-interior trade were whalebone clubs and composite harpoon points.

Historic Period (A.D. 1750-1855)

The Historic Period in the Willamette Basin witnessed the rapid decline in the native population, the acculturation of the aboriginal peoples to Euro-American ways, and the eventual abandonment of the traditional aboriginal way of life. Archaeological sites in the Willamette Valley occupied during the Historic Period are so few, and the length of time involved is so brief—approximately one century—that only a single cultural phase appears to be represented.

Ethnographic Phase

The Ethnographic Phase encompasses archaeological manifestations in the Willamette Basin dating from the time of historic contact to the final removal of the native population to reservations. The phase extends from approximately A.D. 1750, which is about as early as items of Euro-American manufacture might have been introduced into the region, to A.D. 1855 when the Dayton Treaty was signed between the U.S. government and the Kalapuya and Molala peoples (Mackey 1974).

Archaeological sites known to have been occupied during the Ethnographic Phase are relatively rare. The limited number of sites known to have been occupied at this time is undoubtedly a reflection of the decimation of the aboriginal inhabitants as a result of the introduction of European diseases (Cook 1955; Taylor and Hoaglin 1962;

Boyd 1975).

Archaeological components assigned to the Ethnographic Phase contain items of Euro-American manufacture. These materials have so far been reported at only eight localities: the Fuller and Fanning mounds (Laughlin 1943), Spurland Mound (Laughlin 1941), the Davidson site (Davis et al. 1973), 35LA118 (White 1975a:73,107), the Gettings Creek sites (White 1975a:71,105), the Tracer site (Davis 1978), and the Kirk Park site (Cheatham 1984:106). Artifacts of Euro-American manufacture recovered from these sites include copper ornaments and bracelets, copper tombac buttons, glass trade beads, iron nose plugs, and iron knives. In addition, pictographs of riders on horseback are found at Baby Rock Shelter, indicating some use of this site during historic times (Olsen 1975).

Seven burials with accompanying grave goods consisting of Euro-American materials can be attributed to the Ethnographic Phase. All are found at sites in the Middle Willamette Valley. Six are from Fuller Mound (Laughlin 1943) and one from Spurland Mound (Laughlin 1941). Four of the seven burials follow the traditional mortuary pattern with the skeleton placed in a flexed position. Three interments, all from Fuller Mound, may represent cedar cyst burials, a practice common on the Columbia River at this time (Sprague 1971). Four of the seven burials attributed to this phase exhibited fronto-occipital deformation of the cranium, a custom practiced by the neighboring Chinook of the Lower Columbia River.

Prospects for Refinement of the Cultural Sequence

The foregoing cultural sequence has been proposed with the objective of elucidating both the temporal and spatial relationships between archaeological components in the Willamette Valley. A principal advantage of this cultural sequence is that it provides a flexible context for examining the nature of cultural variation within the Willamette Valley, as well as for assessing the extent to which the prehistoric inhabitants of the region were affected by developments elsewhere in the Pacific Northwest.

The archaeological evidence so far available seems to indicate that the peoples of the Willamette Valley shared a rather generalized culture for most of the prehistoric past. Cultural variation only becomes apparent during the Late Archaic, when significant differences begin to be seen in archaeological assemblages in the Middle and Upper Willamette Valley and the Cascade foothills.

The extent to which these geographic provinces supported different cultures obviously remains to be more fully explicated. Inter-regional differences in culture probably represent divergences from a common background which evolved over time through the geographic separation of aboriginal groups. This situation may account for the cultural subtypes found in the region at the time of historic contact, as represented by the different linguistic divisions of the Kalapuya on the floor of the Willamette Valley, and the perhaps distantly related Molala in the Cascades.

CHAPTER VIII

SUMMARY AND CONCLUSION

The 6000-year record at the Flanagan site represents the longest continuous sequence of occupation so far documented in the Willamette Valley. The distribution of artifacts and cultural features suggests that significant changes took place over time in the activities carried out by aboriginal peoples at the site.

Review of the Flanagan Site Sequence

The early component at the Flanagan site, estimated to date from 4000-6000 years ago, was occupied during the Hypsithermal climatic interval when warmer and drier conditions prevailed (Hansen 1947:116; Heusser 1960:184). Oak trees were at their maximum distribution at this time, and evidence of the exploitation of the acorns produced by these trees is well represented by the mortars and pestles found in the lowermost levels of the site. The overall low frequency of cultural materials in the early component suggests, however, that aboriginal use was relatively restricted. The artifact assemblage from these early levels consists of a limited number of tool types, primarily projectile points of the Heavy Broad-necked series, used flakes, and grinding tools. The limited nature of the tools indicates that the site was probably initially used as both a hunting camp and a locality where acorn processing was carried out.

The occupation represented in the middle component, estimated to date between 2000–4000 years ago, took place at the beginning of the Late Postglacial when the climate of the Willamette Valley became cooler and moister (Hansen 1947:118; Heusser 1960:186). During this period oak trees, which had attained their maximum distribution during the Hypsithermal, were gradually reduced in area in favor of conifers. A corresponding interval of transition seems to be indicated in the archaeological remains found in the middle component. Many of the rock features, interpreted to be camas ovens, occur in this middle component, along with a majority of the cobble choppers and the remainder of the grinding tools. The middle levels thus reflect a dual emphasis on the gathering and processing of both acorns and camas. The increased size and variety of the artifact assemblage also suggests that the Flanagan site saw increased use, perhaps serving as a base camp for summer or fall hunting and food gathering activities.

By the time of the occupation represented in the late component, within the last 2000 years, the climate of the Late Postglacial had become essentially like that in the Willamette Valley today. The absence of milling stones in the uppermost levels of the cultural deposit indicates the cessation of acorn processing, but the continued presence of rock ovens indicates that camas gathering and processing were still being conducted. As was the case in the middle component, an extensive and varied artifact assemblage is also represented during the late occupation of the site, suggesting that the Flanagan site continued to be used as a base camp during much of this time.

The upper two levels of the cultural deposit which are thought to date within the last few hundred years, however, show a tapering off of use of the site for camas processing and a corresponding increase in the proportion of projectile points and used flakes. This situation may indicate a reduction in the local availability of camas and increased use of the site primarily as a hunting camp.

Implications of the Flanagan Site Investigations for the Regional Cultural Sequence

The results of the Flanagan site investigations make it possible to both expand and refine the cultural sequence recently proposed for the Willamette Valley (Minor and Toepel 1981:161-176). The three components defined at the Flanagan site reflect occupation during the Middle and Late Archaic periods in regional prehistory. Significantly, the early component at the site represents the earliest substantial occupation on the floor of the Willamette Valley. This component was used as the basis for defining the Flanagan phase, which represents prehistoric occupation on the valley floor between 4000 and 2000 B.C.

Information obtained from the Flanagan site investigations has also been useful in developing better characterizations of the following Lingo and Hurd phases in the Upper Willamette Valley. The Lingo Phase appears to have been a time of transition corresponding with the change from the warm and dry climate of the Hypsithermal to the cooler and moister conditions of the Late Postglacial interval. At the Flanagan site this change in the local environment was reflected in a shift in subsistence practices from an early emphasis on acorns to a later emphasis on camas. The archaeological record from the Willamette Valley indicates that camas has long been an important food for the native inhabitants. It appears from the evidence at the Flanagan and other sites on the valley floor, however, that the exploitation of camas became most intense within the last several thousand years.

The Flanagan site thus has significance as the first locality so far investigated in the Willamette Valley where shifts in the adaptive strategies of prehistoric peoples can be reasonably correlated with environmental changes which occurred during the transition from the Hypsithermal to the Late Postglacial climatic intervals. Although at least six other major sites on the valley floor known to have been occupied during this time of climatic transition have been investigated (all of the sites of the Lingo phase), none has produced such clear evidence of the response of native peoples to changes in the landscape.

Cultural Position of Prehistoric Willamette Valley Peoples

The earliest aboriginal peoples in the Willamette Valley probably shared a fairly generalized culture with other contemporary peoples in North America. This situation is suggested, for example, by the discovery in the valley of Clovis and Folsom projectile points which are characteristic of the Paleo-Indian Horizon in North America (Allely 1975; Minor 1985). A generalized culture probably persisted among the prehistoric peoples of the Willamette Valley into the Early Archaic, as suggested by the presence in the valley of the leaf-shaped "Cascade" point which occurs widely throughout the Pacific Northwest.

By Middle Archaic times, however, traits highly characteristic of the historic Kalapuya Indians begin to be in evidence in the archaeological record. The most noteworthy of these traits are the frequent use of the rock oven for roasting camas and exclusive use of the flexed burial position. A sense of cultural continuity is also provided by the fact that most of the major sites so far investigated on the valley floor (e.g., the Flanagan, Lingo, Benjamin, Hurd, Hager's Grove and Davidson sites) were first occupied during the Middle Archaic and continued to be used by aboriginal peoples essentially up to historic contact. The appearance of a lifeway similar to that of the historic Kalapuya coincides with the shift from the warmer and drier Hypsithermal to the Late Postglacial and the onset of climatic conditions like those of today.

Although it has sometimes been suggested the Kalapuya peoples of the Willamette Valley were affiliated with the Northwest Coast Culture Area, the archaeological record clearly indicates the interior as opposed to coastal orientation of the prehistoric inhabitants. Beginning in Middle Archaic time the peoples of the Willamette Valley shared most aspects of their lifeways in common with peoples of the interior Columbia Plateau. These correspondences are understandable when it is considered that the prairie grasslands of the Willamette Valley supported many of the same botanical and faunal resources also available in most areas of the Columbia Plateau.

While the environments of the two regions have much in common, the Willamette Valley differs from the Columbia Plateau in lacking dependable runs of anadromous fish. In this regard it has recently been asserted that, contrary to the prevailing interpretation, fish were able to surmount Willamette Falls in sufficient numbers that they could have represented a significant resource (McKinney 1984). Unfortunately, the archaeological evidence so far obtained does not support this idea. The only sites so far investigated that contained evidence of fishing are the Fuller and Fanning Mounds on the South Yamhill River. It is quite likely, however, that the occupants of those sites carried out their fishing not in the South Yamhill River but in nearby coastal streams, a practice documented among the Tualatin band of Kalapuya (Zenk 1976:70). The bulk of the available archaeological evidence clearly indicates that the subsistence strategies of prehistoric Willamette Valley peoples were based on hunting and gathering; fishing was not a major aspect of the diet.

Indications of cultural affiliations with the Columbia Plateau are present in the Willamette Valley as early as Middle Archaic times. Such affiliations are suggested, for example, by the occurrence of edge-ground cobbles in the valley, which in addition to the Flanagan site have also been found on the valley floor at Perkins Peninsula on the Long Tom River (Cheatham 1984:146), as well as at Cascadia Cave (Newman 1966:17) and Horse Pasture Cave (Cheatham 1983) in the Cascade foothills. These distinctive artifacts occur widely throughout the Columbia Plateau, usually in relatively early contexts (Sims 1971).

A further suggestion of early contact with Columbia River peoples is represented by the cobble celt found in the early component at the Flanagan site. These distinctive artifacts have not been previously reported in the Willamette Valley, but they are relatively common in the adjacent Portland Basin section of the Columbia River, where they occur in contexts dating earlier than 1000 B.C. (Pettigrew 1981:116).

More compelling evidence of cultural affiliations between the Willamette Valley and the Columbia Plateau are reflected in the mortuary practices of the two regions. Flexed burial, which is the only form represented in the Willamette Valley from Middle Archaic times until historic times, is also the prevailing mode of interment on the Columbia Plateau during the same time span (Sprague 1971).

From the information presented in this study it is apparent that for most of the prehistoric past the aboriginal peoples of the Willamette Valley had little contact with coastal cultures. Evidence of sustained trade relations with the coast is not found until the Late Archaic and may date for the most part within the last few hundred years before historic contact. The bulk of the evidence of contact with coastal cultures occurs at sites in the Middle and Lower Willamette Valley. Relatively few indications of trade relations with the coast have been found in the Upper Willamette Valley and the Cascades.

It now seems clear, then, that the common assignment of the Willamette Valley to the Northwest Coast Culture Area is in error. The archaeological record in the Willamette Valley clearly demonstrates the interior as opposed to coastal nature of the prehistoric inhabitants. The absence of a significant anadromous fish resource makes the Willamette Valley unique in comparison with the remainder of the Pacific Northwest. Aside from the non-dependability of anadromous fish as a reliable staple, the closest affiliation for most of Willamette

Valley prehistory seems to have existed with the interior Columbia Plateau.

APPENDIX A

HYDRATION ANALYSIS OF OBSIDIAN FROM THE FLANAGAN SITE

By Rick Minor

As part of the analysis of the artifact collection from the Flanagan site, obsidian hydration analysis was carried out on selected specimens from the 1976 collection (Minor 1980). While an obsidian hydration rate which would allow the measurements to be converted into calendric dates had not yet been developed for the Willamette Valley, application of a rate previously established for the adjacent Portland Basin section of the Lower Columbia River Valley (Minor 1977) yielded age estimates suggesting that the total span of occupation at the Flanagan site approached 6000 years.

This magnitude of antiquity for the Flanagan site occupation subsequently received partial support as a result of the acquisition of radiocarbon dates of 3230 B.P. and 3300 B.P. from the middle levels of the cultural deposit. Later, a specific attempt at determining the age of the early component resulted in the acquisition of radiocarbon dates of 5570 B.P. and 5750 B.P. These radiocarbon dates generally support the age estimates previously obtained through the application of the Portland Basin hydration rate to the Flanagan site specimens.

A given hydration rate is applicable only to the climatic zone in which it was established. The hydration rate for the Portland Basin, while useful for purposes of approximation, is thus not directly applicable to the dating of obsidian in the Upper Willamette Valley. The purpose of this study, then, is to propose a hydration rate which is specifically applicable to the Upper Willamette Valley area in which the Flanagan site is situated.

Obsidian Sources in the Upper Willamette Valley

It has long been recognized that much of the obsidian used by the prehistoric inhabitants of the Willamette Valley was obtained from local stream gravels. These gravels are secondary deposits which originate in two different areas. Obsidian pebbles found in the gravels of the McKenzie River on the eastern side of the Willamette Valley have been traced by neutron activation and X-ray fluorescence analysis to the Obsidian Cliffs flow adjacent to the North Sister in the Cascade Range (Toepel and Sappington 1982). Obsidian pebbles and cobbles are also present in the gravels of Inman Creek and other streams entering the Long Tom River on the west side of the Willamette Valley. The original source of this obsidian has not yet been established. The pebbles and cobbles in the Long Tom drainage may have been deposited long ago by streams originating in the Cascades (Baldwin and Howell 1949:122), or the original source may lie in the mountains of the Coast Range to the west (Skinner 1983). The results of X-ray fluorescence analysis of a sample of artifacts from the Flanagan site indicate that obsidian from both of these secondary sources, Inman Creek and the McKenzie River, account for most of the obsidian represented (see Appendix B).

Control of Hydration Variables

Obsidian, a form of natural volcanic glass, absorbs molecular water from its surroundings through a complex process of diffusion, producing an hydration layer which can be measured in thin-section form with the aid of a microscope. The hydration process begins the moment the surface of an obsidian artifact is exposed by flaking and the absorption of water continues at a relatively constant rate. Measurement of the thickness of the hydration layer, then, provides an indication of the time that has elapsed since the surfaces of an obsidian artifact were exposed by flaking (Friedman and Smith 1960).

In addition to time, two other variables are known to affect the hydration process. The first variable, temperature, is controlled in this case by the fact that all of the obsidian specimens examined are from the same archaeological site. The second variable which affects the hydration process is the chemical content of obsidian. Obsidian which differs significantly in terms of its chemical composition has been shown to hydrate at different rates. Because of variation in chemical content, the rate at which obsidian hydrates usually varies between individual sources. This situation has given rise to the current emphasis on the identification of "source specific" hydration rates. The most common approach is to work only with obsidian specimens which have been identified, by means of X-ray fluorescence or neutron activation analysis, as coming from one source (Ericson 1975, 1977). Although sourcing studies have begun to be conducted in the Upper Willamette Valley (e.g., Toepel and Sappington 1982), the specimens used in the present study have not yet been analyzed and their original source(s) thus remain unknown.

Index of Refraction Analysis

A more direct way of assessing the chemical variability of obsidian has been suggested by Friedman and Long (1976), who demonstrated that a high correlation exists between rate and silica content and between rate and refractive index. Silica content is an especially important variable to measure in evaluating the variability of obsidian because silica comprises by far the largest proportion of the chemical content of obsidian. To determine the variability in the silica content of obsidian specimens from the Upper Willamette Valley, the glass-bead method was used (Kittleman 1963; Huber and Rinehart 1966). With this method, the silica content of obsidian may be estimated by means of a curve that correlates the index of refraction of artifical glass beads made from the specimens with chemically determined silica.

A total of 54 obsidian specimens from seven major archaeological sites in the Upper Willamette Valley were tested for silica content using the glass bead method. The specimens were obtained from the Lingo site (35LA29) and three Benjamin sites (35LA41, 42, 43) on the Long Tom River, the Hurd site (35LA44) on the McKenzie River, the Flanagan site (35LA218) on the Willamette Valley floodplain roughly midway between the Long Tom and McKenzie rivers, and the Lynch site (35LIN36) on Little Muddy Creek, a tributary of the Willamette River. The index of refraction of artificial glass made from the obsidian specimens used in this study ranges from 1.482-1.495, with the majority (41 or 76%) measuring 1.486-1.487 (Table 18). The corresponding values for the silica content range from 75.3-72.3%, with 46 specimens or 85% of the sample having indices of 74%.

Since specimens from sites on both the Long Tom and McKenzie Rivers are included in the sample analyzed for silica content, it seems safe to conclude that obsidian from both of these sources is represented. The range observed in the indices of refraction may reflect these different sources. At the same time, however, the overall consistency in the indices of refraction measured on obsidian from the seven different archaeological sites indicates a high degree of uniformity in the silica content of obsidian in the Upper Willamette Valley. The results of this analysis thus suggest that obsidian recovered from archaeological contexts in this area will hydrate at approximately the same rate regardless of whether it was obtained from the McKenzie or the Long Tom River gravels.

Results of Hydration Analysis

In selecting obsidian specimens for hydration analysis from the Flanagan site, an attempt was made to sample each 10 cm level within the cultural deposit. In all, 25 specimens were selected from two 1x1

TABLE 18. Index of refraction of artificial glass beads made from selected obsidian specimens from Upper Willamette Valley sites.

Site/Specimen	Index of Refraction	Site/Specimen	Index of Refraction
35LA29/010	1.486	35LA44/670-D	1.486
35LA29/014	1.483	35LA44/636-I	1.488
35LA29/003	1.487	35LA44/670-F	1.487
35LA29/017	1.486	35LA44/455-E	1.486
		35LA44/670-C	1.486
35LA41/104	1.486	35LA44/660-A	1.487
35LA41/112	1.487	35LA44/636-A	1.486
35LA41/071	1.486	35LA44/496-B	1.486
35LA42/131	1.487	35LA218/013	1.482
35LA42/017	1.487	35LA218/028	1.487
35LA42/078	1.487	35LA218/007	1.487
34LA42/085	1.487	35LA218/003	1.487
		35LA218/016	1.486
35LA43/002	1.489	35LA218/029	1.487
35LA43/019	1.487		
35LA43/089	1.486	35LIN36/100-D	1.486
		35LIN36/104-C	1.492
35LA44/451-I	1.486	35LIN36/150-A	1.486
34LA44/521-A	1.486	35LIN36/62-C	1.495
35LA44/84-H	1.486	35LIN36/144-A	1.482
35LA44/451-A	1.486	35LIN36/143-A	1.485
35LA44/454-E	1.485	35LIN36/202-B	1.484
35LA44/451-C	1.487	35LIN36/152-A	1.486
35LA44/84-D	1.493	35LIN35/190-A	1.487
35LA44/454-F	1.487	35LIN36/96-A	1.482
35LA44/618-B	1.486	35LIN36/140-A	1.487
35LA44/670-H	1.486	35LIN36/122-B	1.487
35LA44/562-F	1.482	35LIN36/108-A	1.487
35LA44/496-F	1.486	35LIN36/130-B	1.487

meter units excavated during the 1976 field season. To prevent an awareness of the provenience of the specimens from biasing the measurements of the hydration layers, each micro slide was assigned a random number. An average of five readings was made on each of the 25 specimens examined, and from these measurements the mean thickness of the hydration layer on each specimen was calculated (Table 19).

A basic assumption of obsidian hydration analysis is that older specimens will have thicker hydration layers than younger specimens.

TABLE 19. Obsidian hydration measurements from the Flanagan site.

Excavation Unit	Slide Number	Excavation Level	Microns
Unit HO	018	1	1.2
	021	1	2.5
	020	2	1.2
	023	3	1.7
	027	4	2.1
	029	4	1.6
	028	5	1.8
	019	7	2.3
	022	7	1.0
	024	7	2.3
	026	7	1.2
	017	9	1.6
	016	11	2.8
Unit MJ	011	1	1.0
	013	1	1.0
	008	2	1.7
	009	2	1.6
	001	3	0.7
	012	3	1.6
	003	7	2.8
	014	8	0.8
	010	9	1.6
	007	10	1.6

It is therfore assumed that specimens with thicker hydration layers will be found in the lower levels of a site in association with earlier cultural materials. Several inconsistencies are noted, however, in the vertical distribution of the obsidian samples from the Flanagan site which were subjected to hydration analysis.

For example, in Level 1, just below the ground surface, one of the specimens (021) has a hydration layer 2.5 microns thick. This layer is much thicker than those obtained from the other obsidian specimens examined from this level. Indeed, the hydration layer on this specimen is one of the thickest found at the site. Likewise, the specimens from the lower levels also show considerable variability. In Levels 9 through 11, measurements range from as thin as 1.6 to 2.8 microns, which is the thickest hydration layer found among the Flanagan site sample.

Deviations from the expected pattern can be attributed to either mixing of the cultural deposit or to the presence of obsidian from more than one source which might be hydrating at different rates. It has previously been shown through glass bead analysis that obsidian in the Upper Willamette Valley is characterized by a high degree of uniformity in terms of silica content. It is thus expected that obsidian in this area will generally hydrate at approximately the same rate, and that inconsistencies in the patterning of hydration readings with increasing depth below surface are primarily a reflection of the mixing of the site's cultural deposit. Sources of this disturbance at the Flanagan site are known to include root intrusions, rodent activity, and probably most devastating, the activities of the aboriginal inhabitants themselves while constructing rock ovens for roasting camas.

Determination of Hydration Rate

Although considerable mixing of the cultural deposit is evident at the Flanagan site, it is nevertheless possible through careful selection to correlate certain of the obsidian specimens and radiocarbon dates in order to calculate a hydration rate. Of the two units from which hydration measurements are available, Unit HO is more internally consistent than Unit MJ. Unit HO is also closer to the units in which the radiocarbon dates were obtained. For these reasons, only measurements from Unit HO were used in calculating a hydration rate. The hydration rate is based on regression and correlation of five obsidian specimens and five associated radiocarbon dates (Table 20).

Although a number of equations that express hydration of obsidian have been proposed (e.g., Clark 1964; Johnson 1968; Meighan et al. 1968), in the present study Friedman's equation has been used (Friedman and Smith 1960; Friedman et al. 1966; Friedman and Long 1976; Friedman and Trembour 1983). Friedman and his co-worker's use an equation of the form $x^2=kt$, where x is the thickness of the hydrated layer in micrometers, k is a constant for given temperature and composition of obsidian, and t is time in years.

The product-moment correlation coefficient for the hydration measurements and associated radiocarbon dates from the Flanagan site is 0.99, which is significant at the .01 level. Analysis by the least squares method (Johnson 1968) was used to determine the regression coefficients from which the hydration rate was obtained. Friedman's equation can be written $x=k^bt^b$ where b, which corresponds to the slope of the regression line, is 0.50. The value of the regression coefficient, b, for the data from the Flanagan site is 0.40. A t-test (Dixon and Massey 1957:194) indicates that this calculated value of b does not differ significantly from 0.50. I follow Johnson (1968) in basing my calculation of k upon the value of 0.50 for b. The hydration rate for obsidian from the Flanagan site calculated in this manner is

TABLE 20. Correlation of obsidian hydration measurements and radiocarbon dates from the Flanagan site.

Specimen Number	Excavation Level	Thickness of Hydrated Layer	Years B.P.	Sample Number
LATE COMPONENT:				
023	3	1.7*	1800 ± 110+	GaK-8362
028	5	1.8*	1760 ± 100+	GaK-8363
MIDDLE COMPONENT:				
	6		3230 ± 150** 3300 ± 220**	GaK-8368 GaK-8369
019	7	2.3		
024		2.3		
EARLY COMPONENT:				
016	11	2.8		
	12		5750 ± 200	GaK-9220

* Mean = 1.75
\+ Mean = 1778 ± 74
** Mean = 3253 ± 124

1.6 μm^2 per 1000 radiocarbon years.

The hydration rate calculated from the Flanagan site data is consistent with the rate of 1.3 μm^2 per 1000 radiocarbon years previously established in the Portland Basin (Minor 1977). The Flanagan site is located more than 100 miles south and is subject to slightly warmer and drier climatic conditions than in the Portland Basin. It thus is reasonable that obsidian at the Flanagan site hydrates at a slightly faster rate.

Establishment of an obsidian hydration rate based on data from the Flanagan site provides a means of dating prehistoric archaeological sites containing obsidian in the Upper Willamette Valley in terms of their radiocarbon age.

APPENDIX B

TRACE ELEMENT ANALYSIS OF OBSIDIAN FROM THE FLANAGAN SITE

by Robert Lee Sappington

Sixty obsidian items from the Flanagan site were analyzed by non-destructive energy dispersive X-ray fluorescence in order to determine their geological source areas. The system employed for this analysis was provided by the Idaho Bureau of Mines and Geology and consists of a Tracor Northern NS-880 instrument, a Nuclear Semiconductor 512 amplifier, a silicon (lithium-drifted) detector with a New England americium 242 100 mCi source and a dysprosium secondary target, attached to a PDP 11/05 computer and a Decwriter II printer. All items were analyzed in air for a 300 second counting period and the intensities of ten trace elements were recorded (Table 21). Four of these elements (Fe, Sn, La, and Ce) are unreliable for determining sources. The remaining six elements (Rb, Sr, Y, Zr, Nb, and Ba) were employed as the variables for SPSS discriminant analysis using the Mahal stepwise method. Comparisons were made with 17 regional sources (Figure 40).

Nearly all (54 or 90%) of the items from the Flanagan site were correlated to three sources at acceptable probabilities (greater than .6800) (Table 22). The Fern Ridge (Inman Creek) source predominated (33 items or 61.1%), followed by the North Sister (15 items or 27.8%) and the South Sister (6 or 11.1 %) sources.

Located 13 km west of Eugene, the Fern Ridge source consists of pebbles and cobbles of obsidian which occur in the bed of Inman Creek and other streams draining into the Long Tom River. This source has recently been described (Skinner 1983) and has been identified as the major source for samples from sites situated near Fern Ridge Reservoir (Sappington 1983, 1984a) as well as for samples from sites located elsewhere in the Willamette Valley (Sappington 1984b, 1984c). Fern Ridge obsidian occurs as float material in a number of locations ranging from the Siuslaw River Valley to as far north as Corvallis. Its widespread availability probably accounted for the popularity of this obsidian with the aboriginal inhabitants of the Willamette Valley.

North Sister obsidian is available both as large nodules in the vicinity of Obsidian Cliffs in the Cascades some 90 km east of the study area, and also as much smaller nodules in the gravels of the McKenzie River near Eugene (Toepel and Sappington 1982:28; Skinner 1983:7). Considering its local occurrence, it is not surprising that this obsidian is second in frequency in the Flanagan site sample. South Sister obsidian occurs approximately 13 km south of the North Sister. South Sister obsidian has not been identified as occurring in streambeds on the valley floor and, therefore, cannot be considered to be a local resource. The infrequent occurrence of South Sister obsidian is undoubtedly a direct result of its relative distance from the study area.

In conclusion, the results of the X-ray fluorescence analysis of obsidian items from the Flanagan site indicates that most of the identified specimens were obtained from the nearby Fern Ridge source. North Sister obsidian was second in frequency; this obsidian was probably obtained from the gravels of the neary McKenzie River rather than by actual visits to the source. Least commonly represented was South Sister obsidian. Unlike the situation with the other two sources, South Sister obsidian was not locally available on the valley floor, and direct visits to the source in the Cascades were presumably required in order to acquire it.

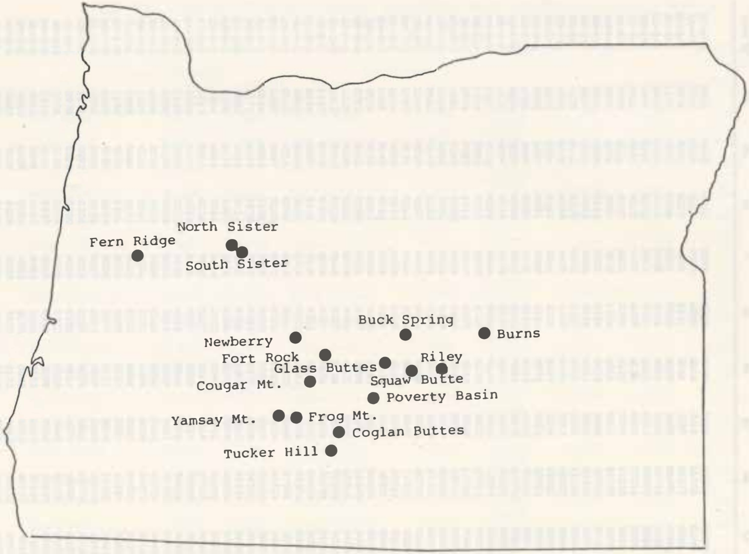


FIGURE 40. Location of sources used for comparison with the sample (scale: 1 inch = 60 miles).

TABLE 21. Trace element intensities for the Flanagan site specimens.

Item No.	Fe	Rb	Sr	Y	Zr	Nb	Sn	Ba	La	Ce
HI-4-2	0854	0078	0128	0034	0202	0085	0050	03211	0000	0065
IK-4-1	0746	0065	0064	0000	0096	0046	0015	01900	0000	0107
GL-5-1	0678	0031	0177	0000	0231	0054	0020	06673	0000	0206
HL-3-4	1173	0072	0196	0000	0292	0090	0009	05891	0000	0006
GJ-5-2	0889	0090	0164	0028	0243	0096	0025	06794	0000	0172
HN-2-3	0967	0104	0172	0014	0312	0086	0042	07950	0000	0138
IK-3-2	0881	0084	0125	0007	0299	0100	0020	07012	0000	0082
GM-6-2	0849	0111	0197	0035	0392	0120	0000	11225	0000	0172
HN-4-3	0701	0100	0099	0020	1320	0066	0010	03583	0000	0063
GN-4-1	0996	0089	0150	0027	0180	0070	0048	04012	0000	0054
GM-2-1	0847	0023	0054	0000	0158	0033	0029	04246	0000	0054
GI-8-1	1129	0130	0238	0052	0357	0104	0067	11156	0000	0188
GN-7-1	1079	0139	0259	0029	0435	0150	0015	08929	0000	0150
JL-2-3	0979	0094	0165	0004	0217	0087	0034	05061	0000	0153
GN-5-1	0763	0027	0071	0000	0114	0075	0018	02912	0000	0002
JJ-4-1	0786	0090	0103	0005	0199	0047	0000	06142	0000	0175
GN-1-1	0825	0027	0108	0000	0153	0064	0078	02773	0005	0127
HL-3-2	1025	0094	0166	0029	0137	0111	0045	04258	0000	0096
HM-8-8	1347	0124	0319	0060	0451	0134	0060	12056	0000	0447
HN-11-7	1329	0082	0333	0040	0707	0139	0028	15318	0000	0157
IM-6-2	0706	0087	1313	0010	0275	0113	0028	11746	0000	0180
GI-8-2	1191	0140	0350	0037	0694	0168	0057	12513	0000	0170
II-7-1	0749	0065	0151	0016	0279	0072	0038	09008	0000	0164
HM-1-1	0681	0140	0163	0048	0330	0116	0049	11393	0000	0000
IM-2-2	1035	0069	0207	0035	0306	0106	0025	06703	0000	0000
GM-7-3	1707	0131	0212	0023	0354	0123	0045	11755	0026	0243
GL-2-1	1134	0096	0174	0030	0320	0110	0030	08534	0018	0188
HM-4-2	1005	0149	0162	0034	0295	0136	0057	08501	0000	0141
IM-6-1	0976	0054	0211	0006	0312	0113	0022	08194	0000	0195
HM-9-6	0787	0043	0156	0011	0307	0096	0061	12349	0000	0120
JI-6-1	1220	0100	0311	0029	0583	0121	0058	10216	0000	0078
II-2-2	1312	0162	0239	0049	0267	0128	0032	07370	0000	0123
GK-6-1	1032	0106	0225	0024	0367	0134	0034	09359	0000	0061
HI-3-3	0728	0087	0121	0028	0222	0115	0055	06809	0051	0165
HL-4-1	0902	0065	0111	0014	0242	0083	0048	05371	0000	0066
JI-2-1	0723	0116	0156	0019	0291	0139	0000	07906	0000	0145
GN-2-1	1029	0067	0165	0012	0256	0100	0038	04716	0000	0116
JJ-5-1	0834	0085	0158	0004	0229	0104	0001	05303	0000	0122
JK-2-1	1173	0124	0178	0036	0242	0075	0049	04722	0000	0061
GJ-2-4	0693	0045	0114	0022	0201	0093	0037	07238	0000	0182
GJ-4-1	1376	0132	0281	0012	0368	0171	0049	08566	0000	0240
GK-1-1	1084	0063	0165	0014	0202	0091	0051	06249	0000	0215
II-2-1	1017	0087	0158	0000	0227	0042	0018	07639	0000	0031
HJ-2-2	1016	0147	0216	0024	0357	0109	0015	09990	0000	0242
IJ-5-2	1198	0073	0172	0028	0255	0084	0022	04610	0000	0000
JK-2-2	1086	0135	0190	0033	0285	0099	0042	07770	0000	0147
GN-2-2	0698	0036	0078	0004	0148	0054	0019	03723	0000	0039
GN-4-2	1316	0101	0167	0021	0271	0089	0009	04473	0000	0114
IL-4-1	1088	0084	0191	0024	0246	0088	0030	04915	0027	0159
IM-1-5	1104	0128	0221	0073	0405	0156	0000	10564	0000	0206
HI-7-5	0984	0150	0192	0009	0407	0133	0018	11365	0000	0190
GI-3-2	0904	0069	0158	0027	0215	0087	0040	05105	0000	0063
GK-5-1	1171	0092	0204	0030	0285	0079	0046	05776	0000	0090
JI-4-1	0978	0116	0200	0026	0338	0112	0071	08761	0000	0240
IM-6-3	1076	0120	0239	0035	0322	0109	0046	08100	0000	0228
GK-2-1	1413	0111	0227	0019	0332	0098	0000	06937	0000	0209
HL-2-1	0911	0096	0167	0042	0305	0152	0024	08334	0000	0271
GN-3-1	0802	0058	0069	0002	0175	0082	0032	04174	0027	0152
HJ-6-4	0802	0139	0204	0055	0333	0123	0047	12422	0000	0135
GN-10-1	0728	0123	0160	0025	0306	0167	0028	10746	0000	0057

TABLE 22. Correlations of Flanagan specimens with obsidian source groups (probability of the fit is indicated by P[G/X]).

	Highest Probability			2nd Highest						
Item No.	Group	P(X/G)	P(G/X)	Group	P(G/X)	Discriminant Scores				
HJ-4-2	Fern Ridge	0.0760	0.7181	Tucker Hill	0.2819	-1.8841 -0.4945	-5.0657	-5.1778	-1.6381	-0.9077
IK-4-1	Fern Ridge	0.0736	0.9941	Tucker Hill	0.0059	-1.8242 -0.1610	-5.9542	-4.0627	-0.4199	-0.3973
GL-5-1	Poverty Basin	0.0000	0.6736	Newberry	0.3264	8.0212 -0.7202	-6.6323	3.5443	-4.3266	-0.8672
HL-3-4	North Sister	0.0290	0.9962	Fern Ridge	0.0028	-3.3403 0.2384	-6.1680	0.0435	-0.2146	0.8154
GJ-5-2	Fern Ridge	0.0095	0.9994	North Sister	0.0006	-2.9816 0.1240	-7.3933	-1.6863	0.1619	-1.6933
HN-2-3	Fern Ridge	0.1263	0.9778	Coglan Buttes	0.0111	-1.8777 0.2609	-5.1517	-1.9667	-1.5338	-0.2417
IF-3-2	Fern Ridge	0.0052	0.7157	North Sister	0.2754	-2.8642 -0.1971	-6.4223	-1.5010	-1.0033	0.5310
GM-6-2	Fern Ridge	0.0384	0.9907	North Sister	0.0085	-2.9355 0.0136	-6.2628	-2.4046	-0.2987	0.1204
HN-4-3	Fern Ridge	0.0001	0.9959	North Sister	0.0041	-2.4080 0.2579	-8.2269	-1.5808	-0.5412	-0.3359
GN-4-1	South Sister	0.0000	0.9994	North Sister	0.0006	-2.9121 0.4260	-9.1464	0.1108	-0.2634	1.9492
GM-2-1	Fern Ridge	0.4472	0.9970	Tucker Hill	0.0030	-1.4326 0.4140	-4.4928	-4.4292	-1.1441	-2.1131
GI-8-1	Fern Ridge	0.0039	0.9974	Tucker Hill	0.0015	-2.6228 -0.0728	-7.0695	-2.8733	-1.1135	0.2835
GN-7-1	Fern Ridge	0.1980	0.9128	North Sister	0.0862	-3.1079 0.0027	-5.4412	-1.3168	-0.3788	-0.7635
JL-2-3	South Sister	0.2701	1.0000	North Sister	0.0000	-2.7105 0.7464	-11.6916	3.7247	0.7588	2.1376
GN-5-1	Fern Ridge	0.2734	0.7991	Tucker Hill	0.1904	-2.6574 -0.6849	-4.4490	-3.3141	-1.7671	-0.1373
JJ-4-1	Fern Ridge	0.0122	0.6793	North Sister	0.3150	-2.8453 0.2041	-6.1670	-1.2954	-0.3377	0.3027
GN-1-1	North Sister	0.2371	0.8626	Coglan Buttes	0.1357	-3.8022 -0.2170	-4.4703	-1.0599	-0.6683	1.6195
HL-3-2	Coglan Buttes	0.0065	0.6096	North Sister	0.3070	-3.0547	-5.3925	-2.0234	-1.3353	1.9704
HM-8-8	North Sister	0.0000	0.9559	Fern Ridge	0.0295	-2.9596 0.5535	-7.9163	-0.0855	-0.1425	0.8074

TABLE 22 (continued)

Item No.	Highest Probability			2nd Highest		Discriminant Scores				
	Group	P(X/G)	P(G/X)	Group	P(G/X)					
HN-11-7	North Sister	0.0000	0.9471	Fern Ridge	0.0501	-4.0817 -0.3313	-8.2592	-2.2145	0.0204	2.6764
IM-6-2	South Sister	0.1712	1.0000	North Sister	0.0000	-2.6022 0.3966	-11.0809	2.2339	0.9215	0.7601
GI-8-2	Fern Ridge	0.0000	0.8834	North Sister	0.1141	-2.8566 0.8513	-8.1166	-0.4644	0.2147	-0.8195
II-7-1	North Sister	0.0008	0.8758	Fern Ridge	0.1212	-3.1487 0.0546	-7.0323	-1.0046	-0.5057	1.0242
HM-1-1	Fern Ridge	0.0001	0.9933	North Sister	0.0067	-2.8813 -0.3186	-8.0693	-2.1650	0.1712	0.2717
IM-2-2	Fern Ridge	0.0498	0.9999	North Sister	0.0001	-2.5353 0.0599	-6.6271	-2.9820	-0.0110	-0.5523
GM-7-3	North Sister	0.0046	0.9854	Coglan Buttes	0.0145	-3.1985 0.1878	-6.1063	0.1464	-1.8794	2.0539
GL-2-1	North Sister	0.0013	0.9954	Fern Ridge	0.0038	-3.3292 0.4134	-6.7077	-0.3430	0.9240	1.4403
HM-4-2	Fern Ridge	0.0004	0.9994	North Sister	0.0006	-2.6634 -0.0671	-7.9078	-2.6339	-0.0004	0.0251
IM-6-1	Fern Ridge	0.0018	0.9968	Tucker Hill	0.0027	-2.1053 -0.2339	-7.1600	-2.9096	-0.8301	0.4408
HM-9-6	Fern Ridge	0.6724	0.9970	Tucker Hill	0.0029	-1.6947 -0.0369	-4.4624	-4.0852	-1.1188	-1.8720
JI-6-1	North Sister	0.0004	0.6511	Fern Ridge	0.3185	-3.4422 -0.4277	-6.7043	-2.0509	-0.6790	1.5934
II-2-2	Fern Ridge	0.0058	0.9999	North Sister	0.0001	-2.2511 -0.0503	-7.3223	-2.7857	0.0331	-0.4155
GK-6-1	North Sister	0.0005	0.9971	Coglan Buttes	0.0018	-3.7422 -0.2877	-7.1496	-0.6335	-0.9183	2.0406
HI-3-3	Fern Ridge	0.0386	0.9443	North Sister	0.0542	-3.5110 -0.6610	-6.1277	-2.1315	-1.0969	-0.0334
HL-4-1	Fern Ridge	0.0458	0.9992	North Sister	0.0008	-2.9484 0.2969	-6.7065	-2.4531	-0.1416	-0.6735
JI-2-1	South Sister	0.0001	1.0000	North Sister	0.0000	-3.3622 0.9522	-10.2032	0.0531	-0.2314	1.9350
GN-2-1	Fern Ridge	0.8914	0.9996	North Sister	0.0002	-2.5703 0.4878	-4.5227	-2.5309	-0.2376	-1.4335
JJ-5-1	Fern Ridge	0.0003	0.9815	Tucker Hill	0.0155	-2.8837 -0.7923	-7.1408	-3.3733	-0.5375	1.1893
JK-2-1	Fern Ridge	0.0115	0.9985	Tucker Hill	0.0007	-2.3259 0.3004	-6.8019	-2.6423	-1.0795	-0.0083

TABLE 22 (continued)

Item No.	Highest Probability Group	P(X/G)	P(G/X)	2nd Highest Group	P(G/X)	Discriminant Scores				
GJ-2-4	Fern Ridge	0.0068	0.9999	North Sister	0.0001	-1.9467 0.3749	-7.2674	-2.5061	-0.4759	-0.5865
GJ-4-1	Fern Ridge	0.0079	0.6183	North Sister	0.2146	-2.5434 0.5170	-5.6957	-1.7963	-1.2344	0.9411
GK-1-1	Fern Ridge	0.4435	0.9969	Tucker Hill	0.0028	-1.7642 0.1074	-5.0520	-2.9400	-1.0653	-0.8803
II-2-1	Fern Ridge	0.3703	0.9777	Tucker Hill	0.0108	-2.4545 0.3524	-4.6653	-2.8287	-0.8183	-0.0956
HJ-2-2	North Sister	0.1884	0.9354	Fern Ridge	0.0642	-3.5963 0.7419	-4.8191	0.2472	-0.0199	-1.4011
IJ-5-2	North Sister	0.0125	0.9994	Coglan Buttes	0.0004	-4.0499 0.1621	-6.5499	0.0351	-0.6478	1.5568
JK-2-2	Fern Ridge	0.0002	0.9916	North Sister	0.0084	-2.6968 0.3666	-7.9775	-1.4835	0.7617	-0.4135
GN-2-2	South Sister	0.6966	1.0000	North Sister	0.0000	-3.1312 0.9344	-10.4765	4.8951	1.7946	0.2028
GN-4-2	South Sister	0.0779	1.0000	North Sister	0.0000	-4.6142 0.2228	-10.0962	1.3825	1.9408	1.6512
IL-4-1	Fern Ridge	0.0208	0.9974	Tucker Hill	0.0026	-2.6648 -0.4610	-6.5155	-3.8542	-0.4396	0.0415
IM-1-5	Fern Ridge	0.0042	0.9987	Tucker Hill	0.0011	-3.0373 0.1638	-6.9081	-3.8831	-0.1674	0.3667
HI-7-5	Fern Ridge	0.2068	0.9999	Tucker Hill	0.0001	-1.5686 0.2342	-5.9516	-3.9147	-0.7093	-2.0187
GI-3-2	North Sister	0.0005	0.9994	Fern Ridge	0.0004	-4.4310 -0.3217	-7.3283	-0.2934	0.6454	1.5582
GK-5-1	Fern Ridge	0.7291	0.9963	Tucker Hill	0.0037	-1.5419 -0.2143	-3.5536	-3.9688	-1.3287	-2.4115
JI-4-1	North Sister	0.0000	0.8330	Fern Ridge	0.0980	-3.6416 -0.0966	-8.5029	-1.1303	0.2738	1.3024
IM-6-3	Fern Ridge	0.0202	0.8436	North Sister	0.1443	-2.5768 0.8222	-5.7964	-1.5279	-0.0658	0.3414
GK-2-1	Fern Ridge	0.0000	0.6065	North Sister	0.3728	-3.0086 -0.1162	-8.6792	-1.2733	-0.2922	0.9625
HL-2-1	North Sister	0.0914	0.8300	Coglan Buttes	0.1609	-3.1807 0.9332	-4.8909	-0.8584	-1.1338	1.2086
GN-3-1	North Sister	0.0821	0.9986	Coglan Buttes	0.0013	-4.4824 -0.0342	-5.6808	-0.3116	-0.1847	1.7656
HJ-6-4	Fern Ridge	0.3905	0.8248	Tucker Hill	0.1749	-0.3988 0.2064	-3.9578	-3.9237	-1.7932	-1.1962
GN-10-1	North Sister	0.5914	0.8824	Coglan Buttes	0.0884	-3.5296 0.5371	-3.8378	-0.6994	-1.1885	-0.0704

APPENDIX C

BOTANICAL REMAINS FROM THE FLANAGAN SITE

by Rick Minor and Christine Pickett

The recovery, identification, and analysis of botanical remains were undertaken at the Flanagan site with the general objectives of obtaining information about the aboriginal use of plants at this locality. The present analysis supersedes the results described in an earlier preliminary report (Pickett 1980).

Floral Setting

The Flanagan site is an open midden which is bounded on three sides by a grove of Oregon ash (Fraxinus latifolia) trees. Additional flora found in the vicinity of the site include a mixture of native and introduced species (Table 23). The area around the site is currently used for raising grass seed and as pasture land.

The earliest descriptions of the area around the Flanagan site are contained in the records of the original cadastral survey undertaken by the General Land Office on January 6, 1853. The area around the site was described as level prairie. In the vicinity of the site there were a series of swales which were "inundated from 1 to 3 feet deep by the Willamette River at high water." The surveyor noted "a few scatterings of oaks with W[hite] ash along the swales" in this area and also observed that "plenty of camus [was] found in these wet places" (Ives 1853:420).

Recovery Methods

Three methods were employed in recovering botanical remains from the Flanagan site. An initial sample of plant macrofossils was obtained during the course of the systematic surface collection carried out during the 1975 and 1976 field seasons in order to define the boundaries of the site. A total of 71 plant macrofossils, or 15% of

TABLE 23. Flora in the vicinity of 35LA218.

Family	Genus	Species	Common Name	Native Plant
Compositae	*Cirsium*	*vulgare*	Bull Thistle	
	Cirsium	*arvense*	Canadian Thistle	
	Crepis	*setosa*	Bristly Hawksbeard	
	Hypochaeris	*radicata*	False Dandelion	X
	Lactuca	*serriola*	Lettuce	
	Senecio	*jacobaea*	Tansy Ragwort	
Cyperaceae	*Carex* sp.		Sedge	X
Geraniaceae	*Geranium*	*dissectum*	Cut-leaved Geranium	
Gramineae	*Phalaris* sp.		Canary Grass	
	Phleum sp.		Timothy	
	Unidentified (4)			
Juncaceae	*Juncus* sp.		Rush	X
Labiatae	*Mentha*	*arvensis*	Wild Mint	X
	Stachys	*rigida*	Hedge Nettle	X
Leguminosae	*Vicia*	*sativa*	Cultivated Vetch	
Oleaceae	*Fraxinus*	*latifolia*	Oregon Ash	X
Onagraceae	*Epilobeum*	*adenocaulon*	Evening Prinrose	X
Polygonaceae	*Rumex*	*crispus*	Curly Dock	X
Rosaceae	*Geum*	*macrophyllum*	Large Avens	X
	Physocarpus	*capitatus*	Ninebark	X
	Rosa sp.		Wild Rose	X
	Spiraea	*douglasii*	Hardhack	X
Saxifragaceae	*Heuchera* sp.		Alum Root	X
Scrophulariaceae	*Veronica*	*americana*	Common Speedwell	
Solanaceae	*Solanum*	*dulcamara*	Bittersweet Nightshade	
Umbelliferae	*Lomatium* sp.		Bisquit Root	X

TABLE 24. Inventory of plant macrofossils recovered during surface collection and from ¼-inch screen.

	Excavation Level										
Plant Species	Surf.	1	2	3	4	5	6	7	8	9	Totals
Wild onion (Allium sp.)			1	1		13	3	1			19
Walnut (Juglans sp.)	3	1									4
Acorns (Quercus garryana)	2	2		2	1					1	8
Wild cherry (Prunus emarginata)	38	108	1		1						148
Klamath plum (Prunus subcordata)	7	49	2		1						59
(Rosa sp.) (spines)		8									8
Prunus sp.)	8	50						1			59
Unidentified	13	3									16
TOTALS	71	221	4	3	3	13	3	2		1	321

the total sample, was recovered in this fashion (Table 24).

A second sample of plant macrofossils was obtained as a result of dry-screening in the field. During the course of the excavations the cultural deposit was passed through 1/4-inch mesh screen. A total of 250 plant macrofossils, or 53% of the total sample, was recovered through the dry-screening process (Table 24).

A third sample of plant macrofossils was recovered by means of the water flotation technique in the laboratory. Four soil columns (one 10x10cm and three 20x20 cm) spanning the depth of the cultural deposit (120 cm) and a single bulk soil sample from a large rock feature (Feature 7) were processed using the water-separation technique described by Struever (1968). A total of 151 plant macrofossils, or 32% of the total sample, was recovered through the water flotation process (Table 25).

Identification of Botanical Remains

Following field and laboratory separation from the soil matrix, all plant macrofossils were grouped according to morphological similarity. Identification of the morphological classes was accomplished through comparisons with herbarium seed reference materials, field reference collections, and seed identification manuals.

Approximately 96% of the recovered botanical remains were identified on at least some level during this study. The collection includes ten genera, four of which are also identifiable as to most likely

TABLE 25. Inventory of plant macrofossils recovered during flotation.

	Excavation Level									
Plant Species	1	2	3	4	5	6	7	8	9	Totals
Wild onion (*Allium* sp.)						6*				6
Rose (spines) (*Rosa* sp.)	29	6								35
Salmonberry (*Rubus spectabilis*)	10	43						1	1	55
Prunus sp.	3	1	1							5
Sedge (*Carex* sp.)	21	9	5							35
Barley (*Hordeum* sp)		1								1
Gramineae (sheaths)	7	2							1	10
Unidentified	1				1			2		4
TOTALS	71	62	6		1	6		3	2	151

* One whole and 2 fragmentary charred wild onion bulbs were recovered from the large rock oven designated Feature 7.

species: wild onion (Allium sp.), wild cherry (Prunus emarginata), Klamath plum (Prunus subcordata), Oregon white oak (Quercus garryana), salmonberry Rubus spectabilis), walnut (Juglans sp.), sedge (Carex sp.), barley (Hordeum sp.), Prunus sp. and Rosa sp. (without species data, the common names for Prunus and Rosa cannot be determined). In addition, one variety of plant macrofossil was identifiable only at the family level, as 19 specimens assigned to the Gramineae (grass) family were found.

All plant macrofossils for which both genera and species data are available are native to the Pacific Northwest (Hitchcock and Cronquist 1973). The Allium and unidentified Prunus and Rosa are very likely native. It cannot be determined on the basis of genus alone if the Carex and Hordeum are native to the region or introduced. In view of the occurrence of these genera only within the uppermost levels of the ~~cultural deposit,~~ however, it is quite possible that the Carex and Hordeum remains represent introduced species. Walnut (Juglans sp.) is definitely an introduced genera.

All genera for which likely species data are available are edible and therefore potential food resources. In addition, many species of Allium, Rosa, Prunus, and Hordeum are edible. Several members of the Graminea family are also known to have been used as foods by aboriginal peoples.

Notes on Identification and Use

Most of the genera and species of plant macrofossils recovered occur widely throughout the Pacific Northwest. In addition, they represent botanical resources commonly exploited by aboriginal peoples. Plants, of course, served not only as food resources, but also for medicinal purposes, as construction materials, and for other uses. While only limited ethnographic data is available for the Kalapuya of the Willamette Valley, it seems reasonable that these people used plants in much the same way as neighboring aboriginal groups. The following brief listing of ethnographic references provides information on the ways in which the botanical remains found at the Flanagan site were used by the Kalapuya Indians and neighboring aboriginal peoples of Oregon and Washington.

Wild Onion (Allium sp.)

Wild onion augmented the diet of aboriginal peoples much as it adds variety to our diet today. The onion was eaten raw by the Kalapuya (Jacobs et al. 1945; Hartless 1974:43) and by the Indians of western Washington (Gunther 1974:24), and was cooked by the pit roasting method by the Sanpoil and Nespelem of northeastern Washington

(Ray 1933:101). The Indians of western Washington also used wild onion for medicinal purposes (Gunther 1974:24).

Wild Cherry (Prunus emarginata)

The Kalapuya ate wild cherries, presumably fresh, as it is not recorded that they were stored or specially prepared in any way (Hartless 1974:43; Zenk 1976:88). The Indians of western Washington used the bark of the wild cherry tree on imbricated baskets, and as a wrapping for fish spears and fire drills. Some groups chewed the bark to facilitate childbirth; others boiled the bark and drank the liquid as a laxative or as medicine for colds. Rotten cherry wood was also mixed with water and drunk as a contraceptive (Gunther 1974:37).

Klamath Plum (Prunus subcordata)

The wild plum was eaten by the Klamath Indians both fresh and dried (Coville 1897:99). The plum was sometimes pitted before being dried for storage (Spier 1930:165).

Oregon White Oak (Quercus garryana)

Two methods of leaching acorns from the Oregon white oak to prepare them for consumption have been recorded for the Kalapuya. One method was to roast the acorns in hot coals in the ground until they cracked. The acorn meat was then dried, later leached in water in a soft skin bag for a day or two, and then boiled prior to consumption (Jacobs et al. 1945:20). The second method involved keeping pulverized acorns submerged in water in a basket for several months (Zenk 1976:61).

Salmonberry (Rubus spectabilis)

The salmonberry was eaten either fresh or dried by the Kalapuya (Hartless 1974:43) and many other aboriginal peoples in the Pacific Northwest (Gunther 1974:35). The berries could be simply dried in the sun (Jacobs et al. 1945) or cooked to a pulpy mass, formed into cakes, and then dried (Hartless 1974:43). In addition, the sprouts of the salmonberry bush were eaten as greens by the Kalapuya (Zenk 1976:94) and other native peoples (Gunther 1927; Olson 1936; Drucker 1951). The leaves and bark of the salmonberry bush were also recognized fro their astringent property and were used medicinally by the Indians of western Washington (Gunther 1974:35).

Sedge (Carex sp.)

No references to sedge as a food resource were found in the ethnographic literature. The leaves of sedge were woven into mats by the Klamath (Coville 1897:92) and into baskets by the Makah (Gunther 1974:22).

Grasses (Gramineae)

Various species of Gramineae were used in a wide variety of ways by the aboriginal peoples of the Pacific Northwest. Lacking species identification for the specimens from the Flanagan site, it is not possible to determine the particular ways in which grasses may have been used at this site. It is worth noting, however, that Agrostis, Beckmania, and Elymus, all grasses thought to be native to the Willamette Valley (Franklin and Dyrness 1973:110-122), produce seeds which were eaten by the Klamath Indians (Coville 1897:91-92; Spier 1930:163, 166). The leaves of Juncus, another grass thought to be native to the Willamette Valley, were woven into mats by the Klamath (Coville 1897:92) and into baskets by the Quinault (Gunther 1974:23). The sprouts of Juncus were eaten raw by the Snoqualmi and the bulbs were eaten raw by the Swinomish (Gunther 1974:23)

In addition to the botanical remains discussed above, the processing of camas (Camassia quamash) was an important activity at the Flanagan site as indicated by the presence of numerous rock ovens. Camas was a staple food of the Kalapuya and the use of rock ovens for preparing camas bulbs is commonly described in the ethnographic literature (Jacobs et al. 1945:18-19; Hartless 1974:43; Zenk 1976: 53-56). Several small charred bulbs recovered in association with the largest rock oven (Feature 7) at the site were tentatively identified as camas in the preliminary report (Pickett 1980:50). Most of these small charred specimens have now been identified as wild onion (Allium sp.) bulbs. It is possible, however, that camas is represented among the unidentified charred remains.

Discussion

The botanical remains contained in the plant macrofossil collection from the Flanagan site may have been introduced into the cultural deposit by one or more of the following processes: (1) as the direct result of the collection, processing and use of plants by aboriginal peoples; (2) as the indirect result of the use of the plants, rather than the seeds, fruits or nuts, for various purposes by aboriginal peoples; and (3) by burrowing animals or from the natural seed rain (Minnis 1981:145).

All genera represented in the plant macrofossil collection are among the contemporary flora in the site vicinity. In view of this fact, it is quite likely that a sizable portion of the recovered plant macrofossils may have been introduced into the cultural deposit by natural processes rather than aboriginal activity. Because of the problem of distinguishing plant macrofossils associated with aboriginal occupation from those introduced by other processes, some ethnobotanists prefer to consider only charred botanical remains as valid evidence of aboriginal plant use. Of the plant macrofossils in the collection from the Flanagan site, only the wild onion bulbs and acorns are consistently charred.

The problem with only accepting charred remains as valid evidence of aboriginal plant use, of course, is that many genera were eaten raw or otherwise used without being burned. This is particularly the case with native fruits and berries. While certainly not foolproof, another way to weed out (so to speak) the genera least likely to have been associated with aboriginal occupation is to set aside all plant macrofossils found only in the uppermost levels of the cultural deposit. For example, if all of the botanical remains found above Level 3 (within 30 cm of the ground surface) are excluded, the genera that are left include wild onion, acorn, wild cherry, Klamath plum, unidentified _Prunus_, and specimens of the Gramineae family.

The ripening time or seasonality of botanical remains recovered from archaeological deposits is commonly used to estimate the time of year at which a site was occupied. The seasonal availability of the plant macrofossils considered most likely to have been used by aboriginal peoples—wild onion, acorns, wild cherry, salmonberry and Klamath plum—ranges from summer to fall. Considering the presence of mortars and pestles generally associated with acorn processing and the discovery of numerous rock features which fit the description of camas baking ovens, occupation at the Flanagan site seems to have been strongly focused on the exploitation of acorns and camas. Both of these genera were available throughout the warmer months of the year, although there may have been some tendency for more intense exploitation of these resources in the fall at which time provisions were being stockpiled for the winter.

Summary

From the foregoing review of the ethnographic literature as well as the provenience and condition of the botanical remains, it seems that the wild onion, wild cherry, Klamath plum, salmonberry, and acorns would have been the most likely to have been deposited as a result of direct resource use by the site's inhabitants. Whether the remaining specimens were associated with aboriginal occupation, introduced by rodents, or a result of the natural seed rain is problematical. The nature of the botanical remains recovered is consistent with interpretation of the site as a seasonal base camp occupied during the summer and fall.

Acknowledgements

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APPENDIX D

FAUNAL REMAINS FROM THE FLANAGAN SITE

by Ruth L. Greenspan

The faunal collection from the Flanagan site includes 441 fragments of bone, 36 fragments of tortoise shell, and two pieces of freshwater shell. Most of the specimens are highly fragmentary and many have been altered from exposure to fire or from contact with acidic sediments. In this analysis all of the faunal remains were considered for identification, and all specimens were identified to the lowest possible taxonomic unit.

Faunal remains recovered during the 1975 and 1976 field seasons, including all of the birds identified to the species level, were analyzed by Donald K. Grayson using comparative skeletal collections available at the University of Washington. Faunal materials found during the 1978 field season, which were more restricted in nature, were identified by the author using comparative collections housed at the Condon Museum of Geology, University of Oregon.

The distribution of taxa identified in the faunal collection from the Flanagan site is shown in Table 26. The data are presented according to 10 cm excavation levels, with the exception of faunal materials collected from the surface and the 0-5 cm level during the 1975 field season. The numbers in the table represent element counts. Minimum number of individuals (MNI) is not shown, because with only a few exceptions it was never greater than one for any given provenience unit. The taxonomic terminology in the following discussion follows that of Robbins (1966) and Maser and others (1984).

Large Mammals

Large mammals inhabiting the Willamette Valley at the time of historic contact included elk (*Cervus elaphus*) and two subspecies of deer, black-tailed (*Odocoileus hemionus columbianus*) and white-tailed deer (*O. virginianus leucurus*) (cf. Bailey 1936:81-91). No remains

TABLE 26. Inventory of faunal remains from the Flanagan site.

	Excavation Level														
Category	Surf	½*	1	2	3	4	5	6	7	8	9	10	11	12	Total
Large Mammals															
Deer				10	3	1									14
Artiodactyl tooth							1								1
Unident. large mammal				2	1	10	9	3	4	1	3	2			35
Bison**												1	1	1	3
Small Mammals															
Dog or coyote				1	10	2									13
Beaver											1				1
Muskrat			4				1								5
Gopher					1										1
Vole	11	27	5												43
Shrew		2													2
Medium-sized rodent					1										1
Unidentified rodent													1		1
Small mammal or bird							5		1	2			3		11
Unidentified mammal				4	3	16	13	5	2	3			1		47
Birds															
Mallard	10	1													11
Teal	1														1
Wood duck	1														1
Duck-sized bird						1									1
Blue grouse		8													8
Grouse or pheasant			5												5
Red-winged blackbird	2	10													12
Small bird							1								1
Tortoise Shell								36							36
Freshwater Shellfish		1								1					2
Introduced Fauna															
Horse			1		1										2
Cow		1													1
Human Teeth				1		1									2
Unidentified	5	71	10	2	23	13	32	12	14	5	11	4	15	1	218
TOTALS	30	121	25	20	43	44	62	56	21	12	15	7	21	2	479

* ½ = 0-5 cm below surface, 1975 season

** for discussion of bison finds, see Appendix E definitely attributed to elk were identified. Fourteen elements, all of which are teeth, were identified as deer. Of these, eight are referred to as "Odocoileus cf. hemionus" while the others are simply referred to Odocoileus sp. Nine of these deer teeth were recovered in close proximity to the hearth recorded as Feature 3 which yielded a radiocarbon date of A.D. 1490.

A single tooth identified only as "artiodactyl" and 35 elements classified only as "large mammal" presumably also represent the remains of deer or elk. Other faunal elements attributed to large mammals include a humerus and two other fragmentary bones recovered from the bottom of the cultural deposit which are believed to be from bison (see Appendix E).

Small Mammals

Thirteen elements from dog or coyote were recovered. Two teeth are most likely from coyote (Canis latrans). The remaining elements, which include five skull fragments, a mandible, three teeth, a vertebra and an ulna were all recovered in the same unit/level. The cusp pattern on the teeth suggests that they may represent domestic dog (Canis familiaris).

The rest of the small mammals identified are rodents of various sizes. Remains of large rodents include five elements identified as muskrat (Ondatra zibethicus) and a single tooth from a beaver (Castor canadensis). Remains of small rodents, most of which were probably intrusive in the cultural deposit, include 1 element from a gopher (Thomomys sp.), 41 elements from voles (Microtus sp.), and 2 elements from shrews (Sorex sp.). Among the vole remains are 13 elements specifically identified as from long-tailed voles (Microtus longicaudus) and one from Townsend's vole (Microtus townsendi).

Eleven elements are classified as from either small mammals or birds. These elements consist of long bone fragments of a size and texture consistent with hares or rabbits or of duck-sized birds.

Birds

A variety of birds is represented in the faunal collection. Waterfowl remains include 11 elements from mallards (Anas platyrhynchos), one element from a teal (Anas sp.), and one element from a wood duck (Aix sponsa). Other bird remains include 8 elements from a blue grouse (Dendragopus obscurus), 12 elements from a red-winged blackbird (Agelaius phoenicaus), and five elements from an immature galliforme. The latter remains were found within 10 cm of the ground surface and thus could represent either native grouse or introduced pheasant.

Tortoise

The faunal collection includes 36 fragments of tortoise shell. These were all recovered in the same unit/level and thus presumably represent only one individual.

Freshwater Shell

Freshwater shellfish are represented in the faunal collection by two fragments. These fragments are too small to permit identification even on a very general level.

Introduced Fauna

The remains of two animals introduced in historic times by Euro-Americans were recovered at the Flanagan site. These include two elements identified as horse (Equus sp.), a tooth found in Level 1 and an unidentified element found in Level 3. A single tooth from a cow (Bos taurus) was collected from 0-5 cm below surface during the 1975 field season. Additional bovid remains recovered from 100-120 cm below surface are thought to represent native bison (see Appendix E).

Human Remains

Human remains recovered from the Flanagan site were limited to two teeth. One is a molar from an adult and the other is an incisor from a juvenile.

Conclusions

Identification and analysis of the animal remains recovered from archaeological sites in the Willamette Valley are generally limited by their poor preservation in the acidic soils of the region. The faunal assemblage from the Flanagan site is fairly typical in this respect. Of the 479 faunal elements recovered, approximately 46% were totally unidentifiable and another 20% could only be assigned to general classes of mammals or birds.

The poor quality of the preservation is also reflected in the fact that approximately 84% of the faunal remains were recovered in the upper 60 cm of the cultural deposit. Presumably, most of the animal remains associated with earlier occupation at the site have already decomposed. This situation indicates, of course, that the bulk of the faunal remains recovered reflect subsistence practices within only the last few thousand years.

The faunal assemblage from the Flanagan site and other sites on the floodplain appear to represent a generalized hunting pattern as reflected in the occurrence of animals associated with both terrestial and aquatic habitats. The content of the faunal assemblages seems to indicate an emphasis on large mammals. Given the poor bone preservation, however, it is not unlikely that the samples are biased in favor of large mammal remains, the bones of which tend to preserve better than do those of small mammals and birds.

Because of the generally poor preservation of faunal materials, relatively few animals have been identified in the faunal collections from previously excavated sites on the Willamette Valley floodplain. Only elk, deer, bear, beaver, squirrel, hare, mouse, and various species of birds have been previously identified (White 1975:33; Sanford 1975:270). The presence of several animals at the Flanagan site not previously reported, including dog or coyote, muskrat, grouse, tortoise and most notably bison, considerably expands the range of fauna known to have been exploited by the prehistoric inhabitants of settlements on the Willamette Valley floodplain.

For the most part the taxa represented in the faunal assemblage from the Flanagan site are available in the general site vicinity today. The only exception is the bovid bones recovered from the lowest levels which are thought to be from bison. The faunal assemblage does not provide any clearcut clues as to season of occupation, although the presence of waterfowl bones could be interpreted to give slightly greater weight to the idea of use of the site during the fall.

APPENDIX E

AN ARCHAEOLOGICAL OCCURRENCE OF BISON AT THE FLANAGAN SITE

by Rick Minor

During the last week of excavations in the 1976 field season at the Flanagan site, three large bones were recovered near the bottom of the cultural deposit. Although the identification and dating of these bones is not as clearcut as would be desirable, there is reason to believe that the remains of a bison were represented. If this interpretation is correct, this find constitutes the first reported archaeological occurrence of bison west of the Cascade Range in Oregon.

Description and Identification

Because of their size and weight, the three bones in question were initially assumed to be those of an elk, the largest mammal generally associated with prehistoric archaeological sites in the Willamette Valley. Subsequent analysis of the small faunal collection recovered during the 1975 and 1976 field seasons by Donald K. Grayson of the University of Washington indicated, however, that the bones were actually those of a bovid, either a bison (*Bison* sp.) or a cow (*Bos taurus*). Unfortunately, the postcranial skeletons of bison and cows are very similar, and isolated elements are difficult to assign to one animal or the other (Olsen 1960:3).

The three bones in question were catalogued in the faunal collection from the Flanagan site as specimens B-41, B-43, and B-46. Specimens B-41 and B-46 were highly fragmentary and were never identified as to specific element. Specimen B-41 was classified as "unidentified" by Grayson, but Specimen B-43 was assigned to the order Bovidae.

Specimen B-43, the largest and most complete of the three bones, was identified as a bovid humerus. The total length of this element could not be determined, but the maximum length of this fragmentary specimen was 22 cm. The only other meaningful measurement which could be obtained was that of the anterior-posterior section, which was a minimum of 4.75 cm and a maximum of 7.85 cm cross-section.

Specimen B-43 was thought by Grayson to more likely have been from a cow than a bison, and was identified by him as "Bovid: cf. Bos taurus":

> Not only is the humerus very lightly built for Bison, but the morphology of the posterior edge of the lateral epicondyle agrees with Bos, not Bison. This latter character seems quite reliable: not only have I found it to separate Bison and Bos, but Olsen uses it in his key to these two genera (Grayson, personal correspondence, December 21, 1976).

Grayson later elaborated further on the identification of this element:

> The comparative material for bovids which we have here is primarily Bison, with some Bos. Most of the Bison which we have came from sizeable animals. The trait I used to refer the element in question to Bos--the morphology of the posterior border of the distal edge of the shaft, immediately proximal to the (missing) lateral condyle--is reflecting, in part, the robusticity of the animal. It is possible that, with a large comparative series (Berkeley may be the closest) a small Bison would show the morphology of this specimen. It was for that reason that I only referred the ~~specimen~~ to Bos ("cf.") (Grayson, personal correspondence, January 4, 1976).

In an effort to obtain a more precise identification, Specimen B-43 was then sent for examination to S. David Webb, Curator in Vertebrate Paleontology at the Florida State Museum. The result of this second attempt at identification was also inconclusive:

> I am afraid I can shed little useful light on your study, however. The specimen is the right humerus of a mature bovid. The epiphyses are sealed, and in Bison the proximal end is not sealed until the fifth or sixth year. The size of this element suggests that it belonged to Bos rather than Bison, but there is very broad overlap between the two. No character of this humerus clearly distinguishes it from one or the other (Webb, personal correspondence, May 4, 1977).

In summary, Specimen B-43 was identified as a humerus from a mature bovid. Both Grayson and Webb observed that the size of the element was more typical of Bos than of Bison. Both faunal consultants also noted that there is considerable similarity in the postcranial elements of these animals. Indeed, as noted by Webb "isolated bones of Bos and the latest Pleistocene Bison cannot usually be distinguished" (Webb, personal correspondence, January 5, 1977).

Stratigraphic Context

The identification of faunal remains from archaeological sites dating from the protohistoric and early historic periods as belonging to bison must be carefully evaluated, because of the possibility that the remains of domestic cattle have been misidentified as bison (Schroedl 1973:7). A single element identified as from a cow was recovered within five centimeters of the ground surface in Unit QD at the Flanagan site. The three bones which are thought to be from bison were found 14 meters away and almost one meter below the location of the cow bone.

The three bovid bones were found together and appeared to the author at the time of their discovery and removal to have been articulated. The bones were recovered from adjacent 10 cm levels in adjacent 1 by 1 m excavation units. Specimens B-41 and B-43 were found in Levels 10 (90-100 cm) and 11 (100-110 cm) below surface, respectively, in Unit IO. Specimen B-46 was found in Level 12 (110-120 cm) below surface in Unit HO.

The bovid bones were recovered near the bottom of the cultural deposit, which in this area of the site occurs at about 120 cm below surface. In terms of site stratigraphy, the bones were found near the junction of Stratum 2, the lower of the two cultural strata defined at the site, and Stratum 3, the culturally-sterile deposit which underlies the site.

The sediments at the Flanagan site consist of clay loam which is highly compact. These sediments have obviously become mixed to some degree as a result of both natural processes (e.g., root growth and rodent digging) and the activities of the aboriginal occupants themselves (notably in the excavation of rock ovens). There was no indication in the stratigraphy exposed in the pertinent excavation units, however, to suggest that the bones might have been accidentially introduced into the lower levels of the cultural deposit.

In summary, the bovid bones were recovered below approximately one meter of compact clay loam. There was no indication in the site stratigraphy to suggest disturbance on a scale which would have been required to move skeletal elements as large as the bovid bones to near the bottom of the cultural deposit. On stratigraphic grounds, then, the bovid bones were definitely associated with the early occupation at the Flanagan site.

Dating

In an attempt to resolve the controversy as to whether the bovid bones were those of a bison or a cow, the specimens were submitted for dating to the Radiocarbon Laboratory at the Smithsonian Institution. A date of 210 ± 55 radiocarbon years: A.D. 1740 (SI-3234) was obtained (Stuckenrath, personal correspondence, September 20, 1978).

Although this date suggests a prehistoric age for the bovid bones, it is sufficiently recent so that at two standard deviations it falls within the historic period when domestic cattle were introduced into the Willamette Valley. The results of the radiocarbon dating are thus somewhat ambiguous and do not conclusively demonstrate whether the bovid bones are from a cow or a bison.

The radiocarbon date obtained from the bovid bones is also inconsistent with other dates and the general chronology of prehistoric occupation at the Flanagan site. The stratigraphic position of the bones in Levels 10-12 places them in association with the Early Component. Radiocarbon dates of 5570 B.P. (GaK-9219) from Level 8 and 5750 B.P. (GaK-9220) from Level 12 are thought to accurately reflect the age of this component, which was assigned an overall time range from 4000 B.P. to 6000 B.P.

Distribution of Bison in Oregon

The known distribution of bison in Oregon is generally assumed to have been confined to the southeastern corner of the state. The bison in this area, as well as in adjacent areas of northern Nevada and northeastern California apparently became extinct around the time of historic contact. Living bison apparently were never observed first-hand by Euro-Americans in these areas, but bison were well remembered in the folklore of the native inhabitants. The former presence of bison was also indicated in the form of skeletal remains of recent age found in these areas.

At the time of historic contact, bison appear to have been most numerous in Oregon around Harney and Malheur Lakes and the Owyhee and Malheur Rivers (Bailey 1923; 1936:57-59). From Oregon the distribution of bison extended eastward into the Snake River region of Idaho, which was the most favorable habitat for these animals west of the Rocky Mountains (Butler 1978). Within Oregon, bison were known to range as far west as Goose and Warner Lakes (Bailey 1936:59-60). From there the distribution of bison extended southward into northern Nevada and northeastern California (Merriam 1926). The western limit of the bison range in northeastern California may have reached the crest of the Sierra Nevada mountains (Riddell 1952).

Bison were much more widespread in Oregon in prehistoric times, however, as indicated by both paleontological and archaeological evidence. The remains of both the extinct form of larger bison (Bison Antiquus) and the smaller modern form (Bison bison) have been reported. Remains of the extinct form have been found in both eastern and western Oregon, but the modern form of bison has been reported only east of the Cascades.

The only previously recorded occurrence of bison west of the Cascade Range in Oregon is represented by specimens in the paleontological collection at the Condon Museum of Geology, University of Oregon. Bones from Bison antiquus were found along with those of mammoth and sloth near Hillsboro in the northern Willamette Valley (Accession Nos. 315, 324). The age of these bones has never been established. The absence of associated artifacts suggests, however, that the remains of these animals predate the appearance of native peoples in this region.

Considerably more evidence of bison is available in the archaeological record. The only other locality in Oregon where Bison antiquus has been reported was at Dirty Shame Rockshelter in the southeast corner of the state. Ten elements were recovered in strata dated between 6300 and 7900 B.P. at this site (Grayson 1977).

Additional early finds of bison bones, apparently representative of Bison bison, were made at several caves in the Fort Rock Basin in central Oregon. At Connley Cave No. 4, five bison elements were recovered from strata dated between 9500 and 11,200 B.P. Another 10 elements were recovered at Connley Caves No. 4 and 5 from strata dated between 7200 and 9500 (Grayson 1979). An unknown number of bison bones were also among the faunal remains found below 7000-year-old Mazama pumice at Paisley Cave No.3 in the nearby Summer Lake Basin (Cressman 1942:93). The occurrence of bison in central Oregon apparently declined in post-Mazama times. At Fort Rock Cave bison were represented by only five elements in the stratum above Mazama pumice, and only a single element was found at Connley Cave No. 3 in a stratum dated between 3000 and 3400 B.P. (Grayson 1979).

Elsewhere in Oregon bison continued to occur in relatively large numbers during post-Mazama times. Thirty bison bones were recovered from strata dated between 6000 and 2000 B.P. at the Nightfire Island site in the Klamath Basin (Grayson 1973). Bison remains occurred in even more recent contexts at the Wildcat Canyon site on the Middle Columbia River, where 70 bison elements were recovered from strata dated between 2500 and 450 B.P. (Schroedl 1973).

The paleontological and archaeological evidence indicates, then, that bison have a very long time depth in Oregon and that they were formerly very widespread. Remnant populations continued to exist in the southeastern part of the state into protohistoric times. The eventual extinction of bison in this area was probably brought about as a result of the acquisition of the horse by native peoples which considerably enhanced their abilities to hunt these animals (Kingston 1932:171-172).

Summary and Conclusion

While the attempts at more precise identification and dating yielded ambiguous results, the stratigraphic context of the bovid bones at the bottom of the cultural deposit at the Flanagan site argues strongly for the idea that these elements were in fact from a bison. If the bones had been found in the upper levels of the site there would have been some possibility of them being from cattle introduced by Euro-American settlers. In view of the recovery of the bovid bones in question beneath more than one meter of compact clay loam from cultural deposits radiocarbon dated to between 5570 and 5750 B.P., however, it seems reasonable to conclude that these remains represent an archaeological occurrence of bison.

The idea that bison are represented in the early component at the Flanagan site is consistent with the information available from both paleontological and archaeological sources about the prehistoric distribution of bison in Oregon. The larger *Bison antiquus*, which had a very wide range, was probably extinct by around 7000 to 8000 years ago, but the smaller *Bison bison* survived almost up to the time of historic contact. Considering the fact that both faunal consultants compared the bovid bones from the Flanagan site to those of a domestic cow, it is likely that these remains are representative of the modern form of bison.

The discovery of bovid bones referrable to bison at the Flanagan site is significant because it represents the first reported occurrence of this species in an archaeological site west of the Cascades. The presence of bison remains in an archaeological context expands the range of fauna available for exploitation by the prehistoric inhabitants of the Willamette Valley around 6000 years ago.

Acknowledgements

I am grateful to Donald K. Grayson and S. David Webb for their efforts in identifying the bovid bones from the Flanagan site. The

services of Robert Stuckenrath in radiocarbon dating the bone is also greatly appreciated. Needless to say, I alone am responsible for the interpretations and conclusions drawn in this study.

APPENDIX F

METRIC DATA FOR FLANAGAN PROJECTILE POINT ASSEMBLAGE

This appendix presents metric descriptions for 226 classifiable projectile points from the Flanagan site. The three major point groups are presented separately: stemless points (Table 27), narrow-necked points (Table 28), and broad-necked points (Table 29). Definitions of these measurements are presented in Chapter V, which also contains a discussion of the projectile point analysis and resulting typology.

Specimen numbers are coded with an alpha designation for the provenience unit followed by the excavation level and then by a catalog number (for example, specimen HK-4-3 is from Unit HK, Level 4, third specimen catalogued). The locations of the coded excavation units (indicated by upper case letters) are shown in Figure 41. A similar map giving the designations for the 2x2 m surface collection grid units (indicated by lower case letters) is presented in Figure 42.

TABLE 27. Metric attributes of stemless projectile points.

Specimen Number	Wb	Wm	Wb/Wm	T	T/Wm	Serra- tions	Raw Mat.
SMALL STEMLESS SERIES (SS)							
Small Triangular (SS1):							
GK-1-2	7.1	7.3	0.97	2.0	0.27	X	obs
GN-1-1	10.4	10.4	1.00	2.0	0.19	X	obs
GN-5-1	8.7	8.7	1.00	1.6	0.18	X	obs
HL-3-2	11.0	11.0	1.00	2.2	0.20	X	obs
HM-2-1	8.2	8.4	0.98	2.2	0.26	X	obs
IO-1-1	7.0	7.5	0.93	1.9	0.25	X	obs
IR-7-1	11.0	11.0	1.00	3.5	0.32		chert
JL-2-3	14.1	14.1	1.00	2.3	0.16	X	obs
KF-2-1	10.0	10.1	0.99	2.2	0.22	X	obs
KF-6-1	8.7	8.7	1.00	2.4	0.28	X	obs
KH-1-2	12.0	12.0	1.00	1.9	0.16	X	obs
MQ-4-2	8.0	8.4	0.95	2.3	0.27		obs
NG-1-2	10.2	10.2	1.00	2.6	0.25	X	obs
RH-4-2	10.2	10.2	1.00	2.0	0.20	X	obs
Small Leaf-shaped (SS2):							
TP2-2-1	9.2	13.9	0.66	4.8	0.35	X	obs
fc-0-1	9.2	16.0	0.58	3.7	0.23	X	obs
BF-1-1	8.2	13.5	0.61	4.1	0.30	X	obs
CJ-7-1	9.2	12.1	0.76	3.7	0.31	X	obs
GN-7-1	5.8	11.6	0.50	3.6	0.31	X	obs
GN-7-2	5.0	7.0	0.71	1.9	0.27	X	obs
HI-4-2	5.2	10.5	0.50	2.7	0.26		obs
HJ-2-1	7.3	10.1	0.72	2.2	0.22		obs
HL-3-1	4.0	8.4	0.48	2.0	0.24		obs
IK-4-1	4.7	6.3	0.75	1.5	0.24		obs
IR-4-2	4.6	9.7	0.47	2.2	0.23	X	chert
JJ-4-1	5.6	10.4	0.54	2.9	0.28	X	obs
KE-2-1	5.7	12.2	0.47	4.5	0.37	X	obs
MJ-4-2	8.1	12.4	0.65	3.0	0.24		obs
MD-1-1	6.7	11.4	0.59	3.0	0.26		obs
NG-1-1	2.9	6.5	0.45	2.0	0.31	X	obs
OE-3-1	4.6	7.6	0.61	3.2	0.42		obs
QF-1-1	4.1	8.2	0.50	2.5	0.30	X	obs
RH-4-5	6.4	13.3	0.48	4.6	0.35		obs

TABLE 27 (continued)

Specimen Number	Wb	Wm	Wb/Wm	T	T/Wm	Serrations	Raw Mat.
SMALL STEMLESS SERIES (continued)							
Small Lanceolate (SS3):							
MG-1-1	1.1	7.6	0.14	4.3	0.57		chert
HEAVY STEMLESS SERIES (HS)							
Heavy Leaf-shaped (HS2):							
GI-8-1	9.9	12.3	0.80	5.2	0.42	X	obs
Heavy Lanceolate (HS3):							
CJ-8-2	—	17.8+	—	6.9+	0.39		basalt
GL-9-1	4.9	19.7	0.25	7.1	0.36		basalt
IM-6-2	4.9	13.2	0.37	5.3	0.40		obs
IM-9-3	3.1	15.5	0.20	6.7	0.43		obs
KE-5-1	5.2	14.8	0.35	6.0	0.41		chert
NB-6-1	—	19.2	—	7.3	0.38		basalt
RJ-6-1	5.0	20.7	0.24	10.4	0.50		basalt

Measurements (in mm): Wb = basal width
Wm = maximum width
T = thickness

TABLE 28. Metric attributes of narrow-necked projectile points.

Specimen Number	Wn	Wb	Wm	Wb-Wn	Wb/ Wm	Wn/ Wm	T	Serra- tions	Raw Mat.	Breakage
NARROW-NECKED SERIES (NN)										
Unidentifiable:										
HJ-2-2	4.7	—	17.3	—	—	0.27	3.0	X	obs	ST
HK-3-1	3.9	—	14.7	—	—	0.27	4.4	X	chert	BS
HL-3-4	3.4	—	12.9	—	—	0.26	2.5	X	obs	BST
HO-6-1	4.3	—	14.1	—	—	0.31	2.9	X	obs	BS
HP-5-2	3.5	—	14.9	—	—	0.23	2.6	X	obs	S
II-7-1	5.8	—	11.7	—	—	0.50	3.5	X	obs	ST
IJ-5-2	2.7	—	11.2+	—	—	0.24	2.1	X	obs	BS
IP-3-9	3.5	—	12.2	—	—	0.29	3.2		chert	S
JG-1-1	5.8	—	15.3	—	—	0.38	3.3		obs	BST
JJ-1-1	5.0	—	11.4	—	—	0.44	2.4		obs	BS
JL-2-2	4.8	—	16.4	—	—	0.29	3.7	X	chert	BS
KG-1-3	4.9	—	13.9	—	—	0.35	3.6		obs	BST
LI-3-1	3.6	—	12.7	—	—	0.28	2.7	X	obs	S
LJ-1-2	4.0	—	14.8+	—	—	0.27	3.1	X	obs	BS
OF-1-1	3.3	—	15.2	—	—	0.22	2.3	X	obs	ST
OJ-1-1	3.2	—	13.2+	—	—	0.24	2.6		obs	BS
QH-1-1	4.1	—	18.6	—	—	0.22	3.2		chert	ST
Corner-notched (NN2):										
0-10	4.3	4.8	12.2+	+0.5	0.39	0.35	2.9		obs	BT
eh-0-2	3.4	2.9	9.4	-0.5	0.31	0.36	2.9	X	obs	B
hf-0-1	3.3	3.5	11.9	+0.2	0.29	0.28	3.6		obs	
jg-0-1	4.5	4.0	12.1	-0.5	0.33	0.37	3.0	X	obs	B
TP2-2-2	3.9	3.3	12.9	-0.6	0.26	0.30	2.9		chert	BS
TP2-2-3	3.9	4.3	12.1	+0.4	0.36	0.32	2.8		obs	
TP3-1-1	4.4	3.2	12.4	-1.2	0.26	0.35	2.4		obs	
TP4-8-1	4.6	5.9	15.8	+1.3	0.37	0.29	3.0	X	obs	
TP4-9-2	3.8	4.3	13.3+	+0.5	0.32	0.29	2.0		obs	B
BE-1-1	3.1	2.9	12.0+	-0.2	0.24	0.26	2.6	X	chert	BST
BF-2-1	3.5	4.0	10.8	+0.5	0.37	0.32	3.0		obs	B
BG-1-1	3.5	2.1	9.8	-1.4	0.21	0.36	2.3	X	obs	BS
BJ-3-1	3.1	3.1	12.8	0	0.24	0.24	3.2		obs	BS
CG-1-1	3.1	2.8	12.6	-0.3	0.22	0.25	2.0	X	obs	ST
CI-2-1	4.0	4.1	8.8	+0.1	0.47	0.45	2.5		obs	

TABLE 28 (continued)

Specimen Number	Wn	Wb	Wm	Wb–Wn	Wb/ Wm	Wn/ Wm	T	Serra- tions	Raw Mat.	Breakage
Corner-notched (NN2):										
CJ-3-1	5.1	4.7	15.3	–0.4	0.31	0.33	4.0		obs	B
EF-1-1	6.2	7.4	14.8	+1.2	0.50	0.42	3.6		obs	B
EF-1-2	3.2	3.8	8.6	+0.6	0.44	0.37	2.7	X	obs	BT
EH-1-1	4.1	4.7	10.0	+0.6	0.47	0.41	2.3		obs	T
GJ-2-4	4.8	5.1	11.1	+0.3	0.46	0.43	3.5		obs	S
GJ-4-1	4.8	3.2	13.1	-1.6	0.24	0.37	3.0		obs	
GJ-5-2	5.4	3.3	16.7	-2.1	0.20	0.32	3.3	X	obs	BS
GK-1-1	4.3	3.8	14.5	–0.5	0.26	0.30	2.5	X	obs	S
GK-2-1	3.3	4.0	14.5	+0.7	0.28	0.23	2.8	X	obs	BT
GK-5-1	5.0	5.3	13.8	+0.3	0.38	0.36	2.9		obs	
GK-6-1	3.9	5.0	15.0	+1.1	0.33	0.26	3.0		obs	
GL-1-1	3.2	2.6	10.3	–0.6	0.25	0.31	2.5		obs	B
GL-2-1	4.0	4.5	15.8	+0.5	0.28	0.25	2.9		obs	B
GL-2-2	3.0	2.9	8.0+	–0.1	0.36	0.38	2.3		obs	BST
GL-2-3	4.2	4.6	9.0	+0.4	0.51	0.47	2.9	X	obs	ST
GL-5-1	4.1	3.7	11.9	–0.4	0.31	0.34	4.6	X	obs	
GM-2-1	3.5	3.1	11.9	–0.4	0.26	0.29	2.5	X	obs	B
GM-3-1	4.5	6.8	11.3	+2.3	0.60	0.40	3.2		obs	BT
GM-6-2	6.0	6.0	13.6	0	0.44	0.44	4.8	X	obs	T
GM-7-3	6.9	7.4	13.5	+0.5	0.55	0.51	4.0	X	chert	B
GN-1-2	4.4	4.6	12.2	+0.2	0.38	0.36	2.9		obs	B
GN-2-1	3.8	4.6	12.9+	+0.8	0.36	0.29	2.4		obs	B
GN-2-2	4.1	3.0	13.3	-1.1	0.23	0.31	2.5		obs	
GN-3-1	3.1	2.2	9.0	–0.9	0.24	0.34	2.7		obs	
GN-4-1	2.9	4.0	13.6	+1.1	0.29	0.21	2.7	X	obs	T
GO-1-1	5.1	6.0	22.3	+0.9	0.27	0.23	3.9	X	obs	B
GO-1-2	4.2	4.5	15.1	+0.3	0.30	0.28	2.7	X	obs	B
GO-2-2	4.8	5.5	13.8	+0.7	0.40	0.35	2.8	X	obs	B
GP-2-2	4.5	4.4	10.3	–0.1	0.43	0.44	3.0		obs	T
GP-4-3	3.4	3.3	11.5	–0.1	0.29	0.30	2.3	X	obs	B
HJ-5-1	3.6	3.8	10.0+	+0.2	0.38	0.36	2.8	X	chert	BT
HL-2-1	4.7	3.6	12.6	-1.1	0.29	0.37	3.3		obs	BS
HL-4-1	5.3	6.4	9.2	+1.1	0.70	0.58	2.5		obs	B
HM-1-1	6.7	6.5	11.8	–0.2	0.55	0.57	5.3		obs	S
HM-3-1	3.6	3.5	8.3	–0.1	0.42	0.43	2.4		obs	BS
HM-4-2	5.9	6.5	14.3	+0.6	0.45	0.41	2.9	X	obs	B
HM-9-6	6.4	11.0*	16.3	+4.6	0.67	0.39	5.1	X	obs	ST
HN-1-1	3.8	4.2	11.3	+0.4	0.37	0.34	3.8		chert	
HN-2-3	4.2	4.7*	16.3+	+0.5	0.29	0.26	3.1	X	obs	BS

TABLE 28 (continued)

Specimen Number	Wn	Wb	Wm	Wb-Wn	Wb/ Wm	Wn/ Wm	T	Serra- tions	Raw Mat.	Breakage
Corner-notched (NN2):										
HN-4-3	3.6	3.4	12.0	-0.2	0.28	0.30	2.3	X	obs	BS
HP-1-4	4.2	4.1	16.7	-0.1	0.25	0.25	3.4		obs	BS
HP-3-2	3.2	4.5	13.0	+1.3	0.35	0.25	3.3	X	obs	
HP-3-3	4.2	4.5	11.0	+0.3	0.41	0.38	2.4	X	obs	BT
HP-4-2	3.1	3.2	11.2	+0.1	0.29	0.28	2.9		obs	T
HP-7-5	3.6	1.8	8.7	-1.8	0.21	0.41	2.6	X	obs	
II-2-1	4.0	2.8	13.0	-1.2	0.22	0.31	3.6	X	obs	
II-2-2	3.8	4.7	15.0	+0.9	0.31	0.25	2.2		obs	T
IK-3-2	3.5	3.7	14.9	+0.2	0.25	0.23	3.5	X	obs	T
IM-1-5	6.2	5.0	19.8	-1.2	0.25	0.31	3.4		obs	T
IM-2-1	3.1	3.5	10.1	+0.4	0.35	0.31	1.8		obs	T
IM-2-2	5.0	6.1	12.6	+1.1	0.48	0.40	3.3	X	obs	
IM-6-1	4.7	5.2	13.0	+0.5	0.40	0.36	4.3		obs	B
IM-6-3	4.7	3.8	16.1	-0.9	0.24	0.29	3.5	X	obs	BS
IO-4-1	4.4	2.4	10.5	-2.0	0.23	0.42	3.5		chert	BS
IO-8-1	6.5	5.0	9.7	-1.5	0.52	0.67	4.3		obs	
IP-3-7	4.1	4.8	15.5	+0.7	0.31	0.26	3.2	X	chert	
IP-3-8	5.2	5.4	12.7	+0.2	0.43	0.41	3.2	X	chert	
IP-4-2	3.0	3.1	8.4	+0.1	0.37	0.36	1.5		obs	BT
IP-7-9	4.0	4.2	11.3	+0.2	0.37	0.35	3.6	X	obs	S
IP-7-10	4.1	4.7	13.6	+0.6	0.35	0.30	2.0	X	obs	T
IR-1-1	3.3	3.9	10.9	+0.6	0.36	0.30	2.7		obs	B
JE-1-1	4.6	5.3	11.6	+0.7	0.46	0.40	3.2	X	obs	B
JF-4-1	3.6	2.9	14.8	-0.7	0.20	0.24	3.1		obs	BT
JI-2-1	3.9	4.1	14.6	+0.2	0.28	0.27	3.5		obs	T
JI-3-2	4.4	4.8	11.1	+0.4	0.43	0.40	3.4		obs	B
JI-4-1	4.5	4.7	13.7	+0.2	0.34	0.33	3.1		obs	BT
JI-6-1	7.0	7.8	18.4	+0.8	0.42	0.38	3.8	X	obs	
JK-2-1	3.5	3.8	10.0	+0.3	0.38	0.35	2.2		obs	B
JK-2-2	4.4	4.6	15.9	+0.2	0.29	0.28	4.8		obs	T
JM-5-1	3.6	3.5	13.3	-0.1	0.26	0.27	1.7		chert	
KE-1-1	4.5	5.0	15.8+	+0.5	0.32	0.28	3.2		obs	BT
KG-3-1	4.8	4.1	13.7	-0.7	0.30	0.35	3.2	X	obs	
KG-4-1	4.4	3.5	14.5	-0.9	0.24	0.30	3.0	X	obs	
KL/LL-3-3	3.4	2.7	13.0	-0.7	0.21	0.26	2.5		obs	BT
KL/LL-5-1	4.5	3.9	12.5	-0.6	0.31	0.36	2.9		obs	BS
LC-1-2	3.9	4.8	14.5	+0.9	0.33	0.27	2.6		obs	
LE-1-1	4.4	4.0	12.6+	-0.4	0.32	0.35	3.0		obs	BT

TABLE 28 (continued)

Specimen Number	Wn	Wb	Wm	Wb–Wn	Wb/ Wm	Wn/ Wm	T	Serra- tions	Raw Mat.	Breakage
Corner-notched (NN2):										
MI-2-1	4.1	4.1	12.8	0	0.32	0.32	2.0	X	obs	B
MI-3-1	4.0	4.2	9.2	+0.2	0.46	0.43	2.6	X	obs	B
MJ-4-3	4.1	3.3	9.7	-0.8	0.34	0.42	2.8		obs	B
MJ-6-1	4.5	4.0	11.5	-0.5	0.35	0.39	3.4		obs	BT
ML-1-1	4.2	3.5	9.9	-0.7	0.35	0.42	3.6		obs	BT
NB-2-3	3.8	3.9	13.4	+0.1	0.29	0.28	3.0	X	chert	T
NB-5-2	3.9	4.1	10.1+	+0.2	0.41	0.39	1.7		obs	BS
OE-1-1	5.9	6.9	14.2	+1.0	0.49	0.42	2.8		obs	T
PE-1-1	5.0	5.7	15.0	+0.7	0.38	0.33	3.1	X	obs	
PJ-1-1	3.9	4.1	12.6	+0.2	0.33	0.31	3.8		chert	BT
PS-4-1	5.0	6.1	13.4	+1.1	0.46	0.37	2.4		obs	T
QJ-1-1	3.6	2.8	10.9	-0.8	0.26	0.33	3.2		obs	BS
RF-1-1	3.5	5.4	9.2	+1.9	0.59	0.38	2.5	X	obs	
RG-1-2	3.4	3.7	12.1	+0.3	0.31	0.28	3.1		obs	T
RG-1-3	4.0	4.3	13.4	+0.3	0.32	0.30	2.5		chert	B
RH-3-2	4.8	5.7	15.5	+0.9	0.37	0.31	2.8	X	obs	ST
RH-4-1	4.5	4.3	14.7	-0.2	0.29	0.31	4.1	X	obs	B
RH-5-1	5.3	6.5	13.4	+1.2	0.49	0.40	3.9	X	chert	
RJ-2-1	4.8	4.8	11.5+	0	0.42	0.42	2.9	X	obs	BS
RJ-2-2	3.6	3.8	12.9	+0.2	0.29	0.28	4.0		obs	T
RJ-4-1	2.9	3.1	13.1	+0.2	0.24	0.22	3.5	X	obs	
SA/TB-1-1	4.2	5.3	11.3	+1.1	0.47	0.37	3.4	X	obs	BT
SG-1-1	3.9	3.6	15.0	-0.3	0.24	0.26	2.8	X	obs	B
TI-3-1	4.0	5.3	12.2	+1.3	0.43	0.33	2.6		obs	T
UP-1-1	3.9	3.9	11.2	0	0.35	0.35	2.3		chert	B
Basal-notched (NN3):										
TP2-3-1	3.4	2.6	13.5	-0.2	0.19	0.25	2.3	X	obs	BS
EN-3-1	1.8	1.3	8.3	-0.5	0.16	0.22	2.2		obs	
GI-3-2	3.0	<2.7	14.4	-0.3	0.19	0.21	2.5		chert	ST
GM-7-1	1.6	0.9	10.5+	-0.7	0.09	0.15	2.1		obs	BST
GN-4-2	2.7	1.8	11.6	-0.9	0.16	0.23	2.7	X	obs	B

TABLE 28 (continued)

Specimen Number	Wn	Wb	Wm	Wb-Wn	Wb/ Wm	Wn/ Wm	T	Serra- tions	Raw Mat.	Breakage
Basal-notched (NN3):										
HK-4-3	4.2	1.6	16.6	-2.6	0.10	0.25	2.7	X	chert	B
II-5-1	4.1	3.1	16.6	-0.8	0.19	0.27	2.3	X	chert	BST
IJ-2-2	3.7	1.7	12.0	-2.0	0.14	0.31	4.3		obs	BT
IL-4-1	3.3	1.6	16.5*	-1.7	0.10	0.20	2.6	X	obs	BT
IR-4-1	3.4	2.2	12.3	-1.2	0.18	0.28	3.4		chert	
IR-8-1	3.2	2.9	15.7	-0.3	0.18	0.20	2.1	X	obs	
JJ-3-1	1.4	0.4	13.7	-1.0	0.03	0.10	2.8		obs	BST
JJ-5-1	3.2	2.0	12.0	-1.2	0.17	0.27	2.2		obs	
KG-2-7	3.4	2.1	15.2+	-1.3	0.14	0.22	2.3		obs	BT
KJ-1-1	2.4	2.3	11.9	-0.1	0.19	0.20	2.8		obs	T
KL/LL-3-2	3.2	2.7	14.5*	-0.5	0.19	0.22	2.0		obs	BST
KL/LL-3-4	3.7	2.5	14.0*	-1.2	0.18	0.26	2.5		chert	BT
MB-1-1	3.2	2.2	11.5+	-1.0	0.19	0.28	2.9		chert	BST
NB-4-2	2.9	2.2	12.7	-0.7	0.17	0.23	2.8		obs	BT
OE-2-4	1.7	0	9.7	-1.7	0	0.18	2.0		obs	B
RF-2-1	3.9	1.8	15.7	-2.1	0.11	0.25	2.5		obs	T
SE-1-1	2.8	1.9	10.3	-0.9	0.18	0.27	2.8	X	obs	
TI-4-1	2.6	1.7	16.1	-0.9	0.11	0.16	2.3	X	obs	

\+ measurement of fragmented aspect
* estimated measurement of fragmented aspect

Measurements (in mm): Wn = neck width
Wb = basal width
Wm = maximum width
T = thickness

Breakage: B = barb
S = stem
T = tip

TABLE 29. Metric attributes of broad-necked projectile points.

Specimen Number	Wn	Wb	Wm	Wb-Wn	Wb/ Wm	Wn/ Wm	T	Serra- tions	Raw Mat.	Breakage
MODERATE BROAD-NECKED SERIES (MB)										
Unidentifiable:										
JG-3-1	8.9	—	17.3	—	—	0.51	4.3	X	obs	S
KL/LL-6-3	8.7	—	15.4	—	—	0.56	4.8	X	obs	S
Side-notched (MB/HB1):										
GN-10-1	8.7	14.6*	14.6	+6.8	1.00	0.60	5.0		obs	B
GR-2-1	10.2	19.0*	18.0+	+8.8	1.05	0.57	4.3		obs	B
Corner-notched, Expanding Stem (MB2):										
EN-8-1	8.3	8.8	13.9	+0.5	0.63	0.60	4.5	X	obs	B
HJ-6-4	7.7	9.6	14.5	+1.9	0.66	0.53	3.7		obs	
IL-11-1	8.0	8.9	16.2	+0.9	0.55	0.49	7.5		chert	T
JE-1-2	8.2	9.4	13.8	+1.2	0.68	0.59	4.7	X	obs	B
KE-8-1	8.3	11.6	15.3	+3.3	0.76	0.54	5.9		chert	T
Corner-notched, Contracting Stem (MB3):										
GI-8-2	7.5	5.3	14.2	-2.2	0.37	0.53	3.8		obs	
GP-7-2	8.2	5.4*	14.7	-2.8	0.37	0.56	4.2	X	obs	
IJ-7-1	8.3	7.1	14.4	-1.2	0.49	0.58	4.0	X	chert	
IP-2-4	7.8	4.9	19.1	-2.9	0.26	0.41	5.0		obs	T
HEAVY BROAD-NECKED SERIES (HB)										
Unidentifiable:										
IP-11-3	10.9	—	24.1	—	—	0.45	4.0		obs	S
Corner-notched, Expanding Stem (HB2):										
GM-11-1	10.1	10.5	19.3	+0.4	0.54	0.52	8.5		chert	BS
GN-12-1	11.7	15.6	19.0	+3.9	0.82	0.62	6.5		chert	
GR-10-1	12.4	18.0*	21.8*	+5.6	0.83	0.57	4.9		obs	BS
GR-10-2	12.2	14.0*	22.5	+1.8	0.62	0.54	8.3		chert	S
HN-11-7	9.5	9.7	20.4	+0.2	0.48	0.47	6.6		obs	S
IR-8-2	11.8	13.4	18.9	+1.6	0.71	0.62	4.6		obs	
JE-5-1	11.0	13.3	19.1	+2.3	0.70	0.58	5.9		chert	T

TABLE 29 (continued)

Specimen Number	Wn	Wb	Wm	Wb-Wn	Wb/ Wm	Wn/ Wm	T	Serra- tions	Raw Mat.	Breakage
HEAVY BROAD-NECKED SERIES (continued)										
Corner-notched, Expanding Stem (HB2):										
JJ-8-1	10.3	13.9	25.1	+3.6	0.55	0.41	6.7		chert	
KD-2-1	9.9	10.0	13.9	+0.1	0.72	0.71	4.0	X	obs	
KF-3-1	10.9	12.1	17.5	+1.2	0.69	0.62	5.6		obs	ST
KF-6-2	11.5	13.8	17.0*	+2.3	0.81	0.68	6.2		chert	S
Corner-notched, Contracting Stem (HB3):										
GF-5-1	9.6	6.4	15.8	-3.2	0.41	0.61	6.0	X	obs	
IN-10-3	10.2	4.1	19.6	-6.1	0.21	0.52	6.8		chert	T

\+ measurement of fragmented aspect
* estimated measurement of fragmented aspect

Measurements (in mm): Wn = neck width
Wb = basal width
Wm = maximum width
T = thickness

Breakage: B = barb
S = stem
T = tip

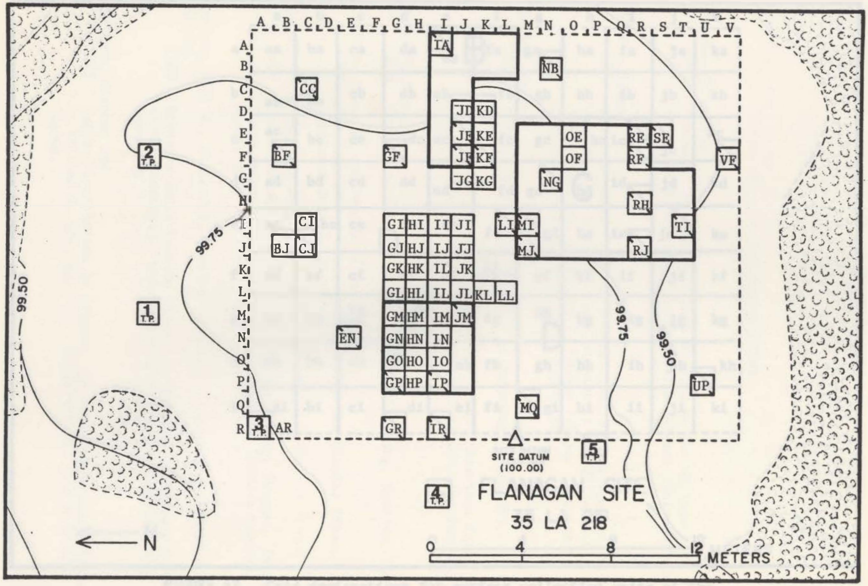

FIGURE 41. Grid designations for excavated units at the Flanagan site.

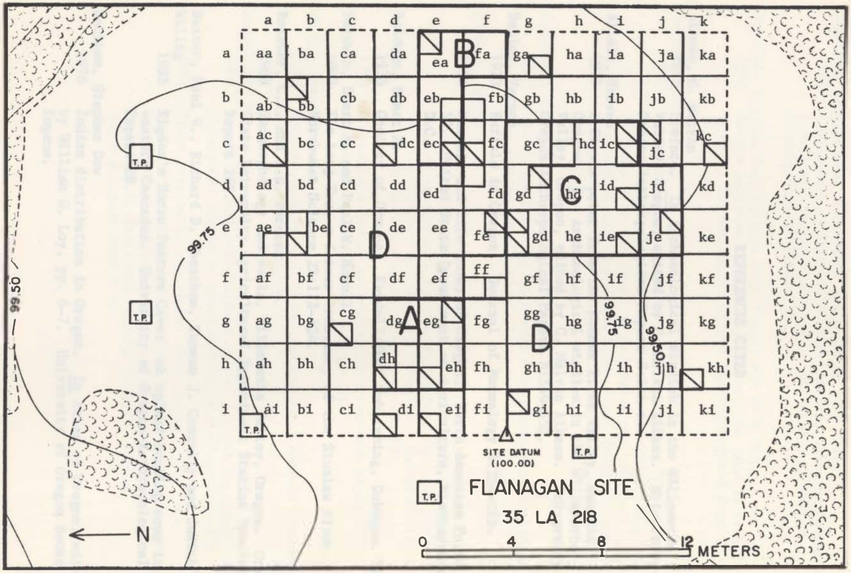

FIGURE 42. Grid designations for surface collection units at the Flanagan site.

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