OZETTE WOODWORKING TECHNOLOGY

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by

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This report describes the activities during Phase XIV of the Ozette Archaeological Project, and is submitted in partial fulfillment of Heritage Conservation and Recreation Services contract number C-9009(80). The project is a cooperative effort among the Makah Nation, Washington State University, and Interagency Archaeological Services, Heritage Conservation and Recreation Service. All contract information is filed at the Laboratory of Anthropology--B, Washington State University, Pullman, under budget coding 11N-4970-0008.

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ABSTRACT

The Ozette Archaeological Site on Washington's Olympic Coast, with its extensive deposit of excellently preserved vegetal material, has yielded, on a qualitative as well as quantitative basis, numerous material culture items of a single Northwest Coast culture. The material culture items indicate a wide ranging dependence on wooden artifacts. Among the items recovered are woodworking tools, wood preforms, and wood debitage. The problem became to create a model that would describe how the Ozettes worked wood, and would provide a means for using the extensive collection of woodworking related artifacts to aid in the explanation of cultural behavior relating to maritime adaptation.

For this study, technology is the abstraction of material culture items that defines and explains material culture as man's interaction with the physical environment, as well as aspects of culture such as social order, economics, religion, and aesthetics. For this study, woodworking technology is focused on the production of wooden material culture items. Woodworking data derived from tools, debitage, scars, preforms, and artifacts are used to construct a five-level model comprised of materials, tools, transformations, manufacturing or production sequences, and products. Variation in the levels among spatial or temporal units is indicated to be sensitive to certain differences in social or economic concerns.

TABLE OF CONTENTS

Chapter		page
I.	INTRODUCTION	1
	Purpose	1
	Ozette Village Site	1
	Ethnic Identity	2
	Location and Environment	2
	Archaeological Survey of the Ozette Region	7
	Excavations--1966	8
	Excavations--1967	9
	Excavations Since 1970	10
	Previous Accounts and Research on Northwest Coast Woodworking	16
	Ethnohistoric Sources	16
	Ethnographic Sources	19
	Studies of Woodworking Technology	20
	The Study of Wooden Artifacts and Woodworking Activity at Ozette	21
II.	CONCERNS AND SCOPE OF STUDY	24
	Introduction	24
	Theoretical Concerns	25
	Leslie White - The Grand Scheme	25
	Decision Making Models - Davis and Bonnichsen	25
	The Anthropological/Archaeological Viewpoint	29
	Summary	31
	Ozette Woodworking--Methodological Concerns	31
	Purpose of a Technological System	32
	Archaeological Evidence of Technological Systems	33
	Ozette Applications	36
	Area-wide Applications	37
	Summary	37
	Technical Concerns	38
	Temporal and Spatial Concerns	38
	Temporal Units	38
	Spatial Units	40
	Woodworking Data	40
	Exploratory Data Analysis	42
	ONEWAY	42
	Discriminant Analysis	43
	Chi-Square	44
	Summary	44
	Scope of Inquiry	45

III. TOOLS 46

Introduction 46
Blades - Introduction 46
Stone 46
Beaver Tooth Blades 48
Bone Blades 48
Mussel Shell Blades 50
Metal Blades 50
Blade Configurations 53
Summary 54
Woodworking/Cutting Tool Descriptions - Introduction . . . 57
Indirect Percussion 59
Mauls 59
Wedges - Introduction 62
Chisels 89
Gouges 93
Direct Percussion 94
Weighted Straight Adzes 94
D-Adzes 97
Non-Percussive, Linear Motion 101
Knives - Introduction 101
Plane 123
T-Handles 125
Non-Percussive, Circular Motion 126
Drills 126
Whetstones 130
Summary 131
Spatial and Temporal Assemblage Variation 132

IV. WOODWORKING TRANSFORMATIONS 135

Introduction 135
Transformations 136
Subtractive Transformations (1) 136
Massive Subtractive Transformation (11) 136
Medium Subtractive Transformation (12) 138
Minor Subtractive Transformation (13) 140
Additive Transformation (2) 141
Bound Additive Transformation (21) 141
Non-bound Additive Transformation (22) 144
Structural Transformations (3) 145
Thermal Structural Transformation (31) 145
Non-thermal structural transformation (32) 145
Comments and Summary 147

V. WOODWORKING PRODUCTION SEQUENCES 149

Introduction 149
Wedge Manufacture 150
Knife Manufacture 154
Summary 155

VI. WOODCHIPS AND WOODSCARS 158

Introduction 158
Debitage 158
Sample Selection 158
Attributes 162
Chip Types 164
Cultural Implications of the Woodchips 164
Woodscars 165
Woodchips and Woodscars as Indicators of Tool Use . . . 168
Summary 169

VII. WOODWORKING ACTIVITY IN HOUSE 1 170

Introduction 170
Cultural Environment 171
Cultural Implications of House 1 Woodchip Distribution . 178

VIII. SUMMARY AND CONCLUSIONS 184

REFERENCES CITED 186

APPENDIX 197

LIST OF TABLES

Table		page
1.	Large Mauls	61
2.	Household Maul	61
3.	Whale Bone Wedges	63
4.	Antler and Bone Wedges	65
5.	Short, Large Oval Wood Wedges	72
6.	Medium to Long, Large Oval Wood Wedges	73
7.	Short, Large Rectangular Wood Wedges	75
8.	Medium to Long, Large Rectangular Wood Wedges	75
9.	Medium Oval Wood Wedges	77
10.	Small Oval Wood Wedges	79
11.	Small Rectangular Wood Wedges	81
12.	Oval Wood Marking Wedges	82
13.	Rectangular Wood Marking Wedge	82
14.	Short, Rod Wedges	84
15.	Medium to Long, Rod Wedges	85
16.	Wood Wedge Preforms	87
17.	Chisels	90
18.	Gouge Blade	93
19.	Weighted Straight Adzes	95
20.	D-Adzes	98
21.	Hafted Mussel Shell Knives	107

22. Beaver Incisor Knives 108

23. Expanding Base, Knife Handles 113

24. Three Dimensional Pommel, Knife Handles 116

25. Two Dimensional Pommel, Knife Handles 118

26. Plain Handled Knives 120

27. Other Knife Handles 122

28. Plane 123

29. T-Handles 125

30. Drills 127

31. Summary of chi squares for woodworking tools 133

32. Tabulation of Woodworking and Cutting Tools by Level 198

33. Chi-square of Unit III and Unit V Tools 203

34. Chi-square of Unit IV and Unit V Tools 204

35. Chi-square of House 1 and House 2 Tools 207

36. Chi-square of House Floor and Exterior Midden Tools 209

37. Woodchip Dimensions 211

38. Woodscar Dimensions 212

39. Chip Dimensions for Woodchips Classed by Woodscar 213

LIST OF ILLUSTRATIONS

Figure		page
1.	Northwest Coast	3
2.	Olympic Peninsula	4
3.	Ozette Village Site complex	5
4.	Main village area	6
5.	Site stratigraphy	12
6.	Unit V houses	14
7.	Stone and shell adze blades	47
8.	Bone blades	49
9.	Metal bladed tool x-rays	51
10.	Chisel cut whale vertebra	55
11.	Adze and chisel blade edge margins	56
12.	Mauls	60
13.	Whale bone wedges	64
14.	Antler wedges	66
15.	Histograms for lengths of certain wedges	69
16.	Cumulative frequency curves for certain wedge lengths	70
17.	Medium to long, large oval wood wedges	74
18.	Medium to long, large rectangular wood wedges	76
19.	Medium oval wood wedges	78
20.	Small oval wood wedges	80
21.	Wood marking wedges	83

22. Medium to long, rod wood wedges 86
23. Chisels 91
24. Chisel with metal blade 92
25. Weighted straight adzes 96
26. D-adzes 99
27. Replica of madrone D-adze 100
28. Slate knives 103
29. Mussel shell knives 106
30. Beaver tooth knives 109
31. Metal bladed knife nomenclature 111
32. Expanding base knife handles 114
33. Three dimensional pommel knife handles and T-handle tools . . 117
34. Two dimensional pommel knife handles 119
35. Plain knife handles and other knife handles 121
36. Plane 124
37. Drills 128
38. Histogram of drilled hole diameters 129
39. Subtractive transformations 137
40. Additive transformations 142
41. Structural transformations 146
42. Wedge manufacture and use, part 1 152
43. Wedge manufacture and use, part 2 153
44. Knife manufacture 156
45. Water-screened House 1 floor midden squares 160
46. Woodchip nomenclature 161
47. Woodchip and woodscar length and width histograms 166
48. Relative artifact density by house area 174

49. Relative artifact density for house areas by arbitrary house floor levels 175

50. Relative density of subsistence items and processing and production items by living area 176

51. SYMAP of woodchip distribution 180

52. SYMAP of fish bone distribution 181

53. SYMAP of shell distribution 182

54. Discriminant analysis of large rectangular, oval and rod wood wedges 214

55. Discriminant analysis of woodchips by profile 216

56. Discriminant analysis of woodscars by artifact groups 218

57. Discriminant analysis of woodchips by profile and angle . . . 220

58. Discriminant analysis of House 1 areas by woodchips, chip class not included 222

59. Discriminant analysis of House 1 areas by woodchips, chip class included 224

Chapter I

INTRODUCTION

1.1 PURPOSE

The purpose of this study is to provide a general understanding of the woodworking technology of the Ozettes. The study will delimit a particular synchronic woodworking system and, insofar as possible, will relate this to behavioral patterns as seen from the archaeological data. This study is not designed as the study of a single tool, single effect, or single manufacturing sequence, but is designed to integrate various lines of archaeological evidence into the reconstruction of a general technical pattern that served to alter certain classes of raw material into desired artifacts. The problem faced in this study is, can this patterned behavior be isolated, described, organized, and then related to broader cultural processes?

In the last section of this chapter, this problem is discussed in more detail. Specific objectives are stated, and a general strategy for achieving these objectives is outlined. First, however, various aspects of the data base used in this study must be viewed. The Ozette site, from which the archaeological data are derived, will be described, as will the history of the excavations and the importance of the site. Relevant historic documents concerning the first European contacts and the nature of woodworking at contact will be discussed. Ethnographic information about tools and their uses, as well as about manufacturing sequences used by woodworkers and carvers, will be presented as part of a general description of the nature of Northwest Coast woodworking technology. This will be followed by a discussion of previous studies of woodworking on the Northwest Coast and elsewhere. Finally, we will return to a fuller discussion of the problem.

1.2 OZETTE VILLAGE SITE

This section describes the physical and biotic setting of the village as well as the nature and extent of the site. The excavation of the site which began in 1966 is discussed. Changes in research design and excavation strategy necessitated by the discovery of vast amounts of preserved vegetal material are outlined.

1.2.1 Ethnic Identity

The data for this study come from the archaeological deposits at Ozette Village (45CA24). The Ozette Village is the southernmost of the five main villages of the Makah Indian tribe of the Cape Flattery area of Washington State(Figures 1, 2, 3). The Makah are closely related on both a social and linguistic basis to the Nitinat of southern Vancouver Island. Linguistically, they are all Nootkan speakers. To the east of the Makah are the Clallam, Coast Salish speakers, and to the south are the Quileute, Chemakuan speakers.

1.2.2 Location and Environment

Ozette Village is located on the Pacific shore 14 miles south of Cape Flattery and 2 miles south of the mouth of the Ozette River(Figure 3). The offshore area immediately in front of the site is a broad rock shelf which is exposed during most low tides. Offshore islands, Ozette and the Bodeltehs, and the tidal island, Tskawahyah or Cannonball, form the rest of the features close to shore near the site(Figure 3). The site lies on a narrow bench, 20 to 30 meters at its widest and varying in height from 1 to 5 m (Figure 4). Behind the site is a sharply rising hillside which levels off into another bench at about 30 meters in elevation. The offshore shelf and islands, as well as the villages elevation of up to 5 m above mean high tide, protect it from both surf and storm winds. The mitigation of the local surf conditions provided by the rock shelf also allows for the easy launching of canoes in most weather conditions.

The climate at the site is a mild, wet, maritime one. Temperatures range from a January mean of 3.8C to a July mean of 17.3C. Mean annual precipitation is between 180 and 250 cm. These climatic conditions have given rise to a well developed Sitka spruce zone in the site area. In addition to the predominant Sitka spruce (Picea sitchensis), there is Douglas fir (Pseudotsga menziesii), western hemlock (Tsuga heterophylla), red alder (Alnus rubra), and western redcedar (Thuja plicata) (Franklin and Dyrness 1973:58).

The subsistence economy focused on maritime resources. Cannonball Island provided a prime vantage point for the spotting of whales which were hunted by certain members of the village. Sea otters were taken from nearby kelp beds and sea lions from nearby rocks. In historic times, the site lay close to the migratory route of the pelagic fur seal. Archaeological evidence from the site indicates that all these mammals were taken prehistorically (Gustafson 1968).

Bottom fish, such as red snapper and ling cod, abound in the area offshore of Ozette. To the northwest of Tatoosh Island at Cape Flattery lie excellent halibut banks. Along the littoral zone, resources such as kelp and various shellfish were harvested. Rivers such as the Ozette yielded salmon, including the sockeye, coho, chinook, and chum (Huelsbeck 1980).

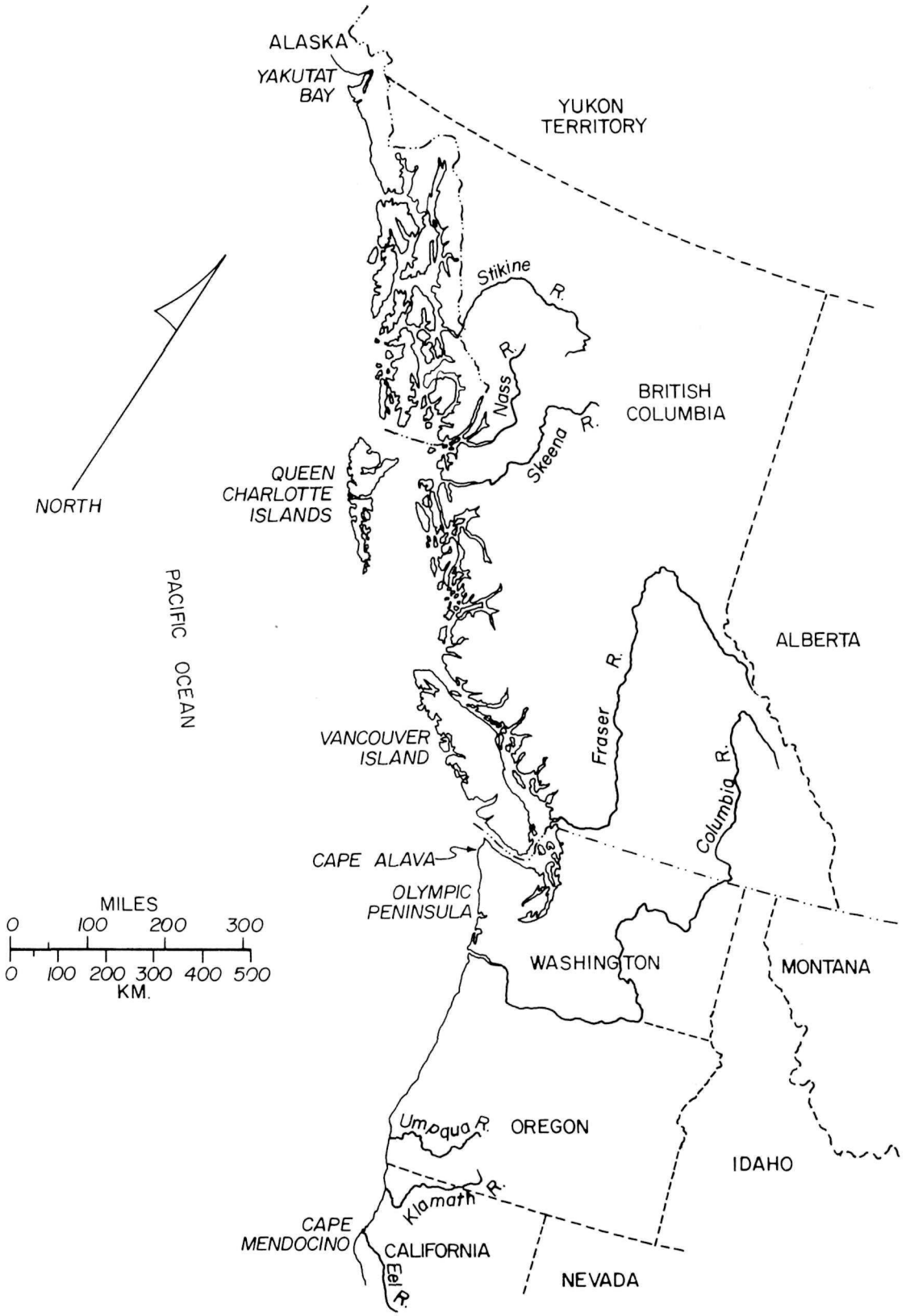


Figure 1. Northwest Coast.

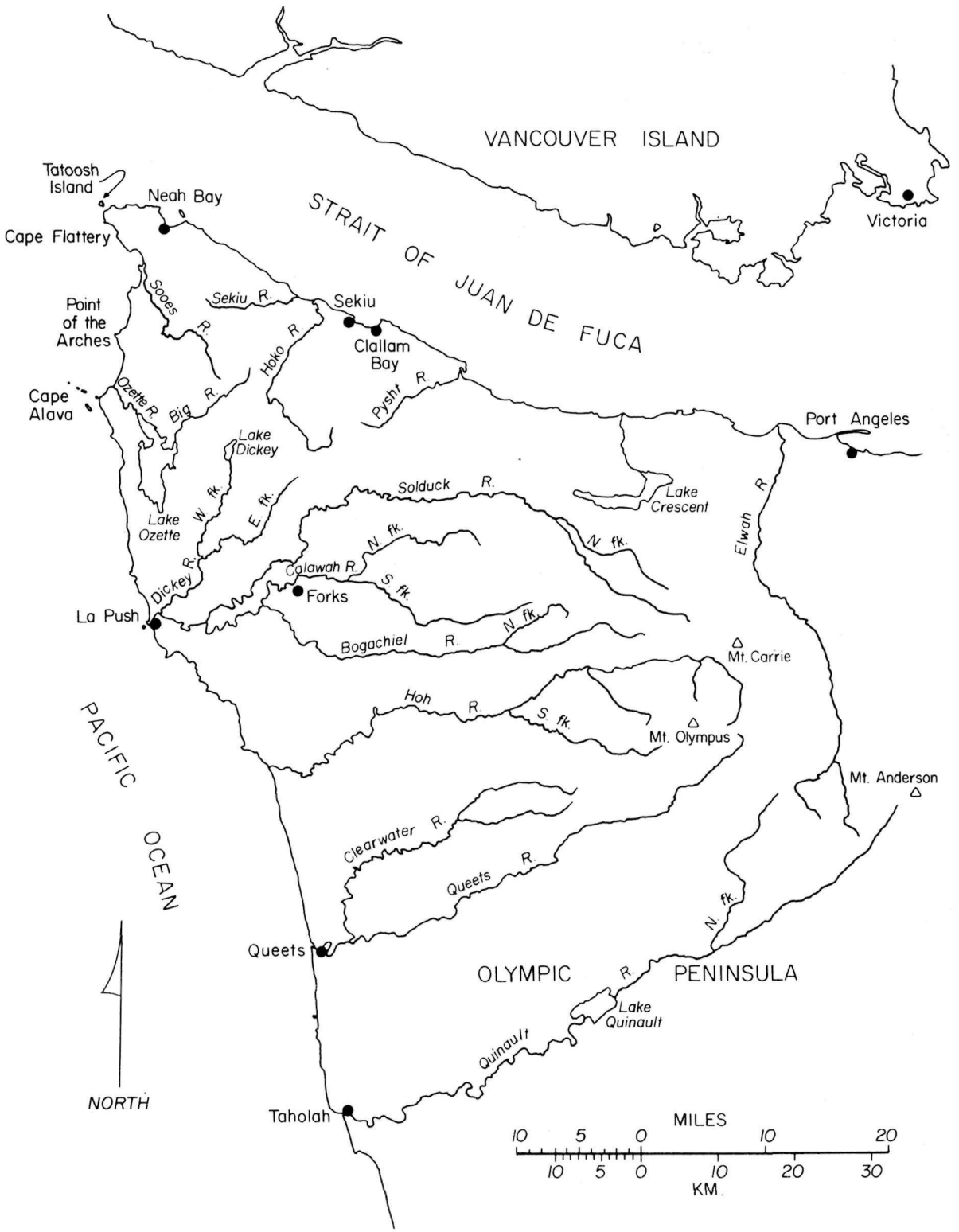


Figure 2. Olympic Peninsula.

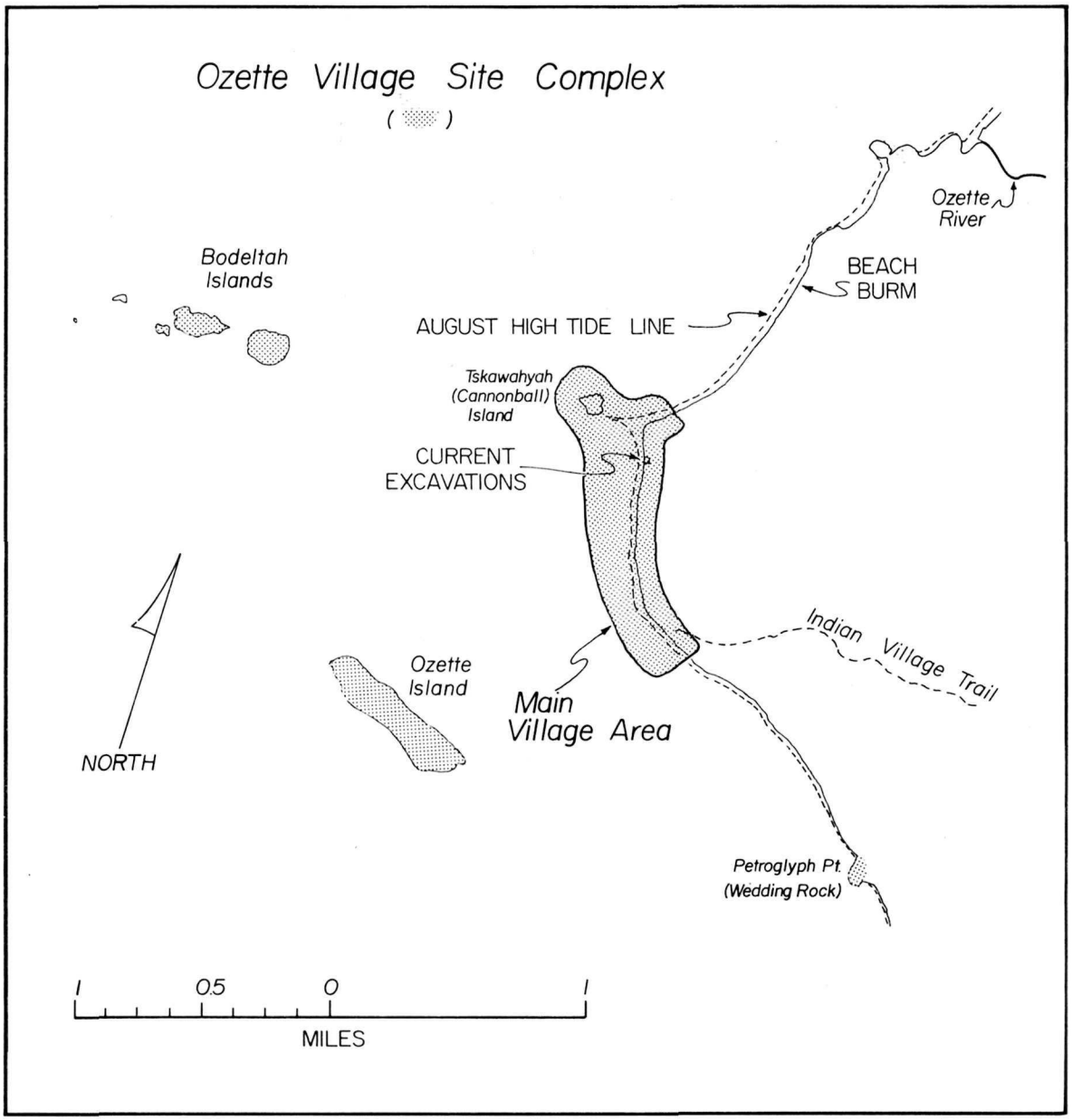


Figure 3. Ozette village site complex.

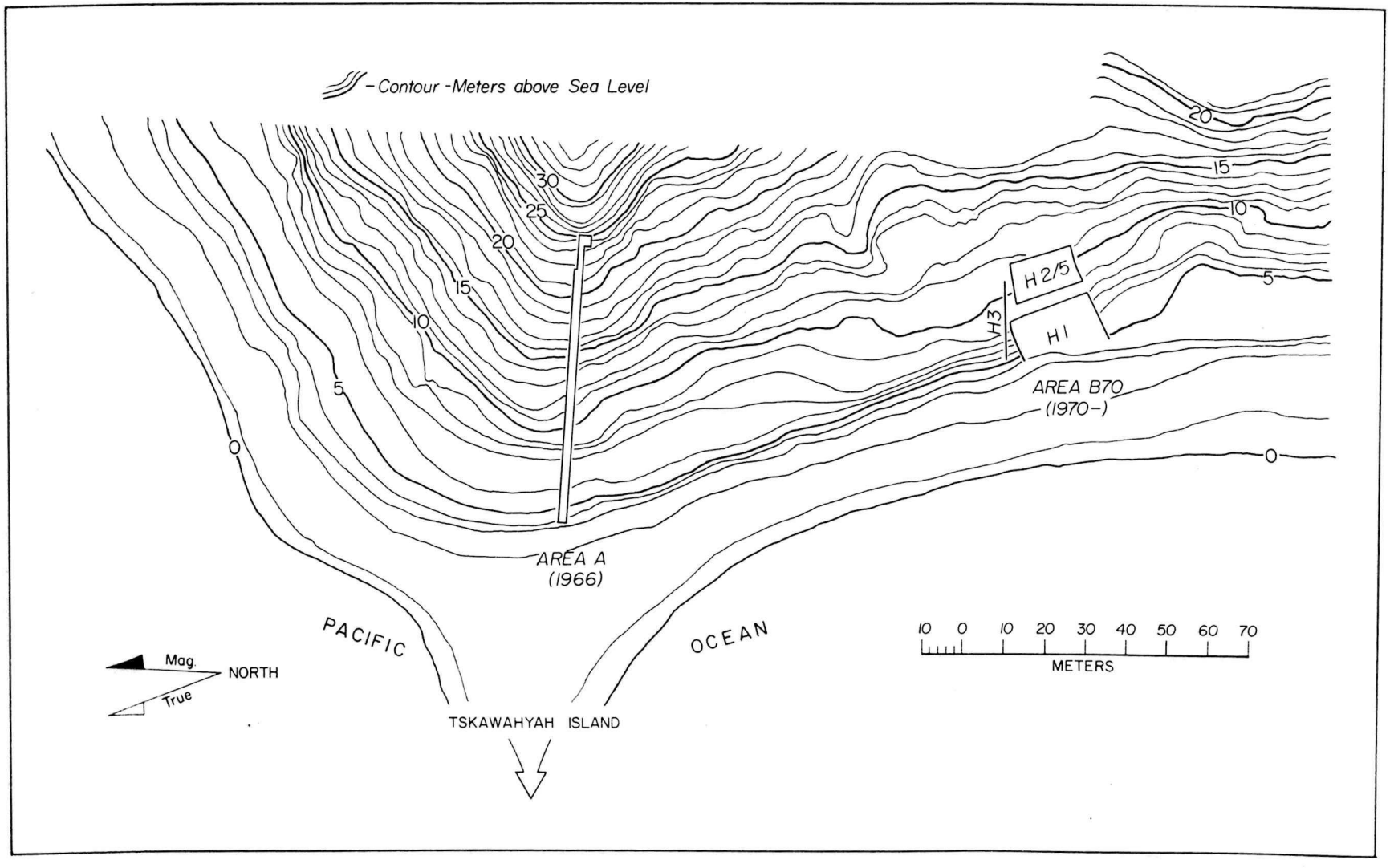


Figure 4. Main village area.

Augmenting the maritime resources were forest products, including deer, elk, salmonberry, salal berry, and various other plants. Although these do not appear to have contributed a large amount to the diet, the plants may have been an essential source of certain minerals and vitamins (Steven Gill, personal communication).

1.2.3 Archaeological Survey of the Ozette Region

The Ozette Village was occupied into the early twentieth century. It was abandoned when families moved to Neah Bay to be in compliance with Bureau of Indian Affairs regulations stipulating that all Native American children attend agency schools (Stallard and Denman 1955:76-79). By the 1920s, the village site was being used as a seasonal fishing and hunting site.

Systematic archaeological survey of the coast line began in the late 1940s, 30 to 40 years after Ozette village was abandoned. It was not so much a question of finding the site, but of assessing its importance as an archaeological resource. Daugherty visited the site in 1947, and recognized it as the largest undisturbed midden deposit on the Washington coast. Stallard and Denman (1955) did cursory testing of the site. Clearing portions of the eroded sea face of the midden revealed midden deposits with a depth of at least seven feet.

Two sites found to the south of Ozette--White Rock Village (45CA30) and Toleak Point (45JF9)--have been excavated (Guinn 1963; Newman 1959). White Rock Village is about 3 miles south of Ozette. Toleak Point, in Quileute territory, is over 30 miles south of Ozette. The material culture assemblage recovered from these two sites is small and does not differ from materials recovered in later excavations of Ozette Village. Both sites are along the beach and have exposed midden along the sea face.

The extremely dense vegetation and the highly active stream beds make archaeological survey extremely difficult. Edward Friedman (1976) surveyed the area north of Ozette and at Cape Flattery. He was able to locate a number of ethnographically recorded sites along waterways, but was unable to locate any additional inland sites. Wessen, in a survey of various river valleys south of Ozette, attributed the paucity of archaeological remains in an area of known historic sites to not only the highly organic and perishable character of the material culture, but also to the removal of site locales by river erosion (1978:71-72). The frustration of surveying locations historically known to have been occupied without finding any evidence of archaeological remains is best typified by Lake Ozette and the Ozette River. Stallard and Denman (1955:53-55) and Edward Friedman (1976:25) both surveyed the area. In spite of ethnographic, ethnohistoric, and living informant reference to the use of this seemingly desirable area, no evidence of occupation or use has been found around the lake or along the river. Therefore, given the difficulty in locating sites, the paucity of located sites, and the generally small size of the sites, Ozette Village, which extends for

over a kilometer along the coast with a depth of cultural deposit of over two meters, was an obvious candidate for excavations.

1.2.4 Excavations--1966

Richard Daugherty, with Roald Fryxell, Carl Gustafson, and Harvey Rice, began excavations at Ozette with a crew of 30 people in 1966. Ozette had been selected because it was viewed as a locale where various interdisciplinary studies of cultural, biotic, and geologic variables could be pursued with resulting contributions to Northwest Coast prehistory (Daugherty and Fryxell 1965:1-2). To assess the nature and depth of the deposits, Area A, a 2 m wide and 70 m long trench was excavated near the north end of the site, which appeared to be its deepest part. At the ocean end of this trench, the deposits were over 3 m deep.

To test the extent of the site, test pits were dug in other locations, including Cannonball Island, at the south end of the mainland part of the site near a stream, and to the north of the main trench. Surface survey was also done on the mainland and offshore islands. Excavation was also begun in Area B, the historic deposits about 100 meters south of the main trench (Area A).

The pits to the north of the trench revealed no midden, but the other excavations yielded a number of bone, shell, and stone artifacts as well as copious amounts of unworked shell and bone. Excavations in the Area B historic remains yielded a number of highly decayed, but still intact, cedar boards. No well preserved boards, such as reported by Stallard and Denman (1955:17-21), were encountered in any of the excavations.

The evidence that preservation of perishables was likely to be excellent came from two different sources. First, Makah senior citizens recounted traditions of mud slides covering portions of the village. Second, a geologic testing program based on core samples revealed that in certain portions of the village there were deposits of massive, water-saturated clays interbedded with midden deposits. These midden deposits contained preserved vegetal matter.

The initial excavations at Ozette demonstrated that the site had extensive, thick midden deposits, and that occupation extended from the historic period back to 2010±190 years BP (WSU-1123). The material culture and faunal remains reflected a well developed maritime adaptation (Gustafson 1968; McKenzie 1974). Cultural features included historic house floors, and a succession of prehistoric house floors were documented in the stratigraphic profile. The extent and the time depth of the deposits, as well as the preservation of various perishable materials at the site, made it obvious that the site would provide unique contributions to understanding past cultures on the coast.

1.2.5 Excavations--1967

Daugherty and Rice returned to the site in 1967. Because of budgetary limitations, it was necessary to reduce the scope of the excavations. The emphasis of this field season was on the recovery of materials from the area that had exhibited a high concentration of perishable materials. Based on the coring program of the previous year, the area of the historic investigations of the previous year was selected for expansion.

Excavations encountered preserved materials just at the top of the clay deposit. The preservation was due to saturation by water running along the surface of the deposit. This clay deposit was over a meter thick in the squares excavated. Below it, in one test excavation, were baskets, mats, wood points, and several boards. Because the boards ran into adjacent unexcavated squares, only a few pieces of basketry and mat fragments and several small wood tools were actually removed.

The boards and artifacts encountered under the clay deposit cast the Ozette excavations in a new light. It was obvious that the mudslides reported by the Makah senior citizens did represent a truly catastrophic event. Portions of an occupied village were being overridden by clays, sealing the deposits and preserving the vegetable materials. While the discovery of the preservation opened a number of possible areas of analysis, it presented several serious excavation problems.

Given the ethnographic evidence for the extensive use of wood products on the Northwest Coast, coupled with the general absence of preservation of wood in archaeological sites, the preservation of wood at Ozette provided an excellent opportunity to study the material culture. Additionally, if the slides did cover occupied structures, it would be possible to study the deposition of material culture items in relationship to various use areas. Material culture studies had been limited either to museum collections which had been obviously biased by the purchaser or to ethnographic accounts written over 100 years after contact. The Ozette deposits would allow a fairly unbiased view of a particular Northwest Coast material culture.

Additionally, the clay slide added two new dimensions to midden excavation. First, the clay slide would provide a definite stratigraphic marker to define an extensive contemporaneous surface. In most instances, because shell midden is built from a number of small refuse piles, it is difficult to talk of contemporaneity over a broad area of a site. The clay slide, however, neatly defined such a surface. Second, the presence of the preserved organic material in conjunction with the more imperishable items of stone, shell, and bone would provide an excellent opportunity for a fuller reconstruction of the human occupation of a midden deposit, as well as a means for developing a better understanding of the depositional relationship between perishable and non-perishable materials in a midden.

While the benefits of excavating such a deposit were clear, it was also clear that, tactically, these deposits presented numerous excavation problems. First, because the site was in an isolated area four miles from the nearest road, there was a logistical problem to be solved. Second, there were massive amounts of overburden to be removed. Third, there was the need to devise excavation approaches that would not damage the preserved but waterlogged artifacts. Fourth, once the artifacts were removed, there was a question of how they could be stabilized both effectively and economically.

Given these problems and the fact that the deposits were not in danger at the time, it was felt best to stop excavation at the site until excavation methods had been devised to cope with the problems and until sufficient funding could be secured. For the next two years, Daugherty worked on other more pressing problems at Marmes Rockshelter (45FR50) and at Minard (45GH15).

1.2.6 Excavations Since 1970

The integrity of the Ozette deposits was severely jeopardized in January of 1970 (Gleeson 1973a:1-3). Abnormal winter storms had deeply eroded the bank, undercutting the midden and causing it to slump onto the beach. As a result, numerous wooden artifacts were strewn along the upper reaches of the beach. Bentwood box fragments, baskets, mats, arrows, boards, and stakes were being collected by local beach walkers. This situation was brought to the attention of the Makah Tribal Council. Ed Claplanahoo, then Tribal Chairman, requested that Daugherty return to Ozette and start salvage excavations in the area that was slumping onto the beach.

Daugherty and Gerald Grosso visited the site in January of 1970 to appraise the situation. Grosso returned shortly thereafter to establish a camp, recover exposed artifacts, and provide security for the site. In the following months, Grosso perfected an hydraulic excavation procedure that had previously been used by Rice in test excavations at the Hoko River Site (45CA213), which also contained preserved wood and other artifacts of vegetal material. The procedure was well adapted for this situation because one could create a pressurized flow of water strong enough to erode the matrix but weak enough to preserve the perishable artifacts. While the system had the capability to work on very delicate recovery, it could, with increased flow and pressure, remove the massive clays between cultural deposits. This system solved two of the problems of excavation at Ozette: the removal of delicate water-soaked woods, and the removal of massive clay deposits.

Also during this period, Grosso field-tested various approaches to the field stabilization of the water-saturated wooden artifacts. Although these artifacts had not been subjected to fungal decay, there had been some alteration of the cell wall structure. Consequently, many artifacts would either check or develop radial splits when they were air

dried. After soaking in a 50 percent solution of polyethylene glycol and water, however, the artifacts held their shape and, in most cases, did not check or split. Additional benefits of this approach were that the baskets and other woven artifacts maintained their pliability. Thus, a third major problem was solved.

The spring was spent collecting the material from the slump block and test excavating the slump face. The slump face stratigraphy (Gleeson 1973a:7-9) revealed a thin historic level (Unit I) underlain by Unit II, a massive clay deposit (Figure 5). Below this was a thin layer of preserved midden (Unit III), which, in turn, was underlain by Unit IV, another massive clay deposit. Under Unit IV was a relatively thick midden deposit (Unit V) containing numerous boards. Under Unit V was another clay deposit (Unit VI), which was underlain by beach sands.

A full crew began excavating at the site in June. The project was initially conceived as a salvage project. Enough funds had been secured to allow excavations to continue through the following fall. The aim of the project was to salvage the deposits along the sea bank and to stabilize the bank to prevent further slumping. The test excavation of the spring had indicated that most of the preserved artifacts were coming from the Unit V deposits. Because it was known that there was an extensive historic deposit at the site and because Unit V appeared to be the prime source of the perishables on the beach the winter before, it was decided to remove the upper four levels, collecting the artifacts, and then to concentrate excavation efforts on Unit V (Gleeson 1973b:7-9).

Excavations revealed a wealth of information. Unit III contained remnants of a protohistoric/historic component with ceramics, glass, and metal artifacts recovered in conjunction with wooden artifacts. Unit V was a protohistoric deposit dating to 440±90 BP (WSU-1778). This unit had many preserved wooden artifacts, but no ceramic or glass artifacts were encountered (Gleeson 1980). Metal artifacts, not of any obvious European design, were recovered. This was the first incontrovertible evidence for the use of iron and steel on the coast before known European contact (Grosso 1974:34-36). Numerous structural remains of houses were also recovered in Unit V (Gleeson 1973c:5-6). The most important of the structural remains was the still-standing lower portion of three sides of a house (Mauger 1974:6-7). Not only did these yield much information on house construction (Mauger 1978), but they provided a clear, culturally defined boundary between interior housefloor deposits and exterior midden deposits. The slides at Ozette had preserved not only much of the material culture, but also some of the boundaries of the living and use space in which these artifacts had been used.

The excavations revealed that the clay slide had hit the village and covered it virtually instantaneously. Some disturbance had occurred when the slide had collapsed several houses and carried the shattered remains along (Gleeson 1974a:9). At the instant this catastrophe occurred, the whole area had been covered with clay, removing all contact with air. The aerobic fungi responsible for the decay of wood

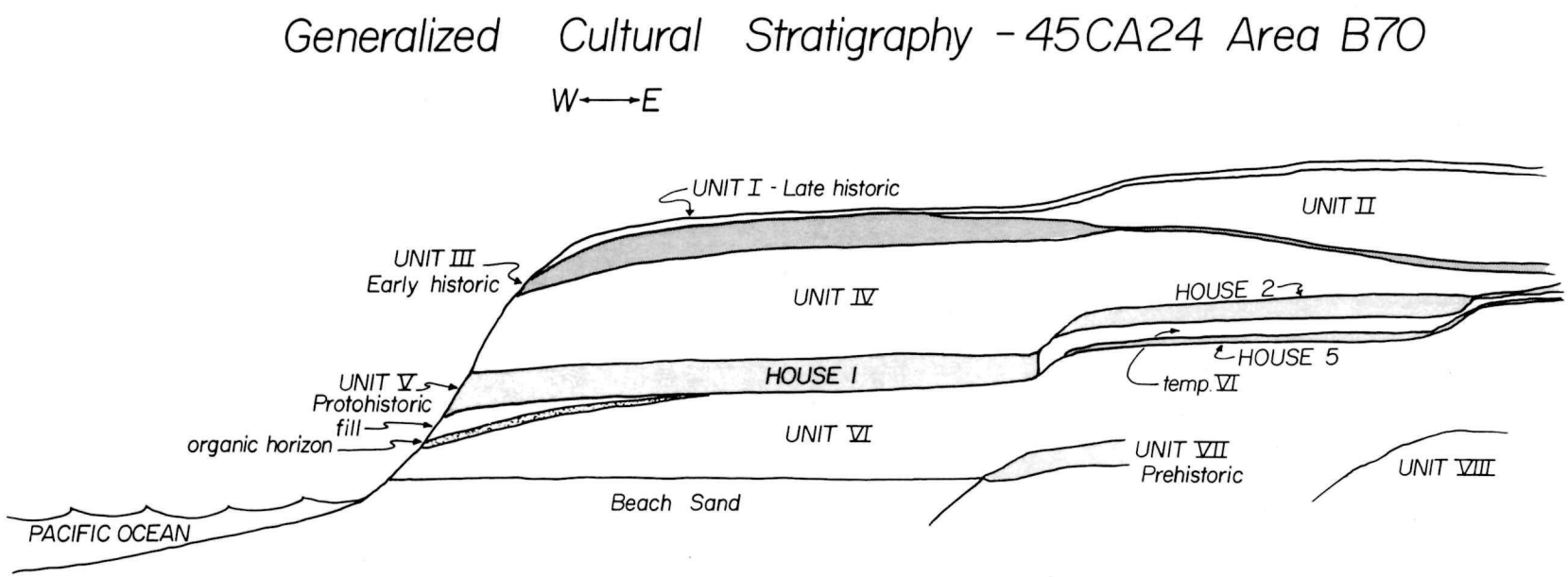


Figure 5. Site stratigraphy.

and vegetal fiber became dormant or died. Consequently, the wood and vegetal material remained as it was when the slide hit the village. So perfect was the preservation that leaves, when first excavated, were still green.

Within Unit V, the remains of at least eight houses have been uncovered. The house boundaries were determined by the remnants of the lower house walls. These wall remnant consisted of wall boards and the poles driven into the ground to serve as supports for the wall planks. The house floor areas delineated by the walls were roughly rectangular areas that were as large as 21 meters by 11.5 meters. The long axis of the structure was either parallel or perpendicular to the beach. The one observed doorway opened to the beach.

The slightly sloping terrace in this area of the village was levelled to create a house platform either by digging out high portions of the terrace and depositing the backdirt in the low spots or by the dumping of cultural refuse such as bones, shells, and fire cracked rock. Several houses might occupy serially the same house platform. A house would be built, occupied, and abandoned. After an unspecified period, another structure would be built on the same platform. Two such platforms have been fully excavated at the site. One platform contained a single house (House 1) and the other platform contained two houses (Houses 2 and 5)(Figure 6). House 5, the first house built on its platform, was apparently abandoned because off the inability of its inhabitants to deal effectively with the massive amounts of water from hillside seeps that flowed across the house platform. Houses 1 and 2 were destroyed by the massive Unit VI mudslide that covered this area of the site.

The presence of wall boards provided a boundary between interior, i.e. covered, or housefloor, midden and exterior, i.e. exposed or pathway/drainage midden. Midden is an archaeological deposit which is built up primarily through cultural activity, as opposed to other archaeological deposits that owe their build-up to natural occurances such as over bank deposition. The Ozette midden has a matrix of sand with the inclusion of rock (pebbles and fire cracked rock), bone, (predominately whale and seal), shell (predominately mussel, clam, and sea urchin), and a wide range of vegetal material as well as artifacts. The inclusions in the exterior midden tend to be larger than those found within the interior midden. The interior midden could be subdivided on the basis of the size of the inclusions. The central open area of the house had primarily extremely small inclusions, while the bench and storage areas along the walls had larger inclusions. The inclusions in the doorway area of the house had a wide range of sizes. The material in the doorway was probably swept from the open, central area of the house and was to be dumped on the sea bank in front of the house.

The area excavated consisted primarily of interior midden. The houses were built close together, usually within two meters of one another. The areas between the houses appeared to have been either pathways or drainage areas. There was no indication that these between house areas were used as areas for production or processing activities.

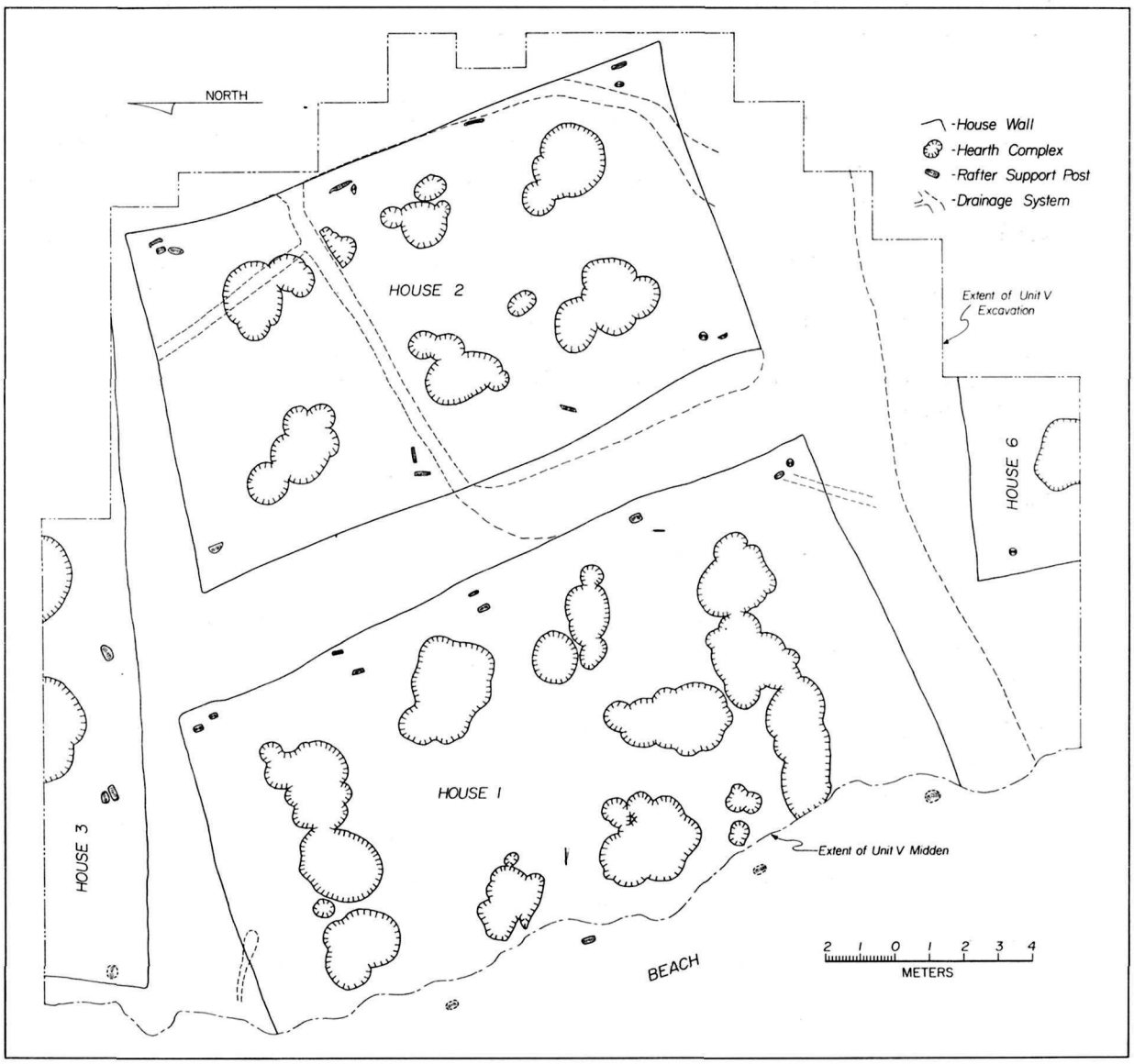


Figure 6. Unit V houses.

Within the immediate area of the village such activities probably occured on the beach in front of the site during warm, dry periods and within the dwellings during colder, wet periods of the year. Recovery of manufacturing and cooking byproducts around the numerous hearth areas within the houses supported the concept of the houses as a location for production and processing activities.

The exterior midden could be subdivided also into between house exterior midden and sea bank exterior midden. The volume of between house exterior midden was much less than the volume of refuse one would expect to have been cycled through the houses. While cultural debris was probably added to the between house exterior midden to prevent pathways from becoming large puddles, much of the cultural debris was probably deposited in the sea bank in front of the house to offset the encroachment of the ocean on the village terrace. Excavation in 1966 revaled riprapping of the sea bank with whale bones and other cultural debris. Historic photographs of the area of the house platforms show houses practically canterlevered over the beach indicating that the encroachment was a constant problem at this location. The problem of encoachment accounts for the absence of sea bank midden and portions of the House 1 platform and interior midden.

The 1970 excavation revealed another problem. The Unit V deposit was densely packed with artifacts, faunal remains, and debitage. Many were two to four meter long planks that had been piled like so many jackstraws by the slide. In many squares, the boards extended into all four side walls. Within a four-month excavation season, there was no way to stabilize or fully salvage the area. Given the impossibility of stabilization and the obvious wealth of artifacts and information, it was evident that additonal excavation would be required. Substantial additional funding was secured to make this possible.

Excavations have continued at the site since 1970. Over 50,000 artifacts, in addition to many faunal items and structural remains, have been recovered (Gleeson 1980). Remains of at least eight houses have been encountered, and three of these have been completely excavated(Figure 4). The Unit V deposit has proved to be complex, with various episodes of rebuilding and reoccupation. Complex series of drainage features have been found in association with the structures. Initial studies of the distribution of artifacts and faunal remains indicate highly structured depositional patterns within House 1 and 2. Broad artifact classes show definite patterning according to economic association (Gleeson, Fleisher, and Gamble 1979). Further inferences of subsistence activities from these patterns depends on an adequate understanding of how the various classes of artifacts were used. Describing and classifying the artifacts has been substantially slowed because the majority of the artifacts are wood, a material rarely encountered in archaeological deposits. Hence, few comparable studies exist that would provide guidance for dealing with a collection such as this one from Ozette.

The problem of wood as an archaeological phenomenon on the Northwest Coast has to be dealt with because the artifactual items, or

material culture, recovered from Ozette are predominantly derived from trees. The houses which provided protection from the elements were constructed of beams and boards made from the trunks. The boards were tied together with spruce and cedar roots to form the walls. Mats woven of cedar bark may have been hung on the interior of these walls to reduce drafts through the cracks in the walls. The canoes, which were the main method of transportation, were also constructed from trunks of cedar. Various structural elements of the canoe were either pegged, or sewn on with root and limb. The accoutrement of the canoe, e.g., the oars, the bailers, and the boxes, were all forest products. Hunting, fishing, sealing, and whaling all depended heavily on wood for the necessary implements. In hunting, the bow and arrows were wood. The arrows had wood shafts and points, which were bound with bark. Many of the fishing hooks were also wood, as were the clubs. Success in sealing and whaling depended in part on the selection of proper varieties of wood for the harpoon shafts. Resources collected by the subsistence activities were stored, cooked, and served in wooden containers. Wooden tools also had a major role in producing all these items. Wedges of wood were used to split wood into usable pieces. Wood also served as the handles for the various knives, chisels, and some adzes. Ceremonial activities had focal pieces such as a lifesized cedar effigy of a whale's dorsal fin and large cedar planks incised with personal power, or tamonowous, symbols. Items of wood played important roles in the various aspects of Ozette culture.

1.3 PREVIOUS ACCOUNTS AND RESEARCH ON NORTHWEST COAST WOODWORKING

An emphasis on wood as the major component of the material culture has been documented ethnographically and ethnohistorically for the whole of the central and northern portions of the Northwest Coast. Written accounts of woodworking span 200 years from the first contact by the Spanish and English in the 1770s through the ethnographic accounts of the twentieth century. The later ethnographic works are more concerned with social, economic and ceremonial activities than with woodworking tools and technology. Taken as a whole, these accounts describe a rather uniform tool kit and generally similar woodworking procedure. Syntheses of data on woodworking are few, and are generally concerned with the introduction of metal as an impetus for the rise of the monumental totem poles (Barbeau 1973). Accounts of prehistoric woodworking have been limited to descriptions of adze and chisel blades and mauls in site reports.

1.3.1 Ethnohistoric Sources

The ethnohistorical accounts, while spotty, provided some of the best information on the nature of the woodworking tools. First documented European contact with the central area of the coast came in the late 1770s, when the first Spanish and English ships put into Nootka Sound (Cook 1973). These accounts indicate that metal bladed tools were in

wide use in this area at time of contact. Rickard (1939) determined that these items were not being traded from the inland and were probably secured from iron and steel associated with drift wood or vessels from Japan. Cook (1846:288) points out that in 1778 iron was used for knives and chisels. In fact, only one chisel having a non-metal blade was seen (Barbeau 1973:19). There is no mention of iron being used for adze blades. However, adzes attributed to ethnographic collections made by Cook do have metal blades (Bill Holm, personal communication).

There is no mention of the adze in the accounts from Nootka Sound. Dixon's account (1968:228) of the brisk trade in the wedge-shaped pieces of metal called toes may, however, indicate the use of this metal for adze blades. The lack of mention of these may be an oversight. However, it is troublesome that a tool that is seen as being so characteristic of the local woodworking technology is not mentioned.

Cook does provide a description of both the chisels and knives in use in Nootka Sound in 1778:

> The chisel and the knife are the only forms, as far as we saw, that iron assumes amongst them. The chisel is a long flat piece, fitted into a handle of wood. A stone serves for a mallet, and a piece of fish skin for a polisher. I have seen some of these chisels that were eight to ten inches long, and three or four inches broad; but, in general, they were smaller. The knives are of various sizes; some very large and their blades are crooked, somewhat like our pruning knife; but the edge is on the back or convex part. Most of them, that we saw, were about the breadth and thickness of an iron hoop; and their singular form marks that they are not of European make. Probably, they are imitations of their own original instruments, used for the same purposes. They sharpen these iron tools upon a coarse slate whetstone; and likewise keep the whole instrument constantly bright (Cook 1846:288).

This passage from Cook is the best discussion in the early historic accounts of the range and nature of woodworking tools. Even so, there is no mention of drills, wedges, or adzes. Of great interest is the detailed description of the knife blade. Even in a situation like Ozette, with excellent preservation, most blades have rusted away leaving only the hafting tang.

One additional quote concerning knife blades is quite interesting because it indicates the speed with which new forms may have been adopted or developed. In Dixon's 1787 account is the following description of the knives at King George Sound, now known as Nootka Sound.

> A fondness for carving and sculpture was discovered amongst these people by Captain Cook: iron implements were then also in use; and their knives are so very thin that they bend them into a variety of forms, which answer their every purpose nearly as well as if they had recourse to a carpenter's tool chest (Dixon 1968:243).

Barbeau (1973:20) attributes this account to a man who had spent one year among the Nootka. The source of this information may then be John McKey, a man whom Dixon seemed to hold in rather low regard (Dixon 1968:232). Nonetheless, the quote is important because it is the first reference to the actual bending of the blade, which is so characteristic of later Northwest Coast carving, or crook, knives (Gunther 1966:52). If the knife that Cook describes was typical of precontact knives, then the crook knife characteristic of the later Northwest Coast carvers appears to have become part of the tool inventory within ten years of the first Euro-American contact at Nootka.

The ethnohistoric references to specific woodworking tools are generally limited to naming the occurrence of the tool. with little description of the item. Generally, this occurs in conjunction with a discussion of the material used for a cutting edge (usually metal).

While a number of the tools that were collected by early expeditions have found their way into European museum collections, there are many problems associated with assigning a particular area of origin or time of collection to any specific tools. As Gunther has pointed out (1972:xiii), while the journals, logs, and other documentation were considered to belong to the sponsors of an expedition, the artifacts or curios were not. At the end of the voyage, a number of these would be divided among the crew. No documentation was done on these items. Subsequently, they might be bequeathed by certain families to various museums. The museums further compounded the uncertainties of time and place by trading items among themselves, again with minimal documentation (Bill Holm, personal communication). A museum collection from one of the Cook voyages may have had materials from other collections traded into it, and parts of the original collection may have been traded into numerous museum collections across Europe. The lack of documentation by collectors and museums, coupled with the mixing of collections, make it impossible to be sure of an item's specific time or place of collection in most cases. This is unfortunate because it makes it virtually impossible to use these museum specimens to determine what tools were in use at contact and what the effect of contact was on the woodworking tools up and down the coast.

Whereas one might wish the ethnohistorical sources were more informative, these sources are still important for their documentation that iron was in wide use for both chisels and knives. The tool inventory accounted for also includes mauls and abraders. The accounts make few references to how tools were manufactured or used. There is little information on the general woodworking practices of the early contact period other than a discussion of the use of metal and of some tool types.

1.3.2 Ethnographic Sources

There is a considerable ethnographic literature for the Northwest Coast. For the purposes of this study, accounts of the Ozette area and surrounding groups will be examined. This will include the groups on Vancouver Island, as well as those on the Straits of Juan de Fuca and on the northern Washington Pacific Coast. This includes the Nootkan, Kwakiutl, and Chemakuan--all thought to be linguistically related--as well as several Coast Salish speaking groups. The data from these groups will be used to create a general picture of woodworking activities for this area.

The ethnographic sources come from periods which reflect differing levels of interest and professional concerns. The first period is that of the gentleman scholars, such as Swan (1870), Gibbs (1877), Eells (1887), and Sproat (1868), who provided accounts of the lifestyles and material culture of the Makah and other groups in the area. Professional anthropological work on the coast began with Boas's extensive descriptive work on the Kwakiutl (1909; 1921). In a similar vein is Koppert's work (1930) on the material culture of the Clayoquot, as well as works by Drucker (Nootka; 1951), Elmendorf (Twana; 1960), Olson (Quinault; 1936), Gunther (Clallam; 1927), and Suttles (Straits Salish; 1951). These accounts include various data on both tools and their use. Areal distributions of tool types and uses are also listed in Culture Element Distribution works by Drucker (1950) and Barnett (1939). These sources depict the similarity of general tool types and uses throughout the area.

As summarized by Arima (1975:21-23), the basic tool kit consisted of maul, wedge, chisel, adze, drill, knife, and abraders. Of all the ethnographic works, Boas provides the most detailed discussion of the tool types and their uses. Most of the other reports carry information on most of the tool types, but, in many instances, they appear to depend on Boas for basic structure and direction.

Discussions of tool use are uneven, and, again, Boas's work stands out. In most accounts, there is little information on the use of the tool. Mention of manufacturing usually sketches only steps in the manufacturing process. Among the ethnographers, canoe manufacture is discussed in practically all sources. House building is the second most popular topic, followed by bentwood boxes. None of the sources, with the exception of Boas, presents an integrated discussion of woodworking as a whole.

At least two factors contribute to the way woodworking has been handled in the ethnographic accounts. First, many aspects of traditional woodworking practices had been abandoned or superseded by European goods by the time the ethnographers were in the field. Second, the interests of ethnographers were changing with the development of the profession; social and economic structure increasingly recieved more attention than questions concerning material culture and technology. Consequently, little was reported in detail on the woodworking technologies of the Northwest Coast.

There are several studies of subjects related to woodworking. Arima (1975) has made a detailed report of the canoe-making procedures of a Nitinat family. Olson (1927) discussed adze types and their distribution throughout the Northwest Coast area. Duff has presented a conceptual model for the different stone maul types found in the area (1975:89). Hillary Stewart (1973) has prepared a general account of classes and their variability for the whole coast area. Of all these studies, only Arima's really attempts to discuss the tools in conjunction with other aspects of culture, and hence begins to consider broader questions of Northwest Coast woodworking technology. There is no comprehensive study of the known variation in the various types of woodworking tools or of the basis and implications of these variations. Because woodworking is such a major part of the regional technology and because many of the techniques used on wood are also applicable to bone, a comprehensive study of woodworking technology has major implications for any archaeological study of regional development or change.

1.4 STUDIES OF WOODWORKING TECHNOLOGY

Few studies have been done on woodworking by either archaeologists or ethnographers. Most ethnographers and ethnologists have focused their interests elsewhere and, in most cases, archaeologists do not encounter wood as part of their excavations. Studies on the subject of woodworking are usually concerned with morphological studies of woodworking tools and with trying to determine use of specific stone tools thought possibly to be woodworking implements. Some of the more interesting studies have resulted when archaeologists were faced with large collections of prehistoric wood (e.g., Coutts 1977; Muller-Beck 1965).

Studies such as Duff's work on stone adzes of Southeast Asia and other parts of Oceania (1970:145) look primarily at spatial and temporal differences in morphological attributes of specific woodworking tools. Crosby (1977) has provided an informative discussion of the problems of creating a morphological classification with stone adzes as found in museum ethnographic collections. Morphological studies of woodworking adzes have been used, independently of any discussion of technological systems, to trace supposed trans-Pacific contacts (Beirne 1971). Without recourse to the analysis of either local systems of woodworking or broader patterns of woodworking technology, most of these studies serve only to delimit the distribution of particular tool types.

In the literature on lithic tools, there are a number of studies of the effects of cutting, scraping, and adzing wood on lithic artifacts. These studies are concerned with the resulting evidence for edge wear on tools. Semenov (1970:122-135) presents detailed evidence of the differences between edge wear on axes and adzes. In a similar study of the eloueras of Australia, Kamminga (1977) examines the nature of the wear and its relationship to known types of wood used in the region. Studies such as these, while touching on questions of woodworking, are more centrally concerned with questions of lithic

technology. This is understandable because, in most cases, only lithics were available to the investigator for study.

Bryan Hayden's study (1977) of stone tool use in the Western Desert of Australia indicates some of the problems that may be inherent in a number of studies of lithic use wear analysis and its implications for discerning the functions of stone tools. In an examination of aboriginal lithic tool use, he discovered that many of the tools selected were available cores or flakes that best fit the job at hand. The range of tools used in woodworking was much greater than would ordinarily be assumed in most studies of edge wear. Most investigators have been quite sensible in avoiding detailed studies of woodworking on a data base limited to only stone tools. As indicated by Hayden and more fully developed as part of this study of Ozette, woodworking is a complex system that cannot be reconstructed from study of the tools alone.

As time passes, there are more and more discoveries of sites with preserved organics and, especially, with evidence of woodworking. Schweingruber (Muller-Beck 1965) and undoubtedly many others have devoted much effort to the study of the wood from the Swiss lake deposits and other European sites from which preserved wood has been recovered. Coutts (1977) has done a detailed examination of the effects of various adze types on wood, both in terms of surface scars and debitage. This work formed part of his doctoral dissertayion on a European/Maori contact site in New Zealand (1972).

Although there has been little previous interest in studies of Native American woodworking, the situation is now changing with the discovery of numerous water-saturated sites on the Pacific Northwest Coast (Croes 1976), in the Arctic, and elsewhere (MacDonald and Croes 1979). These increasing encounters with such sites will make the problem dealt with in the present study more common, and should lead to a greater interest among archaeologists in the problem of analyzing a worldwide sample of woodworking technologies.

1.5 THE STUDY OF WOODEN ARTIFACTS AND WOODWORKING ACTIVITY AT OZETTE

Although analysis of wooden artifacts and associated debitage has so far not been a major problem for other archaeological projects in North America, it has become a primary concern within the study of the Ozette site. Because over 40,000 wooden artifacts have been recovered, not counting house remains and debitage, it was necessary to study these items in such a way as to strengthen their overall analytical potential. Because the data base is large and the categories so numerous, the analysis was divided into several stages, of which this study represents the second stage.

In the study of wood, the first stage is to develop a method for identifying the various wood species and determining which were preferred for various uses by the Ozettes. The second stage is to

delimit the nature of Ozette woodworking technology: what woodworking tools were being used, how were they applied to general problems, and does the nature and distribution of debitage resulting from use of these tools reflect structuring of woodworking activity at the site. The third stage is to apply the results of the first two stages to the problem of the production and use of specific classes of wooden artifacts. When the third stage is started, there will be an adequate descriptive and technological basis for subdividing the various classes of artifacts as parts of studies of the numerous subsistence and other cultural activities at the site.

Stage one was Janet Friedman's work (1975) on the use of wood at the site. In this study, Friedman examined the types of wood used for a number of specific artifact classes. Her findings indicated that the artisan selected a piece of wood not only according to species, but also to anatomical part. While there were cases of both complete agreement and disagreement with the ethnographic record, in many instances the variation from the ethnographic record reflected alternative woods of similar properties that were substituted for the usual wood. A knowledge of the species and parts used, as well as permissible alternatives, was essential for the study of the woodworking tools; as some of the early replication indicated, the selection of the proper raw materials was necessary for success in making and using various tools and other artifacts.

The second stage of the analysis, covered in this study, reconstructs the production system for manufacturing wooden artifacts. Woodworking data derived from tools, debitage, scars, preforms, and artifacts are used to construct a five level model comprised of material, tools, transformations, manufacturing or production sequences, and products. This system must be understood prior to assessing the importance of various artifact classes to, and their articulation with, other cultural systems at Ozette. A reconstructed production system is needed, for example, so that we may begin to distinguish between the traces of manufacture and of use or function of particular artifacts. Of greater importance, the reconstructed production model is needed so we may interpret the spatial patterns in which the various by-products of a woodworking technology were deposited. Such questions will move this study from Stage 2 concerns to Stage 3 problems. The patterns of deposition for wood debitage will be examined as possible primary and secondary evidence of social and economic structures of units such as the family, the household, and the village.

In order to be sensitive to such questions, the reconstructed production system, or model, should be designed so that it articulates with other broad cultural patterns. The definition and delimitation of the general topic of woodworking technology should be both comprehensive and explicit enough so that it might be sensitive to differing levels of variation and by extension relate to questions of cultural and technological integration beyond the realm of just woodworking. The study of the woodworking technology also points to the question of exactly how to define and delimit any technological system. This presents certain problems because, like the term culture, the term

technology has been applied to many different levels of integration. A major concern of a study such as this is to define the concept of woodworking technology.

Because the data base from Ozette has a breadth, both qualitatively and quantitatively, that is much greater than is found at most archaeological sites, and because the material in question--wood--is not usually a part of archaeological analysis, it will be possible to approach the question of technology from different lines of evidence and in different degrees of detail than is usually the case with other archaeological studies of technology, e.g., lithic or ceramic. An emphasis of this study will be to develop a production model that may be used to explore various questions of cultural behavior. While it will not be possible to develop each of the proposed approaches, an attempt will be made to show how these could be formulated and applied to various problems.

This study will attempt to integrate various lines of evidence concerning woodworking activity at Ozette. Available and pertinent ethnohistorical, ethnographic, and archaeological data will be used. The discussion of the ethnographic and ethnohistorical data in this chapter indicates that, while they will be of considerable help in questions of specific tool type and use, they will be of little use for detailed discussions of woodworking technology. The Ozette woodworking-related data base, which consists of tools, artifact preforms, finished artifacts, and debitage, will be used to develop a comprehensive view of the general woodworking technology at the site. This comprehensive view will be developed in such a way that it remains sensitive to localized variations of the overall pattern.

Chapter II

CONCERNS AND SCOPE OF STUDY

2.1 INTRODUCTION

The data of archaeology are, to a great degree, derived from the remains of material culture items and of behavior that resulted in depositing these remains in particular configurations in each site. The material culture remains recovered from a site represent only a small part of the material culture that was present. What is recovered from a site are those items that were impervious to decay, that were lost, that were considered exhausted or broken beyond reclamation or those elements that were the by-products of on-site production of other material culture items. The items that are recovered do not representatively reflect culture any more than do the items that are conserved by the many museums of this and other countries. What these items reflect is a technology. In archaeology, technology is the abstraction of material culture items that defines and explains material culture as man's interaction with with the physical envionment as well as aspects of culture such as social order, economics, religion, and aesthetics. In developing archaeological data as an index of cultural interaction and change, the archaeological data about material culture must first be raised to the level of technological systems. If this is done, then the archaeological data can be related to questions of cultural relationships and organization. This is because the technological systems affect and are affected by social, political, economic, and other spheres of cultural life. This can not be so strongly claimed for material culture as such.

On the Northwest Coast the indigenous peoples had a great deal of knowledge about the use of wood and of how to transform this raw material into both delicate and monumental pieces of material culture. Friedman(1975) has demonstrated that the inherent structural qualities of various species and cuts of wood were taken into account by the native artisan. Once the appropriate section of the desired species was found, it was then cut or reduced to size. When necessary it was bent or straightened to the desired shape. Finally it might be joined with one or more additional pieces to make the final desired artifact. The transformation from one state to another was done through definite procedures using various tools, knowledge, and experience. A consideration of the knowledge of wood properties, means of the transforming the wood, and the tools and the special procedures used move one from the study of items - material culture - to studies of processes - technology.

2.2 THEORETICAL CONCERNS

While parts of this study are devoted to pragmatic problems of defining the archaeological evidence of woodworking and some of the temporal and spatial variation in the deposition of this evidence, there are broader archaeological and anthropological concerns that relate to data under study. The following sections touch on various theoretical, methodological, and technical concerns that the author has considered as part of this study. Although a number of these concerns are not dealt with directly in this study, it is felt that they are either natural outgrowths of such a study or factors that should be considered or explored more fully in future studies of woodworking technology.

Definitions of technology are as varied, though not as numerous, as the definitions of culture. For many the definition is apparently self-explanatory (Davis 1972:15-17). At present the term is either defined in such a manner as to be the underpinning to all existence or it is so narrowly defined that it becomes synonymous with a single type of manufacturing sequence. Some examples of approaches to technology that are relevant to the development of archaeological applications of the concept are briefly reviewed in the following sections.

2.2.1 Leslie White - The Grand Scheme

White, given his 'energetic' approach to culture, sees technology as the underpinning of all the various aspects of culture (1959:19). White's treatment of technology is important in that he demonstrates the relationship of technology to other aspects of culture. White defines technology as the part of culture which harnesses energy and puts it to work (1959:27). Stripped of any deterministic arguments, this is an excellent definition of technology. It covers all those pursuits, both historic and prehistoric, that deal with man's purposeful alteration of the environment and its constituents. White uses this definition in conjunction with various other parameters to argue his basic tenet that as technology develops, culture evolves, i.e., greater and greater amounts of energy are controlled with the same input of human energy. Unfortunately, although White sees technology as the cornerstone of man's cultural evolution, his approach is so broad that it is difficult to relate it to the the mechanics of technologies of specific culture.

2.2.2 Decision Making Models - Davis and Bonnichsen

Wilbur Davis (1972) approaches the problem of technology in terms of observable archaeological data and their usefulness in addressing questions of culture change through innovation. Davis' work, written in the early 1960s, is in part a reaction to the use of taxonomic and typological approaches for deriving normative behavior to deal satisfactorily with archaeological and anthropological questions. Davis advocates the study of archaeological questions through a technological

systems approach. The utility of such an approach is that it allows the archaeologist to deal with concepts that are likely to be sensitive to spatial, temporal, and idiosyncratic variation in behavior.

Davis defines a technological system as follows:

1. Any material object shaped by man is the product of a purposive act, or idea system.

2. The manufacture of an object is a series of systematic, hierarchically ordered techniques, starting with the gathering of the materials and continuing in a logical sequence until the object is finished.

3. The techniques are so ordered that the appearance of each technique is predicated upon the successful appearance of a preceding technique. Such a sequence is called a technical sequence.

4. Any technique of a given hierarchical ranking may be substituted for any other technique of the same rank order.

5. Techniques are free to be combined in any logically consistent procedural sequence which may be used to make a specific kind of object for a specific purpose. A group of such combinations oriented about the manufacture of objects for a specific purpose is called a technological system (1972:56-57).

Davis, in spite of his own cautions, develops an emphasis in which technology is aimed at the manufacture of an item, i.e., the transformation of a raw material such as rock or clay into a finished product such as an arrowhead or pot. This is one common view of technology in which the concept is defined as the various methods and knowledge used to transform a specific material into desired material culture items. Another and equally valid approach to technology is to look at the various methods and knowledge used to extend man's control of his environment. In this sense, technology includes fishing, farming, and other similar pursuits. This latter definition draws from many areas included by the former and, more importantly, begins to approach a definition of technology that may be used to operationally investigate some of the questions that White raised. Both definition and emphasis are involved with the transformation of nature for a specific cultural result. The difference between the two are whether you are transforming an item or the immediate environment of an item.

As was Davis, Bonnichsen (1977) is disillusioned with various taxonomic and typological approaches, especially as applied to lithic remains (1977:7-56, 202-208). The basis for these schemes is usually not explicit and, where explicit, is usually based on morphological

characteristics of artifacts without reference to the forces, or decisions, that helped to create these characteristics. Specifically, he has the following general objections to the morphological attributes that have commonly been used in hypotheses that attempt to link the form and functions of lithic tools.

1. The lack of an underlying theory and use of conflicting theories of fracture

2. Problems of isomorphism in both formal and technological attributes

3. Poor or inaccurate ethnographic analogs

4. The use of uncontrolled experimental analogs

5. The intuitive selection of attributes by using projective analogy

6. Failure to distinguish between cultural and non-cultural variables (Bonnichsen 1977:50).

Additionally, the form-function hypotheses generally have assumed a single function for each tool, which makes them difficult to use in explaining human behavior which is essentially multidimensional. Given the problems with such classificatory schemes, it is understandable that there has been only limited success in attempts to explain the similarities and variations of lithic tool types both in temporal and spatial distributions.

Bonnichsen sees the solution to a number of these problems in an approach which recognizes four levels of decisions which go into the production of a specific lithic artifact. The levels are:

1. selection of materials;

2. how to articulate the input variables of force, impactor, holding position and materials, shape, and torque;

3. microstructural or spatial concepts for setting up cores for flake removal;

4. macrostructural decisions concerning the ultimate form of the artifact (Bonnichsen 1977:208-209).

These levels of decision are seen to reflect the individual's decision-making process as reflected by archaeologically recovered artifacts. Using current knowledge of lithic technology and archaeological data, Bonnichsen has derived a systemic cognitive model to gauge the variability in the production of various archaeological samples.

Bonnichsen develops a detailed artifact production system for inferring the input, feedback, and output that occurs among the artisan, his goal, the material at hand, and his previous experiences (1977:73). Approaching the problem on the level of the individual, it is then possible to explore the assumption that the group of artisans in close contact will share the same cognitive decision-making model or system. By breaking down the analysis of the lithic data into the four levels, it is possible to assess the nature and implication of variation in the production of lithic artifacts within a synchronic sample. The model of the decision-making process can then also be tested by replication, or simulation, to see if the model produces similar production stages and debitage.

Given a well-defined decision-making model for a single component, it is possible to examine questions of temporal and spatial variation among several components and to explain cultural and environmental shifts reflected in the variation. By being able to examine various levels of decision-making, the level of variation can be examined to see if, in cases of similar morphology, there are variations in the production sequence, production methods, or material. Similarly, it is feasible to discuss widely divergent morphological types that share extensive similarities in production sequences and production methodologies. Such an approach is critical to discussions involving questions of migration, diffusion, or in situ development (Bonnichsen 1977:198).

Bonnichsen's work is important because it explores the preexisting approaches to prehistoric material culture and their application to the understanding of culture process. His approach allows for testability and for application to a wide number of technological questions. Most important, it dissects technological processes, especially production, or manufacturing, technology into analytic stages which may be related in a systematic manner.

A larger question arising from Bonnichsen's work is the relationship of technology to other aspects of culture. Even though the main thrust of his work is aimed at the development of usable models for the description and comparison of technological systems, he does explore the implications of the relationship of technology to certain culture processes in his discussion of the Clovis materials.

Bonnichsen tested hypotheses concerning migration versus diffusion or in situ development as an explanation for the appearance of Clovis. In addition to morphological differences, there were "distinctly different decision models in tool making operations" (Bonnichsen 1977:201). For Bonnichsen, these observations support diffusion or in situ explantion for the development of Clovis.

Bonnichsen's approach not only delimits the differences among similiar artifacts, but also demonstrates how these differences in form relate to differences in production technology. It is the understanding of the variation in production technology that allows for more elegant inference of the culture change predicted by the different archaeological collections. In the following section is a discussion of how Lechtman and Steinberg (1979) have traced the development of archaeological thought and practice in the matter of technology.

2.2.3 The Anthropological/Archaeological Viewpoint

Lechtman and Steinberg (1979) have explored the questions of how technology articulates with other cultural subsystems, how technology may be defined, and how this knowledge may be used to explain temporal and spatial shifts seen in the archaeological record. They approach technology as a means of interpreting material culture in relationship to other aspects of culture. Their general finding is that, while material culture is the backbone of archaeology, the discipline has been surprisingly lax in developing the concept of technology and its application to the understanding of various cultural systems (1979:140).

For them, technologies are defined as "the cultural traditions developed in human communities for dealing with the physical and biological environment. . . . they are important not only because they affect social life but also because they constitute a major body of cultural phenomena in their own right" (Merrill 1968:577, 581). Technology, then, may be seen as a cultural subsystem similar to religion, art, social organization, or economics. The question becomes how technology is integrated with other aspects of culture. In part, technologies are a compromise between the physical constraints--material properties and means of alteration--and the cultural constraints--religious, social, asthetic, or political practices. As a result of this compromise, technological systems, from an etic point of view, may reflect broad cultural ideals (Lechtman and Merrill 1977:12-15). The objective then is to be able to predict the effect of a change, in either the technological aspect or the other cultural aspects, on one another. Such predictions can only be based on a sound understanding of the interrelationship of technology with the other cultural aspects.

Lechtman and Steinberg cite Leone's assessment of the importance of the concept of technology for archaeology and the profession's apparent inability to develop the concept to its advantage.

> At the moment, material culture as a category of phenomena is unaccounted for. It is scattered between interior decorators, advertising firms, and historians of technology. But when one considers how little we know about how material culture articulates with other cultural subsystems, one begins to see the potential. There exists a completely empty niche, and it is neither small nor irrelevant. Should archaeology become

> the science of material objects or technology, many of the aims, problems, methods, and data of the field would be transformed. A scientific revolution would take place (Leone 1972:18).

Leone then develops this argument further indicating that the study of technology not only has import for the profession at large but also may allow the profession, because of its peculiar perspective, to make substantive contributions toward understanding problems faced by our society.

> In finally focusing concerted attention on [culture change], it may be necessary both to extend the horizons of the field for data and to address ourselves to the more pressing needs of our own culture. These calls may be met in some of the developments going on in historic archaeology, ethnographic archaeology, and in the study of material objects. Fuller sources of data covering lengthy periods are available using historic materials. Material culture, on the other hand, has so long been neglected by ethnographers that archaeologists have been forced to build their own analogues. . . . the exigencies of our own culture point out quite clearly that we know almost nothing about the effects of technology and material culture on other cultural subsystems and vice versa. That archaeology should expand into such domains would seem implausible, if it had not already begun. The area which we are as yet only dimly aware of is the study of material culture, objects, or technology.
>
> The scholarly and scientific study of technology as a cultural subsystem has very diffuse roots and even more disparate practitioners. . . . Yet there is no coherence to these studies when taken as a group, and a list of such [practitioners] is almost a list of mavericks. These examples provide incomplete models for the study of material culture at the same time that they demonstrate the openness of the niche that archaeologists have been preadapting to for a century. . . .
>
> More to the point, however, is the skill we barely know we possess. The average archaeologist knows an enormous amount about the artifacts of prehistory. He can tell reams about the most arcane item. Or so it would seem. But no one can analyze what plastic has done to American culture and, ludicrous as it may seem, the archaeologist is better fit to do the job than anyone (Leone 1972:26-27).

Leone's comments are particularly telling when one considers the success of scholarly papers discussing culture change on the basis of subsistence, climatic, and ecological data versus those concerned with explaining culture change through integration material culture with other aspects of cultural behavior. Leone's criticism of the profession is relatively gentle when one considers Lechtman and Steinberg's pointed observation that

> As impoverished as archaeology must always remain, by the very sources of its data, it has nevertheless failed to exploit the single area in which it is unquestionably rich and through which it may be led to a deep understanding of the technological aspect of man (1979:140).

While Lechtman and Steinberg do not address themselves to the detailed particulars of technological studies, they do differentiate between general and micro-technological studies (1979:141-142). General studies relate to historic developments such as the introduction or development of generalized technological systems, such as argriculture or metallurgy, that occur across various areas and times. The micro-technological studies focus on specific technological systems and developments within a locale, a culture, or culture area. Whereas the general studies address themselves to questions of broad anthropological interest such as suggested by Leone, Lechtman and Steinberg caution that these studies can best be tested and expanded on the basis of the concatenation of many smaller studies or sets of studies. The specific micro-studies need to be completed, systems defined, changes explained, and effects on other cultural aspects determined in order to discuss in detail the mechanics concerning technological developments and their impact on various aspects of culture.

2.2.4 Summary

While the general relationships of technology to other aspects of culture should be a main concern for archaeology and anthropology, it is the more particularistic studies espoused by Davis and Bonnichsen, as well as Lechtman and Steinberg, that will provide the opportunites to actually investigate these relationships. This study of woodworking is directed toward the level of specific decision-making models as discussed in part by Bonnichsen and is also concerned with specific micro-technological studies as espoused by Lechtman and Steinberg.

2.3 OZETTE WOODWORKING--METHODOLOGICAL CONCERNS

The aim of this study is use archaeological data to develop a model of the technological system that produced the various wooden artifacts recovered from Ozette. While taking into account the possibility of temporal variation, the study will focus on remains from one time period and, specifically, from a single habitation unit. The boundaries of the woodworking system are defined by the purposeful alteration of wood for the production of artifacts. The articulation of this system will be discussed, as will the relationship of the system to both temporal and spatial concerns. Additionally, a number of cautions concerning the application of this or any other technological system will be noted.

2.3.1 Purpose of a Technological System

Technology may be seen as culturally-patterned problem-solving that depends upon available knowledge, skills, and manipulation of aspects of the physical environement. Knowledge exists both as verbally communicated and taught ideas and facts and as information acquired through observation, imitation and experienced insight. The second type of knowledge is extremely hard to quantify. It is the type of knowledge that leads one to know when a particular rock will work, where to hit a piece of machinery to make it run again, where to hit a piece of wood to split it. These examples are simple, but they do reflect a certain body of knowledge in all human communities. Similar to this is skill. While a certain level of skill can be achieved through practice and observation, there are always individuals who, because of certain inherent capabilities, such as a hand eye coordination or reflex reaction time, are more adept than their compatriots. For the purpose of this paper, technology is considered to be the application of knowledge, skills, and material culture by a particular group of people to solve specific problems.

A problem may be defined as the requirement for some action to satisfy a specific need. In the instance that technology is involved items of material culture will be either used or produced as part of this process of solution. The artisan or group will take the problem in hand and consider it in terms of physical and social environmental conditions and limitations. The available knowledge and skills of the group are then applied to arrive at a culturally acceptable and achievable solution.

Once a solution has been settled upon, it then becomes a matter of implementing the decision. This will necessitate the scheduling of personnel needed for the project. The collection or acquisition of certain raw material will be entailed, and the availability of certain tools will also have to be taken into consideration. Then, it will then be possible to proceed with direct action to solve the problem.

Direct action will occur as observable technical sequences. Technical sequences are linked series of transformations or ways of altering a raw material or its immediate environment. It should be noted that in some instances, such as in making a bow and arrow or a box, raw materials are altered into a final product; while, in order to catch a fish, material culture items are used to alter the environment in order to bring the fish under the control of the fisherman. In other cases, raw materials - either foodstuffs or manufacturing materials - are altered in order to preserve, transport, or store them for later use. In all cases, there are a number of culturally prescribed techniques that are assembled into technical sequences. In fact, the sequences themselves may often be culturally prescribed. These sequences produce material culture items or useable raw materials, including foodstuffs, as well as by-products in terms of either debitage or unwanted faunal or floral portions.

Such products are parts of subsistence, shelter, storage, role labeling, ceremonial, and various other areas of cultural activities (Binford 1962). The creation of these products was an answer to some need or problem that was articulated within or by one of these areas. A solution was sought through a section of culture best defined as technology, or the application of cultural knowledge and skills involving the manipulation of the biophysical environment.

Basically then, technology can be divided into three subsections each having a different general purpose. Procurement technology involves the collection of raw materials whether they be subsistence items or manufacturing raw materials. Processing technology is the alteration or stablization for later use of the materials collected by the various procurement technologies. Production technology involves the use of raw materials, preprocessed or not, to create items for use or consumption. One of the advantages to such a tripartite division of technology is that it does integrate various aspects of the material culture realm with that of subsistence.

This study focuses on a particular production technology, woodworking. The understanding of basic woodworking technology, or for that matter bone, stone, ceramic, or shell production technologies, is necessary for any studies of function as one must be able to separate those alterations of a tool that result from manufacture from those of use.

2.3.2 Archaeological Evidence of Technological Systems

A technology as a body of knowledge is an extremely difficult item to isolate, even in an ethnographic situation where there are informants who are still practicing the various crafts. In such situations, it is difficult to determine whether parts of the manufacturing process are being performed because of specific knowledge of a material's physical properties (patterned understanding) or because these part work (insight). In a similar vein, the acquisition and transfer of this knowledge is unclear in many cases. As a matter of ethnographic inquiry, knowledge systems associated with a specific technology may prove to be a very elusive area of study. Given the problems associated with studying the technology of living cultures, one should be extremely cautious of uncritical use of studies of knowledge systems of prehistoric cultures.

Technological models in archaeology can be divided into three categories: manufacturing, or production, activities; collection, or procurement, activities; and processing activities. Much of the present work in archaeology that passes under the rubric of technology is concerned with models of artifact manufacturing. Archaeological data on instrumental tools, on preforms and debitage, and on finished artifacts are combined with one or another model to create basically a technical production model.

In making the transition from the data to the manufacturing, processing, or the collection model, it is necessary to bridge the gap between the data and the model. This bridge is best seen as a theory that establishes a coherent sequence of stages and transitions. These activities are postulated by the investigator as a way of accounting for the characteristics of the available data taking into account the contingent environmental (social and physical) factors that can be deduced about the situation under study. Because one is dealing with prehistoric materials, the sequence becomes the investigator's own cognitive map for solving a given prehistoric problem with the tools and constraints that would be available at the time. To the extent that the model accounts for new data, and can be verified by replication, it may be thought to resemble a prehistoric cognitive model. Such an explanation can be falsified, but probably can never be proved.

What, then, the archaeologist is constructing when he presents a technical sequence is his best explanation for the data at hand. This is similar to the observation that an ethnological explanation or understanding of how one should act or react in a given cultural situation is as good as any other etic or emic explanation as long as it generates a response that is recognizable and is culturally acceptable (Burling 1969:426). The difficulty in explaining and, to some degree, in the testing of such solutions for the archaeologist is, "how well do his explanations of a certain set of relationships work with other sequences for that particular culture?" It is not, then, sufficient to be able to establish an explanation for a single sequence, but, in fact, the archaeologist should be working with a large enough aspect of his area so that it is possible to see if a number of such sequences can be permutated into larger, more complex, systems that may reflect the acceptable decision-making models for his particular site, period, or problem.

Approaching the problems of either manufacturing technologies or collection technologies, one must be cognizant of the fact that the sequences of stages and transitions are the constructs of the investigator. These constructs are testable only in that they may be observed to occur and that they are not inconsistent with other data and systems developed out of the same cultural milieu.

Woodworking technology is the culturally patterned method of altering wood into the various material culture items used by a society. The understanding of the woodworking technology of a specific society involves the isolation of specific raw material alterations and their patterning into a systematic relationship which results in a predictable and uniform product. A technology is present in a culture both as a body of knowledge and as a set of tools, products, and by-products. The tools may be used in various ways (transformations), producing by-products (debitage) and in various sequences (manufacturing sequences) producing specific products (artifacts). While emically there may be no differentiation between the body of knowledge and the production system, etically it is important to differentiate between the two because the testing of archaeologically derived models will be based primarily on the production system.

A technology, viewed as the systematic use and relationship of tools, products, and by-products, may be studied from an archaeological data base. Given a specific purpose or task, a production technology will then involve the selection of adequate raw materials, the use of certain tools in particular ways, and the selection of specific manufacturing processes. Within an archaeological sample, evidence of all three of these aspects will be present in terms of the product itself, the tools used to manufacture the product, and the by-products of the manufacturing sequence. In many cases, the investigator must also be concerned with the use of the product, so as to be able to distinguish traces left by the use of the product from those that remain from the manufacturing. The validity of a proposed manufacturing and use sequence is best approached by replicating the sequence in a situation that most closely approximates the assumed prehistoric situation.

The manufacturing of an object can be seen as a series of alterations or transformations. With wood, these fall into several general categories: reduction, or subtraction, such as splitting, cutting, or drilling; shaping, as in steaming for bending or straightening; and addition, as in pegging or binding to join two or more pieces together to form a composite artifact. Within each of these categories, the culturally available procedures depend upon the technological knowledge and tools available to that particular group. The solutions that are available to any one group in a synchronic framework will depend upon the number and breadth of the available transformations and their ability to be strung together to produce complex items or solutions in answer to specific demands.

The approach taken was to seek data applicable to the broad areas of tools, transformations, and manufacturing or production sequences. This was done on the assumption that any one of these three categories not only does not necessarily predetermine the other two, but also that the selection of particular aspects within any of the categories might show considerable variation and yet produce a similar end product. In cases where determination of cultural acceptability is not strongly voiced until the final stage of manufacture, one may be able, by dividing the data according to these three categories, to arrive at useful information concerning not only differences in production technology, but also useful information on variation among families, households, villages, and regions.

The tools, transformations done by these tools, and the ordering of the use of these tools into production sequences form the production technology of the spatial or temporal unit (e.g., house, site, subarea, etc.) being analyzed. The tools represent the range of tools found in the unit or inferred to have been used there. Variation is determined by the presence, absence, and relative emphasis of the various types of tools. Because many woodworking tools are multi-purpose and because a percentage of these purposes will overlap with other tools, one cannot initially determine the functional implications of variations in a distribution. The second aspect to be examined is the transformations. The transformations are basically the way wood is altered by reduction,

addition, or manipulation of its physical properties. The isolation of these transformations not only tells how the tools were being used, but also provides the components of production sequences. Reconstruction of production sequences involves determining which transformations were selected and how they were ordered to produce a specific item. With woodworking, there is enough latitude in tool function and in the choice of transformations that several production sequences may be taken to arrive at the same final form. By splitting the manufacture into tools, transformations, and production sequences, one can better sense variations, both spatial and temporal, of a production technology. This approach has shown differences in wedge manufacture and may serve to differentiate production technologies among various social areas within a unit, as well as serving to delimit and explain the nature of differences between temporal units at Ozette.

The approach of using archaeological data derived from tools, debitage, scars, preforms, and artifacts allows for the construction of a five-level system comprised of material, tools, transformations, manufacturing sequence, and products. Because the system involves a number of archaeologically observable phenomena, it should be possible to test archaeological units (e.g., levels, houses, features, sites, etc.) for either synchronic or diachronic variation. The test of the model will be if it can be applied to a number of data bases and if it can generate comparable results consistently.

2.3.3 Ozette Applications

The Ozette Site has yielded several different data sets that directly relate to the question of woodworking technology and its relation to other aspects of culture. Of particular interest is the possibility that there was synchronic variation in the production system among nuclear family units and extended family households represented in Unit V. Such differences could provide clues to the articulation of technology with socio-political and economic structures. The Ozette Site will also provide the data base to examine diachronically the effects of the introduction of metal as cutting edge material for woodworking tools. Test excavation of Unit VII indicates a premetal technology at about A.D. 1100. Unit V, dating to about A.D. 1600, has a metal using woodworking technology without any Euro-American influence. Unit III has an extensive deposit of Euro-American trade materials. It will be possible in the future, as certain areas of excavation are completed, to define the premetal woodworking system and then to examine the effect of first the introduction of a new material, metal, and second to examine the subsequent introduction of a Euro-American woodworking cognitive system which also used metal tools. The data are not presently available for this study. The model constructed as part of this dissertation is designed to be useful in examining broader questions of this sort. Although the emphasis here is on reconstructing the production technology represented in Unit V, enough data from other stratigraphic units are available to permit preliminary assessment of both the premetal aboriginal system, and the later, Euro-American influenced system.

2.3.4 Area-wide Applications

With the excavation of an increasing number of sites containing wood on the Northwest Coast (Croes 1976), it will be possible to examine more broadly temporal and spatial variation in woodworking technology. Wet sites have been found from Ozette north to Lachane in Prince Rupert Harbor. The wet sites range in time from the 18th century at Ozette to 2700 B.P. at Hoko River. While not all sites have the same in situ habitation deposits as Ozette, the abundant wood material and debitage from many of these sites will provide extensive data that may be studied in a frame of reference similiar to that used here for the Ozette materials. The range of sites will allow not only the investigation of temporal and spatial questions, but also the investigation of woodworking practices at various functionally different locations such as winter villages, summer villages, and fishing camps.

Moving away from areas of primarily technological concern, the 'technological system' approach outlined here may also provide ways to investigate the development of other aspects of Northwest Coast culture. On the west coast of Vancouver Island, there was in historic times a certain degree of craft specialization by village (Sproat 1868:19). Apparently, some villages were renowned for their canoes, others for art work, and still others for manufacturing hunting equipment. Although beyond the scope of the present study, specializations such as these can perhaps be documented archaeologically. If it is possible to distinguish manufacturing sequences and attendant specialized tools, then it may be possible to look at variations in craft specialization through both time and space in the archaeological record.

The study of woodworking technology may be a way to investigate the rise of craft specialization on the Northwest Coast. Indications of specialization may occur in the archaeological record in terms of esoteric woodworking tools or processes, standardization of production sequences, quantitative differences in artifact production, or the reduction or absence of certain subsistence-related technologies. These might be used as indicators for the appearance and distribution of artisans who were deriving main support from their craft activity. The appearance of the products of such roles would be an indicator of a trade network that involved enough material wealth to permit individuals to commission, or purchase, various items. On the earlier time levels, this would reflect in part the growing complexity of Northwest Coast culture as indicated through higher production of tradeable wealth. Craft specialization, then, if it can be demonstrated archaeologically, could serve as one indicator of the rise of complexity in Northwest Coast culture.

2.3.5 Summary

The purpose of this study is to devise a model for understanding how the Ozette modified wood into material culture objects. The model will consist of five levels--material, tools, transformations, production

sequences, and artifacts. Data about these levels will be derived from study of archaeologically recovered tools, debitage, preforms, and artifacts, and from the distribution and association of these items at the Ozette site. Variations within the different aspects (i.e. raw material, tools, transformations, and production sequences) of the production model may indicate significant changes in the general cultural pattern of which this technology is a part.

2.4 TECHNICAL CONCERNS

The study is based on the use of archaeological existing data from Ozette as indicators of the methods used to alter wood into usable and desired products. The data derived from artifacts, preforms, tools, and detritus; each provide specific critical information for the understanding of Ozette woodworking. The following sections delimit how the data was generated, partitioned, and manipulated.

2.4.1 Temporal and Spatial Concerns

Artifacts may be seen as a means for gauging changes in woodworking technology. Changes in type and frequency of tools may reflect corresponding changes in the overall technological pattern, or they may more simply reflect variations in tools used within the same technological pattern. Finally, variation between temporal units may only reflect the unequal recovery of activity areas. To understand the import of varying tool inventories from one temporal unit to another, it becomes necessary to assess first the nature of the sample, then its relation to the proposed reconstruction of technological patterns.

2.4.1.1 Temporal Units

In order to begin assessing the level-to-level differences, one must understand the natural level distinctions that occur in the Ozette deposits. Basically, the levels distinguish major catastrophic episodes from major cultural ones. Units I, V, and VII are major cultural deposits. Unit I-III is also a major cultural unit. However, because Unit II is missing in the northern portion of the excavation, it was impossible to distinguish conclusively the boundary between Unit I and Unit III.

The dating of the cultural units containing preserved vegetal material is tentatively held to range from about 1920 A.D. to 1200 A.D. Unit VII is dated to 790±80 BP (WSU-1865). Unit V is dated to 440+90 (WSU-1778). Unit III, which contains a number of trade goods, would at least encompass the period subsequent to the 1770s (Cook 1973). Unit I dates to the abandonment of the village in the early twentieth century (Mauger 1975a:5-6). Some people still living in Neah Bay were born at

Ozette in the early 1900s. The village was abandoned when it became law that Native American children attend BIA schools. After 1903, a number of families moved from Ozette to Neah Bay, the location of the nearest agency school. The date of the Unit II slide which separates Unit I and Unit II has not been established.

Because we are dealing with time periods that enter into a zone of some uncertainty for radiocarbon dating, and because there is a large amount of wood that has been recovered from Ozette, emphasis has not been placed on extensive radiocarbon dating. Instead, a program is now underway to develop a dendrochronology for Ozette which should give a rather exact reckoning of the time span for the various units, as well as for particular features such as houses within various units.

It should be further understood that the slide process continued throughout the occupation of this area in varying degrees of intensity. The major cultural units also have minor clay flow and slurry activity. This is particularly notable in Unit V. The same can be said about Unit VI, a major slide unit which is actually comprised of at least two clay deposits with a short period of stability representing the boundary between the two sub-units. The major unit breaks were recognized where it was possible to trace an event over a broad area of the excavations. These easily recognized and empirical boundaries should be minimally time-transgressive.

Artifacts recovered from the major slide units usually occur in the lower portion of the unit. There are artifacts, baskets of artifacts, boards, and occasionally whole blocks of midden that have been swept along by the force of the slide. The artifacts recovered from these portions of the unit reflect items that were in use or on the surface when the slide occurred. For instance with Units IV (a slide) and V (a midden), it is not surprising that 79 percent of the wedge preforms are from Unit IV, while 59 percent of the exhausted wedges are from Unit V.

The cultural Units I, III, V, and VII represent samples collected in differing degrees and in different ways. Initially, large portions of the western part of Units I and III were of necessity removed as part of the initial salvage of Unit V (Gleeson 1973a, 1973b). All of Unit IV and below was excavated with close attention to depositional detail. Whereas the excavations in Units IV, V, and VI cover a broad area, Unit VII excavations are limited to a single 2 m by 2 m test pit.

The area defined by the remnant house walls can be further subdivided. The location of hearths and roof supports, as well as the concentrations of artifacts, stakes, and postmolds, define a number of similar subdivisions within the house (Samuels 1980). On the basis of ethnographic information (Drucker 1951), these subdivisions are seen to relate to nuclear family units within the extended family of the house.

2.4.1.2 Spatial Units

The cultural units may be subdivided spatially by the remains of house walls. The eastern portion of one house has been excavated in Unit III (Mauger 1975b). Three whole structures as well as portions of four other structures have been exposed in Unit V (Mauger 1979,1980; Gleeson 1974b, 1980; Gleeson and Fisken 1977; Gleeson, Mauger, and Fisken 1976). Because the excavation of a second complete structure in Unit V has just been completed, the analysis of within-house activity areas for this study will be based only on House 1 from Unit V.

The Ozette deposits can be broken into four major temporal units over a time span of 800 years. This study, while focusing on the 440 BP time level, will also consider at the variation in the woodworking technological system through the past 800 years. Temporal shifts in technology will be discussed in the chapter on the Ozette woodworking tools.

2.4.2 Woodworking Data

In order to understand the scope of Ozette woodworking, it was first necessary to isolate the various ways wood was altered. This problem was first approached by cataloging the observable evidence of cuts, joining, and bending of the wood. Much of this evidence could be associated with one particular tool or another. Certain processes, such as steaming, were inferred on the basis of ethnographic analogy and obvious transformation of flat boards into box sides.

In part, ethnographic information pointed to how certain tools were used and what effects they produced. In other cases, this information was derived by replicating various tools recovered and determining what, if any, application they might have had in producing some of the unexplained effects observed in the archaeological materials. The use of a metapodial gouge to flute the surface of wood planks (Mauger 1978:71) was discovered by such replication.

Replication of the tools and their use was an important part of the study of the woodworking technology. Certain of the tools could produce many of the effects in isolated instances. It was the ability of a tool to produce a particular effect repetitively and effortlessly that indicated to us that it was probably the one used. As part of the study of the use of the replicated tools, modern carvers were consulted regarding the ease of use and application of specific tools.

Tools from the site were replicated using the same raw materials used originally. Cutting and shaping was done with power tools. Braided nylon seine cord was substituted for sinew and pitch and other binding wraps. Using modern materials was especially helpful because several blade configurations might be tried and it was necessary to be able remove and replace the bindings easily.

For items such as knife blades and weighted adze blades, no examples of which were recovered archaeologically, it was necessary to infer the configuration. The shape of the replicated blades for the weighted adzes was based on the length and width of the haft area, the wear marks in the haft area, and the shapes of metal available at the site. Although it was possible to infer the shape of some of the missing blades with considerable confidence, in other cases, such as the D-adzes, it was not as easy. The broad finishing scars on planks, probably representing the width and the bit curvature of the D-adzes blades, are likely the best evidence of the shapes. The fragmentary nature of the D-adze handles, unfortunately, made it difficult to infer the morphological configuration of the blades with any assurance.

The woodchips from the house floor were sampled and described. Certain morphological parameters, such as shape of cross section, were proposed as reflecting certain types of cutting activity. These were tested, non-rigorously, by replication. Exploratory statistical tests were then performed to see if these categories could be differentiated by size, cutting angle, and other attributes.

Similarly, metric information was gathered from a number of artifact types whose manufacturing scars were still evident. Data from the woodscars were compared with those from the debitage to assess the range and nature of tool manufacture reflected by the debitage from the house floor. The woodscar data in conjunction with morphological data were used to distinguish manufacturing steps in the production of certain tool types. Because the range of tolerances decreases as manufacture proceeds, it was thought that scar size of later stages of manufacture would be smaller, and that scar data as related to manufacturing stage would aid in the interpretation of debitage collected from the house floor. It was thought also that these data would support arguments concerning manufacturing activities within the house.

The tool types and debitage were used in conjunction with the examination of a number of artifact types to determine the various ways wood was transformed at Ozette. The examination of the artifact types yielded information on binding, joining, steaming, and finishing. Many of these procedures are not tied directly to any specific tool use.

Another aspect of the manufacturing procedure study was the delineation of the sequence in those cases where most of the manufacturing evidence, i.e., scars and preforms, were absent. In this instance, the general production technology was used to propose logical production sequences that would result in forms similar to those recovered.

The information from the woodworking tools, debitage, and other artifact types was then organized into a production model that encompasses all of the transformations of wood observed in the Ozette collection and that is consistent with the woodworking tools recovered. The model will be considered successful to the extent that it can be used to replicate effects seen in the collections, that additional tools

or transformations can easily be incorporated into it, that is sensitive to the shifts from pre-metal bladed woodworking patterns to metal bladed tools and then to European tools.

The information on the tools, the detritus, the production model, and specific manufacturing sequences was viewed in the larger scope of the household. Within House 1 of Unit V it was possible to delimit occupation areas on the basis of hearth and sleeping bench patterns. Subsistence and maintenance or processing artifact classes were examined from area to area in terms of overall density and compared by relative density within each area. The variation in the recovery of woodworking tools and detritus was then integrated with the model of house activity areas based on the density of subsistence and processing data. Because the model of the subsistence and processing artifact deposition could be tied to certain patterns of social and economic behavior, it was possible to relate the woodworking activities to the proposed socio-economic patterns of House 1.

2.4.3 Exploratory Data Analysis

In the study and explanation of the variation among the proposed groups of detritus and woodscars, various continuous and discrete variables were generated. Data were collected on attributes that were thought to be related to the manufacturing processes. It was felt that if these attributes could be used to determine variation within the classes of debitage, then activity areas in the houses could be examined for differences in woodworking technology.

Among the relationships examined were similarities between the samples derived from the house floor and the evidence for woodworking activities derived from manufacturing scars; the differentiation of classes of chips thought to be indicative of differing tool use or cutting procedure; and the use of the distribution of these classes to isolate and define socio-economic activities within the house.

The problem then becomes, "are certain sets of data similar or dissimilar?" Each of the question areas proposed above allows the data to be broken into specific groupings or sets. The data in each of these sets consist of both continuous and discrete attributes. The continuous attributes of the data may be used to generate sub-set means and standard deviations which may, in turn, be used to assay the similarity and dissimilarity of the groups.

2.4.3.1 ONEWAY

The procedure used to analyse the relationship of the predetermined subsets of the data is One-Way Analysis of Variance(ONEWAY) (Nie, et al. 1975:422-432). The *a posteriori* contrast options available in this procedure make it possible to compare the means for several groups on a

single attribute and test the possibility that the subgroups could have been drawn from the same population (the null hypothesis). Questions were be posed so that variables useful in defining group membership could be identified. The rejection of the null hypothesis constitutes evidence that the predefine groups can be statistically distinguished and, possibly, that these differences can be related to different processes operating within each grouping.

If the several groups do not appear to be randomly drawn from the same population, one then has to ask, "Are all the predefined groups sets different?, If not, how many are similar, and how are they related?" The a posteriori contrast options in ONEWAY are particularly helpful in approaching this problem, because these statistical tests lump together all sets which do not have significantly different means on some continuous attribute (Nie, et al. 1975:427). There are a number of tests that do this sort of comparison and grouping. Two, the Least-significant Difference (LSD) test and Scheffe's test, were used because both are exact for groups of unequal size. Scheffe's test was chosen because it is the most conservative in the separation of groups and LSD was chosen because it is the least conservative. By using both these tests it was not only possible to see what subsets might exist, but it was possible to see how strong this grouping was.

The SPSS procedure ONEWAY generates an F-test score as a measure of significance for accepting or rejecting the null hypothesis. For these analyses, a significant F-test indicates that the selected attribute allows meaningful partitioning of the sample. It is not felt, however, that a significant F-score proves that these attributes explain the differences between these groups. The attributes with a significant score reflect, at best, only a portion of the complex system of woodworking processes. However, the presence of significant scores does indicate that these attributes may be used in formulating explanations of cultural phenomena related to woodworking technology. Because the hypotheses being tested are rather general, a number of variables may affect the results at the traditional .05 rejection level for the null hypothesis. For this reason, the null hypothesis was rejected at the .005 level or better.

The ONEWAY statistic was used in the analysis of wedges (Chapter 3), woodchips (Chapter 6), woodscars (Chapter 6), and house areas (Chapter 7). The ONEWAY statistic with the LSD and Scheffe tests served to indicate how best to group predetermined subsets for analysis.

2.4.3.2 Discriminant Analysis

Because there are a number of attributes being used to distinguish the groups statistically, an additional question is, "what attributes contribute most to the delimitation of the groups and what is the relative contribution of each?" Testing for these questions was done by using the SPSS discriminant analysis procedure (Nie, et al. 1975:435-467). The discriminant analysis was done by the stepwise

method using Wilks criterion for inclusion. The stepwise approach is helpful in that it selects variables for inclusion in order of decreasing discriminatory power.

The discriminant analysis provides a measure of the effectiveness of the linear discriminant variable created in the analysis by optionally reclassifying the observations into their most probable group using the linear discriminant functions. The result is a percentage figure of correct assignment of cases to originally determined groups, reflecting the degree to which the attributes selected can differentiate between the predefined groups. The lower the percentage of correct assignments, the less diagnostic are the values of these attributes for determining group boundaries.

Discriminant analysis is used to delimit the attributes contributing the most to the differentiation of the predetermined subsets, or units, grouped by ONEWAY. Differentiating attributes were isolated for subsets of wedges (Chapter 3), chip profiles (Chapter 6), woodscar groups (Chapter 6), and woodchips grouped by house area (Chapter 7). The ability of these attributes to predict group membership was tested by using the classification routine. The discriminant analysis of the woodscars was used to classify the woodchip sample into groups similiar to those observed for the woodscars. The derived grouping of the woodchips enabled them to be used analytically as representative of the same type of actions that created the woodscars.

2.4.3.3 Chi-Square

The chi-square test (Dunn 1964:112-122; Sall 1979:215-220) is used to quantify the difference between units based on the counts of woodworking tool types. The sample was checked for cell size and all tool types with an expected cell size of less than five were eliminated from consideration. The distribution of tools in Unit IV was checked against that in Unit V to discern if there was any difference between the counts of tools in use and tools discarded or lost. Additionally, Unit V was compared with Unit III to see if the appearance of the Europeans had any discernible impact on the tools in use.

2.4.4 Summary

The Ozette data are well-bounded both temporally and spatially. The items recovered from the excavations reflect a wide range of woodworking activity. Much of this activity can be reduced to metric data. In other instances, replication of tools and application of these tools to simulated woodworking problems have indicated possible use patterns. Spatial and temporal differences have been summarized by statistical procedures such as ONEWAY, discriminant analysis, and chi-square.

2.5 SCOPE OF INQUIRY

This chapter has ranged from specific problems of the analysis of woodworking to the broad problems involving the relation of technology to other aspects of culture. The chapter pointed to ways that the Ozette data might be brought to bear on various levels of the discussion. Taking to heart Lechtman and Steinberg's caution that the micro-technological studies must form the foundation for the testing any broad technological hypotheses, this study focuses on two specific problems--the creation of a specific woodworking model for Ozette and an examination of the debitage distribution in relation to known spatial features. The former will provide a foundation to test various hypotheses concerning spatial and temporal variation and change at Ozette and the latter will examine the feasibility of associating deposition of woodworking debitage with other depositional patterns.

Chapter III

TOOLS

3.1 INTRODUCTION

This chapter describes the tool blades and tools recovered from Area B70 at Ozette and used in woodworking and cutting. Available ethnographic data are used to infer use. When ethnographic data are lacking, replication is used as a means for inferring use. In addition to providing a descriptive morphology of the blades and tools, the spatial and temporal distributions of the tool and the assemblage are discussed. Archaeological occurrence of a number of the types is presented, and the assemblage is tested for spatial and temporal variation within the Ozette Site. Possible explanations for the variation are presented.

3.2 BLADES - INTRODUCTION

The observed and inferred blades for the Ozette tools come from five sources: shell, metal, stone, tooth, and bone. Many of the Ozette cutting tools are composite tools consisting of a handle, a blade, and a binding to attach the blade to the handle. This section is a discussion, by material, of the blades used at Ozette. The following section is a discussion of the complete tool.

3.2.1 Stone

Large and small celts as well as slate blades have been recovered from Ozette (Figure 7). A triangular fragment (212-III-48) of the blade corner of a medium to large celt was recovered from Level III. This piece of light green stone had a bit angle of almost 45 degrees. This type of blade appears not to have any wide use at Ozette because only one such fragment has been found in all the excavations at the site.

A number of small cobble spall tools were recovered from the 1966-1967 exploratory trench (McKenzie 1974:117). These spalls are produced by a bipolar flaking process (Jeffrey Flenniken, P.C.). The edge opposite the bulb of percussion is sharpened and straightened by grinding the ventral surface. The resulting blade is small. Replication of these blades has shown that, when hafted on a weighted adze handle, they are quite efficient as adze blades. Along with shell blades, these may have been the pre-metal adze blades. These blades also may have been used as chisel blades. However, for deep chiselling, they would not have been as effective as deer or elk metapodial bones.

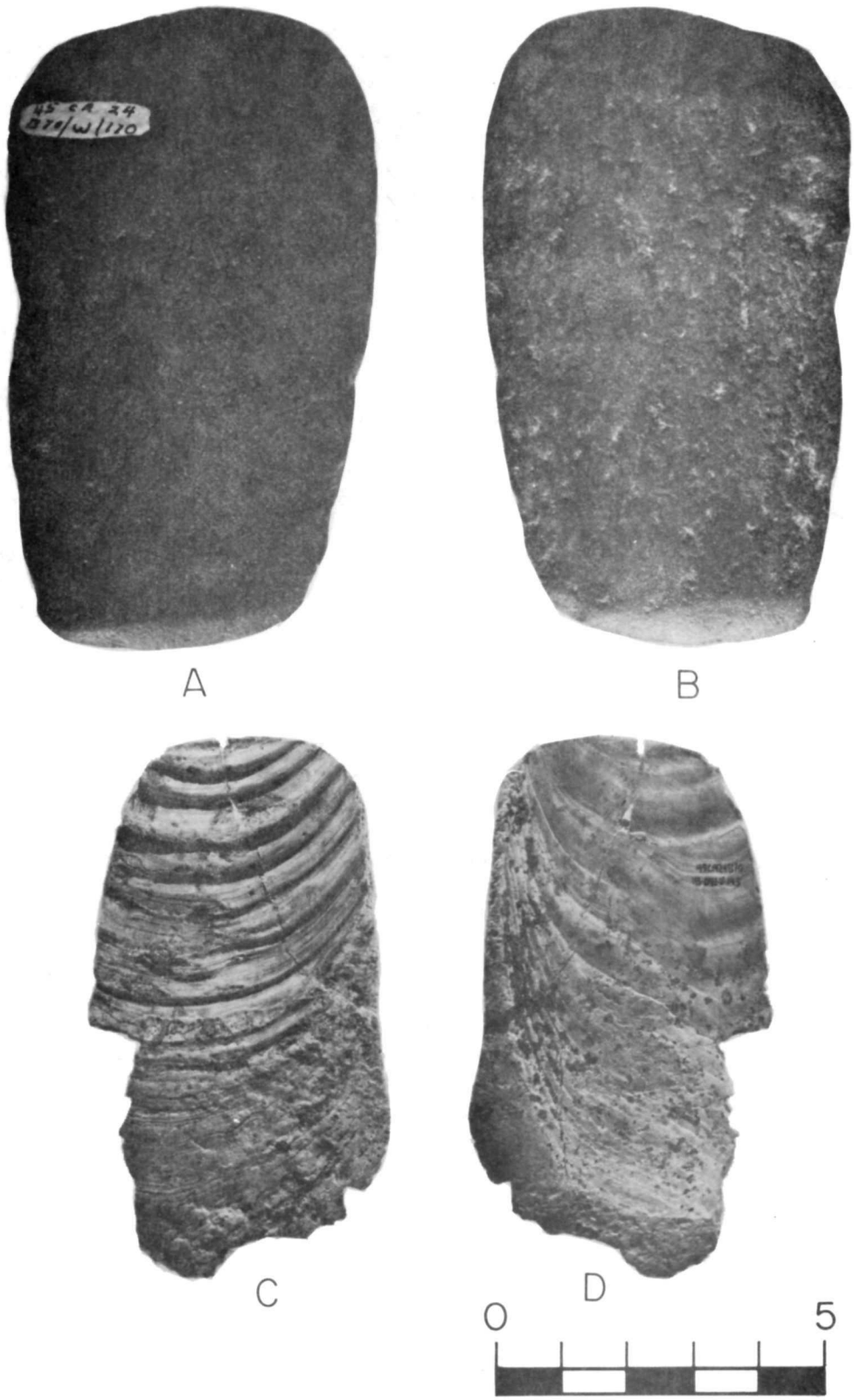


Figure 7. Stone and shell adze blades. A-B, stone aze blade (W-170); C-D, shell adze blade (041-V-193).

Slate was the most common stone cutting material used at Ozette. The nearest slate beds are on the east side of the Olympic peninsula in Salish country (Tabor 1975:22). Slate was probably a material for which the Ozettes had to trade with their neighbors. The slate was used primarily for large semi-lunar knives. Thirty whole knives or fragments of this sort of knife have been recovered. The function usually inferred for this form is for flensing large animals and fish. From the preponderance of mussel shell knives and the presence of metal flensing knives,it would appear that the slate semi-lunar knife had a low popularity at Ozette at all time periods.

3.2.2 Beaver Tooth Blades

Five pieces of lower first incisor of the beaver have been reworked into cutting tools. Except for one example where the tooth was reworked while still in the mandible, all the examples have had the root cut off after which the occlusal surface was ground flat. Replication has shown that the tool is particularly well-shaped for the laying on of decorative effects involving incising and other bas relief techniques. Because of the curve of the incisor there is a distinct increase in ease of use when the left incisor is used with the left hand and when the right incisor is used with the right hand.

3.2.3 Bone Blades

Bone blades are made from elk metapodials (Figure 8). The distal end of the bone is removed. The bone is scored along the long axis and then broken in half. The proximal end is ground flat. The distal end is sharpened into a cutting edge. Depending on how the bone is split, the blade is either straight for a chisel or concave-convex for a gouge.

Only one of these bone gouge blades (26-V-90) has been recovered from the excavations in Area B Unit V, whereas 13 were recovered from the 1966-1967 excavations. The large metapodial blade (43-V-1) with a sharpened distal margin may have been used as an adze blade. This type of blade, found elsewhere on the coast (Matson 1976:163-165), could have been used with the stubbier, weighted straight adze handle (McKenzie 1974:67).

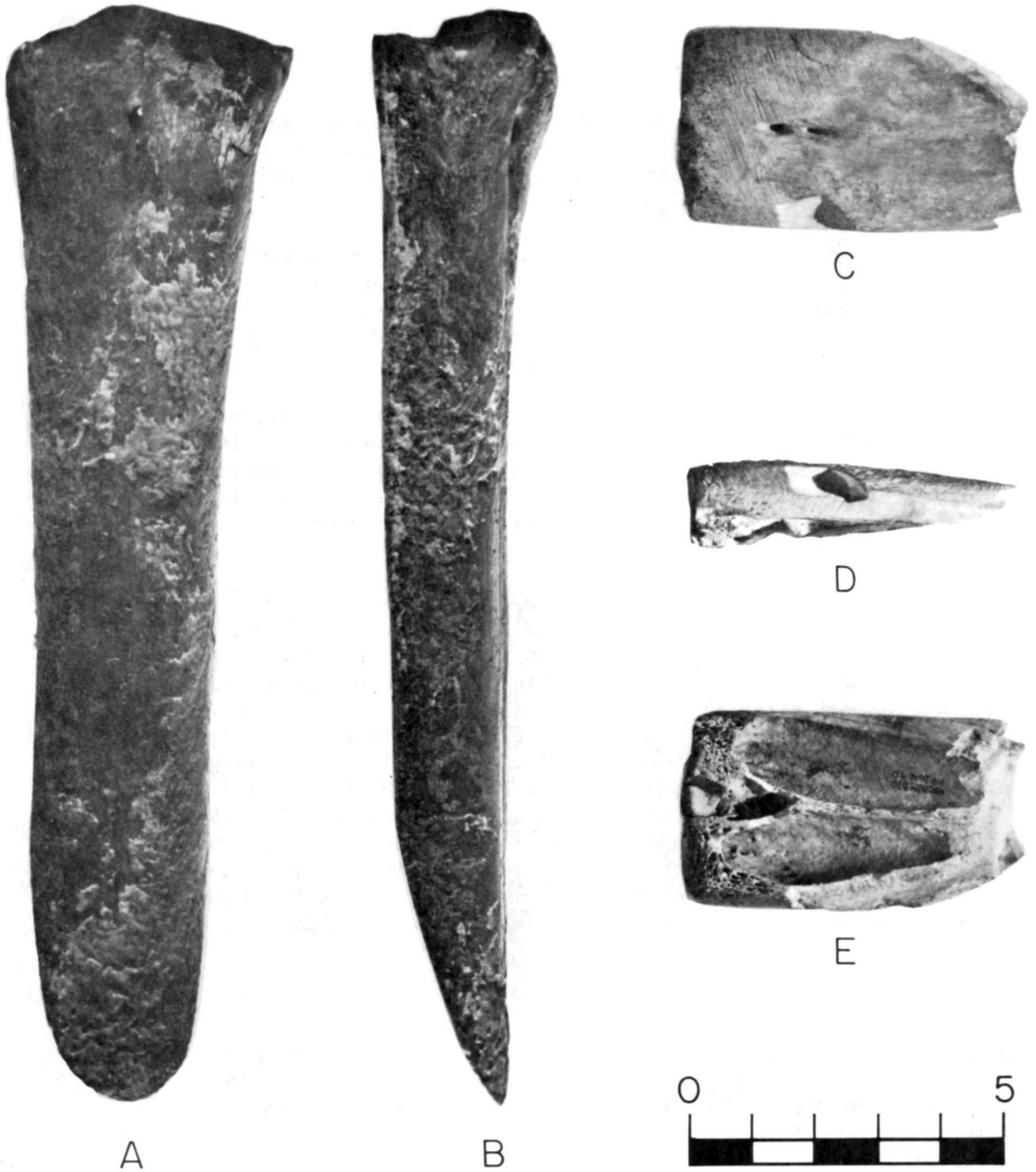


Figure 8. Bone blades. A-B, possible adze blade (43-V-1); C-E, gouge blade (26-V-90).

3.2.4 Mussel Shell Blades

Mussel shell blades are the most common cutting edge material used at Ozette, with over 500 examples recovered. The mussel shell is used primarily for harpoon points and as knives. Mussel shell, while quite brittle, takes a durable, razor sharp edge.

The mussel shell harpoon blades are cut from large Mytilus californianus shell. Most of the knives are made simply by grinding the occlusal surface flat and removing the periosteum along the ventral margin. Knife blades are made by cutting the shell and then shaping the blade to the handle and purpose at hand.

In replication experiments it was found that mussel shell was easy to work. One of the common knives could be made in less than 15 minutes, producing an edge that was quite capable of cutting flesh or working wood. The ease of manufacture plus the easy availability at Ozette clearly explain why this material is the most common blade stock found at Ozette.

One complete mussel shell adze or chisel blade (41-V-193) (Figure 7) and two possible fragments have been identified in the collection. The whole mussel shell adze/chisel blade measures 8.4 by 4.2 by 0.4 cm. Mussel shell adze blades have been recovered in archaeological sites from the Gulf Islands north to the Tsimshian area. South, these blades are found at Cattle Point (King 1950:59; Carlson 1960:575, 579), Locarno Beach (Borden 1970:99-101), St. Mungo's (Calvert 1970:71), Fossil Bay (Kidd 1969:47), Lachane (MacDonald and Inglis P.C.), Glenrose (Matson 1976:177), and Namu (Leubbers 1971:98). These blades are generally illustrated as rectangular pieces of shell sharpened on one of the shorter edges and having an appearance similar to that of the small stone celts or adze blades. At Montegue Harbor, there is a reported instance of a shell blade possibly used as a gouge (Mitchell 1971:144).

3.2.5 Metal Blades

Numerous metal bladed tools have been recovered from the pre-Euro-American trade levels at Ozette. Although 28 ferrous bladed and 14 ferrous stained tool hafts have been found in Levels IV and V, no ceramics, beads, or glassware have been recovered from this level. Additionally, none of the metal bladed tools is in a recognizable Euro-American form. All, however, are in forms that may be derived from known or assumed indigenous Northwest Coast forms.

The metal from Ozette is present as solid pieces of metal, as heavily rusted fragments of metal (Figure 9), and as stains on tool handles. Spectographic analysis of the testable pieces of metal reveal that they are all high carbon steel (Gleeson and Grosso 1974:33-36).

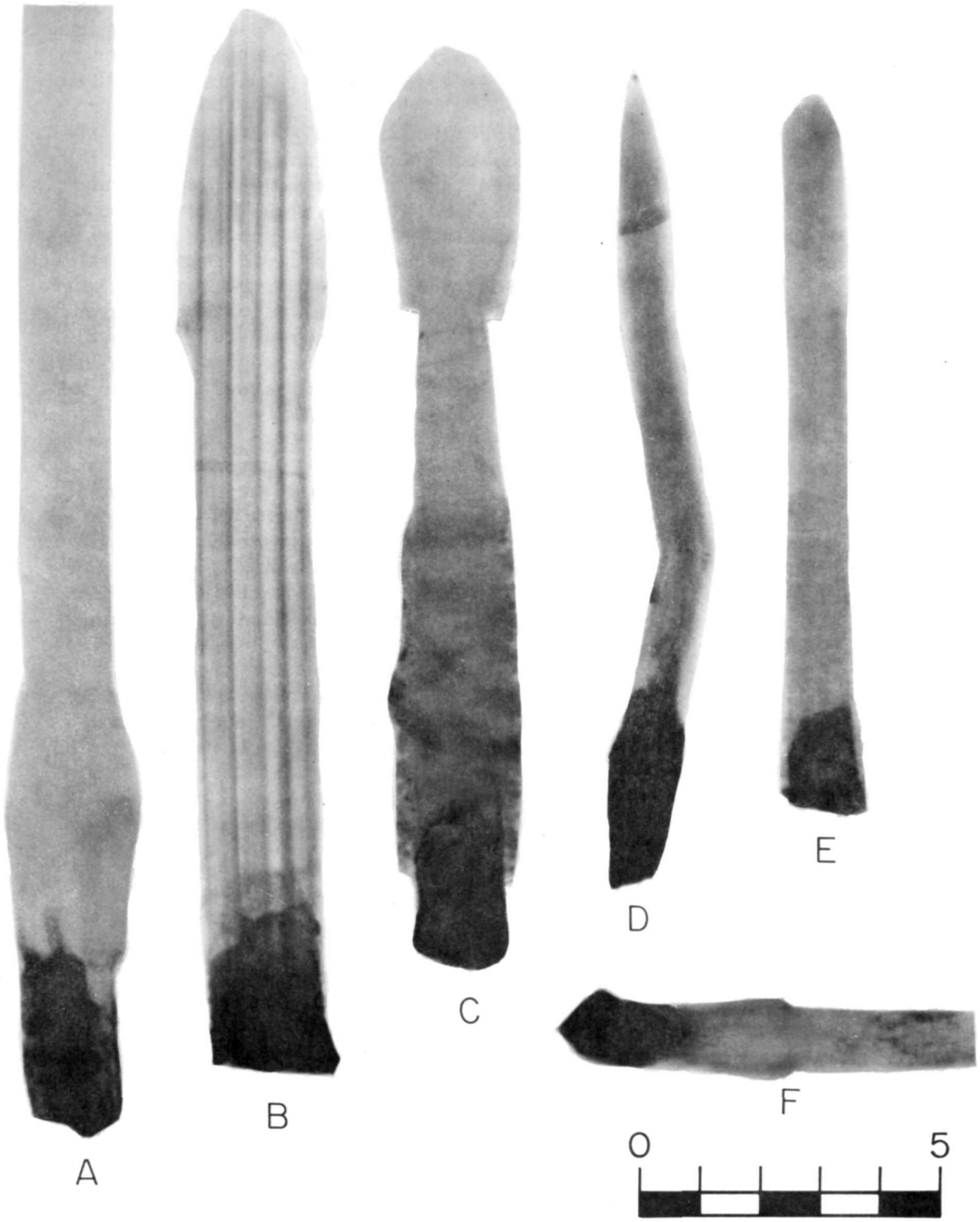


Figure 9. Metal bladed tool x-rays. A, drill (71-IV-35); B-C, two-dimensional pommel knife handles (27-W-3), (36-IV-30); D-E, plain knife handles (8-IV-27), (40-V-60); F, other knife handle (62-V-38). Note that the black areas represent the presence of metal blades.

From the tools and blades recovered it appears that the metal was of three basic shapes: flat plates about 3 mm thick, which was used for knife blades; rectangular stock of varying cross section and length which was used for chisel blades; and small square to rectangular in cross section, nail-like pieces which were used as drill bits.

If the date of 440±90 B.P. (WSU-1778) is the general time of the House 1, then this occupation predates both Russian and Spanish expansion into the region. Iron however had been common in Japan since 300 AD (Sugimoto and Swain 1978: 2-3). Additionally, the Kiro Shiro, or the Japanese Current, was sweeping materials from Japan to the beaches of Ozette as evidenced by the two pieces of bamboo recovered in the House 1 excavations. There are numerous accounts in North Pacific maritime history of drift junks being sighted near or on the Washington Coast (Bunzo and Junzo 1970:1-5; Gibbs 1962:1-5, 1964:260-261; Richard 1939). On the North Pacific there was not only a source but also a means and an agent for the fairly regular transport of steel and iron to the Ozette area.

There have been no comparative studies of the Ozette metal with those of Japan to determine the possible degree of similarity between the two metals. However, personnel who ran the spectographic tests on the Ozette materials had just previously run similar tests on several samurai swords. They noted that there was a close similarity between the trace elements curves of the Ozette metal and the metal of the swords. This similarity, they felt, would arise from similar smelting processes (G. Grosso, personal communication).

Another area that metallurgic studies may be able to clarify is the actual methods used to rework the metal once it was recovered from the beaches. Gibbs's account of metal working at the mouth of the Columbia River indicates only a rudimentary knowledge of metal working(1964:55-60). The chisel blades with their expanded bit, upset proximal end, and varying lengths would indicate that the metal had been reworked. The varying lengths of blade inset areas on the chisel handles indicate varying lengths of chisel shanks. The abandonment of some of these chisel handles could reflect the shortening through sharpening of chisel blades to the point that a new handle with a shorter inset was needed. The shape of the chisel bit could be formed only by first hammering out the end of the rectangular stock into a convex shape and then sharpening it. There are three possible manners in which this may have been accomplished.

The material might have been hammered cold. This would have spread the metal, but it would have resulted in failure cracks in the metal.

The material could have been heated in the fire and then hammered. This would have produced a spread area with little chance of cracks as long as the heat level remained high enough during the hammering. If the processing stopped at this point, a servicable edge could have been produced.

In addition to hot hammering, the material could have been tempered. This would have involved heating the metal to a cherry shade and then annealing, or slowly cooling it. The metal would then be ground to a clean surface free of oxidation, after which the metal would be heated to a specific temperature or color. The result would be a compromise between the hardness of the metal and its brittleness. The tempering process would give a metal capable of holding a fine edge.

It is not likely that the material was only cold hammered. Because metal was obtained from drift it is likely that a certain amount of it was recovered intentionally or unintentionally by burning away the wood surrounding the metal. In the process, it might become apparent to anyone who was working with the metal that heat induced certain changes in its characteristics. It is distinctly possible that the increased workability of the drift metal through heating was independently discovered without the aid of Japanese sailors.

The knowledge of tempering in the absence of the smelting technology and a highly developed sense of forging does not seem likely. In the absence of direct Japanese contact, it is likely that there was a low degree of forging and the absence of tempering. Even untempered steel would be more durable than stone, bone, or shell. With the metal working technology at this level, the complex bent knives, so characteristic of nineteenth century Northwest Coast woodworking, were probably not known until the appearance of the Spaniards and English in the late eighteenth century.

The distribution of tool handles with metal blades or metal stains on the haft area between Unit VI and Unit V indicates that metal blades may have been quite common. Unit VI yielded 16 tools with metal discernible under x-ray and two handles with metal stain, whereas Unit V yielded 10 tools with discernible metal and 10 with stains. If metal was extremely rare, one would not expect such a proportion of metal blades in Unit V which, in part, represents tools lost or abandoned. The beaches of the Ozettes may have yielded a sporadic, but reliable, supply of the material. The supply may have been good enough that iron and steel may have formed an important part of the tradeable resources of the Ozettes.

3.2.6 Blade Configurations

Only seven examples exist of metal, stone, or shell adze or chisel blades. The majority of the adzes and chisel handles recovered had apparently been thrown out without their blades attached. Two metal blades were associated with chisel handles. Beacause none of the other five blades, all non-metal, could be definitely associated with a specific tool type, there is no direct evidence of blade types or blade margin configurations for either the weighted straight adze or D-adze.

The edge margin for the weighted straight adze, the D-adze, and the chisel can be inferred from tool marks left on planks, whale bones,

and large morticed holes. Occasionally on these pieces, the tool stroke was not complete, leaving an imprint of the blade or cutting margin. The use of woodscars as analytic tools is more fully discussed in Chapter 6, but for now the discussion will be limited to cutting margin imprints.

The location of certain tool scars indicates the use of specific tools. The dressing of planks is traditionally done with an adze. The removal of the cancellous of the whale vertebra centrums (Figure 10) and cutting of large morticed holes could have only been done with a chisel. Tool marks from these items reflect cutting edge configuration for the speciric tool.

The scars from the whale vertebra and the morticed holes describe a margin that is like blade margins of the recovered chisel blades (Figure 11). There is a wider range of blade width and height found on the planks. This range may reflect the use of two adze types. The weighted straight adze from the Minard site (Roll 1974:147) has a configuration similar to the smaller end of the range. The larger end of the range is comparable to stone adze blades in museums and archaeological collections. The wider blade works more effectively with the greater mass of the D-adze. The larger blade margin configuration may, then, reflect use of the D-adze, while the narrower scars reflect use of the weighted straight adze.

3.2.7 Summary

The most important cutting edge materials at Ozette are mussel shell and steel. Although numerically the emphasis on mussel shell is much greater, the effective working life represented by the total number of the mussel shell blades and the total of the steel blades is probably similar. Although stone blades may have been less important after the appearance of metal blades, certain special application bone blades and beaver tooth blades continued to be used.

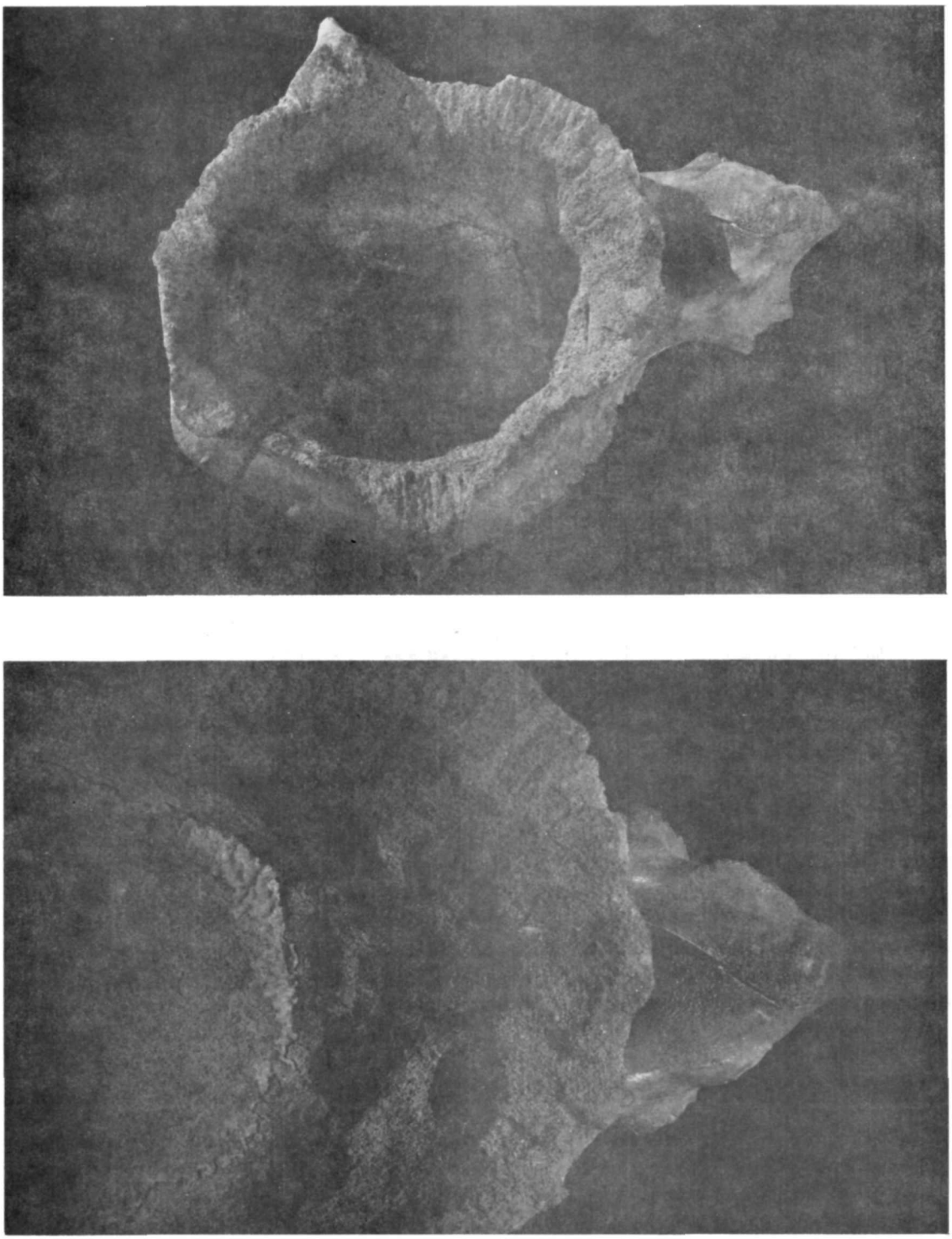


Figure 10. Chisel cut whale vertebra. Upper, vertebra area chiseled out; lower, close-up of chisel marks.

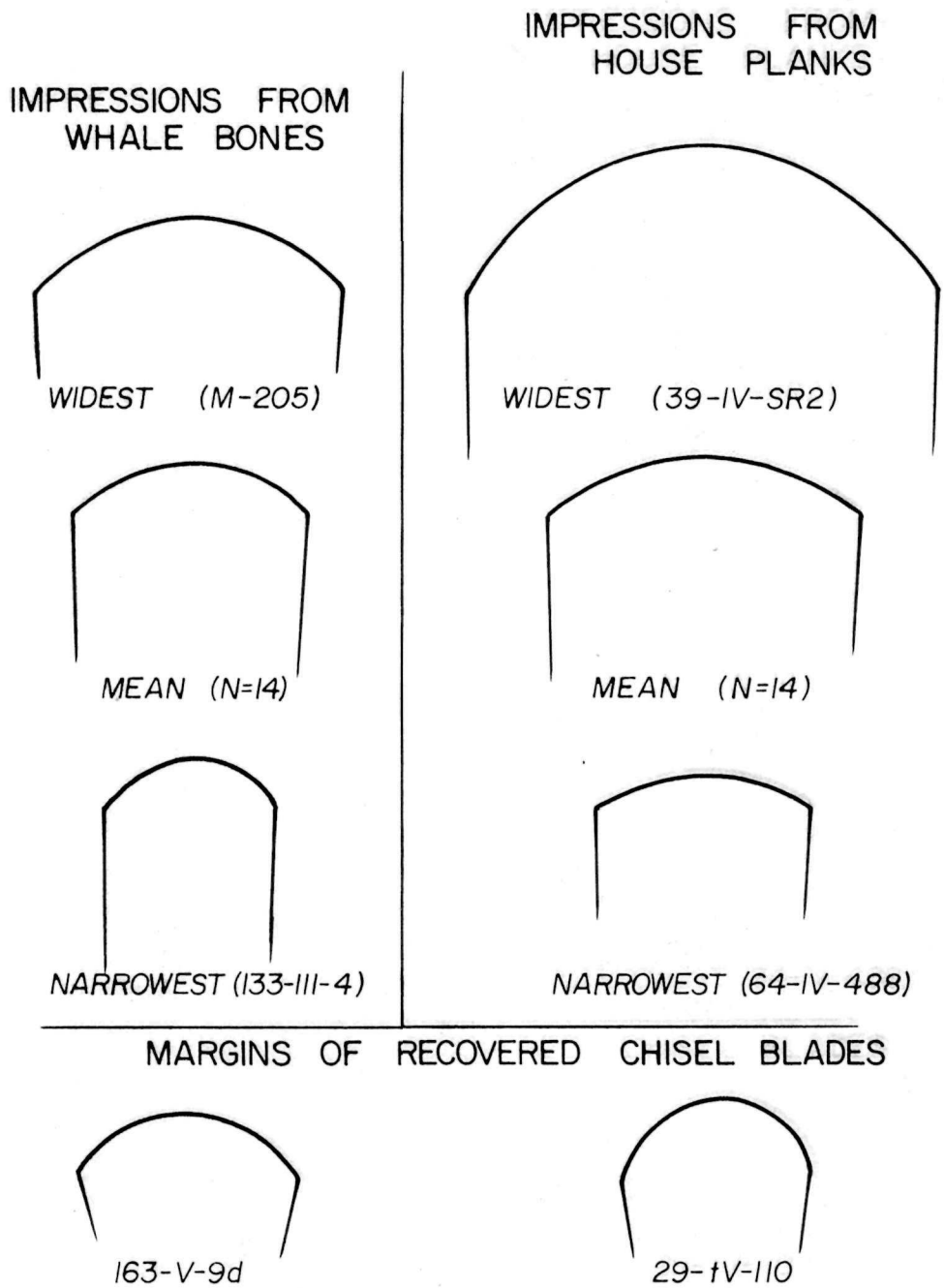


Figure 11. Adze and chisel blade edge margins.

3.3 WOODWORKING/CUTTING TOOL DESCRIPTIONS - INTRODUCTION

The following sections cover the description and use of the various artifacts considered during this study. Artifacts capable of cutting or transforming wood were examined, and replicas were made to assess their utility for woodworking. The tools are grouped according to motor patterns of their use. Indirect percussion subsystem includes mauls, chisels, gouges, and wedges. Direct percussion includes adzes. Non-percussion linear motion tools include knives and planes. Non-percussion, circular motion tools include drills.

For each category, morphology and measurements are provided. Additionally, manufacture and use observations are included. Information on ethnographic and archaeological distribution is noted. For categories such as knives or wedges, where there is a number of varieties based on material, morphology, or size, distinguishing features are discussed in the introductory remarks for that section.

The description of each category includes those features which typify the grouping and distinguish them from others. The detail and extent of the description is directly related to the complexity of the artifact. Decorative motifs, unless integral to the isolating or function of the tool, are not discussed extensively.

Manufacture sequence is discussed in general terms. Manufacture is used as a means to help explain some of the salient points used to describe individual categories. Manufacture of certain categories, such as wedges and metal bladed knives, is discussed in a separate chapter concerned with ways of examining the archaeological record for evidence of manufacturing sequences.

Function, or more precisely, use, is mentioned when information is available. Admittedly, the starting point for this information was the available ethnographic data. The ethnographic information was supplemented, in most every instance, by replication or simulation. Replicas of the majority of tools discussed were made and used as part of the study. The use of these tools was an aid in understanding and, in many cases, augmenting the ethnographic data. In those instances where the ethnographic data were totally lacking, the replicas are used to test for various applications of the tool.

Archaeological and ethnographic distributions of the various tool types are taken from the available literature. In several instances, tools illustrated in the literature have been misidentified or, more commonly, several functionally discrete items have been lumped. An attempt has been made to offer alternative classifications for these items.

Numerics for the categories include the total number of specimens recovered and measurements of a number of dimensions. For

each dimension, the range, mean, standard deviation, and number in the sample are given. Specific artifact measurements are in the author's and site archive's files and are available on request. A tabulation of the types by level appears in Table 33, Appendix.

3.3.1 Indirect Percussion

Indirect percussion tools include mauls and any tools used in conjunction with the mauls. Used primarily with the mauls were various types of wedges, chisels and gouges.

3.3.1.1 Mauls

Twelve stone mauls were recovered (Tables 1 and 2, Figure 12). Morphologically, they are all similar. Each has a flat top and bottom which expands beyond the conical handle. The surfaces of the top and bottom are slightly concave. Most mauls average about 16.8 cm in length. One example (28-V-60) is considerably shorter, being only 10.2 cm long (Table 2). This maul also differs in that the handle is not as clearly conical as the larger examples. As a result, the top and bottom surfaces are about the same diameter.

The mauls are made from basalt cobbles available on the rock shelf which forms the intertidal region in front of the site. The mauls were roughed into shape by pecking with another rock. Given the material available in this region for hammerstones, manufacture by pecking was most likely a time-consuming process. Most of the mauls (67%) have a smoothed surface finish with all evidence of pecking removed. Twenty-five percent have a combination of pecked and smoothed surface and 8 percent have only a pecked surface. The mauls were probably used extensively with wedges and chisels. The high percentage of broken mauls may indicate that the mauls were used occasionally to strike hard substances such as stone, or may reflect off-center striking which could also induce failure.

These mauls are similar to those illustrated by Boas (1909:314) and to Drucker's Type IB(1943:49). The household maul referred to by Boas (1909:315) is found at Ozette and has a morphology similar to the larger all-purpose maul. Sproat indicates that a similar type of maul was used by the Nootka at Alberni Sound (1868:86).

Further elaboration of the maul morphology, such as the nipple topped maul (Drucker's Type IBI), is not found at Ozette. The lateral blow mauls of the Quinault (Goddard 1945:38; Boas 1909:316) or those found at the Minard site (Roll 1974:122) are not present in the collection.

While Sproat and Koppert refer to the use of the maul, Boas's description is the most detailed. Essentially, this type of maul would be used for woodworking in conjunction with wedges for splitting or with a chisel or gouge for cutting.



Figure 12. Mauls. A-B, large mauls (042-IV-4), (635-AC-31); C, small or "household" maul (28-V-60).

TABLE 1

Large Mauls (N=11)

Dimensions*	Range	Mean	SD	Sample
Length	15.9-17.8	16.8	.70	6
Diameter-Proximal End	5.5- 8.3	6.8	.85	9
Diameter-Grip	4.4- 5.2	4.8	.31	9
Diameter-Distal End	6.8-10.1	9.0	1.21	7
Weight**	559.0-1341	1016.6	299.66	11

*weight in grams and linear measurements in centimeters
**includes all fragments

TABLE 2

Household Maul (N=1)

	Catalog Number
Dimensions	28-V-60
Length	10.2
Diameter-Proximal End	5.0
Diameter-Grip	3.7
Diameter-Distal End	5.5
Weight	421.0

3.3.1.2 Wedges - Introduction

Wedges are the most common woodworking tool recovered at Ozette. In fact, the thirteen-hundred-plus count of the wedges puts them in a group with other artifacts which occur in large numbers: arrows, points, items of basketry, mats and mat fragments, withe, and items of cordage. Wedges were an easily-made tool and had a high use and loss rate.

The number of wedges is not surprising, as splitting was the most efficient procedure for the removal of large amounts of waste wood. The superb splitting qualities of western red cedar and, to a lesser degree, fir are realized not only in the numerous house planks but also in everything from canoes to arrow shafts. Except for a few items such as harpoon shafts and seal clubs, the manufacturing sequence included one or more steps relying on the splitting procedure.

Because the splitting procedure was applied to a number of different forms with the purpose of achieving specific shapes or sizes, it is to be expected that wedges would have a variety of shapes, sizes, and other properties. Wedges with the characteristic battered proximal end and highly polished bit were made from antler, bone, and wood.

The initial separation of the wedges is done on the basis of material. In this case, the material isolates certain morphological types which have functional implications. Antler wedges, of which there is only one morphological variety, are low angled short dense wedges that were most likely used for starting splits. Whale bone rib wedges, of which there is only one variety, are broad flat wedges possibly used to split and support wide thin boards such as would be used for boxes. The wood wedges are the most numerous and occur in a number of varieties. The wood wedge varieties are notable for the wide range in thickness, far exceeding either the antler or bone wedges. The wood wedges, made primarily from compression spruce (Janet Friedman 1975:121), are quite easy to manufacture. The large number most likely reflects their use in running splits in large pieces. This type of operation would necessitate a large number of wedges.

3.3.1.3 Whale Bone Wedges

Seventy-one artifacts classified as whalebone wedges have been recovered (Table 3, Figure 13). These items are rectangular in cross section and have a pointed to rounded tip and a well battered proximal end.

Ninety-six percent of the wedges are made from rib and 4 percent are from mandible. The bone was cut from the rib or mandible with either an adze or chisel. The lateral margins of the wedge and the bit were then shaped with an adze.

Bit edges were rounded and not sharpened as acutely as the wood or antler wedges. Many of the wedges are curved longitudinally because of the natural curve of the rib.

A number of the wedges recovered have been broken or snapped perpendicular to the longitudinal axis. It is possible that these tools were used in conjunction with either the antler or wood wedges as a pry bar. Once the split was started by the more acutely bitted antler and wood wedges, the rounded tipped whale bone wedges were driven in either laterally or in line with the other wedges. The whale bone wedges with their greater length would function well as a pry bar to extend the split.

There are no ethnographic accounts of the large whale bone wedges. In addition to Ozette, they have been recovered from archaeological sites at White Rock Village (Guinn 1963:14), Toleak Point (Newman 1959:54) and at Minard (Roll 1974:135). The occurrence of these items at present is limited to the Washington coast, possibly because of the abundance of raw material.

TABLE 3

Whale Bone Wedges (N=71)

Dimensions	Range	Mean	SD	Sample
Length	12.0-54.0	32.7	9.89	48
Width	2.1- 7.0	4.9	1.06	71
Thickness	1.1- 3.0	2.0	.54	71

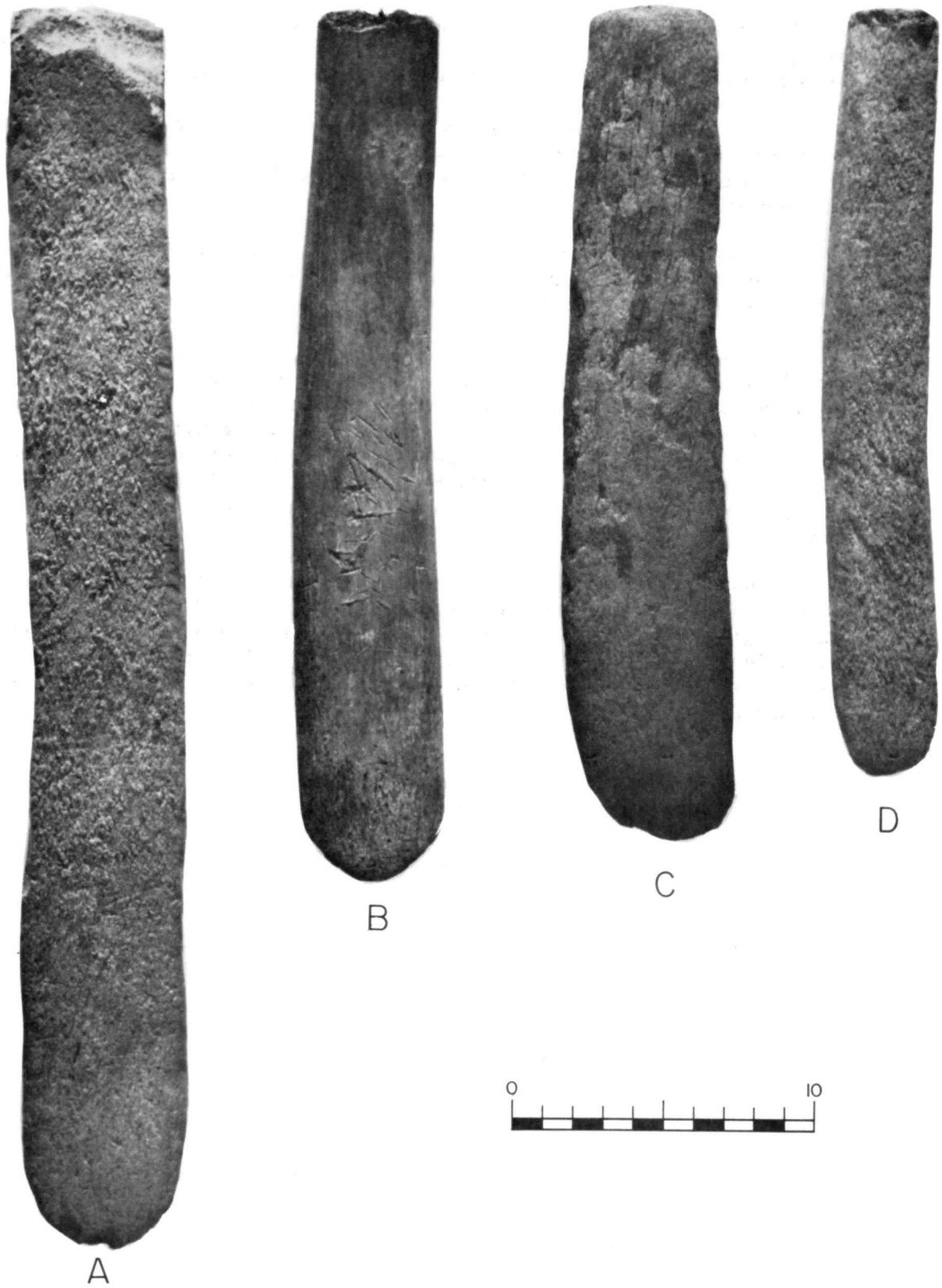


Figure 13. Whale bone wedges. A-C, (194-ST35-1), (148-V-38), (5-V-203), (28-V-76).

3.3.1.4 Antler and Bone Wedges

Fifty-six antler and bone wedges have been recovered (Table 4, Figure 14). These are characterized by battered proximal ends and acute bifacially ground tips exhibiting high use polish.

Two of these wedges are made from bone and the rest from elk antler. Various parts of the antler were used as wedge material: base (1); whole beam (19); split beam (17); joint as proximal end (1); tine (1); and indeterminate tip fragment (16).

Most manufacturing evidence has been obliterated by use. It does appear, however, that some of the final shaping was done with an adze and grindstone. From the marks on the cut antler by-products, it is assumed that the initial cutting of the antler was done with a chise or possibly an adze.

Antler wedges are noted in every ethnographic and archaeological report for the Coast. They were used for starting splits in large thick pieces (Stern 1934:95). The degree of friction would be highest when the split was being started, and would certainly account for the high degree of use polish found on the tips.

TABLE 4

Antler and Bone Wedges (N=56)

Dimensions	Range	Mean	SD	Sample
Length	6.9-26.6	16.0	5.20	38
Width	2.1- 7.2	4.6	1.23	33
Thickness	1.3- 5.6	3.7	1.14	33
Bit Angle*	12 -31	20	4.41	24

* Angle measured in degrees.

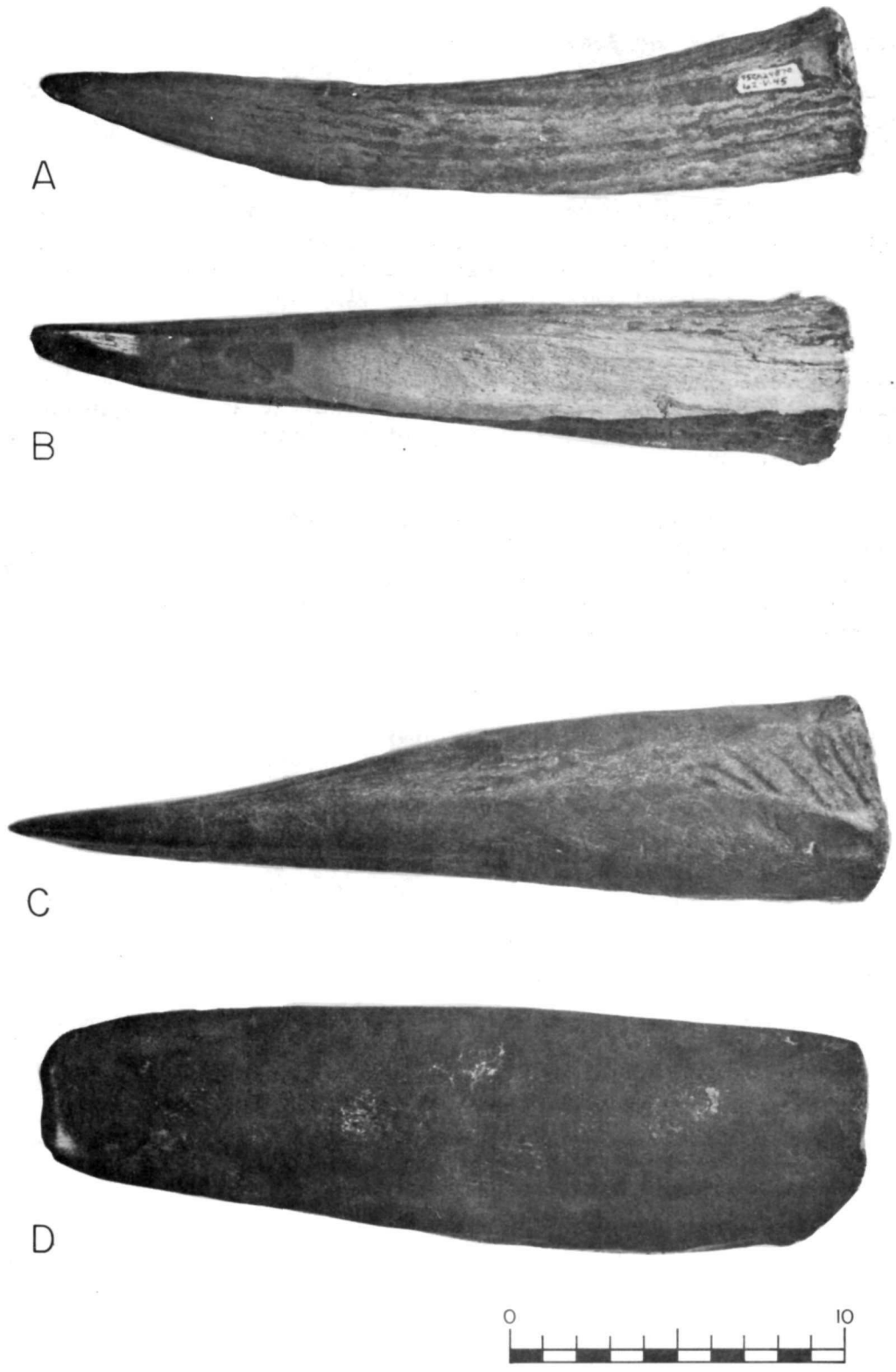


Figure 14. Antler wedges. A-B, (62-V-45); C-D, (145-IV-147).

3.3.1.5 Wood Wedges

Over eleven hundred wooden wedges have been recovered from the excavations. These have been grouped into seven sub-types on the basis of morphology and size. Forty-two preforms have been recovered that delineate nine manufacturing steps. Additionally, both wedge fragments and complete wedges with evidence of repair indicate steps used to maintain the wedges.

Ozette wood wedges are made primarily from compression spruce wood (Friedman 1975:121). A spruce limb is cut to length and the non-compression wood is split and removed. The remaining piece of compression wood is then split to size. The piece is roughed out with a point on either end. The proximal end is finished to an abrupt conical point, while the distal end is finished to a long, tapering, oval bit. The proximal end is bound where the proximal cone joins the body of the wedge. Once used, the proximal ends have a characteristic battered appearance (see Chapter 6 for a more detailed discussion of wedge manufacture).

The varieties of wood wedges are based on cross section morphology, cross section size, and length. Cross section morphology is divided into two groups, oval and rectangular. Cross section size is divided into several groups based on relative reduction of both width and thickness dimensions. Generally, a reduction in cross section is accompanied with a non-proportional reduction in length. Within certain of the larger cross section wedges, asymmetric distribution of the length parameter is used to further subdivide these categories.

The Ozette collection has a much wider range of wedge types than is reported in the ethnographic literature for the Northwest Coast. Although it is supposed that the majority of the large cross section oval wedges were used for heavy duty splitting such as removing large blocks from standing or fallen trees, the rectangular wedges represent a somewhat different approach. Because the oval wedges have their bit in the same plane as the thickness dimension, their lifting height is therefore equal to their thickness. The bit of the rectangular wedges is in the same plane as the width; thus, for the rectangular wedges, their lifting height is equal to their width and not their thickness. Throughout the wood wedge section, thickness is labeled as lift. Additionally, whereas the oval wedges are symmetrical, the rectangular wedges are asymmetrical on the width axis, one side being straight and the other convex. This morphological characteristic could work to advantage when splitting wide thin pieces of cedar that would be likely to develop secondary splits or fractures.

The one class of wood wedges that does not fit neatly into the foregoing description is the rod wedge. The rod wedge is a long slender wedge almost circular in cross section. The proximal ends of these wedges are not grommeted and the distal end has more of a point than the convex bit margin of the other wedges.

The wedges have been separated into whole wedges, preforms, and fragments. The class of whole wedges was then subdivided into rectangular, oval, and rod wedges. The rectangular and oval wedges were then further subdivided into large, medium, small, and marking (extra-small) on the basis of general proportions of length, width, and lift. The four most numerous categories were large rectangular wedges, large oval wedges, rod wedges, and preforms.

Histograms (Figure 15) and cumulative frequency curves (Figure 16) were plotted for each of the four most numerous wedge categories. All but the preforms, which have a somewhat symmetrical but bimodal distribution, exhibit a highly asymmetrical distribution by length. It is felt that the asymmetry of the distribution relates to the exhaustion of the wedge. The wedge became useless when its length became less than that necessary to hold the wedge and effectively use it for splitting. The large rectangular wedge, the large oval wedge, and the rod wedge categories were seperated into length categories of short and medium to long. The short wedges are seen to be those that may have been cycled out of use, while the medium to long wedges are probably still usable. The point of separation is indicated in Figure 15 .

A discriminant analysis was performed to see if the groups perceived on the basis of proportion could be distinguished statistically. Only categories of wedges thought to be "in use" were included in this analysis. The short large rectangular, short large oval, and short rod wedges were not included. The discriminant analysis (Figure 54, Appendix) indicated that width and lift served to account for 81 percent of the variance among the groups. The reclassification rate based on the three functions derived was a respectable 90 percent. The groups of wedges in use are morphologically distinct.

The groups of wedges are assumed to reflect the splitting of both differing shapes and sizes of wood. Unfortunately, no association or "basket of wedges" was recovered that would give insight into the native categories. The breakdown of the wedge collection is consistent with the author's experience using both Ozette replica wedges and modern equivalents.

Ethnographically, wood wedges are ubiquitous on the Northwest Coast from Eyak in Alaska (Birket-Smith and deLaguna 1938:77) to the Yurok in California (Elmendorf 1960:177). Archaeologically, they are present in about every known wet site on the Coast. They have been found in archaeological contexts from the Skeena River south to the Cathalamet area on the Columbia River. The time depth for this tool goes back at least to 2500 BP at the Hoko River site and nearly as long at Lachane on the Skeena (Croes 1976).

The general morphology of the wood wedges reported in the ethnographic literature does not vary from that described for Ozette. The raw material does vary with a general preference shown for yew. This may be accounted for either by ethnographic sweeping generalities or by local preference and availability. The reported length of the wedges ranges from three feet to several inches (Drucker 1951:78).

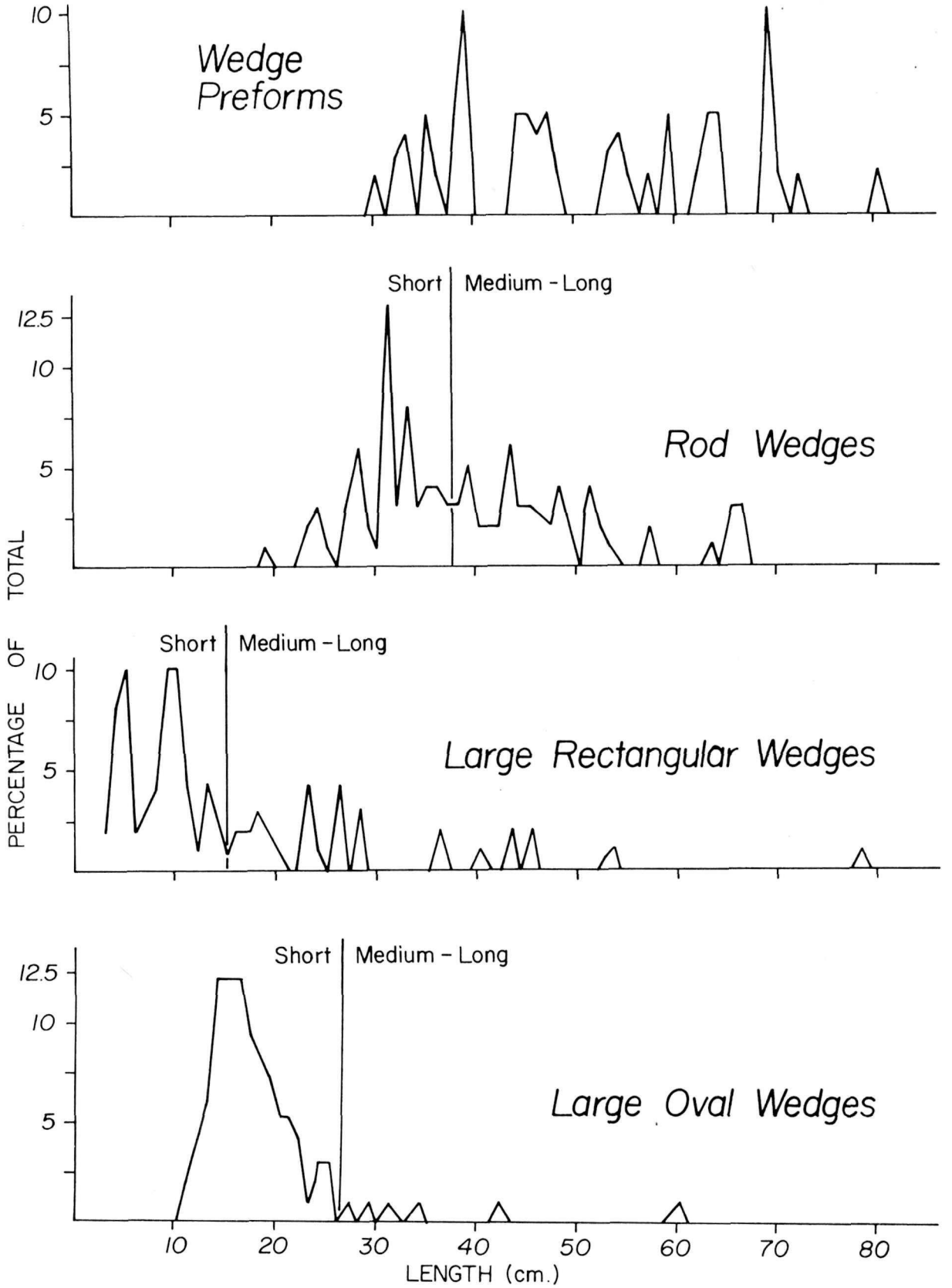


Figure 15. Histograms for lengths of certain wedges.

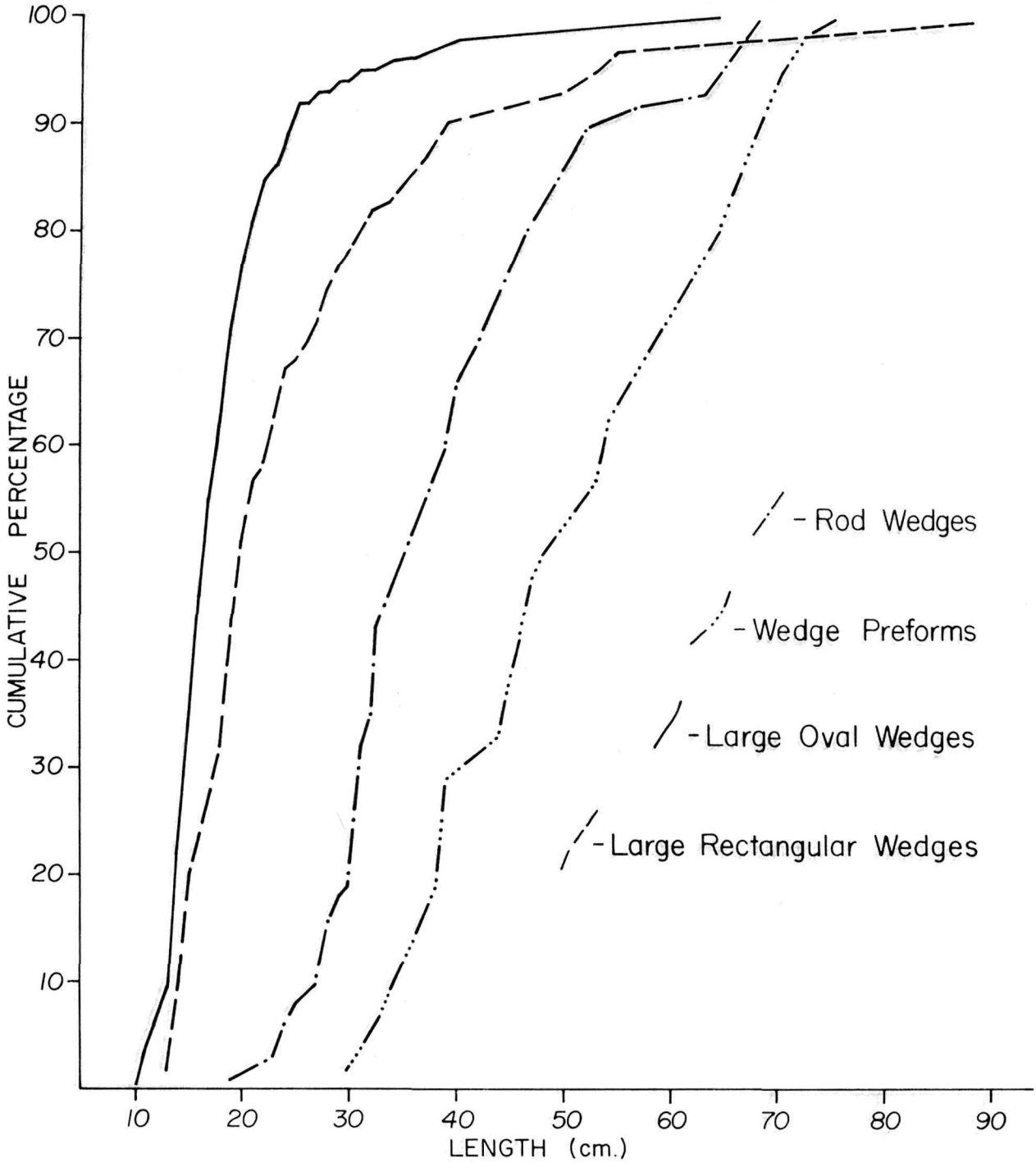


Figure 16. Cumulative frequency curves for certain wedge lengths.

Boas (1909:323) has the most detailed description of the manufacture of wedges. According to his informants, they were made of the trunk of yew wood selected for the proper thickness. After the proper length had been cut the trunk was not split but used whole. The wedge was then adzed into a bi-pointed shape. The grommet was placed on the wedge and was set by pounding the end on a rock and soaking it in water. Final blade preparation was done by abrading, and then fire hardening and soaking with grease.

Ethnographically, the wedges were used primarily for the manufacture of planks and for clearing excess wood from the interior of canoes. There are also numerous references to the use of wedges for splitting fire wood and as a beater in fish preparation (Boas 1921:387-394, 391). It is interesting to note that there are a number of references in Boas to the use of wedges by women both for splitting wood and preparing fish. While woodworking is generally considered to be a male task, the archaeological distribution of wedges may reflect either male or female tasks.

In the Ozette collection there is a wide range of shapes and sizes for the wedges, but, unfortunately, the ethnographic data provide little information of the relationship between morphology and use. Drucker indicates that there was a range of sizes and that these were used according to the task at hand (1951:78). Boas talks of at least seven sizes being used for the splitting of boards (1909:253,324). He also notes that small wedges (about 20 cm long) were used for splitting fire wood. The only other specific reference is to a small marking wedge used to set up lines for placing the larger wedge (Boas 1909:324). Boas (1909:323) does make a reference to at least two bit configurations but does not explain the application of these. Drucker refers to a wedge basket (1951:78). Unfortunately, no such association was recovered from Ozette.

3.3.1.3.1 Large Oval Wood Wedges

These wedges have an oval to circular cross section (Tables 5, 6, Figure 17). One hundred and fourteen examples have grommet still intact on the proximal end. The remaining 304, with the grommet missing, have an extremely battered proximal end which is typical of wedges. Generally, there is no change in the body cross section as it approaches the collar. The transition from the body to the distal tip is gradual. The edge margin is convex and in the plane of the width. The edge is slightly rounded.

The wedges recovered vary in length. There is no appreciable difference in the lift or width measurements of the short variety in comparison with the longer variety. Most likely this concentration in the short end of the length range reflects reuse of the wedges after tip wear or tip breakage. This seems to be a reasonable assumption given the general length range of the preforms. The length of the shorter variety is approximately that of the blade length, plus the collar, plus a hand's width. The wedge is discarded when the length of the tool is shortened to the point of ineffectiveness when held. These are similar to both the medium and large oval wedges but with yet another marked decrease in size. Also, a majority of these wedges have no collar. The collars that are present seem to be done haphazardly in comparison with most collars recovered.

TABLE 5

Short, Large Oval Wood Wedges (N=384)

Dimensions	Range	Mean	SD	Sample
Length	10.0-25.8	17.4	3.34	380
Width	2.2- 5.8	4.0	.52	369
Lift	1.9- 5.5	3.1	.58	379

TABLE 6

Medium to Long, Large Oval Wood Wedges (N=34)

Dimensions	Range	Mean	SD	Sample
Length	26.1-64.5	37.2	9.68	34
Width	3.5- 5.5	4.6	.52	29
Lift	1.9- 4.6	3.5	.77	31

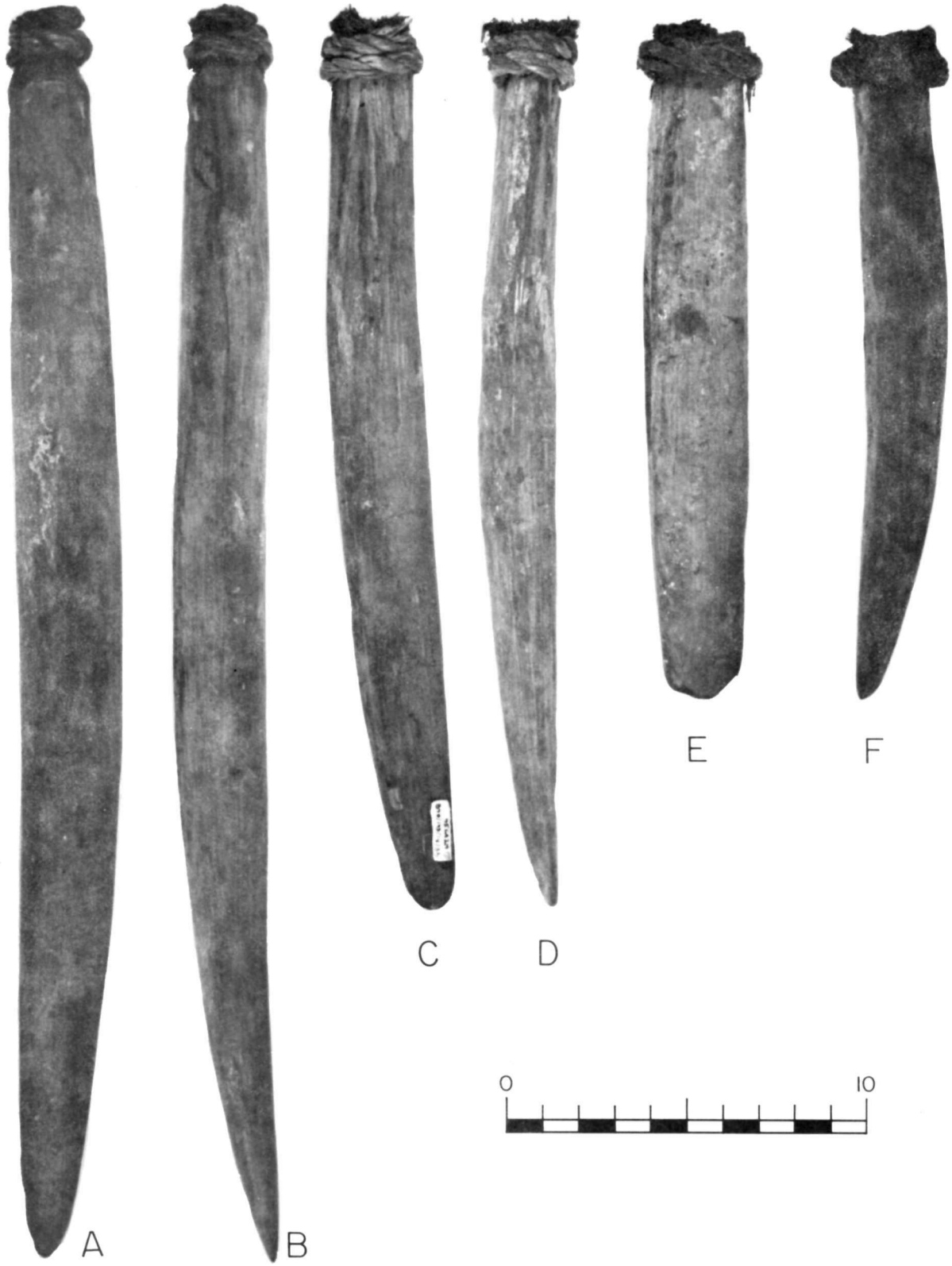


Figure 17. Medium to long, large oval wood wedges. A-B, (45-IV-105); C-D, (145-IV-36).

3.3.1.3.2 Large Rectangular Wood Wedges

The rectangular wedges differ from the oval wedges in four major aspects. The most obvious is that the cross section is rectangular. There is a transformation of the rectangular body to an a circular grip as it approaches the collar. The body is asymmetrical with one margin of the width being straight while the other margin is convex. Finally, the tip margin is in the plane of the thickness.

The rectangular wedges reflect the same length distribution as the oval wedges and there is the same corresponding decrease in width as the length decreases (Tables 7, 8, Figure 18). One wedge with a rather squarish cross section (109-III-3) exceeded the length for all other wedges in the collection.

TABLE 7

Short, Large Rectangular Wood Wedges (N=41)

Dimensions	Range	Mean	SD	Sample
Length	25.0-13.3	18.7	3.22	41
Width	2.6- 4.5	3.5	.48	41
Lift	3.4- 5.3	4.2	.49	41

TABLE 8

Medium to Long, Large Rectangular Wood Wedges (N=19)

Dimensions	Range	Mean	SD	Sample
Length	26.0-88.0	41.6	16.34	19
Width	3.0- 5.6	3.9	.56	19
Lift	4.0- 7.0	5.4	.95	16

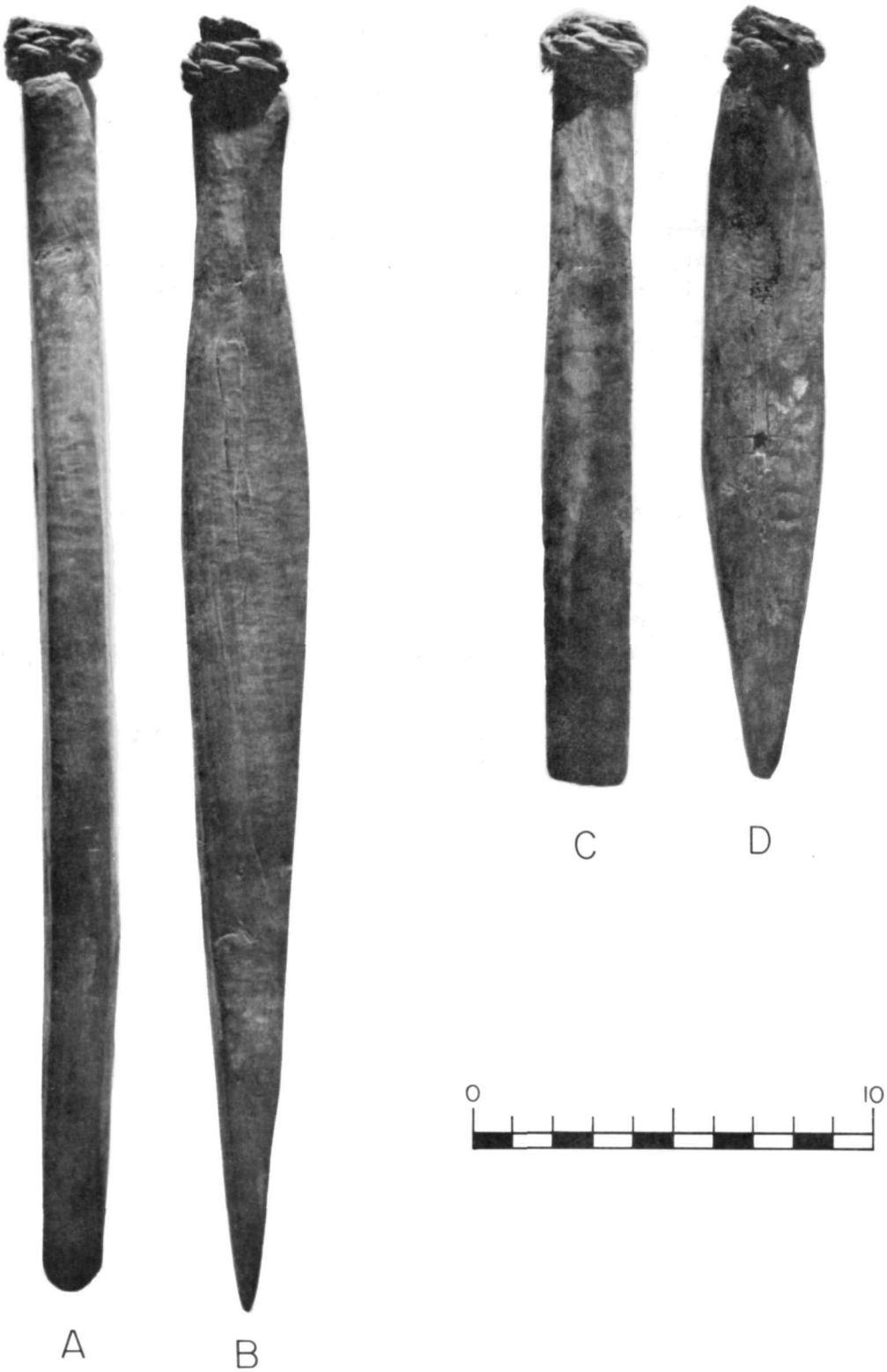


Figure 18. Medium to long, large rectangular wood wedges. A-B, (95-IV-16); C-D, (95-V-163).

3.3.1.3.3 Medium Oval Wood Wedges

The medium oval cross section wedges are all of approximately the same length (Table 9, Figure 19). Morphologically, they are similar to the large oval cross section wood wedges.

TABLE 9

Medium Oval Wood Wedges (N=13)

Dimensions	Range	Mean	SD	Sample
Length	11.5-20.5	15.1	2.55	11
Width	2.2- 4.0	3.1	.54	13
Lift	1.0- 3.1	2.3	.60	13

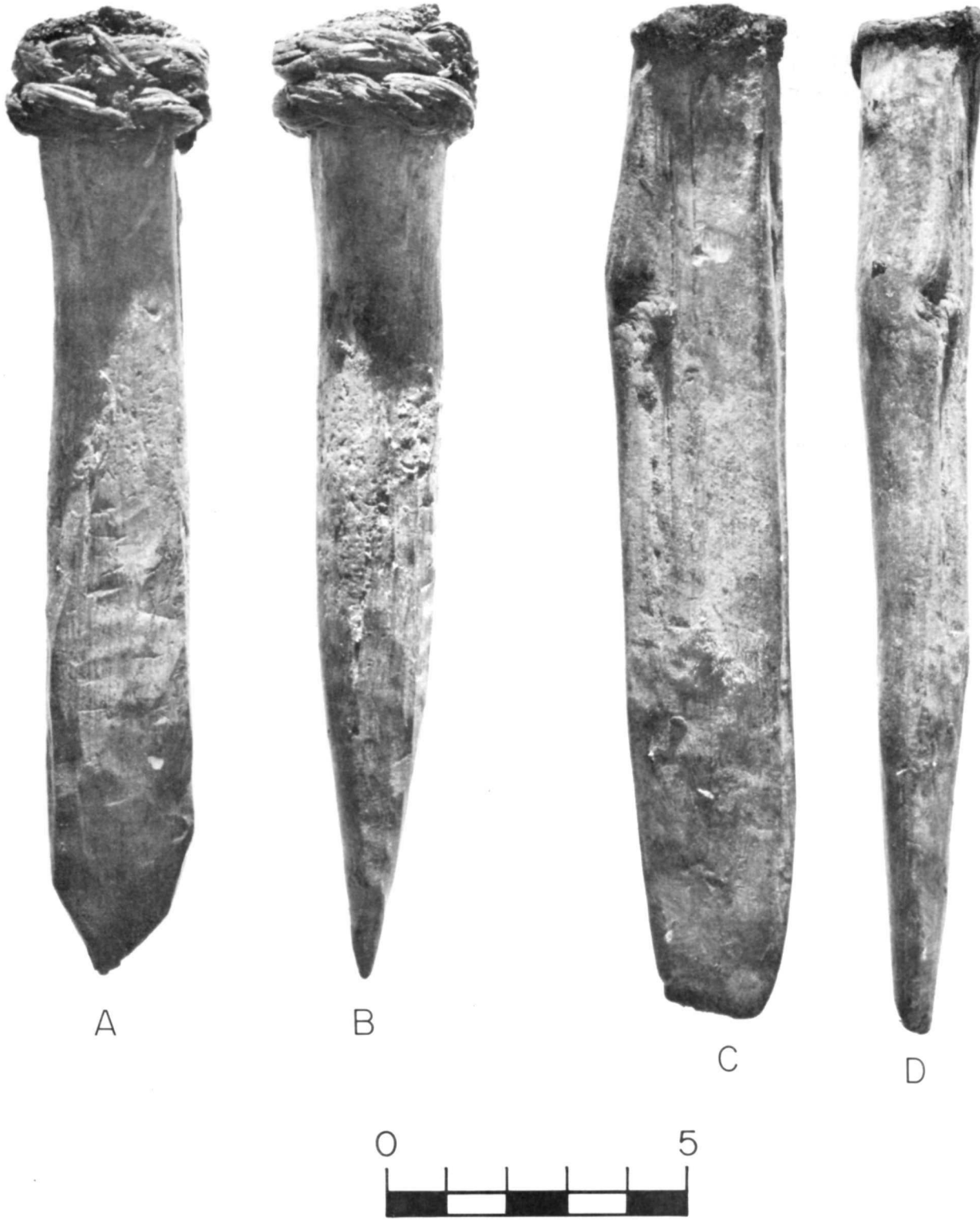


Figure 19. Medium oval wood wedges. A-B (77-III-23); C-D, (33-IV-34).

3.3.1.3.4 Small Oval Wood Wedges

Twenty-two small oval wood wedges were recovered (Table 10, Figure 20). Tips from what appear to have been large oval wedges are included as a variety of this type. These tips, after having been broken from the body, have been redressed and used again as a wedge. Functionally these recycled tips would perform like the small oval wedges because the lengths and thicknesses are similar.

TABLE 10

Small Oval Wood Wedges (N=22)

Dimensions	Range	Mean	SD	Sample
Length	8.7-18.1	11.9	2.48	22
Width	1.2- 3.4	2.2	.54	20
Lift	.8- 2.2	1.4	.36	22



Figure 20. Small oval wood wedges. A-B, (97-V-25); C-D, (117-V-96); E-F (116-V-117).

3.3.1.3.5 Small Rectangular Wood Wedges

Seven small rectangular wedges were recovered (Table 11). These wedges have the same proportions and morphological characteristics as the large rectangular wedges.

TABLE 11

Small Rectangular Wood Wedges (N=7)

Dimensions	Range	Mean	SD	Sample
Length	9.0-16.5	12.7	2.97	5
Width	1.0- 2.4	1.4	.48	7
Lift	.9- 2.8	2.1	.66	7

3.3.1.3.6 Marking Wood Wedges

Twenty-four small finely finished wedges of both the rectangular and oval cross section were recovered (Figure 21). These wedges are elongated in relation to length and thickness dimensions. The small cross section dimensions distinguish this type from all others. Although 10 have an oval cross section (Table 12) and 14 have a rectangular cross section (Table 13), there is no significant difference between the means for either the width or thickness. These rectangular cross section wedges are similar to the one illustrated by Boas and identified as a marking wedge. It is felt that functionally there would be no difference between the rectangular and oval wedges of this size for marking.

TABLE 12

Oval Wood Marking Wedges (N=12)

Dimensions	Range	Mean	SD	Sample
Length	8.5-18.5	12.9	3.32	10
Width	.9- 1.6	1.2	.24	10
Lift	.7- 1.1	1.0	.13	10

TABLE 13

Rectangular Wood Marking Wedge (N=14)

Dimensions	Range	Mean	SD	Sample
Length	10.5-21.0	14.7	3.49	14
Width	.6- 1.5	1.0	.32	14
Lift	.9- 1.8	1.3	.26	14

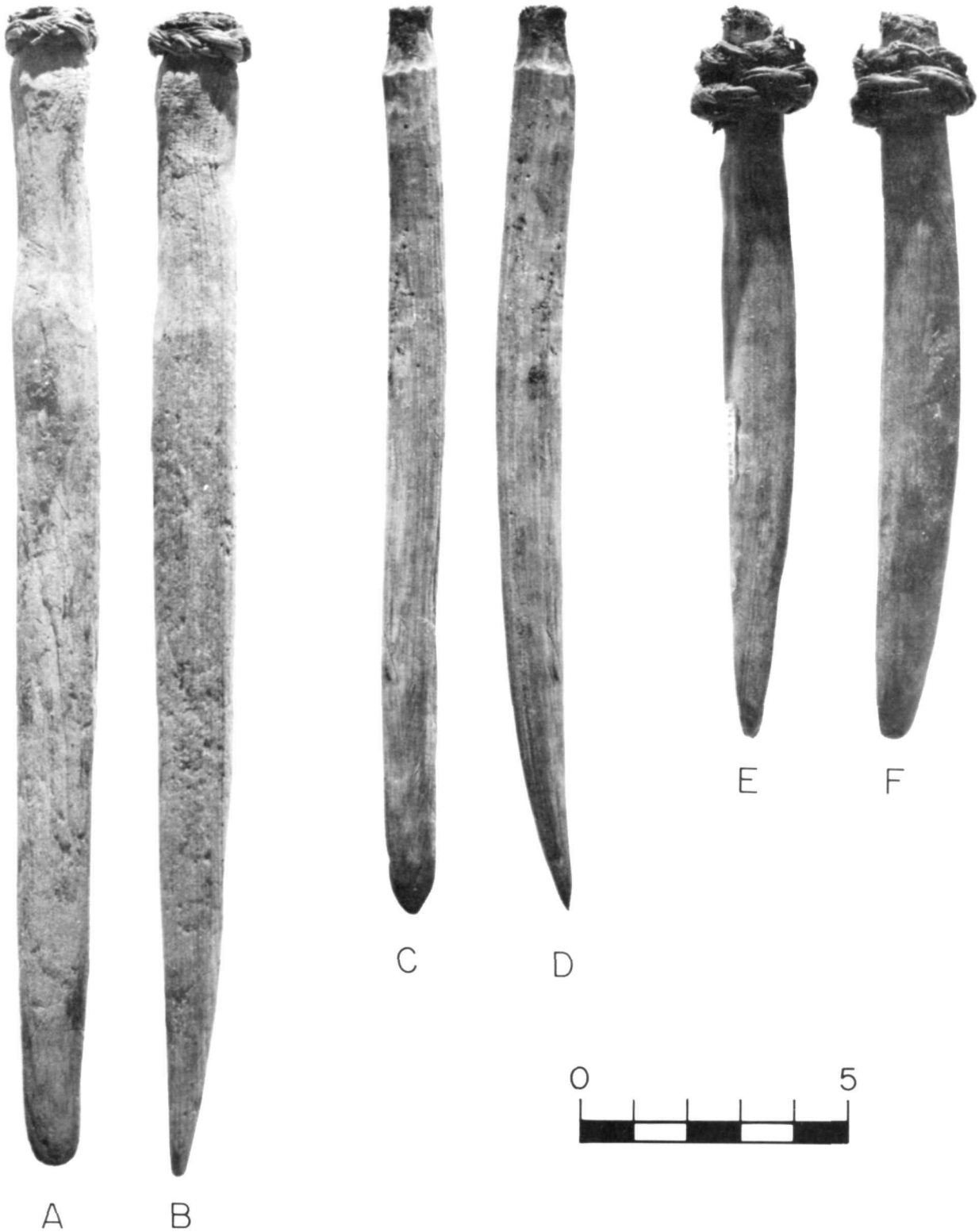


Figure 21. Wood marking wedge. A-B, rectangular (127-V-44); C-D, rectangular (9-V-158); E-F, oval (203-AII-1).

3.3.1.3.7 Rod Wood Wedges

These are proportionally long, thin, round to oval cross sectioned wedges (Tables 14, 15, Figure 22). As with the large oval and rectangular wedges, there is a weighting of the length distribution to the short end of the curve. There are no collars on these wedges, and the battering of the proximal end is generally light compared with the other wedges. The distal tips vary from a convex margin to a conical point.

The lift of these wedges is about the same as that of the whale bone wedges. The distal tips of both these wedge types range from a convex margin to a conical point. Neither the rod wedges nor the whale bone wedges have a highly polished or a fine edge like the other wedge categories. The proximal ends, while battered, are not bound.

The morphology and wear of these two types of wedges indicate that they were not used to initiate splits nor were they used for heavy or high lifts. These factors in conjunction with the length and parallel nature of the length axis make these wedges ideal for splitting long planks and especially thin boxsides. To split a piece of cedar along the tangential axis for a box side one must support the thin, wide piece of cedar or it will split along the radial axis also, rendering the cedar board useless. To split such a piece one must support it throughout the splitting process. One must split the board off a little at a time with full support as happens when a froe is used to split cedar shakes. The configuration of the rod wedges and the whale bone wedges would function as the froe does, lifting a little at a time across the whole width of the board.

TABLE 14

Short, Rod Wedges (N=53)

Dimensions	Range	Mean	SD	Sample
Length	19.5-36.5	30.8	3.91	37
Width	1.9- 3.5	2.6	.35	52
Lift	1.0- 3.0	2.2	.41	52

TABLE 15

Medium to Long, Rod Wedges (N=31)

Dimensions	Range	Mean	SD	Sample
Length	37.5-66.5	48.0	9.17	31
Width	2.0- 4.0	2.8	.54	31
Lift	1.5- 3.7	2.4	.52	31

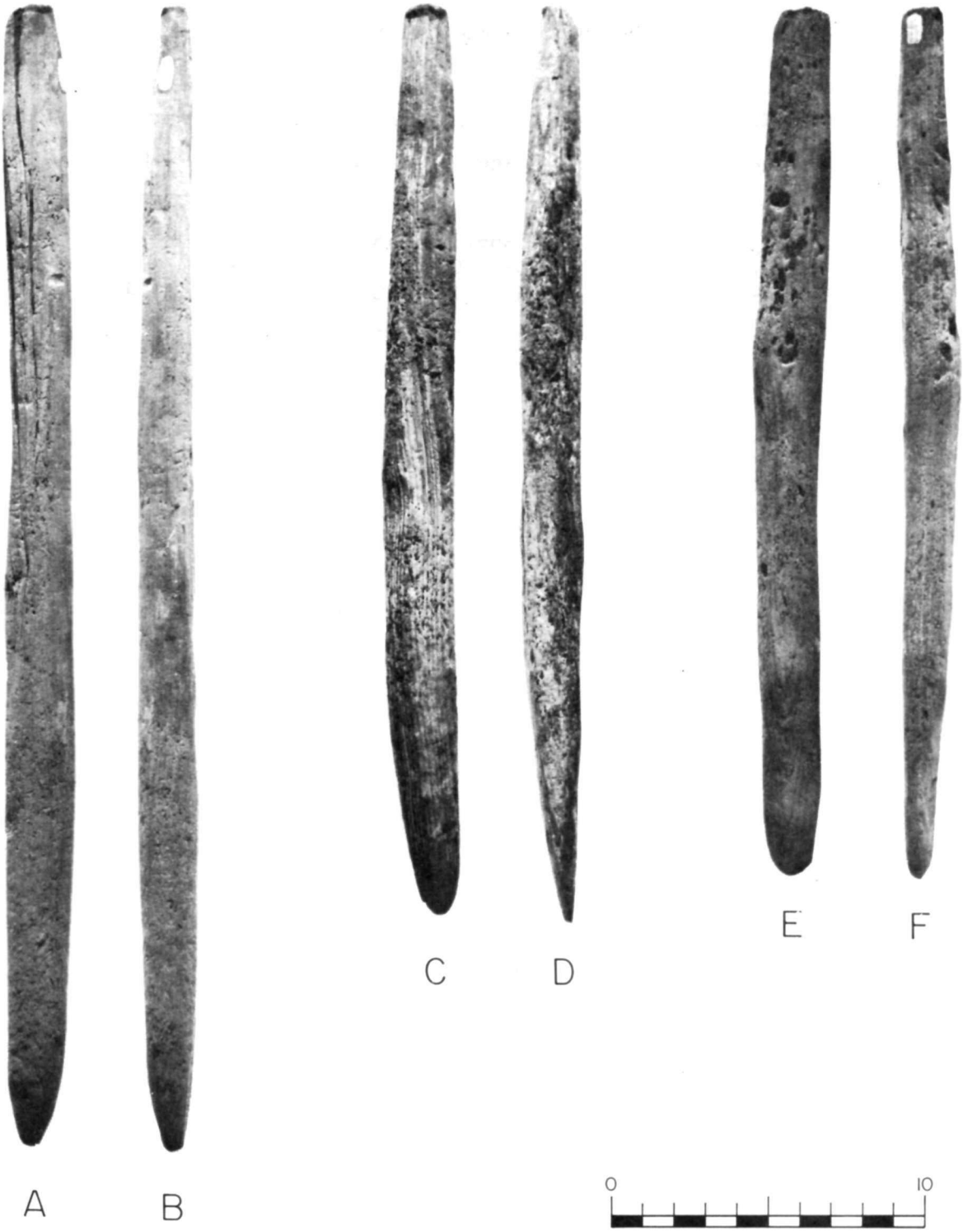


Figure 22. Medium to long, rod wedges. A-B, (78-V-112); C-D, (32-V-3); E-F, (27-V-144).

3.3.1.3.8 Wood Wedge Preforms

Fifty-four wedge preforms were recovered (Table 16). Most of the preforms represent various stages of manufacture of either large oval or large rectangular wood wedges. The preforms recovered represent nine of the 11 stages of wedge manufacture. The stages and the manufacturing process are discussed in detail in Chapter 5.

TABLE 16

Wood Wedge Preforms (N=54)

Dimensions	Range	Mean	SD	Sample
Length	30.0-80.0	51.5	12.99	42
Width	3.0- 6.0	4.5	.76	42
Lift	2.0- 5.5	3.7	.85	42

3.3.1.3.9 Wedge Fragments

Numerous wedge fragments were recovered. These consisted of proximal, longitudinal, and distal wedge sections as well as the grommets or collars placed around the proximal end of the wedge to prevent splitting.

Distal and longitudinal fragments outnumber proximal fragments eight to one. Probably the proximal fragments are recycled into medium or small oval wood wedges. More wedge fragments are found in the exterior midden than within the houses. The number of broken wedges, especially distal tips, would indicate that there was a considerable amount of wood splitting activity within the village area.

The grommets or wedge collars recovered were most likely cycled out of the system when the wedge broke longitudinally. Recycling such a wedge would include a reduction of its cross section and the manufacture of a new collar. A description of these collars and their manufacturing techniques is discussed in detail by Croes (1980).

3.3.1.6 Chisels

Chisels are used with mauls for both precision cutting and for cutting in deep narrow places (Table 17, Figure 23). The chisel handles from Ozette are all made of wood except for one made of bone. The recovered blades of these chisels are of steel. Those examples that have no blade appear to have been prepared to take a metal blade.

In most instances, the proximal end of the chisel handle is bound with a grommet of cedar limb in the same manner as the wedges. This manner of construction helps prevent the splitting of the handle when it is struck with a maul. The distal end of the handle has a deep inset for hafting the metal blade (Figure 24). After the blade was inset, the exposed side of the proximal end of the blade was covered with a small piece of wood, and then the whole distal end of the chisel was bound, probably with sinew, and then set with pitch.

The blades which are made of steel vary in length. A similar variation in length is seen in the blade insets of the handles that are recovered without a blade. These insets range in length from 1.8 cm to 16.5 cm. Apparently, the blades were sharpened and reformed again and again, each time the length of the metal blades becoming shorter.

The proximal end of the blades is heavily hammered, causing it to mushroom. This expanded area absorbed and transmitted the blow applied to the proximal end of the handle without driving the metal blade into the handle stock. The distal end of the metal blade is crescent-shaped with the ears of the blade flared beyond the blade shaft. The flairing most likely was created by hammering while the metal was hot.

Chisels are reported ethnographically for the entire region. Archaeologically they are represented throughout the region by stone, bone, and occasionally shell chisel blades.

Both Boas (1909:320, 380) and Drucker (1951:78) describe the chisel that is essentially similar to that found at Ozette. The only point of departure is that neither mentions the use of sinew and pitch as a binding medium. Boas notes that the handles of the chisels were of variable length to accommodate the depth of the cut being made.

Chisels were an all purpose cutting tool for woodworking. They were used for felling trees, shaping and notching pieces and sundry other applications.

TABLE 17

Chisels (N=20)

Dimensions	Range	Mean	SD	Sample
Length	12.0-34.0	23.5	6.96	16
Width	1.6- 4.1	3.1	.83	16
Thickness	1.4- 3.9	2.8	.87	15
Socket Length	1.8-16.5	5.3	4.39	15
Socket Width	1.3- 3.9	2.3	.80	14
Blade Length	5.4-17.5	11.5	8.56	2
Blade Width	2.7- 2.8	2.8	.07	2
Blade Thickness	.5- .9	.7	.27	2

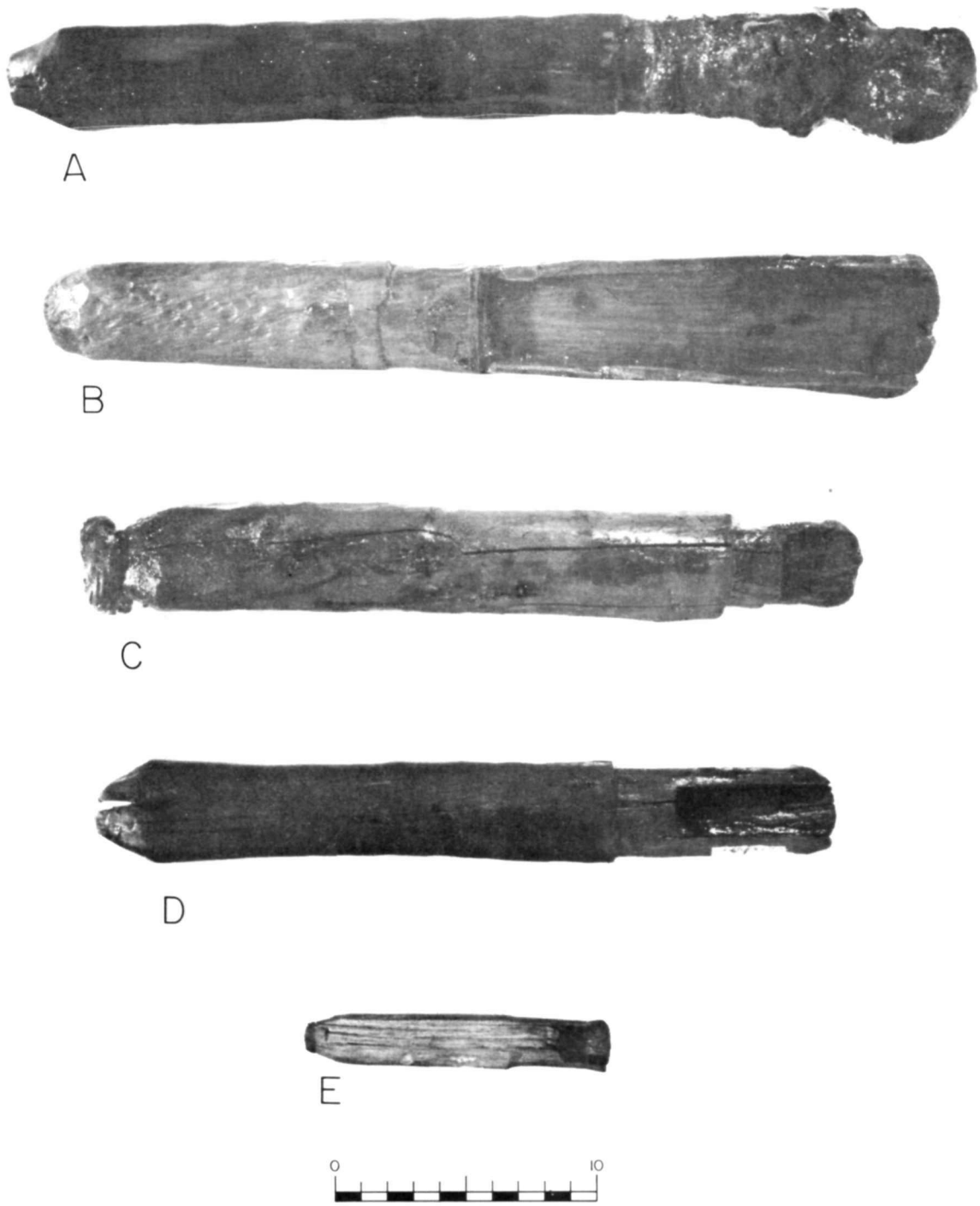


Figure 23. Chisels. A-E, (34-IV-3), (106-IV-3), (145-V-160), (71-V-7), (144-IV-169). Note that A has a metal blade.



Figure 24. Chisel with metal blade (29-IV-110). A, chisel handle and blade; B, blade in inset area; C, cover cap and inset area lateral margins in place.

3.3.1.7 Gouges

One gouge blade made from the longitudinal half of an elk metapodial was recovered (Table 18, Figure 8). The proximal end is flattened through grinding. The distal process is cut or broken off and then the shaft end is sharpened to a stout angle, with a V-shaped bit.

No hafted gouges were recovered at Ozette, nor are any recorded in the ethnographic literature. The proximal end of the blade is not battered. Because these are not unlike chisels, a wooden handle was shaped and used with a replicated gouge blade. The tool worked admirably to produce flutes such as those found on a number of the house planks from Ozette.

In several instances, gouges have been classified archaeologically as chisel blades or wedges. However, because the cross section is concave-convex, these should be classified as gouges. Functionally, they are a different tool than a chisel in that they create a relatively deep concave depression and are used for fluting and scooping out areas.

On the basis of information provided in numerous site reports, it would appear that this tool is present at Beach Grove (Abbott 1962:75-76; D. Smith 1963:45), Cattle Point (Carlson 1960:575; King 1959:59), Montague Harbor I and III (Mitchell 1971:133, 206), Yuquot (Dewhirst 1978:11), Fort Columbia (Kidd 1960:57-58, 73), Minard (Roll 1974:134), Toleak Point (Newman 1959:36-37), White Rock Village (Guinn 1962:16) and in the early excavation at Ozette (McKenzie 1974:37). The gouge would appear to be common at least within the central Coast Salish, Nootkan area. It is not clear if this tool was used among the northern coastal groups.

TABLE 18

Gouge Blade (N=1)

	Catalog Number
Dimensions	26-V-90
Length	6.4
Width	3.1
Thickness	1.5

3.3.2 Direct Percussion

Direct percussion tools are those that are struck against the piece of wood. Direct percussion tools in this collection are limited to the weighted straight adze and the D-adze.

3.3.2.1 Weighted Straight Adzes

The weighted straight adze is the most common adze type at Ozette (Table 19, Figure 25). It is generally made from a section of the tubercle end of a whale rib. The handle is carved from the interior margin of the rib, giving the entire handle a pronounced curve. The handle consists of a cylindrical grip with a large asymmetrical knob. The haft area is a cut step with a binding projection.

None of the weighted straight adzes was recovered with a hafted blade. Wear marks in the proximal end of the haft area would indicate the use of a thin metal blade or possibly a mussel shell blade of about the same thickness as the knife blades. The handles have an average weight of 191 grams with a range of 120 to 321 grams. This weight made the relatively small and light metal blades very effective for cutting wood. The presence of short stubby handles may be a variation within this type, but the functional differences of these tools are not apparent. They were shaped by adzing and chiseling; the surface was finished with abrading, possibly with sandstone.

According to Olson, the distribution of straight adzes on the Northwest Coast is from the Strait of Juan de Fuca south (1927:15-16). The weighted straight adze is a particular variety of the straight adze without the integral knuckle guard (Olson 1927:5). Except for a similar sub-variety found at the Minard site (Roll 1974:141), the Ozette/Cape Flattery area appears to be the only known location of this particular tool in either the archaeological or ethnographic record.

TABLE 19

Weighted Straight Adzes (N=9)

Dimensions	Range	Mean	SD	Sample
Length	20.0- 24.0	22.4	1.97	5
Width	4.4- 13.0	8.0	2.64	9
Thickness	1.6- 4.1	3.0	1.03	9
Grip Length	6.2- 14.4	9.2	2.99	8
Grip Width	1.3- 2.8	2.0	.45	9
Grip Thickness	2.6- 1.5	2.1	.40	9
Blade Inset Length	2.0- 4.5	2.8	1.04	5
Weight	120.0-321.0	191.1	62.33	9

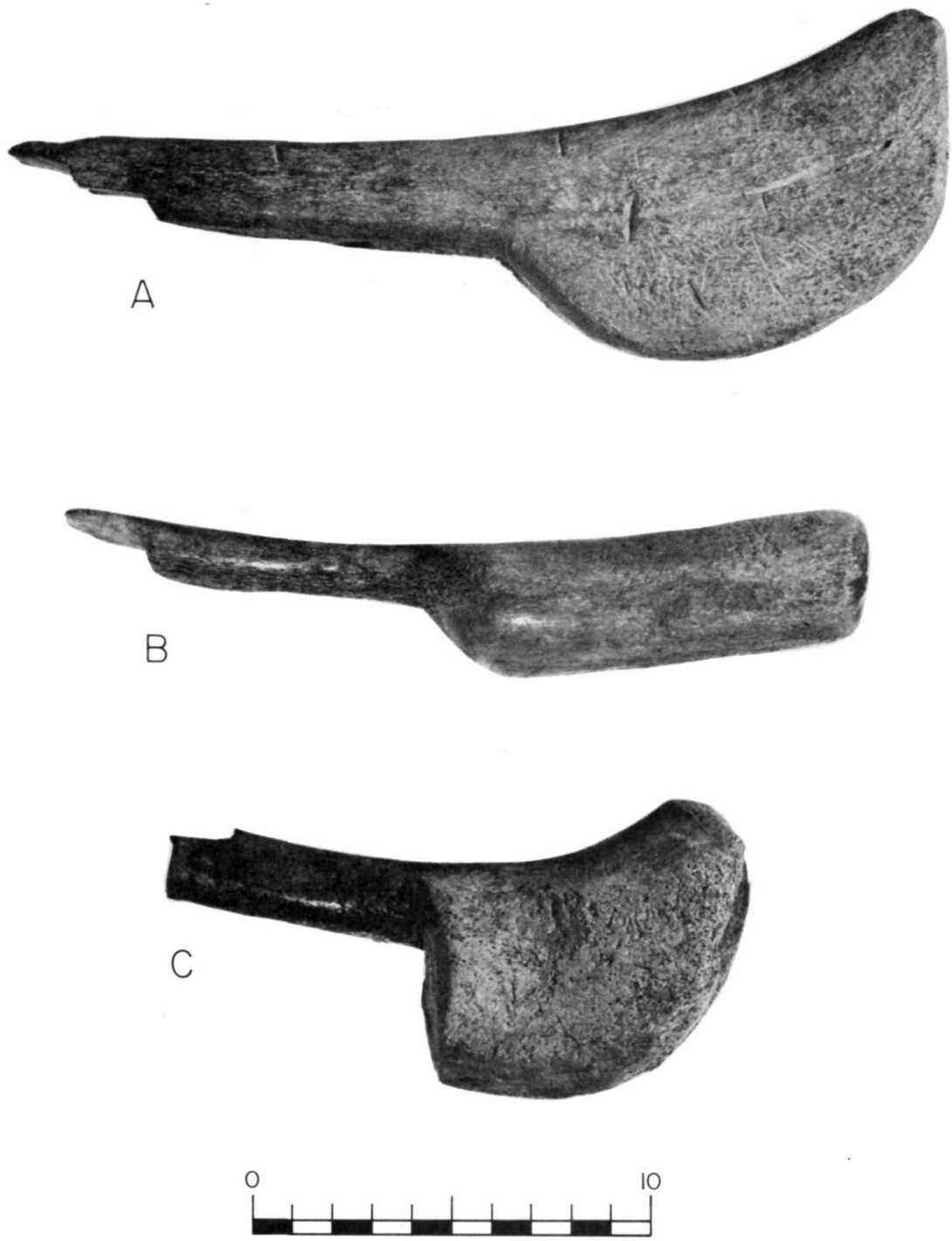


Figure 25. Weighted straight adzes. A-C, (163-VII-10), (125-V-101), (143-III-33).

3.3.2.2 D-Adzes

Five D-shaped adze handles were recovered from the site (Table 20, Figure 26). Four were made from whale bone and one was made of wood. Because these handles were few in number and fairly diverse in appearance and temporal deposition, they will be discussed individually. Two of the adze handles were recovered from the Unit IV clays over House 1, one from the historic Unit I deposits, and two were of uncertain provenience. All but one of the handles were either preforms or had been broken. None of the adzes recovered had blades.

The adze handle (040-I-76) from the historic level is a massively proportioned whale rib handle with an anthro/zoomorphic front. This handle fragment is much larger than D-adze handles from either the Ozette collection or from the various collections of Northwest Coast woodworking tools that are found in the museums of North America. It is best seen as a variant created by someone who was not really familiar with the D-adze, or for trade as a curio.

The adzes of uncertain provenience were made of whale bone. One was a preform (107-AIV-2) and the other (360-W-2), a section of whale rib, was a finely crafted fragment of the grip part of the handle. The latter handle, while being well made, is of a simple functional design with neither surface elaboration nor zoomorphic representation involved. The proportions of this handle are similar to those in ethnographic collections from Nootkan culture areas.

The two adzes that were recovered from the mud slide fit nicely with the adzes found in many museum collections. One (133-III-3) is of whale mandible with a zoomorph on the other end. The other D-adze is made of Pacific madrone wood and is highly sculptured and decorated. Both of these handles are distinctive in that the hafting plane is not parallel to the handle plane. The madrone handle is also distinctive in that it has a flaired butt to the handle, this is similar to some Coast Salish and Nootka examples in the museum collections. However, the museum collections are generally in the form of a bird with the flaired butt corresponding to the bird's tail. The Ozette handle (Figure 27) has a definite vulvic-phallic appearance (Duff 1975:59). Friedman (1975:199) has noted that the nearest source of the madrone is in the drier Port Angeles area, which is part of Clallam country. The material or the item itself may have been traded from the Clallams. The fact that only two out of several thousand wood identifications are madrone increases the likelihood of this being a trade item.

Compared with the straight adzes and chisels, D-adzes are not as numerous in the Ozette collection. The lack of hafted adzes, either of the D or straight variety, is notable.

According to Olson, the distribution of the D-adze was from Alaska south to the Columbia River (1927:15-16). D-adzes are only occasionally reported in the archaeological record.

The morphology of the Ozette D-adzes is generally comparable to those of the Nootkan area (Boas 1909:320-322). Olson notes that flairing of the handle similar to that in the madrone handle was common among the Clallam, Skokomish, and Swinomish to prevent slippage on short handled elbow adzes (1927:17). This flair was noted by the author in a number of museum collections from Coast Salish groups. It may very well be that, while most of the D-adzes are classic Nootkan, the madrone handle on the basis of morphology and raw material is Coast Salish in origin.

An occasionally cited use of the D-adze is for finishing. Goddard notes that D-adzing with the grain gives a fluted appearance, while adzing cross-grain gives a rippled appearance to the surface (1945:38). Boas, however, indicates that the D-adze was more of an all-purpose tool (109:330-369).

TABLE 20

D-Adzes (N=5)

	Catalog Number				
Dimensions	360-W-2	133-III-3	207-AIV-2	040-I-76	99-IV-1
Length	17.5	19.4	20.3	22.5	22.3
Width	--	6.6	--	--	7.0
Thickness	--	3.2	--	--	--
Handle Width	2.1	2.0	--	3.5	3.3
Handle-Thickness	2.3	1.8	--	--	3.1
Opening-Length	10.3	7.9	--	10.3	9.0
Opening-Width	2.8	3.6	--	--	--
Haft-Thickness	--	1.7	--	--	--

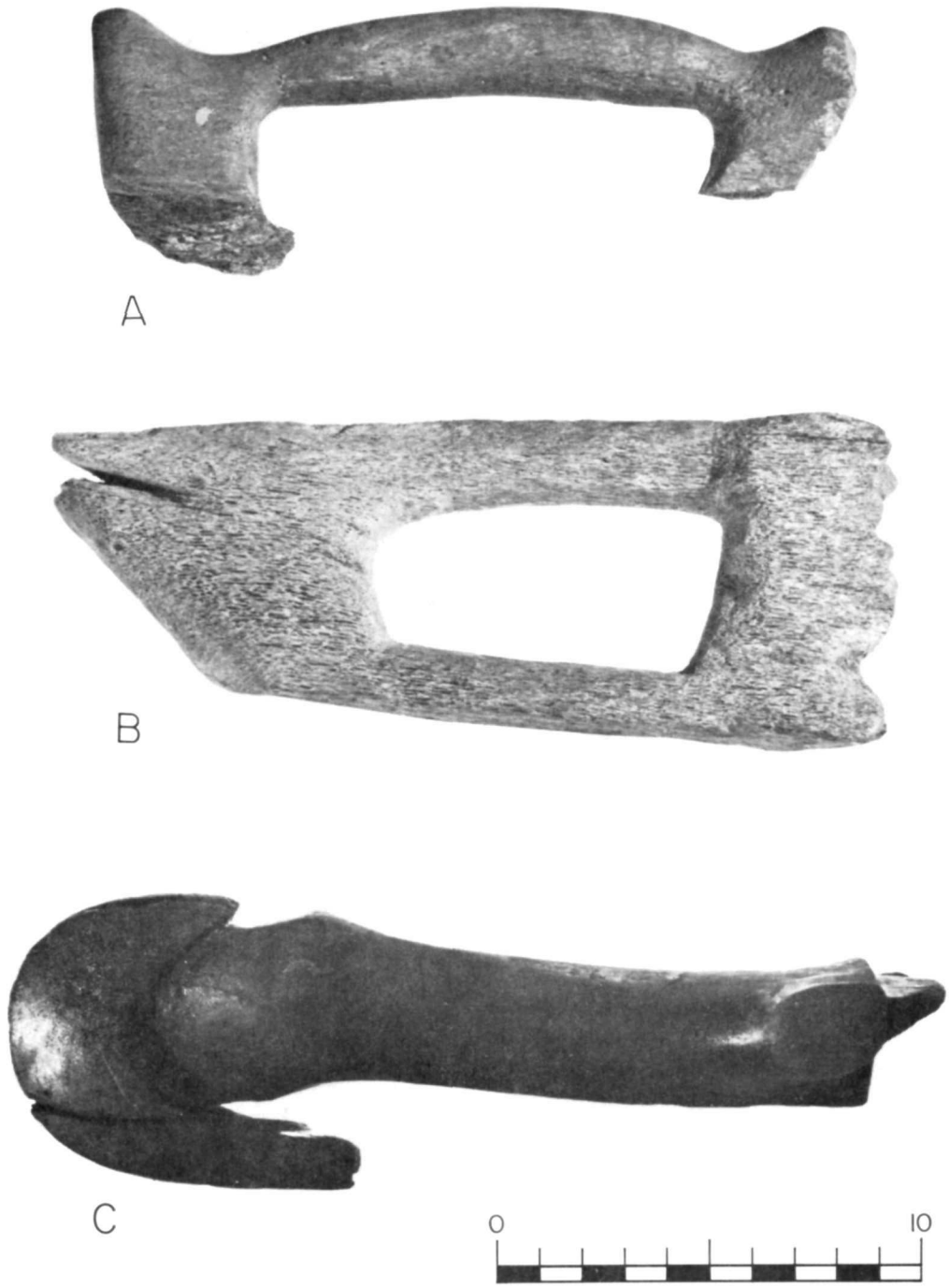


Figure 26. D-adzes. A-C, (360-W-2), (133-III-3), (99-IV-1).



Figure 27. Replica of madrone D-adze (133-III-3).

3.3.3 Non-Percussive, Linear Motion

Non-percussive, linear motion, tools are used by placing the blade edge against the wood, and pushing into the wood, towards or away from the body, in a linear motion to remove excess wood. This category includes various types of knives and planes.

3.3.3.1 Knives - Introduction

Knives are acutely edged tools that are used in a sliding, pushing motion. In woodworking, knives are used for shaving off wood in the shaping and finishing process. The knives are particularly important for the execution of complex shapes where control of removal is important. Knives are also important in the development of decorative effects, especially those relying on incised lines.

Knives generally are used to remove small amounts of wood at a single stroke. The removal of a mass of wood when it has to be done with a knife is generally accomplished with a number of quick strokes. In order to assure that the strokes come effortlessly, an effective knife for woodworking should be able to take an acutely sharp, durable edge. In the Ozette collection, metal, mussel shell, beaver incisor, and slate are used for knife blades.

The knives from Ozette can be grouped into broad general groups on the basis of blade material. Slate bladed knives are ulu shaped and probably intended primarily for fish processing. Shell bladed knives include whole shell, wrapped portions of shell, and shell pieces hafted in a wooden handle. The shell bladed knives appear to be intended for a multitude of uses. Metal knives are all hafted in wooden handles which can be sorted into two broad groups. The first is composed of broad bladed knives whose handles have an expanding haft or base. The intended use of these knives appears to be for flensing. The second group of knives have small metal blades and handle haft areas that are either parallel or contracting. These knives appear to have been part of the woodworking process and other manufacturing processes.

3.3.3.1.1 Slate Bladed Knives

Slate bladed knives, and the ground slate industry in general, are not common at Ozette. The recognizable slate bladed knives at Ozette are the ulu type with cresentic cutting edges (Figure 28). Several examples were recovered with wooden cylinders for handles. The handles were notched along the length and set on the blade with pitch. Only 30 pieces of slate appear to have been used as knife blades.

There is no indication in the ethnographic material nor from the Ozette excavations that any of the recovered slate blades were used for woodworking. The broad slate blade with its handle on the back of the blade would work well for sliding, rocking cuts such as those used in the filleting of fish.

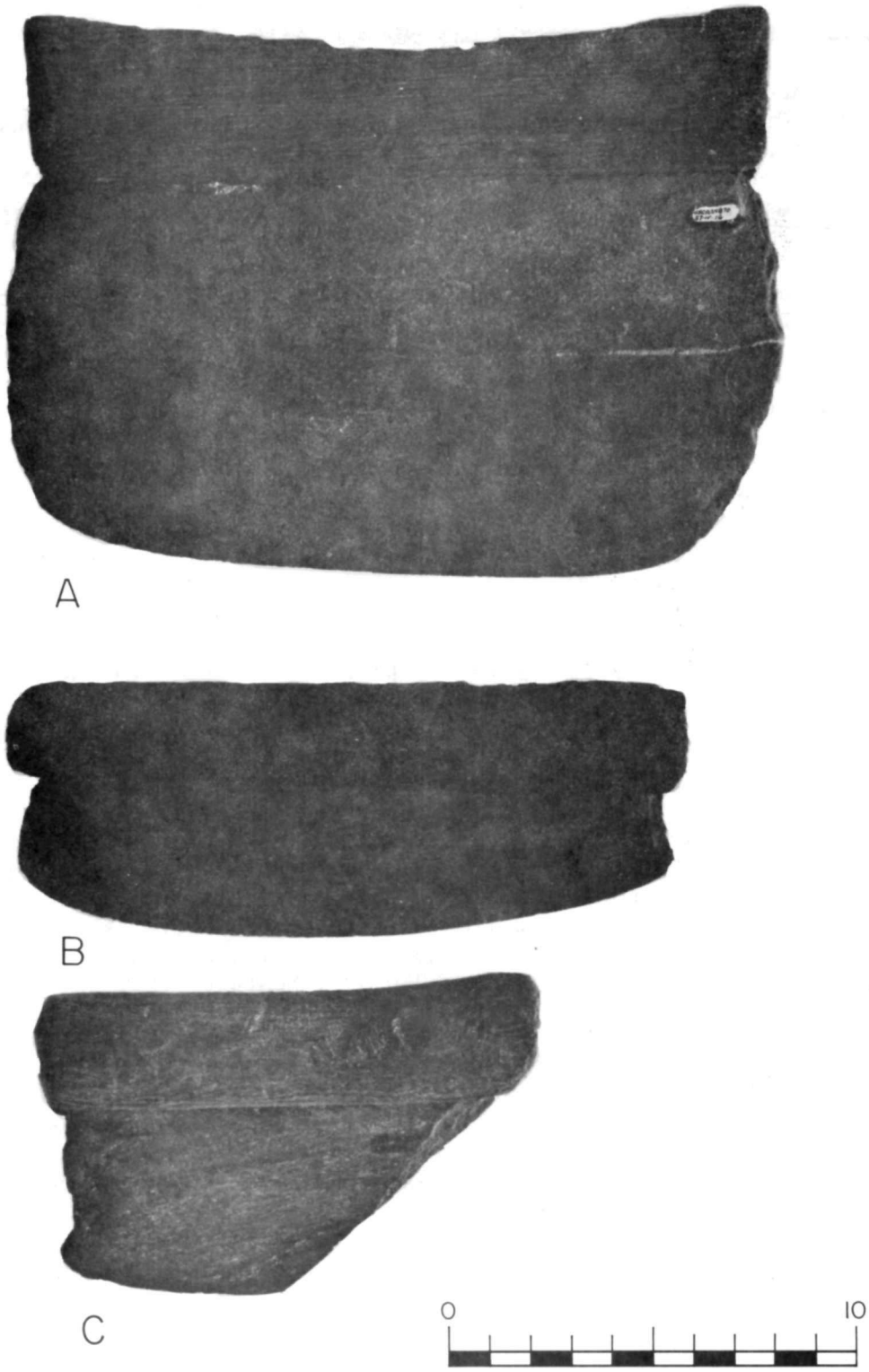


Figure 28. Slate knives. A-c, (27-IV-16), (S-15), (176-V-16).

3.3.3.1.2 Shell Bladed Knives - Introduction.

Shell bladed knives at Ozette all use mussel shells for blades. All the mussel shells appear to be the Mytilus californianus. The periosticum or leathery covering of the shell is ground off in the area to be sharpened. Grinding for sharpening is bilateral. The shells are used either whole or in hafted or unhafted fragments.

The most common mussel shell knife seems to be made by using a whole shell. In this instance, the periosticum is ground from the ventral portion of the shell on a large sandstone block. The shell is then turned over and the occlusal margin of the shell is ground on the sandstone. The result is a very acute and very sharp edge. The degree of sharpness can be enhanced by honing with a finer particle size stone. The hinge area of the margin may or may not be ground flat during this preparation of the cutting edge.

The resulting edge on the mussel shell is extremely sharp. The shape of the shell provides several convenient grasping methods. When used in a slicing motion, the shell nestles quite firmly in the hand with little chance to slip no matter how greasy or oily one's hands may be. If the shell is layed with the occlusal margin flat on a surface, the dorsal bulge provides an adequate handhold. A mussel shell used in this manner on a piece of adzed wood such as a box side or a plank removes the peaks left by adzing with a planing motion. Ethnographic uses include fish cutting. Additional uses for the mussel shell knife were multitudinous. Present day informants, for instance, relate that men among the Makah carried a pouch with several mussel shells and a sandstone abrader. As a knife wore out or was broken, it could be replaced. The indication from this account and others is that the mussel shell knife was a multi-use cutting/slicing implement. They are widely mentioned in both the ethnographic and archaeological accounts. This implement appears to be the all-purpose cutting tool for the region. They have been reported from sites at Beech Grove (Abbott 1962:65; D. Smith 1962:27), Locarno Beach (I and II) and Whalen (Borden 1950:15, 16, 20), Cattle Point (King 1950:59), Montague (Mitchell 1968:40), Kwatna (Carlson 1971:45, 47), Prince Rupert (Ames 1976:155; MacDonald 1969:6), and Indian Island (Blukis-Onat 1976:77).

Drucker relates that the women used mussel shell knives for various purposes, not the least of which was cutting fish (1951:63, 91). Like the men, they would keep a number of sharpened or unsharpened blades and a whetstone handy, When a blade dulled or broke, it was resharpened or replaced immediately. The shells used were from the offshore rocks or islets which are presumed to have been, as today, a source of larger, thicker, and, hence, stronger blades.

3.3.3.1.2.1 Wrapped Mussel Shell Fragment Knives. One wrapped mussel shell fragment knife(163-V-22) was recovered at Ozette (Figure 29). This small knife was made from an oval fragment of shell (6.5 cm by 2.7 cm). The proximal end of the blade was wrapped with cedar bark. The oval distal end was sharpened along the whole margin. The blade is thin and the edge is delicate. From replication experiments, it would appear that this knife would be more suitable for fine delicate work. There is no known reference to this specific type of knife. Drucker does, however, refer to a specially made mussel shell knife for cutting the umbilicus on a newborn baby (1951:129). The care devoted to the manufacture of this knife, the unique form, the size and sharpness, and the lack of any other obvious utility of this item argue for the possibility of such a function for this knife.

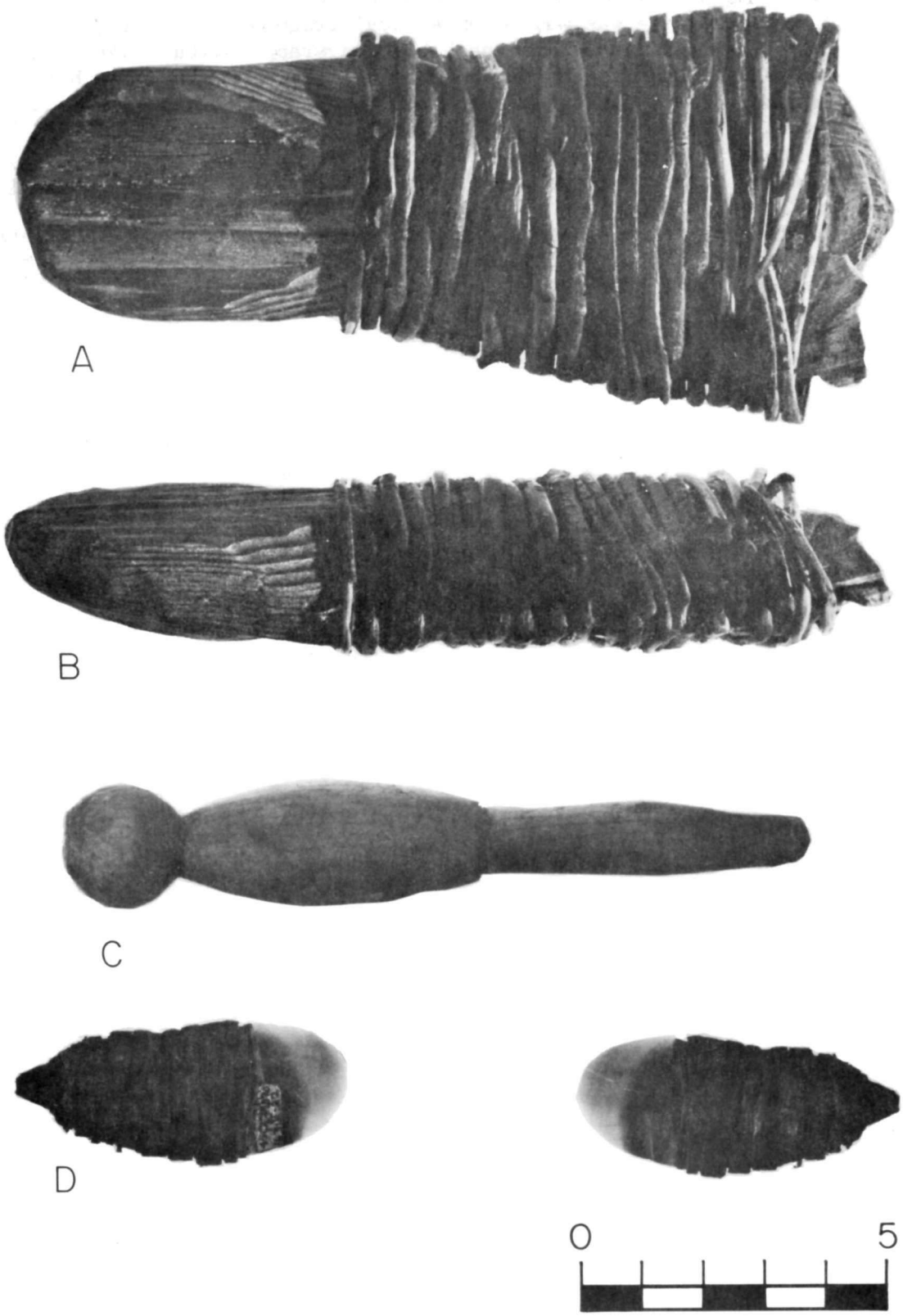


Figure 29. Mussel shell knives. A-B, (165-VII-7); C, (163-VII-11); D-E, (163-V-22).

3.3.3.1.2.2 Hafted Mussel Shell Knives. Two different types of mussel shell hafted knives were recovered. Each category is represented by only one example (Table 21, Figure 29).

The first type has a handle similar to the parallel and contracting base metal bladed knives. It differs from the grip of handles in that the handle is apparently made from a piece of lathe turned wood. The piece was replicated on a lathe and all salient effects were duplicated. Wear on the handle is similar to that found on chairs with turned wood post in their back. The handle material is yew, which is not common in the Orient.

The blade is broken off, except for the tang. The tang thickness is comparable to the metal blade stock in the parallel to contracting stem knives. There is no indication of method of binding.

The second type of mussel shell knife handle is not similar to any of the other artifacts from the collection. This knife(165-VII-7) uses the major part of the ventral half of the shell which is fitted to a wooden handle and bound with root or limb. Although there is no known correlate for this tool that the author has seen, the replica of this tool worked extremely well as a hide scraper. Given shell knives were used by the Klayoquot for skin dressing(Koppert 1930:96), this may have been the skin dressing knife of the Ozettes.

TABLE 21

Hafted Mussel Shell Knives (N=2)

	Catalog Number	
Dimensions	163-VII-11	165-VII-7
Length	11.9	14.5
Width	2.1	4.5
Thickness	2.1	2.5
Distal Handle Width	1.1	--
Distal Handle Thickness	.9	--
Blade Tang Length	2.8	7.8
Blade Tang Width	1.1	6.3

3.3.3.1.3 Beaver Incisor Knives

Three hafted beaver tooth incisors and two unhafted, but modified incisors have been recovered (Table 22, Figure 30). Generally, the lower incisor is removed from the mandible. The tooth is then cut or snapped and the half to two-thirds with the root portion is discarded. After the occlusal surface has been ground flat, the tooth is ready to be hafted.

Two of the hafted beaver teeth have wood handles and the third (66-W-14) was used in its own mandible with only minor modification. The wooden handles had V-shaped grooves for hafting the incisor. Because the binding was absent on both handles, it is assumed that it was of animal matter, probably sinew.

TABLE 22

Beaver Incisor Knives (N=5)

	Catalog Number				
Dimensions	164-V-23	37-IV-24	66-W-14	9-V-228	114-V-99
Length	16.8	16.3	--	--	--
Width	1.8	1.5	--	--	--
Thickness	1.7	1.4	--	--	--
Tooth Length	4.4	6.5	--	5.5	4.8
Tooth Width	--	.6	--	.7	.9
Cutting Angle*	40	42	35	42	43

*Angles measured in degrees.



Figure 30. Beaver tooth knives. A-D, (164-V-23), (37-IV-24), (66-W-14), (3-V-70). Binding on B is modern.

3.3.3.1.4 Metal Bladed Knives - Introduction

This category covers 46 examples, all having wood handles (Figure 31). Of these, 17 still have metal tangs, and 14 have a metal stain in the haft area. The remaining 15 knives are morphologically similar and are considered to have been most likely hafted with a metal blade.

The metal bladed knives can be broken into two broad classes on the basis of the nature of the haft area. One set of knives has an expansion or pronounced flair to the hafting area. The tang width of these knives is considerably greater than that of those knives with a parallel or contracting hafting area. Within the set of parallel to contracting based knife handles, there appears to be at least one further level of differentiation which may or may not have functional implications.

In both major types of handles, complete or partial blade preservation is rare. There is only one handle in each type having what could be considered a fairly complete blade preserved. Apparently, given the number of tangs preserved and the nature of deposition of the preserved blades, the sandwiching of the metal between wood reduces the rate of the decomposition process for the thin metal blades.

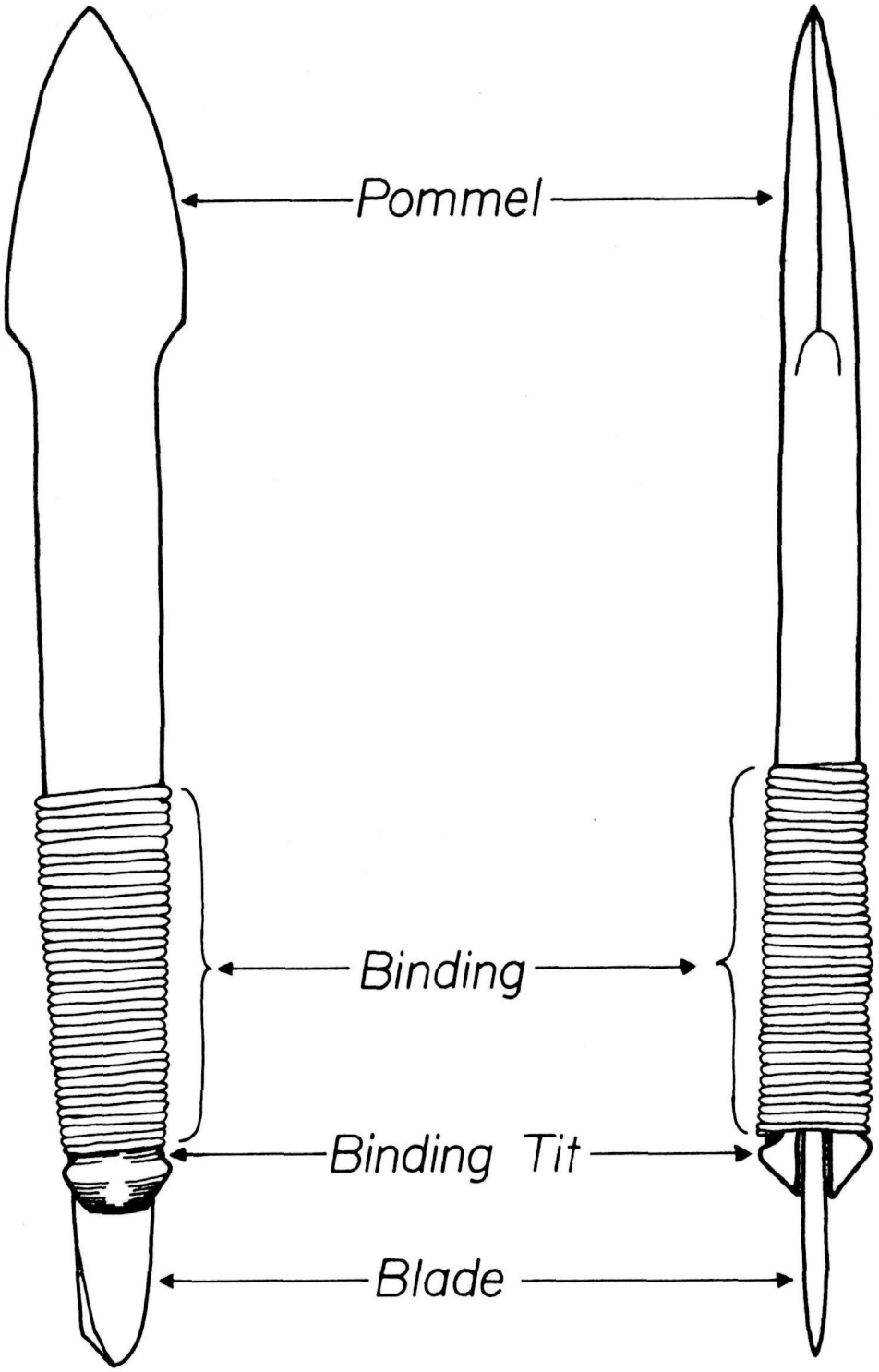


Figure 31. Metal bladed knife nomenclature.

3.3.3.1.4.1 Expanding Base Knife Handles. Six expanding based handles were recovered (Table 23, Figure 32). All have a pommel on the proximal end. In four cases, the handles have a hole drilled in the pommel. Although a cord was not was found in the hole, it is supposed that a lanyard type cord may have been attached to the pommel through the hole. Because the cord is uniformly missing, it is assumed that sinew may have been used for the cord.

Decorative effects on this type of knife are limited to one example in which a face has been incised on the pommel. In this case, the pommel hole doubles as the mouth for the face.

As noted in the introduction to this section, the base width of this type of knife is much larger than on the parallel or contracting based knife. The mean width of the base is 4.3 cm with a range of 3.0 to 6.5 cm. This is in obvious contrast to the parallel to contraction based knife handles with their mean width of 1.3 cm with a range of 0.6 to 2.6 cm. Three examples had metal blade tangs, one had rust stains, and two were indeterminate. One example (29-IV-109) was recovered with its blade present. The blade was oval shaped with a rounded sharpened tip and apparent sharpening along the lateral margins. The blade was 20.5 cm by 9.0 cm by .2 cm. The tang on this blade was triangular and extended 8.0 cms into the handle.

Two of the knives had evidence of the binding method present. One knife (71-V-5a) was bound with pitch and two-strand cedar bark cord. In this case, the pitch appears to have been spread on the handle and then the cord wrapped around the handle. Pitch does not appear to have been intentionally spread over the outer part of the binding. The second example of binding is found on the handle with the face (29-IV-109) in which straight sinew was used. The two-strand twisted sinew cord has rotted away but was cast by the decomposition of the metal. The final expanding based handle (36-IV-1) has the most complex binding. The base was covered with pitch, bound with two-strand twisted sinew, covered again with pitch, and then wrapped with cherry bark for the outer covering. Once again, the sinew is inferred from the casts of it in the pitch.

The manufacture of these knives is similar to that for the other metal bladed knives and the process is discussed in detail in the manufacturing section of the parallel and contracting based knives.

The use of the expanding based knives has no direct reference in ethnographic literature. There is one photo of a Makah butchering a whale using a two-handed knife. The larger expanding based handle knives are certainly two-handed knives. The blade shape with the sharpening of the rounded point would function quite well as a flensing knife for whale blubber. The range in size of the handles may reflect the size range of sea mammals hunted, ranging from the 120 pound female fur seal, through the various weights of seals and sea lions, up to the 60 ton right or humpback whale. Replicas have been used with excellent results on seals. The knives proved most adequate for the removal of blubber from the skin and carcass. Drucker relates that large whale

flensing was done possibly with large (12-14 inch) mussel shell blades (1951:40). It would not be inconceivable that this form developed into the metal bladed expanding based knives recovered from Ozette.

Alternative uses of this knife may include weaponry. One of these (29-IV-109) was found under the front edge of a sleeping bench. This knife would have made an extremely effective weapon in hand-to-hand combat. The length of the blade and the shortness of the tang make these knives fairly useless for woodworking. The knives may have been used for some machete like clearing of light brush and some light shaving activities. Generally, though, the length of the blade created a greater mechanical advantage than the tang would have been able to contend with for the majority of the woodworking activities.

TABLE 23

Expanding Base, Knife Handles (N=6)

Dimensions	Range	Mean	SD	Sample
Length	13.9-26.3	18.8	5.90	5
Width	2.2- 4.0	2.7	.68	6
Thickness	1.8- 2.5	2.1	.30	4
Distal Handle Width	3.0- 6.5	4.3	1.38	6
Distal Handle Thickness	1.7- 2.4	2.1	.31	4
Pommel Width	3.3- 7.1	5.3	1.80	4
Pommel Thickness	1.9- 2.4	2.2	.22	4
Blade Tang Length	4.0-10.0	7.3	3.06	3
Blade Tang Width	4.0- 6.7	5.3	1.35	3



Figure 32. Expanding base knife handles. A-D, (29-IV-109), (71-V-5), (36-IV-1), (7-V-70).

3.3.3.1.4.2 Parallel or Contracting Based Knives - Introduction. The parallel or contracting based knife handles can be broken into two major categories. The first category includes all handles in which the proximal end or pommel expands beyond the thickness of the handle, giving the handle pommel a three-dimensional appearance. In the second type, which is most numerous, the pommel cross section tends to reflect the handle cross section.

3.3.3.1.4.2.1 Three Dimensional Pommel Knives. Only three examples of this type were recovered, but their presence in the collection stood out because of the treatment of the proximal end (Table 24, Figure 33). All these handles have a three dimensionally expanded pommel area. All the other handles in the collection have a proximal end which is of the same cross sectional thickness as the grip area of the handle. Some knives have the width of the pommel expanded beyond that of the grip, but the thickness of the pommel is the same as that of the grip.

The haft areas of these knives are indistinguishable from the non-knobbed handles with parallel contracting stems. Blade portions of the knobbed handle knives were not recovered. One had rust stains in the haft area, but there was no indication of the blade material in the other two cases.

The manufacture of these knives appears to be basically similar to that for the non-knobbed knives, except that a relatively larger stock piece must be used so that the knob pommel can be created.

There is no ethnographic information on the use of this type of handle. From replication, the handle fits comfortably in the palm of the hand and works well for cutting in recessed areas.

TABLE 24

Three Dimensional Pommel, Knife Handles (N=3)

	Catalog Number		
Dimensions	111-EVC-82	125-V-44	148-V-12
Length	13.7	16.2	16.5
Width	2.1	1.7	2.0
Thickness	1.8	1.7	2.0
Distal Handle Width	1.2	1.5	1.7
Distal Handle Thickness	.9	1.0	1.2
Pommel Width	--	3.7	3.0
Pommel Thickness	--	3.9	2.7



Figure 33. Three-dimensional pommel knife handles and T-handle tool. A-B, three-dimensional pommel knife handles (148-V-12), (125-V-44); C, T-handle tool (74-V-1). Note scale change.

3.3.3.1.4.2.2 Two-Dimensional Pommel Knife Handles. The second variety of knives includes those with a pommel created by expanding the handle in one dimension or by notching the handle to remove some of the grip area (Table 25, Figure 34). The pommel on these knives probably served for a thumb rest when the knife was drawn towards the person using it. One knife had cherry bark binding and another knife had two-strand cedar bark cord for binding. There was no obvious evidence of pitch on any of these handles.

No complete metal blades were found in this group of knives. Seven metal tangs were found. Five handles had rust stains in the haft. The blades for the seven remaining handles could not be determined.

Three handles had zoomorphic pommels. Two of the examples appear to have been carved expressly as knife handles, while the third appears to be a recycled piece of another artifact. Two of the zoomorphs appear to be wolf-like animals. The third handle is not recognizable. It has large nocturnal eyes, a pointed snout or beak, and small ears on the top of the head. The representation has a bird-like appearance.

In all three cases, the head seems to serve as a thumb rest. No binding or pitch was present on any of these handles.

TABLE 25

Two Dimensional Pommel, Knife Handles (N=19)

Dimensions	Range	Mean	SD	Sample
Length	8.9-19.3	14.0	2.83	18
Width	.8- 2.5	1.7	.57	18
Thickness	.8- 2.1	1.4	.40	15
Distal Handle Width	.6- 2.6	1.4	.56	17
Distal Handle Thickness	.6- 1.8	1.1	.36	14
Pommel Width	.8- 2.8	2.0	.65	17
Pommel Thickness	.7- 2.0	1.4	.42	15
Blade Tang Length	1.9- 3.5	2.5	.56	7
Blade Tang Width	.8- 2.5	1.5	.56	7

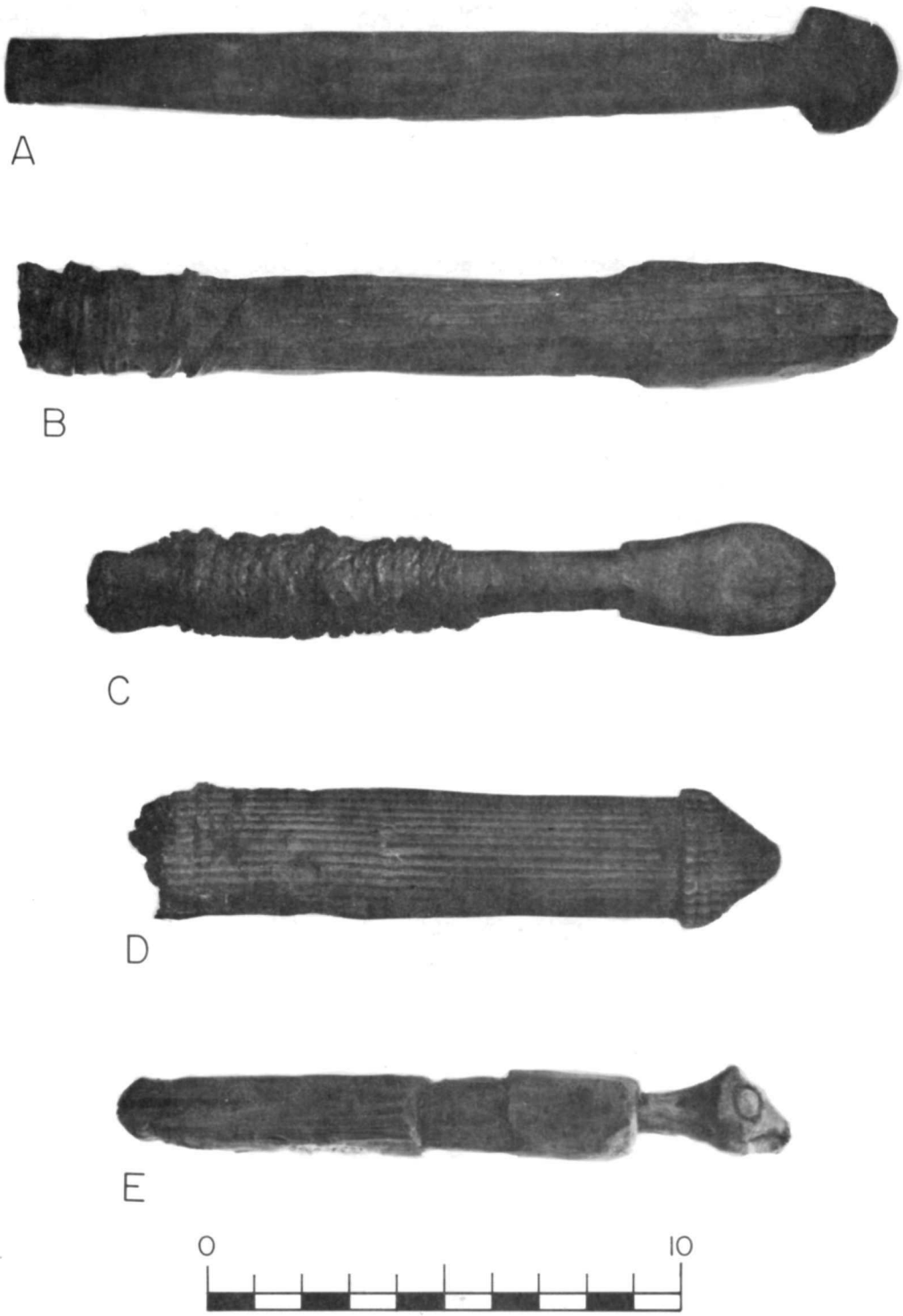


Figure 34. Two-dimensional pommel knife handles. A-E, (72-W-1), (27-W-3), (36-IV-30), (94-IV-19), (175-IV-3).

3.3.3.1.4.2.3 Plain Handled Knife. This is the most common handle in the Ozette collection, with 17 examples recovered (Table 26, Figure 35). The binding areas on these handles are all parallel to contracting side haft area type. Metal blade tangs were present in six cases, and metal stains were found in seven of the handles.

The plain handle of either branch or recycled wood is the most common variety. Little or no effort was extended in the preparation of the grip area of the handle. Only minimal work was done on the haft area. Usually, there is some constriction of the haft area to match the tang base width. Additionally, there is some attempt to provide a binding tit so that the binding will not slip. Three varieties were bound with cherry bark. Some evidence of pitch is found on many of the knives. It is assumed that a large percentage of the knives without any binding present were bound with sinew cord.

One of the plain handle knives (8-IV-27) did have a nearly complete metal blade (Figures 35, 9, 11). The blade is 2.0 cm long and 1.2 cm wide. The tang is 1.6 cm long and 1.2 cm wide. The cutting margin is convex and the back is hipped.

TABLE 26

Plain Handled Knives (N=17)

Dimensions	Range	Mean	SD	Sample
Length	8.0-18.5	12.7	2.75	15
Width	.9- 2.0	1.4	.33	16
Thickness	.8- 1.6	1.2	.30	14
Distal Handle Width	.8- 1.8	1.1	.29	13
Distal Handle Thickness	.4- 1.4	0.9	.32	9
Blade Tang Length	1.4- 4.1	2.2	.88	9
Blade Tang Width	.7- 2.0	1.1	.42	7

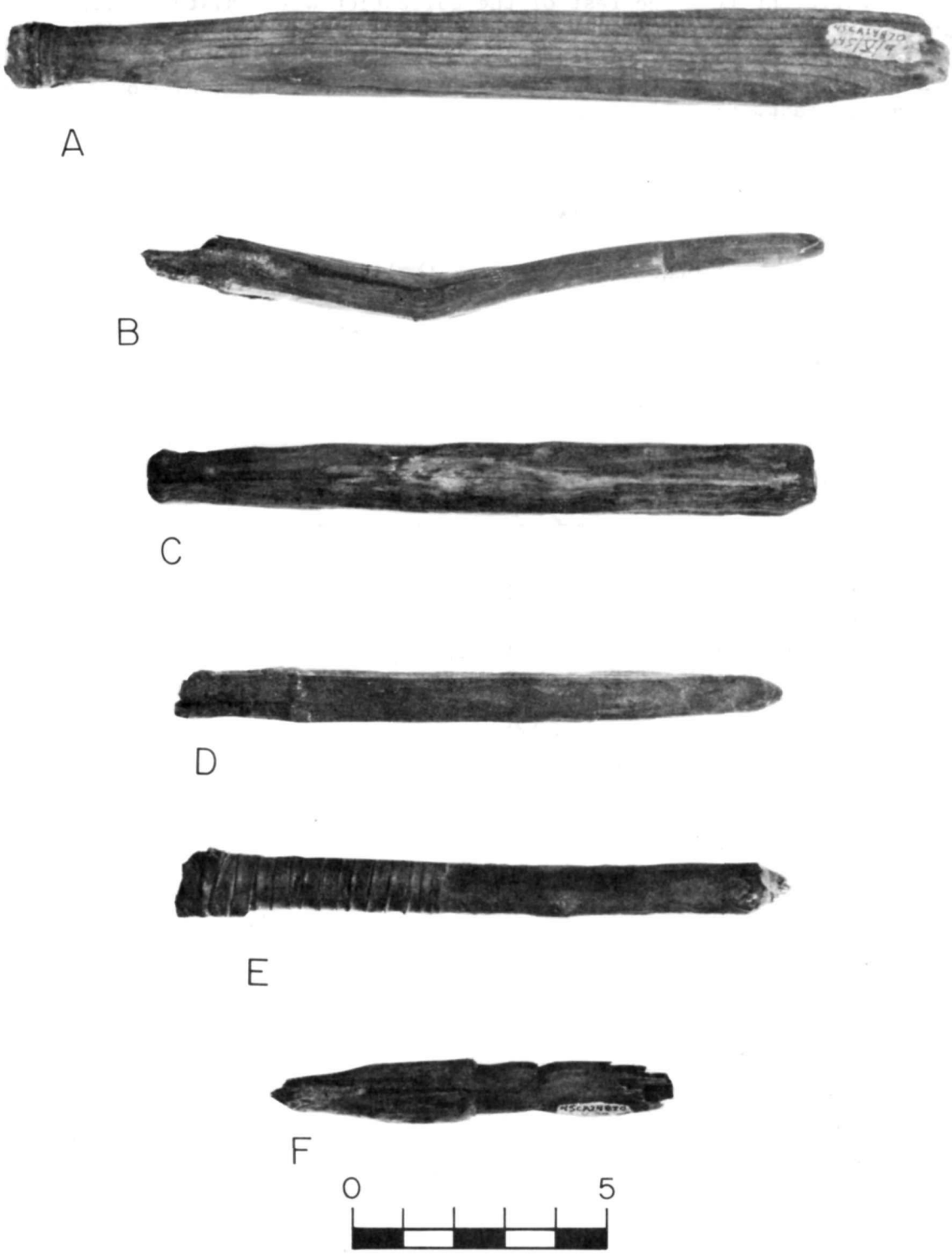


Figure 35. Plain knife handles and other knife handles. A-E, plain knife handles (40-V-60), (8-IV-27), (77-V-87), (128-V-(145-V-9); F, other knife handles (62-V-38).

3.3.3.1.4.2.4 Other Knire Handles. One knife-like fragment recovered which was different from the rest of the collection was a distal handle fragment with a metal blade (62-V-38) (Table 27). There are notched constriction and triangular weeping eye incisions in the grip area (see Figures 9, 35). This is possibly a case of recycling a broken, decorated artifact.

TABLE 27

Other Knife Handles (N=1)

	Catalog Number
Dimensions	62-V-38
Length	--
Width	1.1
Thickness	1.0
Distal Handle Width	1.1
Distal Handle Thickness	.6
Blade Tang Length	1.6
Blade Tang Width	1.1

3.3.3.2 Plane

One whale bone tool was classified as a plane (Table 28, Figure 36). It was a curved piece of whale bone with extensive ornamentation using both anthropo- and zoomorphic motifs. The handle is curved like the weighted adzes and is made from whale rib. The weight is less than that of the adzes and there is no grip area adjacent to the haft. The grip appears to be the proximal end of the handle. Given this sort of grip, it would appear that the tool was used for measured, well-controlled strokes; its classification as a plane.

There is no specific mention of a plane or plane-like tool in either the ethnographic or archaeological sources. Either of the tools mentioned would have been useful in the manufacturing stage between surface adzing and abrading.

TABLE 28

Plane (N=1)

	Catalog Number
Dimensions	92-III-1
Length	24.5
Width	5.0
Thickness	3.8
Haft Length	4.0
Haft Width	2.2



Figure 36. Plane (93-III-1).

3.3.3.3 T-Handles

Two of these handles were recovered (Table 29, Figure 33). One had the distal hafting area burnt off. The other was complete, except for the blade, plate, and binding.

This tool has a T-handle which joins a shaft whose distal end expands into a stepped hafting area. Bladed examples were not recovered. The blade was probably laid in the step and then covered with a wood plate and bound. No blades or caps were recovered with T-handle tools. The proportions of the tools are more delicate than those of the morphologically similar canoe paddle handles. It appears, then, that these T-handles are not recycled canoe handles.

There is no ethnographic or archaeological information on the use of this tool.

TABLE 29

T-Handles (N=2)

	Catalog Number	
Dimensions	74-V-1	162-V-14
Length	24.0	--
Width (Shaft)	1.8-2.6	1.6-2.8
Thickness (Shaft)	1.7-2.3	1.0-1.8
T Width	8.1	9.0
T Thickness	1.8	1.8
T Height	3.2	3.4
Haft Length	4.9	--
Haft Width	2.6	--

3.3.4 Non-Percussive, Circular Motion

These tools are used against the surface of the wood in circular motion. Drills and whetstones are used in this manner.

3.3.4.1 Drills

Four drills were recovered (Table 30, Figure 37). Three had metal bits and one had a bone bit. The bone-bitted drill is the only one with a complete bit. The metal bits have all rusted back to the haft area. The handles for the drills are cylindrical pieces of wood. The bits are hafted in a lateral inset on the drill handle. On the metal bitted drills, the inset drill shank is covered with a piece of cappping or cover wood before the binding is applied. This type of haft is similar to that used for chisels. All drills appear to have been spun by hand, because there are no wear patterns that would indicate that the drills had been used with a bow or other mechanical aid.

The Ozette drills are similar to those reported for the surrounding area. Olson describes a drill with a one-foot shaft and a bone bit (1936:79). Among the Kwakiutl, the drill had a bit which varied in width from 5 to 10 mm (Boas 1909:321-323). The tang of the bit was square, inset in a groove, covered with a cap of wood, and then bound with cedar bark. Drucker reports a similar tool for the Nootka which was sharpened on a sandstone abrader (Drucker 1951:79). Unfortunately, there is no description in either Boas or Drucker of the configuration of the drill tip itself. Drucker does note that the appearance of the bow drill in the area was well into the historic period, probably introduced by sealers returning from Alaska or Asia (1951:79).

The drill had a limited, but important, place within the woodworking tradition. The drill was used for making the holes for pegging the boxes (Drucker 1951:89), and for drilling holes along splits in a plank to sew it back together. Drilling was also used for gauging the thickness of canoe walls and for attaching the bow and stern of the canoe (Waterman 1920:12, 16).

The diameter of the drill holes has a bimodal distribution (Figure 38). The majority of the holes were drill to join bentwood box sides and bottoms. The first peak (2.5 mm) are holes drilled to sew box parts together. The second peak (5.0 mm) are holes drilled to peg box parts together.

TABLE 30

Drills (N=4)

Dimensions	Catalog Number			
	58-IV-93	71-IV-35	125-V-27	8-V-103
Length	20.7	31.0	8.9	--
Width	1.1	1.4	1.1	1.1
Thickness	1.0	1.4	1.1	1.9
Distal Haft Length	1.0	1.8	.7	1.1
Distal Haft Width	1.1	1.8	.6	1.9
Tang Length	2.2	2.8	1.5	3.8
Tang Width	.5	.7	.5	.7
Bit Length	--	--	--	3.3
Bit Diameter	--	--	--	.7



Figure 37. Drills. A-D, (71-IV-35), (58-IV-93), (125-V-27), (8-V-103)

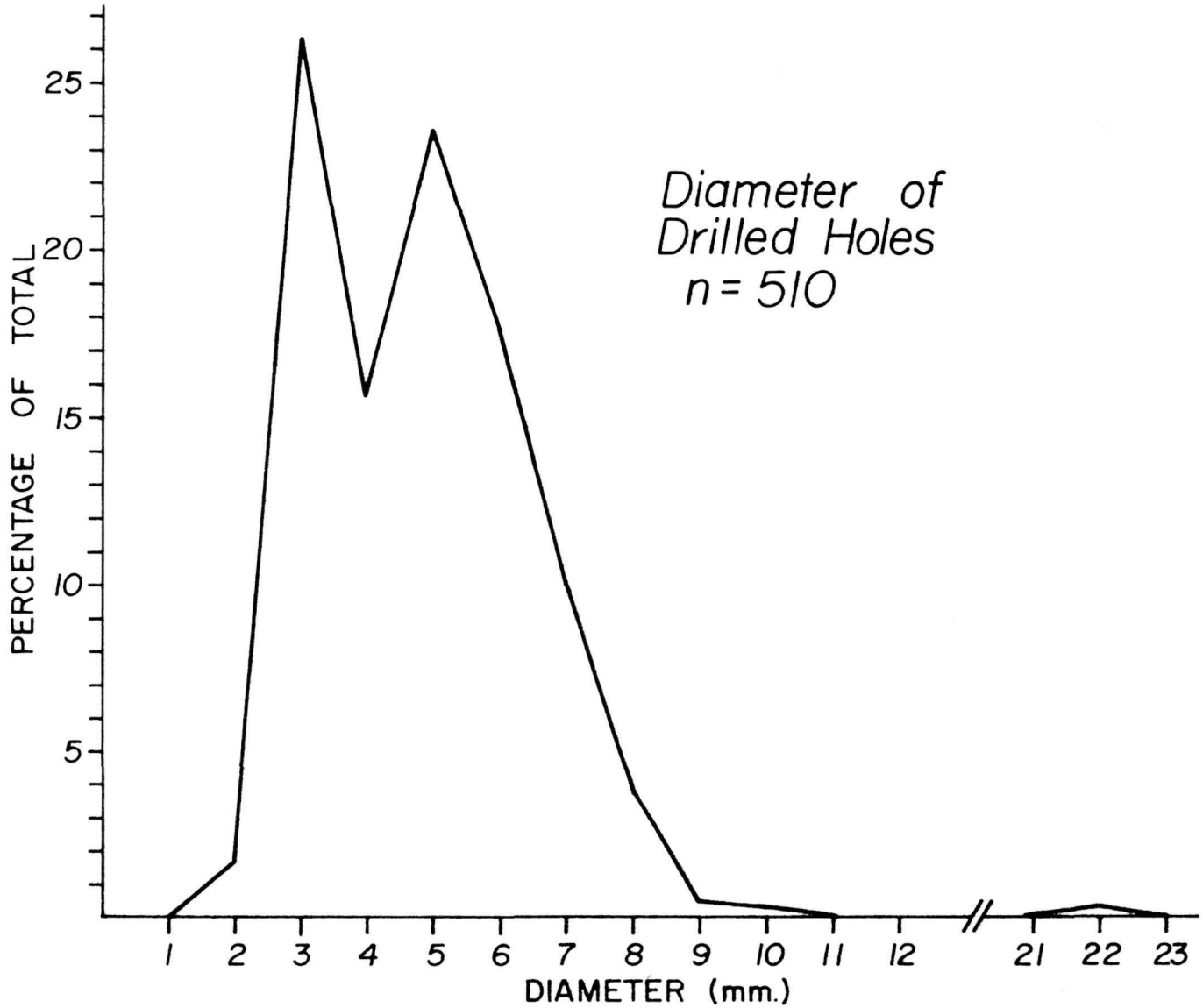


Figure 38. Histogram of drilled hole diameters.

3.3.4.2 Whetstones

Seven hundred and eighty-nine sandstone whetstones have been recovered during excavation. These are recognizable by surfaces that are differentially smoothed, dished out, or grooved. The sizes range from blocks 50 cm long to small pebbles. Grit size ranges from coarse to fine. These stones are common on all the beaches near the site.

The range of grit sizes and block sizes occurring naturally is excellent for woodworking and, in this area, may have supplanted the ethnographically reported use of sharkskin for an abrasive. Detailed examination of the range of whetstone types and applications are part of the lithic analysis of the site. Alan Stanfill will be reporting on this aspect of the woodworking material culture.

3.3.5 Summary

Descriptions, along with ethnographic and archaeological information, have been presented for 2,444 tools from the Ozette collection (Table 32, Appendix). Except for the slate knives, the expanding base knife handles, and a portion of the shell knives, all of these tools have a role in the alteration of wood as part of the woodworking technology.

The inventory reflects the ethnographic accounts. Weighted straight adzes, D-adzes, mauls, chisels, wedges, knives, drills, and whetstones are present at Ozette. The variation in knife and wedge types was not predicted by the ethnographic data. Metal as a knife blade material was not unexpected, given the ethnohistorical accounts. However, the preponderance of metal was not expected. The T-handle was a tool not predicted by either ethnographic or ethnohistoric sources.

The large number of whetstones, mussel shell blades, and antler wedges was to be expected on the basis of other archaeological excavations in the region. The number of wood wedges was surprising at first, but when one considers the abuse that they took and the ease with which they were made, the number of wedges is reasonable. The wedges are a classic example of Binford's concept of curation (1976:338-340). The wedges are present in a 150:1 ratio with the mauls, which is a tool requiring a considerable input of time and effort to produce.

Clearly defined trade items are rare among the cutting and woodworking tools. The nonlocal items, the madrone D-adze and the slate blades, were probably traded from Clallam country. Although no proof exists at this time, it would not be surprising if metal blades were being traded out of the Ozette area along with dentalia, whale bone tools, whale oil, and other outer coast resources.

The woodworking tool assemblage at Ozette is what one would expect for this part of the region. There is a greater variety within certain types of tools than was expected on the basis of ethnohistorical and ethnographic sources. The tools appear to be primarily of local manufacture. The assemblage of woodworking tools is a representative cross section of a particular Northwest Coast village's woodworking tool kit.

3.4 SPATIAL AND TEMPORAL ASSEMBLAGE VARIATION

In lieu of specific, individual tool kits, the assemblage can be divided into subsets that might reflect temporal or spatial variation. Temporal units include Unit III, Unit IV, and Unit V. Spatial sets within Unit V can be established for Houses 1 and 2 and for exterior and interior, or house floor midden. These contrast sets were tested to determine if the artifacts were randomly distributed in both sets.

The chi-square statistic was used to test for randomness, or, more specifically, to evaluate the null hypothesis that the number of samples might be drawn from the same population. Because this test requires an expected frequency of at least five within each cell and because many cells had expected frequences of less than five, it was necessary to do these tests for randomness with an attentuated set of tool types. Certain tool types such as short oval wedges, mussel shell blades, and whetstones are common to all. Types such as mauls, chisels, adzes, and knives were absent from all tests.

The test examines the randomness of the distribution of items of expedient manufacture, wood wedges and mussel shell knives, and those readily available items of broad technological application, whetstones. Temporal variation, or non-random distribution, of such tools may reflect changes in the importance of the activity with which the tool is associated (Binford 1976:349). By extension, intrasite spatial variation of such tools may well reflect either dumping areas or activity areas. Dumping areas are melanges of tools, debitage, and faunal remains found in, near or around habitation sites. Activity, i.e., production or consumption, areas consist of a less chaotic grouping of tools, debitage, and faunal remains in close association with such habitation features as hearths, pits, and houses. Variation in the deposition of such items of expedient manufacture between habitation areas and dumping areas is indicative of the degree of cleaning deemed necessary by the occupants of the site. Variation of these items from a house to house locus or among areas within a house may be indicative of the structuring of production or consumption activities.

The house floor, or interior midden, covers parts of three houses that are as large as 21 meters by 11.5 meters. The exterior midden area is much smaller, generally limited to an area less than two meters wide between the houses (Samuels 1980:8-12). The house is one of three production and processing locations mentioned in the ethnographic accounts. Production areas for woodworking were in the woods at the source of logs for canoes and large planks; on the beach in close proximity for the village; and in the house. The beach was a popular area for work during the milder, dryer periods. Manufacturing activities occurred in the house especially during the late winter when the inhabitants were preparing for spring and summer fishing and hunting.

Four contrasts, two temporal and two spatial, were examined. The temporal contrasts were Unit III (early historic period) versus Unit

V (steel using protohistoric) and Unit IV (tools in use) versus Unit V (tools lost or abandoned). Spatial contrasts were House 1 versus House 2, Unit V, (a contrast of two spatially distinct social units) and Unit V exterior midden versus all Unit V house floor middens (sheltered habitation space versus open habitation space).

Chi-square tests for randomness yielded a chi-square statistic which was significant at the .005 alpha level (Table 31). The null hypothesis that the two samples being compared were drawn from the same population of tools can be discarded.

TABLE 31

Summary of chi squares for woodworking tools

Comparison	Chi Square	Degrees of Freedom	Probability	Contingency Coefficent	Lambda Symetric
Unit III vs. Unit V	37.747	4	0.0001	0.187	0.000
Unit IV vs. Unit V	200.136	12	0.0001	0.346	0.031
House 1 vs. House 2	42.763	6	0.0001	0.302	0.051
Exterior Midden vs. Housefloor	24.263	8	0.0021	0.151	0.007

The question then becomes what factors might be contributing to the observed differences in the distribution of the artifacts. Excavation procedures should account for only a small part of the variation and primarily in the Unit III/Unit V contrast where there was a difference in the level of detail in the collection procedure. Units VI and V were excavated under the same procedures, hence it is unlikely that excavation procedures would accentuate differences between these stratigraphic levels. The factor of the slide may have some effect on the Unit VI/Unit V contrast. However, because the slide swept across the whole area excavated, it is assumed that the material would be removed randomly and as a result the slide should not affect the contrast between Unit VI and Unit V. Because there is little non-cultural effect on the distribution between contrast subsets, one must look to cultural factors for the variation in distribution.

For the temporal variation, the Unit III/Unit V contrast (Table 33, Appendix) covers the greatest period of time and spans the time from pre-Euro-American contact to post-contact. The variation indicated for this contrast may relate to either the introduction of Euro-American tools or Euro-American technological/cognitive patterns. The other temporal variation, the Unit IV/Unit V contrast (Table 34, Appendix), is a short period variation. While short, it is extremely important because it is a contrast between tools in use and tools discarded. This factor is amply demonstrated by the large number of wedge preforms and medium to long wood wedges in Unit IV (tools being produced or used) and the large number of short wedges and broken tools in Unit V (worn out tools having been discarded).

The spatial contrast of House 1/House 2 may relate to any number of production or procurement pattern differences (Table 35, Appendix). The true nature of these differences will only be known after various specific models have been tested for each unit. The exterior midden/house floor contrast (Table 36, Appendix) may relate more to dumping activity than to production, processing, or other such activities. The space between the structures is narrow. The build up within this area of exterior midden may reflect pathway maintenance done primarily through the addition of shells and other household sweepings.

The distribution of the woodworking tool assemblage indicates that there are differences among various temporal and spatial units at Ozette. These differences appear to be the result of shifts in cultural activity. The explanation of these differences lies in an understanding of more complex models than can be created exclusively with the woodworking tools.

Chapter IV

WOODWORKING TRANSFORMATIONS

4.1 INTRODUCTION

The previous chapters have outlined and organized the archaeological data on woodworking tools from the Ozette site. This chapter will pull together the various lines of data and observations into an overall system for the manufacture of wood artifacts. Toward this end, the base set of transformations of wood will be presented in a manner so that they can be distinguished and used to establish manufacturing sequences for the various artifacts recovered from Ozette.

As presented earlier, a production technology, while relating to other cultural aspects, is a system based on transformations of raw material. These transformations may be organized serially in a directed fashion to create manufacturing techniques. The range of transformations used by a group represents one level of cultural selection and, hence, identification. The organization of these transformations into specific manufacturing techniques represents an even more distinct case of cultural selection and identification. Within this study, the transformations used by the Ozettes have been isolated and are presented here. Two of the manufacturing sequences based on these transformations are presented as part of the following chapter.

The isolation of the various woodworking transformations used at Ozette is based on examination of the tools recovered and the manufacturing effects observed on preforms and finished artifacts. The tools recovered from Ozette have been discussed in an earlier chapter. Debitage and tool scars, discussed in Chapter 6, have added to the understanding of the tool kit as recovered. In addition to these data, this chapter adds data on non-subtractive transformations of the wood. These data include such aspects as additive sequences which may be characterized by various joints and bindings. These data also include transformations which are neither additive nor subtractive, but use the application of heat, weight, and moisture to alter the shape or structure of the wood. The presentation of the additive transformations and the non-additive or non-subtractive transformations is based on observation of much of the artifact collection and on selective replication experiments. The transformations used by the Ozettes, then, may be split into three major categories based on subtractive transformations, additive transformations, and non-additive and non-subtractive transformations.

Within each of the categories, the transformations are distinguished by specific attributes. The attributes vary from one category to the next because each category is dealing with specific types of alteration. The subtractive category deals with tools used to remove excess wood. The attributes used in this category reflect the amount removed, the type of cut made, and the motor pattern involved in the tool use. The additive category is broken down according to types of joints or binding used to hold one or more pieces of wood together. The non-additive and non-subtractive transformations are distinguished by attributes reflecting the external forces exerted on the wood to alter its shape.

The following sections develop the transformations of wood observed in the Ozette site. Following the description of the transformations is a short section commenting on the application of these to a general discussion of manufacturing techniques.

4.2 TRANSFORMATIONS

This section presents the various transformations of wood observed in the Ozette collection. The transformations are distinguished from one another on the basis of attributes that, in most cases, would be discernible on the piece being worked. Within the text, each level of transformation appears as a digit in the number before the title of the transformation. Any mention of woodworking tools within the text is suffixed with a number which refers to the numbering system used in the chapter on tool types. Additional references to transformations in the text are suffixed with the numbering system used in this chapter. For clarity's sake, transformation reference numbers when referred to in later sections of this text are prefixed with a "TR." The reader is forewarned that the next 18 pages are dullingly descriptive. Unless one is extremely interested in the problems of woodworking, or a close friend of the author, the reader is directed to the various figures in this section that abstract the definitions.

4.2.1 Subtractive Transformations (1)

These transformations involve the removal of wood to achieve a size or shape that approaches the desired final product (Figure 39). The first level breakdown in this category is determined by the amount of wood removed: massive, medium, minor.

4.2.1.1 Massive Subtractive Transformation (11)

This transformation results in a relatively large reduction of the piece of wood being used. The reduction is along a major cleavage plane of the wood structure is performed with a WEDGE and MAUL.

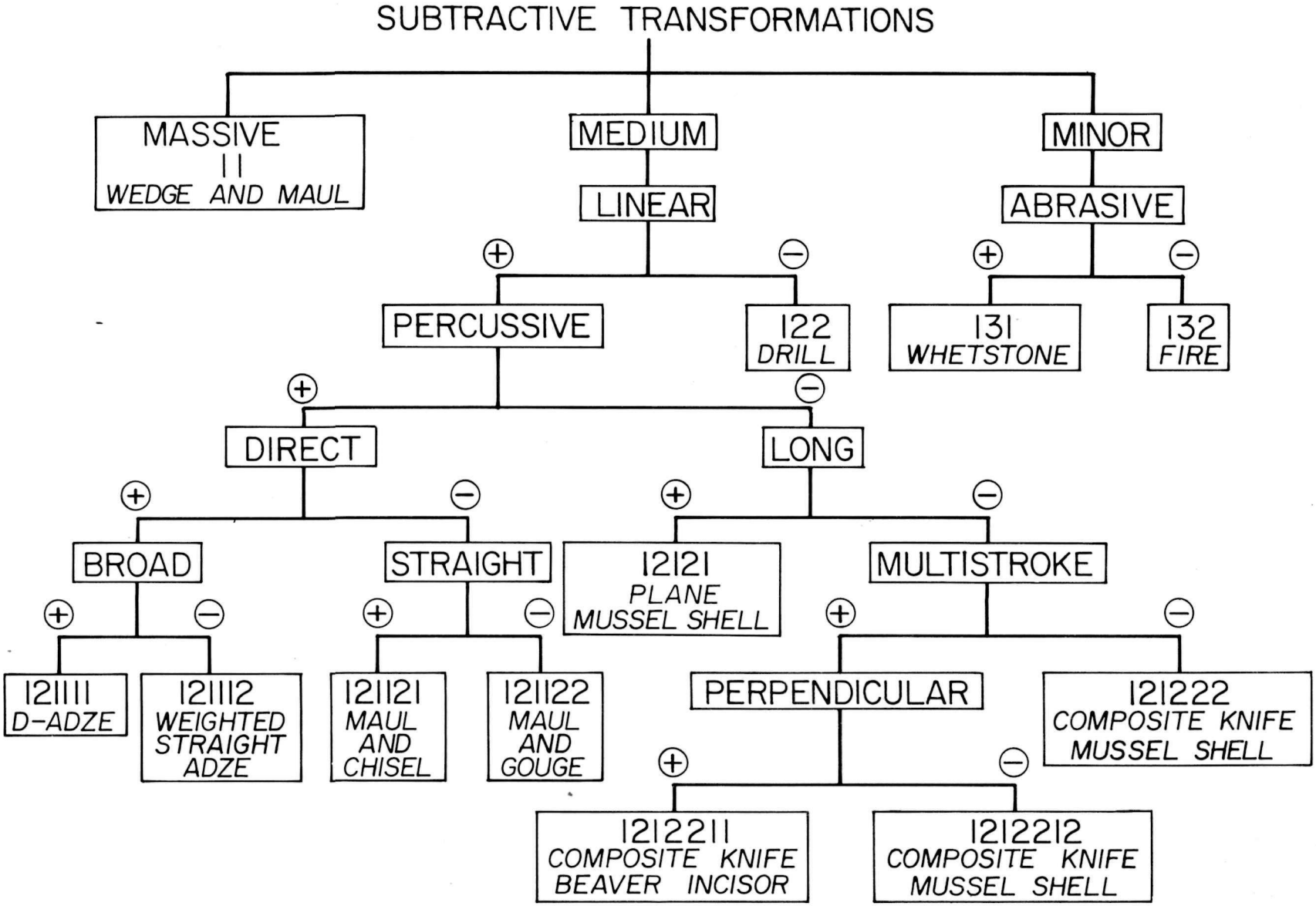


Figure 39. Subtractive transformations.

4.2.1.2 Medium Subtractive Transformation (12)

This transformation results in medium-sized pieces being removed. The removal of pieces is multidirectional in relation to the major cleavage planes of the wood. This transformation is broken down into linear versus circular tool movement.

4.2.1.2.1 Linear Medium Subtractive Transformation (121)

This transformation involves all removal of wood that is done in a relatively straight line. The transformation is broken down according to whether or not the motion used is a percussive motion. A percussive motion is one where the removal is done by striking the wood with the tool, removing the unwanted wood.

4.2.1.2.1.1 Percussive Linear Medium Subtractive Transformation (1211). This transformation involves the removal of wood with a striking motion which may be either direct or indirect.

4.2.1.2.1.1.1 Direct Percussive Linear Medium Subtractive Transformation (12111). This transformation is created by tools that are held in the hand and struck against the piece being worked. This transformation is effected by adzes. The distinction between D-adzes and weighted straight adzes at Ozette may only be related to the amount of wood removed with a single stroke. While there may be overlap in the width of the cutting blade, it would appear that the D-adze blade is generally wider than that of the weighted straight adze.

4.2.1.2.1.1.1.1 Broad Direct Percussive Linear Medium Subtractive Transformation (121111). These transformations are seen as the broad scars found on planks and other structural remains. These are also seen on the conical ends of various poles and posts. The marks are made by a broad blade adze, most likely a D-ADZE.

4.2.1.2.1.1.1.2 Narrow Direct Percussive Linear Medium Subtractive Transformation (121112). These are seen as the scars found on some planks and as part of the initial or medial stages of manufacture of various tools such as wedges and halibut hooks. The patterning of the tool scars is similar to that achieved with adzing. These marks are most likely made with a WEIGHTED STRAIGHT ADZE.

4.2.1.2.1.1.2 Indirect Percussive Linear Medium Subtractive Transformation (12112). This transformation is accomplished with a tool with a cutting edge and a weighted tool which is used to strike the tool with the cutting edge. The cutting tool is placed where the cut is to be made and then struck with the weighted tool, usually a maul, to remove the unwanted wood. The resulting cuts are either straight to slightly concave or concave to v-shaped.

4.2.1.2.1.1.2.1 Straight Indirect Percussive Linear Medium Subtractive Transformation (121121). This transformation is accomplished with a straight-edged blade with a curved margin cutting edge. The tool is held at the place where the wood is to be removed. The tool is then struck with a weighted tool and the wood is removed. This transformation involved the precise removal of unwanted wood. This transformation is used almost exclusively for removing wood across the end grain (notching trees, morticing loom uprights, and dressing the ends of planks). The cut is made generally perpendicular to the surface of the wood. This transformation is done with a MAUL and CHISEL.

4.2.1.2.1.1.2.2 Concave Indirect Percussive Linear Medium Subtractive Transformation (121122). This transformation is accomplished by a concave-convex cross-section blade with a curved margin. The blade is held at the place where the wood is to be removed. The tool is then struck with a weighted tool and the wood is removed. This tool is generally held at a 30 to 45 degree angle to the surface and is directed along the grain. The evidence for the use of this tool is the deep fluting found on a number of planks. This transformation may have also been used to remove excess wood from the interior of such artifacts as bowls. The tools used to accomplish this transformation are the MAUL and GOUGE.

4.2.1.2.1.2 Non-percussive Linear Medium Subtractive Transformation (1212). This transformation involved placing the cutting edge of the tool against the surface of the wood, catching the sharp edge of the tool in the wood, moving the tool into the wood along the surface, and removing a portion of the wood. The motion may be either towards or away from the woodworker. This transformation can be divided into those motions which are long (the full extension of the arm) or short (wrist or forearm motion).

4.2.1.2.1.2.1 Long Non-percussive Linear Medium Subtractive Transformation (12121). This transformation involves the removal of relatively thin pieces of wood over a long surface area in a single motion. This transformation usually results in the removal of a scar peak left by either adzing or knife work. The transformation involves planing-like changes. This smoothing is accomplished with either a MUSSEL SHELL KNIFE or PLANE.

4.2.1.2.1.2.2 Short Non-percussive Linear Medium Subtractive Transformation (12122). This transformation involves the removal of medium to short lengths of wood. Generally, this transformation is performed at a low angle in a single motion. However, there is a set of cuts that require two cutting motions to free the wood.

4.1.1.2.1.2.2.1 Multi-stroke Non-percussive Linear Medium Subtractive Transformation (121221). This transformation occurs when excess wood is being removed from where either two distinct surfaces intersect concavely along a line or where an incised area is being cut into a surface. With the former transformation, the cuts are both made at a low angle to the surface, while with the latter transformation, at least one of the cuts is made at an angle that approaches the perpendicular to the surface.

4.2.1.2.1.2.2.1.1 Perpendicular Multi-stroke Non-percussive Linear Medium Subtractive Transformation (1212211). This transformation occurs as an incised line or area cuts into the surface. One or more margins of the cut are approaching the perpendicular to the surface. This transformation is made by using either a BEAVER INCISOR KNIFE or a COMPOSITE SHELL or METAL BLADED KNIFE.

4.2.1.2.1.2.2.1.2 Non-perpendicular Multi-stroke Non-percussive Linear Medium Subtractive Transformation (1212212). This transformation, where two surfaces join concavidly along a line, is performed by either a MUSSEL SHELL KNIFE or a COMPOSITE KNIFE.

4.2.1.2.1.2.2.2 Single-stroke Non-percussive Linear Medium Subtractive Transformation (121222). This transformation consists of a small medium to short length removal of excess wood. The debitage removed is thin with low angles of entry and exit. The tool used for this transformation is either a MUSSEL SHELL KNIFE or a COMPOSITE KNIFE.

4.2.1.2.2 Non-linear Medium Subtractive Transformation (122)

This transformation is caused by rotating the tool on its axis instead of moving it along a line. The result is the creation of a hole with the diameter equal to the width of the distal cutting edge. The tool used for this transformation is the DRILL.

4.2.1.3 Minor Subtractive Transformation (13)

These transformations involve the removal of minute amounts of excess wood to create a smooth surface. These transformations may be subdivided according to whether the excess is removed with an abrasive or by some other means.

4.2.1.3.1 Abrasive Minor Subtractive Transformation (131)

This transformation involves the removal of minute amounts of excess wood with a tool that has an abrasive surface. This transformation is done with a WHETSTONE.

4.2.1.3.2 Non-abrasive Minor Subtractive Transformation (132)

This transformation involves the removal of minute amounts of excess wood non-abrasively. This transformation is accomplished by using fire to burn small wood fibers from the surface.

4.2.2 Additive Transformation (2)

These transformations involve the addition of one or more materials to a piece of wood (Figure 40). The first subdivision of these transformations is based on whether the addition includes a binding, such as some lashing material, or the addition is done by some other means.

4.2.2.1 Bound Additive Transformation (21)

These transformations involve the use of a material to effect the joining of two or more pieces or the holding of one piece together.

4.2.2.1.1 Single-element Additive Transformation (211)

This transformation involves the binding of a piece of wood either to prevent splitting or to repair splitting. The former is done as part of the manufacturing technique, while the latter is done only if there is a structural failure during or after the execution of the manufacturing technique.

4.2.2.1.1.1 Predetermined Single-element Additive Transformation (2111). This transformation involves the binding of a piece of wood during the manufacturing technique to prevent splitting during manufacture or use. This transformation usually occurs as withe collar binding placed around the proximal end of tools that are used in indirect percussion, e.g., wedges, chisels, and gouges.

4.2.2.1.1.2 Non-predetermined Single-element Bound Additive Transformation (2112). This transformation occurs when a manufactured wood piece has begun to split or has split completely. Holes are drilled or morticed on either side of the split. Withe is then threaded through the holes and tied off. In such a manner, splits are prevented or repaired in bench planks and canoes (Mauger 1978:99-101).

4.2.2.1.2 Multi-element Bound Additive Transformation (212)

This transformation involves the joining of two or more pieces together. These transformations can be broken into those joints which the binding

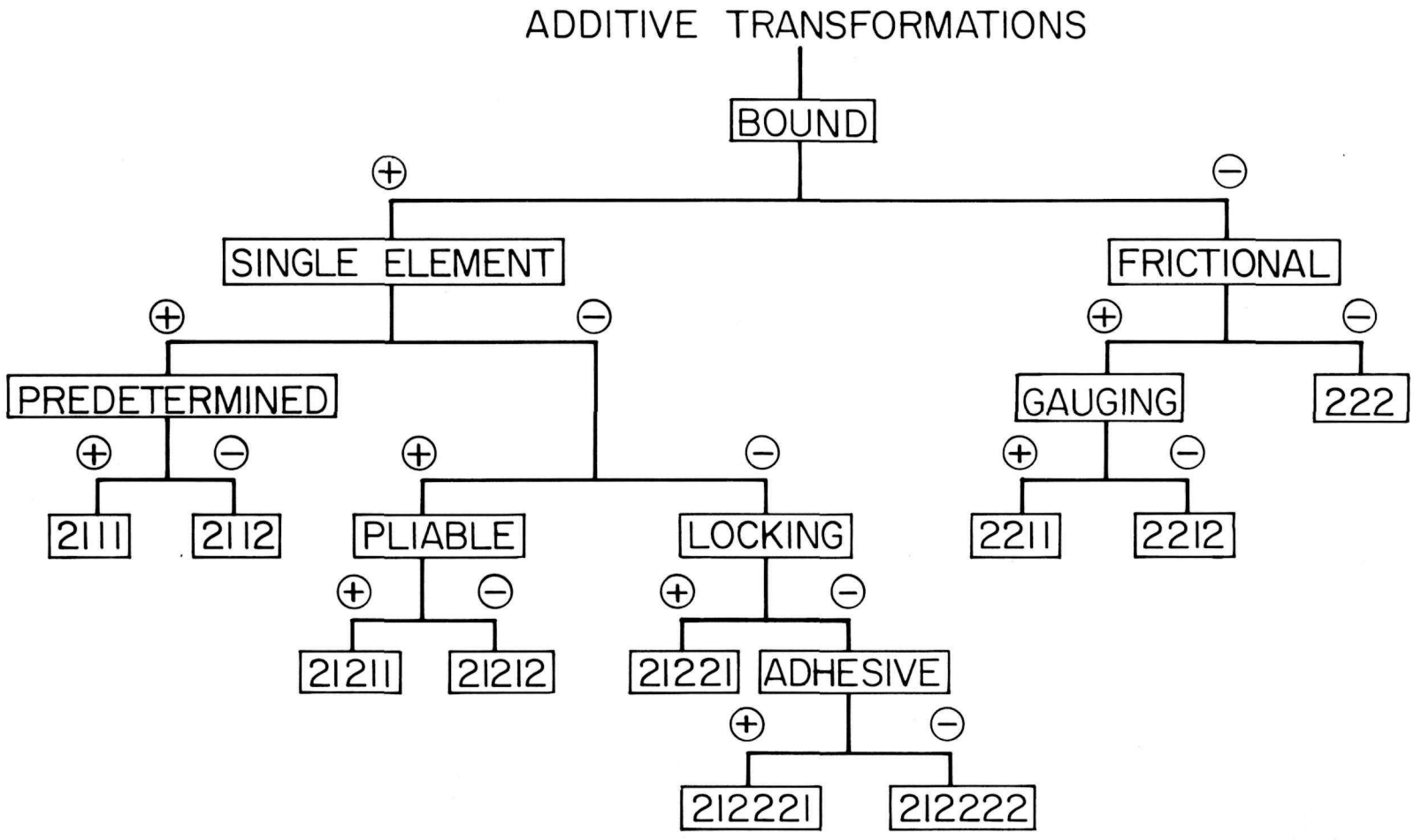


Figure 40. Additive transformations.

element runs through a hole drilled through both pieces or in which the binding element is wrapped around the pieces.

4.2.2.1.2.1 Drilled Multi-element Bound Additive Transformation (2121). This transformation involves the joining by drilling or cutting holes through the pieces to be joined and then running a binding element through the holes. The transformation can be broken into pliable and non-pliable binding elements.

4.2.2.1.2.1.1 Pliable Drilled Multi-element Bound Additive Transformation (21211). In this case. the binding element--either withe or baleen--is threaded through a set of holes and then tied off, or it is run through several sets of holes and then bound off. This transformation is usually found as part of the manufacture of canoes and, occassionally, boxes.

4.2.2.1.2.1.2 Non-pliable Drilled Multi-element Bound Additive Transformation (21212). This transformation involves the joining of a set of holes by driving a cedar peg through both holes and then cutting off the excess. This type of joint is usually found in the manufacture of boxes.

4.2.2.1.2.2 Lashed Multi-element Bound Additive Transformation (2122). In this transformation, no holes are drilled in pieces to be joined. The pieces are laid side-by-side or one is inserted in another. The two or more pieces are then lashed with some binding material. This transformation can be broken down into those joints where the two pieces mechanically lock onto one another and those joints where there is no mechanical lock.

4.2.2.1.2.2.1 Locking Lashed Multi-element Bound Additive Transformation (21221). In this transformation, the joining surfaces of two pieces are constructed so that they are locked together when force is applied in one or more directions. The two pieces are held together with a binding line, usually of cherry bark. This type of joint usually occurs as a scarf joint on whaling harpoon shafts and other shafts.

4.2.2.1.2.2.2 Non-locking Lashed Multi-element Bound Additive Transformation (21222). In this transformation, the two or more pieces are laid side-by-side and bound. This transformation may be subdivided depending upon whether or not pitch is used with the binding line.

4.2.2.1.2.2.2.1 Adhesive Non-locking Lashed Multi-element Bound Additive Transformation (212221). In this transformation, two or more pieces are laid together and lashed. Pitch is applied after, and sometimes before, the lashing is applied. This type of transformation occurs with some composite knife handles.

4.2.2.1.2.2.2.2 Non-adhesive Non-locking Lashed Multi-element Bound Additive Transformation (212222). In this transformation, two or more pieces are laid together and lashed. No pitch is used with this lashing. This transformation occurs with composite knife handles, arrows, and many other artifacts.

4.2.2.2 Non-bound Additive Transformation (22)

These transformations involve the addition of material to a piece of wood with no lashing. These transformations may be subdivided on the basis of whether the addition is maintained by friction or some other force.

4.2.2.2.1 Frictional Non-bound Additive Transformation (221)

These transformations involve the driving of the added piece into a prepared hole in the piece of wood where it is held in place by friction. These transformations may be subdivided into those where the hole goes through the finished piece or those where the hole stops short of the other surface. Because there is no adjective that adequately expresses the difference between the former and the latter, the former state will be referred to as gauging and the latter transformation will be known as non-gauging.

4.2.2.2.1.1 Gauging Frictional Non-bound Additive Transformation (2211). This transformation involves the drilling of a hole, and then a peg of a specified length is driven in the hole. When making a canoe, a series of these are placed in the sides and bottom of the canoe to gauge the thickness of that section of the side or bottom (Arima 1975:139). This transformation is, then, a measuring device.

4.2.2.2.1.2 Non-gauging Frictional Non-bound Additive Transformation (2212). This transformation involves the cutting or drilling of a hole into which is forced a tooth or operculum. This transformation results in inlaid designs.

4.2.2.2.2 Non-frictional Non-bound Additive Transformation (222)

This transformation involves the rubbing or soaking the piece with oil. The piece absorbs the oil, helping to close or fill any surface pores and to make the surface smoother. This transformation is done at times in conjunction with heating (TR-312).

4.2.3 Structural Transformations (3)

These transformations do not involve the removal of excess wood or the addition of some material (Figure 41). These transformatons involve alteration of the wood's environment such that there is a change in the structure of the wood. These transformations can be subdivided on the basis of the use of heat.

4.2.3.1 Thermal Structural Transformation (31)

These transformations involve subjecting the piece to a heat source. These transformations can be subdivided by the presence or absence of added moisture in the immediate environment.

4.2.3.1.1 Moist Thermal Structural Transformation (311)

This transformation involves placing the piece in a hot moist environment, increasing the pliability of the wood. The piece is bent to the desired shape and then let to cool and dry. The piece will then retain its new shape. This transformation is most often used in the manufacture of bent wood boxes.

4.2.3.1.2 Dry Thermal Structural Transformation (312)

The piece is placed near a heat source in an environment in which no additional moisture is added. The temperature is raised close to the burning point. The result is a smoother, harder, and more brittle surface (Panashin and deZeew 1970:202). At times, this is done in conjunction with the addition of oil to the piece (TR-222; see also TR-311).

4.2.3.2 Non-thermal Structural Transformation (32)

This transformation involves the alteration of the wood structure without the addition of thermal energy. This alteration may be subdivided into those transformations that involve static force and those that are non-static.

4.2.3.2.1 Static Non-thermal Structural Transformation (321)

This transformation may be subdivided into those where weight is applied and those in which no weight is used.

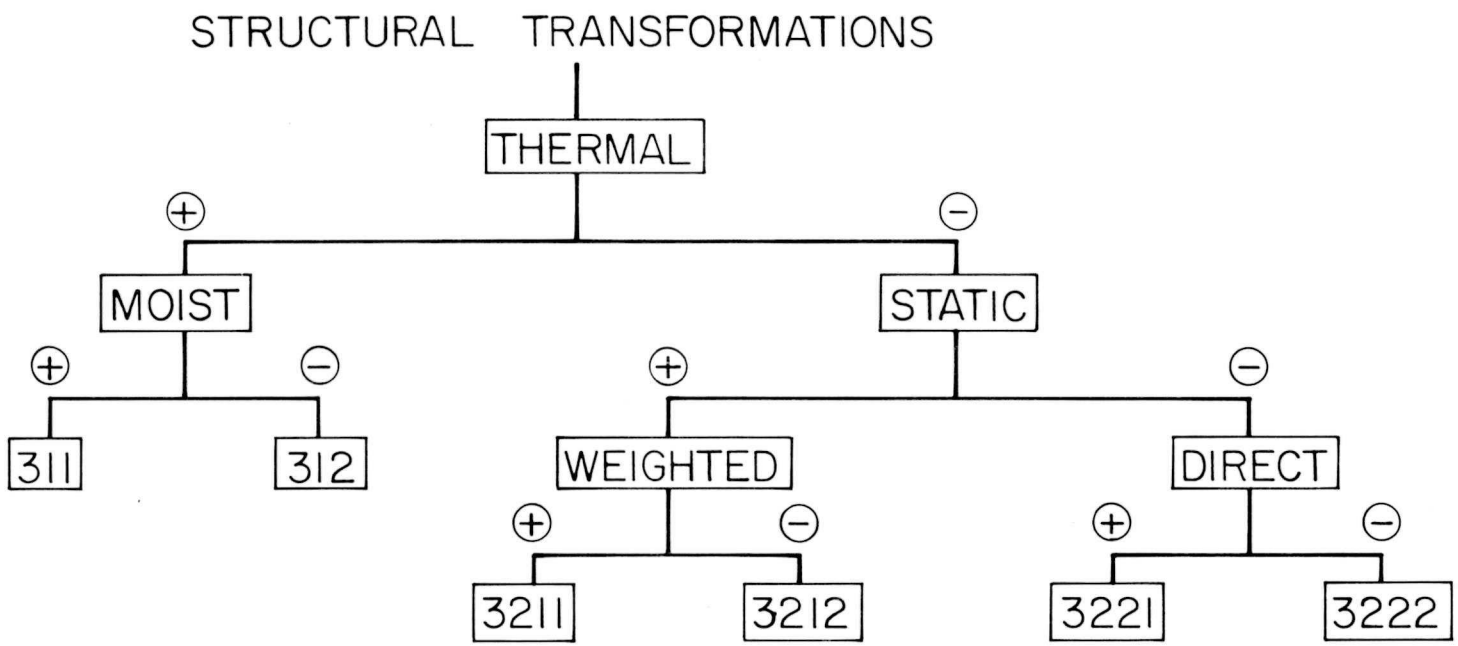


Figure 41. Structural transformations.

4.2.3.2.1.1 Weighted Static Non-thermal Structural Transformation (3211). This transformation involves storing the wood before use with a considerable amount of weight on it. This transformation will either prevent warping while drying occurs or will tend to straighten warped green lumber.

4.2.3.2.1.2 Non-weighted Static Non-thermal Structural Transformation (3212). This transformation involves the structural changes brought about by drying or seasoning in which the wood is allowed to stabilize according to the various stresses of the piece.

4.2.3.2.2 Non-static Non-thermal Structural Transformation (322)

This transformation involves the compression of certain areas of the surface. This transformation is achieved with a tool. This transformation may be subdivided according to whether the motion used is direct or indirect.

4.2.3.2.2.1 Direct Non-static Non-thermal Structural Transformation (3221). This transformation involves the dragging of a tool across the surface of the piece, resulting in the compression of the early wood bands. The transformation can be done with any pointed tool. The distinctive surface of many of the box exteriors are formed this way. The Beaver incisor knife is dragged across the surface to create a patterned effect.

4.2.3.2.2.2 Indirect Non-static Non-thermal Structural Transformation (3222). This transformation is caused by placing a small wedge against the surface and striking it lightly. This results in compression and some breakage of the wood fibers. This transformation is used for marking lines on the wood.

4.3 COMMENTS AND SUMMARY

The delineation and organization of the transformations used in woodworking as presented in the previous section includes all the ways that wood has been altered in the Ozette collection. In all but two cases, the transformations discussed are observed on one artifact or another. In two cases, oiling (TR-222) and marking (TR-3222), the transformation is inferred. The inference is based on the ethnographic accounts and on the fact that it would be consistent with our general knowledge of Northwest Coast woodworking. The use marking is easier to support because of wedges that are equivalent to marking wedges. Oiling will be somewhat harder to document. Probably, this question will not be resolved until microscopic analysis is performed on various artifacts for the presence of oil. The question, then, would be whether the oiling is intentional.

The tools discussed in Chapter 3 have been assigned to the transformation of most likely use. Several cases of multiple use have been documented. The mussel shell knife can be used for several transformations (TR-12121 and TR-121221). Other multiple uses are possible. The weighted straight adze may have been used for planing and the chisel may have been used for both adzing and planing. The assignment of tools to specific transformations is based on what would be the easiest and, hence, most economical use of a tool.

The ordering of the transformations is not done to reflect a production technique. However, the ordering of the major and minor distinctions does, in general, reflect the sequence in which the transformations might occur. A better comprehension of the preferred ordering will only be available after a number of manufacturing sequences have been isolated.

In addition to tool use, the transformations include other means that the Ozettes used to modify wood in the production of desired artifacts. In sum, these transformations represent a range of the Ozette's woodworking knowledge. As such, they also represent a cultural characterization of the Ozettes, which could be used when examining various other woodworking technologies on the Coast.

On a more immediate level, the transformations provide a means for discussing with comparable terms the manufacture of various artifacts. The manufacture of an item may be discussed as a sequence of transformations. This sequence may be seen as a production technique.

Chapter V

WOODWORKING PRODUCTION SEQUENCES

5.1 INTRODUCTION

Detailed manufacturing sequences provide means not only for perceiving basic differences within an overall technology, but also provide a possible means for isolating idiosyncratic behavior. The manufacturing sequences are obviously important for interpreting spatial or temporal changes. Using the data available from the sample, a manufacturing sequence may be established that in the most efficient and economical way, produces a final product that is consistent with the artifacts recovered.

The data that may be initially brought to bear on this problem range from situations where the manufacturing process is quite explicit to those where most of the process has to be inferred. In some instances, one may recover not only the final form of the artifact, but also numerous examples of manufacturing stages, the tools used, and the transformations that occurred at each stage. In other instances, one has only the completed tool from which to work.

In the Ozette collection there are a number of artifacts for which most of the manufacturing stages are demonstrated by preforms in the collection. Wedges, halibut hooks, and whale bone clubs are some of the items whose manufacturing steps are documented archaeologically by preforms. However, for many of the artifacts, no preforms have been recovered.

The lack of preforms is to be expected for a number of reasons. Most obvious is the likelihood that the items were not under manufacture when the house was hit. As a corollary, it is interesting to note that few of the recovered preforms were from within the house midden, indicating that preforms may have been curated or recycled to the point that they were not likely to become part of the general living detritus. This is a departure from lithic manufacture, where manufacturing problems may result in the abandonment of preforms at various stages of manufacture.

One might argue that because the deposits represent primarily a sleeping and eating area of a winter village, one would expect that manufacture of task specific items in a transhumant culture would occur at the activity sites. The great number of halibut hook preforms and wedge preforms, both artifacts from decidedly extra-household activities, would not support this view. One must assume that manufacturing evidence may reflect a broad range of tools and activities

and that the presence of preforms will reflect either intentional or unintentional abandonment.

The following sections examine the manufacture of wedges and knives. The wedges are, numerically, the largest class of woodworking artifacts. Numerous wedge preforms, representative of various stages of manufacture, have been recovered. No preforms have been recovered for the knives. The production sequence for the wedges is generated on the basis of the preforms recovered. The knife manufacturing sequence is based on achieving the final form by using only the woodworking transformations previously discussed. Detailed discussion of the woodchips and other by-products of these sequences will be part of a future presentation.

5.2 WEDGE MANUFACTURE

The manufacturing steps for long large oval wedges are probably one of the best-documented in the Ozette collection (Figures 42, 43). Preforms have been recovered which represent most of the stages of manufacture. It is possible therefore to demonstrate a manufacturing sequence with very few inferred stages. In the following discussion of the manufacture of the wedges, inferred stages are labeled as such. Fifty-four wedge preforms have been recovered from the site. They appear to be preforms for the two most common types: large oval and large rectangular. The proportion of oval preforms to rectangular is similar to that for finished oval to rectangular wedges.

1. The first step (inferred) is to cut a spruce limb from the tree and then cut it to length. This is probably accomplished with an adze (TR-12111).

2. The second step (inferred) would be to isolate the compression wood (Friedman 1975:121) (TR-11). This would be accomplished by splitting off the top of the limb through its center. The top is then discarded, burnt, or used for some unknown purpose.

3. The third step (inferred) (optional) would be to split the compression wood into several pieces (TR-11). This would be done either to reduce the compression to an appropriate cross section or to manufacture several wedges from one length of compression wood.

4. The fourth step is rough adzing to remove high spots on the preform and to begin pointing the distal tip (TR-121111).

5. The fifth step is to shape the split surfaces with heavy adzing (TR-121111).

6. The sixth step is to shape the cortex (outer bark) surface and to complete the rough shaping of the wedge (TR-121111).

7. The seventh step consists of two parts which may be done in any order. Pointing of the proximal end of the wedge is completed (TR-12111). The surface of the whole wedge is smoothed with fine adzing or planing with either a mussel shell blade or planing tool (TR-12121). The surface texture is now covered with small shallow chip scars.

8. The eighth step is the final finishing of the surface by abrading with a sandstone abrader. As part of the step, the final shape is given to the distal tip (TR-131).

9. The ninth step is the attachment of the collar (Croes 1980), which is slipped over the conical proximal end (TR-2111). The collar is made with a small enough diameter so that it will only go about two-thirds of the way down the proximal end. When the woodworker begins pounding on the wedge, it will seat the collar firmly in place at the bottom of the cone.

The preceding nine steps are all that are needed to manufacture a wedge. Archaeological evidence for ethnographic accounts of heating (TR-312) and oil soaking (TR-222) of wedge tips was not demonstrated. Because this step would leave no noticable signs, it is not possible to comment with any certainty on the presence or absence of this step. It should be noted that there has been little problem with the conservation of the wedge with conventional carbowaxing. In many cases where the artifact has been heavily oil soaked (e.g. bowls, canoe paddle handles), the oil has created a stabilization problem. With the absence of this stabilization problem for the wedges, it may be assumed that the use of oil was minimal or absent.

While not developed as part of this study, it is important to consider the implications of the optional order of the substeps of Step 7 in the manufacturing sequence. The sample taken as a whole provides no insight as to why this option exists when all other steps lack any indication of transformation ordering options. A single case such as this does not provide a sufficient base upon which to build an argument, but the occurrence of such variation if it could be seen in a number of manufacturing sequences would be worth examining for spatial and other considerations. Such variation may reflect individual, family, or rank distinctions. This is a subtle type of variation which in many cases can only be discerned through a thorough understanding of the raw materials, the tools, the transformations, and the manufacturing sequence.

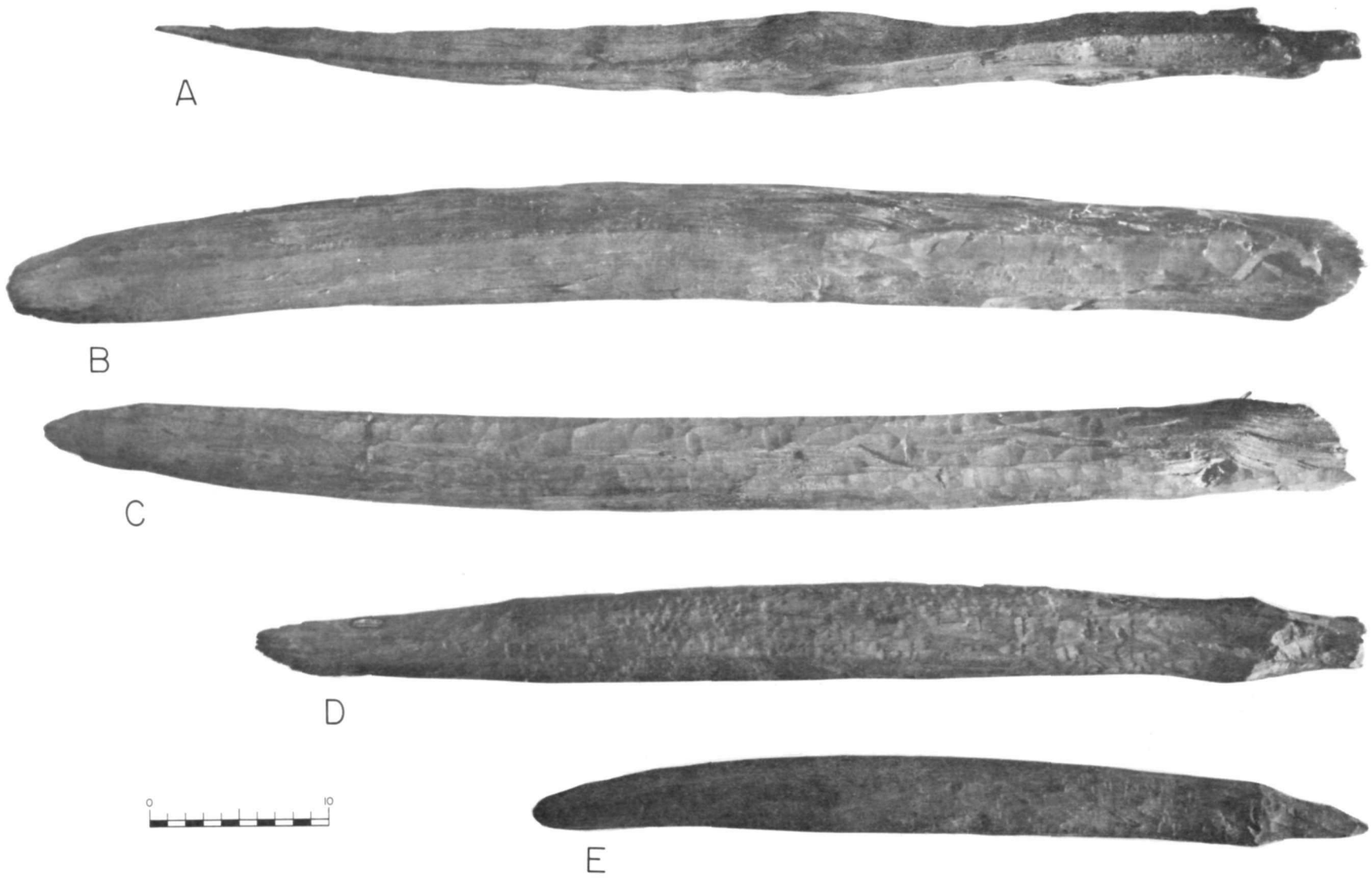


Figure 42. Wedge manufacture and use, part 1. A, Step 3 (27-IV-37); B, Step 4 (042-IV-16); C, Step 5 (145-IV-11); D, Step 6 (58-IV-30); E, Step 7a (5-V-1).

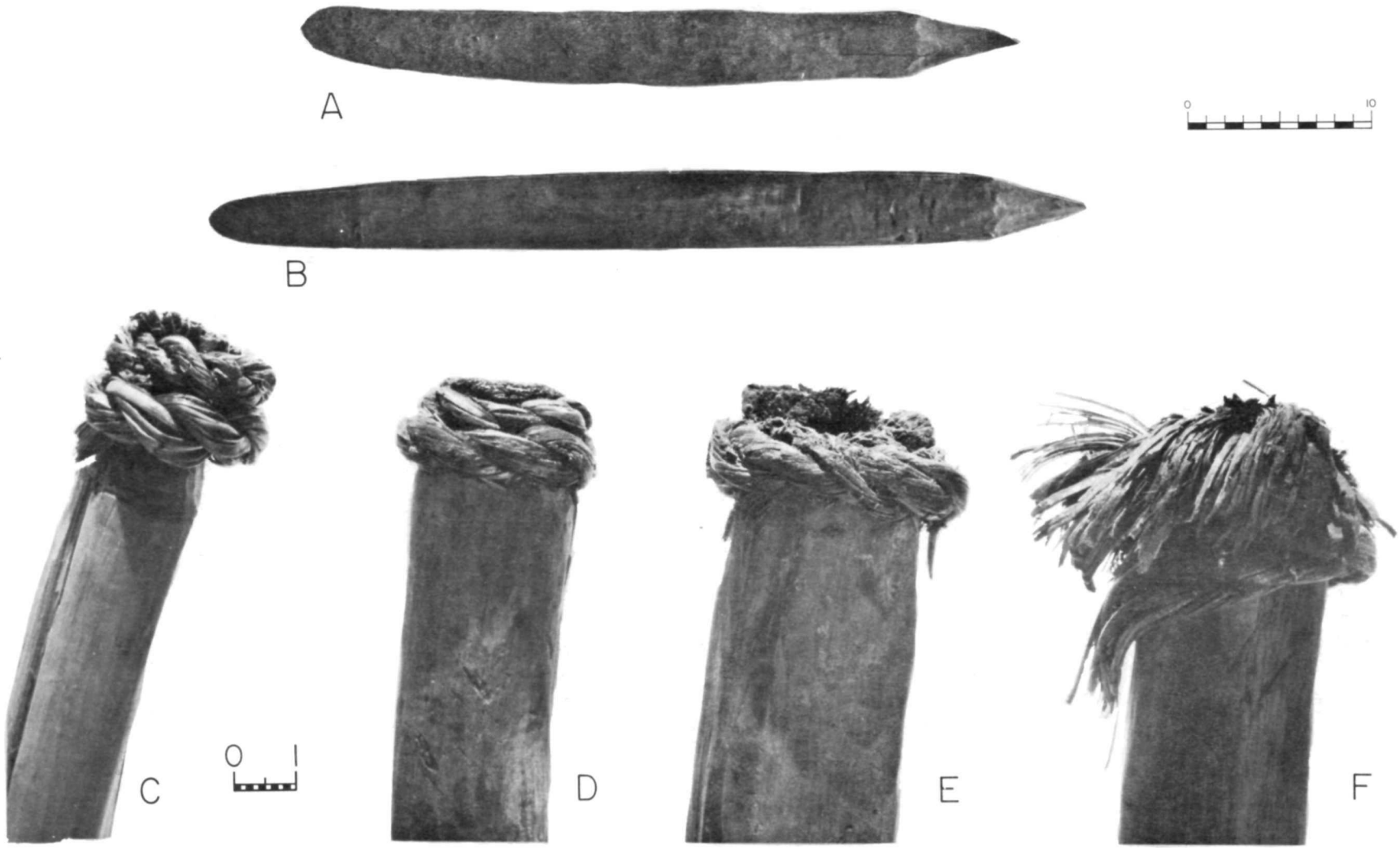


Figure 43. Wedge manufacture and use, part 2. A, Step 7b (042-IV-3); B, Step 8 (144-IV-33); C, newly seated collar (78-IV-5); D, well seated collar (173-V-28); E, worn collar (43-V-73); F, broken, ineffective collar (149-VTVI-49).

5.3 KNIFE MANUFACTURE

The manufacture of the metal bladed knives would appear to follow a set pattern (Figure 44). The manufacturing sequence is derived from the finished products and from replication of these handles. The sequence is inferred because no unfinished knives were found in the collection.

1. Select the desired type of wood to be used. There seems to be a preference for yew, which is a fine-grained, easy to split wood. Cedar and branch segments are also used, but is probably not preferred.

2. Cut the wood to the desired length of the handle, plus about four to six inches (adze (TR-12111) or chisel and maul (TR-121121)).

3. Split the wood to approximate width and thickness (maul and chisel or maul and wedge (TR-11)).

4. Leaving the excess on distal end of handle, carve grip to approximate shape (knife (TR-121221 and TR-1212221)).

5. Carve pommel, if desired (knife (TR-121221 and TR1212221)).

6. Reduce haft width to width of metal blade to be inserted (knife (TR-121221)).

7. Reduce thickness of hafting area thickness to leave binding tit (knife (TR-121221)).

8. Place temporary binding half way up grip area (TR-2111).

9. Split handle on width axis from distal end (knife or maul and chisel or wedge (TR-11)).

10. Spread split and insert prepared metal blade.

11. Begin binding at grip beyond end of blade tang. Bind handle until tang end of blade is encountered. Squeeze excess wood on distal end together, tightly clamping the tang. Continue binding and tie off when binding tit is reached (TR-21222).

12. Cut off excess wood on distal end (knife (TR-121221)).

13. Finish handle (knife (TR-121221) and abrasives (TR-13)).

This manufacturing sequence is based on the tools available from the collection and the transformations catalogued to date. Several knives were replicated before the requisite transformations were isolated. The knives in the collection do not show the variation that would indicate a different set of transformations. The ordering of certain parts of the sequence can be changed and still similar results will be obtained. Because no knife preforms have been recovered, it is not possible to assess the validity of this specific order. It will be possible to test for the transformations. Knives recovered as excavations continue can be examined and replicated to determine if the same set of transformations can be used. Such an approach may not describe variation within a single component, but may be quite useful in comparing broader temporal or regional variation.

5.4 SUMMARY

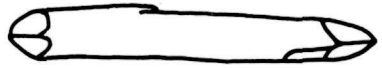
The production techniques form the third part of this studies approach to the understanding of woodworking technology. In this section, the sequence of transformations has been described for wedges and inferred for composite metal bladed knives. While the degree of certainty for each model is different, both models present explicitly the pattern for the production of acceptable replicas.

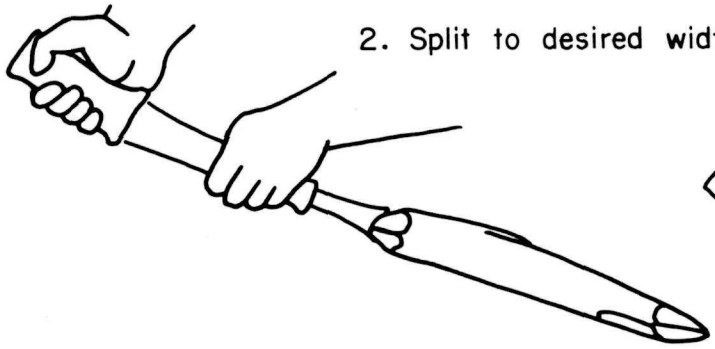
With an explicit pattern, it is possible to relate the composite knives to rocktongs, salmon stakes, and fish hooks, all of which use similar production techniques, and to fish knives, harpoon heads, and lance heads, which have similar cutting functions. Understanding the nature and extent of this or other production techniques allows an explicit means for looking at variation in cultural processes.

The production techniques, when applied to differing classes or artifacts, provide a means for distinguishing between manufacturing effects and use effects. This is particularly helpful in looking at those cases in which the tools put to a similar use have differing morphology and/or manufacture. Similarly, because general manufacturing practices may be used for a number of different classes, the production techniques approach helps to demonstrate the breadth and, hence, the strength of certain patterns within a culture.

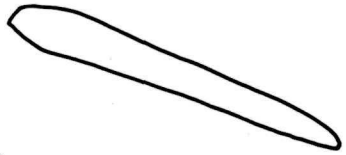
On a more specific level, the production techniques allow for the characterization of general patterns of manufacture within a component. It may even be possible to begin isolating idiosyncractic behavior. Certainly, it will be possible to distinguish not only repair patterns, but also recycling patterns. These and similar types of information that can be gained from use of the production techniques will allow for a more explicit data base from which more sophisticated understanding of the use of various areas within a component can be derived.

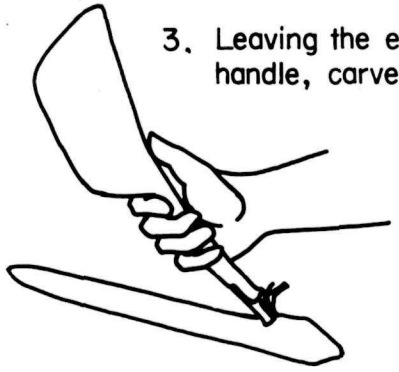
1. Select desired type of wood. Cut wood to desired length plus four to six inches.



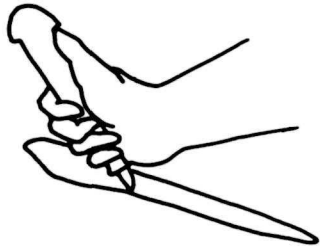


2. Split to desired width and thickness.

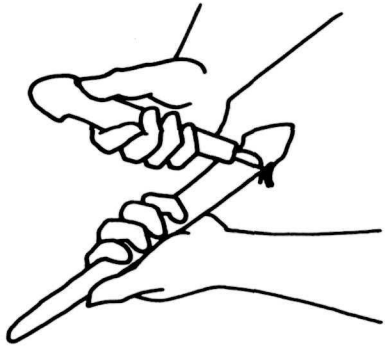




3. Leaving the excess on the distal end of handle, carve grip to approximate shape.



4. Carve pommel if to be present.



5. Reduce thickness of hafting area to leave binding tit.

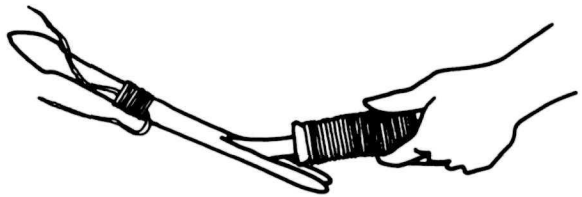




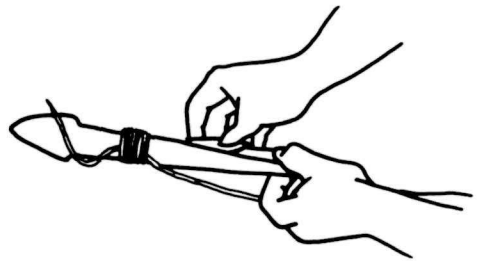
6. Reduce haft width to width of metal blade to be inserted.



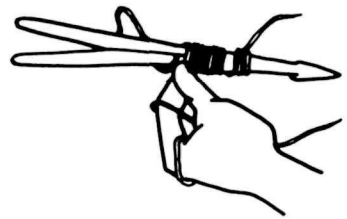
7. Place temporary binding halfway up grip area. Split handle on width axis from distal end.



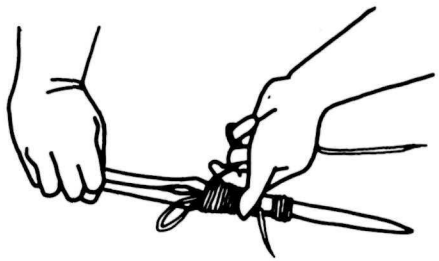
8. Spread split and insert prepared metal blade.



9. Begin binding at grip beyond end of blade tang. Bind handle until blade tang is reached.



10. Squeeze excess wood on distal end together, tightly clamping the tang. Continue binding and tie off when binding tit is reached.

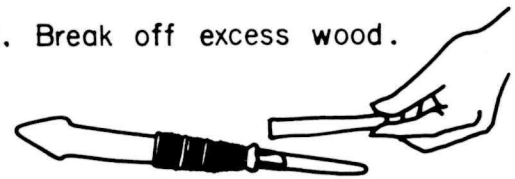




11. Notch below binding tit.



12. Break off excess wood.



13. Finished knife

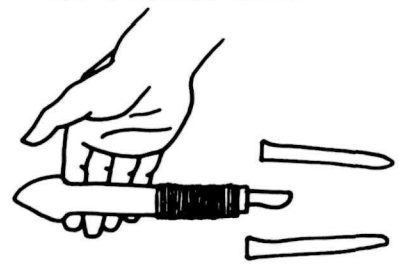


Figure 44. Knife manufacture.

Chapter VI

WOODCHIPS AND WOODSCARS

6.1 INTRODUCTION

This chapter is concerned with the delineation of the debitage and manufacturing marks, and their use for defining and answering certain questions concerning the woodworking process and its structure within House 1 at Ozette and within the broader context of Nootkan socio-economic patterns.

The delineation of woodworking debitage and manufacturing scars is a new area of inquiry for the Northwest Coast culture area, and, to a certain degree, for archaeology in general. A considerable amount of detailed discussion is devoted to the attributes used for this particular study. Because this is a new area of study, initially, a broad spectrum of attributes was considered as possibly being indicative of certain procedures or best suited to delimit certain effects. As this study reached its conclusion, it became apparent that some attributes were not too useful, and that other uncollected attributes might have been more helpful, but that a number of the collected attributes did, in fact, bear on a number of the author's analytic concerns.

The artifact assemblage and the site itself were partitioned and sampled to arrive at data sets that would have integrity and yet be of manageable size. Data were collected from the artifacts themselves on manufacturing processes and, especially, woodscars. The site was broken into culturally bounded areas; houses and, specifically, the floor of one of these houses was extensively sampled for debitage, or more precisely, woodchips. Various statistical routines were used to manipulate the data collected from both the chips and scars. Scar data were compared with chip data to determine the range of activity represented by the sample from the floor deposit. Variability within the woodchips sample itself was studied for the relationship of general chip classes to various types of tool use.

6.2 DEBITAGE

6.2.1 Sample Selection

The woodchips from the site were sampled in the following manner. Twenty-four house floor squares that were excavated within a twelve-month period were screened (Figure 45). The screening was done through

a quarter-inch mesh which had been determined to be a minimum size to recover all the material except for seeds and sand and/or a small fraction of the midden matrix. Fire-cracked rock was removed from these samples and discarded in the field. The samples were then returned to Washington State University, where they were dried and then floated to remove the wood material from each sample. Bone, stone, and shell material was removed from the lag deposit and then the remainder of the sample was discarded.

The wood sample was measured in terms of volume and weight. For further sampling, one half of a cubic foot of material was selected. The sample was then gone through to pick out all the woodchips present.

A woodchip was defined as any piece of wood that had been obviously cut from a piece of wood as distinguished from any that may have been split or broken off. Generally, woodchips can be distinguished in that there is a definite difference between the point where the blade entered the wood and where the blade exited removing the chip. The point of entry on the detritus is usually marked with a splitting, fraying effect that is referred to here as feathering (Figure 46). When cutting through the wood, a blade--whether it be stone or metal or shell--first cuts through the wood, then stresses the wood, such that it cleaves or splits along the nearest plane of weakness. The alternate cutting and splitting as the chip is removed makes it a fairly easy chore to identify most woodchips. The only point where there is some uncertainty in identifying chips is where they are being shaved off a piece by a fine edge in the final finishing processes. These pieces tend to be oval in shape, thin in cross section, and unfaceted on the upper surface. In part, they were identified subjectively by the investigator, but were based on his familiarity with the effect of planing or shaving wood with an acutely edged blade.

The sample of woodchips from each square was laid out on a numbered grid, and fifty chips were selected on the basis of a random number table. In an abbreviated form, fifty additional chips were selected by random rows. The first sample from the square formed the basic sample that was quantified. The second sample was used as back-up. When a sample-one chip was too decayed to measure features such as entrance and exit angle of the cutting, it was replaced with a chip from the back-up sample. With 24 squares included in the study, it was expected that there would be a sample of 1200 chips with which to work. The final result was that the sample, after it was selected for measurable, i.e., non-decayed, chips numbered 1150.

The square in the sample represents a fair cross section of known areas of utilization of the house floor. The central area, the hearth areas, the bench area, and the storage areas are all represented, and in apparent proportion to their actual extent in the house floor area.

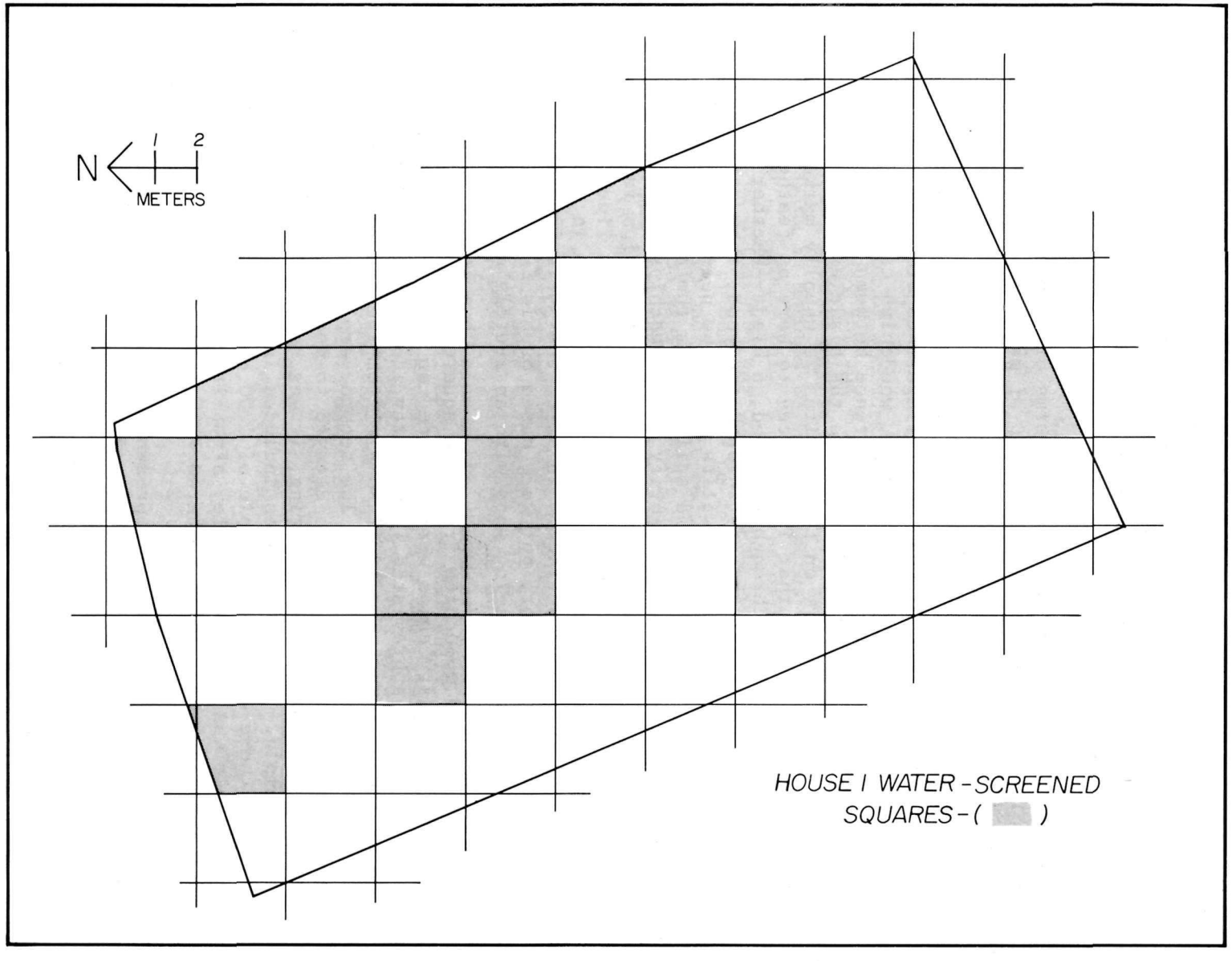


Figure 45. Water-screened House 1 floor midden squares.

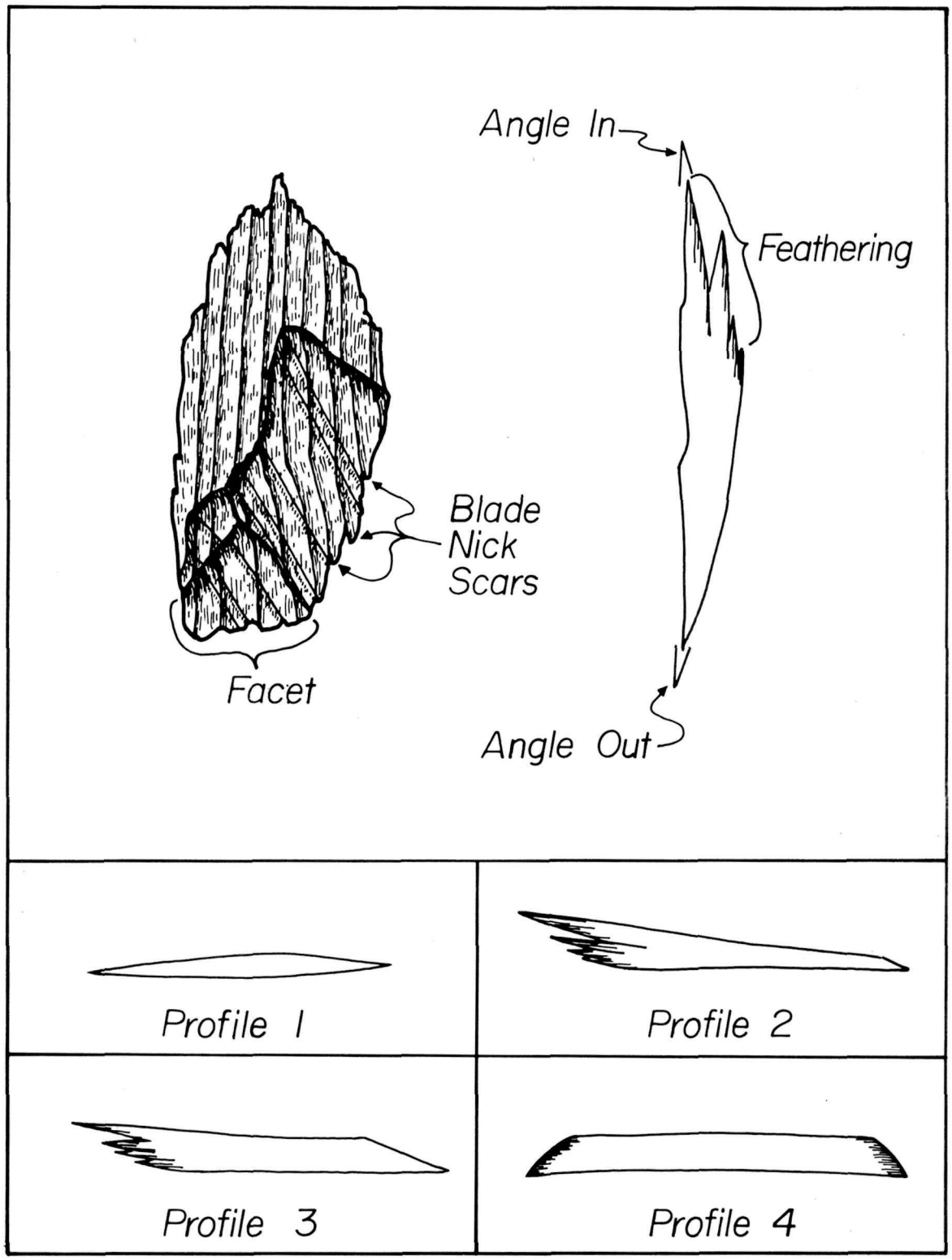


Figure 46. Woodchip nomenclature.

The square sampled represents 45 percent of the house floor area of House 1. The chip count for the sampled area is about 16,000 chips, which would give a possible total for the house of over 35,000 chips. Additionally, it is assumed that, because the chips have a large surface area in relationship to volume, they are quite susceptible to decay processes. This, coupled with the fact that the partially decayed chips were selected out of the sampling process, leads to the assumption that the chip sample and its distribution reflect activities at an unspecified length of time in the latter part of the occupation of this structure.

6.2.2 Attributes

Various data were recorded for each chip. At the outset of the study, it was felt that given the different types of tools having differing cutting edges and using differing motor patterns, there should be discernible morphological differences in the debitage population. Both metric and descriptive attributes were collected. Metric attributes were length, width, thickness, weight, cutting blade entrance angle, and cutting blade exit angle. From this data area, volume and density was computed. Descriptive attributes included fragmentation, profile, faceting, tangential-radial orientation, feathering, blade knicks, charring knots, and cortex. It was felt that the profile attribute and the entrance and exit angle would be the best delimiters of chip types because these were most closely related to the manner of chip removal. The descriptive attributes will be discussed first because they were used to orient the chips for the collection of the metric data.

Feathering is the splitting of the woodchip by the cutting edge of the blade. Chip removal is effected by the blade first cutting into, or seating itself, in the wood, and subsequently splitting the downstroke wood along planes of weakness. In many cases the wood debitage removal was more a matter of splitting or wedging off the excess than it was a matter of cutting off the debitage. The feathering effect is present on practically all the chip profiles. The one exception is Profile 1. Because these chips are extremely thin and are removed with the cutting edge at a highly acute angle, the resulting chip has a tendency to curl off instead of splitting off. It is with this planing type of cut that one is not as likely to see the feathering.

Fragmentation was described for the length, width, and thickness dimensions. The presence or absence of entrance and exit cuts served to determine the fragmentation of the length axis. Width fragmentation appeared as split lateral margins, usually along either the tangential or radial plane. Fragmentation of the thickness was difficult to determine, because the rough splitting along the planes of weakness could be induced as a function of debitage removal. In many cases, the ventral surface of a freshly removed chip will have a split texture. Additionally, it is not uncommon for chips removed with a high entrance angle to fracture on removal or for them to leave a split surface on the

core. Because fragmentation along the thickness dimension can be induced by several factors which are difficult to distinguish, it was decided for the purposes of this study not to take into account thickness fragmentation.

Profile of the length axis was described on geometric terms (Figure 46). Profile 1 was flat or low ellipse. This type is seen as resulting from a shaving or planing activity. Profile 2 was triangular. This type was seen as resulting from heavy shaving or light adzing. Profile 3 was a parallelogram. This type was seen as resulting from high angle adzing, stake pointing, or chisel reduction. Type 4 was trapezoidal. This type is seen as the result of notching with an adze or, more likely, a chisel. Type 5 was used for irregular cross section and type 6 was used for indeterminate cross sections. It was assumed that the profiles represented a functional, as well as morphological, reality.

Faceting is a count of the number of separate cutting strokes present on the dorsal surface of the chip.

Tangential-radial orientation refers to whether the chip tends to the tangential or radial plane of the piece from which it was removed. Tangential debitage would result from removal of debitage from limb or trunk without any preparatory work. Radial debitage would generally indicate the piece had been split preparatory to the production of the debitage.

Blade nicks are the ridges that are produced on flake scars by nicks in the edge of a cutting blade. These are informative because they do indicate the direction that the cutting tool travels across the piece. Because the nick patterns are as distinctive as fingerprints, they can be used to distinguish the use of the same tool in several places. This attribute has not been fully developed for this study. However, the presence of these ridges was recorded for future study.

Charring was noted when encountered. Because it is felt that a portion of the debitage was used as kindling, it was hoped that it would be possible to document this use. Knots were noted because on a number of the planks it was obvious that special techniques were used to cut and treat the area of large knots. No special treatment was noted for the smaller knots. The presence of cortex on the chip was also noted. This, as would have been expected, was rare.

The metric attributes, as noted, included length, width, thickness, weight, entrance angle, and exit angle. The entrance angle (ANGIN) was taken on the feathered end of the chip. The exit angle (ANGOUT) was to the opposite margin of the chip. These angles were measured with a gauge having 2.5 degree increments.

The length was measured in millimeters from the entrance angle margin to the exit angle margin. The width was measured in millimeters perpendicular to the length axis.

Thickness was measured in tenths of millimeters. Weight was measured in hundreths of grams.

The data from the chips were collected and coded for computer storage and manipulation. General summaries of these data are given in Table 36, Appendix. The raw data can be obtained from the author.

6.2.3 Chip Types

The debitage was separated into six groups on the basis of the profile of the length axis. The first four of these groups are assumed to be related to either tool use or to topography of the piece of wood being reduced. From non-rigorous replication of woodwork tool use, it is probable that the profiles result from a combination of both tool use and topography. It was felt that, if these types did reflect such differences, one might expect a differential distribution of the types of chips and that these types could be distinguished metrically.

A discriminant analysis (Figure 55, Appendix) was performed on Profiles 1 to 4 woodchips to determine which of the metrics was contributing the most to the distinctions among the four types. It was expected that the angles of entry and exit would be the most important because the profile characteristics are essentially geometric shapes. Angle of entry (ANGIN) was the most important accounting for 95 percent of the variance in the sample. The reclassification percentage was calulated using the discriminant functions derived by the procedure; angle in, angle out, and thickness; made the most important contribution to the first (and overwhelmingly most important) contributor to this function. The reclassification percentage is the percentage of chips which were correctly assigned to their original group on the basis of their scores on the linear discriminating functions. For this sample, the reclassification percentage was 74 percent.

The angle that the tool edge enters the piece (angle in). does significantly determine chip profile. Because the angle of entry reflects how the tool is applied to the work, then the profile classification may indicate various motor patterns or tool use.

6.2.4 Cultural Implications of the Woodchips

The profiles, then, can be distinguished on factors that may be related to manufacturing tool and topography. The detritus may be used to a certain degree in the discussion of woodworking activity and its patterning within the social and economic activities. Caution, however, is advised because there are still undetermined aspects of the woodworking technology or other factors within the deposition pattern that may be affecting the sample recovered in the excavations.

There are few pieces of debitage that exceed 5 cm in either length or width. There is no direct evidence for heavy woodworking within the house. It should be noted though that the 35,000 wood chips in the house floor could be produced by the manufacture of only several dozen wedges. Given the generally clean nature of the house floor, the distribution of debitage lengths and width most likely reflects the gauge of the broom, branches, or whatever was used to sweep the debris from the work areas. Probably, most of the collected debitage was consigned to the fire, either as starter or to just get it out of the way. While some of the densest accumulations of detritus are around the hearth area, a heavy concentration of wood debris was noted during the excavation of the doorway. Unfortunately, the doorway was not part of the area that was water-screened for debitage. Whereas there is some assurance that part of the debitage was burnt, it would also appear that some of the debitage was swept out of the structure. The debitage sample studied, then, would be comprised primarily of small debitage that was not removed during housecleaning or debitage that was deposited in the house in areas that were not kept as clean as the central floor area. The result, obviously, is that the sample, while containing distinguishable types of chips, is biased. The question then becomes to what degree the sample is biased and how one might test for the bias. These questions can be approached by first looking at the data from the woodscars.

6.3 WOODSCARS

In addition to the data collected on chips, data on manufacturing marks, or chips scars, were collected from preforms and completed artifacts and structural remains. Length and width of twenty scars were collected randomly on each item analyzed.

Wedges, preforms, harpoon scarfs, boxes, canoe sides, and house boards were the prime sources for these data. Many of the other artifact classes have all evidence of manufacturing processes obliterated in the final surface finishing and are of little use for manufacturing studies. The scar data were collected to give an idea of the expected range of debitage sizes. As with the debitage data, the scar data were also coded into the computer.

Figure 47 shows the length and width ranges for each artifact class and for the total sample. For comparative purposes, the length and width ranges are also presented for the debitage sample from House 1. As can be seen from this table, the ranges for several artifact classes exceed that for detritus from the sample. The debitage from the manufacture of planks and canoes is definitely not included in the sample from the house. Additionally, the upper ranges of debitage for wedges and boxes are not included in the sample. Wedge preforms, in all states of manufacture, were recovered from the house. Thus, one would expect debitage to be present. This is especially true because the wedge is an extremely common artifact. The House 1 cleaning effect proposed as part of the detritus sections seems to be holding as a means for introducing bias in the sample.

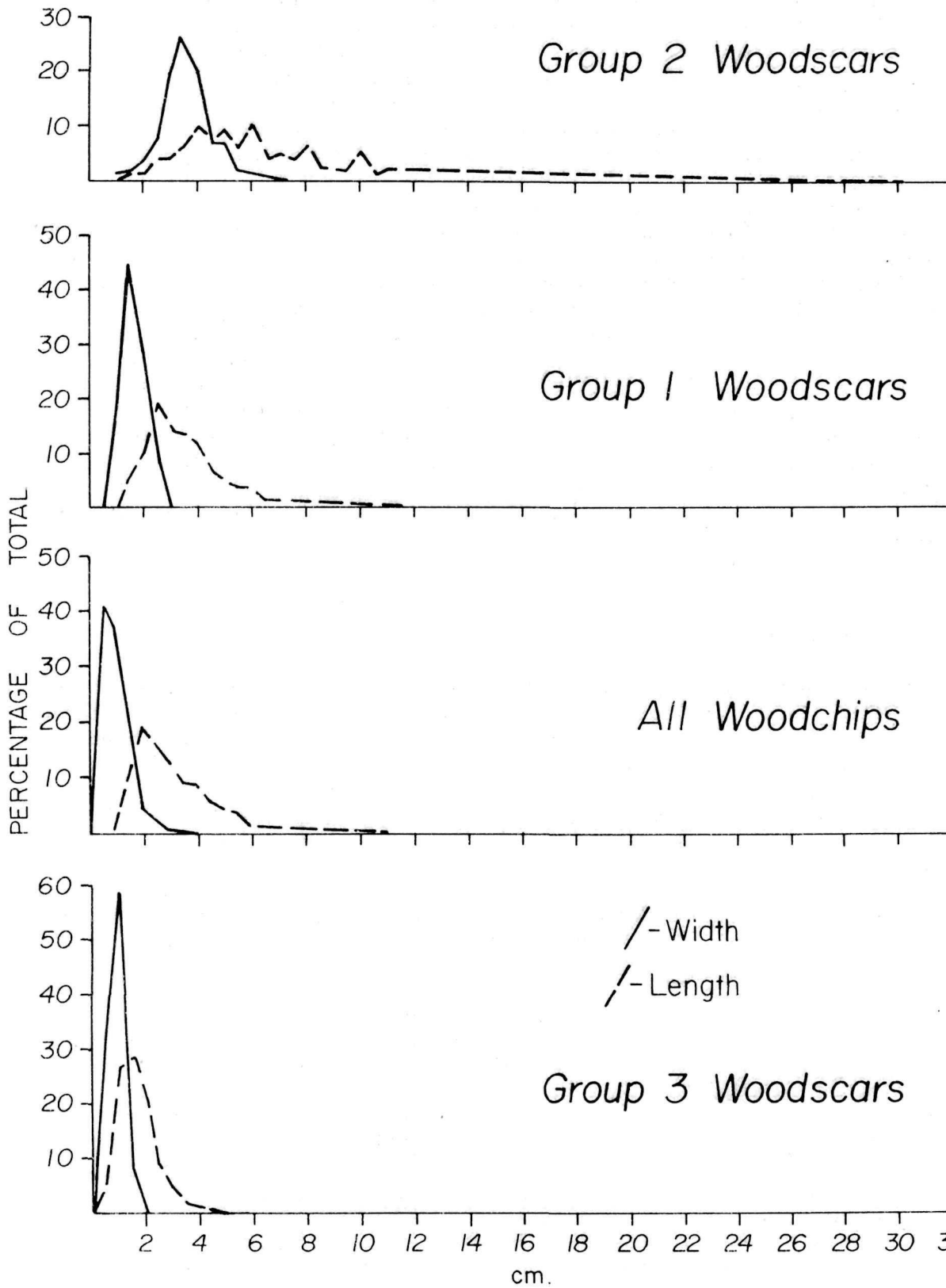


Figure 47. Histograms of woodchip and woodscar lengths and widths.

The woodscar data show variation that might be related to manufacture and tool use. Artifacts with discernible inner and outer surfaces, i.e., boxes, canoe sides, harpoon scarf joints, as well as the wedge preforms, were tested with One-Way ANOVA to determine if there was any significant variation between inner and outer surfaces and among preforms. There was no significant difference between the inner and outer surfaces for any of the artifact types. The wedge preforms sorted into two groups on the basis of the wood scars, the first group consisted of wedges from steps four and five and the second group consisted of wedges from steps six and seven. The woodscars were divided according to artifact type except for the wedges which were broken into two groups.

A One-Way ANOVA test with LSD and Scheffe test was then run on total sample of woodscars broken down into box parts, canoe sides, harpoon scarfs, planks, and two wedge varieties. The test showed significant variation and grouped the artifacts into three groups: (1) box parts, canoe sides, and step four/five wedge preforms; (2) harpoon scarf joints and step six/seven wedge preforms; and (3) planks. The metric for these groups are given in Table 37, Appendix. The scars for Group 3 are the largest, with Group 1 being between Groups 2 and 3. Discriminant analysis (Figure 56, Appendix) was performed to determine the import of the length and the width in separating these three groups. Width was the most important, accounting for 99.5 percent of the discrimination. The reclassification test was able to properly reassign 89 percent of the woodscars.

The three groups may reflect differences in types of tools used. The dressing of planks has been traditionally done with a D-adze. The edge margin imprints on the planks were the largest and as indicated in Chapter 3 were felt to represent D-adze blades.

Replication experiments with the weighted straight adze has resulted in surfaces like those found on the box parts. It may be that the final dressing of the canoe sides was done with a smaller adze to achieve a smoother surface. The presence of the wedges in this group brings the subject of topology to the discussion. In replication experiments with the wedge the steps four/five were done with both a D-adze and a weighted straight adze and produced a similar surface texture. The D-adze was more economical in that it removed a greater amount of the excess wood for the same effort. Because the wedge is a highly curved surface, the wider bladed D-adze leaves a scar not much bigger than the narrower bladed weighted straight adze. It is possible that the canoe sides and especially the wedges were done with a D-adze and that topography of the artifact creates a surface texture similar to that of the boxes.

The scars on the harpoon scarf joint are similar to those achieved with a replicated beaver toothed tool or a small, metal bladed knife. The wedge preforms, especially stage six, could have been done as easily with a weighted straight adze as with a knife. Again, topography may be causing a decrease in scar size.

Topography notwithstanding, the scars differentiate according to ethnographically reported uses and replicative results. The use of the scars may be of help in determining manufacturing sequences of various artifacts. The scar data also provide an additional means for defining the character of the debitage distribution.

6.4 WOODCHIPS AND WOODSCARS AS INDICATORS OF TOOL USE

The woodscar groups defined by the discriminant analysis can be used to classify the debitage. The statistical manipulations that are used in determining the relative contribution to the variation in the discriminant analysis and which are then used to reclassify the observation at the end of the discriminant analysis can also be used to classify a sample such as the woodchips. The resulting grouping of the woodchips would reflect the relative importance of the three groups and provides an indication of possible tool use within House 1. It should be recognized at this point that topographic variation can alter the classification of the chip and that burning and sweeping activities can affect the nature of the sample. Such a test as proposed here argues for the presence, but not necessarily the absence, of certain activities.

The debitage sample was reclassified into the three groups on the basis of the discriminant analysis of the woodscars (Table 38, Appendix). As was expected, the small and medium sized chips account for over 95 percent of the sample. Discriminant analyses of complete chips, Profiles 1 to 3, were run using the woodscar generated classification. Predictably, any length with related parameter such as area contributed almost exclusively to the group discrimination and resulted in a reclassification level of 87 percent. With the exclusion of the length and width derived measurements, thickness became the major discriminating value (94%), but the reclassification was only 75 percent. Thickness shows a strong relationship to length and width, as would be expected. The removal of thickness parameter from the test resulted in Profile becoming the major discriminating value (96%) (Table 41, Appendix). However, the reclassification with profile dropped to 58 percent (Figure 57, Appendix). Once the length and width related measures are removed, the reclassification of the chips classed by woodscar data by discriminant analyses drops precipitously.

The classification of woodchips by profile indicate that this sorting reflects motor use, or the angle which the cutting blade enters the surface. The classification of chips according to the woodscar classes relates to overall size of the chip. If the profile classes were combined with the woodscar classes of chips may reflect either size classes reflecting tool use, or topology and tool use.

This type of classification will be examined in the next chapter. Profile 4 is excluded from the classification because no Profile Four type scars were measured or included in the woodscar data. The woodchips then can be classified into nine groups depending upon

each chip's profile number and woodscar reclassification number. Because these classes are determined by factors relating to size and to character of removal, the classes may be more amenable to reflecting variation in the distribution of the debitage.

6.5 SUMMARY

A sample of 1,150 woodchips and 1,718 woodscars was analyzed. The profile classes of the chips determined primarily by the angle of the tool blade cutting through the surface may separate the chips into profile classes possibly reflecting tool specific motor patterns. The woodscars collected from a number of artifacts could be subdivided into three broad size classes. These size classes may, on the basis of ethnographic data, relate to tool use. Size group membership was predicted for each woodchip on the basis of the woodscar results. There is not a one-to-one correspondence between the chip classes and the size classes, nor is the distribution random. Differing applications of the tool in relation to such factors as the surface morphology being transformed may account for some of the unexplained variation. The range of woodscar size classes in comparison with those recovered from the house floor shows that the house floor sample is biased toward the smaller chip classes while inhouse manufacture would generally not produce many of the larger woodchips.

The presence of the woodchips and woodscars has provided an opportunity to examine the possibility of connecting woodworking tool use with woodworking debitage. Much more work is needed before such association can be exploited with surety of data units. If such an association can be developed it will be possible to discuss in detail the distribution of specific woodworking activities in relation to other activities.

Chapter VII

WOODWORKING ACTIVITY IN HOUSE 1

7.1 INTRODUCTION

The distribution of woodworking remains, in conjunction with other data recovered from Ozette, reflects the structuring of some woodworking activites. More importantly, the organization of these lines of evidence indicates some broader patterns of spatial organization within the household, which reflect status differentiation and, possibly, sex roles.

In the study of activity areas, the occurrence of cultural boundaries is a welcomed phenomenon. Within a component, one of the more obvious ways to bound activity areas is to be able to determine the limits of buildings or other types of shelter. Given this, it is then possible to examine either internal versus external activities or to compare or discuss internal house structuring. The evidence of house walls or some other types of shelter allow the bounds to be drawn on the basis of known cultural activities. In such a case, then, the units being studied or compared do have some reality within the behavioral patterns of the group.

For the study of woodworking activities, at least four sets of data could be used: tools, transformations, production techniques, and debitage. Of these, debitage seems to be the best suited for this use at this time.

Because most of the tools in use were probably kept in kits which were carried away by the slide, it is not possible to use the location of complete tool kits to help define activity areas. The tools that have been recovered come primarily from the storage areas under and around the bench areas. These represent lost or discarded items, most likely. Tools from the area beyond the benches are primarily wedges. In many cases, these are wedges that have been recycled as some sort of stake. Only a few examples of in-use tool recovery are found in House 1 at Ozette. Thus, the tool, while helpful, are numerically too small on a class by class count to permit use in dealing with activity areas with any degree of certainty.

A similar problem exists at the present with the use of transformations or with the use of production techniques to examine the difference among, and significance, of activity areas. Before either of these will be sufficient to discuss such problems, it will be necessary to examine a number of artifact classes to see if these vary among the activity areas or among the nuclear family units or households.

Variation among households could be expected. Variation from family unit to family unit may reflect differing occupations or villages of origin. Differing activity areas may vary, but, if they reflect a communal gathering place, there is a likelihood that the intensity of differing backgrounds and activities may make all but the most general patterns impossible to discern. Examining these sorts of areas with either data base would be fruitful because it could be related to specific artifact manufacturing patterns.

Debitage is available in great quantities from the housefloor described in Chapter 6. A random sample of debitage from water-screened squares has been analyzed into some broad groups. Those chips not swept out of the house may be used to look at the differences among family units and between areas of differing density. The debitage is seen to possibly reflect differing types of woodworking activity. In addition to the overall distribution of the debitage, specific debitage classes can be examined. The four debitage profiles represent either combinations of transformations or parts of transformations. Profile 1 represents a combination of at least transformations TR-12121 and TR-121222. Profile 2 is a combination of TR-121222 and TR-121112. Profile 3 is a combination of TR-121112 and TR-121121. Profile 4 is a TR-121121. In a more general sense, as pointed out in Chapter 6, Profile 1 is seen as resulting from shaving or planing activity. Profile 2 is seen as resulting from heavy knife work or light adzing. Profile 3 is seen as resulting from high angle or heavy adzing, stake pointing, or chisel reduction. Profile 4 is notching with possibly an adze, but most likely with a chisel. The profile and size class is seen as resulting from various tool use and thus, the distribution of the these classes can be used to discuss the possible variation in woodworking activity within a house at Ozette.

7.2 CULTURAL ENVIRONMENT

The woodworking activities to be examined are those that would take place within a structure. Existing house walls provide an outer limit for the activities. Internally, the area can be divided between individual family areas along the walls and the central common area of the house. The individual family areas can be subdivided into storage areas, bench areas, and hearth areas. In addition, the family areas can be separated from one another on the basis of the associations with hearth areas.

Because the debitage was collected by square and level, the comparison unit for woodworking activity will be by units composed of whole squares. The unit of comparison will be basically the family unit. Squares falling within a family area as defined by a hearth will be compared with other such units.

In order to understand the specific function of each of these units in social and economic terms, archaeological, linguistic, and ethnographic data have been used. A detailed discussion of the social

and economic structure of the generalized Nootkan longhouse extended family unit using the above data base has led to some new insights on the interaction of family units within the house (Gleeson, Fleisher, and Gamble 1979). The organization and interaction of these units will be summarized for this discussion of the debitage. The organization of the family units provides a background which helps to explain the distribution of the woodworking debitage.

The linguistic, ethnographic, and archaeological data come from three sources. The linguistic data were derived from field work done by Fleisher at Hesquiat on the west coast of Vancouver Island. The ethnographic data are from Northern and Central Nootkan Tribes (Drucker 1951). The archaeological data are based on the excavations of House 1 at Ozette.

The linguistic data name various areas of the house without any overt ranking or function denoted by the name. The ethnographic data assign social ranking to the various family areas within the house and explain how these areas articulate socially. The archaeological data were divided into certain classes of procurement or subsistence, artifacts, and processing and production artifacts. The distribution of these classes, in conjunction with the known social organization, provides an understanding of the economic structure and its articulation with the social order.

For this study, artifacts or artifact associations were selected that would closely correlate with specific economic activities. Thus, bows, arrowshafts, and arrowpoints were associated with bird, sea otter, and land mammal hunting; fishhook shanks were associated with fishing activities; harpoon valves, shell inset blades, and float plugs were associated with medium to large sea mammal hunting.

Wedges, cordage, and basketry are non-subsistence items that have extensive distribution. These items were related to manufacturing and storage processes. The woodworking, basketry, and cordage are not closely tied to any particular subsistence activities. The deposition of these items may vary independently with the subsistence-related artifacts.

Given mechanisms for redistribution of subsistence items, it was thought that, while there might be differential distribution of subsistence or procurement artifacts, one might not expect variation in production and processing evidence within a single structure. Thus, while certain individuals or family units may be more involved with one procurement activity than others, processing of the items gathered may be done by many of the family groups within the house.

The sample of artifact classes was then used to assess intensity of deposition, the duration of deposition, and differential deposition. The house area was divided into five family areas, two (north and south) central floor areas, and the door area. The house floor, which ranged in thickness from 20 cm along the back wall to 40 cm in the doorway, was assumed to have been deposited in a relatively uniform manner.

Elevations on a 0.000 to 1.000 scale were given to all artifacts. The scale was based on the thickness of the floor where the artifact was recovered. The actual base elevation was recalculated as 0.000 and the surface of the floor calculated as 1.000; the elevation of the artifact was interpolated between these two points. On this basis, the housefloor artifacts were divided into temporal units reflecting the first quarter through the fourth quarter of the house occupation. Given these spatial and temporal definitions, it was then possible to examine the variation in artifact deposition.

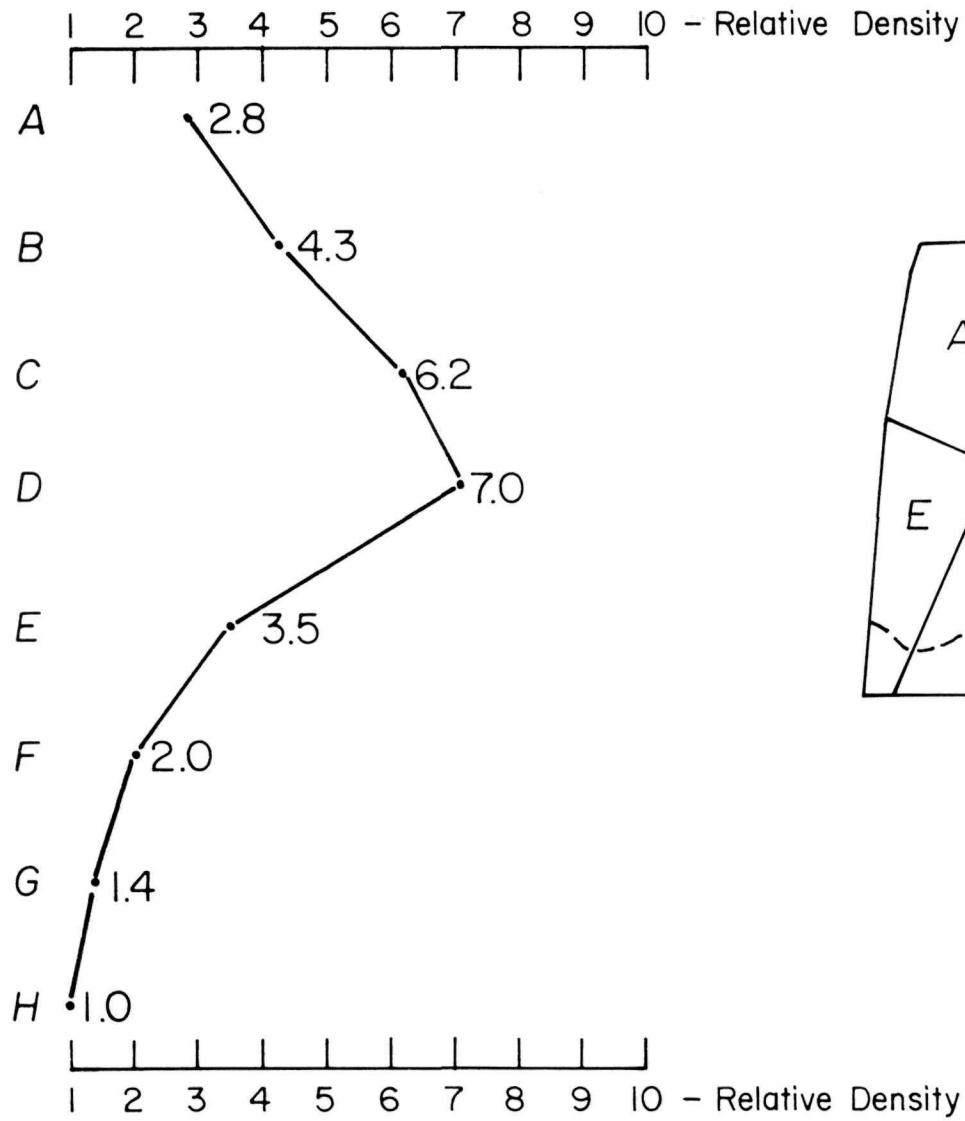
Variation was then looked at in three aspects as a reflection of economic activity. First, the density of artifact deposition was assumed to reflect intensity of production and maintenance activity among similar areas. Secondly, the relative distribution of procurement, production, and processing artifacts was used to indicate and rank the economic concerns of particular intrahouse areas. Thirdly, the distribution of ornamented common artifacts was used as an indicator of social ranking.

Overall, the central floor area (Areas G and H) and the doorway (Area F) had a very low density of artifacts throughout the occupation (Figure 48). This was to be expected from the other lines of evidence that indicated that these areas were swept regularly. The two back corners (Areas A and C) had fairly consistent density throughout occupation (Figure 49). Area A consistently had a relatively low density of artifacts, while Area C had a relatively high density of artifacts. The other family areas (B, D, and E) show broad variation in depositional density of artifacts through time, probably reflecting differing periods of use for each of these family areas. The temporal quarter with the highest density for each family area was then compared on the basis of procurement artifacts and the production and processing artifacts.

The relative density of the procurement-related artifacts varied among the family areas to a much greater degree than did the production- and processing-related artifacts (Figure 50). Areas A and C showed the least degree of internal variation in the subsistence-related artifacts, possibly reflecting an equal involvement in all three aspects. The other three family areas showed skewed interest in only one or two of the subsistence-related activities.

In looking at the distribution of ornamented common artifacts, these were found to cluster primarily in Area A.

Thus, on the basis of the archaeological data, the back two corners of the house appear to have been occupied continuously, and exhibit an equal concern with all aspects of the economic activities as represented by the artifacts. The other family areas show variation both in period of occupation and emphasis in economic interests. Area A can be distinguished from Area C on the basis of a lower density of artifacts and the presence of ornamented common artifacts.



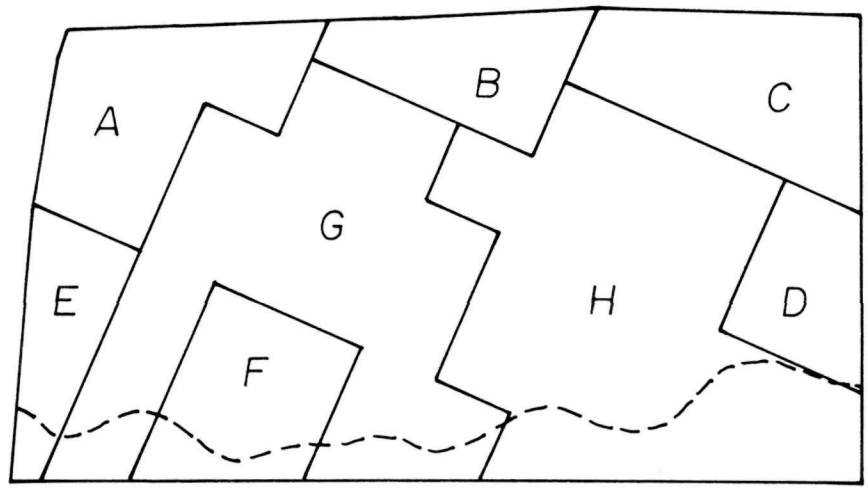


Figure 48. Relative artifact density by house area.

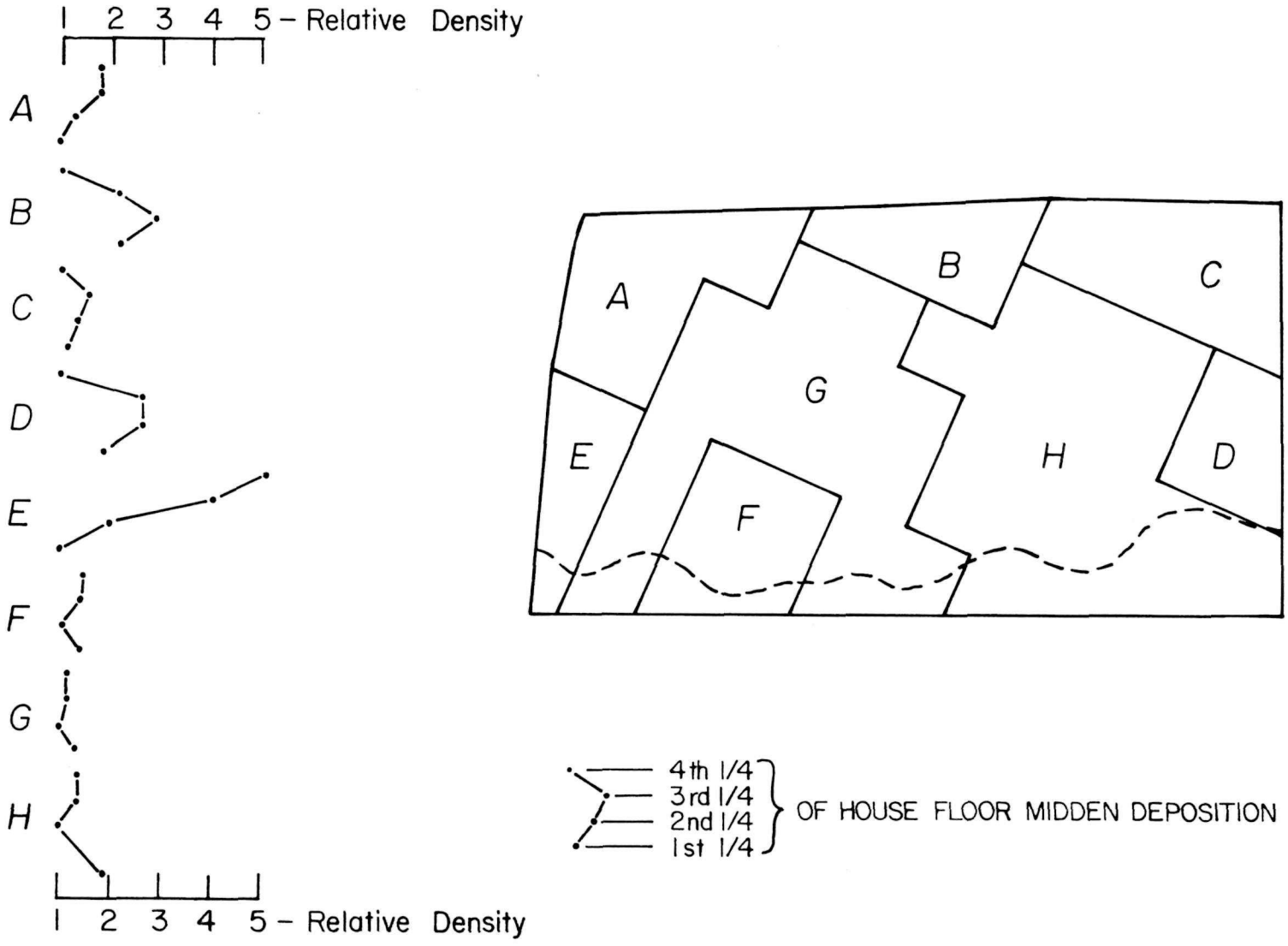


Figure 49. Relative artifact density for house areas by arbitrary house floor levels.

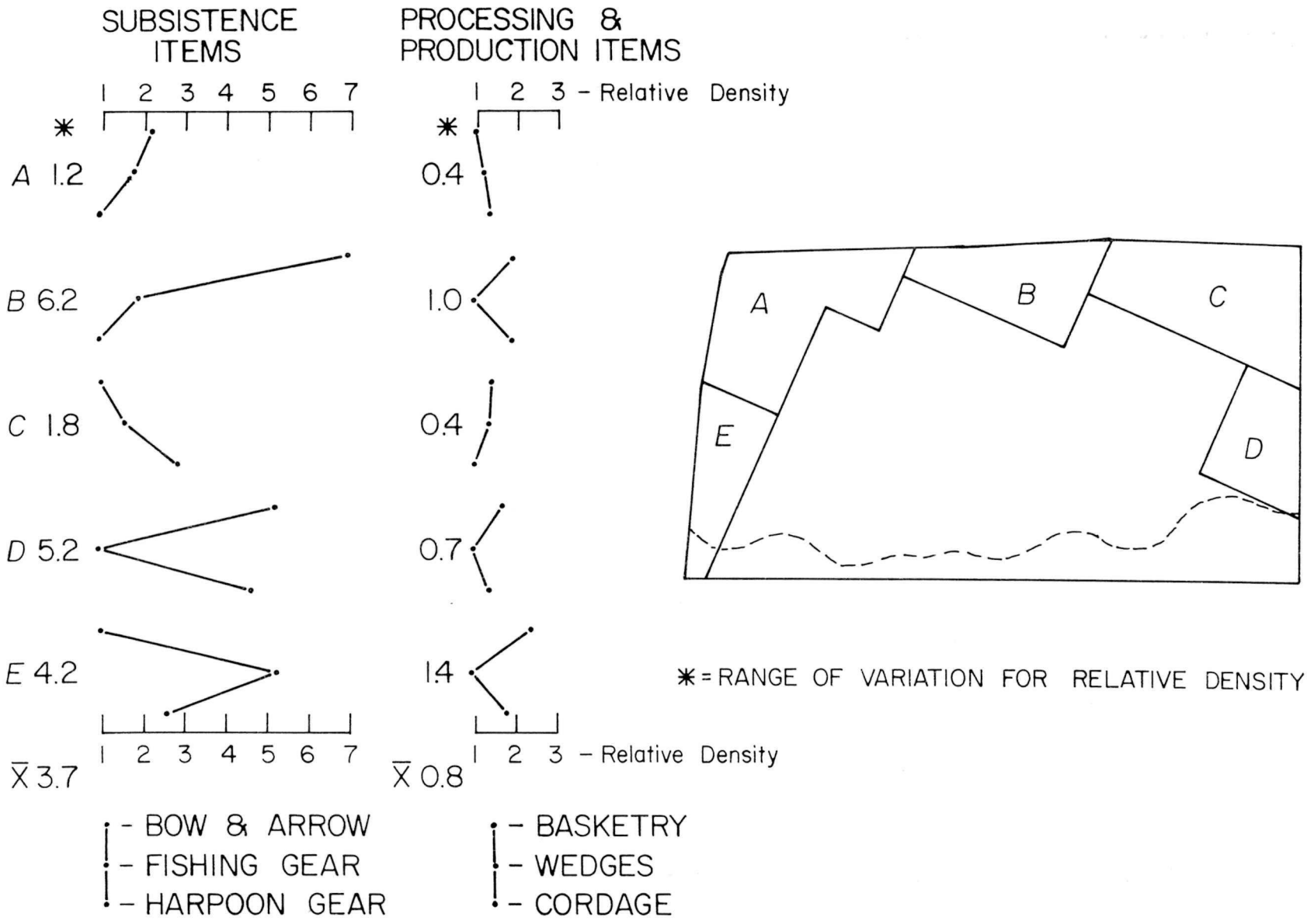


Figure 50. Relative density of subsistence items and processing and production items by living area.

The understanding of these variations was ennanced by the linguistic and ethnographic data. The Hesquiat linguistic data indicated a structuring of the space within the house. The ethnographic data indicated the social importance and ranking of these areas. From Drucker (1951:71), it follows that the corners were the most important, with Area A being the number one position and Area C being the number two position. The number one position belonged to the head or chief of the household or extended family. The number two position was his closest assistant, most likely a brother or a son.

The archaeological, linguistic, and ethnographic data support our understanding of the social structure within the house, and indicate possible economic roles related to this social structure. The pertinent observations from the three data bases are as follows.

The highest ranking individual within the socio-political organization of the house resides in Area A. In this area, we encounter a relatively low density of subsistence-related artifacts, and a higher density of ornamented and possibly ritually-related artifacts.

Area C is marked by a high density of subsistence-related artifacts and a relative absence of ornamented artifacts.

Areas B, D, and E show artifact distributions which indicate a lesser concern with subsistence on a consistent basis, and involvement in only certain aspects of the overall harvesting and processing of resources.

On a more general level, the generalized Nootkan longhouse is a corporate group in the Weberian sense (Weber 1947:145-146). The Nootkan corporation was primarily constituted on political groups with economic functions being added. Among the Nootka, the locus of power within the corporate group resides in the chief's family. The structure and organization of our generalized Nootkan longhouse is focused on a unilinear descent group within whose jurisdiction falls the rights and obligations of economic management. The economic functioning with respect to interpersonal relationships within the generalized Nootkan longhouse are these:

1. The head chief, occupying Area A at Ozette, is responsible for the overall decision-making processes within the house with respect to political and economic decisions.

2. The administrative and executional responsibilities of economic activities fall in the hands of the highest chief's closest relative, who is residing in the left rear of the house area, Area C in the Ozette house.

3. The responsibility of performance lies in the hands of more distant relatives residing along the walls of the house, Areas B, D, and E.

Thus, the spatial and cultural environment within which the debitage was collected can be broken into specific family areas which have probable social and economic interaction and ranking.

7.3 CULTURAL IMPLICATIONS OF HOUSE 1 WOODCHIP DISTRIBUTION

The debitage sample was partitioned into units that reflect the areas outlined in the previous section. The variation among these units was tested using discriminant analysis. The results of this test were compared with certain hypotheses generated concerning the articulation of the house units. The pattern associated with intensity of debitage, mollusk, and fish remains adds further insight into the patterns proposed in the previous section.

The family areas and general areas as outlined in the previous section were examined to see if the debitage would show variation in relation to the economic emphasis indicated by the deposition of artifacts. If there are significant differences among the groups, this may possibly be related to the production or maintenance of specific procurement-related artifacts. If the relationship is strong, then it may be tested for its relationship to subsistence artifacts by simulating the production of these items and analyzing the debitage. This last step is beyond the scope of this particular study. However, the step would allow for strengthening the argument for particular family areas having certain economic emphases.

The debitage is examined in terms of overall distribution and variation in distribution of classes of chips among the living and other use areas of the house. The overall distribution is examined in relation to distributions of other groups of material, such as shell and bone, to determine general patterns of deposition within the house. The family areas and use areas are used to partition the sample of woodchips. The subsets created by this partitioning are examined for variation in the distribution of classes or attributes of the chips that might reflect on specific activities within any area or set of areas within the house.

The overall distribution of the woodchips is presented in Figure 51. The woodchip deposition is concentrated around the southern periphery of the head chief's living area. The second densest accumulation of chips is at the number two position, Area C. On the basis of artifact distribution, the evidence of repair and manufacture was strongest for Area C. However, the evidence of the by-products, debitage, of manufacture and repair is highest in Area A, the area which exhibited the lowest amount of artifactual evidence for manufacture or repair.

The distribution of fish bones and certain types of shells may help explain this paradox. Figure 52 and Figure 53 map the distributions of fish bones and shells. Exotic shells (abalone, dentalia, and red turban opercula) are trade items. Because the

identified shell sample is over 200,000, these shells form a very small part of the sample. Several of the esoteric species have their known use as primarily inlay items for decorating artifacts (Wessen 1980). Also, in this area are the highest concentration of razor clams. Hence, within the southern periphery of Area A are concentrated fish bones, esoteric shell, and woodchips. This location is to the right, i.e., down rank, of Area A. The items that are concentrated in this location relate to manufacture and to eating.

The items recovered from this area are small in size and could easily have been missed in cleaning the general area. Like the rest of the central area, this part of the house has very few artifacts deposited in the house floor midden. Those that do occur are also small in size. Thus, there is no reason to believe that the concentration results from differential cleaning of the house floor. Hence, the concentration must be seen to reflect by-products of activities occurring in this area.

The activities reflected are manufacture/repair and eating. Within Northwest Coast culture, woodworking is generally a male occupation. In extended family social units, it is not uncommon for the males to eat together in a specific place. In such a situation, the females may eat with the males (two steps behind and one step over), eat with themselves, or their children. The broad impression from the ethnographic literature is that, while the male pattern within a culture may be fairly well set, the female pattern may vary with the specific woman's rank, resources, and responsibilities. The sex-related differences in eating patterns appear to be in force in House 1.

While it is not possible to determine the female pattern, it would appear that certain inferences can be made concerning a facet of the male eating/working patterns within the house. Around the hearth associated with the highest ranking male are the highest concentrations of both woodchips and fish remains. The rare shellfish, some perhaps a culinary treat, are also clustered around this hearth. These distributions may indicate that members of the household, especially males, may have congregated in this area in possible deference to the exaulted position of the hearthholder.

The distribution of the woodchips by living and use area is not as clearly patterned as is the overall distribution. ONEWAY grouped six of the areas together. The remaining two areas, Area D and Area E, are distinct from, and more loosely associated than, the cluster of the other six areas. The three sets of living areas are discriminated by chip length (92%) and thickness (8%) (Figure 58, Appendix). When these class designations are used as a discriminating factor among the three sets, the discriminating attributes are chip thickness (90%) and class (10%) (Figure 59, Appendix). The woodchips from Areas D and E are of greater thickness, angle, and width than those from the group of six areas. Because the relationship of the chip class to tool use is not clear at present, one cannot predict specific manufacturing activities for the isolation of Areas D and E from the rest of the living use areas. However, it is notable that these areas did show a wide

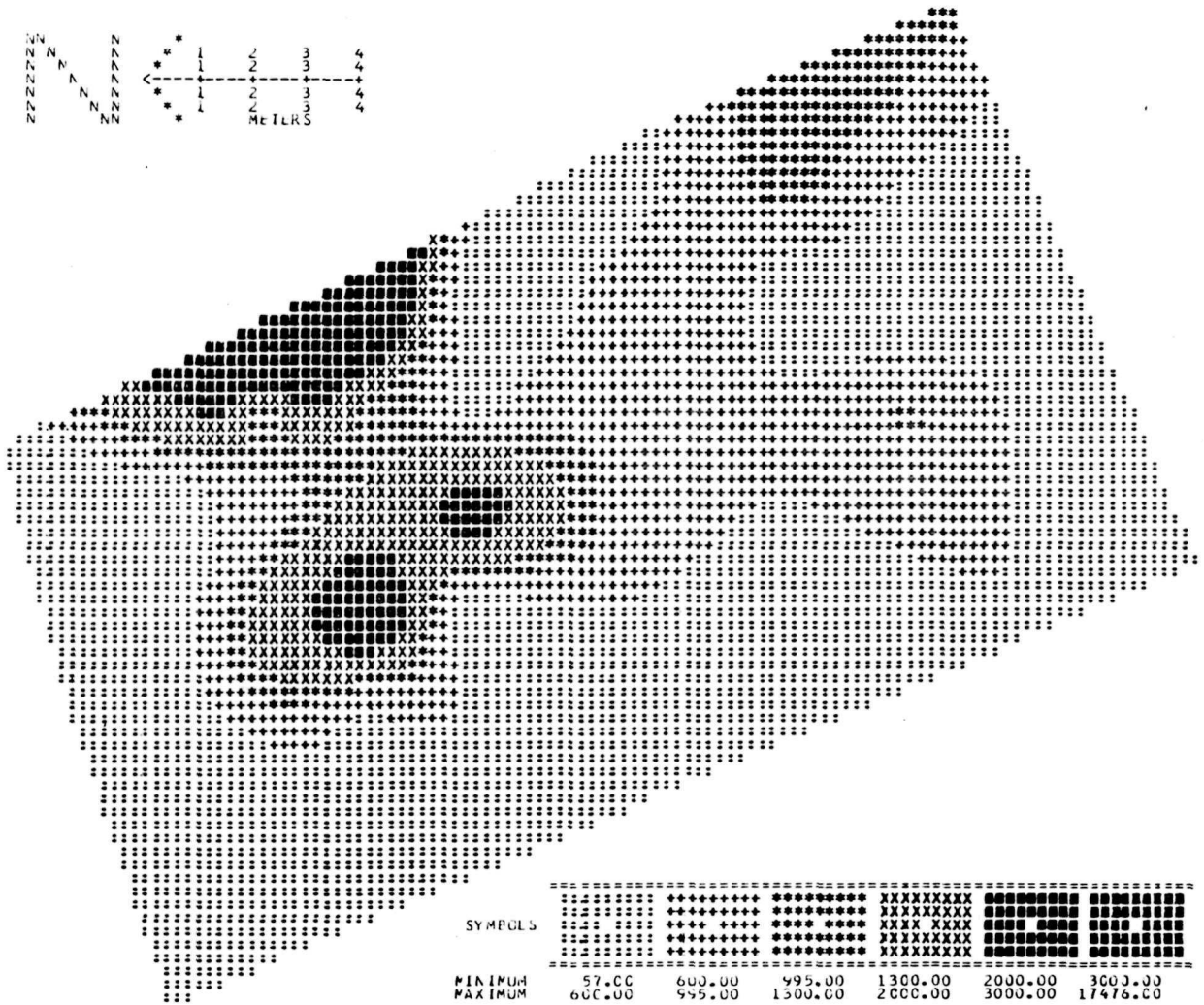


Figure 51. SYMAP of House 1 woodchip distribution.

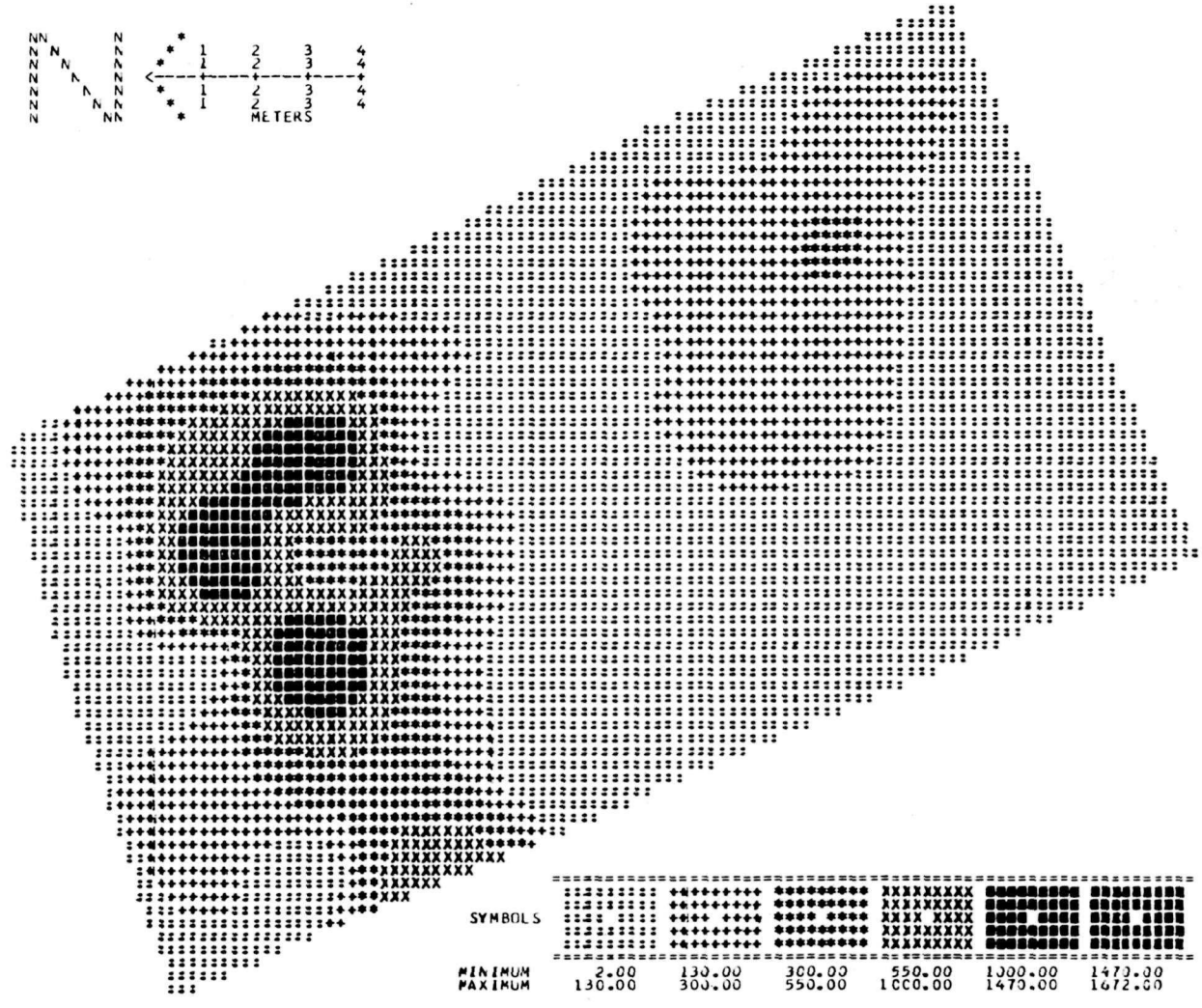


Figure 52. SYMAP of House 1 fish bone distribution.

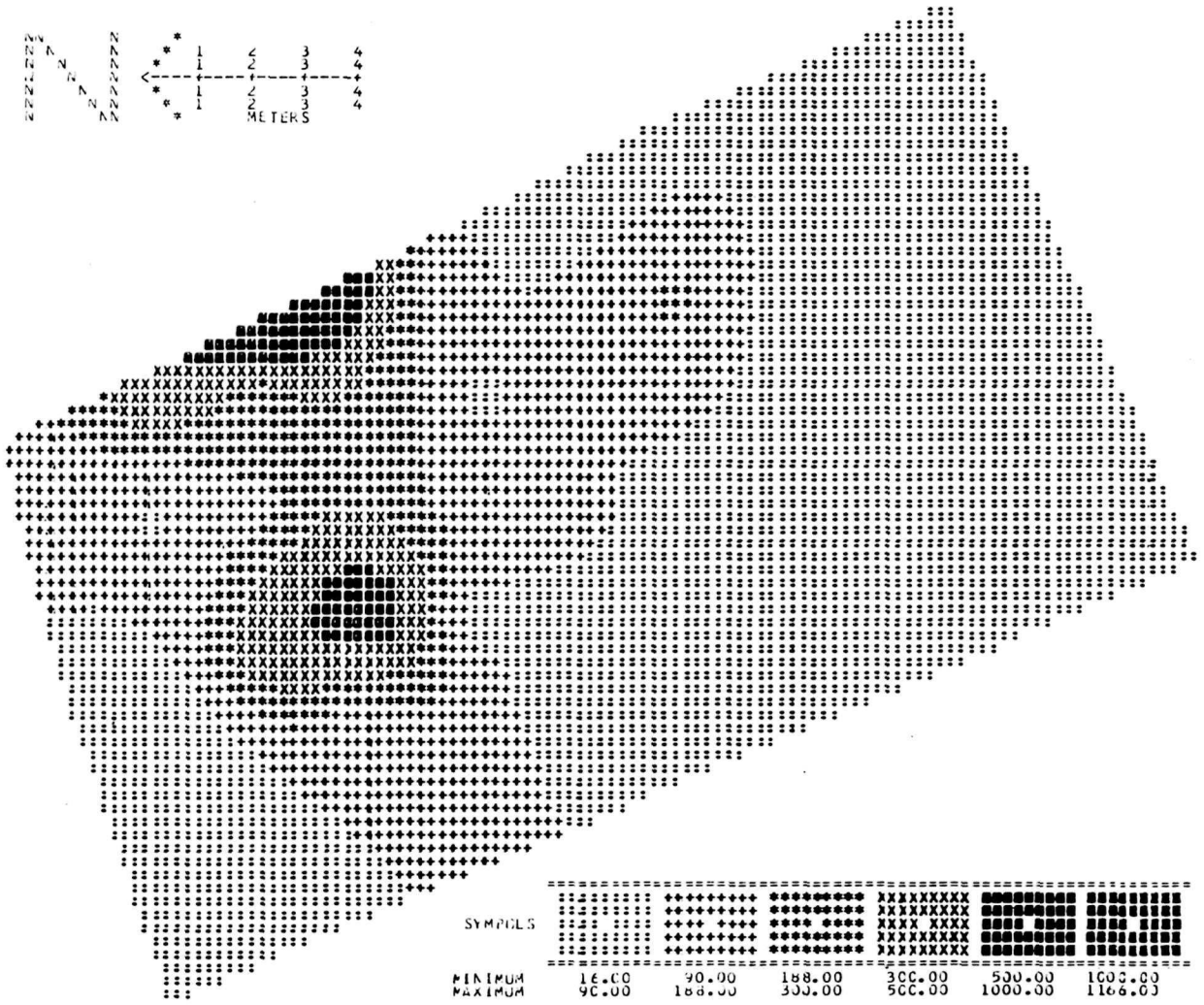


Figure 53. SYMAP of House 1 shell distribution.

divergence in the deposition of subsistence-related artifacts. The debitage differences may be related to manufacture/repair activities connected to various subsistence pursuits and/or to the relative ranking of the families occupying these two positions.

The explanations of these patterns are presented more as hypotheses to be tested than as conclusions. Much work remains to be done before the full implications of the debitage data can be realized. The propositions presented here, based on patterns that admittedly are weakly defined, do indicate that it will be feasible to use the woodworking data not only to study questions of artifact manufacture but to broader questions of cultural integration.

Chapter VIII

SUMMARY AND CONCLUSIONS

The avowed purpose of this study was to integrate various lines of evidence concerning woodworking activity at Ozette, and, in doing so, develop methodology that would allow for the use of these results as part of the explanation for broader cultural patterns.

The Ozettes had a fine appreciation not only for specific types of trees, but also for the various cuts of tree, each cut having its own peculiar set of structural properties. These desired pieces of timber were altered with a tool kit which is richer in variety than was recorded in the ethnographic or ethnohistoric literature. These tools were used, some interchangably, to alter, or transform, the wood in specific ways. These transformations were used in a highly patterned manner, or sequence, to manufacture the various artifacts needed to survive and enjoy the environment, both physical and cultural, of the Ozettes. The use of the tools in this patterned, or manufacturing, sequence had as its by-product debitage, which is primarily manifested as woodchips. These woodchips may be related to tool use through the recovery of artifacts in various stages of manufacture. If the relation between the debitage and the preforms can be more clearly defined, as well it may be by replicating the tool use and manufacturing process, then the distribution of chips may be analyzed to answer questions concerning the structuring of woodworking activities within and around the houses at Ozette. These activities did not exist in a vacuum, but were part of a broader organization that integrated social, economic, political, religious, and ceremonial activities. It is this achievement of an understanding of the broader organization, through the use of archaeological data and general anthropological concepts, that makes it possible to appreciate the uniqueness of the Ozettes' own adaptation and to explain how this particular adaptation may be generalized to explain man's observable patterned behavior as a means of survival.

In describing the woodworking technology of the Ozettes, it was first necessary to define technology and then to isolate that part of technology that relates to wood. With a concept of woodworking technology in hand, it was then possible to look at the archaeological record from Ozette to see which remains were present in sufficient quantities to test assumptions concerning aspects of woodworking technology. The following data sets could be derived and applied to specific problems: raw material; species and anatomical part; selection, which relates to the understanding of the extent of the Ozette knowledge of the properties of wood; tools, which relate to how the Ozettes might alter wood; preforms and completed artifacts, which relate to how the Ozettes might transform wood and in what order;

evidence of woodworking remaining on artifacts, which could be related to both tool use and woodchip production; and woodchips, which, if related to tool use, could reflect the location and possible association of the activity with other activities.

The integration of these lines of evidence was based on observation, replication, and statistical manipulation of continuous and discontinuous data. Because the purpose was to derive an overall model, a greater dependency was placed on verification through observation and replication than on verification through statistical manipulation. There are parts of the model that need to be more rigorously tested. Testing will most likely bring about changes in the model. It is felt that these changes will not so much alter the structure of the model, as they will lead to a more sophisticated understanding of the woodworking process and its implications for adaptation and culture change at Ozette.

Although this study is decidedly synchronic in nature, my original purpose and continuing interest is the effect of European contact on Native American cultures, using syncretic evidence to understand the accommodation made in various cognitive systems. I had originally planned to look at such variation between the protohistoric and early historic occupations at Ozette. The more this topic was examined, the more it became clear that to pursue this topic the woodworking process would have to be understood. Thus, the synchronic emphasis here is directed toward such an understanding.

As the excavations of Ozette have expanded, it has become obvious that Ozette will provide an excellent data base for explaining various aspects of culture change. Probably one of the more interesting such studies that are possible relates to the changes in the woodworking technology that are documented at Ozette. The Ozette data on woodworking span from the premetal technology to the introduction of European tools and concepts. Thus, at Ozette it is possible to study the introduction of a new raw material separately from the introduction of a new cognitive system within the same aspect of technology.

The most provocative problem remains: how do such changes affect the other aspects of society? The present study has looked at how a portion of archaeology and technology coexists but not how it relates to other aspects of culture. As seen by Letchman, Steinberg, and Leone, the unfulfilled promise of archaeology--the explanation of the dynamics of technology as a part of culture--has yet to be adequately understood.

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APPENDIX

Table 31

Tabulation of Woodworking and Cutting Tools by Level

TOOL* / UNIT FREQUENCY PERCENT ROW PCT COL PCT	UNIT I	UNIT II	UNIT III	UNIT I-III	UNIT IV	UNIT V	UNIT VI	UNIT VII	OTHER	TOTAL
STONE ADZE BLADE	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.04 50.00 0.61	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.04 50.00 0.29	2 0.08
BONE ADZE BLADE	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.04 100.00 0.07	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.04
SHELL ADZE BLADE	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	3 0.12 100.00 0.21	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	3 0.12
MAUL	2 0.08 18.18 4.44	0 0.00 0.00 0.00	1 0.04 9.09 0.61	1 0.04 9.09 4.55	2 0.08 18.18 0.50	3 0.12 27.27 0.21	0 0.00 0.00 0.00	0 0.00 0.00 0.00	2 0.08 18.18 0.58	11 0.45
HOUSEHOLD MAUL	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.04 100.00 0.07	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.04
WHALE BONE WEDGE	1 0.04 1.41 2.22	0 0.00 0.00 0.00	9 0.37 12.68 5.49	1 0.04 1.41 4.55	10 0.41 14.08 2.52	40 1.64 56.34 2.80	0 0.00 0.00 0.00	0 0.00 0.00 0.00	10 0.41 14.08 2.89	71 2.91
ANTLER WEDGE	0 0.00 0.00 0.00	0 0.00 0.00 0.00	4 0.16 7.27 2.44	1 0.04 1.82 4.55	7 0.29 12.73 1.76	37 1.51 67.27 2.59	2 0.08 3.64 8.70	0 0.00 0.00 0.00	4 0.16 7.27 1.16	55 2.25
SH LG OVAL WED	0 0.00 0.00 0.00	0 0.00 0.00 0.00	41 1.68 10.68 25.00	0 0.00 0.00 0.00	56 2.29 14.58 14.11	235 9.62 61.20 16.45	8 0.33 2.08 34.78	3 0.12 0.78 37.50	41 1.68 10.68 11.85	384 15.71
TOTAL	45 1.84	10 0.41	164 6.71	22 0.90	397 16.24	1429 58.47	23 0.94	8 0.33	346 14.16	2444 100.00

Table 31 (Continued)

TOOL* UNIT FREQUENCY PERCENT ROW PCT COL PCT	UNIT I	UNIT II	UNIT III	UNIT I-III	UNIT IV	UNIT V	UNIT VI	UNIT VII	OTHER	TOTAL
MDLN LG OVAL WED	0	0	2	0	19	10	0	0	3	34
	0.00	0.00	0.08	0.00	0.78	0.41	0.00	0.00	0.12	1.39
	0.00	0.00	5.88	0.00	55.88	29.41	0.00	0.00	8.82	
	0.00	0.00	1.22	0.00	4.79	0.70	0.00	0.00	0.87	
SH LG RECT WED	0	1	5	0	7	25	1	0	2	41
	0.00	0.04	0.20	0.00	0.29	1.02	0.04	0.00	0.08	1.68
	0.00	2.44	12.20	0.00	17.07	60.98	2.44	0.00	4.88	
	0.00	10.00	3.05	0.00	1.76	1.75	4.35	0.00	0.58	
MDLN LG RECT WED	0	0	2	0	8	8	0	0	1	19
	0.00	0.00	0.08	0.00	0.33	0.33	0.00	0.00	0.04	0.78
	0.00	0.00	10.53	0.00	42.11	42.11	0.00	0.00	5.26	
	0.00	0.00	1.22	0.00	2.02	0.56	0.00	0.00	0.29	
MD OVAL WED	0	0	2	0	1	6	0	0	4	13
	0.00	0.00	0.08	0.00	0.04	0.25	0.00	0.00	0.16	0.53
	0.00	0.00	15.38	0.00	7.69	46.15	0.00	0.00	30.77	
	0.00	0.00	1.22	0.00	0.25	0.42	0.00	0.00	1.16	
SM OVAL WED	0	0	1	0	3	17	0	0	1	22
	0.00	0.00	0.04	0.00	0.12	0.70	0.00	0.00	0.04	0.90
	0.00	0.00	4.55	0.00	13.64	77.27	0.00	0.00	4.55	
	0.00	0.00	0.61	0.00	0.76	1.19	0.00	0.00	0.29	
SM RECT WED	0	0	0	0	1	6	0	0	0	7
	0.00	0.00	0.00	0.00	0.04	0.25	0.00	0.00	0.00	0.29
	0.00	0.00	0.00	0.00	14.29	85.71	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.25	0.42	0.00	0.00	0.00	
MARKING WED	0	0	0	0	1	21	0	0	2	24
	0.00	0.00	0.00	0.00	0.04	0.86	0.00	0.00	0.08	0.98
	0.00	0.00	0.00	0.00	4.17	87.50	0.00	0.00	8.33	
	0.00	0.00	0.00	0.00	0.25	1.47	0.00	0.00	0.58	
SH ROD WED	0	0	1	0	4	41	0	0	7	53
	0.00	0.00	0.04	0.00	0.16	1.68	0.00	0.00	0.29	2.17
	0.00	0.00	1.89	0.00	7.55	77.36	0.00	0.00	13.21	
	0.00	0.00	0.61	0.00	1.01	2.87	0.00	0.00	2.02	
TOTAL	45	10	164	22	397	1429	23	8	346	2444
	1.84	0.41	6.71	0.90	16.24	58.47	0.94	0.33	14.16	100.00

Table 31 (Continued)

TOOL* UNIT FREQUENCY PERCENT ROW PCT COL PCT	UNIT I	UNIT II	UNIT III	UNIT I-III	UNIT IV	UNIT V	UNIT VI	UNIT VII	OTHER	TOTAL
MDLN ROD WED	0	0	0	0	11	14	0	0	6	31
	0.00	0.00	0.00	0.00	0.45	0.57	0.00	0.00	0.25	1.27
	0.00	0.00	0.00	0.00	35.48	45.16	0.00	0.00	19.35	
	0.00	0.00	0.00	0.00	2.77	0.98	0.00	0.00	1.73	
WED PREFORM	0	0	1	0	42	9	1	0	1	54
	0.00	0.00	0.04	0.00	1.72	0.37	0.04	0.00	0.04	2.21
	0.00	0.00	1.85	0.00	77.78	16.67	1.85	0.00	1.85	
	0.00	0.00	0.61	0.00	10.58	0.63	4.35	0.00	0.29	
PROX WED FRAG	0	0	0	0	7	40	1	1	1	50
	0.00	0.00	0.00	0.00	0.29	1.64	0.04	0.04	0.04	2.05
	0.00	0.00	0.00	0.00	14.00	80.00	2.00	2.00	2.00	
	0.00	0.00	0.00	0.00	1.76	2.80	4.35	12.50	0.29	
LONGTUD WED FRAG	1	0	10	1	20	155	1	1	20	209
	0.04	0.00	0.41	0.04	0.82	6.34	0.04	0.04	0.82	8.55
	0.48	0.00	4.78	0.48	9.57	74.16	0.48	0.48	9.57	
	2.22	0.00	6.10	4.55	5.04	10.85	4.35	12.50	5.78	
DIST WED FRAG	0	0	8	0	16	170	4	2	21	221
	0.00	0.00	0.33	0.00	0.65	6.96	0.16	0.08	0.86	9.04
	0.00	0.00	3.62	0.00	7.24	76.92	1.81	0.90	9.50	
	0.00	0.00	4.88	0.00	4.03	11.90	17.39	25.00	6.07	
GROMMET	1	0	5	0	8	38	0	0	6	58
	0.04	0.00	0.20	0.00	0.33	1.55	0.00	0.00	0.25	2.37
	1.72	0.00	8.62	0.00	13.79	65.52	0.00	0.00	10.34	
	2.22	0.00	3.05	0.00	2.02	2.66	0.00	0.00	1.73	
CHISEL	0	0	1	0	8	10	0	0	0	19
	0.00	0.00	0.04	0.00	0.33	0.41	0.00	0.00	0.00	0.78
	0.00	0.00	5.26	0.00	42.11	52.63	0.00	0.00	0.00	
	0.00	0.00	0.61	0.00	2.02	0.70	0.00	0.00	0.00	
GOUGE	0	0	0	0	0	1	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.04
	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	
TOTAL	45	10	164	22	397	1429	23	8	346	2444
	1.84	0.41	6.71	0.90	16.24	58.47	0.94	0.33	14.16	100.00

Table 31 (Continued)

TOOL* / UNIT FREQUENCY PERCENT ROW PCT COL PCT	UNIT I	UNIT II	UNIT III	UNIT I-III	UNIT IV	UNIT V	UNIT VI	UNIT VII	OTHER	TOTAL
STRAIGHT ADZE	0	0	2	0	2	2	0	0	2	8
	0.00	0.00	0.08	0.00	0.08	0.08	0.00	0.00	0.08	0.33
	0.00	0.00	25.00	0.00	25.00	25.00	0.00	0.00	25.00	
	0.00	0.00	1.22	0.00	0.50	0.14	0.00	0.00	0.58	
D-ADZE	1	0	1	0	2	0	0	0	1	5
	0.04	0.00	0.04	0.00	0.08	0.00	0.00	0.00	0.04	0.20
	20.00	0.00	20.00	0.00	40.00	0.00	0.00	0.00	20.00	
	2.22	0.00	0.61	0.00	0.50	0.00	0.00	0.00	0.29	
SLATE KNIFE	0	0	0	0	4	12	0	0	2	18
	0.00	0.00	0.00	0.00	0.16	0.49	0.00	0.00	0.08	0.74
	0.00	0.00	0.00	0.00	22.22	66.67	0.00	0.00	11.11	
	0.00	0.00	0.00	0.00	1.01	0.84	0.00	0.00	0.58	
MS SHELL KNIFE	0	0	0	0	10	159	1	0	5	175
	0.00	0.00	0.00	0.00	0.41	6.51	0.04	0.00	0.20	7.16
	0.00	0.00	0.00	0.00	5.71	90.86	0.57	0.00	2.86	
	0.00	0.00	0.00	0.00	2.52	11.13	4.35	0.00	1.45	
BEA TOOTH KNIFE	0	0	0	0	1	3	0	0	1	5
	0.00	0.00	0.00	0.00	0.04	0.12	0.00	0.00	0.04	0.20
	0.00	0.00	0.00	0.00	20.00	60.00	0.00	0.00	20.00	
	0.00	0.00	0.00	0.00	0.25	0.21	0.00	0.00	0.29	
EXPD BASE KNIFE	0	0	0	0	2	3	0	0	1	6
	0.00	0.00	0.00	0.00	0.08	0.12	0.00	0.00	0.04	0.25
	0.00	0.00	0.00	0.00	33.33	50.00	0.00	0.00	16.67	
	0.00	0.00	0.00	0.00	0.50	0.21	0.00	0.00	0.29	
3-D POMMEL KNIFE	0	0	0	0	0	3	0	0	0	3
	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.12
	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	
2-D POMMEL KNIFE	0	0	2	0	6	8	0	0	3	19
	0.00	0.00	0.08	0.00	0.25	0.33	0.00	0.00	0.12	0.78
	0.00	0.00	10.53	0.00	31.58	42.11	0.00	0.00	15.79	
	0.00	0.00	1.22	0.00	1.51	0.56	0.00	0.00	0.87	
TOTAL	45	10	164	22	397	1429	23	8	346	2444
	1.84	0.41	6.71	0.90	16.24	58.47	0.94	0.33	14.16	100.00

Table 31 (Continued)

TOOL* / UNIT FREQUENCY PERCENT ROW PCT COL PCT	UNIT I	UNIT II	UNIT III	UNIT I-III	UNIT IV	UNIT V	UNIT VI	UNIT VII	OTHER	TOTAL
PLAIN KNIFE	0	0	1	0	2	13	0	0	1	17
	0.00	0.00	0.04	0.00	0.08	0.53	0.00	0.00	0.04	0.70
	0.00	0.00	5.88	0.00	11.76	76.47	0.00	0.00	5.88	
	0.00	0.00	0.61	0.00	0.50	0.91	0.00	0.00	0.29	
OTHER KNIFE	0	0	0	0	0	1	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.04
	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	
PLANE	0	0	1	0	0	0	0	0	0	1
	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04
	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.00	0.00	
T-HANDLE	0	0	0	0	0	2	0	0	0	2
	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.08
	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	
DRILL	0	0	0	0	2	2	0	0	0	4
	0.00	0.00	0.00	0.00	0.08	0.08	0.00	0.00	0.00	0.16
	0.00	0.00	0.00	0.00	50.00	50.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.50	0.14	0.00	0.00	0.00	
WHETSTONE**	39	9	63	18	135	330	4	1	197	796
	1.60	0.37	2.58	0.74	5.52	13.50	0.16	0.04	8.06	32.57
	4.90	1.13	7.91	2.26	16.96	41.46	0.50	0.13	24.75	
	86.67	90.00	38.41	81.82	34.01	23.09	17.39	12.50	56.94	
TOTAL	45	10	164	22	397	1429	23	8	346	2444
	1.84	0.41	6.71	0.90	16.24	58.47	0.94	0.33	14.16	100.00

*ABBREVIATIONS -- BEA, BEAVER; DIST, DISTAL; EXPD, EXPANDING; FRAG, FRAGMENT; LG, LARGE; LN, LONG; LONGITUD, LONGITUDINAL; MD, MEDIUM; MS, MUSSEL; PROX, PROXIMAL; RECYL, RECYCLED; SH, SHORT; SM, SMALL; WED, WOOD WEDGE.

**THIS COUNT WAS DERIVED FROM THE FIELD CATALOG IDENTIFICATIONS.

Table 32

Chi-square of Unit III and Unit V Tools

TOOL*	UNIT		
FREQUENCY EXPECTED DEVIATION CELL CHI2 PERCENT ROW PCT COL PCT	UNIT III	UNIT V	TOTAL
WHALE BONE WEDGE	9 5.8 3.2 1.8 0.86 18.37 7.32	40 43.2 -3.2 0.2 3.84 81.63 4.35	49 4.70
SH LG OVAL WED	41 32.6 8.4 2.2 3.93 14.86 33.33	235 243.4 -8.4 0.3 22.55 85.14 25.57	276 26.49
LONGTUD WED FRAG	10 19.5 -9.5 4.6 0.96 6.06 8.13	155 145.5 9.5 0.6 14.88 93.94 16.87	165 15.83
MS SHELL KNIFE	0 18.8 -18.8 18.8 0.00 0.00 0.00	159 140.2 18.8 2.5 15.26 100.00 17.30	159 15.26
WHETSTONE**	63 46.4 16.6 5.9 6.05 16.03 51.22	330 346.6 -16.6 0.8 31.67 83.97 35.91	393 37.72
TOTAL	123 11.80	919 88.20	1042 100.00

STATISTICS FOR 2-WAY TABLES

CHI-SQUARE	37.747	DF= 4	PROB=0.0001
CONTINGENCY COEFFICIENT	0.187		
LAMBDA SYMMETRIC	0.000		

*ABBREVIATIONS -- FRAG, FRAGMENT; LG, LARGE; LONGITUD, LONGITUDINAL; MS, MUSSEL; SH, SHORT; WED, WOOD WEDGE.

**THIS COUNT WAS DERIVED FROM FIELD CATALOG IDENTIFICATIONS.

Table 33

Chi-square of Unit IV and Unit V Tools

TOOL*	UNIT		
FREQUENCY EXPECTED DEVIATION CELL CHI2 PERCENT COL PCT	UNIT IV	UNIT V	TOTAL
WHALE BONE WEDGE	10	40	50
	11.4	38.6	
	-1.4	1.4	
	0.2	0.1	
	0.68	2.72	3.40
	20.00	80.00	
	2.98	3.53	
ANTLER WEDGE	7	37	44
	10.1	33.9	
	-3.1	3.1	
	0.9	0.3	
	0.48	2.52	3.00
	15.91	84.09	
	2.08	3.27	
SH LG OVAL WED	56	235	291
	66.6	224.4	
	-10.6	10.6	
	1.7	0.5	
	3.81	16.00	19.81
	19.24	80.76	
	16.67	20.74	
MDLN LG OVAL WED	19	10	29
	6.6	22.4	
	12.4	-12.4	
	23.1	6.8	
	1.29	0.68	1.97
	65.52	34.48	
	5.65	0.88	
SH LG RECT WED	7	25	32
	7.3	24.7	
	-0.3	0.3	
	0.0	0.0	
	0.48	1.70	2.18
	21.88	78.13	
	2.08	2.21	
TOTAL	336	1133	1469
	22.87	77.13	100.00

Table 33 (Continued)

TOOL*	UNIT		
FREQUENCY EXPECTED DEVIATION CELL CHI2 PERCENT ROW PCT COL PCT	UNIT IV	UNIT V	TOTAL
SH ROD WED	4	41	45
	10.3	34.7	
	-6.3	6.3	
	3.8	1.1	
	0.27	2.79	3.06
	8.89	91.11	
	1.19	3.62	
MDLN ROD WED	11	14	25
	5.7	19.3	
	5.3	-5.3	
	4.9	1.4	
	0.75	0.95	1.70
	44.00	56.00	
	3.27	1.24	
WED PREFORM	42	9	51
	11.7	39.3	
	30.3	-30.3	
	78.9	23.4	
	2.86	0.61	3.47
	82.35	17.65	
	12.50	0.79	
PROX WED FRAG	7	40	47
	10.8	36.2	
	-3.8	3.8	
	1.3	0.4	
	0.48	2.72	3.20
	14.89	85.11	
	2.08	3.53	
LONGTUD WED FRAG	20	155	175
	40.0	135.0	
	-20.0	20.0	
	10.0	3.0	
	1.36	10.55	11.91
	11.43	88.57	
	5.95	13.68	
TOTAL	336	1133	1469
	22.87	77.13	100.00

Table 33 (Continued)

TOOL*	UNIT		
FREQUENCY EXPECTED DEVIATION CELL CHI2 PERCENT ROW PCT COL PCT	UNIT IV	UNIT V	TOTAL
GROMMET	8	38	46
	10.5	35.5	
	-2.5	2.5	
	0.6	0.2	
	0.54	2.59	3.13
	17.39	82.61	
	2.38	3.35	
MS SHELL KNIFE	10	159	169
	38.7	130.3	
	-28.7	28.7	
	21.2	6.3	
	0.68	10.82	11.50
	5.92	94.08	
	2.98	14.03	
WHETSTONE**	135	330	465
	106.4	358.6	
	28.6	-28.6	
	7.7	2.3	
	9.19	22.46	31.65
	29.03	70.97	
	40.18	29.13	
TOTAL	336	1133	1469
	22.87	77.13	100.00

STATISTICS FOR 2-WAY TABLES

CHI-SQUARE	200.136	DF= 12	PROB=0.0001
CONTINGENCY COEFFICIENT	0.346		
LAMBDA SYMMETRIC	0.031		

*ABBREVIATIONS -- FRAG, FRAGMENT; LG, LARGE; LN, LONG; LONGITUD, LONGITUDINAL; MD, MEDIUM; MS, MUSSEL; PROX, PROXIMAL; RECYL, RECYCLED; SH,SHORT; WED, WOOD WEDGE.

**THIS COUNT WAS DERIVED FROM FIELD CATALOG IDENTIFICATIONS.

Table 34

Chi-square of House 1 and House 2 Tools

TOOL*	HOUSE		
FREQUENCY EXPECTED DEVIATION CELL CHI2 PERCENT ROW PCT COL PCT	HOUSE 1	HOUSE 2	TOTAL
WHALE BONE WEDGE	4 9.8 -5.8 3.4 0.94 26.67 1.44	11 5.2 5.8 6.4 2.58 73.33 7.38	15 3.51
SH LG OVAL WED	52 49.5 2.5 0.1 12.18 68.42 18.71	24 26.5 -2.5 0.2 5.62 31.58 16.11	76 17.80
SH ROD WED	9 10.4 -1.4 0.2 2.11 56.25 3.24	7 5.6 1.4 0.4 1.64 43.75 4.70	16 3.75
DIST WED FRAG	29 35.8 -6.8 1.3 6.79 52.73 10.43	26 19.2 6.8 2.4 6.09 47.27 17.45	55 12.88
TOTAL	278 65.11	149 34.89	427 100.00

Table 34 (Continued)

TOOL*	HOUSE		
FREQUENCY EXPECTED DEVIATION CELL CHI2 PERCENT ROW PCT COL PCT	HOUSE 1	HOUSE 2	TOTAL
GROMMET	23	0	23
	15.0	8.0	
	8.0	-8.0	
	4.3	8.0	
	5.39	0.00	5.39
	100.00	0.00	
	8.27	0.00	
MS SHELL KNIFE	52	48	100
	65.1	34.9	
	-13.1	13.1	
	2.6	4.9	
	12.18	11.24	23.42
	52.00	48.00	
	18.71	32.21	
WHETSTONE**	109	33	142
	92.4	49.6	
	16.6	-16.6	
	3.0	5.5	
	25.53	7.73	33.26
	76.76	23.24	
	39.21	22.15	
TOTAL	278	149	427
	65.11	34.89	100.00

STATISTICS FOR 2-WAY TABLES

CHI-SQUARE	42.763	DF= 6	PROB=0.0001
CONTINGENCY COEFFICIENT	0.302		
LAMBDA SYMMETRIC	0.051		

*ABBREVIATIONS -- FRAG , FRAGMENT; DIST, DISTAL; LG, LARGE; MS, MUSSEL; SH, SHORT; WED, WOOD WEDGE.

**THIS COUNT WAS DERIVED FROM FIELD CATALOG IDENTIFICATIONS.

Table 35

Chi-square of House Floor and Exterior Midden Tools

TOOL*	MIDDEN DEPOSIT		
FREQUENCY EXPECTED DEVIATION CELL CHI2 PERCENT ROW PCT COL PCT	HOUSE FLOOR	EXTERIOR MIDDEN	TOTAL
WHALE BONE WEDGE	20 22.3 -2.3 0.2 1.90 51.28 3.32	19 16.7 2.3 0.3 1.81 48.72 4.23	39 3.71
SH LG OVAL WED	127 132.9 -5.9 0.3 12.08 54.74 21.10	105 99.1 5.9 0.3 9.99 45.26 23.39	232 22.07
SH LG RECT WED	14 13.7 0.3 0.0 1.33 58.33 2.33	10 10.3 -0.3 0.0 0.95 41.67 2.23	24 2.28
SH ROD WED	26 23.5 2.5 0.3 2.47 63.41 4.32	15 17.5 -2.5 0.4 1.43 36.59 3.34	41 3.90
WED PREFORM	10 12.0 -2.0 0.3 0.95 47.62 1.66	11 9.0 2.0 0.5 1.05 52.38 2.45	21 2.00
TOTAL	602 57.28	449 42.72	1051 100.00

Table 35 (Continued)

TOOL*	MIDDEN DEPOSIT		
FREQUENCY EXPECTED DEVIATION CELL CHI2 PERCENT ROW PCT COL PCT	HOUSE FLOOR	EXTERIOR MIDDEN	TOTAL
PROX WED FRAG	16 22.9 -6.9 2.1 1.52 40.00 2.66	24 17.1 6.9 2.8 2.28 60.00 5.35	40 3.81
DIST WED FRAG	89 95.7 -6.7 0.5 8.47 53.29 14.78	78 71.3 6.7 0.6 7.42 46.71 17.37	167 15.89
MS SHELL KNIFE	115 90.5 24.5 6.6 10.94 72.78 19.10	43 67.5 -24.5 8.9 4.09 27.22 9.58	158 15.03
WHETSTONE**	185 188.4 -3.4 0.1 17.60 56.23 30.73	144 140.6 3.4 0.1 13.70 43.77 32.07	329 31.30
TOTAL	602 57.28	449 42.72	1051 100.00

STATISTICS FOR 2-WAY TABLES

CHI-SQUARE	24.263	DF= 8	PROB=0.0021
CONTINGENCY COEFFICIENT	0.151		
LAMBDA SYMMETRIC	0.007		

*ABBREVIATIONS -- DIST, DISTAL; FRAG, FRAGMENT; LG, LARGE; MS, MUSSEL; SH, SHORT; WED, WOOD WEDGE.

*THIS COUNT WAS DERIVED FROM FIELD CATALOG IDENTIFICATIONS.

Table 36

Woodchip Dimensions

DIMENSIONS:	RANGE	MEAN	SD	SAMPLE
PROFILE 1 WOODCHIPS (N=492)				
LENGTH	.4 - 9.4	2.8	1.31	492
WIDTH	.3 - 2.8	.9	.37	492
THICKNESS	.01- .45	.12	.06	492
WEIGHT	.01- .67	.07	.10	492
ANGLE IN*	1 -12	4.0	1.52	487
ANGLE OUT*	1 -15	3.8	1.51	489
FACETS	1 - 8	2.2	1.18	491
PROFILE 2 WOODCHIPS (N=127)				
LENGTH	.9 - 9.0	2.8	1.41	127
WIDTH	.5 - 3.8	1.1	.43	127
THICKNESS	.04- .94	.21	.14	127
WEIGHT	.01- 2.31	.15	.26	127
ANGLE IN*	2 -22	6.4	2.85	125
ANGLE OUT*	2 -38	8.1	6.49	124
FACETS	1 - 6	3.0	1.20	126
PROFILE 3 WOODCHIPS (N=82)				
LENGTH	.7 - 8.8	2.9	1.68	82
WIDTH	.5 - 3.5	1.5	.64	82
THICKNESS	.08- .86	.28	.15	82
WEIGHT	.01- 2.52	.30	.48	82
ANGLE IN*	4 -19	8.2	2.94	82
ANGLE OUT*	3 -36	9.5	6.29	82
FACETS	1 - 9	3.1	1.36	82
PROFILE 4 WOODCHIPS (N=13)				
LENGTH	1.2 - 6.5	2.9	1.44	13
WIDTH	.5 - 2.9	1.5	.78	13
THICKNESS	.17- 1.11	.44	.33	13
WEIGHT	.01- 3.02	.49	.80	13
ANGLE IN*	5 -25	14.3	6.63	13
ANGLE OUT*	5 -36	17.7	8.70	13
FACETS	1 - 6	2.9	1.72	13
ALL WOODCHIPS (N=1150)				
LENGTH	.4 -10.3	2.9	1.45	1150
WIDTH	.2 - 4.0	1.1	.51	1150
THICKNESS	.01- 1.90	.18	.15	1150
WEIGHT	.01- 4.85	.13	.30	1150
ANGLE IN*	1 -56	6.1	4.74	1075
ANGLE OUT*	1 -42	6.4	5.57	1093
FACETS	1 - 9	2.4	1.18	1146

* ANGLES MEASURED IN 2.5 DEGREE INCREMENTS.

Table 37

Woodscar Dimensions

DIMENSIONS:	RANGE	MEAN	SD	SAMPLE
GROUP 1 WOODSCARS (N=721)				
LENGTH	1.0-11.0	3.6	1.69	721
WIDTH	.6- 5.1	1.5	.45	721
GROUP 2 WOODSCARS (N=598)				
LENGTH	.2- 5.4	1.5	.72	598
WIDTH	.2- 1.6	.7	.20	598
GROUP 3 WOODSCARS (N=399)				
LENGTH	1.0-31.0	6.5	3.52	399
WIDTH	1.0- 7.3	3.5	.87	399

Table 38

Chip Dimensions for Woodchips Classed by Woodscars

DIMENSIONS:	RANGE	MEAN	SD	SAMPLE
GROUP 1 WOODCHIPS (N=250)				
LENGTH	.9 - 9.4	3.6	1.49	251
WIDTH	.7 - 2.3	1.4	.31	251
THICKNESS	.03- 2.3	.22	.12	251
WEIGHT	.01- 1.87	.20	.21	251
ANGLE IN*	2 -25	4.7	3.12	445
ANGLE OUT*	1 -40	6.8	5.97	248
FACETS	1 - 9	2.9	1.43	250
GROUP 2 WOODCHIPS (N=452)				
LENGTH	.4 - 6.3	2.3	.96	452
WIDTH	.3 - 1.1	.8	.19	452
THICKNESS	.01- .79	.11	.07	452
WEIGHT	.01- .33	.04	.04	452
ANGLE IN*	1 -36	4.7	3.12	445
ANGLE OUT*	1 -38	4.7	3.12	449
FACETS	1 - 7	2.2	1.09	451
GROUP 3 WOODCHIPS (N=15)				
LENGTH	1.8 - 9.0	4.6	2.10	15
WIDTH	2.5 - 3.6	2.9	.33	15
THICKNESS	.20- 1.11	.57	.31	15
WEIGHT	.15- 3.02	1.16	.94	15
ANGLE IN*	5 -21	11.1	5.19	15
ANGLE OUT*	3 -36	14.3	11.12	14
FACETS	1 - 5	2.5	1.30	15

* ANGLES MEASURED IN 2.5 DEGREE INCREMENTS.

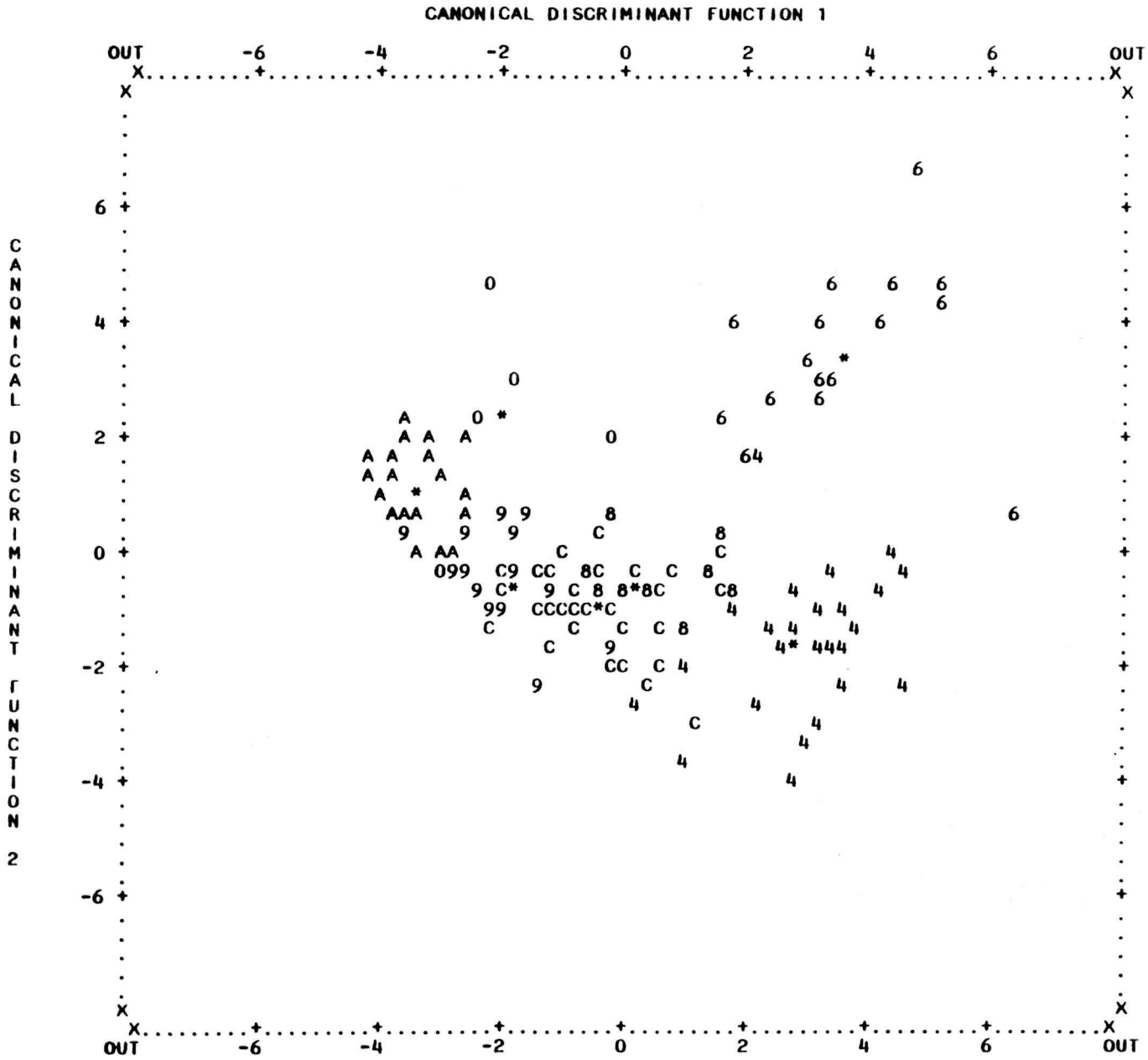

CANONICAL DISCRIMINANT FUNCTION 1
CANONICAL DISCRIMINANT FUNCTION 2
OUT
-6
-4
-2
0
2
4
6
OUT

Figure 54. Discriminant analysis of large rectangular, oval and rod wood wedges.

CANONICAL DISCRIMINANT FUNCTIONS

FUNCTION	EIGENVALUE	PERCENT OF VARIANCE	CUMULATIVE PERCENT	CANONICAL CORRELATION	: AFTER FUNCTION	WILKS' LAMBDA	CHI-SQUARED	D.F.	SIGNIFICANCE
					: 0	0.0117141	573.66	18	0.0
1 LENGTH*	6.21153	55.80	55.80	0.9280803	: 1	0.0844763	318.80	10	0.0
2 WIDTH*	2.82745	25.40	81.20	0.8594939	: 2	0.3233291	145.65	4	0.0000
3 LIFT*	2.09282	18.80	100.00	0.8226001	:				

* MARKS THE 3 CANONICAL DISCRIMINANT FUNCTION(S) TO BE USED IN THE REMAINING ANALYSIS.

STANDARDIZED CANONICAL DISCRIMINANT FUNCTION COEFFICIENTS

	FUNC 1	FUNC 2	FUNC 3
LENGTH	-0.08473	-0.40262	1.09688
WIDTH	0.63917	-0.98033	-0.52031
LIFT	0.51749	1.24683	-0.00411

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 90.37%

SYMBOLS USED IN PLOTS

SYMBOL	GROUP	LABEL
4	9	MEDIUM TO LONG, LARGE OVAL WOOD WEDGES
6	11	MEDIUM TO LONG, LARGE RECTANGULAR WOOD WEDGES
8	13	MEDIUM OVAL WOOD WEDGES
9	14	SMALL OVAL WOOD WEDGES
0	15	SMALL RECTANGULAR WOOD WEDGES
A	16	WOOD MARKING WEDGES
C	18	MEDIUM TO LONG, ROD WOOD WEDGES
*		GROUP CENTROIDS

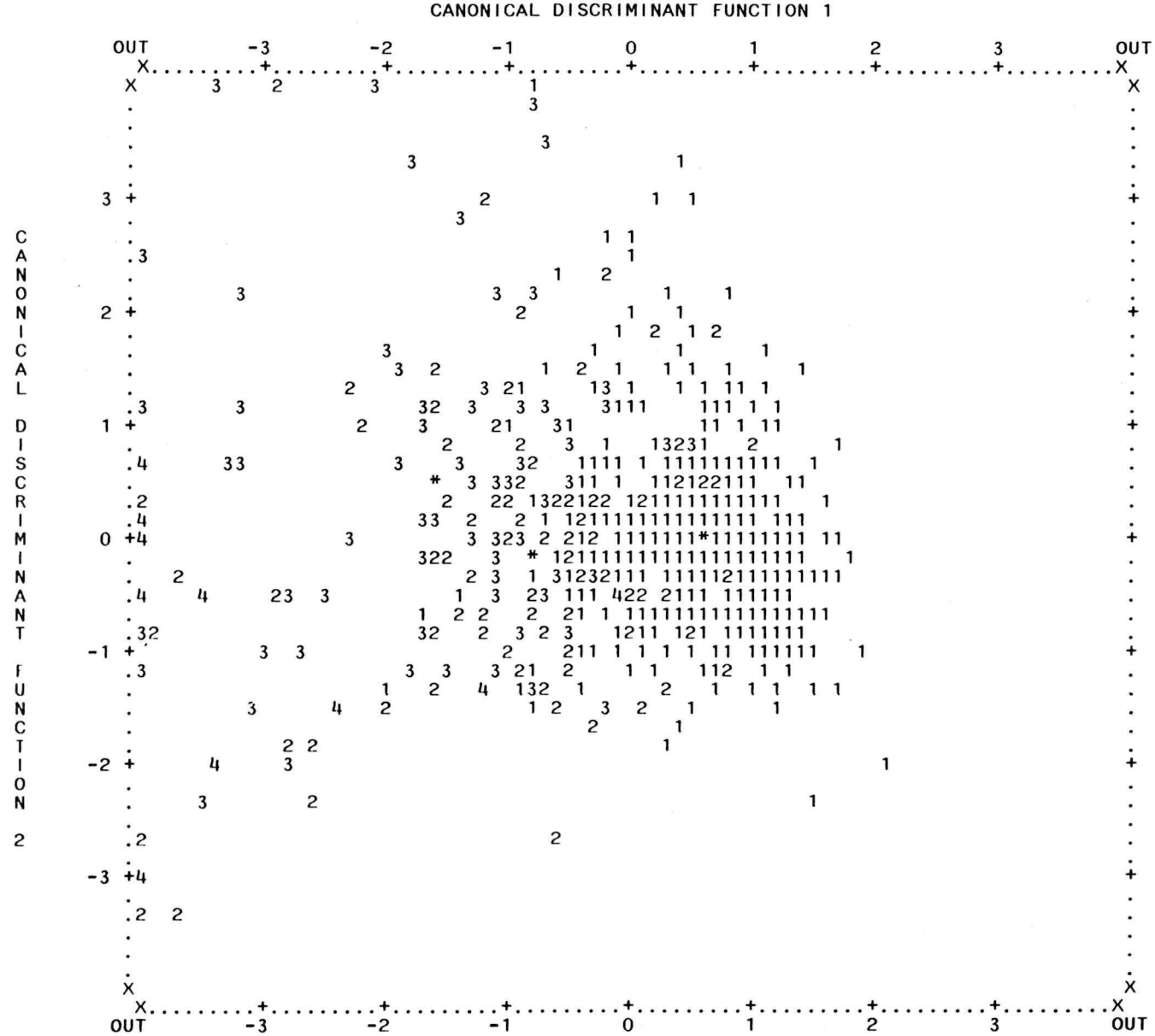

CANONICAL DISCRIMINANT FUNCTION 1
CANONICAL DISCRIMINANT FUNCTION 2
OUT
-3
-2
-1
0
1
2
3
OUT

Figure 55. Discriminant analysis of woodchips by profile.

CANONICAL DISCRIMINANT FUNCTIONS

FUNCTION	EIGENVALUE	PERCENT OF VARIANCE	CUMULATIVE PERCENT	CANONICAL CORRELATION	AFTER FUNCTION	WILKS' LAMBDA	CHI-SQUARED	D.F.	SIGNIFICANCE
					0	0.4776171	515.41	15	0.0
1 ANGLE IN*	0.99679	95.39	95.39	0.7065385	1	0.9537020	33.064	8	0.0001
2 ANGLE OUT*	0.03676	3.52	98.91	0.1882999	2	0.9887603	7.8841	3	0.0485
3 THICKNESS*	0.01137	1.09	100.00	0.1060174					

* MARKS THE 3 CANONICAL DISCRIMINANT FUNCTION(S) TO BE USED IN THE REMAINING ANALYSIS.

STANDARDIZED CANONICAL DISCRIMINANT FUNCTION COEFFICIENTS

	FUNC 1	FUNC 2	FUNC 3
LENGTH	0.19445	-0.43447	0.25617
WIDTH	0.01854	1.15175	-0.12228
THICKNESS	-0.44669	-0.00266	-0.21847
ANGLE IN	-0.50607	-0.16395	0.88147
ANGLE OUT	-0.43880	-0.44988	-0.72340

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 73.97%

SYMBOLS USED IN PLOTS

SYMBOL	GROUP	LABEL
1	1	PROFILE 1
2	2	PROFILE 2
3	3	PROFILE 3
4	4	PROFILE 4
*		GROUP CENTROIDS

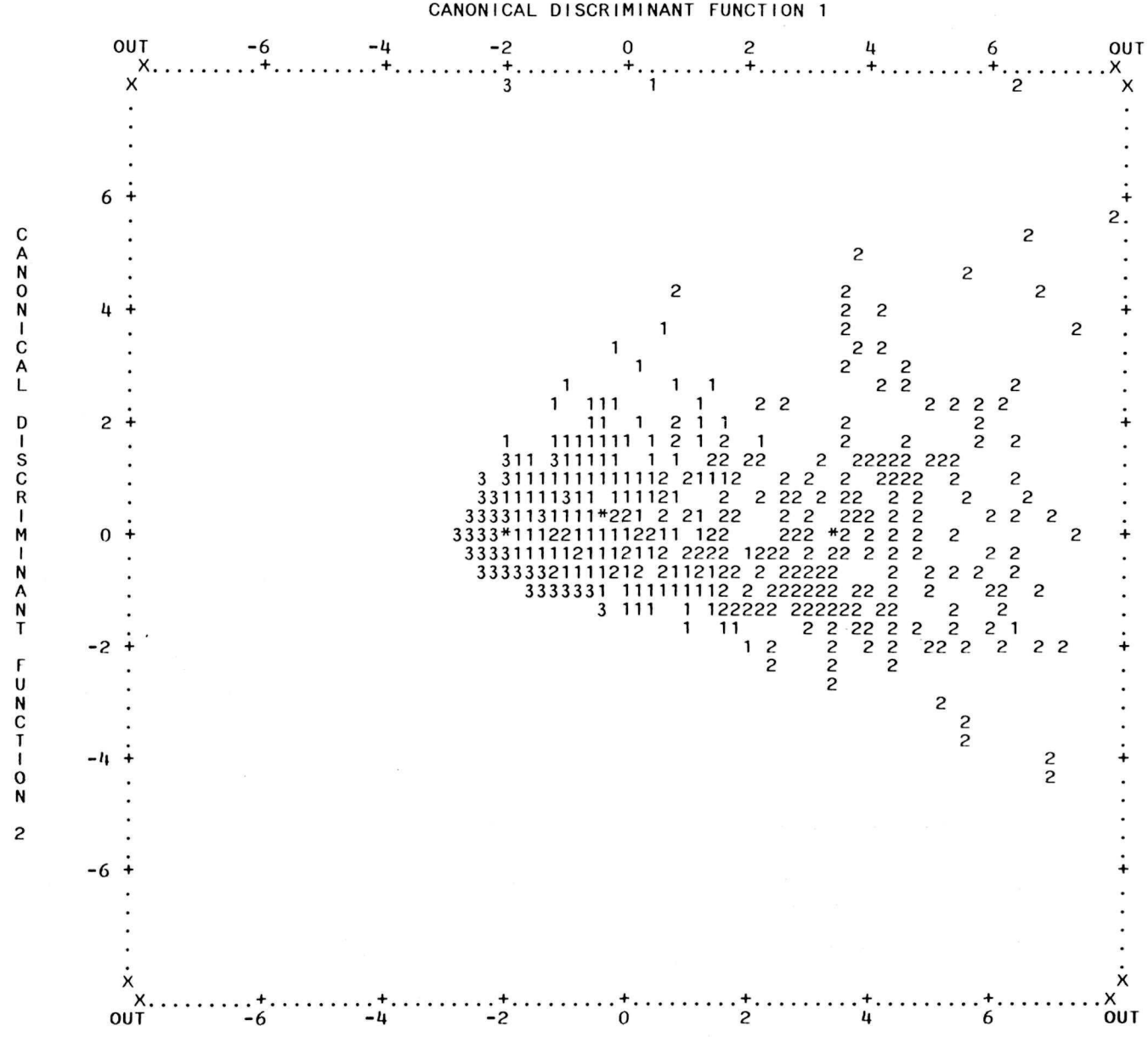

CANONICAL DISCRIMINANT FUNCTION 1
CANONICAL DISCRIMINANT FUNCTION 2
OUT
-6
-4
-2
0
2
4
6
OUT

Figure 56. Discriminant analysis of woodscars by artifact group.

CANONICAL DISCRIMINANT FUNCTIONS

FUNCTION	EIGENVALUE	PERCENT OF VARIANCE	CUMULATIVE PERCENT	CANONICAL CORRELATION	: AFTER FUNCTION	WILKS' LAMBDA	CHI-SQUARED	D.F.	SIGNIFICANCE
					: 0	0.1925297	2791.7	4	0.0
1 WIDTH*	4.08952	99.50	99.50	0.8963915	: 1	0.9798833	34.435	1	0.0000
2 LENGTH*	0.02053	0.50	100.00	0.1418335	:				

* MARKS THE 2 CANONICAL DISCRIMINANT FUNCTION(S) TO BE USED IN THE REMAINING ANALYSIS.

STANDARDIZED CANONICAL DISCRIMINANT FUNCTION COEFFICIENTS

	FUNC 1	FUNC 2
LENGTH	0.04966	1.07556
WIDTH	0.98053	-0.44482

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 89.05%

SYMBOLS USED IN PLOTS

SYMBOL	GROUP	LABEL
1	1	GROUP 1
2	2	GROUP 2
3	3	GROUP 3
*		GROUP CENTROIDS

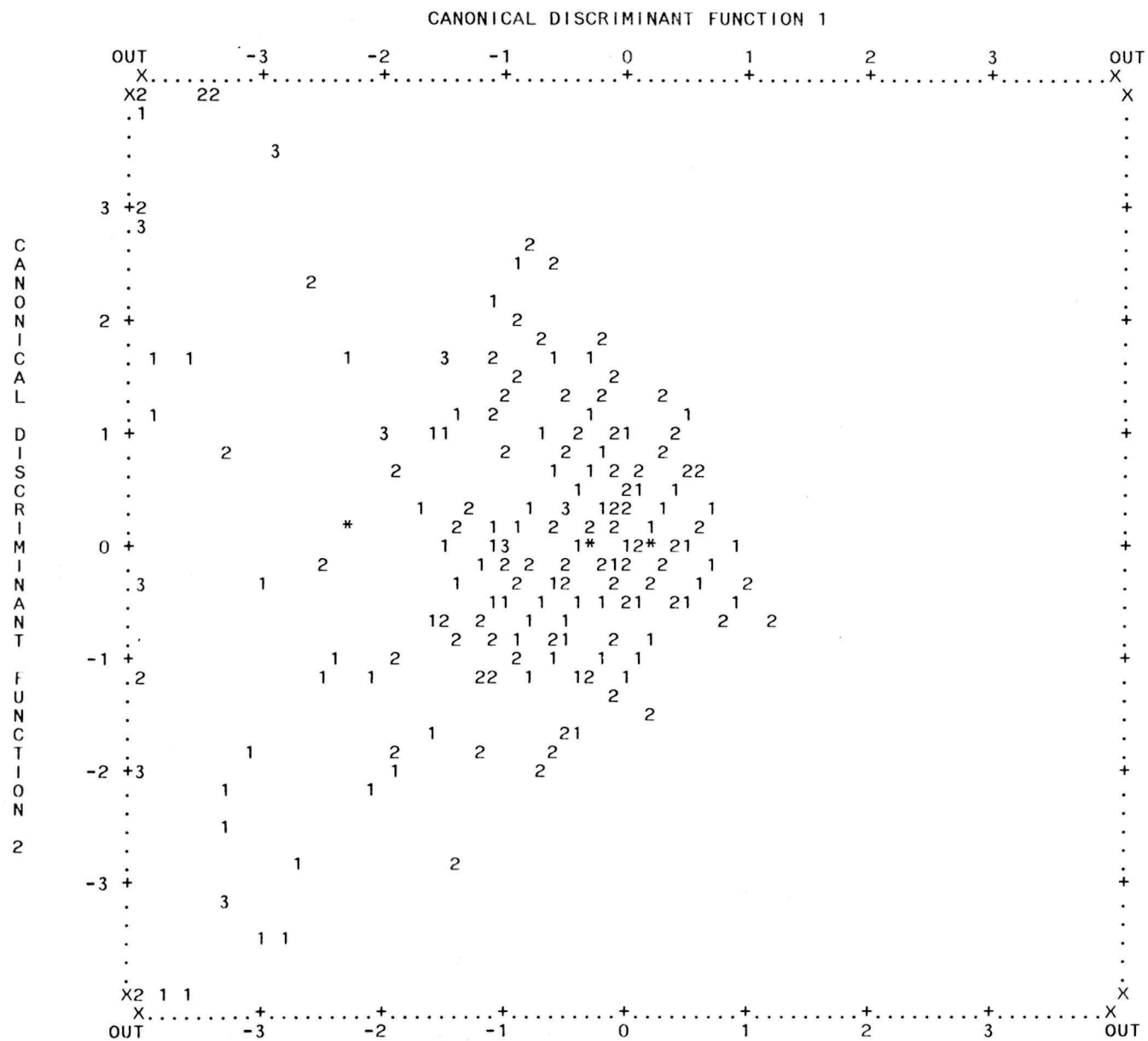

CANONICAL DISCRIMINANT FUNCTION 1
CANONICAL DISCRIMINANT FUNCTION 2
OUT
-3
-2
-1
0
1
2
3
OUT

Figure 57. Discriminant analysis of woodchips by profile and angle.

CANONICAL DISCRIMINANT FUNCTIONS

FUNCTION	EIGENVALUE	PERCENT OF VARIANCE	CUMULATIVE PERCENT	CANONICAL CORRELATION	AFTER FUNCTION	WILKS' LAMBDA	CHI-SQUARED	D.F.	SIGNIFICANCE
					0	0.8649557	101.55	6	0.0000
1 ANGLE OUT*	0.15428	98.97	98.97	0.3655901	1	0.9983976	1.1226	2	0.5705
2 ANGLE IN*	0.00160	1.03	100.00	0.0400297					

* MARKS THE 2 CANONICAL DISCRIMINANT FUNCTION(S) TO BE USED IN THE REMAINING ANALYSIS.

STANDARDIZED CANONICAL DISCRIMINANT FUNCTION COEFFICIENTS

	FUNC 1	FUNC 2
LENGTH	0.15505	0.85856
THICKNESS	0.78668	-0.08882
ANGLE IN	-0.17184	-0.35180
ANGLE OUT	0.39423	-0.20432

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 57.81%

SYMBOLS USED IN PLOTS

SYMBOL	GROUP	LABEL
1	1	GROUP 1
2	2	GROUP 2
3	3	GROUP 3
*		GROUP CENTROIDS

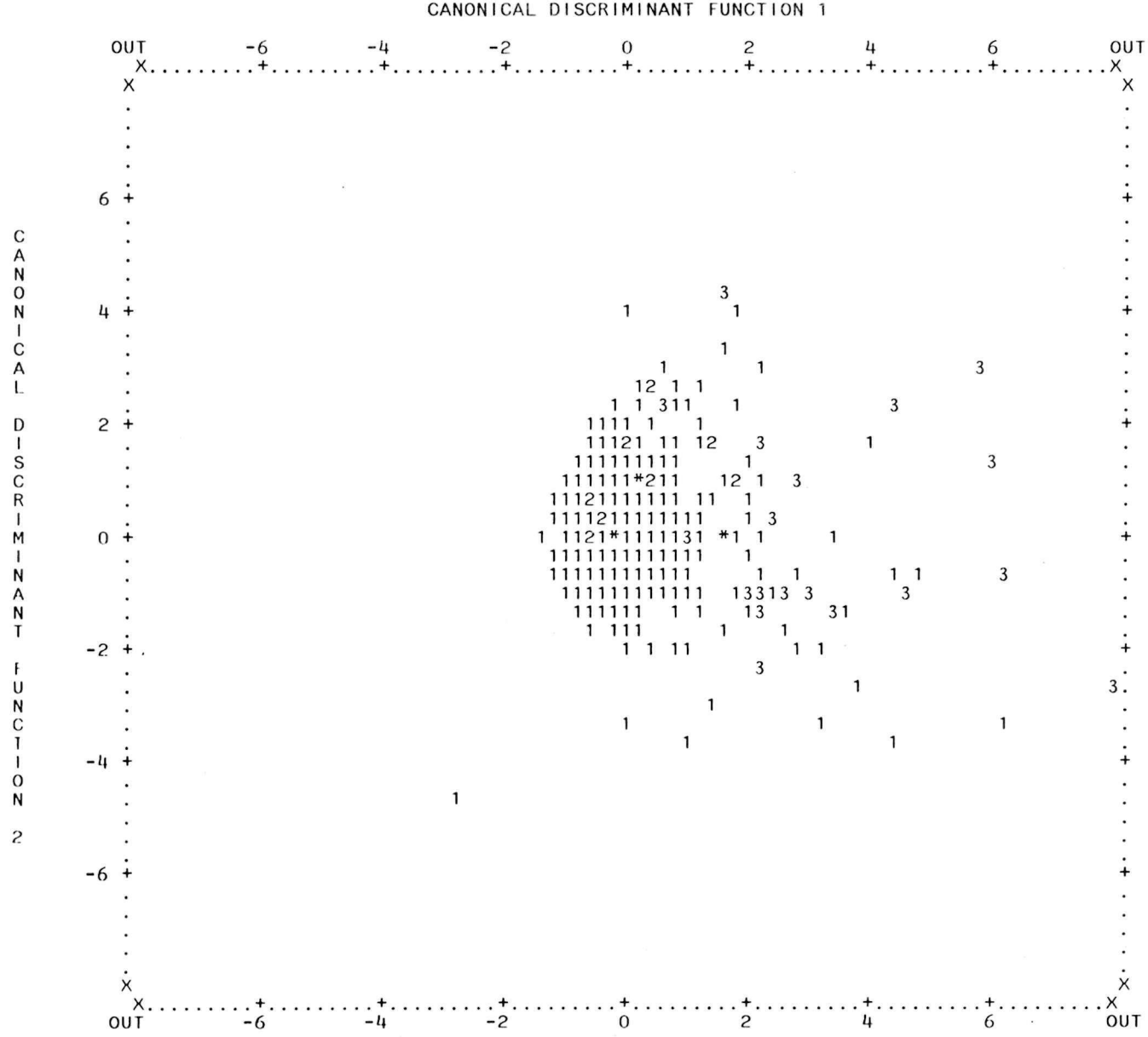

CANONICAL DISCRIMINANT FUNCTION 1
CANONICAL DISCRIMINANT FUNCTION 2
OUT
-6
-4
-2
0
2
4
6

Figure 58. Discriminant analysis of House 1 areas by woodchips, chip class not included.

CANONICAL DISCRIMINANT FUNCTIONS

FUNCTION	EIGENVALUE	PERCENT OF VARIANCE	CUMULATIVE PERCENT	CANONICAL CORRELATION	AFTER FUNCTION	WILKS' LAMBDA	CHI-SQUARED	D.F.	SIGNIFICANCE
					0	0.8399010	122.04	8	0.0000
1 LENGTH*	0.17234	91.70	91.70	0.3834113	1	0.9846485	10.822	3	0.0127
2 THICKNESS*	0.01559	8.30	100.00	0.1239012					

* MARKS THE 2 CANONICAL DISCRIMINANT FUNCTION(S) TO BE USED IN THE REMAINING ANALYSIS.

STANDARDIZED CANONICAL DISCRIMINANT FUNCTION COEFFICIENTS

	FUNC 1	FUNC 2
LENGTH	0.15505	0.85856
THICKNESS	0.78668	-0.08882
ANGLE IN	-0.17184	-0.35180
ANGLE OUT	0.39423	-0.20432

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 68.61%

SYMBOLS USED IN PLOTS

SYMBOL	GROUP	LABEL
1	1	AREAS A, B, C, F, G, AND H
2	2	AREA D
3	3	AREA E
*		GROUP CENTROIDS

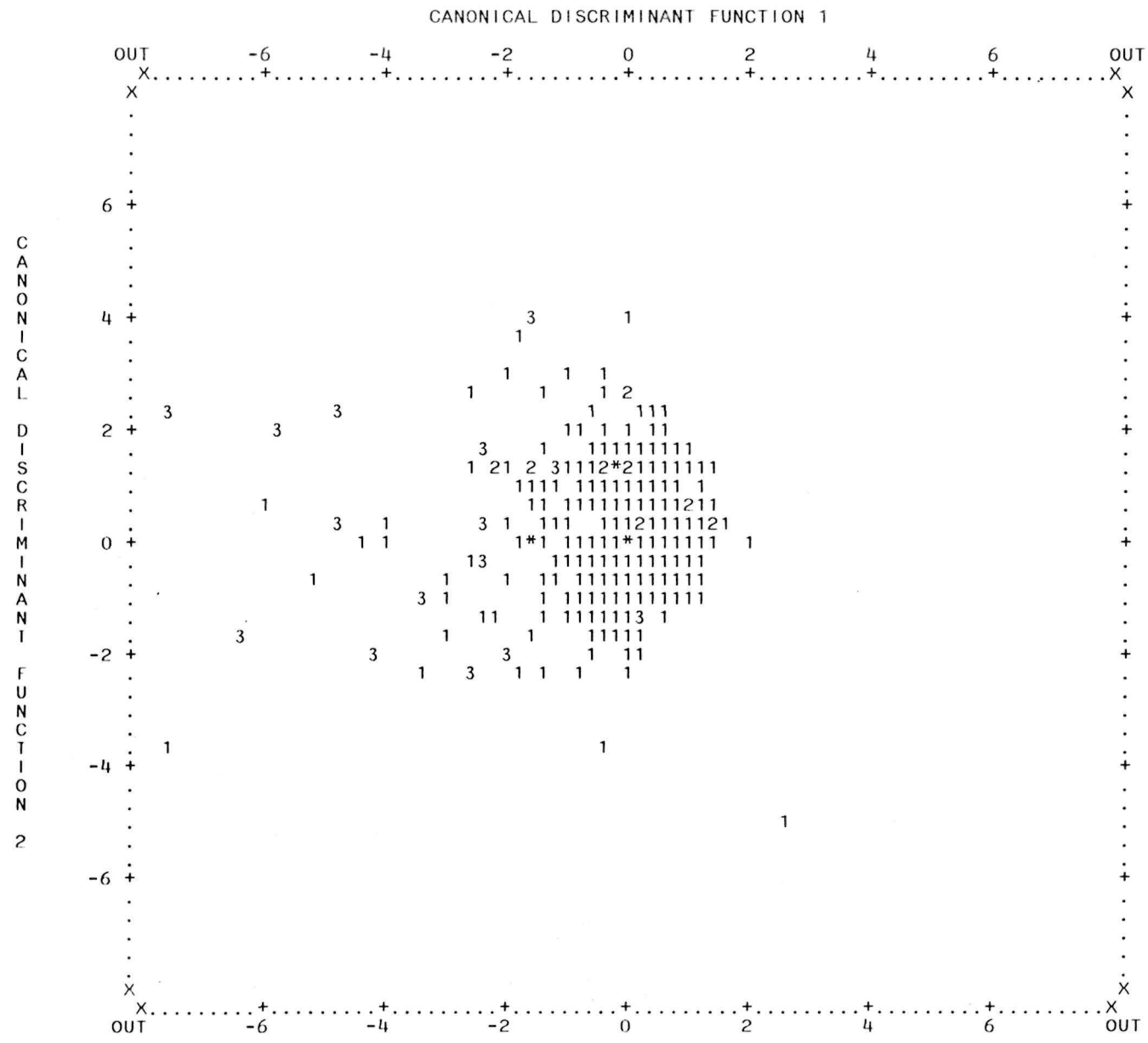

CANONICAL DISCRIMINANT FUNCTION 1
CANONICAL DISCRIMINANT FUNCTION 2
OUT
-6
-4
-2
0
2
4
6
OUT

Figure 59. Discriminant analysis of House 1 areas by woodchips, chip class included.

CANONICAL DISCRIMINANT FUNCTIONS

FUNCTION	EIGENVALUE	PERCENT OF VARIANCE	CUMULATIVE PERCENT	CANONICAL CORRELATION	: AFTER FUNCTION	WILKS' LAMBDA	CHI-SQUARED	D.F.	SIGNIFICANCE
					: 0	0.8476376	113.23	10	0.0000
1 THICKNESS*	0.15999	90.38	90.38	0.3713847	: 1	0.9832546	11.568	4	0.0209
2 CHIP GROUP*	0.01703	9.62	100.00	0.1294040	:				

* MARKS THE 2 CANONICAL DISCRIMINANT FUNCTION(S) TO BE USED IN THE REMAINING ANALYSIS.

STANDARDIZED CANONICAL DISCRIMINANT FUNCTION COEFFICIENTS

	FUNC 1	FUNC 2
LENGTH	-0.31027	0.73515
THICKNESS	-0.65724	0.01904
ANGLE IN	0.14891	-0.34641
ANGLE OUT	-0.35570	-0.15950
CHIP GROUP	-0.48219	-0.27288

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 69.13%

SYMBOLS USED IN PLOTS

SYMBOL	GROUP	LABEL
1	1	AREAS A, B, C, F, G, AND H
2	2	AREA D
3	3	AREA E
*		GROUP CENTROIDS