PRECONTACT ARCHAEOLOGICAL CONTRASTS OF THREE VALLEY SYSTEMS ON OAHU, HAWAII

by

STEWART NEAL CROZIER

B.F.A. Carnegie Inst. of Technology, 1961

A THESIS SUBMITTED IN PARTIAL FULFILMENT
OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in the Department

of

Anthropology

ACCEPTED
FACULTY OF GRADUATE STUDIES

[redacted]

Assoc. DEAN

DATE 30 April 1974

We accept this thesis as conforming
to the required standard

[redacted]

© STEWART NEAL CROZIER, 1974

UNIVERSITY OF VICTORIA

April 1974

All rights reserved. This thesis may not be reproduced in whole or in part, by mimeograph or other means, without the permission of the author.

Supervisor: William Alkire

ABSTRACT

On the island of Oahu, Hawaii, only in the valleys of South Halawa, Makaha, and Kahana, has a significant quantity of data relating to a diverse range of man-made structures been mapped, recorded in detail, and analyzed typologically. Several of the more important sites have been excavated. Archaeological field investigation was carried on in the three valleys, Makaha, Kahana, and South Halawa, between 1968 and 1972. During 1971 and 1972, restoration and reconstruction of several precontact sites took place in two of the valleys.

The three valleys were all occupied in precontact times (prior to 1778). This report describes and analyzes the sites, features, and artifacts which are the archaeological remains covering an approximate 300 year sequence of occupation (A.D. 1400-1700).

The evidence suggests the existence of causal relationships between some environmental factors, e.g. physiography and precipitation, and human activities in each valley. Although not necessarily of an interdependent/dependent nature, it is hypothesized that differential climatic factors significantly influenced habitational and subsistence patterns and the religious life of human communities in the

three valleys. These relationships will be examined from the artifactual remains.

It must be stressed that the direct evidence of this analysis was obtained through a program of salvage archaeology. Therefore, some gaps in data may occasionally exist between the object of the problem being discussed here and the nature of the empirical data utilized for that purpose. There are also some limitations on the extent to which comparative generalizations can be made beyond the areas of investigation. However, the author believes the evidence is certainly adequate for the present conclusions, and although these conclusions will be confined to the empirical evidence available, the nature of the relationship between these variables should be of interest to future research on Oahu and throughout the Hawaiian chain.

Since the field evidence gathered in the course of 1971-1972 project in South Halawa Valley has not been tabulated or published, it is incorporated in the present thesis as an appendix.

W. Alkire [redacted]

N. Rolland [redacted]

B. Farrell [redacted]

R. Pearson [redacted]

ACKNOWLEDGMENT

I am indebted to the following members of my thesis committee for their valuable assistance in the organization of this paper: William Alkire, supervisor; Nicolas Rolland, Bryan Farrell, and Richard Pearson.

I also wish to acknowledge the members of the Department of Anthropology, B. P. Bishop Museum, Honolulu, and Y. H. Sinoto, K. P. Emory, R. C. Green, and E. J. Ladd, who aided this author throughout the field projects.

My sincere thanks also to my typist, Mrs. Eleanor Lowther of Victoria.

TABLE OF CONTENTS

	Page
LIST OF TABLES	viii
LIST OF FIGURES	ix
INTRODUCTION	1
Prehistory of the Hawaiian Islands	1
Archaeological Research on Oahu	4
OBJECTIVES AND RESEARCH	10
The Evidence	10
Aims of the Present Study	15
Method and Terminology	17
ENVIRONMENT AND HUMAN SETTLEMENT (CONTACT PERIOD)	19
Oahu	19
Climate	19
Vegetation	19
Soils	20
Raw Materials	20
Food Resources	24
Socio-Cultural Factors	24
Makaha	26
Climate	26
Vegetation	27
Soils	28
Raw Materials	28
Food Resources	29

Page

Socio-Cultural Factors 29

South Halawa 30

Climate 30

Vegetation 30

Soils 30

Raw Materials 30

Food Resources 31

Socio-Cultural Factors 31

Kahana 32

Climate 32

Vegetation 32

Soils 32

Raw Materials 33

Food Resources 33

Socio-Cultural Factors 34

ARCHAEOLOGICAL EVIDENCE (PRECONTACT PERIOD) 36

Sites and Structures 38

Habitational Features 39

Permanent House Foundation 39

Temporary House Shelter 39

Economic Features 40

Agricultural Terrace 40

Storage Pit 43

Animal Pen 44

Fishpond 45

Page

Religious Features 45

Large Heiau 45

Small Religious Shrine 46

Shrine 48

Burial 48

Portable Artifacts 49

Adze 55

Game Stones 55

Miscellaneous Artifacts 57

DISCUSSION 59

Makaha 62

South Halawa 63

Kahana 64

CONCLUSION 67

APPENDIX I

Glossary of Hawaiian Words Used in This Report . . 69

APPENDIX II

Age Determinations--Methods and Results 71

APPENDIX III

Four Precontact Sites in South Halawa Valley, Oahu, Hawaii 81

REFERENCES 117

LIST OF TABLES

Table		Page
I	Archaeological Research in Makaha, South Halawa, and Kahana, Oahu	7
II	Nature and Number of Excavated Sites in Makaha, South Halawa, and Kahana, Oahu	8
III	Native Plants and Trees	22
IV	Average Annual Rainfall in Makaha, South Halawa, and Kahana, Oahu	27
V	Nature, Number and Per Cent of Selected Remains	38
VI	Description of Soils in Three Inland Sites	42
VII	Provenience of Artifacts--Kahana Valley	50
VIII	Provenience of Artifacts--South Halawa Valley	51
IX	Provenience of Artifacts--Site B1-30--South Halawa Valley	52
X	Provenience of Artifacts--Makaha Valley	53
XI	Age Determinations from South Halawa Valley	74
XII	Estimates of Calendrical Ages for C^{14} Assayed Samples, Site C4-286, Makaha Valley	77
XIII	Estimates of Calendrical Ages for Radiocarbon Dated Samples from Makaha	78
XIV	Platforms of Site B1-67	96
XV	Radiocarbon Age Determinations, South Halawa Valley	113
XVI	Hydration Rind Age Determinations, Site B1-30, South Halawa Valley	114

LIST OF FIGURES

Figure		Page
1	Approximate Location of Makaha, South Halawa, and Kahana Valleys	5
2	Map of Hawaii and Makaha Valley, Showing Principal Landmarks	12
3	Survey Area and Sites in South Halawa Valley	13
4	Map of Kahana Valley Showing Location of Archaeological Sites	14
5	Average Annual Precipitation on Oahu	20
6	General Area of Valley Floor and Talus Utilization in the Lower Valley of Makaha, South Halawa, and Kahana	37
7	Plan of Site C4-18a, Showing Excavation and Cross Sections	41
8	Kaneaki Heiau, Makaha Valley, as Reconstructed	47
9a	Quadrangular-tanged Adzes from South Halawa Valley	56
9b	Quadrangular-untanged Adze from South Halawa Valley	56
10	Per Cent of Habitation, Economic, and Religious Features in Makaha, South Halawa, and Kahana Valleys	60
11	Radiocarbon and Hydration Rind Dates from Kahana Valley	72
12	Radiocarbon and Hydration Rind Dates from South Halawa Valley	76
13	Radiocarbon dates from Makaha Valley	79
14	Location of South Halawa Valley on Oahu	82
15	Survey Area in South Halawa Valley and Location of Sites	83

Figure		Page
16	Plan of Heiau Site B1-33, After Restoration	89
17	View of Site B1-33, Looking East, After Restoration	91
18	View of Site B1-33, Looking Northeast, After Restoration	91
19	Plan of Heiau Site B1-66, After Restoration	92
20	View of Site B1-66, Looking North, After Restoration	95
21	View of Site B1-66, Looking Southeast, After Restoration	95
22	Plan of Platform Complex, Site B1-67	97
23	Plan of Site B1-30	100
24	Feature F, Site B1-30	105
25	Feature G, Site B1-30	105
26a	Feature I, Site B1-30	108
26b	Features H and I, Site B1-30	108
27a	Adzes from Site B1-30	112
27b	Adzes from Site B1-30	112
28	Plan of Site B1-30 Showing Excavation Units	foldout

INTRODUCTION

Prehistory of the Hawaiian Islands

Recent archaeological findings suggest that the first human settlements of Polynesia were established in Tonga and Samoa and from there moved to the Marquesas. The earliest migration to Hawaii was most likely from the Marquesas, although additional voyages probably arrived in later times from the Society Islands (Sinoto 1968:117).

Radiocarbon age determinations combined with volcanic glass hydration rind techniques have dated this first discovery of the Hawaiian chain from the Marquesas at approximately A.D. 450. The Society Island migrants arrived some 200 years later (Sinoto and Emory, personal communication).

The earliest dated archaeological sites have all been on the windward sides of the islands, that is, the East and Northeast coastal areas; on Hawaii (Big Island) at South Point (Emory and Sinoto 1969:9); in the Halawa Valley on Molokai (Kirch 1971:230); and at Bellows Beach on Oahu (Pearson et al. 1971:230).

Apparently settlements were restricted to coastal areas for many generations, and indeed for centuries, since the earliest known dates for an inland agricultural complex is A.D. 1130 at Kahaluu on the Big Island (Crozier 1971:26). Thus far the earliest known inland sites on Oahu were in

Makaha Valley (Green ed. 1970:99). It should be noted that in Hawaii, sites considered to be "inland" may often be only several miles from the coast and should not be confused with "interior" sites as commonly defined or understood in continental areas in North America.

Archaeological remains in Hawaii are usually spoken of as belonging to either the pre- or post-contact period, or prehistoric and historic. The year 1778, when Captain Cook arrived is used as the end of the former period and the beginning of the latter. Acculturation, however, influenced areas at varying rates and the proto-historic period, or approximately between the 1770's and the 1830's, extended throughout much of the island chain. This was clearly evident in this author's excavations on the Big Island where prehistoric stone artifacts were unearthed in the same stratigraphic level with historic metal tools (Kelly and Crozier 1972).

The population of Hawaii in 1779 has been estimated at between 150,000 and 400,000 natives. In 1864, Anderson noted, "One cannot travel through the Islands without discovering conclusive evidence . . . of a far more numerous people than now exists; though the estimate of four hundred thousand, by the scientific gentlemen who accompanied Captain Cook, may have been excessive" (Anderson 1864:269). Most modern authorities have suggested estimates ranging from 200,000 to 300,000 (Warwick 1973:99).

Hawaii, at the time of Western discovery, had a chiefdom form of government. Each island was ruled by one or more chiefs who coordinated economic, social, and religious activities. However, the characteristic terrain of the island, rugged inland mountains, with valleys suitable for agriculture leading out to coastal flatlands and coral reefs in the shallow water, probably encouraged a settlement pattern of small dispersed groups.

Rulers and kahuna (priests) who acted as full time intermediaries between human societies and the supernatural powers certainly enjoyed a high status in Hawaiian culture. One or more chiefs, of high birth on each island, were contestants for power. Despite these struggles, total war was probably not feasible since the people could not stand lengthy periods of unproductiveness.

In the ancient days there were many chiefly tabus (royal privileges), and they were "opportuned according to the status of the chiefs" (Kamakau 1964:9).

Restrictions were also placed on many foods regarding not only who could eat them but their preparation and communal eating arrangements. The importance of these arrangements was evident in several of the sites excavated in the three valleys and will be discussed later. In Hawaii, and generally in Polynesia, certain choice items were reserved for the consumption of the high chiefs (Sahlins 1958:17). But it affected the women most oppressively.

> It was death for a woman to approach a temple, to enter the eating-house of any man, even her husband. Never might she taste the food which had been cooked for a man, even when his meal was finished: hers might not even be cooked at the same fire. All the daintiest meats were reserved exclusively for the male animals,--I cannot call them lords of the creation; for all rank descended only from the female side, and the right of blood gave a woman power to rule all men of lower birth than herself (Cumming 1883:65-66).

King Kamehameha II (Liholiho), during his short reign from 1819 to 1824, finally broke the tabu system by holding a public feast at which women were included and pork and bananas, among other items were served (Wise 1965:102).

Archaeological Research on Oahu

Serious Hawaiian archaeology had its beginning in the early 20th century with factual treatments of specific Polynesian problems and postulated migration patterns. Only within the last decade has extensive archaeological investigation taken place throughout several valleys on Oahu. In 1968, Green directed a program in contract archaeology in connection with the commercial development of the Makaha Valley. The results of this initial program served as the impetus for archaeologists to look toward wide ranging valley research in Hawaii instead of isolated site investigations.

The programs initiated in Makaha, Kahana, and South Halawa (figure 1) may all be considered "contract" or salvage archaeology where the time available, the area to be investigated, and the amount of financial assistance were

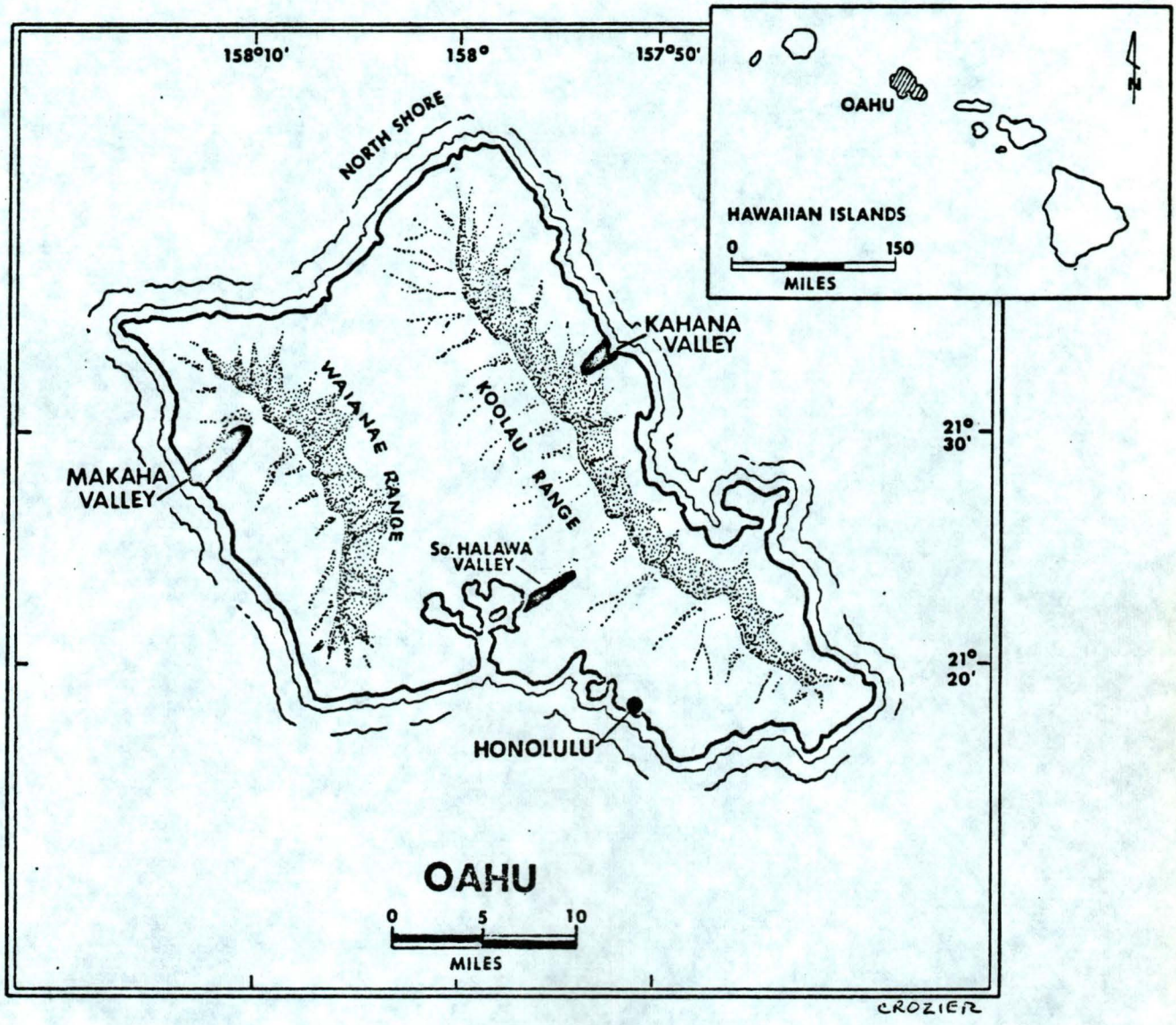


Figure I. Approximate Location of Makaha, South Halawa, and Kahana Valleys.

all defined by the contracting agency. Jennings suggests that there are some advantages to working under a contract. He states that there seems ". . . no reason to attach any invidious connotations to emergency archaeology . . . in defining problems, in applying high standards of technique in field operations, or in producing reports at the descriptive level that are scientifically acceptable" (Jennings 1963:282-84).

Each of the three valleys was under intensive archaeological research by staff archaeologists from B. P. Bishop Museum in Honolulu for periods ranging from 1968 to 1972.

Several publications have resulted from this research: on Makaha--Green, ed. 1969, 1970b; Ladd, ed. 1972, 1973; on Kahana--Hommon and Barrera 1971; Hommon and Bevacqua 1973; and South Halawa--Ayres 1970; Denison and Forman 1971; Crozier, ms. 1972, 1973. The nature of each of these research reports is shown in Table I. Table II notes the variety of sites excavated.

In 1933 McAllister published "The Archaeology of Oahu" and several of his observations are pertinent to this report. He estimated that there were originally 97 coastal fishponds on Oahu (1933:29) including the Huilua pond in Kahana Valley which was investigated by Hommon and Bevacqua (1973). All but six fishponds have since been destroyed, including all the ones noted in South Halawa ahupua'a. (See Appendix I for definition of Hawaiian terms.)

TABLE I

Archaeological Research in Makaha,
South Halawa, and Kahana, Oahu

Makaha Valley	
Period of Research:	1968 through 1970
Sites Surveyed:	302
Features Mapped:	over 1,000
Sites or Site Complexes Excavated:	23
South Halawa Valley	
Period of Research:	1970 through 1972
Sites Surveyed:	51
Features Mapped:	125 (approx.)
Sites or Site Complexes Excavated:	14
Kahana Valley	
Period of Research:	1970 and 1972
Sites Surveyed:	114
Features Mapped:	465
Sites or Site Complexes Excavated:	8

TABLE II

Nature and Number of Excavated Sites in Makaha, South Halawa, and Kahana, Oahu

	Makaha	South Halawa	Kahana
Large Heiau	1		
Shrine	1	2	
Residential Complex		1	
Agricultural Complex	1	2	
Habitation Site	5		2
Stepped Platform	3		
Pavement or Platform		2	1
Platform Complex		1	
Cave		4	
Stone Mound	4	1	
Field Shelter	3		
Clearing	1	1	2
Historical Site	3		
Fishpond			1
Midden Site			1
Total	23	14	8

Source: Makaha--Green, ed. 1969, 1970b; Ladd, ed. 1972. South Halawa--Ayres 1970; Denison and Forman 1971; Crozier, ms. 1972. Kahana--Hommon and Bevacqua 1973.

McAllister (1933:120) was also the first person to record and describe the impressive Kaneaki Heiau in Makaha Valley. His accurate drawing aided the archaeologists during the reconstruction of this pre-Christian temple in 1971.

OBJECTIVES AND RESEARCH

The Evidence

It is important that archaeologists ask the kinds of questions with which their data are equipped to deal.

The evidence suggests the existence of causal relationships between some environmental factors, e.g. physiography and precipitation, and human activities in each valley. Although not necessarily of an interdependent/dependent nature, it is hypothesized that differential climatic factors significantly influenced habitational and subsistence patterns and the religious life of human communities in the three valleys.

We are able to establish a climatic model for the precontact period since an analysis of soil samples indicates a precontact climate similar to the present one (Sabels 1966: 148).

While coastal sites may provide the evidence for stylistic and perhaps functional change to postulate a possible change in the exploitation of the maritime ecosystem (Newman 1968:6), the evidence from sites in Makaha and South Halawa support a pattern of agricultural stability. This contrasts with that of continued change tentatively postulated by Newman (ibid.:7-13) for the exploitation of the terrestrial ecosystem.

The appearance of new features and styles not generally found in Hawaii, such as the features at site B1-30 in South Halawa Valley, may attest to an influence from other areas of Polynesia. Also, during the course of development of Hawaiian culture, the variety of tools brought from the Marquesas and Tahiti by the first settlers were gradually modified, developing a number of distinctively Hawaiian varieties. Other kinds of tools were dropped completely from the inventory while others were invented in Hawaii (Suggs 1960:164).

Both Makaha Valley and South Halawa Valley lie on the leeward side of Oahu while Kahana is situated on the windward side.[1] Makaha, the largest of the three valleys, extends west almost 8 kilometers from the Waianae range to the Pacific Ocean (figure 2). South Halawa Valley extends southwest 7.4 kilometers from the Koolau range to the confluence of the North and South Halawa Streams, approximately 2.4 kilometers east of Pearl Harbor (figure 3). Kahana Valley lies east of the Koolau range and runs to Kahana Bay, a distance of about 6.4 kilometers (figure 4). The mountainous walls of all three valleys form a typical ahupua'a land division.

---

[1]Windward and leeward are common directional terms used in Hawaii and make reference to the prevailing Northeast tradewinds, hence leeward is usually the southwest and windward the northeast side of the island.

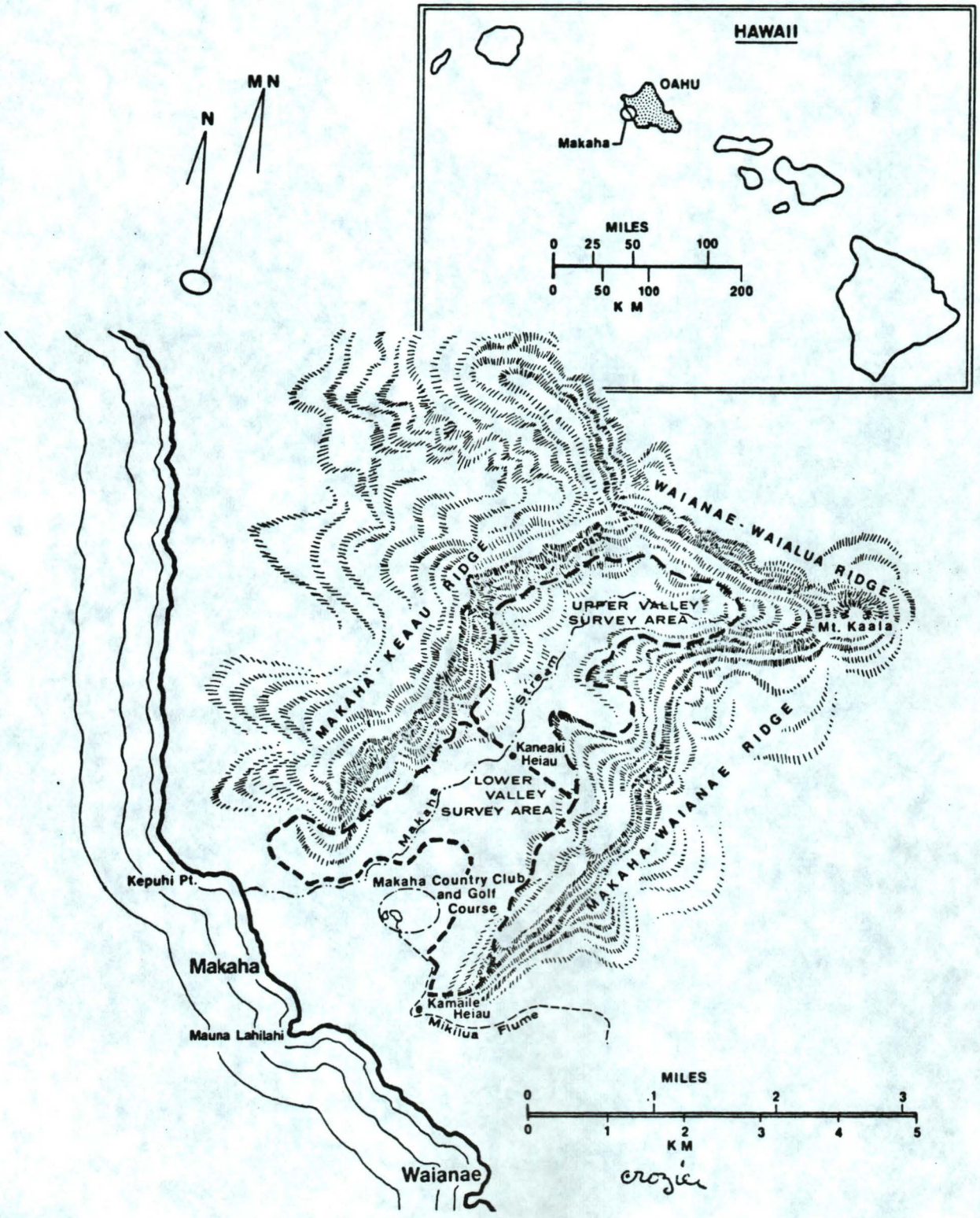


Figure 2. Map of Hawaii and Makaha Valley, Showing Principal Landmarks.

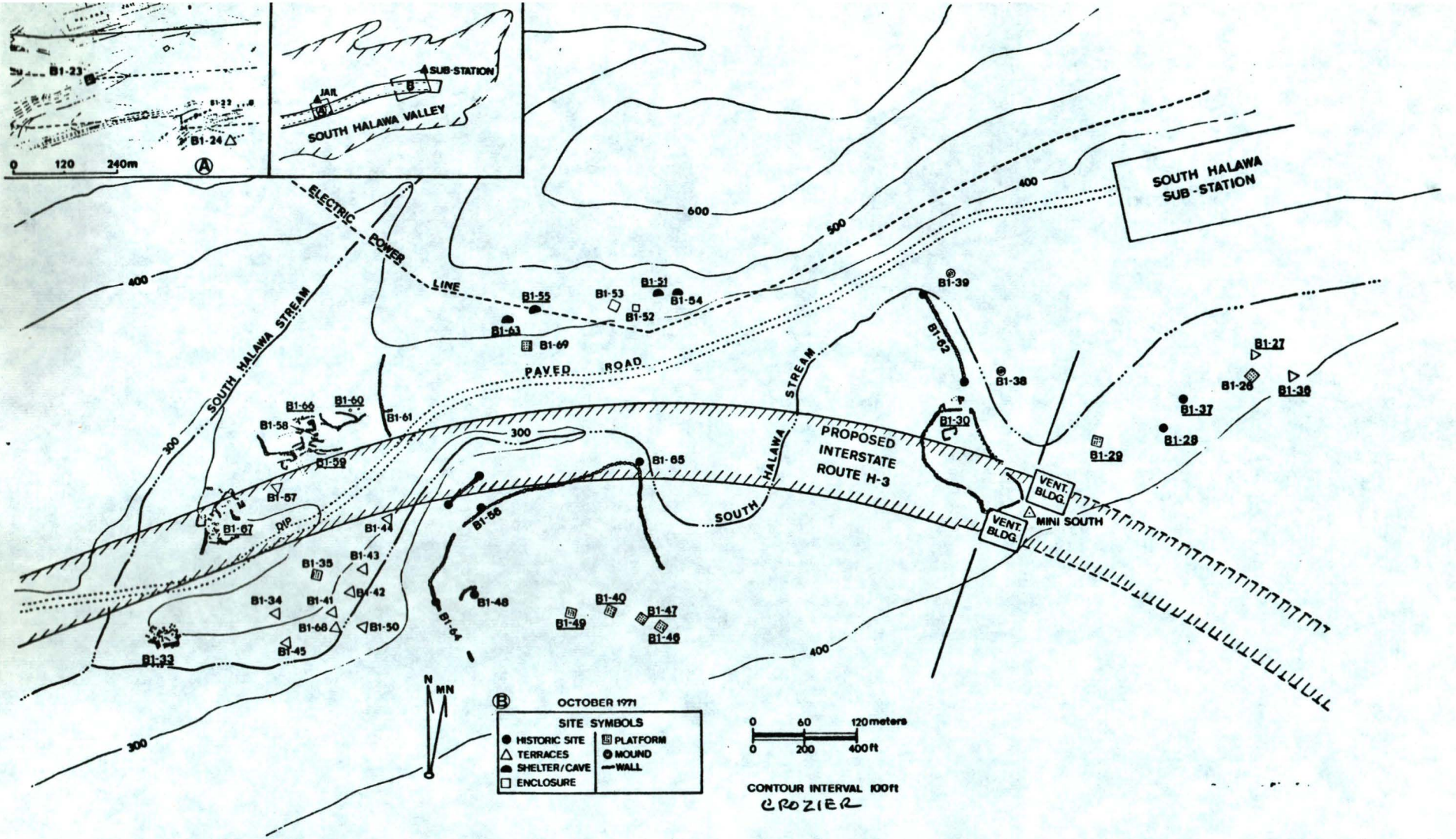


Figure 3. Survey Area and Sites in South Halawa Valley.

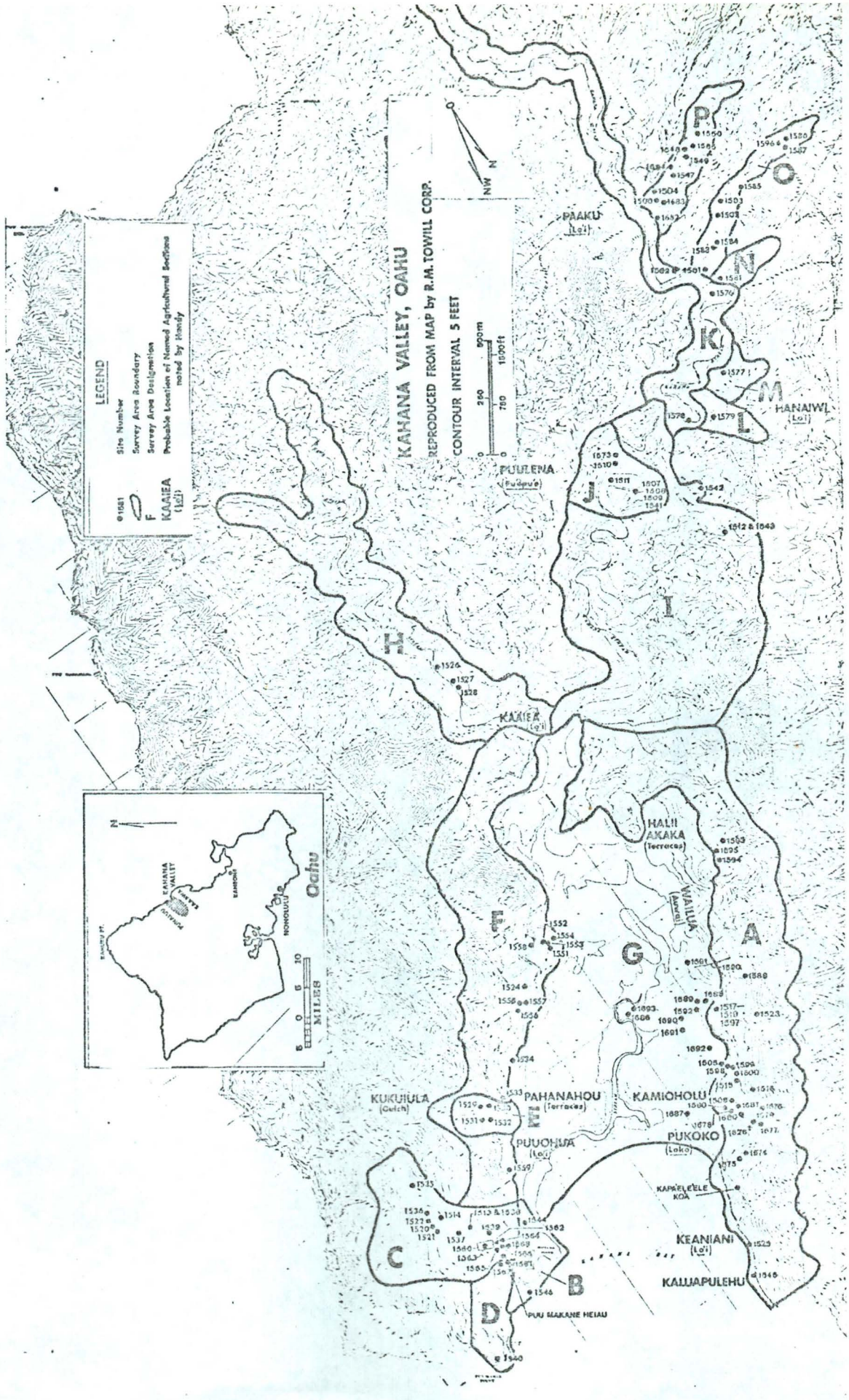


Figure 4. Map of Kahana Valley Showing Location of Archaeological Sites.

Aims of the Present Study

It is the purpose of this paper to describe and analyze the archaeological remains resulting from precontact activities as uniformly applicable to a time range of 300 years (A.D. 1400-1700). This analysis will concentrate on physiographic factors, e.g. climate and precipitation, which may have influenced the daily life pattern and demography of the inhabitants and could contribute to an explanation of these patterns.

The physiography differed enough throughout the three valleys under investigation to significantly induce specific aspects of a man-environment relationship and affect the life patterns of the human communities in the valleys of Makaha, South Halawa, and Kahana.

Deterministic archaeologists have tended to adopt the premise that total cultures are the product of their technology interacting with the natural environment. The open-system approach is based on the assumption that cultural ecology is concerned with the total manner in which human groups adapt to and transform their environments (Trigger 1971:329).

Agricultural groups in Hawaii generally sought locations where the soil and weather were favorable to their crops and their methods of cultivation. The precontact Hawaiian certainly transformed his environment, particularly for the cultivation of taro, yams, and sweet potatoes. This trans-

formation reflects partly on the technology, and partly on the expansion in the population it made possible.

Hawaiians, as all human beings, had "a remarkable capacity to prefer as their staple food the one that happens to grow best or to be easiest to catch in their environment" (Keesing and Keesing 1971:146). The tendency to view population as a response to food production is often considered universal by archaeologists. However, population was related to the total cultural pattern and hence influenced by many different factors. These interrelated factors will be examined in this report.

The archaeological information pertaining to several of the sites and features discussed in this paper are being presented for the first time as new evidence for the study of an environmental/cultural relationship. The nature of utilization of these archaeological features will have significant bearing on the postulated organization of the valley systems under investigation.

This paper will deal with a man-environmental relationship throughout Makaha, South Halawa, and Kahana Valleys based on empirical evidence. A study of the cultural ecology of Hawaii, or even Oahu, is not the intention of this investigation. Postulated causal relationships between some environmental factors and human activities in each of the three valleys will also be examined.

Method and Terminology

Despite varying contract limitations between the three archaeological programs, certain similar research objectives were pursued within the framework of each valley investigation. Besides examining the archaeological remains, e.g. site, feature, and artifact attributes, relevant environmental aspects such as climate, vegetation, soils, raw materials, and food resources were also studied.

Since the three valleys were occupied in precontact times, I have treated the evidence for activities as applicable to a time range of 300 years (A.D. 1400-1700). A complete discussion of these dates and some of the problems concerning their interpretation can be found in Appendix II of this report.

The problem of what constitutes a site in archaeology is, of course, notorious and intimately related to the intensity with which a site survey is conducted (Green 1969: 4).

Throughout this report, I will use the descriptive terminology proposed by Green:

> feature, a nonportable structural artifact that reflects some past human activity rather than the more typical portable one. At this level of recording, an archaeological site may consist of one or more structural features in association with various portable artifacts. The assignment of features to a particular site, therefore, depends largely on factors of spatial contiguity and an assessment of the relationships of these remains to those adjacent (1969:4).

I have added site complex to this list to refer to a locale where interrelated features were so numerous that the term site might be misleading. Hommon (1969:41) has referred to these as zones, however since the term "zone" was only used in the Makaha reports, I have substituted site complex as a means to encompass the phenomena in all three valleys.

It is important that archaeologists and ethnohistorians work together since there can be a serious problem of clearly identifying indigenous and acculturated behavior (Kelly 1967: 399). In this report I shall include any relevant material contributed by all anthropological disciplines.

ENVIRONMENT AND HUMAN SETTLEMENT (CONTACT PERIOD)

Oahu

Oahu, 604 square miles, is made up of two volcanoes, the Waianae and the Koolau. The drainage qualities of the young volcanic soils and large areas of gently sloping lands were conducive to the development of cultivation on a large scale. Furthermore, "irrigation in a young volcanic area is exceedingly fruitful because of the high mineral content dissolved in irrigation waters" (Pelzer 1945:49).

Climate. The average daily temperature on Oahu ranges from about 74°-75° F in March, to 79°-80° F in September. In Honolulu the warmest and coolest months differ only 6.5° F (U.S. Weather Bureau 1961:4). Climatic analysis of soil samples from Oahu indicate a precontact climate which was similar to the present one (Sabels 1966:148).

Lying near the margin of the tropics, Oahu's most prominent air circulation is the trade-wind flow in a general east to west direction which results in a marked wet windward side and dry leeward side to the island (figure 5).

Vegetation. The zonation of plants is closely related to climatic factors. Five vegetation zones are generally recognized throughout Oahu: a coastal and low altitude zone; a lower forest belt; a middle forest zone; dense rain forests; upper forests--each characterized by a particular

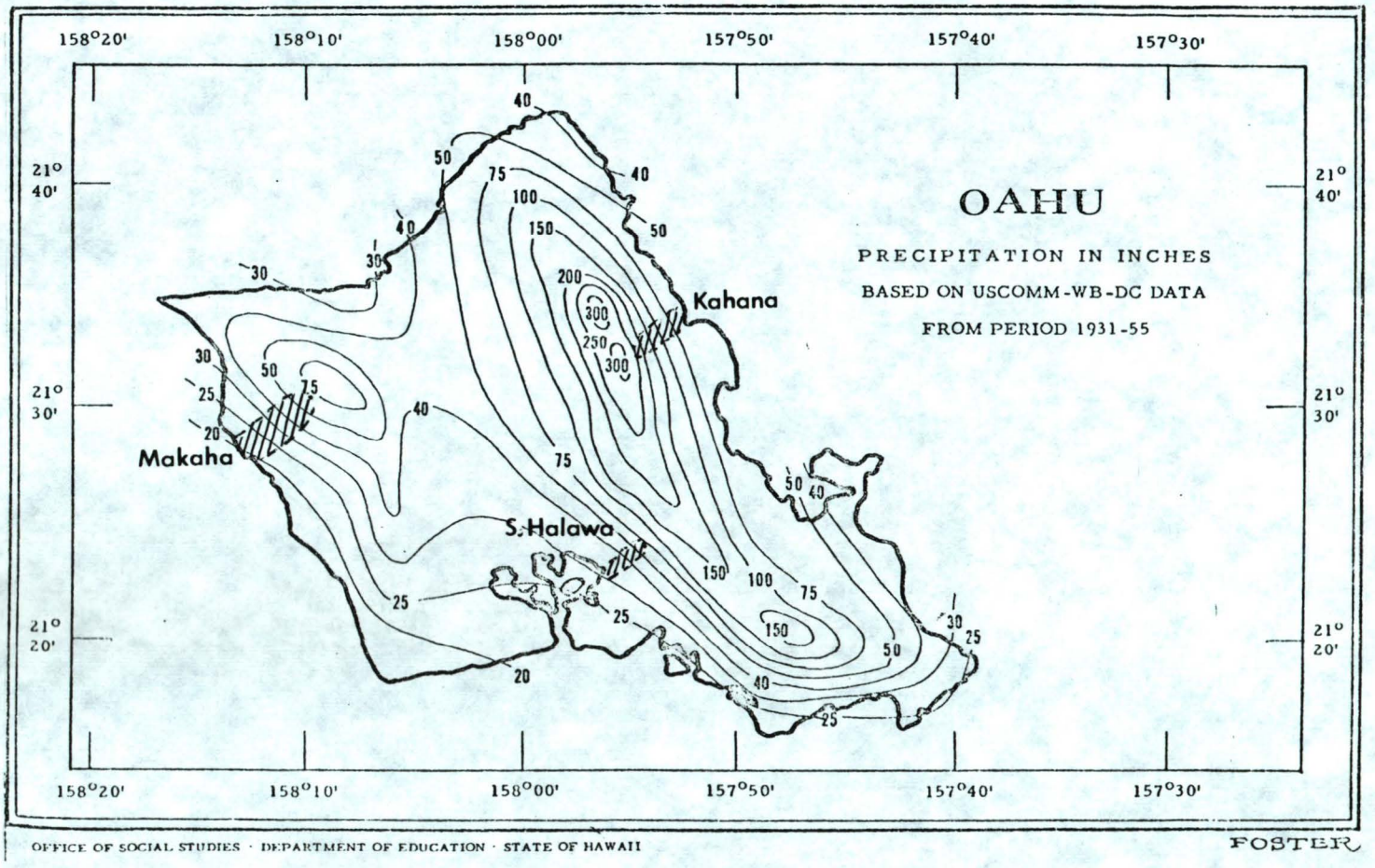


Figure 5. Average Annual Precipitation on Oahu.

botanical complex (Freeman 1951:338-40). The most important climatic factor governing plant distribution in Hawaii seems to be average rainfall at elevations below 5,000 feet (Warwick 1973:65). There are now about 2,500 different kinds of higher plants that occur only in the Hawaiian Islands and nowhere else. Most of the dominant or characteristic plants at lower elevations (below 1,500 feet) are species introduced to Hawaii since 1778.

Table III contains a list of some of the native plants which existed in Oahu prior to 1778.

Soils. The diversity of island environments contributes to the variations in soil. The parent materials from which the soils have been formed differ considerably from island to island and area to area on each island. Soils can also differ because of the following reasons: 1) the length of time to which they have been exposed to weathering, 2) drainage conditions, and 3) temperature and rainfall conditions to which the soils are exposed. Soils on the windward side of Oahu differ markedly from those found on the leeward side because climate and vegetation are not the same.

Raw Materials.

1. Wood. The drainage qualities of Oahu's young volcanic soil plus the high mineral content produced vegetation zones with diversified wood resources. The available sources of wood are briefly discussed under vegetation and listed in Table III.

TABLE III

Native Plants and Trees (from Judd 1965:280-285)

Native Name	Botanical Name	Used for Traditional Material Culture
Akolea	Bochmeria stipularis	Bark for kapa
Hala	Pandanus odoratissimus	Seeds for leis & brushes; leaves for mats, baskets etc.
Hau	Hisbiscus tiliaceus	Wood for canoe outriggers; bark for rope
Kamani	Calophyllum inophyllum	Wood for calabashes
Kauila	Colubrina oppositifolia	Wood for spears, kapa beaters etc.
Ki or Ti	Cordyline terminalis	Leaves for wrapping, thatching etc.
Koa	Acacia koa	Wood for canoes & other implements
Kou	Cordia subcordata	Calabashes; seeds edible
Kukui (candle nut)	Aleurites moluccana	Nuts for torches; oil of nuts for lamp fuel; bark for dyes
Loulu (fan palm)	Pritchardia mortii	Nuts edible; fans & house thatching
Mamani	Sophora chrysophylla	Durable wood for house posts
Milo	Thespesia populnea	Wood for calabashes
Ohia lehua	Metrosideros polymorpha	Wood for spears, kapa beaters & images
Olona	Touchardia latifolia	Fibre plant--strongest cordage known
Pili	Heteropogon contortus	House thatching and sled runs
Uhiuhi	Mezoneurum kauaiense	Spears, kapa beaters etc.
Wauke (paper mulberry)	Broussonetia papyrifera	Bark used for kapa
Wiliwili	Erythrina monosperma	Light wood for canoe outriggers

2. Stone. Only Oahu has sedimentary rocks covering a large area of the island. They consist of layers of reef limestone alternating with beds of clay, tuff, dune sand, with alluvium along the coastal margins.

The more common lava on Oahu is the extrusive alkalic basalt. The matrix is fine grained and stony in appearance. It is mainly pyroxene, plagioclase feldspar, and olivine crystals (Zim and Shaffer 1957:117). Basalt was favored by the Hawaiians for stone tools and construction. Most of the features throughout the survey areas were built with basaltic boulders.

The wide use of rough stone construction in precontact Polynesia makes it appear probable that the first settlers of Hawaii brought with them some knowledge of the mason's art, but the high development of this art was due largely to local conditions. Linton (1923:5) believes that the Hawaiians excelled in stone masonry compared to the Marquesans. Cut stone construction was rare in Hawaii and may be due to the great abundance of natural or water worn stones of various sizes and shapes.

3. Water. Despite rainfalls that commonly exceed 100 inches a year in the mountainous portions of Oahu, very few streams carry water throughout the year. Thus the precontact Hawaiians used irrigated fields and built ditches to carry water for the paddy cultivation of taro, their staple crop.

4. Food resources. There are about 700 species of fish, 400 seaweeds (algae), 1,000 molluscs, and 1,350 other kinds of invertebrates in the shallow waters around the islands (Warwick 1973:77). Almost all the fish were eaten by the early Hawaiians (Sahlins 1958:260). Fishponds were built in order to capture and probably store fish for future use. This will be discussed in more detail on page 45.

By A.D. 1400, the beginning of our precontact period of investigation, the dog, pig, and chicken were all important food supplements to the fish, fruit and vegetable diet. Dogs were bred in large numbers for food, the Hawaiians preferring dog meat to pork (Buck 1964:3). Cumming records this preference:

> As a matter of choice, the Hawaiian gourmet inclines to dog . . . nice little dogs about the size of a terrier and fed on vegetables. Dogs' flesh was accounted much more delicate than pork, and in old times every tenant renting land was obliged to rear a given number of dogs for his landlord's larder (1883:79).

The early Hawaiians had no large, hoofed mammals: these were brought by Europeans in postcontact times.

Socio-Cultural Factors. Today Oahu Island houses approximately 80 per cent of the entire population of Hawaii. However, this was not the case in pre- and proto-historic times. Honolulu, when first visited by missionaries on the 14th of April, 1820, "contained three or four thousand people, living in wretched huts" (Anderson 1864:51). As late as 1860 the population of the Big Island was still larger than that

of Oahu (ibid.:278).

Considering the greater number of prehistoric complexes uncovered on the Big Island compared to those surveyed on Oahu, the majority of the aboriginal people did indeed live on the Big Island, however Captain Cook may have overestimated the entire Hawaiian population based on his 1778 and 1779 coastal survey of that island.

The overall density and distribution of population of a region is determined to a large degree by the nature and availability of the natural resources that are being exploited. But a range of interacting factors must also be examined which affected the particular "micro-space" settlement. I refer to "micro-space" as the spatial distribution of attributes and their overall spatial patterning within a settlement (Chang 1967:37).

Given a particular level of technology, agricultural groups will, generally, seek locations where the soil and weather are favorable to their crops and their methods of cultivation. Whereas community size and location were influenced to a large extent by ecological factors, the layout of communities appears to have been strongly influenced by family and kinship organization (Trigger 1968:61-62). This appears to have been particularly true in precontact Hawaii although the kinship relations were at least partly determined by ecological factors through the ahupua'a. Each Hawaiian kin group, known as an 'ohana, occupied and utilized

a strip of land extending from the offshore fishing areas to the mountain forests (Hommon 1969:85).

The structures in a community often reflect differences in wealth and rank, as well as various social institutions. In such places as the Marquesas, for example, the elaborateness of the platform on which a house was built reflected the importance of its owner in the social hierarchy (Suggs 1960:124). By community I refer to Murdock's example, "the maximal group of persons who normally reside in face-to-face association" (1949:79). However, in the valley systems under examination with areas of generally dispersed settlement we cannot equate a community to a single settlement or therefore an archaeological component (Willey and Phillips 1958:21-22).

Makaha

Climate. The temperature regime between the three valleys under investigation was not as variable as the rainfall which affected not only the physical nature of each valley but also the daily life pattern of the inhabitants.

Since the lowland leeward side of the Hawaiian chain obtains rainfall chiefly from a few winter storms, that rainfall is consequently seasonal. In the wetter areas, such as Kahana, where rainfall comes from both winter storms and year-round trade wind showers, seasonal differences are much smaller. Table IV shows the variations in annual rainfall in the three valleys.

TABLE IV

Average Annual Rainfall in Makaha, South Halawa, and Kahana, Oahu

	Makaha		South Halawa		Kahana	
Average Annual Rainfall (in inches)	lower valley	upper valley	lower valley	upper valley	lower valley	upper valley
	21.96	66.68	35.04	60-70	65	242

Source: U.S. Weather Bureau (1961).

With such wide locational and seasonal variations in rainfall, drought is not unknown in Hawaii, although it rarely affects an entire island at one time. Even so, harsh droughts may be very costly even in irrigated areas. The last severe drought causing strict water restrictions occurred in 1925-26 (U.S. Weather Bureau 1961:9).

The prevailing wind throughout the year is the northeasterly trade wind. The relatively uniform trade wind flow is distorted and disrupted by the mountains surrounding Makaha and averages a gentle 10 knots.

Vegetation. The vegetation zones in Makaha range from a low altitude or lowland shrub to a middle forest zone. In the lower valley, most of the present ground cover is formed by the introduced varieties of vegetation such as kiawe (Prosopis pallida), and koa-haole (Leucaena glauca).

The upper valley harbors large stands of guava (Psidium guajava), kukui (Aleurites moluccana), and thickets of now-wild coffee trees. Some indication of the former vegetation is shown by isolated stands of wiliwili (Erythrina sandwicen-

sis), kukui, lama (Diospyros sp.), and alahe'e (Canthium odoratum).

Soils. The Mollisols and Inceptisols found in Makaha occur in moderately dry areas and are generally rich in plant nutrients. The red kula (clay) also located in Makaha was reported by Sahlins (1958:257) to be very suitable for crops.

Excavations revealed some significant differences between the deposition on the leeward side to that of windward Oahu. This will be discussed in the section on precontact evidence.

Raw Materials.

1. Wood. The available wood sources are briefly discussed under vegetation and listed in Table III.

2. Stone. The Waianae range is composed of three groups of lavas erupted in Tertiary time from three rift zones. The exposed part of the oldest lava is nearly 2,000 feet thick and consists largely of thin-bedded pahoehoe. The upper lavas are about 2,300 feet thick and are mostly massive a'a andesite flows which issued from large cinder cones (Stearns 1966:93).

Though there is no true obsidian in Hawaii, there is a source of volcanic glass in the Koolau range and knives or cutting tools were made from this unusual rock (M. Morgenstein, Hawaii Institute of Geophysics, personal communication 1971). Worked volcanic glass chips were located in great

quantities during the excavations in South Halawa Valley, lesser amounts in Makaha and very few fragments were uncovered in Kahana Valley. Since only one source of this highly valued, glassy textured, extrusive rock is known on Oahu, it is possible that it was one of the few items traded from one area to another.

3. Water. Running through the center of Makaha Valley is the Makaha Stream. It was this stream that gave life to the valley in ancient as well as modern times (Ladd 1969:27). At its lower end it becomes intermittent, except during the rainy periods. Smaller, intermittent streams, extending down the flanks of the Makaha-Keaau and Waianae ridges, join the Makaha Stream forming a widespread drainage pattern.

Food Resources. The Makaha shoreline is uncliffed and the shallow waters held ample marine life for the coastal fishermen and valley inhabitants.

Although no principal game and fowl resource differences existed between Makaha and the other valleys, archaeological evidence indicates that the extent and use of domestication may have differed significantly. This will be examined later in the report.

Socio-Cultural Factors. Based on the sheer number of archaeological remains located in Makaha Valley compared to South Halawa and Kahana, Makaha probably housed the larger population. Ladd (1969:39) reported that there could be no doubt that Makaha Valley had, at one time, a large Hawaiian

population, but he did not elaborate.

Population was related to the total cultural pattern and hence influenced by many different factors. These interrelated factors will be examined in the next section of this paper.

South Halawa

Climate. Temperature, precipitation, and wind in South Halawa is very similar to that of Makaha.

Vegetation. The vegetation zones of South Halawa, as Makaha, range from a low altitude zone to a lower forest and middle forest belt. Vegetation is now predominantly Christmasberry (Schinus terebinthefolius), koa-haole, guava, hau (Hibiscus tiliaceus), monkey pod (Samanea saman), and lantana (Lantana camara).

Soils. Same as Makaha.

Raw Materials.

1. Wood. See vegetation and Table III on page 22.

2. Stone. South Halawa had an abundance of fine grained basaltic boulders which were used by the precontact inhabitants. During the earlier stages of occupation (A.D. 1400), water worn stones were incorporated in the construction of house foundations, platforms, and walls.

3. Water. The main fresh water source in South Halawa Valley is the South Halawa Stream which winds from the Koolau range to the confluence of the North Halawa Stream approximately 2.4 kilometers east of Pearl Harbor. South

Halawa was one of the driest of the three valleys and the streams become but a trickle during the summer months. Two springs were located near site 50-Oa-B1-30[1] which were probably used when the streams dried up.

Food Resources. The South Halawa shoreline is uncliffed and marine life inhabited the shallow waters. The eight species of shellfish uncovered in the excavations can still be found in the Pearl Harbor area.

Excavations also uncovered remains of dog and pig which were important additions to the fish diet.

Socio-Cultural Factors. The precontact Hawaiian transformed his environment, particularly for the cultivation of taro, yams, and sweet potato. Partly this reflects an advancing technology, and partly an expansion in population it made possible.

Sites within the South Halawa survey area were not numerous, however habitation complexes such as B1-30 indicate the presence of an ali'i, or chief, with an extended family. The talus slopes were not extensively utilized as they were in Mahaka, and the narrower flat land certainly did not house as large a population. There is, however, a high density of sites in the small area bounded by South Halawa Stream, including its flood plain, and the major side stream

---

[1]Each site was assigned a Bishop Museum site number, such as 50-Oa-B1-30 (50 = State of Hawaii, Oa = island of Oahu, B = District of Ewa, 1 = South Halawa Valley, and 30 = individual site).

to the west. This area includes residence structures, religious features, and agricultural terraces.

Kahana

Climate. Kahana is one of the wettest valleys in the Hawaiian chain, receiving more than 240 inches of precipitation each year in the upper valley.

Kahana is in a direct line to the northeasterly trade wind which averages 18 knots in the valley. More violent are the winter storm winds which occasionally cause damage to vegetation and structures (Warwick 1973:59).

Vegetation. Kahana is basically a closed middle forest and dense rain forest. We usually think of a tropical rain forest as a lush and fertile place, but this is seldom true. Not enough sunlight penetrates to support thick undergrowth, except where rivers or other openings break the canopy.

The predominant vegetation in the valley consisted of guava, pandanus (Pandanus odoratissimus), Christmasberry, hau, and ironwood (Casuarina equisetifolia).

Soils. The Ultisols of Kahana are usually found on steeper slopes and the more unstable landscape of the higher elevations.

Excavations revealed some significant differences between the deposition on the leeward side to that of windward Oahu. Very little of the red clay mentioned by Sahlins (1958:257) appeared in the stratigraphy at Kahana. Also the dark hued soils and numerous intrusive small rocks did not

occur as often in Kahana as on the leeward side. Possibly the higher humidities on the mountain slopes of the windward side plus the erosion caused by the heavier rainfall could bring about these soil differences which would also alter the agricultural potential of Kahana Valley.

Raw Materials.

1. Wood. See section on vegetation and Table III on page 22.

2. Stone. The rocks of the ancient Koolau Volcano are chiefly thin primitive-type basalts with minor amounts of ash. The lavas were erupted from three rift zones in Pliocene time (Stearns 1966:93).

Although numerous water worn rocks were available for construction, very few were used by the precontact builders. Today, most of the archaeological stone structures are in poor condition compared to Makaha and South Halawa. This may have been caused by the severe storm winds and heavy rainfall.

3. Water. The hydrography of Kahana Valley consists of two branch streams that originate along the ridges of the Koolau range and join to form the Kahana Stream, which winds about 1.2 miles across a broad, swampy floodplain to the bay.

Food Resources. Kahana has a cliffed volcanic coastline while the Makaha and South Halawa shoreline is uncliffed. There is a distinct possibility that marine ecological differences existed between the windward and leeward sides of

the island. "The long-term pounding of the trade wind swell system against the windward coast results in a further reduction of the windward total shallow water zone causing a lower marine biomass to windward" (Newman 1968:15).

There is no evidence that game and fowl resource differences existed between Kahana and the other valleys under investigation.

Socio-Cultural Factors. The "behavior" of cultures is directly geared to their technological control over environments. The laws of science of culture will deal largely with the way technology-in-environment generates cultural forms (social and political organization, and even to a large degree religion and philosophy) (Keesing and Keesing 1971:144).

Virtually all of the archaeological sites in Kahana were found in gently or moderately sloping areas.

The total growing surface of all wet terraces recorded in the valley was less than one-fifth of the area of irrigated terraces in the upper section of Makaha Valley, although it is believed that the actual area of irrigated field in Kahana prior to Western contact may have been larger.

> If the physical characteristics such as soils, topography, and hydrography of this area were such that this area was capable of supporting large crops of wet taro, we would assume that the pre-contact population of the valley was, at least potentially, quite large. If, on the other hand, only parts of the flood plain were suitable for

> wet taro, as is suggested by the scattered pattern of taro patches, . . . the population capacity of the valley would probably be significantly lower (Hommon and Barrera Jr. 1971:75).

ARCHAEOLOGICAL EVIDENCE (PRECONTACT PERIOD)

The number of sites and features recorded was impressive enough that they can be treated as artifacts of equal importance to those of the portable variety. More than 1,500 features were recorded and mapped, while slightly less than 850 precontact portable artifacts were uncovered throughout the three valleys.

Before discussing the site and structure differences, it is important to observe the contrasting precontact agricultural and habitational use of the relatively flat valley floor and the talus of each valley. Figure 6 illustrates these differences in the lower portion of the three valleys.

Particularly in the lower portion of Makaha Valley, archaeological features were located as high as the 800 foot level. In South Halawa, with the postulated smaller population, the higher elevation was not utilized nor necessary for the valley occupants. Above the 400 foot level in Kahana Valley there was only an apparent small random scattering of selected features.

In the relatively flat bottom lands in all valleys were concentrations of features near the major streams. One concentration of sites in the survey area of South Halawa appears to have particular significance. Fully one-third of the sites are in the small area bounded by the South Halawa

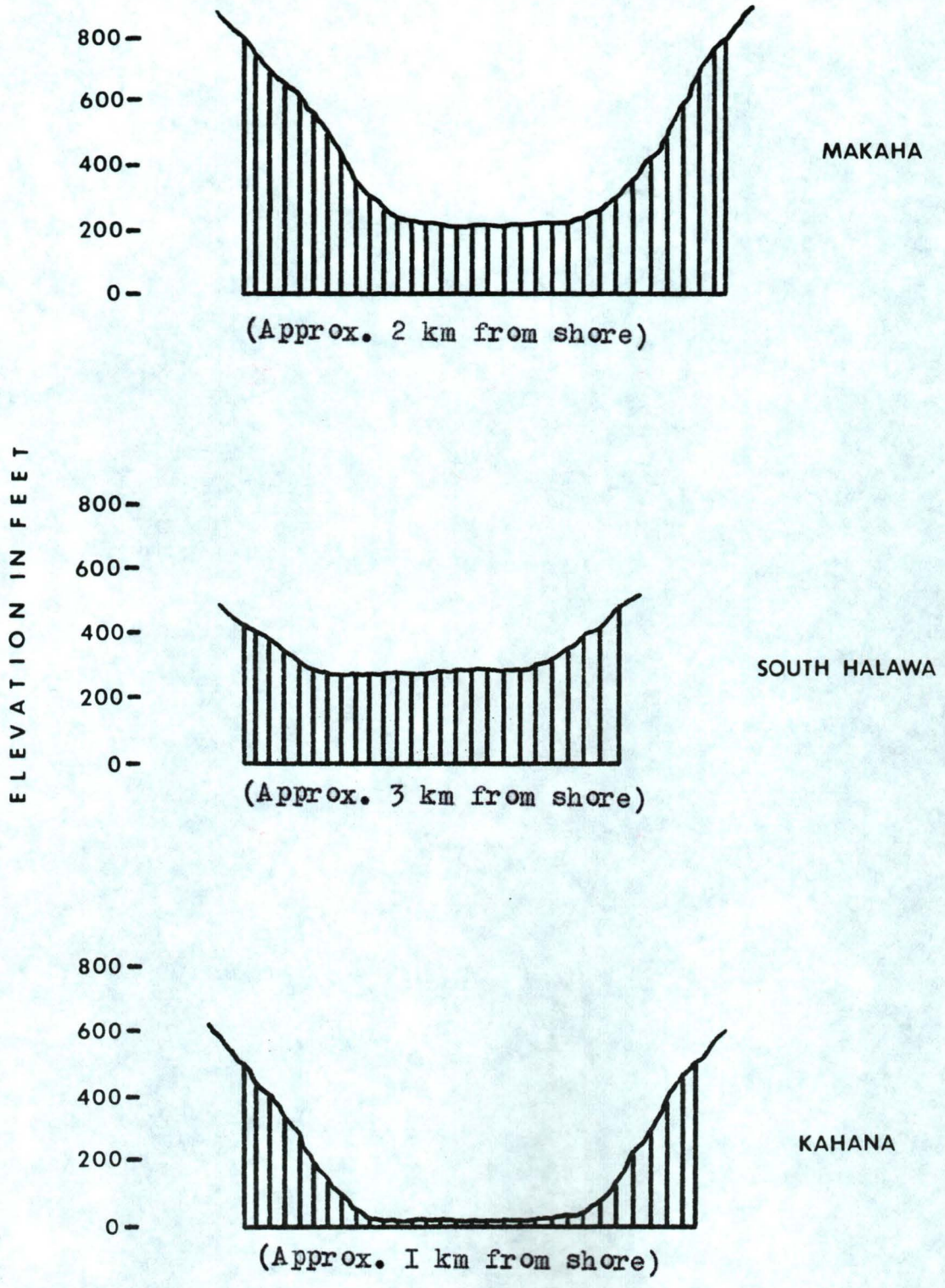


Figure 6. General Area of Valley Floor and Talus Utilization in the Lower Valley of Makaha, South Halawa, and Kahana.

(horizontal scale from USGS)

Stream, a major side stream, and the floodplain to the south. This very high density of sites naturally indicates heavy use perhaps consisting of two or three related families living in proximity to each other.

Sites and Structures

Table V, following, lists the postulated nature, number and per cent of selected archaeological remains located in the surveyed areas of each valley.

TABLE V

Nature, Number, and Per Cent of Selected Remains

Valley	Nature of Feature	Number of Selected Remains	Per cent of Total
Makaha (N=727)	Habitation	103	14
	Economic	572	78
	Religious	52	8
South Halawa (N=180)	Habitation	18	10
	Economic	160	88
	Religious	4	2
Kahana (N=346)	Habitation	56	15
	Economic	282	80
	Religious	8	5

Habitation features mentioned in Table V include enclosures, permanent house foundations, temporary house shelters, and postulated habitational platforms. The economic feature category comprises agricultural terraces, storage pits, animal pens, and fishponds. Large heiau, smaller

shrines, and burials are included under religious features.

A brief discussion of some of these archaeological remains is necessary to understand the implications of their presence or absence throughout the valleys.

Habitational Features

Permanent House Foundation. Buck (1964:76) recorded that permanent shelters at established home sites were walled houses. Without extensive excavation of these features, it is often impossible to determine a permanent dwelling from a temporary shelter, or even possibly a small religious site. Formal evidence varies from site to site concerning precontact use.

Though the number of surveyed permanent house structures would indicate that Kahana Valley housed a larger population than South Halawa, for two reasons I believe that their precontact population may have been equal. First, not all of South Halawa Valley was systematically surveyed and the house complexes mapped would indicate a larger population than the thirteen known house features suggest. Secondly, Hommon and Barrera (1971:50-51) believe that many of the thirty-eight house structures in Kahana have a post-contact origin and should be excluded from this precontact study.

Temporary House Shelter. Not all habitation structures in Hawaii were used on a permanent basis. Seasonal or temporary shelters would often be constructed and used during economic cycles. None was excavated or recorded by Hommon in

Kahana Valley.

One temporary shelter was excavated by this author at site B1-67 in South Halawa Valley which was adjacent to a habitation and agricultural complex and is documented in Appendix III of this paper.

Nine shelter sites were excavated in Makaha Valley. Six of the nine sites in Makaha were excavated and reported by Takayama (1969:55-68; Takayama and Green 1970:35-54), while the other three were reported by Ladd (1973:43-52). Ladd (1970a:20-23) classified the first six sites as L- and C-shaped shelters which were constructed similarly with some stylistic variations--all of which were shelter sites in an agricultural context (figure 7).

Economic Features

Before discussing individual economic features, it is important to look closely at the soil deposition throughout the three valleys since the soil influenced the agricultural potential in each region.

Table VI describes the matrix of three selected inland sites, one in each valley. The similarities between Makaha and South Halawa are obvious, while the Kahana site noticeably was lacking in soils regarded necessary for extensive agriculture.

Agricultural Terrace. The island of Oahu, even though of volcanic origin and mountainous, had a large amount of potentially arable land and much of it was adapted to agri-

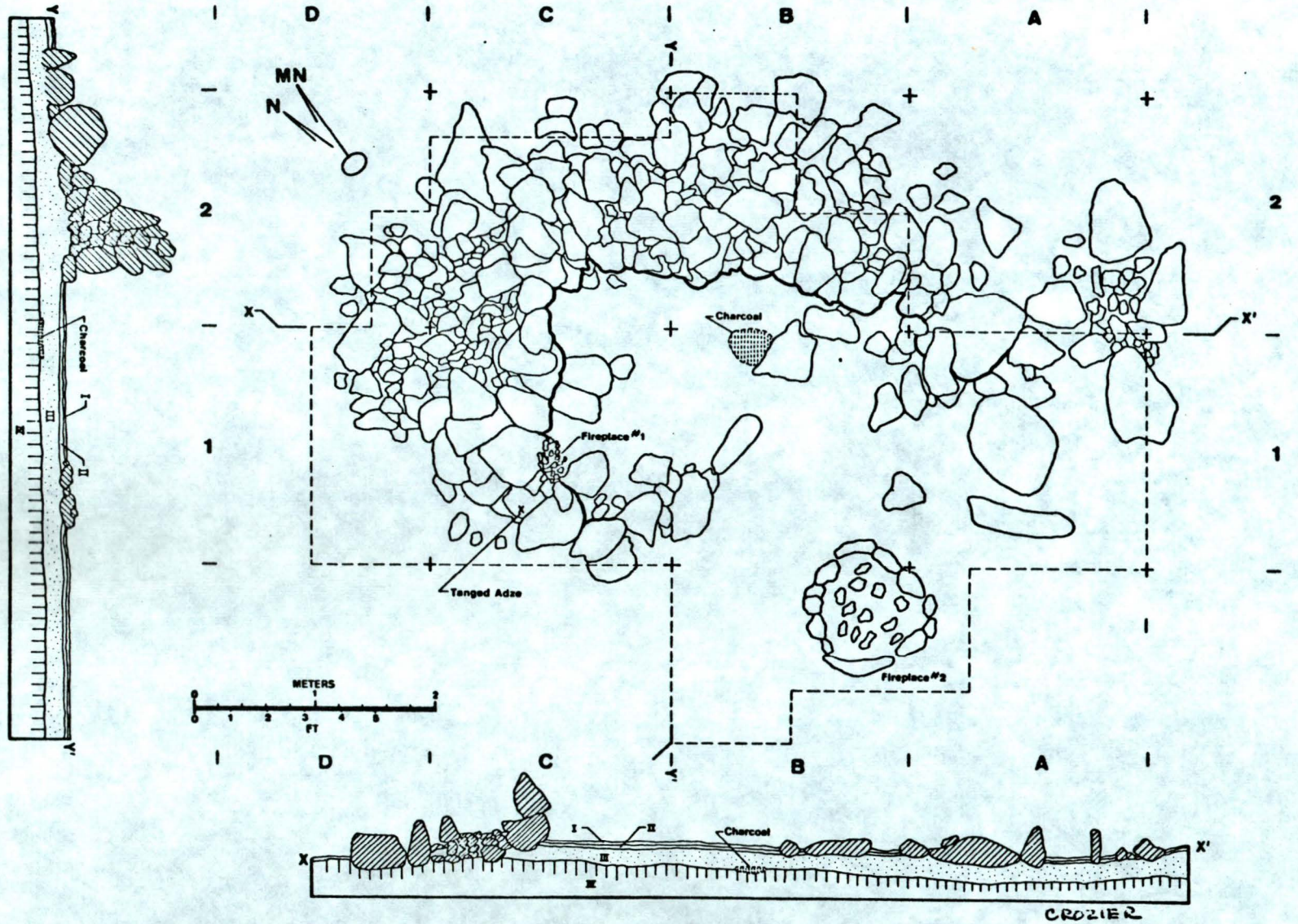


Figure 7. Plan of Site C4-18a, Showing Excavation and Cross Sections.

TABLE VI

Description of Soils in Three Inland Sites

Description	Makaha Site C4-18a	South Halawa Site B1-30	Kahana Site F9-177
Humus topsoil	x	x	x
Brown soil with pebbles	x	x	
Brown soil with clay and charcoal specks	x	x	
Light brown to grey sand			x
Cultural, red to grey clay	x	x	
Buried midden	x	x	
Charcoal	x	x	

culture in prehistoric times. Extensive terrace systems, particularly noticeable in Makaha Valley, give evidence of elaborate irrigation for the cultivation of taro, sweet potatoes, yams, and bananas.

A distinction should be made at this time concerning the wet and dry agricultural patterns: 1) plots of land that were artificially irrigated from permanent streams and constructed for the growing of "wet" taro; 2) those plots of land that received sufficient rainfall for cultivation of "dry" taro and sweet potatoes.

According to Barrau (1961:74), taro (Colocasia esculenta) can be planted at any time throughout the year. "Wet" taro

required 8 to 14 months to mature (Handy 1940:17-31, Table II), but could be left in the ground for 4 to 24 months after maturing without spoiling. More intensive care is required for the "wet" than the "dry" variety of taro (Handy 1940:46), and it must constantly be provided with the proper amount of water throughout its period of growth.

The clustering of "permanent" house enclosures and probable house platforms near the Makaha, Halawa, and Kahana Streams suggests that these areas were occupied on a relatively permanent basis because of the regular care needed for "wet" taro.

Increased populations and the use of "primitive" agricultural techniques were probably responsible for deterioration of both vegetation and soils (Barrau 1961:18). This apparently led to semi-permanent forms of agriculture and the development of taro growing on irrigated terraces in the valleys.

As the entire taro plant furnishes food for man, it has been estimated that one square mile planted to this crop and diligently cultivated, could provide subsistence for over 15,000 people for an entire year (Degener 1930:81).

Storage Pit. Very little is known about the storage practices of the prehistoric Hawaiians and until 1971 at Makaha no storage pits had ever been excavated in Hawaii.

Evidence supports the hypothesis that site C4-15 in lower Makaha Valley was a large, possibly a community, storage pit. Both Ladd (National Park Service) and Sinoto

(Bishop Museum) believe that either breadfruit or sweet potatoes were stored (Ladd 1973:51).

Feature C4-18c was a mound that was entirely different from any category recorded in Hawaii. From the interpretation of the excavated data and the structural remains uncovered, there can be little doubt that the mound covered a stone-lined storage pit. The pit, in contrast to C4-15, was probably a "family" storage pit (Ladd 1973:52).

Both storage pits were located in a highly developed agricultural zone and very near the temporary shelters mentioned earlier.

Animal Pen. Prior to European contact, the Hawaiians bred pigs and dogs in large numbers for food. They were also served as offerings in religious ceremonies.

The previous section discussed the importance of dogs and confirmation of the large number bred is provided by dog-tooth leg ornaments used in dances (Buck 1964:3). Although no animal pens were recorded in the survey area of South Halawa Valley, more than 35 dog canine tooth ornaments were uncovered in the cave excavations. This will be discussed in detail later on page 58.

Twelve animal pens were recorded in Makaha Valley which may attest to a sizable population and fairly large religious ceremonies.

Several small enclosures in Kahana Valley may have housed animals, however this has not been confirmed.

Fishpond. There is some disagreement among historians as to the exact function of the ponds. Several authors (e.g. McAllister 1933:30; Summers 1964:1) suggested that the ponds were used strictly for the storing and fattening of fish, whereas Handy (1932:259) indicated that the fish were systematically bred and raised in the ponds--a process he refers to as "fish farming."

Today only the Huilua fishpond in Kahana has survived, although the survey in Makaha and South Halawa did not cover the coastal regions thus if remains still exist, our investigation would not necessarily have uncovered them.

Religious Features

Large Heiau. Presumably the Hawaiians followed the religious pattern which their ancestors brought from central Polynesia and had many gods who rendered help in the needs and activities of daily life.

The most impressive religious structures were the large temples, or heiau, which were built for important ceremonies connected with some major event, such as war, or to invoke the blessing of Lono for an increase of food supply or other peaceful needs. Temple sites throughout Hawaii are nothing more than stone foundations or bases on which ritual features once stood. These ritual features were constructed of perishable material; usually wood, grass or leaf thatched structures on top of stone platforms or within enclosures, and they have long since decayed and disappeared.

Out of the mass of information available emerges the fact that the ground plans of heiau varied considerably, even on the same island (Buck 1964:514).

Four large heiau were surveyed and excavated in Makaha Valley. Kaneaki Heiau, the most impressive structure in the valley, had the surface features reconstructed following the excavation (Crozier and Apple 1973:31-40; figure 8). The other three features were stepped platforms which Ladd (1970b:94) classifies as religious structures.

There is only one documented, named heiau in Kahana Valley--Pu'u Makane Heiau. This religious structure is smaller than Kaneaki but approximately the same size as the stepped platforms in Makaha (550 square meters).

There were no large temples in the South Halawa Valley survey area and none was mentioned by McAllister in 1933. There were several smaller family heiau, however, and these are discussed in the next section.

Small Religious Shrine. The small heiau differ from the larger temples not only in size but also in construction. They generally are not as elaborately built as the larger religious structures. Without excavation it is often difficult to determine whether a site had a habitation or religious function. This category difficulty arose in many sites throughout the three valleys. Fortunately, at least one religious structure was excavated in each valley and two were reconstructed in South Halawa Valley (see Appendix III).

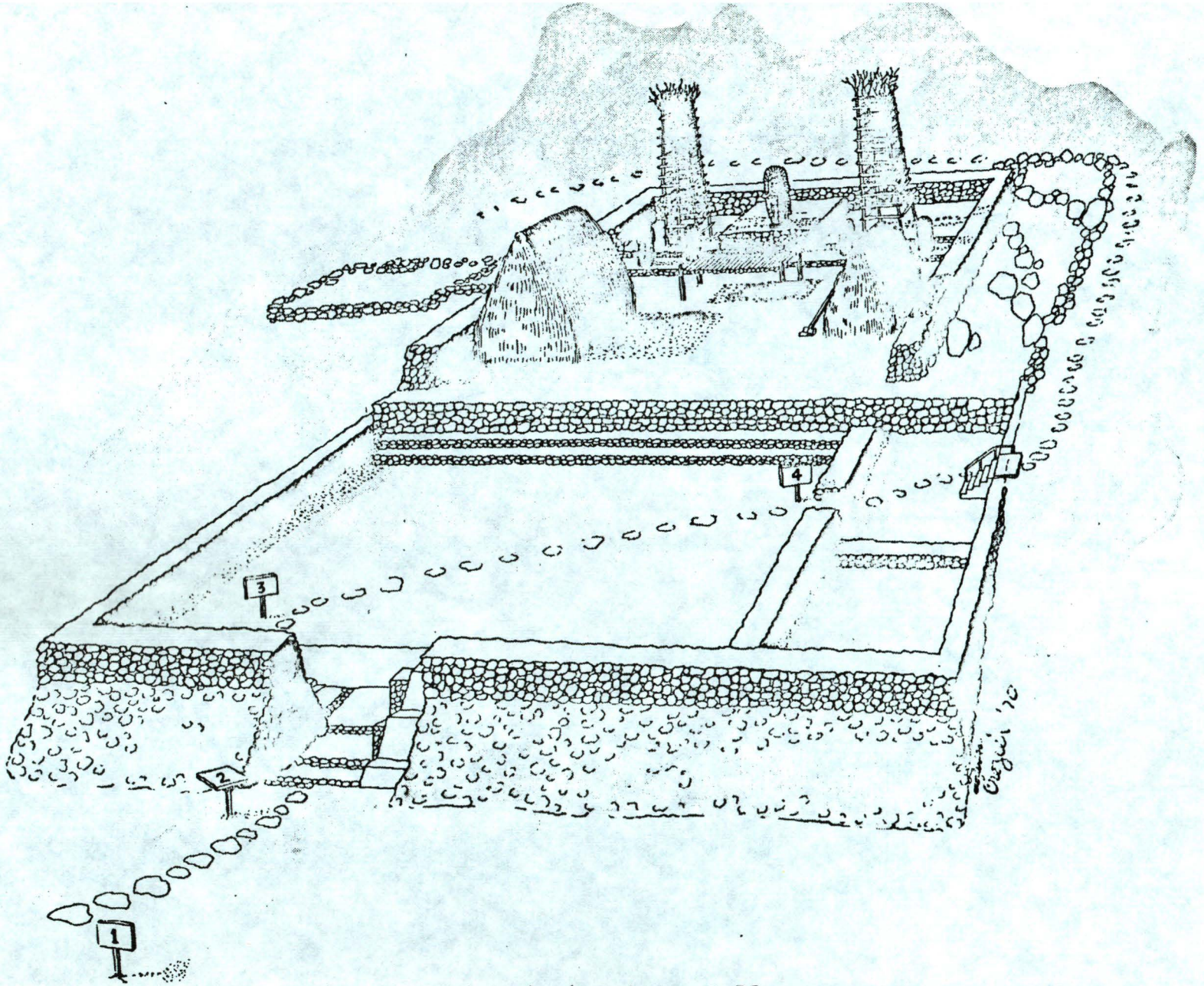


Figure 8. Kaneaki Heiau, Makaha Valley, As Reconstructed.

While South Halawa Valley had fewer religious structures than the other valleys, the two family heiau that were restored showed meticulous workmanship and structural components unique for the island.

Shrine. Shrine is usually a convenient term to designate a simple altar without a prepared court. They were made by individuals or small family groups who conducted a short ritual which required no priest (Buck 1964:528). Shrines varied considerably in construction and very few are known throughout Oahu since many were nothing more than an upright stone.

Fishing shrines (ko'a) often consisted of heaps of stones on or near the water's edge, and men going out to fish contributed a stone to the shrine. Since remains of hooks have been found on these shrines, it is probable that fish were also given as offerings (Buck 1964:287). Two such fishing shrines are located in Kahana Valley; one, the Kapaeleele fishing shrine had a commanding view of the entire bay while the Kauninio shrine could only be seen at low tide. Since only one shrine was investigated, no positive statements can be made at this time concerning their importance throughout the three valleys.

Burial. Numerous mounds scattered throughout the survey areas have been recorded as "possible" graves. Rasor (1969:81-84; 1970:55-64) excavated four mounds in Makaha Valley thought to have been burials. There was no evidence

in any of his excavations to support this interpretation. Hommon and Bevacqua (1973:17) excavated a postulated grave crypt in Kahana and also found no evidence of a burial.

Burial caves abound in all the islands and it is believed that many were also used as residence prior to the burials. Two of the excavated caves in South Halawa Valley had evidence of disturbed burials. Graveyards and burials may provide interesting clues to social and political organizations. For example, status differences can often be traced in graves even better than in house types or family complexes. Unfortunately, with the exception of the burial caves mentioned, the meager uncoverings of burial practices in the valleys fail to provide us with these clues. The artifacts associated with the South Halawa caves are discussed later on page 57.

Portable Artifacts

There is widespread agreement that artifacts must be studied as products, and therefore as reflections of cultural systems (Trigger 1971:324). When viewed in its archaeological context, every artifact may provide information, not only about the economy but also about the social structure. Tables VII through X show the nature of recovered artifacts and their provenience in relation to various features throughout the three valleys. These tables illustrate a breakdown of features mapped compared to portable artifacts, which is shown following Table X.

TABLE VII

Provenience of Artifacts--Kahana Valley

Artifact	Type of Site			Total
	Habitation	Enclosure	Midden Site	
Adze and adze frag.			1	1
Hammerstone	1	1		2
Grinding stone	2			2
Game stone (*ulu maika*)			1	1
Bone pick			1	1
Worked bone			1	1
Basalt flake (ground)			3	3
Volcanic glass	1	1		2
Total	4	2	7	13

TABLE VIII

Provenience of Artifacts--South Halawa Valley*

Artifact	Type of Site			Total
	Cave	Shrine	Platform Complex	
Adze and adze frag.	3	9	2	14
Hammerstone	1			1
Stone chopper		1	1	2
Game stone (ulu maika)		2		2
Game stone (disk)			1	1
Stone chisel	1			1
Stone awl	1			1
Fish hook	1			1
Lava file	1	1		2
Thatching needle	1			1
Bone pick	1			1
Worked bone	4			4
Dog tooth pendant	36			36
Human tooth pendant	1			1
Lei niho Palaoa	4			4
Shell ornament	1			1
Shell bead	3			3
Cordage	2			2
Matting	3			3
Basalt core	1	2		3
Basalt flake (ground)	6			6
Volcanic glass	200+		5	205+
Total	271+	15	9	295+

*Not including site complex B1-30. See Table IX.

TABLE IX

Provenience of Artifacts--Site B1-30--South Halawa Valley

Artifact	Type of Feature					Total
	Men's Eating & Gathering	Family Dwelling	Junction of Walls	Fire Pits	Misc. Areas	
Adze and adze frag.	5	10	3		4	22
Hammerstone				1		1
Grinding stone	1				1	2
Whetstone frag.	5					5
Stone awl	1					1
Cooking stone			1	1		2
Game stone (ulu maika)		1				1
Game stone (konane)	13					13
Stone chopper	2	1				3
Stone bait cup					1	1
Misc. polished stone		1				1
Stone bowl frag.		1				1
Coral file			1			1
Worked wood		1				1
Matting				1		1
Basalt flake (ground)	87	32	13	5	28	165
Basalt chipping waste	12	1	1	9	1	24
Volcanic glass	35	35	42	28	27	167
Total	161	83	61	45	62	412

TABLE X

Provenience of Artifacts--Makaha Valley

Artifact	Type of Site					Total
	Permanent Habitation	Temporary Shelter	Stepped Platform	Shrine or Heiau	Misc. Surface	
Adze and adze frag.	26	3		3	8	38
Hammerstone	2					2
Grinding stone		1		1	1	3
Stone pounder	1				1	2
Cooking stone			1			1
Game stone (ulu maika)	4	1	1		2	8
Game stone (konane)	1	1				2
Stone lamp	1					1
Stone mirror	1					1
Basalt file	1					1
Basalt rubbing stone			1			1
Coral rubbing stone			1			1
Coral file	1		1			2
Sea urchin file					1	1
Cut bone				2		2
Worked shell	1					1
Shell scraper			1			1
Shell stopper			2			2
Basalt flake (ground)	32					32
Basalt core		1				1
Volcanic glass	16				1	17
Total	87	7	8	4	14	120

	Features Mapped	Artifacts
Kahana	465	13
South Halawa	125	707+
Makaha	1000+	120
Total	1590+	840+

The above breakdown is significant since the ratio of features to artifacts certainly does not follow the expected pattern. South Halawa, with the fewest number of features, contained 84 per cent of all uncovered artifacts throughout the three valleys.

Until more excavation is undertaken in Kahana, we can only postulate the importance of this ratio, however it appears that the stone industry was an important aspect of South Halawa's life style.

It is also important to note the distribution of the artifacts since 790, or 94 per cent were uncovered in lower valley habitation areas, whether caves, shelters, or permanent living sites. It should be remembered that volcanic glass flakes were counted as artifacts and they numbered 391 or 46.5 per cent of all recorded portable artifacts.

The maker of an artifact would select certain attributes because they were essential to the proper functioning of the object. And although agriculture was the principal mode of subsistence in the valleys, we find little material evidence

of this since only stone, bone, and shell tools would be preserved while a digging stick or wooden hoe would decay over the centuries. The rectangular basalt adzes may very well have been used for agricultural purposes.

Several of the artifacts had significant implications of the life style throughout the valleys, particularly South Halawa. The attributes and implications are briefly discussed below.

Adze. Most of the adzes uncovered in the excavations were quadrangular in cross section and tanged (figure 9a). Flaking and polishing was the manufacturing method. Two of the adzes from South Halawa Valley displayed earlier Polynesian attributes. One was triangular in cross section which resembled the form of certain Tahitian adzes, while the other was a thin quadrangular, untanged adze similar to a Marquesan style (figure 9b). According to Stokes, flaking required greater skill than pecking and also required special training. "This implies an adze-makers trade, which was indicatively present in Hawaii" (1928:86). The amount of chipping waste and fragments of polished flakes found at the men's house (mua) in site B1-30, South Halawa Valley, would indicate that this adze-makers trade fell to the male members of the family.

Game Stones. The game of 'ulu maika, or simply maika, was played on a prepared course with stone disks. Disks in finished or polished form were found in each of the three

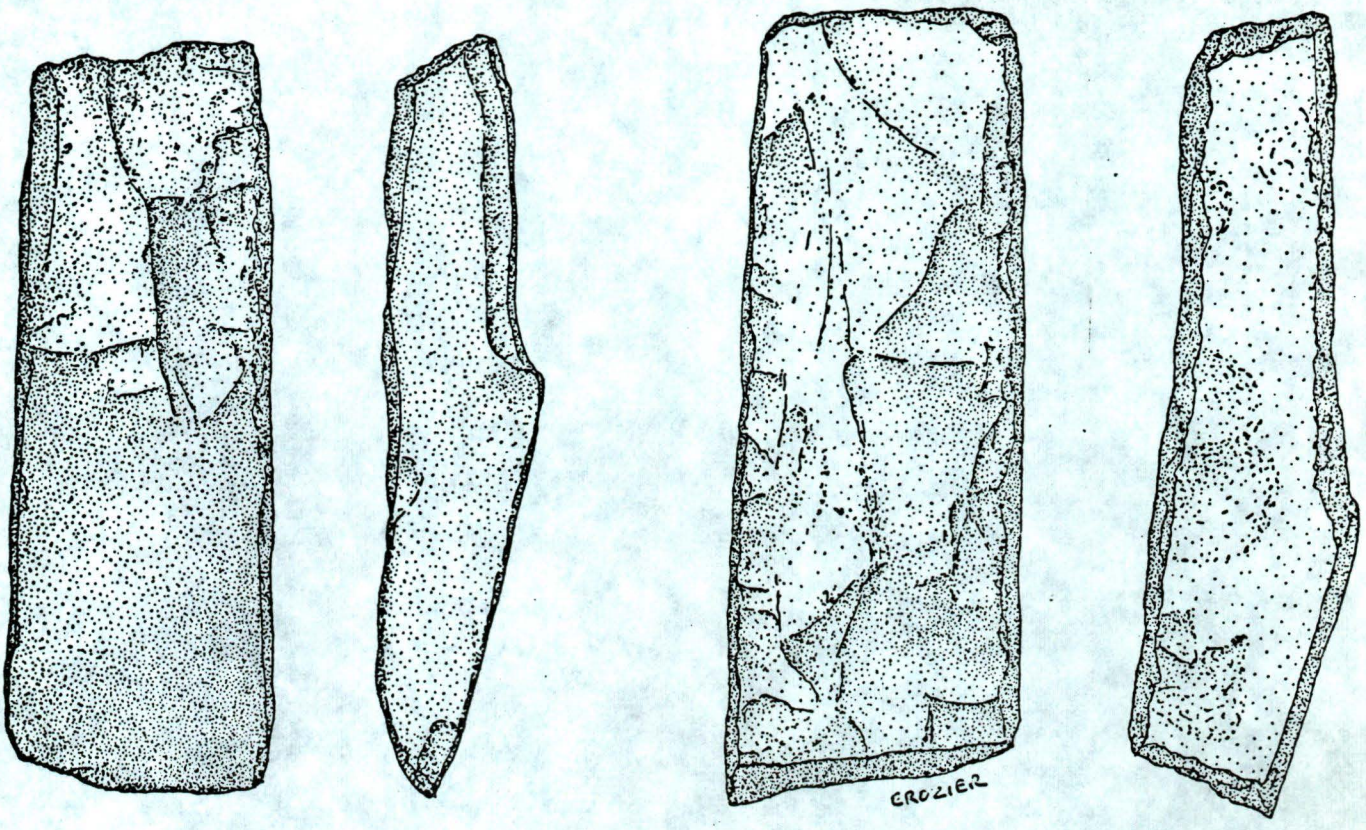


Figure 9a. Quadrangular-tanged Adzes from South Halawa Valley.

SCALE - SAME SIZE

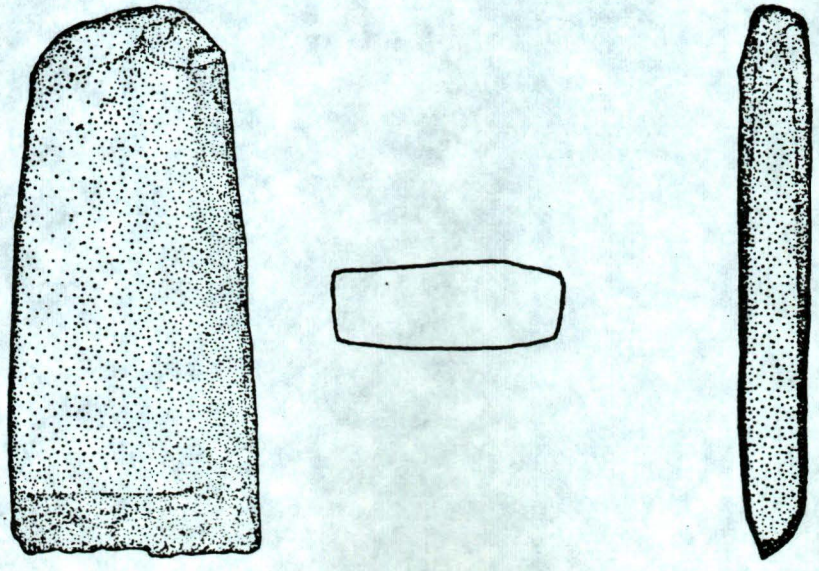


Figure 9b. Quadrangular-untanged Adze from South Halawa Valley.

valleys.

The game of konane (checkers) was played on a board with rows of places for two sets of men--black, close-grained basalt pebbles, and white coral pebbles. Any doubt as to its authenticity as an ancient Hawaiian game is dispelled by the fact that it was being played at the time of Cook's third voyage (Cook 1784, vol. 3:144-45). Thirteen of these black and white game pebbles were uncovered in the mua at site B1-30, South Halawa, thus indicating that the mua was not only a men's eating and gathering area but also a place for games and amusement.

Miscellaneous Artifacts. There were several artifacts also located in South Halawa Valley which enforces the hypothesis that there was a chiefly class, or ali'i with his kin group in the valley. These artifacts were the four Lei niho Palaoa, and the 37 tooth pendants. Peter Buck records that:

> The most spectacular of the Hawaiian ornaments is the lei palaoa, or niho palaoa. It is a hook-shaped ornament made originally from a sperm-whale-tooth and suspended by two coils of braided human hair. Cords are attached to the upper ends of the coils to tie at the back of the neck so that the coils hang over the breast with the free end of the hook forward (1964:535).

The four ornaments uncovered in a cave site in South Halawa Valley were not fashioned from whale teeth but rather from a travertine sedimentary rock which forms in caves by the evaporation of solutions (Arem 1973:132). Although these ornaments were made in some number throughout Hawaii, the

pendant became strictly standardized as an emblem of chiefly rank (Cox 1967:412).

The 36 dog-tooth pendants and one human-tooth pendant were elements of leg ornaments worn only by men dancers and were peculiar to Hawaii (Buck 1964:553). As dogs were killed the canine teeth were extracted and saved until there was a sufficient number to complete a leg ornament. More had to be saved for a second ornament for they were used in pairs. One specimen in the Bishop Museum had a total of 995 teeth, thus 249 dogs contributed the teeth for only one ornament (ibid.:554-557). It is very possible that these specially trained male dancers performed during important ceremonies on the large paved expanse at site B1-30 (see Appendix III).

The stone mirror found in the wall of a habitation site in Makaha Valley denotes the presence of a chiefess since they were the only women who possessed these unique artifacts (Kenneth Emory, personal communication, 1971). It is not surprising that Makaha Valley would house ali'i since the large stepped pavements and Kaneaki Heiau would indicate that a chiefly class inhabited the region.

DISCUSSION

Through the study of archaeological remains throughout Makaha, Kahana, and South Halawa, evidence was uncovered which suggests the composition of a man-environment relationship. The physiography and precipitation differed enough throughout the valleys to significantly induce specific aspects of this relationship and affect the daily life of the human communities in the three valleys.

It is important to remember that an accurate climatic model can be constructed for the precontact period since an analysis of soil samples indicates a precontact climate on Oahu similar to the present one (Sabels 1966:148).

The similarities between the percentages of habitation, economic, and religious features throughout the three valleys (figure 10) are quite significant. The results of this investigation show that for every 100 features surveyed in each valley, approximately 15 pertained to habitation, 78 were in the economic category, and 7 related to religious activities. This model may be tested in other valley systems throughout Oahu, Hawaii, or even Polynesia.

Examination of the masonry construction of the three valleys indicates that during the early periods of occupation the Hawaiians built their stone structures with more care and precision than they did in later periods. Stones of the

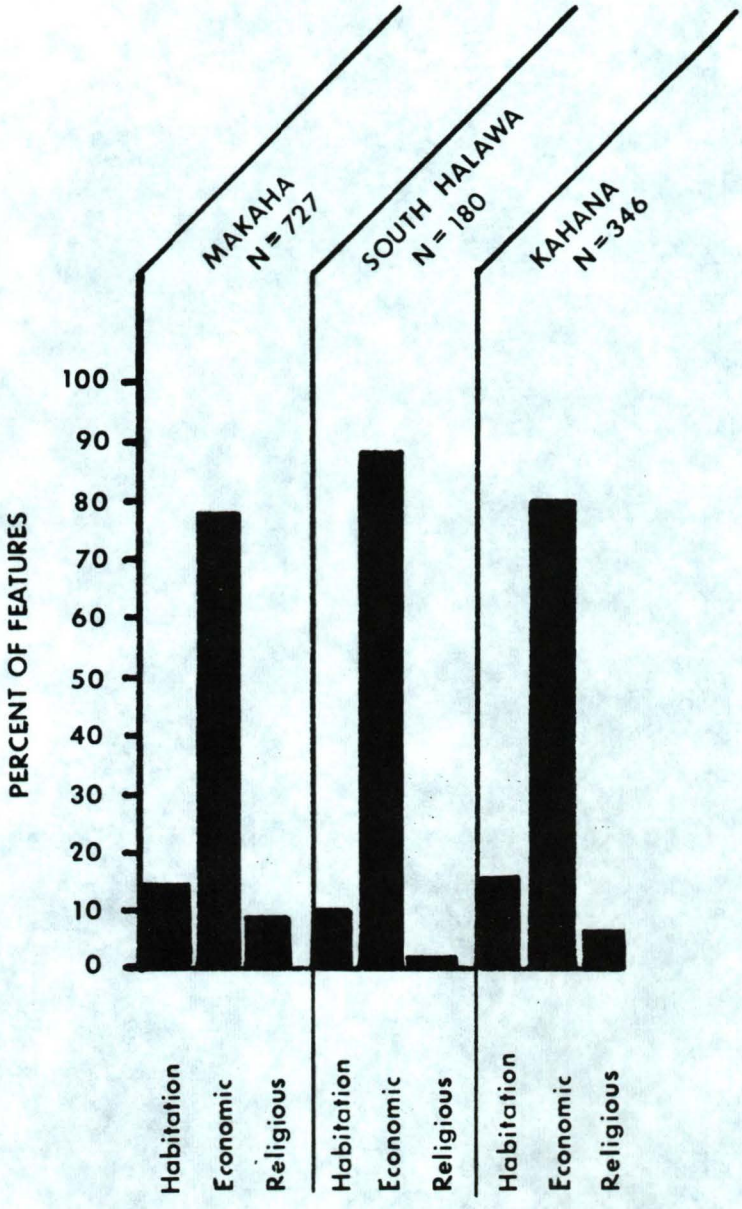


Figure 10. Percent of Habitation, Economic, and Religious Features in Makaha, South Halawa, and Kahana Valleys.

early structures apparently were selected for uniform size and smoothness and were more carefully set in walls and foundations. This was particularly noticeable at Kaneaki Heiau where the 14th century walls showed a meticulous workmanship compared to those walls built in the 17th century (see Ladd 1973:14). I found similar evidence throughout Makaha and South Halawa Valley, and also at several precontact structures on the Island of Hawaii which had been subsequently covered by historic features (Kelly and Crozier 1972:29).

Such similarities were not found in the artifact count where the excavations in South Halawa uncovered the largest number of precontact artifacts in relation to the fewest number of known features. Hypothesis regarding this relationship between Makaha and South Halawa may be premature, however the dearth of subsurface artifacts in Kahana may be an indication of temporary habitation instead of an intensive occupation.

While coastal sites may provide the evidence for stylistic and perhaps functional change to postulate a possible change in the exploitation of the maritime ecosystem (Newman 1969:6), the evidence from sites in Makaha and South Halawa support a pattern of agricultural stability. This contrasts with that of continued change tentatively postulated by Newman (ibid.:7-13) for the exploitation of the terrestrial ecosystem.

Makaha

Annual rainfall and surface winds were not generally severe in Makaha Valley although winter climatic factors apparently influenced the orientation of precontact houses. Approximately 80 per cent of the houses and shelters faced away from the prevailing wind and rain from the east-northeast and east-southeast.

By and large the maximum size of settlements attainable was limited by the nature of the food supply. The two staple items were fish and poi, a paste made from the cooked and pounded root of taro, grown in the valleys in irrigated plots. McAllister (1933:119) recorded extensive taro terraces at least halfway up Makaha Valley. Based on the large number of agricultural terraces located during the Makaha survey, it is apparent that this region was systematically cultivated at a high level of proficiency thus making the population potential quite large.

The attractions of fishing and collecting shellfish may result in concentrations of populations along bodies of water. Unfortunately, the Makaha project did not include a survey of coastal sites, however the inland sites investigated contained fish remains, shell, or coral thus attesting to the importance of the fishing industry to inland agricultural communities.

The numerous large heiau located throughout Makaha Valley which have been carbon dated to the period of this

investigation, attest to not only a large religious assemblage but also a labor force of significant size. The abundance of pre-Christian religious remains indicates a formal system with ali'i and kahuna participating. It is known that King Kamehameha I organized a sizable military force in 1796 in the Makaha area for the invasion of the island of Kauai and Kaneaki Heiau, during its later stage, may have been utilized for the religious ceremony connected to such an undertaking (Crozier and Apple 1973:31).

South Halawa

It is important to keep in mind that only a portion of South Halawa Valley was systematically investigated, possibly only one-third of the area which contained precontact archaeological remains. It is still, however, possible to analyze and compare the surveyed evidence with that of Kahana and Makaha.

The climate and environment of South Halawa is similar to that of Makaha and the known features, e.g. shelters, platforms, and agricultural terraces reflect a similar precontact living pattern. Our investigation uncovered agricultural evidence which concurs with Handy (1940:80), who noted agricultural terraces along the Halawa Stream and reported that taro was planted four or five miles inland on the banks of gulches. McAllister (1933:29) records a large number of fishponds in the Pearl Harbor and Kalihi Basin. Six of the ponds were known to be in the South Halawa

ahupua'a which have since been destroyed. If Hommon's supposition is correct (Hommon and Bevacqua 1973:38) that large or numerous fishponds were associated with areas of dense population, we can postulate a fairly large precontact population for South Halawa. Although no coastal sites were investigated, inland excavations uncovered extensive shellfish remains particularly at site B1-30.

Whereas community size and location were influenced to a large extent by ecological factors, the layout of communities appears to have been strongly influenced by family and kinship organization (Trigger 1968:61-62). Family and kinship ties appear to have been particularly strong in South Halawa Valley as illustrated by the postulated extended family complex at site B1-30, and the two family shrines (sites B1-33 and B1-66).

Kahana

As noted earlier, Kahana is one of the wettest valleys in the entire Hawaiian chain receiving an annual rainfall of up to 242 inches compared to the 35 inches average in Makaha and South Halawa.

All of the sites and test areas investigated in Kahana were located in the lower valley, near the coast, an area that Hommon and Bevacqua believed to have been the concentration of precontact population (1973:8). However, only one coastal habitation site was located while the investigated lower valley sites were disappointing because of the

dearth of subsurface material remains and no inland sites even included the expected fireplace.

Just how serious the heavy rainfall was on the demography of Kahana is open to further investigation. However, it is known that the storm winds were strong enough to damage vegetation and structures (Warwick 1973:59), and these factors may reflect the nature of the precontact settlement.

There is also a distinct possibility that marine ecological differences existed between the windward and leeward sides of the island. "The long-term pounding of the trade wind swell system against the windward coast results in a further reduction of the windward total shallow water zone causing a lower marine biomass to windward" (Newman 1968:15). As documented earlier, only one site in the Kahana Valley investigation (1546) had mollusc shell concentrations and this site was situated on the beach at the border of Huilua fishpond.

Sahlins (1972:124) recorded that the precontact Hawaiian agricultural system probably exploited a given territory at a high level, close to the technical capacity. Although the lower portion of Kahana Valley may have had quantities of taro, archaeological evidence is often difficult to uncover since terraces in windward areas can often become eroded or covered with alluvium soon after they are abandoned. Virtually all of the archaeological sites in Kahana were found in

the lower valley zones, but Hommon and Barrera (1971:76) found evidence of terraces in an area only one-fifth the size of that in Makaha. Handy (1940:92) was only able to locate terraces along the major stream in Kahana.

There is no empirical evidence that ali'i or kahuna resided in Kahana, and only one heiau has been recorded in the valley although other areas of windward Oahu do contain impressive religious structures.

As previously noted, the earliest known archaeological site on Oahu is Bellows Beach near Kailua on the windward side approximately 30 kilometers southeast of Kahana. Hommon and Berrera (1971:76) have postulated that Kahana may have been one of the first ahupua'a to be settled on Oahu. However precontact archaeological comparisons throughout windward "wet" valleys on Oahu based on the Bellows Beach or Kailua data is open to question. Unlike Kahana, the climatic condition at Bellows Beach is similar to that of Makaha and South Halawa on the leeward side and may have been more favorable for extended occupation than that of Kahana.

CONCLUSION

The evidence presented here suggests the existence of causal relationships between some environmental factors and human activities in each valley. Differential climatic factors apparently influenced the nature of archaeological features and the demography of the human communities which varied between the three valleys in the precontact period.

Although this is the first man-environment analysis comparing Makaha, South Halawa, and Kahana, it is not the first study of cultural-ecology in Hawaii. In 1973 Tuggle and Griffin edited a report which examined the problem of population growth and social change, with an ecological orientation, in Lapakahi, Hawaii. However, Lapakahi was "not an ideal area for colonization by an agricultural people" (ibid.:61), and colonization of significant proportions would not be expected until more suitable agricultural areas reached a point of population overflow.

"Agricultural groups will generally seek locations where the soil and weather are favorable to their crops and their methods of cultivation" (Trigger 1968:61). Today, in Hawaii, agriculture is still an important industry and if people have the choice and land is available, they will generally continue to select locations favorable to their crops. Population densities vary widely from district to

district on Oahu, however in 1970 the Kahuna area was sparsely populated compared to the Makaha and South Halawa area (Warwick 1973:118). I contend that this population density was similar in precontact times.

I am not implying that climatic factors in all "wet" valleys or windward regions in Hawaii prohibited dense population or extended occupation. The necessity of ports, for example, would often influence the size of localized settlements, however this was not the case in windward Kahana.

Although this paper has dealt with a man-environment relationship in three valleys, it was not the intention to involve the entire cultural ecology of Hawaii or Oahu. The evidence I have presented is based on empirical data and pertains solely to the three valleys under discussion, however the above mentioned relationships should be of interest to future archaeological researchers on Oahu and throughout the Hawaiian chain.

APPENDIX I

GLOSSARY OF HAWAIIAN WORDS USED IN THIS REPORT

Definitions from Pukui and Elbert (1957)

a'a	clinker lava with rough, sharp points and edges.
ahu	heap, pile; cairn; small platform.
ahupua'a	land division usually extending from the uplands to the sea, so called because the boundary was marked by a heap (ahu) of stones surmounted by the image of a pig (pua'a), or other tribute was laid on the altar as tax to the chief.
ali'i	chief; royal family.
hale	house, building.
hale noa	family sleeping house
heiau	pre-Christian place of worship.
'ili'ili	pebble, small water worn stones.
imu	underground earth oven.
kahuna	priest; expert in a special field.
kai	sea; sea water
kapa	tapa, as made from wauke or mamaki bark.
kapu	taboo, prohibition.
konane	ancient Hawaiian game resembling checkers.
kuleana	right, title, ownership; also a piece of land, ownership for which was obtained by commoners under the Kuleana Law of 1850.
lanai	porch, veranda.
lepo 'ula'ula	red earth.

Lono	one of four major gods; god of clouds, wind, the sea, agriculture, and fertility, patron of the annual harvest (makahiki) festivals.
makai	toward the ocean.
mana	supernatural or divine power, authority; taboo house in a heiau.
mauka	toward the mountains.
mua	men's eating and gathering place.
'ohana	family, relative, kin group.
olonā	a native shrub, the fiber used as cordage and fishnet.
pahoehoe	smooth, unbroken type of lava, sometimes twisted or ropey.
pili	a grass, formerly used for thatching houses in Hawaii.

APPENDIX II

Age Determinations--Methods and Results

More than 50 samples were submitted for radiocarbon and hydration rind age determinations from the three valleys. The wood charcoal samples were sent to the Westwood, New Jersey laboratories of Teledyne Isotopes, while the volcanic glass specimens were dated by the Hawaii Institute of Geophysics under the supervision of Maury Morgenstein. The calculations of true ages of the radiocarbon samples were based on the work of Stuiver and Suess (1966:Table 1:538) and were calculated from both the mean and the range in age at the limits of the first standard deviation. The results were then translated into calendrical years.

Kahana Valley. Four carbon samples and one volcanic glass flake were submitted for age determinations from Kahana. Unfortunately, samples HRC 232, 233, and 235 could not withstand treatment for the removal of humic acids, so that their age determinations were inaccurate and are not included in this report. However, sample HRC 234 returned a true age of less than 293 years (Hommon & Bevacqua 1973: 33) placing it some time between A.D. 1657 and 1850. The hydration rind dating process yielded an age range estimate of A.D. 1552 to 1624 (figure 11).

South Halawa Valley. Three carbon samples were submitted to Isotopes and 28 volcanic glass specimens were dated in

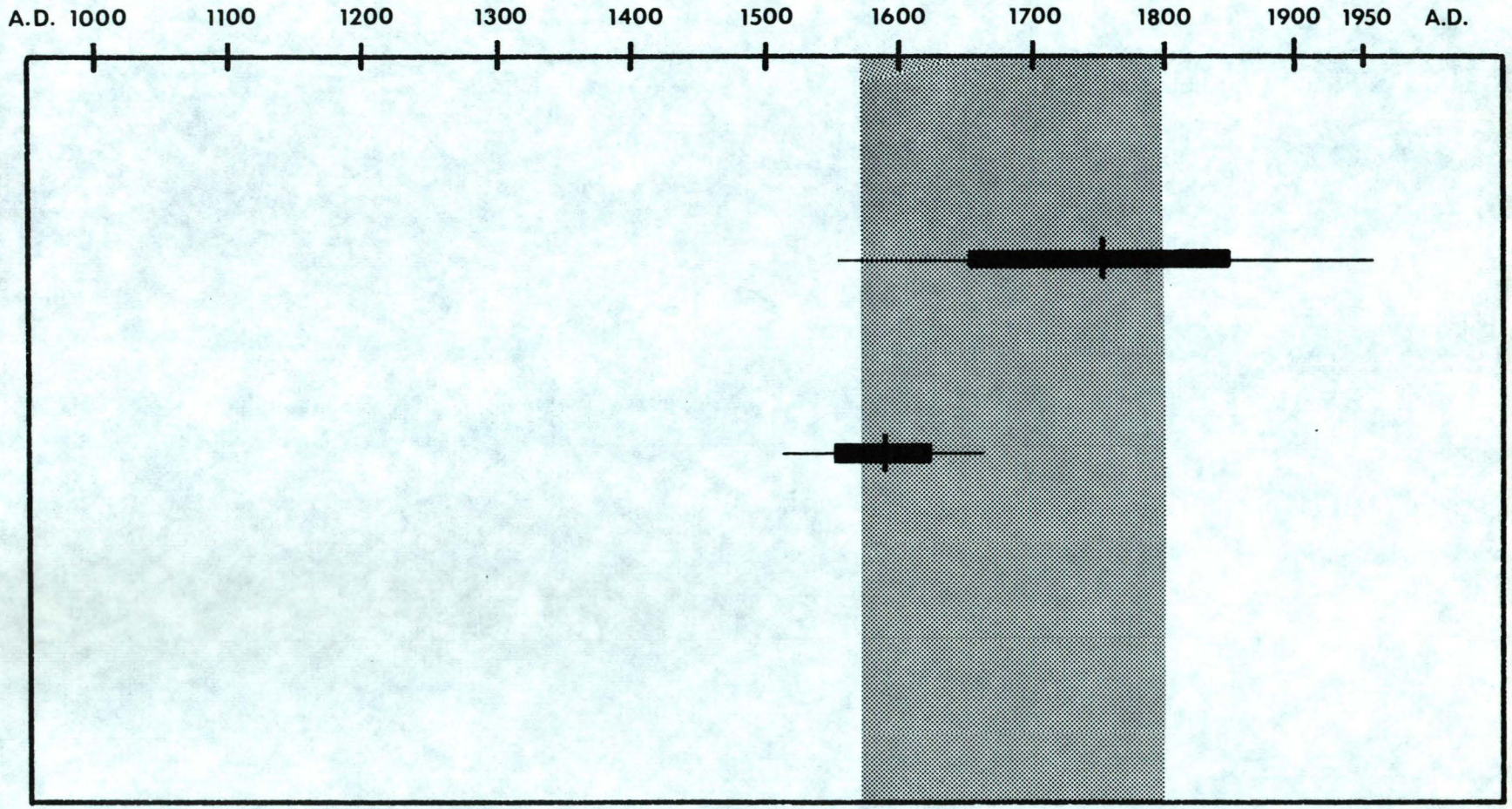


Figure 11. Radiocarbon and Hydration Rind dates. The heavy dark bar represents the time span of the first standard deviation; the thin line, the second. The shaded area represents an estimation of the duration of occupation.

Honolulu. A listing of these dates is shown in Table XI, and an age range chart is illustrated in figure 12.

Makaha Valley. Twenty-eight radiocarbon samples collected from sites throughout Makaha Valley exhibited a prehistoric occupation period of approximately 700 years.

One agricultural complex located in the upper valley (site C4-286) was dated in 1972 and the results are shown in Table XII.

Estimates of calendrical ages from sites in the lower valley are shown in Table XIII, while all dates are combined in figure 13.

Analysis of Age Distribution

The distribution chronologically of features indicates that the pattern of habitation and agricultural adaptation exhibited throughout each individual valley was maintained without major changes during its period of occupation. We can also see that this pattern was probably brought to each valley in an already developed form rather than evolving as a part of a developmental sequence undertaken within the valleys.

While coastal sites may provide the evidence for stylistic and perhaps functional change to postulate a possible change in the exploitation of the maritime ecosystem (Newman 1969:6), the evidence from sites in Makaha and South Halawa support a pattern of agricultural stability, contrasting

TABLE XI

Age Determinations from South Halawa Valley

RADIOCARBON

Isotopes Sample #	Site	C^{14}	Age in Years B.P. 1950	Estimated Dates (A.D.)
I-6345	B1-30	70 ± 14	580 ± 125	1370
I-6346	B1-30	64 ± 19	530 ± 165	1420
I-6347	B1-30	52 ± 15	430 ± 130	1520

HYDRATION RIND

Site	Depth (cm)	Age in Years B.P. 1970	Dates (A.D.)
B1-51 (cave)	10-15	425 ± 64	1545
B1-51	15-20	409 ± 133	1561
B1-51	20-25	428 ± 65	1542

contd.

TABLE XI (contd.)

Feature	Depth (cm)	Age in Years B.P. 1970	Dates (A.D.)
Walls (A & B)	24	387 ± 15	1583
	24	386 ± 14	1584
	24	384 ± 21	1586
	Fill	377 ± 14	1593
	24	376 ± 14	1594
	Fill	373 ± 19	1597
Fire Pits (F & G)	20-40	470 ± 29	1500
	40	323 ± 15	1647
Gathering Area (D)	15	392 ± 20	1578
	10-20	390 ± 27	1580
	10-20	382 ± 20	1588
	21	362 ± 14	1508
	5-15	358 ± 14	1612
	10	347 ± 18	1623
	7-10	325 ± 22	1645
Dwelling (I)	20	502 ± 24	1468
	20	490 ± 16	1480
	20-25	461 ± 22	1509
	20-25	458 ± 17	1512
	15	419 ± 22	1551
	21'	380 ± 24	1590
	21	374 ± 25	1596
	25	371 ± 20	1599
	21	370 ± 21	1600
	7	291 ± 14	1679

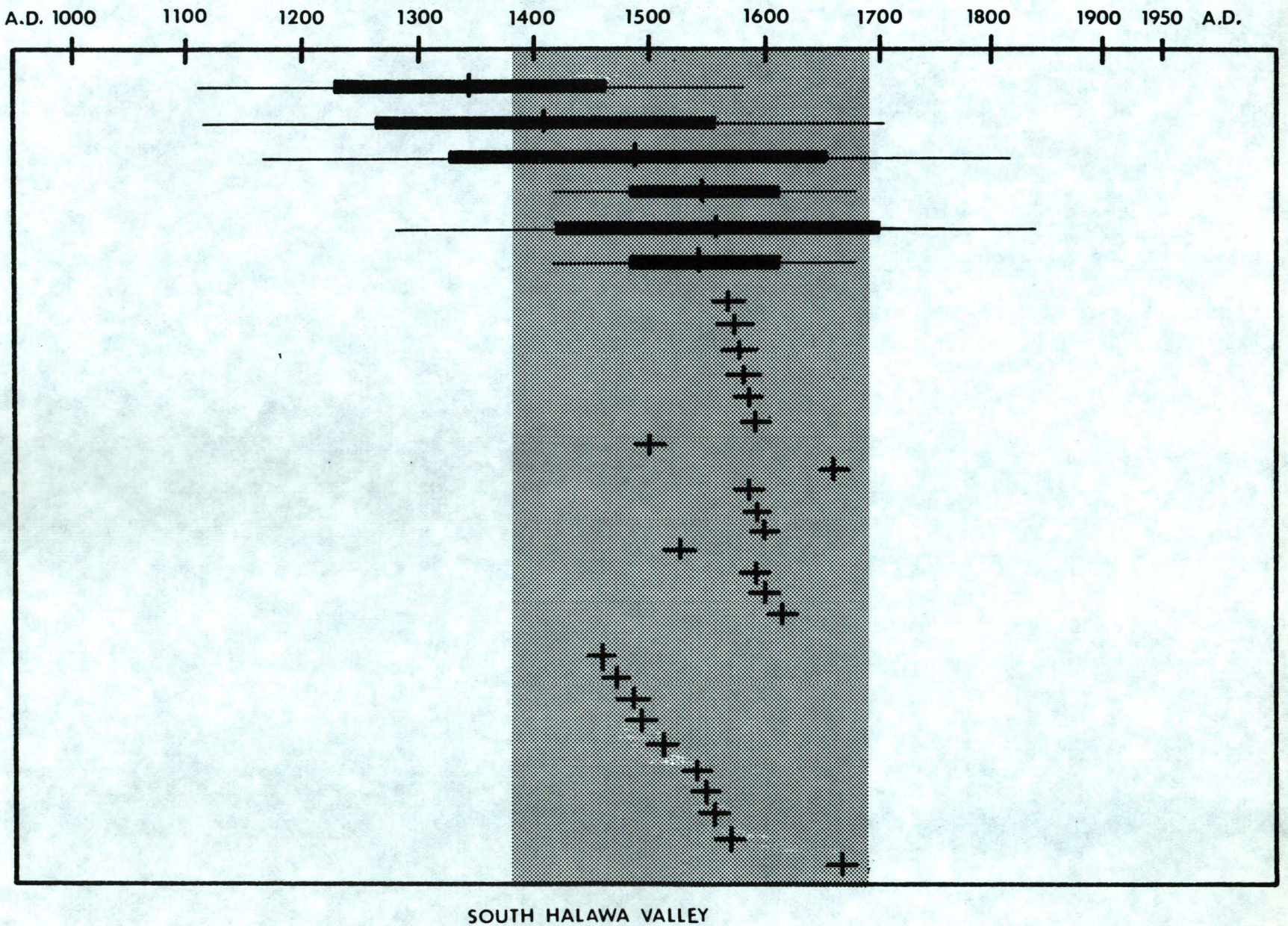


Figure 12. Radiocarbon and Hydration Rind Dates, South Halawa Valley.

TABLE XII

Estimates of Calendrical Ages for C^{14}-Assayed Samples, Site C4-286

Carbon Sample #	Location in Site	Age (Years B.P.) C^{14}	Age (Years B.P.) True	Range of Calendar Years A.D. (within 1σ)
1-4826	T-6, probable habitation feature just above T-1	<185	<293	1655-1855*
1-4823	T-1, upper cultivation layer	200±95	295±100	1555-1755
1-4824	T-1, lower cultivation layer	445±95	515±100	1335-1535
1-4827	T-3, interface of lower cultivation layer and underlying subsoil	405±90	505±100	1345-1545
1-4825	T-2, fill from construction of terrace wall	565±110	565±110	1280-1500

*Upper limit set by historical data

TAPLE XIII

ESTIMATES OF CALENDRICAL AGES FOR RADIOCARBON-DATED SAMPLES FROM MAKAHA*

Sample No. I-	Site C4-	Location in Site	Age (Years B.P.)		Range of Calendar Years A.D.	
			Radiocarbon	True	(within 1σ)	Estimate Selected
4125	50	Midpoint in fireplace	< 185	< 293	< 1657**	1655-1855†
4308	95	Firepit, test trench A-1	< 185	< 293	< 1657**	1655-1855†
4304	50	Base of fireplace	< 205	< 296	< 1654**	1655-1855†
4306	17a	Fireplace no. 1	< 205	< 296	< 1654**	1655-1855†
4120	37	NW Firepit in G-1	< 210	< 297	< 1653	1655-1855†
4309	194a	Test area M-6	205± 90	296+100	1554-1754	
				437-268	‡1513-1682	
			295-115	380-220	1570-1730	1550-1750
				318-200	1634-1750	
				-182	-1768‡	
4310	38	Fireplace no. 1	230± 95	301+100	1549-1749	
				448-278	1502-1672	
			325-135	365-178	1585-1772	1550-1770
				328-155	1622-1795‡	
4307	52	Test trenches E and F	245± 90	304±100	1546-1746	
				453-284	1497-1666	
			335-155	355-284	1595-1666	1500-1750‡
				340-284	1610-1666	
4311	38	Fireplace no. 2	250± 90	305±100	1545-1745	
				410±100	‡1440-1640	1495-1745
			340-160	350-286	1600-1664	
				455-286	1495-1664	
4122	38	Fireplace no. 3		308±100	1542-1742†	
			270± 90	390±100	1460-1660	1430-1660
				423±100	1427-1627	
			360-180	465-292	‡1385-1658	
4121	39	Rectangular fireplace	370± 90	470±100	1380-1580	
				506-430	1446-1520	1380-1580
			460-280	-386	1446-1564	
				-310	1446-1640‡	
4200	17a	Fireplace no. 2	370±100	470±100	1380-1580	
				510-423	1440-1526	1380-1580
			470-270	-390	-1560	
				-308	-1642‡	
4198	168	Base of layer II	445± 95	500±100	1350-1550	1350-1550
			540-350	547-460	1403-1490	
4305	168	Top of layer II	480± 95	520±100	1330-1530	1330-1530
			575-385	567-476	1383-1474	
4201	18a	Fireplace no. 2	720±105	720±105	1125-1335	1125-1335
			825-615	740-638	1210-1312	
4199	17	Fireplace no. 3	730±100	730±100	1120-1320	1120-1320
			830-630	740-640	1210-1310	

* Based on Stuiver and Suess, 1966, and half life of 5568 years.

** At 2σ

† Upper limit set by historical data

‡ Rejected in selecting final estimate

‡ Mixed sample--use estimate with caution.

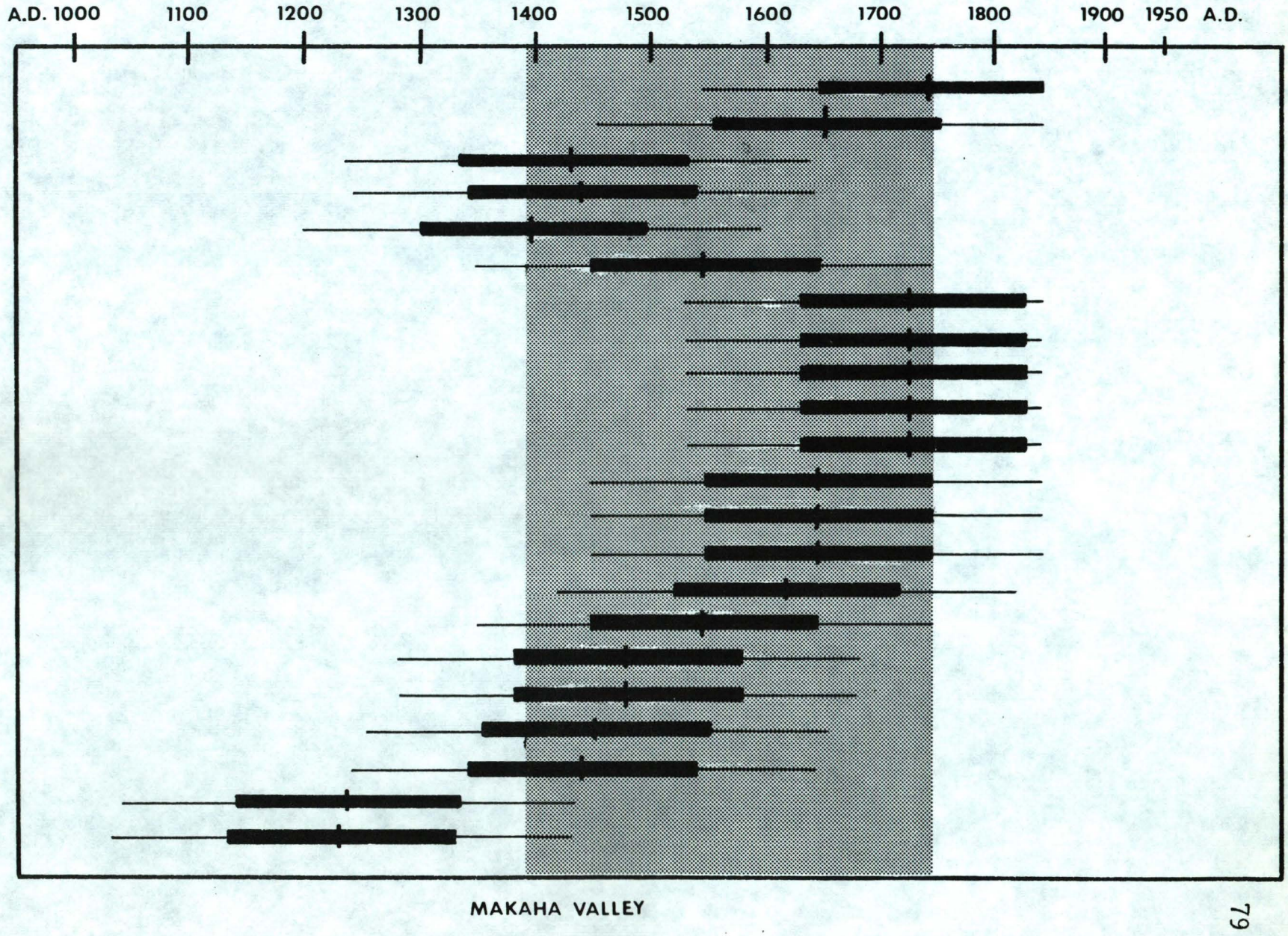


Figure 13. Radiocarbon dates from Makaha Valley.

with that of continued change tentatively postulated by Newman (ibid.:7-13) for the exploitation of the terrestrial ecosystem.

Analysing the habitation and agricultural patterns exhibited in Kahana Valley from a chronological standpoint is, to say the least, more difficult. Until further excavation is undertaken and more dates obtained, we can only hypothesize a pre- to protohistoric age for most archaeological features, and I believe that the valley was only significantly utilized in the protohistoric and historic periods. Although Hommon and Barrera (1971:76) postulate that Kahana may have been one of the first ahupua'a to be settled on Oahu, excavations to date tend to disprove this hypothesis, and I doubt that continued archaeological investigation will uncover evidence of any sustained activity in the valley that can compare to the early occupation periods of both Makaha and South Halawa. Localized climatic conditions in Kahana did not favor an early or extended settlement, especially since other areas may have been more favorable and most likely available to Oahu's inhabitants during the precontact period.

APPENDIX III

Four Precontact Sites in South Halawa Valley, Oahu, Hawaii

Under contract with the State Highway Department and Federal Highway Administration, Bishop Museum Department of Anthropology began archaeological surveys of the proposed H-3 Highway corridor in South Halawa Valley during the summer of 1970. From 1970 through 1972, survey, excavation, and restoration was carried on in the valley. A total of 48 sites were surveyed; 125 features mapped; and 15 sites or site-complexes were excavated.

South Halawa Valley and North Halawa Valley made up the ancient Halawa ahupua'a[1] which ran northeast from the East Loch of Pearl Harbor to the Koolau Mountains on Oahu's leeward side (figures 14 & 15). South Halawa Valley had a relatively short but unique occupation period in comparison to other valleys on the same island.

Both the North and South Halawa Streams flow throughout the winter months thus providing an ample supply of fresh water. Two springs located near site B1-30 gave an additional water source when both streams are dry during the summer. Large water worn rocks were abundant in the stream beds and these were generally favored by Hawaiian builders. However

---

[1] Land division usually extending from the uplands to the sea, so called because the boundary was marked by a heap (ahu) of stones surmounted by the image of a pig (pua'a), or other tribute was laid on the altar as tax to the chief.

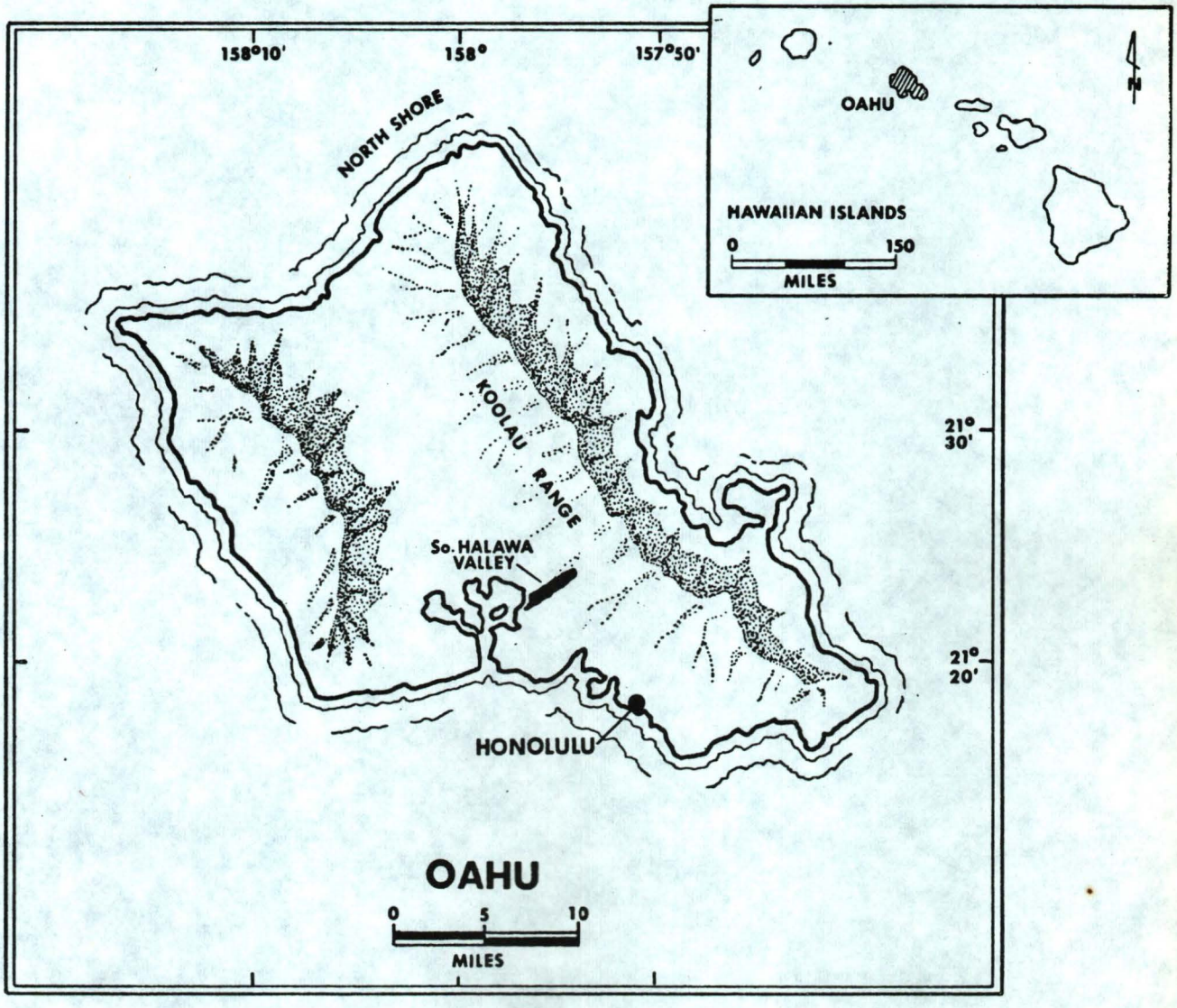


Figure 14. Location of South Halawa Valley on Oahu.

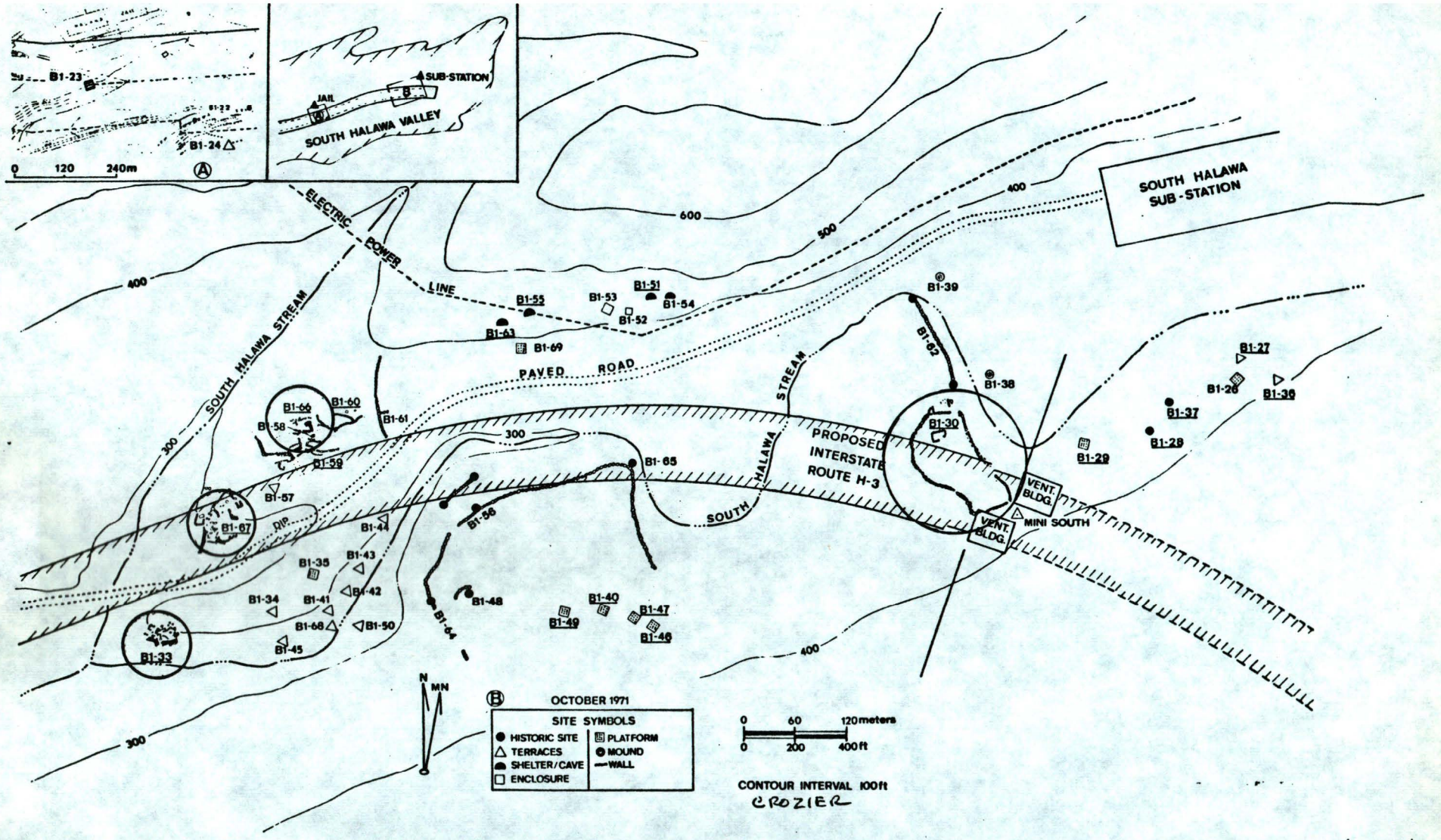


Figure 15. Survey Area and Sites in South Halawa Valley.

very few were used in the construction of any of the features at the sites with the exception of the earliest occupation Period iii at site B1-30. Walls, foundations, and platforms were built utilizing the natural basalt and occasional lava rocks which can be found in great quantities throughout the valley floor and slopes.

Two ecological zones exist in the narrow valley; 1) lower dry forest area and 2) the upper wet forest. Much of the relatively flat lower dry forest zone was cleared in historic times for sugar cane and cattle grazing.

The vegetation cover in the valley has important implications for precontact cultural adaptations for it provided the necessary construction materials. Hau trees (Hibiscus tiliaceus), because of their strength and durability, would have been an ideal wood source for house ridge poles, rafters, and posts. Hau was also used for outrigger canoes and the bark could be stripped and made into strong ropes or beaten into a good quality native cloth, or kapa (Degener 1930:213-215). Ti leaves (Cordyline terminalis) were sometimes used in the thatching of houses. Leaves of the plant were also extensively used for cooking in the imu (earth oven), the food often being wrapped in them so that it would retain most of its flavor and remain clean (ibid.:97).

Based on ethnohistorical evidence, the agricultural terraces located throughout the middle portion of the valley indicate that yams, sweet potatoes, and dry land taro were

cultivated during the precontact period. Sugar cane was grown in the valley as recently as the 1930's.

The people evidently chose to live in the valley because they were primarily agriculturally oriented and their mode of food production was best adapted to this type of environment. However, the midden deposits show that sea foods were also part of their dietary habits; these may have been traded from coastal fishermen. The precise relationship between the coastal groups and the people further inland is not known, however in historic times trade throughout the ahupua'a was quite common.

The Phase I survey--locating and recording all the existing sites in the 500 foot wide, 1.4 mile long corridor alignment--was undertaken in 1970 (Ayres 1970). The Phase II Part I survey--detailed site mapping and excavations of 20 specific sites recommended by the results of the Phase I investigation--was carried out in the summer of 1971 (Denison & Forman 1971). By the end of Part I of Phase II, four sites still needed further intensive study, therefore a recommendation for continuing investigation was proposed.

Part 2 of Phase II was supervised by this writer. It involved the restoration of two heiau sites (family shrines), B1-33 and B1-66, as well as intensive studies of B1-67, a residential and agricultural site, and B1-30, a stone-wall enclosed complex. Because of the importance of site B1-30, a major portion of the field investigation, between November

1971 and February 1972, was concentrated on expanding excavations within this walled complex. Despite the desire to map and excavate many sites throughout the valley, the contract limited time and area to be studied. Therefore we confined our investigations to the two major structures and two complexes.

Site 50-Oa-B1-33 Heiau

When first located, this site was almost completely buried under stone rubble and vegetation. In June 1970, William Ayres and I investigated and mapped site B1-33 and designated it as a "walled house" (Ayres 1970:41). Excavation at the site began in 1971 and it was then determined that the 12 x 15 meter feature was, in fact, a religious site and probably a family shrine.

The site was reclassified for the following reasons: 1) the distribution of sites in the survey area; 2) the size of the structure; 3) the presence of coral; and 4) the negative evidence from the test excavations.

1) From the point of view of site distribution, the main residential structures in the survey area were rectangular platforms clustered near the confluence of the South Halawa Stream and a major side stream. They were built on the lower slopes of the sides of the valley with piled-up retaining walls and dirt surfaces on floors. The structure under investigation was not a complete rectangle and had a stepped-rounded platform in the southern corner. It was situated on

the flat valley floor instead of on the slopes and the floor was carefully paved with small pebbles ('ili'ili). These attributes suggest that the form was too rare and specialized to have been a simple dwelling.

2) The size of this walled structure, compared to that of the platforms, was relatively large. Ayres calculated the average size of the house platforms to be 51 square meters (1970:40). However the inner court of the walled structure at site B1-33 was approximately 90 square meters, considerably larger than the average platform area and very large for a house site. In addition to the large overall area, its walls are massive, averaging 1.5 meters in thickness (with a maximum thickness of 2.17 meters). Thick walls were characteristic of heiau sites B1-33 and B1-66 but not for the eight house platforms in the survey area.

3) Coral was found in and around site B1-33, and has been observed on or incorporated in the construction of shrines and religious structures. McAllister, while studying the archaeology of Oahu in 1930, noted that ". . . throughout the walls and paving [of religious structures] there is much old and weathered coral" (1933:65). He mentioned no coral in the numerous habitation structures that he examined.

4) No midden or artifacts, which would be expected from a residential area, were recovered from the 1971 test pit, although several fragments of artifacts were found in the 1970 pit (Ayres 1970:44). The few stone artifacts found in

the rubble near the walls of the structure in 1971-72 were either broken or unfinished.

There were three principal structural elements in this heiau (figure 16):

1) Rectangular structure with four walls but only three corners. The north and west walls did not meet. These walls were generally double-faced, 1.5 meters in width, and core-filled with small stones to a height of 1.2 meters above the paved floor surface.

2) The second major element was a low, stepped, rounded platform constructed against the southwest corner. The outer edge of the rounded platform and step was defined by a row of upright stones with an inner paving of small, uniformly sized rocks.

3) The last major attribute was a stone paving outside the south wall. Natural bedrock boulders were utilized along with large set base stones. Small fill rocks completed this stepped pavement.

Restoration and Discussion

After examining heiau throughout Hawaii, one realizes the great diversity of construction methods and size. There was, however, a fairly consistent adherence to two main structural forms: the rectangular walled enclosure and the rectangular platform. Linton (1923:48) noted that very few of the surviving structures were of the oval or circular forms. Kamakau (1964:54-56) mentions oval features but

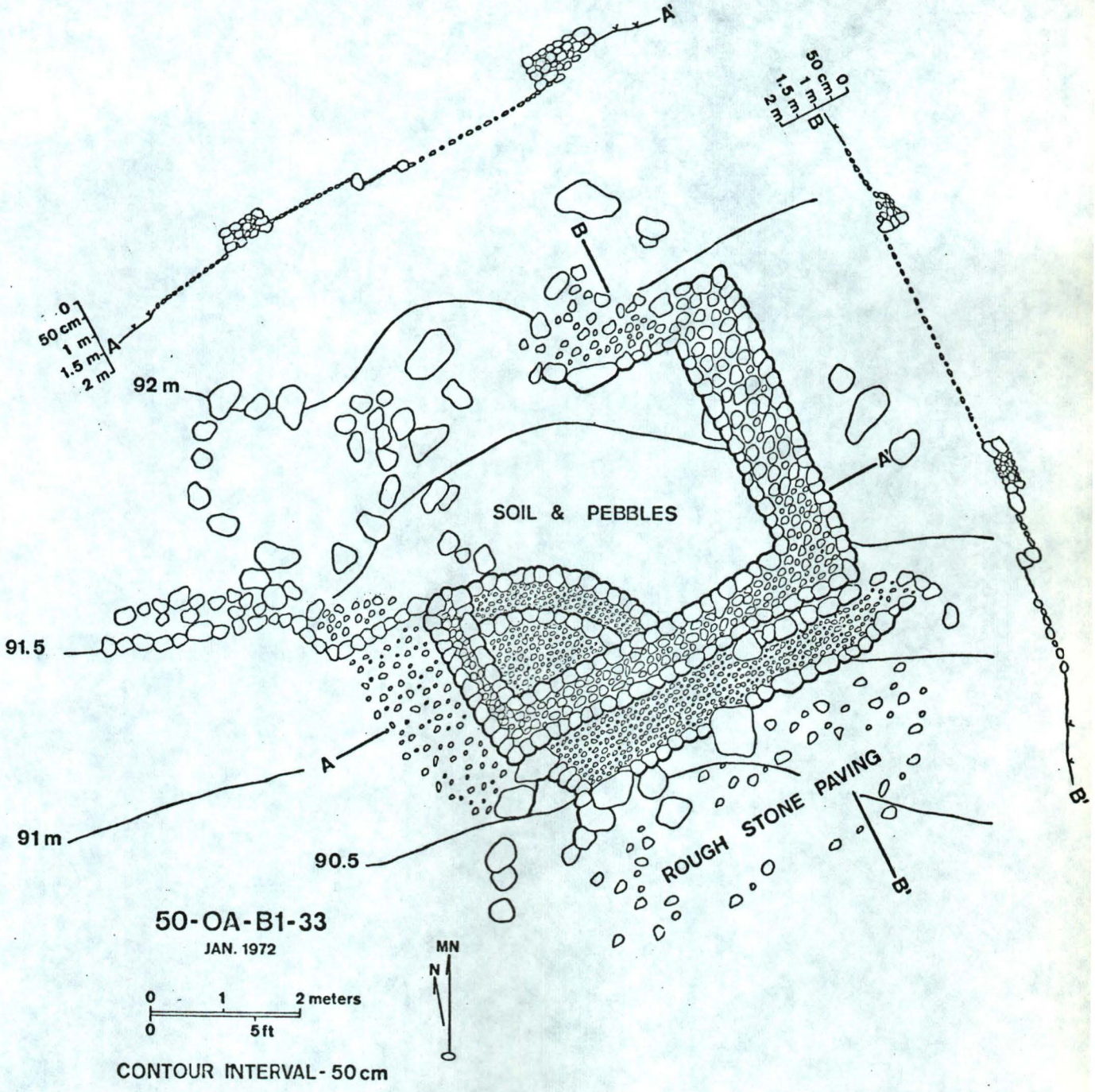


Figure 16. Plan of Heiau Site PI-33 after Restoration.

notes that they were certainly rare. Even more unusual was the combination of a rectangular walled enclosure and a rounded platform as found at site B1-33 (figures 17 & 18).

In view of the uniqueness of this religious site, a restoration project was initiated in 1972. Careful examination of the few remaining undisturbed walls and paved areas indicated original wall height, size of the stones, and width of pavement.

Since the size of this heiau is relatively small in comparison to other religious features throughout Oahu, it most likely served as a shrine for a family of some importance in the valley.

Site 50-Oa-B1-66 Heiau

This heiau, or religious temple, was situated on a fairly steep talus slope just below a ridge. Terrace walls above the structure have helped preserve the heiau from erosion while the incline below prevented damage from roving wild cattle.

Dave Denison, when initially surveying this site, recorded the following information:

> The overall dimensions of the heiau (Fig. 19) are 8.5 meters N-S (up-slope) by 12 meters E-W (cross-slope). A two-tiered wall forms the E and half of the S boundaries of the structure; each tier is approximately 80 cm wide. The upper (inner) tier is an average of 45 cm above the heiau floor and an average of 90 cm above the top of the lower (outer) tier. The wall is double-faced and core-filled, with faces constructed of stacked stones that average about 25 cm in length and 10 cm in thickness. The lower tier, averaging 70 cm above

Figure I7. View of Site PI-33, Looking East, after Restoration

Figure I8. View of Site PI-33, Looking Northeast, after Restoration

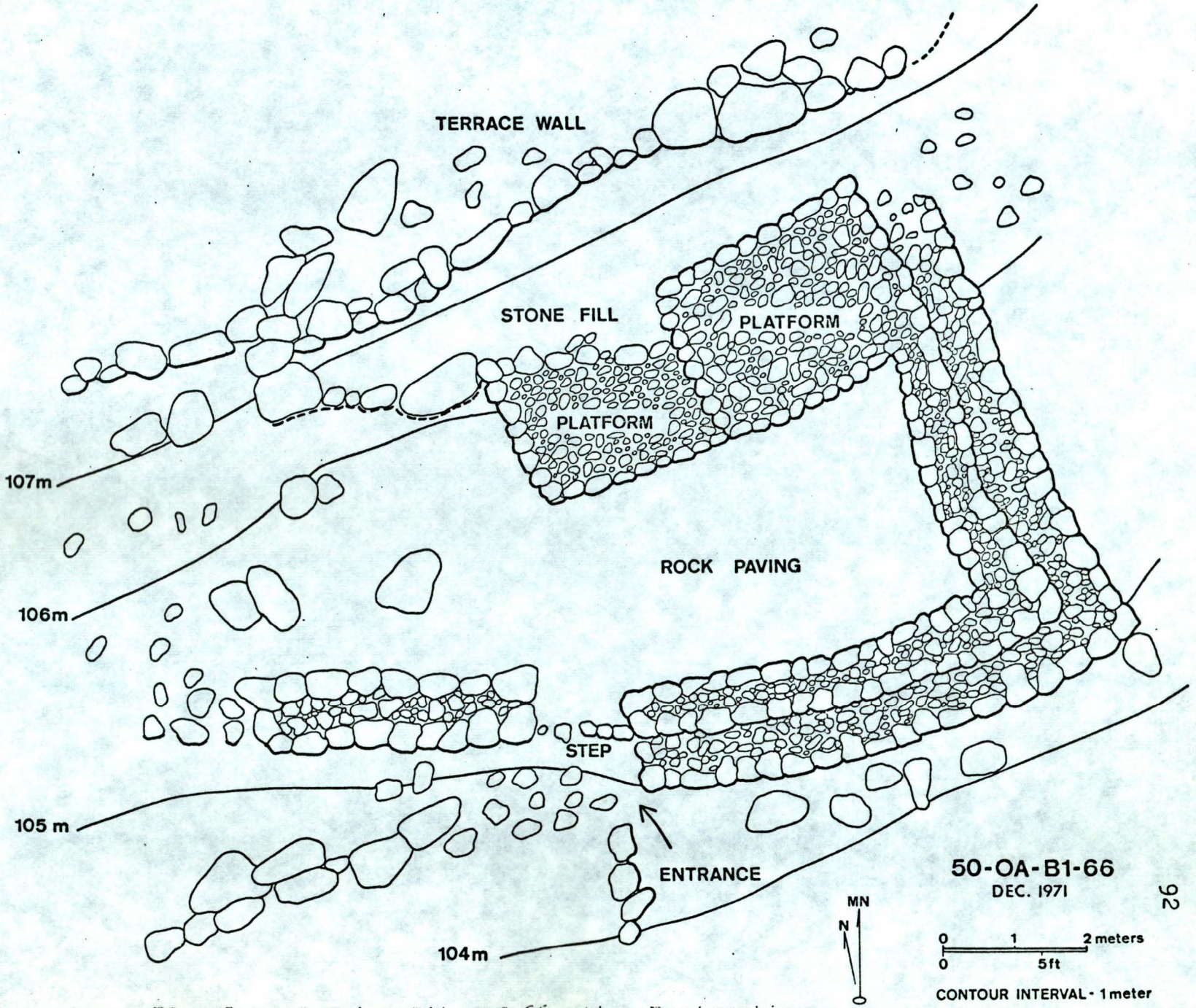


Figure 19. Plan of Heiau Site B1-66 after Restoration.

> ground level, has a single face constructed like the faces of the upper tier. Apparently the upper tier was built from the ground up, and the lower tier was added later (Denison 1971:48).

Two platforms were located in the northern portion of the heiau. The lower western platform measured 2 x 2.7 meters; the larger raised platform was 2.5 x 4 meters and had been constructed as an integral part of the upper tier of the east wall. An entranceway and step were uncovered approximately midway between the south and west sides of the feature which gradually merges into the talus slope. Both platforms and the inner court contained a fairly rough pavement of small stones averaging 10 to 25 centimeters in size. Although numerous water worn stones were available from the nearby stream, very few were utilized during the construction of this heiau. There is an unlimited supply of various sized stones in the immediate area which would have served as building material.

Restoration and Discussion

The plan for the stabilization and restoration of site B1-66 was similar to that for B1-33. The E and W stepped walls had remained in fairly good condition over the centuries and needed only minor stabilization. The platforms and inner court, however, required extensive work.

The small size of the heiau site B1-66 indicated that it was probably a large family or kin group temple. Shrines were constructed for numerous religious beliefs; the most

common were occupational shrines for the worship of the god that presided over a particular profession such as farming or fishing.

Kamakau, noting the temples of the common people, states:

> ". . . some of these were large temples and some were small. Some were surrounded with a wooden enclosure (paehumu) and others were encompassed with stone walls with only one house within. At the outside end was a terrace or steps, and the stone ledge or platform of offering and the altar where the bananas were deposited" (Thrum 1970:55).

The above description fits not only site B1-66 but also site B1-33 and both may have been agricultural shrines whose purposes were either to invoke the blessing of Lono on the crops or for other peaceful needs. Family temples were often used by several generations and structural additions or alterations could be made throughout their history.

This form of religious structure, though unusual for the surveyed area of South Halawa Valley, was not rare in Hawaii. Linton (1923:48) recorded that many Hawaiian platform heiaus were built with several levels or passed into a series of terraces running up the hillside. Since the talus slope is fairly steep in this area of the valley, some rather dramatic construction methods must have been necessary when the structure was first built. In order to obtain horizontal floors it would have been necessary to surround the entire structure with walls of unequal height and resort to artificial leveling in the form of terracing (figures 20 & 21).

Figure 20. View of Site BI-66, Looking North, after Restoration

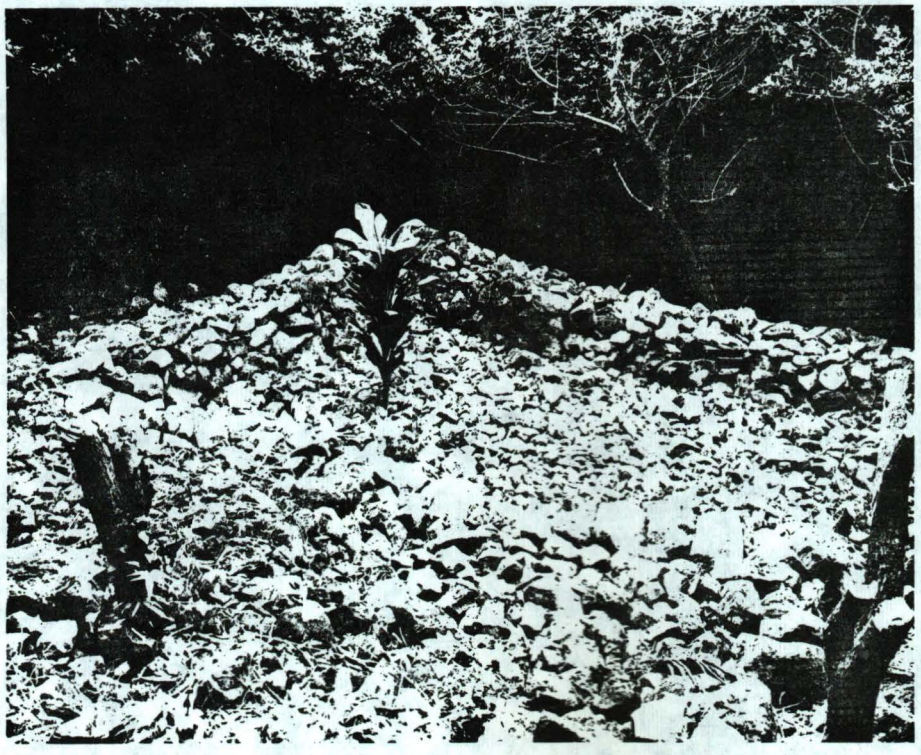


Figure 2I. View of Site BI-66, Looking Southeast, after Restoration

Site B1-67 Habitation and Agricultural Complex

This site, located on a low ridge against the N talus slope, was a series of nine platforms constituting a complex of both residential and agricultural function.

The complex measured 25 x 50 meters along the top of the ridge. The nine platforms are described in Table XIV and illustrated in figure 22.

TABLE XIV

Platforms of Site B1-67

Platform	Dimensions(m) Length	Width	Area (sq. meters)	Comments
A	4.3	3.7	16	Relatively steep;adze blank from surface.
B	6.5	4.3	25	3.3 meter alignment of stones in center of platform runs parallel to S wall.
C	9.8	4.6	45	1.4 meters of rubble fill N of S wall.
D	4.8	4.5	21	
E	10.9	12.2	64	Large, L-shaped; probably more than one functional unit.
F	5.3	5.1	27	Closely associated with G.
G	3.0	1.8	5	Closely associated with F.
H	5.5	4.5	25	
I	6.0	5.0	30	Boundaries uncertain
Avg.	6.2	5.1	29	

Source: Denison 1971:53.

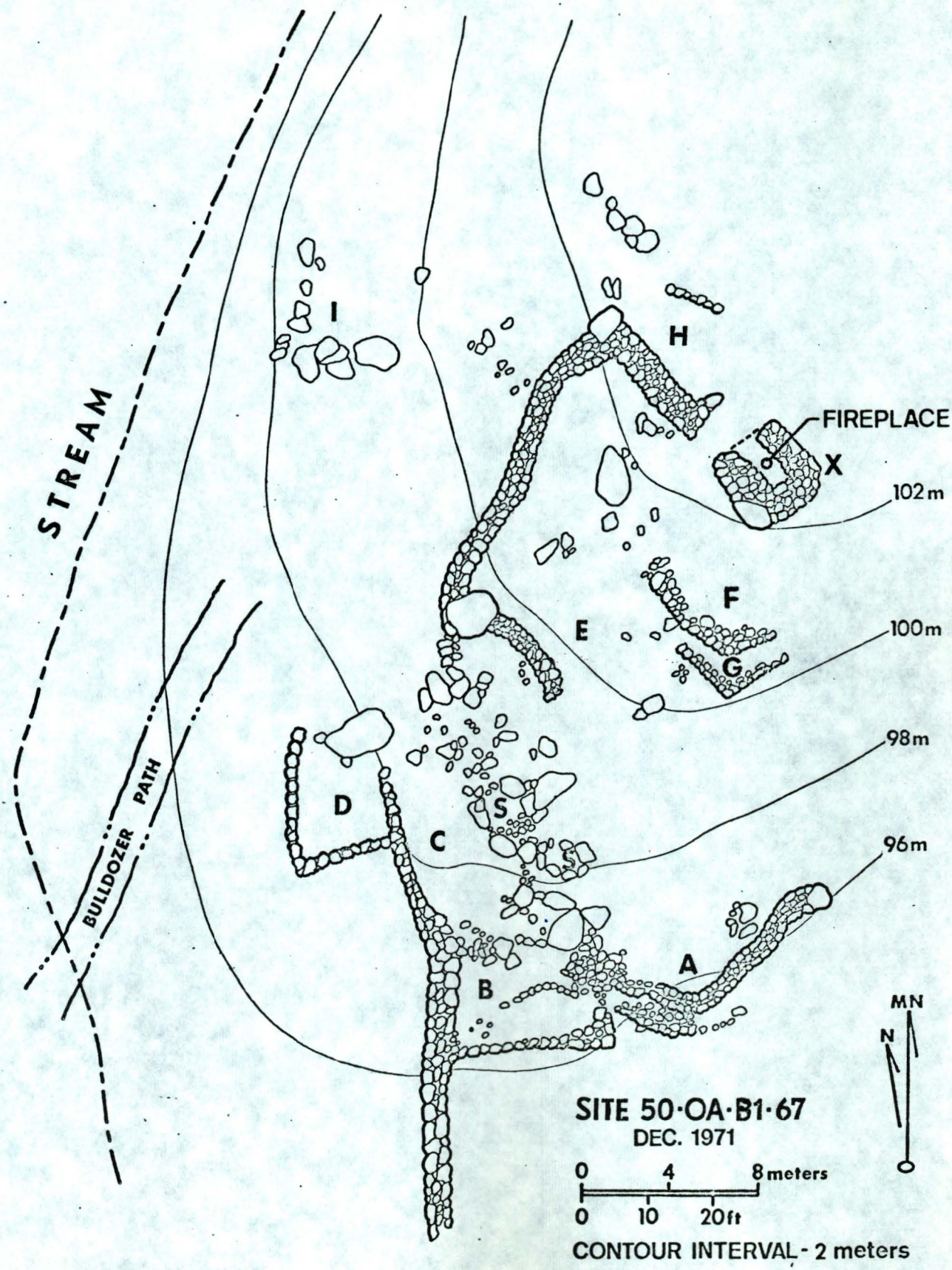


Figure 22. Plan of Platform Complex, Site BI-67.

The platforms were generally level and rectangular in shape bounded on at least two sides by stone alignments or retaining walls. Despite these retaining walls the platforms had eroded and their condition ranged from poor to fair.

Excavation and Discussion

Two randomly selected test pits plus four test trenches were excavated. Feature X (see figure 8) was excavated initially and the U-shaped small enclosure contained a circular stone lined hearth in the center, located 10 centimeters below friable topsoil. Because of its small size and the lack of midden material recovered, the fire pit in the enclosure probably served the function of keeping the inhabitants warm instead of for cooking purposes.

Our excavation indicated that one or, at best, two house shelters stood at this site. Therefore, it is reasonable to hypothesize that this was a small residential and garden complex with a lanai (porch or veranda) south of enclosure X. The location of the site on the ridge would have made it an ideal spot for the field overseer to observe and/or supervise the agricultural work taking place in the lower surrounding area.

Small amounts of charcoal, several worked pieces of volcanic glass, and a fragment of a small stone disk were recovered. This lack of extensive midden or cultural material throughout the site indicates that it was used seasonally or temporarily and not as a year-round dwelling quarters.

Site B1-30 Walled Complex

Circumscribed by a low wall, the following basic structural components were situated within a one-half acre area and identified as: 1) men's eating and gathering enclosure (mua); 2) cooking area with two stone lined fire pits; 3) dwelling house (hale noa); and 4) large paved expanse for ceremonies or entertainment.

Evidence for three successive occupation periods with concurrent structural alterations, between A.D. 1320 and 1670, was found at the site (see Table XV for a complete listing of dates). These were numbered successively Period i, the most recent, to Period iii. Excavations at the hale noa resulted in the discovery of a round-ended house alignment below two later rectangular enclosures.

Feature Attributes

Twelve designated features shown in figure 23, are discussed in brief below.

Feature A: Enclosing Wall

An enclosing wall completely surrounded the site except for a few small breaks where rocks had either been removed or fallen down the steep slope on the eastern portion. The wall, double faced and core filled, averaged 1.2 meters in width and .40 meters in height. Very few water worn stones were used in the construction of this wall. It was probably formed with rocks that were removed while clearing a level area and was intended merely to mark off the limits of the

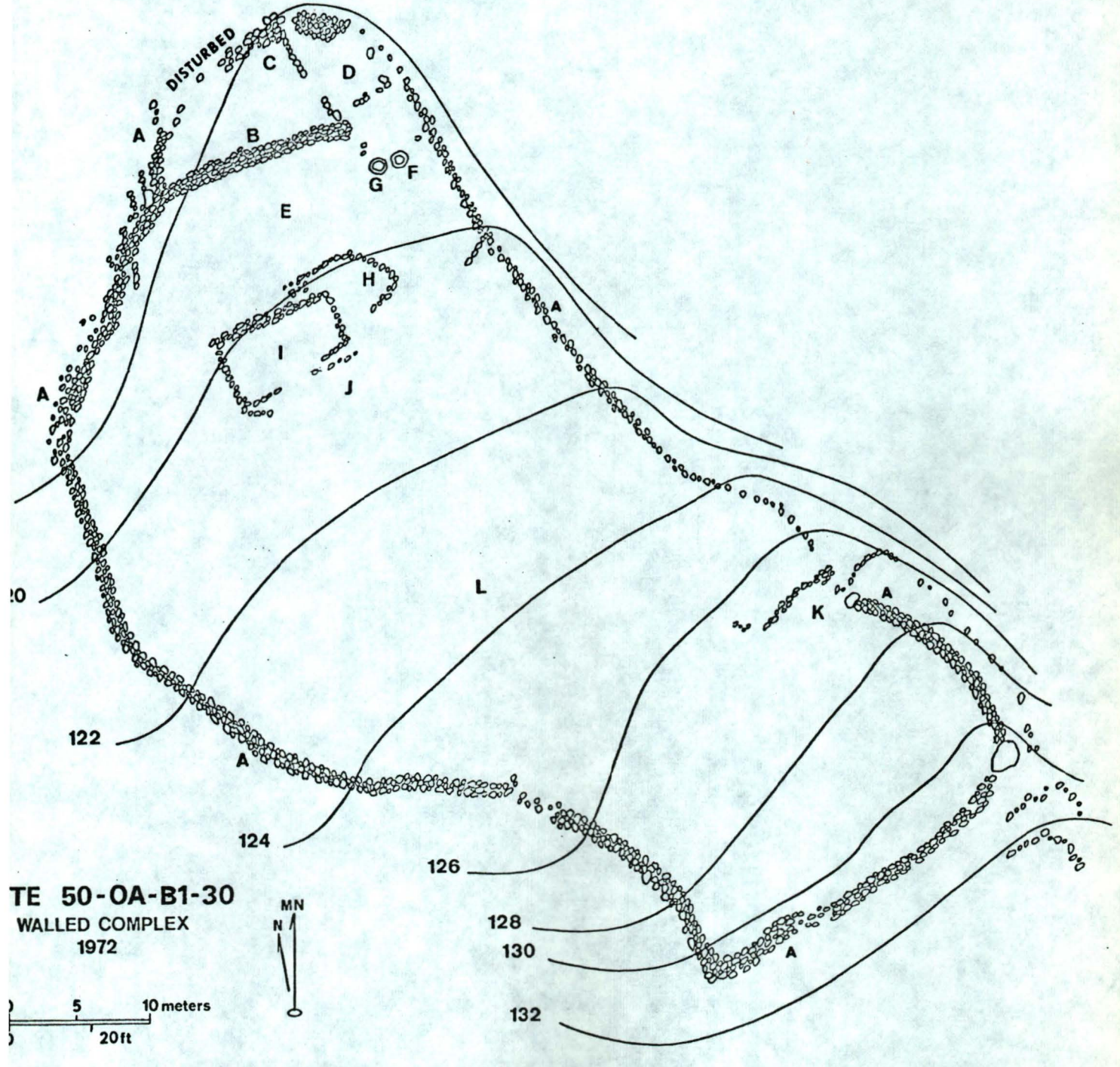


Figure 23. Plan of Site BI-30

family tract. Ledyard mentioned that the pains they took to clear up the woods was astonishing. He noted that "These inclosures also indicate separate property among them, which was a certain intimation in my opinion of an energetic jurisprudence and increasing civilization" (Ledyard 1963:44).

Feature B: Dividing Wall

The junction of wall A and the dividing wall B was of primary interest in order to determine the temporal sequence by examining the construction. Excavation showed that wall A had been built in a continuous line with a sturdy inside facing, while wall B had been added later to abut wall A.

Several large upright stones were positioned throughout wall B. The uprights, which are now in the center of the wall in the eastern section, may have been facing stones for an enclosed structure that stood prior to the construction of wall B. Similar uprights are characteristic of Tahitian and Tuamotuan religious structures and one possible use, noted by Emory, is that the uprights served as back rests for priests or chiefs attending a ceremony (1933:17, 1947: 13).

Feature C: Clearing

Located between wall B, the now-disturbed N section of wall A, and feature D, this small clearing was quite level and contained very few surface rocks. Three randomly selected 2 x 2 m test pits were excavated and no pavement or cultural material was uncovered.

Feature D: Eating and Gathering Enclosure (Mua)

Although portions of the stone alignment delineating this feature had been removed and others had been disturbed by a large Monkeypod tree (Samanea saman) in the southwest corner, there were enough remaining stones to show the rectangular foundation. A stone paved lanai area was located at the north end of this feature. Such structures were usually erected near the house so people could sit under a roof with open sides for free circulation of air (Buck 1964: 100). While lanai were thought to be of foreign influence (ibid.), a prehistoric date was obtained from volcanic glass located on the lanai.

Excavations at the hale noa (Feature I) and mua proceeded simultaneously. Except for balk areas, the entire interiors were excavated, together with the interrelated lanai pavement.

Evidence for three successive occupation periods was found in feature D. It was not difficult to define the floor of the occupation periods since each was clearly marked by a firm, hard packed floor. Period i incorporated a pebble pavement within the larger stone alignment. A circular stone hearth exposed at this level was lined with small fire-cracked rocks. It was of such small size (30 centimeter diameter) that it would have been used for warmth or the reheating of food rather than for cooking large meals.

Below the stone paving a large amount of midden

material, particularly pig bone and shellfish remains, were uncovered. Along with the shell and bone, more than 60 small fine-grained basalt flakes with highly polished faces, 21 pieces of volcanic glass, 11 complete stone artifacts, and 13 konane[2] game stones of both white, compressed coral, and black water worn pebbles were recovered. These pebbles plus four small adzes and the numerous adze chips indicate that the enclosure was utilized not only as a mua (men's eating house) but also as an area of work and relaxation.

The amount of pig bone found in Feature D clearly indicates that the area was used exclusively by men, since pork was among many articles of food that women were not allowed to eat (Wise 1965:102). Malo stated that the men's eating house was termed the mua and that it was forbidden (taboo) to women (1951:29). After a male child was weaned and began to eat ordinary food he was "expelled" to the mua. "The eating tabu was now laid upon the child and it was no longer allowed to take its food in the company of the women" (Malo 1951:87, 94). Circumcision ceremony of a male child also took place in the mua (Kamakau 1964:27).

Feature E: Paving

South of the dividing wall (Feature B) and north of Feature D was a level area with only a few, large, surface

---

[2]The game of konane (checkers) was played on a board with rows of places for two sets of men, black and white (Buck 1964:100).

rocks. Two test pits and three trenches were excavated in this section and in each, between 5 and 15 centimeters below surface, a pavement consisting of small stones was uncovered. If the uprights in wall B had been used as back rests, it is reasonable to believe that ceremonies were conducted upon this paving which abuts the entirety of wall B. Since the pavement corresponds in depth to the most recent periods in Features D and J it was most likely used during the last stages of occupation at the site.

Features F and G: Fire Pits

At 20 centimeters below surface two circular stone lined fire places were uncovered south of the mua. Further excavation revealed that Feature G involved three overlapping, shallow, circular fire places with 4 to 5 centimeters of sterile humic soil separating them. Below these small fire places was a stone lined pit that contained a considerable amount of charcoal. Feature G was rectangular in profile and the stone lining reached a depth of 45 centimeters below the top ring of the fire place stones. Feature F (figure 24) was cone-shaped and stone lined to a depth of 1.15 meters. The heavy deposits of charcoal were located at approximately the same depth in both pits.

Dissection of the pits revealed a layer of charcoal and fire-reddened clay behind the rock lining. One of the pits, Feature G, was found to be partially filled by six large boulders (figure 25) surrounded by a mixed fill of clay and

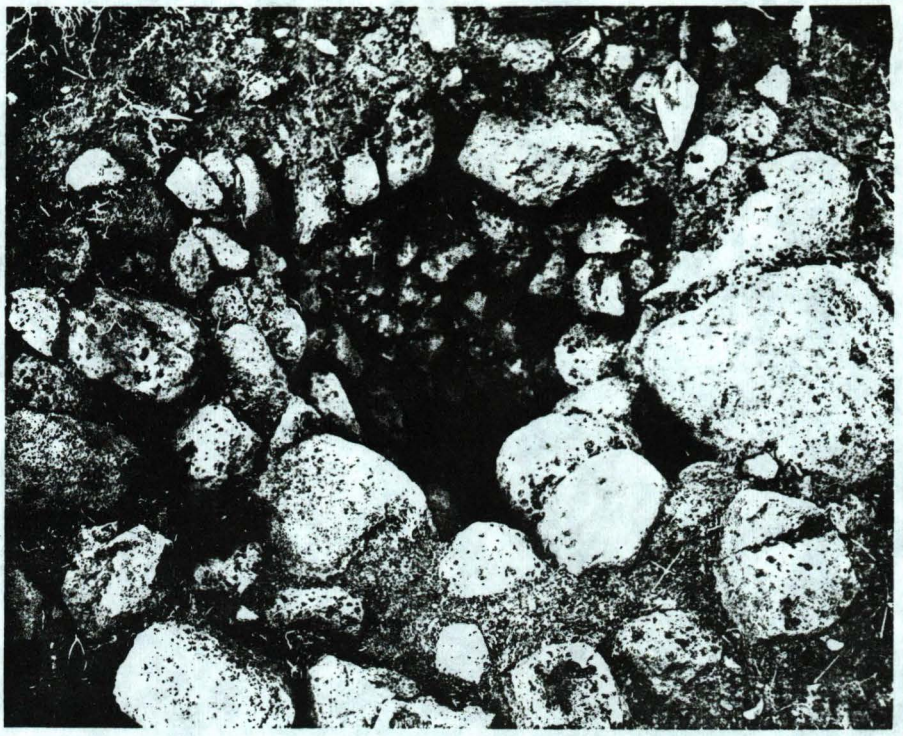


Figure 24. Feature F, Site PI-30

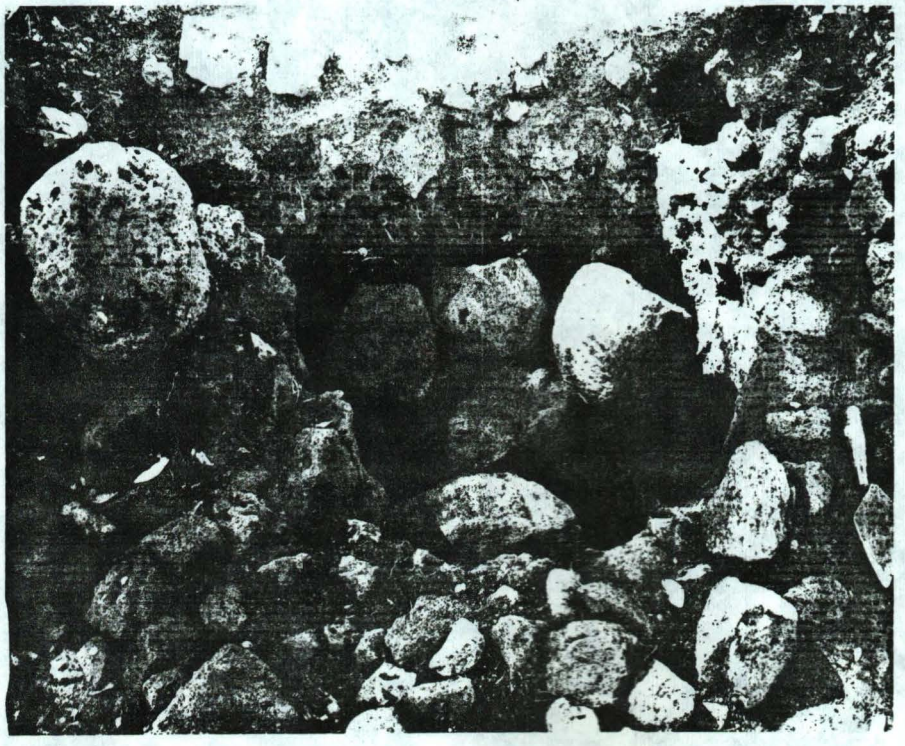


Figure 25. Feature G, Site PI-30

flecks of charcoal. A similar phenomenon was uncovered by Davidson while excavating on the island of Mo'orea, French Polynesia. She noted that it was doubtful that the pit was built to accommodate the boulders but probably that they presented the most convenient way of filling a large unwanted portion of the pit at a time after its previous utilization (1967:133).

Since the heavy deposit of charcoal was found near the lower halves, it is possible that both pits had originally been dug as imu, but it apparently was decided that Feature G could be utilized as a shallower fire pit and the large rocks were thrown in to raise its bottom level. "If several animals were to be cooked in one imu, the imu was built flat, so that the heat would be even. A cone-shaped imu was hotter in the middle than at the sides" (Wise 1965:98).

Peter Buck described the building of an imu which would explain existence of the layer of charcoal and fire-reddened clay behind the stones. "To build an imu, kindling wood is placed in the middle of the hollow [pit], larger pieces of wood built around and over the kindling, a layer of stones arranged over the wood, and the kindling lighted" (1964:18).

Taro, breadfruit, sweet potatoes, ti stems, and the pith of trunks were all cooked, and often preserved, in earth ovens. Ma, a sour paste made from breadfruit, was stored in pits throughout tropical Polynesia, especially in the Marquesas. The surplus crop was preserved in a pit with

stone lining, but it has been generally believed that this practice did not reach Hawaii. The con-shaped pit (Feature F) may have been used as a similar storage receptacle at a time later than its use as an imu.

Features H and I: Stone Alignment and Dwelling Enclosure

Feature H was a round-ended alignment of stones associated with the earliest temporal period of Feature I. The arrangement of small stones ran north and to the east of Feature I and delineated either a lanai or associated platform.

Feature I was one of the major structural components located within the site complex. Evidence for three successive occupation periods with concurrent structural alterations was uncovered at this dwelling enclosure. Excavation revealed a rough stone pavement 5 centimeters below the surface (habitation Period i, figure 26a). A second pavement, 15 centimeters below the existing soil surface, contained small stones set fairly close together on a leveled floor (Period ii). Continued excavation uncovered the earliest habitation period (iii) which incorporated vertically placed water worn foundation stones set in a round-ended pattern and a hard packed floor 35 centimeters below the surface. Associated with the round-ended structure was a pavement outside the alignment (figure 26b). A stone lined fire place located in the center of the floor had been used during both Periods ii and iii, with minor alterations. It was difficult to determine the

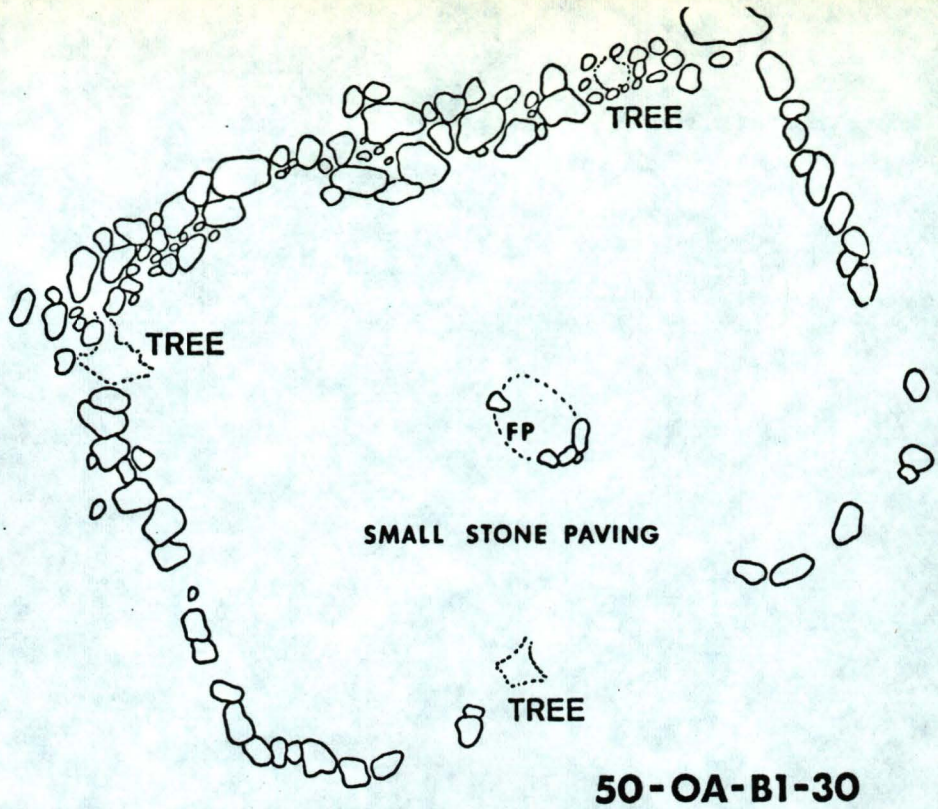


Figure 26a. Feature I, Site BI-30

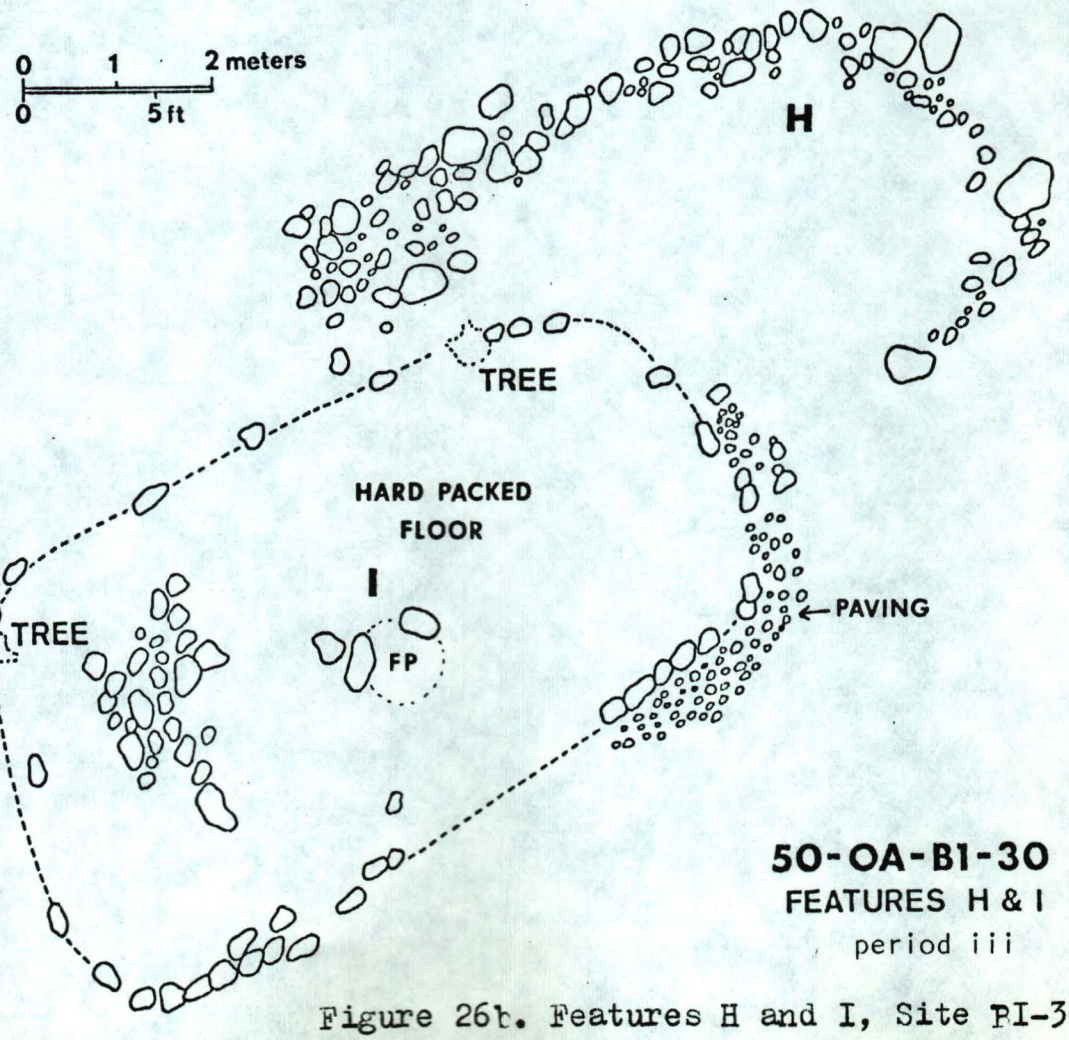


Figure 26b. Features H and I, Site BI-30

outer alignment stones associated with the second period since most of the rocks from the earliest period were also used for the enclosure walls during construction of Period ii.

Stratification in feature I was essentially uniform throughout; the maximum excavated depth was 50 centimeters. The following layers were noted:

Average Date (A.D.)	Phase	Depth (cm)	Description
1679	i	0-5	Sterile, dark brown, humus top soil
		5-15	Dark brown, friable soil
1559	ii	15-30	Cultural deposit of friable soil mixed with clay
		30-35	Secondary, gray clay level
1480	iii	35-37	Secondary, orange-gray clay
		37-50	Primary, orange-gray, sterile clay

The dwelling house, hale noa, was the one place where members of a family mingled on familiar terms and where they slept at night. The hale noa could also be the wife's house but was not taboo to the husband (Handy 1965:76). The associated fairly rough pavements were usually covered with a large quantity of dried grass, over which were spread mats to sit or sleep upon (Cook 1784, vol. 2:234).

Feature J: Paving

To the south of Feature I and abutting the foundation

stones of the rectangular enclosure was a pavement of small stones approximately 7 to 12 centimeters in size. This pavement was associated with Feature L, discussed later in this report.

Feature K: Platform

Located near the southeast section of the site, this platform complex interrupted the enclosing wall (Feature A). The terracing rocks of the platform had been partially disturbed. A possible second feature associated with the platform appeared to have been a retaining wall which almost paralleled the existing wall (Feature A) but portions had fallen down the steep stream embankment.

Excavation in this area showed that pits or trenches had been dug below the surface in order to place the large rocks of the platform and retaining wall. Most ancient Hawaiian structures were constructed on the surface and did not have base stones set below the existing soil level. This style of construction was very similar to features investigated at the northern portion of the site. On that basis, they are believed to be contemporaneous despite the absence of material suitable for dating purposes. The paving eliminates the possibility that the feature had an agricultural function. It was probably associated with Feature L which is discussed below.

Feature L: Paved Area

Thirty 1 by 2 meter test pits were randomly selected in

an area approximately 25 by 35 meters to the south and southeast of the hale noa. Located at 10 to 15 centimeters below the surface was a pavement of small stones ranging in size from 5 to 10 centimeters which related to Period i at Feature I. No second layer of paving was found in any of the pits which were excavated to the sterile clay base.

The absence of any outer alignment stones delineating this extensive pavement, plus the fact that absolutely no artifacts or cultural remains were found in the entire area suggest that it could not have been a habitational or dwelling location. It is possible that this large pavement was utilized as a game or ceremonial dance ground.

Artifacts

A total of 42 prehistoric portable artifacts was uncovered at site B1-30, plus 143 polished basalt adze fragments and 25 volcanic glass flakes. Nineteen adzes were found, several of which are shown in figures 27a and 27b. The majority of the basalt adzes were essentially variations of Duff's Type 2 (1959:131). Flaking was the manufacturing method of the quadrangular or reversed trapezoidal cross section adzes. One of the adzes, from dwelling enclosure Feature I, was quadrangular and untanged, similar to early adzes found in the Marquesas. The fragment of a triangular adze also from Feature I resembles Tahitian adzes (Denison 1971:27).

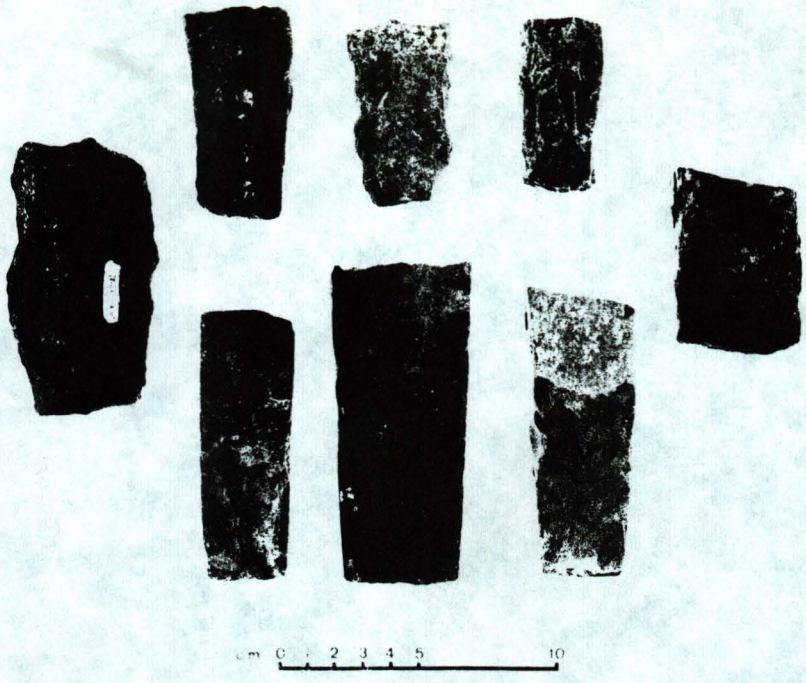


Figure 27a. Adzes from Site BI-30

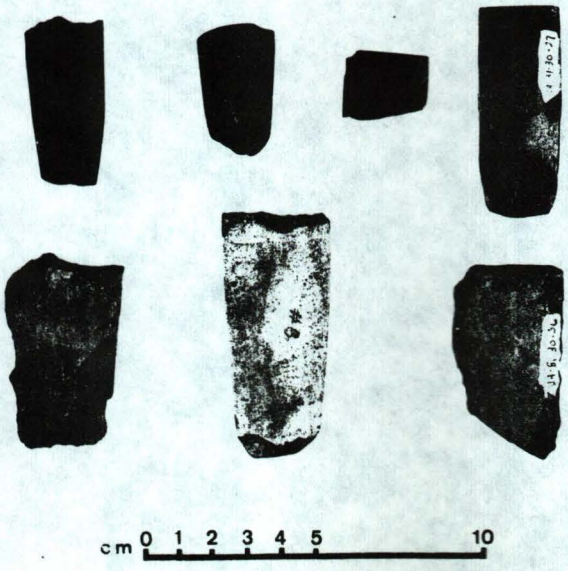


Figure 27b. Adzes from Site BI-30

Dating

Two dating methods were applied for site B1-30; radiocarbon age determination, and hydration rind dating of volcanic glass flakes.

Radiocarbon age determinations were made at Teledyne Isotopes Westwood Laboratories in New Jersey. They are listed in Table XV.

TABLE XV

Radiocarbon Age Determinations

South Halawa Valley

Lab. No.	Museum No.	Location	Age, B.P.
I-6345	HRC-217	Charcoal from fire place in feature I	580±125
I-6346	HRC-218	Charcoal from fire place in feature D	530±165
I-6347	HRC-219	Charcoal from fire pit in feature F	430±130

The hydration rind dating for site B1-30 is listed in Table XVI.

Discussion

There are several salient points which deserve additional discussion concerning site B1-30 (figure 28 foldout). The earliest known dates from inland agricultural sites in Hawaii

TABLE XVI

Hydration Rind Age Determinations*
Site B1-30, South Halawa Valley

Feature	Depth(cm)	Age in Years B.P. 1970	Dates (A.D.)
Walls (A & B)	24	387 ± 15	1583 ± 15
	24	386 ± 14	1584 ± 14
	24	384 ± 21	1596 ± 21
	Fill	377 ± 14	1593 ± 14
	24	376 ± 14	1594 ± 14
	Fill	373 ± 19	1597 ± 19
Fire Pits (F & G)	20-40	470 ± 29	1500 ± 29
	40	323 ± 15	1647 ± 15
Gathering Area (D)	15	392 ± 20	1578 ± 20
	10-20	390 ± 27	1580 ± 27
	10-20	382 ± 20	1588 ± 20
	21	362 ± 14	1508 ± 14
	5-15	358 ± 14	1612 ± 14
	10	347 ± 18	1623 ± 18
	7-10	325 ± 22	1645 ± 22
Dwelling (I)	20	502 ± 24	1468 ± 24
	20	490 ± 16	1480 ± 16
	20-25	461 ± 22	1509 ± 22
	20-25	458 ± 17	1512 ± 17
	15	419 ± 22	1551 ± 22
	21	380 ± 24	1590 ± 24
	21	374 ± 25	1596 ± 25
	25	371 ± 20	1599 ± 20
	21	370 ± 21	1600 ± 21
	7	291 ± 14	1679 ± 14

*Based on information received from Maury Morgenstein of the Hawaii Institute of Geophysics, March 1972.

were obtained on the Big Island at Kahaluu of early 12th cnetury A.D. (Crozier 1971:26). The time range for B1-30 (A.D. 1370 to 1679) falls within the period of agricultural utilization in Makaha Valley (Green 1970:99) and Kahana Valley (Hommon & Bevacqua 1973:33) on Oahu. However, the only other excavated ovate house form in the Hawaiian Archipelago showed a time range of A.D. 600 to 1200 (Kirch 1971: 233), which placed it well within the period of postulated Marquesan settlement of Hawaii (Emory & Sinoto 1965:102, figure 13).

The distribution of round-ended houses in Polynesia is quite widespread and was present in the Society Islands at A.D. 1260±80 (Emory 1933:44; Green et al. 1967:166). They have also been reported in the Marquesas (Suggs 1961:63), Easter Island (Ferdon 1961), and other Polynesian groups as reported by Kirch (1971:233-234).

The ovate hale noa and subsequent rectangular structure were clearly not large enough to have served as anything other than the residence of a ranking member of the community and his nuclear or extended family. The large ovens could testify to full scale entertainment which may have taken place on the large paved area, watched by those who would be seated on the perimeter of the long pavement. Handy (1924: 43) described elaborate private establishments in Samoa, similar to B1-30, as consisting of a large sleeping quarter on a stone platform, a cook house nearby, a house for storing

food, and a paved dance area.

Continued excavation throughout the Hawaiian Islands may uncover similar structural components as found in site B1-30 and South Halawa Valley. At this time, however, the disclosure of a round-ended house with an interrelated outside paving, stone lined storage or ma pits, and a large paved area for ceremonies are all unique in the annals of Hawaiian archaeology.

REFERENCES

Anderson, Rufus
1864 The Hawaiian Islands: Their Progress and Condition under Missionary Labors. Boston, Mass., Gould and Lincoln.

Arem, Joel
1973 Rocks and Minerals. Toronto, New York, London, Bantam Books.

Ayres, William S.
1970 Archaeological Survey and Excavations, Kamana-Nui Valley, Monanalua Ahupua'a. South Halawa Valley, Halawa Ahupua'a. Dept. of Anthropology Report 70-8, B. P. Bishop Museum, Honolulu, Hawaii.

Barrau, Jacques
1961 Subsistence Agriculture in Polynesia and Micronesia. B. P. Bishop Museum Bulletin 223, Honolulu, Hawaii.

Buck, Peter H. (Te Rangi Hiroa)
1964 Arts and Crafts of Hawaii. B. P. Bishop Museum Special Publication 45. Honolulu, Hawaii.

Chang, K. C.
1967 Rethinking Archaeology. New York, Random House.

1968 Settlement Archaeology. Palo Alto, Calif., National Press Books.

Cook, James
1784 A Voyage to the Pacific Ocean . . . for Making Discoveries in the Northern Hemisphere in . . . the "Resolution" and "Discovery" . . . , vols. 1-3 and altas. London. (Volume 3 by James King.)

Cox, J. Halley
1967 The Lei Niho Palaoa. In Polynesian Culture History. B. P. Bishop Museum Special Publication 56, Honolulu, Hawaii.

Crozier, S. Neal
1971 Archaeological Excavations at Kamehameha III Road, North Kona, Island of Hawaii--Phase II. Dept. of Anthropology Report 71-11, B. P. Bishop Museum, Honolulu, Hawaii.

Crozier, S. Neal
1972 ms — A Preliminary Report on the Phase II, Part 2 Survey of H-3 Highway Corridor in the South Halawa Valley, Oahu. Dept. of Anthropology, Ms. No. 041472, B. P. Bishop Museum, Honolulu, Hawaii.

1973 (in press) — Walled Site Complex, South Halawa Valley, Hawaii. A Preliminary Report. In Journal of The Polynesian Society, Wellington, New Zealand.

Crozier, S. Neal and Russell A. Apple
1973 — Reconstruction of Surface Features, Kaneaki Heiau. In Edmund Ladd, ed., Makaha Valley Historical Project--Interim Report No. 4, Pacific Anthropological Records No. 19, Honolulu, Hawaii, pp.31-41.

Cumming, C. F. Gordon
1883 — Fire Fountains--The Kingdom of Hawaii. London and Edinburgh, William Blackwood and Sons (vols. 1 and 2).

Davidson, Janet M.
1967 — Excavations of Two Round-Ended House Sites in the Eastern Portion of the 'Opunohu Valley. In Archaeology on the Island of Mo'orea, French Polynesia. Anthropological papers of the American Museum of Natural History, New York, vol. 51, part 2, pp.119-140.

Degener, Otto
1930 — Plants of Hawaii National Park. Ann Arbor, Mich., Edwards Brothers, Inc.

Denison, David O. and Arthur S. Forman
1971 — Archaeological Investigations in South Halawa Valley, Ewa District, Island of Oahu--Phase II. Dept. of Anthropology Report 71-9, B. P. Bishop Museum, Honolulu, Hawaii.

Duff, Roger
1959 — Neolithic Adzes in Eastern Polynesia. In J. D. Freeman and W. R. Geddes, eds., Anthropology in the South Seas. New Plymouth, Avery.

Edmondson, Charles H.
1946 — Reef and Shore Fauna of Hawaii. B. P. Bishop Museum Special Publication 22, Honolulu, Hawaii.

Ellis, William
1969 Polynesian Researches. Tokyo, Japan, Charles E. Tuttle Co. Reprinted from 1825 edition.

Emory, K. P.
1933 Stone Remains in the Society Islands. B. P. Bishop Museum Bulletin 116. Honolulu, Hawaii.

Emory, K. P. and Y. H. Sinoto
1965 Preliminary Report on the Archaeological Investigations in Polynesia. Dept. of Anthropology, B. P. Bishop Museum, Honolulu, Hawaii, mimeo.

1969 Age of the Sites in the South Point Area Ka'u, Hawaii. Pacific Anthropological Records No. 8, B. P. Bishop Museum, Honolulu, Hawaii.

Ferdon, Edwin N., Jr.
1961 Easter Island House Types. In T. Heyerdahl and E. N. Ferdon, Jr., eds., Reports of the Norwegian Archaeological Expedition to Easter Island and the East Pacific, vol. 1, Archaeology of Easter Island, pp.329-338.

Freeman, Otis W.
1951 Geographic Setting of the Pacific, Hawaii and American Island Outposts and Eastern Polynesia. In O. W. Freeman, ed., Geography of the Pacific. New York, John Wiley and Sons, Inc.

Green, Roger C., et al.
1967 Archaeology on the Island of Moorea, French Polynesia. Anthropological Papers of the American Museum of Natural History, 51 (2), New York.

Green, Roger C.
1969 Makaha Valley Historical Project, Interim Report No. 1. Pacific Anthropological Records No. 4, Honolulu, Hawaii.

1970a Radiocarbon Dating in the Makaha Valley. In Roger Green, ed., Makaha Valley Historical Project Interim Report No. 2, Pacific Anthropological Records No. 10, B. P. Bishop Museum, Honolulu, Hawaii, pp.97-104.

1970b Makaha Valley Historical Project, Interim Report No. 2. Pacific Anthropological Records No. 10, B. P. Bishop Museum, Honolulu, Hawaii.

Handy, E. S. C.
1932 Houses, Boats and Fishing in the Society Islands. B. P. Bishop Museum Bulletin 90, Honolulu, Hawaii.

1940 The Hawaiian Planter. B. P. Bishop Museum Bulletin 161, Honolulu, Hawaii.

1965 Houses and Villages. In Ancient Hawaiian Civilization. Rutland, Vermont and Tokyo, Japan, Charles E. Tuttle Company, pp.69-80.

Handy, E. S. C. and W. C. Handy
1924 Samoan Housebuilding, Cooking and Tattooing. B. P. Bishop Museum Bulletin 15, Honolulu, Hawaii.

Hommon, Robert J.
1969a An Interim Report on Archaeological Zone 1. In Roger Green, ed., Makaha Valley Historical Project, Interim Report No. 1, Pacific Anthropological Records No. 4, B. P. Bishop Museum, Honolulu, Hawaii.

1969b Preliminary Report on the Archaeological Survey of the Upper Makaha Valley. In Roger Green, ed., Makaha Valley Historical Project, Interim Report No. 1, Pacific Anthropological Records, No. 4, B. P. Bishop Museum, Honolulu, Hawaii.

1970 Final Report on the Upper Valley Survey. In Roger Greed, ed., Makaha Valley Historical Project, Interim Report No. 2, Pacific Anthropological Records No. 10, B. P. Bishop Museum, Honolulu, Hawaii.

Hommon, Robert J. and William Barrera, Jr.
1971 Archaeological Survey of Kahana Valley, Koolauloa District, Island of Oahu. Dept. of Anthropology Report 71-3, B. P. Bishop Museum, Honolulu, Hawaii.

Hommon, Robert J. and Robert F. Bevacqua
1973 Excavations in Kahana Valley, Oahu, 1972. Dept. of Anthropology Report 73-2, B. P. Bishop Museum, Honolulu, Hawaii.

Jennings, Jesse P.
1963 Administration of Contract Emergency Archaeological Programs. American Antiquity, 28 (3): 282-285.

Judd, Albert F.
1965 Trees and Plants. In Ancient Hawaiian Civilization, revised edition. Rutland, Vermont and Tokyo, Japan, Charles E. Tuttle Company, pp.277-285.

Kamakau, Samuel M.
1964 Ka Po'e Kahiko: The People of Old. B. P. Bishop Museum Special Publication 51, Honolulu, Hawaii.

Keesing, Roger M. and Felix M. Keesing
1971 New Perspectives in Cultural Anthropology. New York, Holt, Rinehart and Winston, Inc.

Kelly, Marion
1967 Some Problems with Early Descriptions of Hawaiian Culture. In Polynesian Culture History, B. P. Bishop Museum Special Publication 56, Honolulu, Hawaii, pp.399-410.

Kelly, Marion and S. Neal Crozier
1972 Archaeological Survey and Excavations at Waiohinu Drainage Improvement Project, Ka'u, Island of Hawaii. Dept. of Anthropology Report 72-6, B. P. Bishop Museum, Honolulu, Hawaii.

Kirch, Patrick V.
1971 Halawa Dune Site (Hawaiian Islands): A Preliminary Report. The Journal of the Polynesian Society, 80 (2), Wellington, New Zealand, 228-236.

1973 Archaeological Excavations at Kahalu'u, North Kona, Island of Hawaii. Dept. of Anthropology Report 73-1, B. P. Bishop Museum, Honolulu, Hawaii.

Ladd, Edmund J.
1969 Preliminary Report on the Archaeological Survey of the Lower Makaha Valley. In Roger Green, ed., Makaha Valley Historical Project, Interim Report No. 1, Pacific Anthropological Records No. 4, B. P. Bishop Museum, Honolulu, Hawaii.

1970a Results of Field Operations--Final Report for the First Year. In Roger Green, ed., Makaha Valley Historical Project, Interim Report No. 2, Pacific Anthropological Records No. 10, Honolulu, Hawaii.

Ladd, Edmund J.
1970b Test Excavations of Three Stepped Platforms. In Roger Green, ed., Makaha Valley Historical Project, Interim Report No. 2, Pacific Anthropological Records No. 10, Honolulu, Hawaii.

1972 Makaha Valley Historical Project, Interim Report No. 3, Pacific Anthropological Records No. 18, B. P. Bishop Museum, Honolulu, Hawaii.

1973 Makaha Valley Historical Project, Interim Report No. 4, Pacific Anthropological Records No. 19, B. P. Bishop Museum, Honolulu, Hawaii.

Ledyard, John
1963 John Ledyard's Journal of Captain Cook's Last Voyage. Edited by James Munford from the 1783 original. Corvallis, Oregon, Oregon State University Press.

Linton, Ralph
1923 The Native Culture of the Marquesas. B. P. Bishop Museum Bulletin 9, Honolulu, Hawaii.

1925 Archaeology of the Marquesas Islands. B. P. Bishop Museum Bulletin 23, Honolulu, Hawaii.

Malo, David
1951 Hawaiian Antiquities. B. P. Bishop Museum Special Publication 2, 2nd edition, Honolulu, Hawaii.

Murdock, George P.
1949 Social Structure. New York, The Macmillan Co.

McAllister, J. Gilbert
1933 Archaeology of Oahu. B. P. Bishop Museum Bulletin 104, Honolulu, Hawaii.

Newman, T. Stell
1968 Hawaiian Fishing and Farming on the Island of Hawaii in A.D. 1778. Division of State Parks, Dept. of Land and Natural Resources, Honolulu, Hawaii.

Pearson, Richard J., et al.
1971 An Early Prehistoric Site at Bellows Beach, Waimanalo, Oahu, Hawaiian Islands. Archaeology and Physical Anthropology in Oceania, vol. VI, no. 3, pp.204-234.

Pelzer, Karl J.
1945 Pioneer Settlement in the Asiatic Tropics. New York, American Geographical Society.

Pukui, Mary K. and Samuel H. Elbert
1957 Hawaiian-English Dictionary. Honolulu, University of Hawaii Press.

Rasor, Jean
1969 Excavation of Stone Mound, Site OA-C4-50a in Area 1, Makaha. In Roger Green, ed., Makaha Valley Historical Project, Interim Report No. 1, Pacific Anthropological Records No. 4, Honolulu, Hawaii.

1970 Excavations of Three Stone Mounds and a Clearing in Archaeological Zone 1. In Roger Green, ed., Makaha Valley Historical Project, Interim Report No. 2, Pacific Anthropological Records No. 10, Honolulu, Hawaii.

Rouse, Irving
1968 Prehistory, Typology and the Study of Society. In K. C. Chang, ed., Settlement Archaeology. Palo Alto, Calif., National Press Books.

Sabels, Bruno E.
1966 Climatic Variations in the Tropical Pacific as Evidenced by Trace Element Analysis of Soils. In Pleistocene and Post-Pleistocene Climatic Variations in the Pacific Area. B. P. Bishop Museum Press, Honolulu, Hawaii.

Sahlins, Marshall D.
1958 Social Stratification in Polynesia. Seattle, University of Washington Press.

1972 Stone Age Economics. Chicago and New York, Aldine-Atherton, Inc.

Sinoto, Y. H.
1966 A Tentative Prehistoric Cultural Sequence in the Northern Marquesas Islands, French Polynesia. Journal of the Polynesian Society, 75, Wellington, New Zealand, 287-303.

1968 Position of the Marquesas Islands in East Polynesian Prehistory. In J. Yawata and Y. H. Sinoto, eds., Prehistoric Culture in Oceania. Honolulu, Hawaii, Bishop Museum Press, pp.111-118.

Sinoto, Y. H. and K. P. Emory
1970 Personal Communication. Discussion at B. P. Bishop Museum, Honolulu, Hawaii.

Stearns, Harold T.
1966 Geology of the State of Hawaii. Palo Alto, Calif., Pacific Books.

Stokes, J. G. F.
1928 ms Distribution of Pacific Adzes. Manuscript in Dept. of Anthropology, B. P. Bishop Museum, Honolulu, Hawaii.

Stuiver, Minze and Hans Suess
1966 On the Relationship Between Radiocarbon Dates and True Sample Ages. Radiocarbon, 8:534-540.

Suggs, Robert C.
1960 The Island Civilizations of Polynesia. New York, The New American Library.

Summers, Catherine C.
1964 Hawaiian Fishponds. B. P. Bishop Museum Special Publication 52, Honolulu, Hawaii.

Takayama, Jun
1969 Excavation of Four House Sites in Archaeological Zone 1. In Roger Green, ed., Makaha Valley Historical Project, Interim Report No. 1, Pacific Anthropological Records No. 4, Honolulu, Hawaii.

Takayama, Jun and Roger C. Green
1970 Excavations of Three Additional Field Shelters in Archaeological Zone 1. In Roger Green, ed., Makaha Valley Historical Project, Interim Report No. 2, Pacific Anthropological Records No. 10, Honolulu, Hawaii.

Thrum, Tomas G.
1970 Hawaiian Annual for 1970. Honolulu, Hawaii.

Trigger, Bruce G.
1968 The Determinants of Settlement Patterns. In K. C. Chang, ed., Settlement Archaeology. Palo Alto, Calif., National Press Books.

1971 Archaeology and Ecology. In World Archaeology, vol. 2, no. 3. Oxfordshire, England, Routledge and Kegan Paul Ltd., pp.321-336.

Tuggle, David H. and P. Bion Griffin
1973 Lapakahi, Hawaii: Archaeological Studies. Asian and Pacific Archaeology Series No. 5. Social Science Research Institute, University of Hawaii, Honolulu.

U. S. Weather Bureau
1961 Climatography of the United States No. 60-51. Washington, D. C., U.S. Government Printing Office.

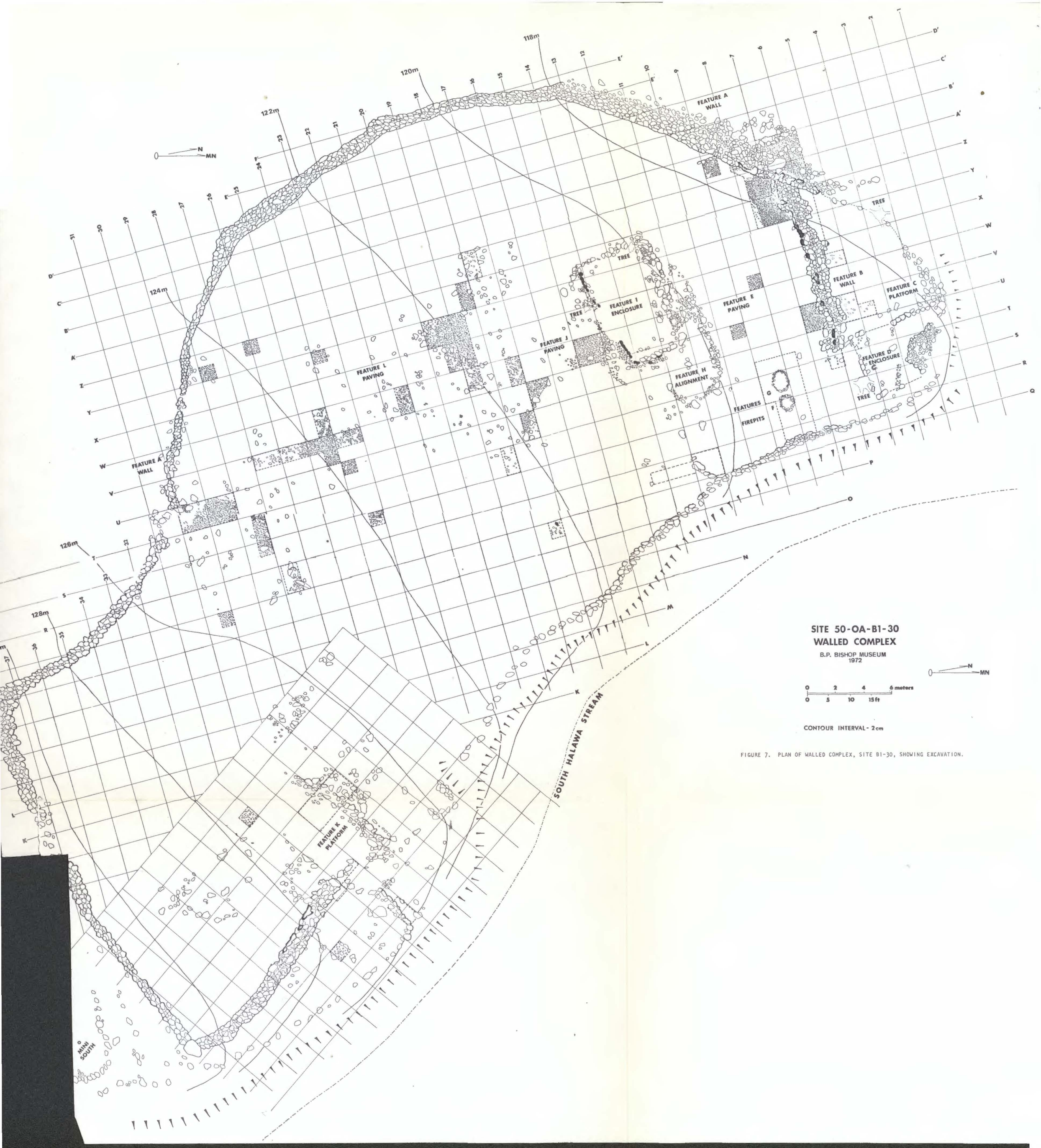
Warwick, R. Armstrong
1973 Atlas of Hawaii. Honolulu, Hawaii, University of Hawaii Press.

Willey, G. R. and Philip Phillips
1958 Method and Theory in American Archaeology. Chicago, Illinois, University of Chicago Press.

Wise, John H.
1965 Food and its Preparation. In Ancient Hawaiian Civilization. Rutland, Vermont and Tokyo, Japan, Charles E. Tuttle Co.

Yen, D. E.
1973 Agriculture in Anutan Subsistence. In D. E. Yen and J. Gordon, eds., Anuta: A Polynesian Outlier in the Solomon Islands, Pacific Anthropological Records No. 21, B. P. Bishop Museum, Honolulu, Hawaii.

Zim, Herbert S. and Paul R. Shaffer
1957 Rocks and Minerals. New York, Golden Press.



SITE 50-OA-B1-30
WALLED COMPLEX

B.P. BISHOP MUSEUM
1972

N
MN

0 2 4 6 meters
0 5 10 15 ft

CONTOUR INTERVAL - 2 cm

FIGURE 7. PLAN OF WALLED COMPLEX, SITE B1-30, SHOWING EXCAVATION.

VITA

Surname: CROZIER Given Names: STEWART NEAL

Place of Birth: NEW YORK CITY, N.Y., U.S.A.

Date of Birth: JANUARY 2, 1935

Educational Institutions Attended,
with Dates of Entering and Leaving:

CARNEGIE INSTITUTE OF TECHNOLOGY, PITTSBURGH	1956	to	1961
UNIVERSITY OF HAWAII, HONOLULU	1970	to	1972
UNIVERSITY OF VICTORIA, VICTORIA, B.C.	1972	to	1974
	___	to	___

Degrees, Diplomas, Etc., Awarded,
with Dates and Names of Institutions:

B.F.A.	1961	CARNEGIE INSTITUTE OF TECHNOLOGY
M.A.	1974	UNIVERSITY OF VICTORIA

Honours and Awards:

TEACHING ASSISTANT, 1973/74

Publications:

Crozier, S. Neal
1971 Archaeological Survey of Kamehameha III Road, North Kona, Island of Hawaii. B. P. Bishop Museum, Dept. of Anthropology Report 71-5. Honolulu, Hawaii.

1971 Archaeological Excavations at Kamehameha III Road, North Kona, Island of Hawaii--Phase II. B. P. Bishop Museum, Dept. of Anthropology Report 71-II. Honolulu, Hawaii.

- contd. -

1972 Archaeological Survey and Excavations at Punalu'u, Island of Hawaii. B. P. Bishop Museum, Dept. of Anthropology Report 72-6. Honolulu, Hawaii.

1972 A Preliminary Report of the Phase II, Part 2 Survey of H-3 Highway Corridor in the South Halawa Valley, Oahu. B. P. Bishop Museum, Dept. of Anthropology, Ms. No. 041472, Honolulu, Hawaii.

1973 (in press) Walled Site Complex, South Halawa Valley, Hawaii --A Preliminary Report. In press, Journal of the Polynesian Society, Wellington, N.Z.

Crozier, S. Neal, and Russell A. Apple
1973 Reconstruction of Surface Features, Kaneaki Heiau. Pacific Anthropological Records No. 19, B. P. Bishop Museum, Honolulu, Hawaii.

Crozier, S. Neal, and Dorothy B. Barrere
1971 Archaeological and Historical Survey of the Ahupua'a of Puala'a, Puna District, Island of Hawaii. B. P. Bishop Museum, Dept. of Anthropology Report 71-1, Honolulu, Hawaii.

Hommon, Robert J., and S. Neal Crozier
1970 An Intensive Survey of the Southern Portion of Kaawaloa, Kona, Hawaii. Ms. Dept. of Anthropology, B. P. Bishop Museum, Honolulu, Hawaii.

Kelly, Marion, and S. Neal Crozier
1972 Archaeological Survey and Excavations at Waiohinu Drainage Improvement Project, Ka'u, Island of Hawaii. B. P. Bishop Museum, Dept. of Anthropology Report 72-6, Honolulu, Hawaii.

PARTIAL COPYRIGHT LICENSE

I hereby grant the right to lend my thesis or dissertation (the title of which is shown below) to users of the University of Victoria Library, and to make single copies only for such users or in response to a request from the library of any other university, or similar institution, on its behalf or for one of its users. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by me or a member of the University designated by me. It is understood that copying or publication of this thesis for financial gain shall not be allowed without my written permission

Title of Thesis/Dissertation

PRECONTACT ARCHAEOLOGICAL CONTRASTS OF THREE VALLEY SYSTEMS ON OAHU, HAWAII

Author [redacted]

Signature

STEWART NEAL CROZIER

Name

April 22, 1974

Date