Kaho'olawe Island Conveyance Commission
Consultant Report No. 14

ARCHAEOLOGICAL INVESTIGATIONS OF THE PU'U MOIWI ADZE QUARRY COMPLEX, KAHO'OLAWE

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ABSTRACT

Archaeological investigations of the Pu'u Moiwi adze quarry complex were undertaken over a period of 8 1/2 days in February and March 1992. The investigations, which consisted of a resurvey of all previously recorded sites in the immediate environs of Pu'u Moiwi and plane table mapping and recording of a number of metrical and non-metrical attributes on a sample of artifacts at four sites, were undertaken for the purpose of obtaining new information to evaluate the interpretive and research potential of the quarry complex and to make more informed recommendations on how it can best be preserved. The survey revealed the existence of additional manufacturing locales or workshops and several examples of what appear to be ritual remains, while the artifact study provided the first quantitative data on the frequency of different adze types and other aspects of the manufacturing technology. The interpretive and research potential of the individual sites obviously varies, but viewed as a collective whole there are great opportunities to simultaneously educate the public and address a number of major research questions, some of which are briefly outlined in the report. How long these opportunities will continue to exist is dependent in large part on the development and implementation of a cultural resource management plan that should address both short-term and long-term concerns and advocate active rather than passive steps to ensure the protection of what is clearly one of the most important site complexes on the

island. The present study includes some general and specific recommendations that could contribute to such a plan, including (1) a brief review of alternative site stabilization techniques; (2) preliminary ideas regarding the development of an interpretive program; and (3) proposals for an intensive site survey, the acquisition of representative artifact collections, test excavations and additional sourcing studies.

INTRODUCTION

BACKGROUND INFORMATION

This report presents the results of an archaeological survey and assessment of what is commonly referred to as the Pu'u Moiwi adze quarry or quarries after the name of a prominent cinder cone that on present evidence was the primary source area of tool-quality basalt on the island of Kaho'olawe (Fig. 1). The study was conducted under contract to the Kaho'olawe Island Conveyance Commission whose mandate included the identification of " lands suitable for use by the State of Hawaii for (i) parks (including educational and recreational purposes; (ii) the study and preservation of archeological sites and remains, and (iii) the preservation of historic structures, sites and remains." (Kaho'olawe Island Conveyance Commission 1991:1).

The present study was part of a larger project funded by the Commission to identify and then document in the form of a "survey report" the "significant" places on the island (Kaho'olawe Island Conveyance Commission 1991:44, 47). It should be noted that objectives similar to those outlined above in the Commission's mandate were set forth some 10 years ago in the Kahoolawe Community Plan (County of Maui 1982) that is also the basis for another concurrent planning study (Kaho'olawe Island Conveyance Commission 1991:3). It is hoped that this report will be of some use to the Planning Committee convened by Governor John Waihee to address issues relating to the interim management and long-term plans for the island.

The organization of the Pu'u Moiwi project followed the Commission's recommendation that each of the individual projects involve both professionals and practitioners (Kaho'olawe Island Conveyance Commission 1991:44). The scope of the project, originally intended to be nothing more than a short reconnaissance survey and assessment, changed. A review of the site records very quickly convinced us that what was most needed at this time was not another "walk-through" survey and assessment, but rather the collection of more substantive data on the sites and artifact assemblages. The fieldwork proceeded on this basis and the result was the acquisition of a large quantity of data that has yet to be fully analyzed. The present report is thus in many respects truly a preliminary report.

REPORT PREPARATION AND FORMAT

The report was written by the senior author who also conducted all of the archival research and artifact analyses. The interpretations, evaluations, and recommendations are likewise those of the senior author who takes full responsibility for the content of the report, including errors and other flaws. The final maps were drafted by Aki Sinoto based on his and Maka's field maps.

The report begins with a description of the project area that includes: (1) a brief summary of the environmental setting; (2) speculations regarding the meaning of the name Pu'u Moiwi; (3) a summary of previous archaeological investigations of the adze quarry sites, and (4) a critical review of management studies and actions.

The next section of the report is a presentation of the research design that was employed, starting with a brief outline of the theoretical orientation that guided the work. This is followed by discussion of the scope of work that includes a brief discussion of specific project objectives, minimal data requirements, and various limitations posed. The project is then situated in the context of several local and regional research problems. The research design section of the report concludes with a discussion of field procedures and the analytical framework that was used.

The research design is followed by a summary of the fieldwork and archival research that was undertaken. The site descriptions in the next section of the report are a synthesis of previous descriptions and new information obtained in the present study. The analysis of the artifact data that was recorded in the field that follows includes a discussion of attribute selection criteria and rationale, a presentation of summary statistics and preliminary interpretations. This leads to a chapter on interpretation and significance. The report concludes with a number of general recommendations.

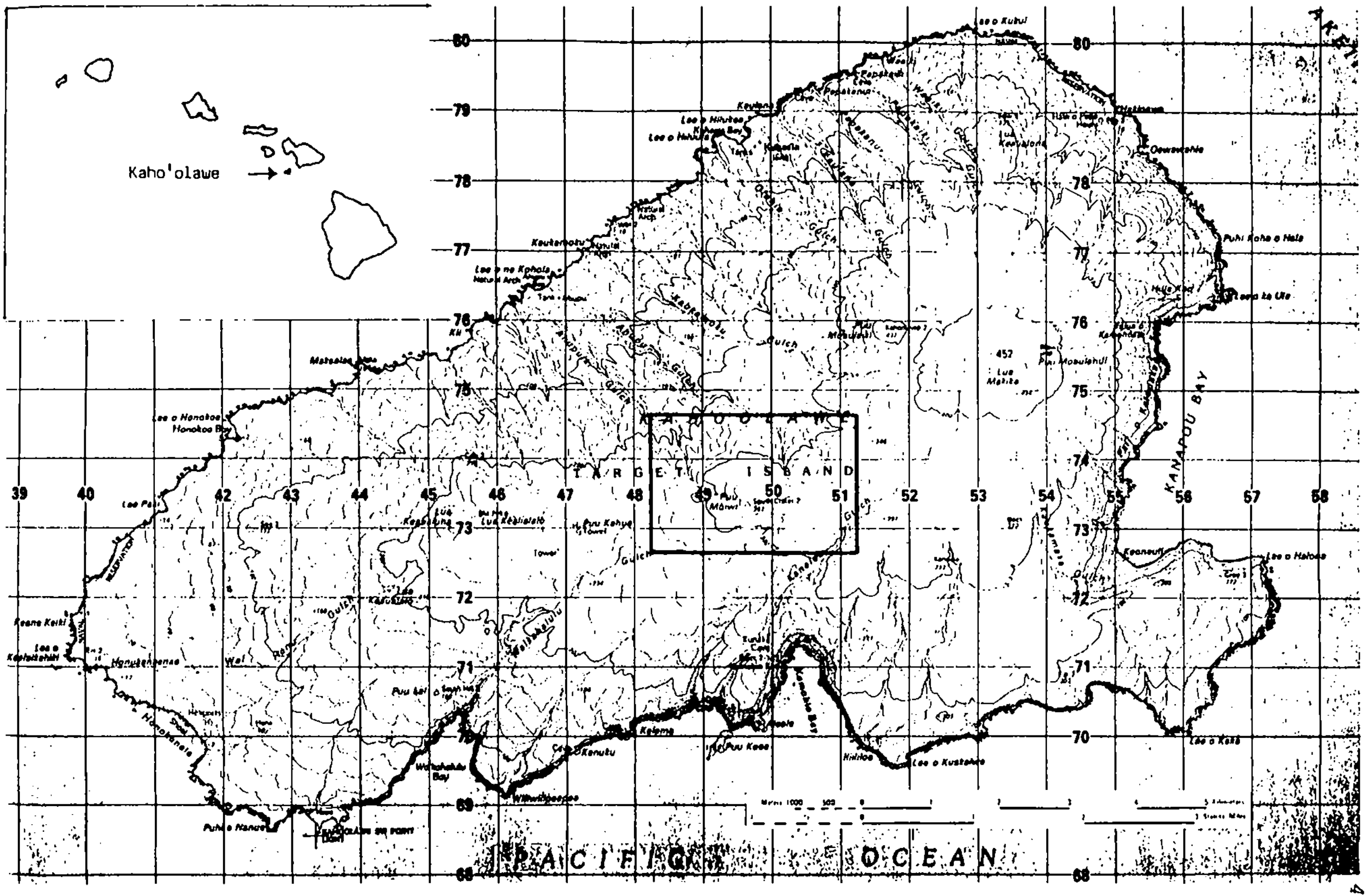

Fig. 1. Project area location map.

THE PROJECT AREA

ENVIRONMENTAL SETTING

For the purposes of the present study the project area was defined as a roughly 1 km^2 area encompassing all of the known archaeological sites on and around Pu'u Moiwi (Figs. 2-4). There is little specific information on the environment of the Pu'u Moiwi area except for the geology and even that is not particularly detailed.

Geology

Pu'u Moiwi, one of the few prominent landmarks in the interior uplands, is located in the approximate center of the island on the crest of the west rift zone at an elevation of roughly 350 meters [1148 feet] above sea level. According to Macdonald and Abbott (1970:336), Pu'u Moiwi is one of two cinder cone remnants of former vent structures on this rift zone, which has been largely obliterated by erosion. The extent of the erosion is clear in the low relief and profile of the cinder cone which rises only 20 to 30 meters [66-98 feet] above the adjacent plain. The United States Geological Survey map shows two craters and in profile the cone does indeed appear to be a composite landform (Fig.1).

One of the earliest and still best descriptions of Pu'u Moiwi and the adze quarry was written by Stearns (1940) and Macdonald (1940). Their separate accounts are quoted in full:

> Moiwi cone, on the southwest rift, poured out voluminous flows but produced apparently only a small quantity of cinders, although erosion may have removed most of them. Near the summit are layers of dense blue basalt that were quarried by the Hawaiians for adzes (p. 18, *B*). Many adze blanks lie among the flakes. The layers dip about 45 away from the vent, hence they are probably flows although they may be dikes. (Stearns 1940:141)

> Lava flows, a few inches to two feet thick, are intercalated in the cinders of Moiwi cone. These flows supplied the ancient Hawaiians with materials for the manufacture of stone adzes (p. 18, *B*). They are as dense as the dike rocks, but free from the platy jointing, detrimental to the manufacture of stone artifacts, which is characteristic of the dikes. A partly finished adze collected at this quarry by Stearns, has been studied in thin section. It (specimen 9) is a very dense, dark-gray rock, with a few, small phenocrysts of white feldspar. The chipped surface is covered by a very thin reddish-brown patine. (Macdonald 1940:167-168)

Macdonald also presented a detailed description of the thin section. A total of 12 new thin sections has been described in the last few years (Cleghorn et al 1985:247-248; Halbig 1992:D11-16, D23-25).

With regard to the surface geology of the project area, the best information still available was recorded by Stearns. The impact that the eroded landscape made on him is evident in his land classification which recognized three geomorphic provinces that he called stony land, dust bowl and dust cap. Pu'u Moiwi is located on the edge of the dust bowl and dust cap (Stearns 1966: Fig. IX-10). Stearns and other geologists saw that the eroded surface that covers so much of the uplands, and that is variously referred to in the literature as a hardpan, a saprolitic hardpan or duripan (Stearns 1966; Shlemon 1980; Morgenstein 1980), was once covered with soil:

> The higher parts of the island were once covered with deep soil, indicating that Kahoolawe is one of the older islands in the Hawaiian group. Overgrazing and strong winds have caused vast quantities of soil to blow away. (Stearns 1966:187)

> Over much of the top of the island the upper soil zone has now been completely removed, exposing the hard surface of the B horizon...The stripping has been as deep as 8 feet, and averages about 5. In places, small flatiron-shaped residuals stand 5 to 8 feet above the general level of the stripped surface, and parallel grooves 6 inches deep have been cut into the exposed surface by wind erosion. (Macdonald and Abbott 1970:338)

Stearns was perhaps the first to recognize or at least to describe the general process that resulted in the distinctively rocky landscape that characterizes much of the interior, including the slopes of Pu'u Moiwi. He wrote that:

> Most of the loose rocks that lie on the summit of Kahoolawe Island are stream-lined and lie with their small ends pointing upward and to the leeward and their broad, heavy ends partly sunk below the surface to the windward. At first the rocks lie buried as residual remnants of a decomposed lava bed. Gradually the matrix is blown away, leaving the rocks supported by pedestals of softer material. They are exposed to a sand blast, and when the wind removes the pedestals, the rocks topple with their heavy ends down. The rocks set up eddies which scour at the windward side, sinking each rock deeper at its heavy end. Meanwhile sand is deposited under the sheltered, leeward side as the rock tilts. Probably the rock rotates slightly during this process if the heavy end has not fallen exactly to the windward at first. Parallel grooves up to six inches deep have been scoured in the hardpan by the wind in some places. (Stearns 1966:10)

In addition to the wind it is clear that water has been a major factor in recent landscape change on the island. In a soil reconnaissance survey of the Lua Makika area Shlemon noted that:

> From a geomorphic standpoint, the Lua Makika area expresses well contemporary, accelerated erosional processes. Headward erosion by gullies is almost everywhere apparent, and rill and sheet wash debris

> (overland flow) mantles most slopes. In fact, though now largely denuded of original soil and vegetative cover, many parts of the reconnaissance area are evolving into badlands. In most areas only scattered hummocks retain remnants of original vegetation; elsewhere an old soil duripan (saprolitic hardpan), sloping several degrees, forms a temporary resistant base for sheet wash. Where the duripan is breached, gully incision now exposes underlying parent material, mainly bedded basaltic flows. (Shlemon 1980:6)

Undoubtedly the most important finding of Shlemon's study is the evidence regarding the origins of one of the most distinctive features of the modern upland landscape, the hummocks. Shlemon concluded that the:

> Hummocks are composite in origin: a basal, strongly-developed buried paleosol is capped by younger, eolian sediments. Several hummocks are protected from erosion by the presence of large basaltic boulders on their upwind and upslope sides. At least some of the boulders were placed on the hummocks <u>after</u> onset of regional landscape degradation and eolian deposition. (Shlemon 1980:1)

The significance of Shlemon's conclusions and how they relate to our observations are discussed later in the report.

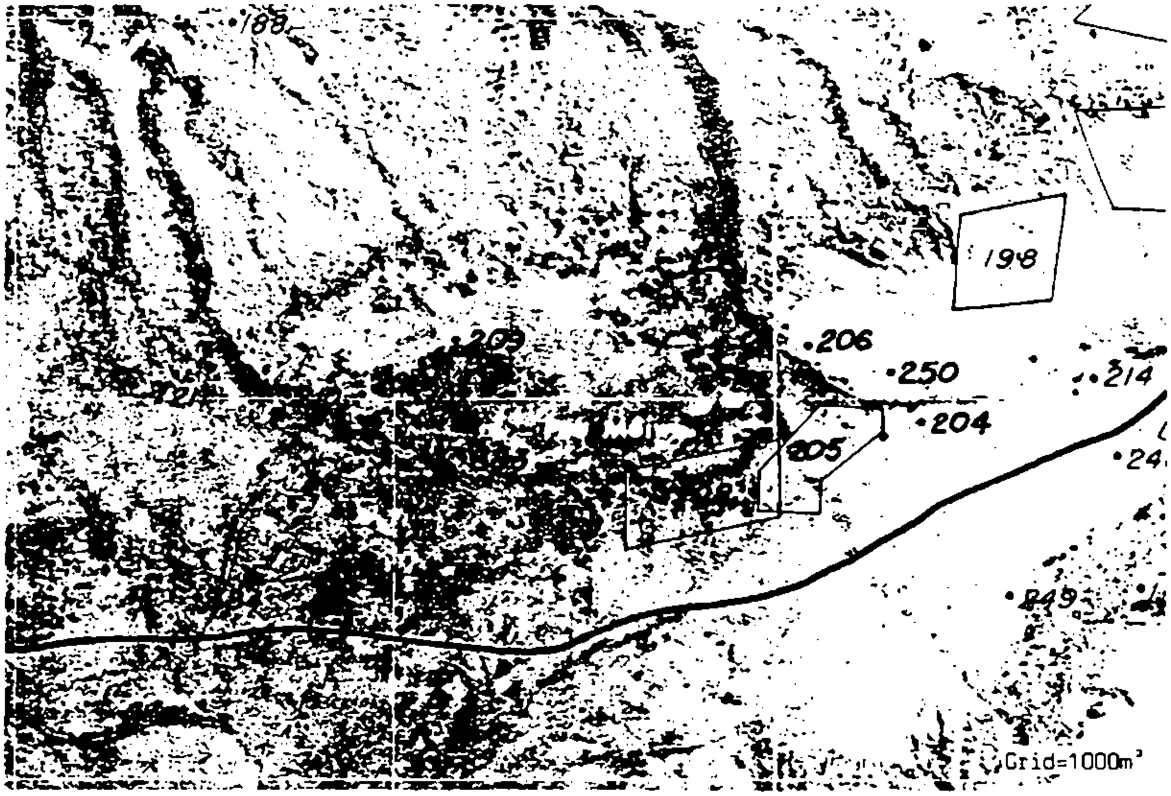

Fig. 2. Quarry site locations based on the 1976-80 survey.

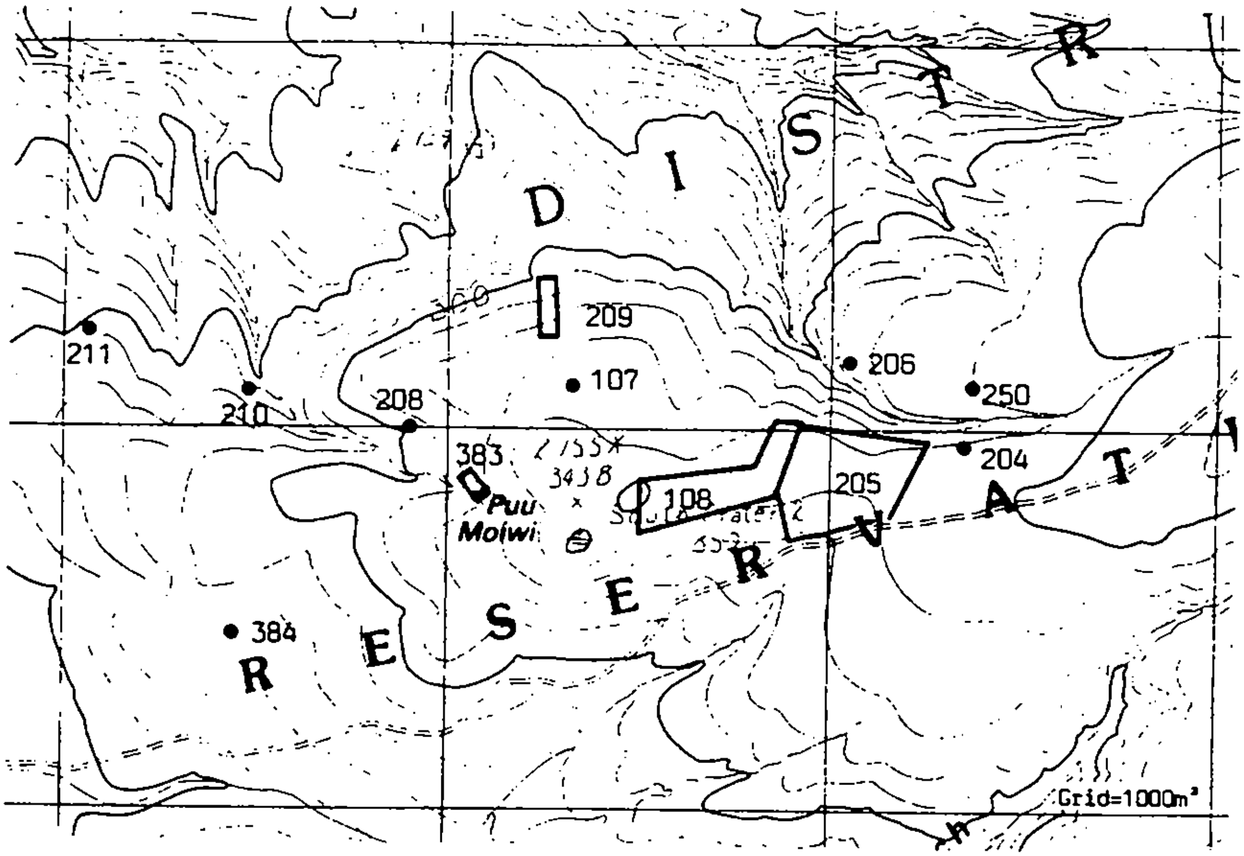

Fig. 3. Topographic locations of the quarry sites.

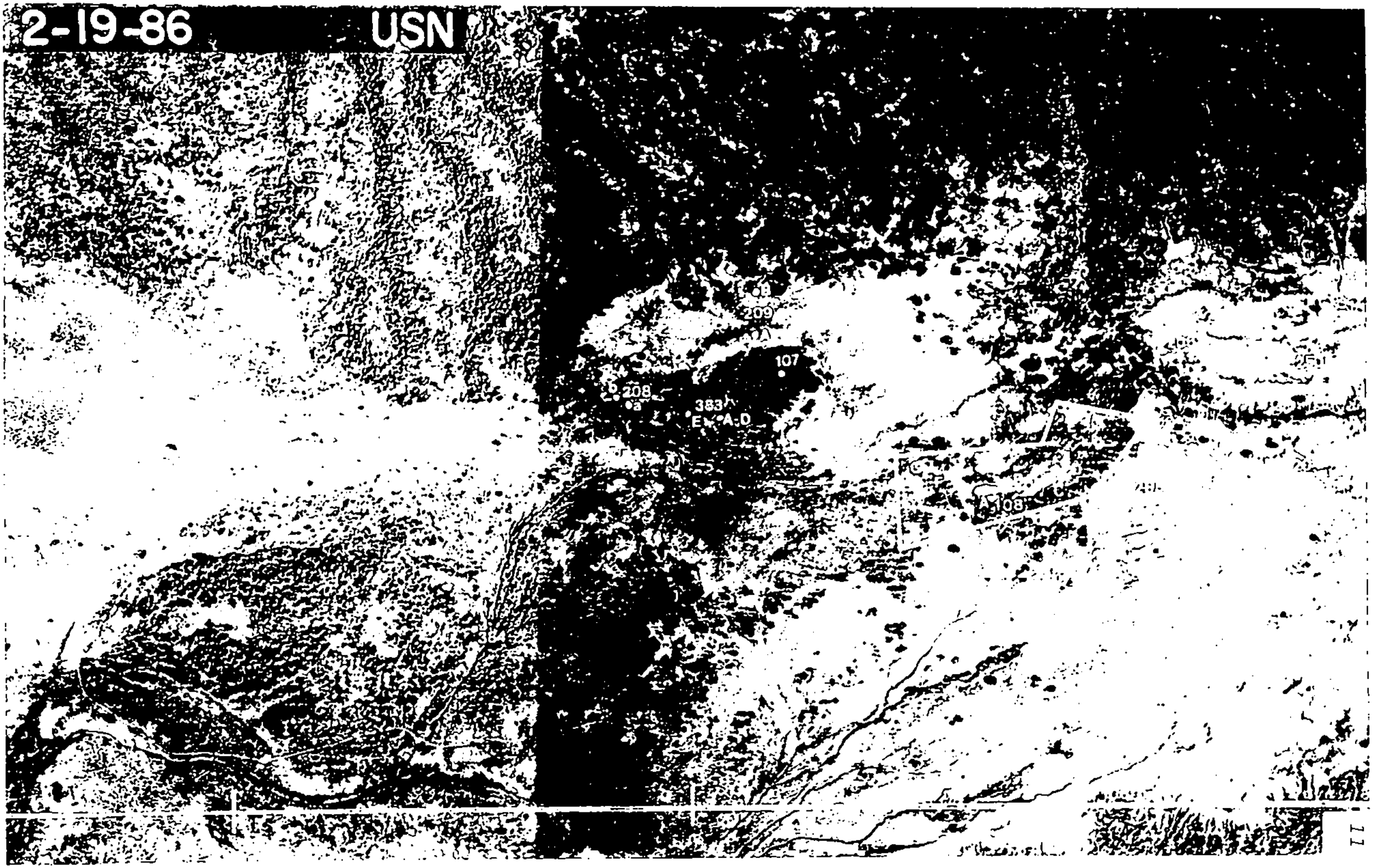

Fig. 4. Quarry site locations based on the 1992 survey.

Vegetation

The vegetation of the island has been variously described. In the Environmental Impact Statement [EIS] prepared by Environmental Impact Study Corporation [EISC] the vegetation was described as consisting of five major zones: hardpan desert, *kiawe* scrub forest, grasslands, coastal strand and precipitous cliff vegetation. (Environmental Impact Study Corporation 1979:2-41-64). According to the recently completed Nature Conservancy survey Pu'u Moiwi is an area of "alien-dominated vegetation" that is comprised of three separate vegetation communities: (1) *Kiawe forest;* (2) *Alien grassland* and (3) *pickleweed flats.* (Nature Conservancy 1992: 41-42 and Fig. 3). The identification of charcoal samples from fireplaces suggests that the precontact vegetation was quite different (Murakami 1983, 1992).

TRADITIONAL HISTORY

There do not appear to be any written or oral accounts of life in this part of the island, which may never have had a permanent resident population [for a contrary view see Hommon 1980a, 1980b] but rather was utilized on a seasonal basis, a land use pattern that may have been abandoned some time before the eventual abandonment of the coastal settlements. The only clue to the traditional history of Pu'u Moiwi, other than the archaeological remains, is the place name.

The name Pu'u Moiwi [cf. also Puu Mo-iwi and Pu'u Mo'i-wi] does not appear in the traditional literature and its proper orthography and etymology are thus both open to debate. In his recent compilation of Kaho'olawe place names Reeve (1992) notes that

> Inez Ashdown gives the name of this place as "Mo'i-wi (a hill) The famine of the king. Kalaniopuu remarked on the desolation and famine of that place as he looked around." (Ashdown Papers, Letter to Pukui 27 March, 1960:6).

The name is listed in the *Place Names of Hawaii* (Pukui et al 1974:153) as: "Mo-iwi. Hill, Ka-ho'olawe. *Lit.*, cut (*mo*-is short for *moku*) bone." Neller (1982:17) is of the opinion that the literal translation, "hill of the cut bone", is "an idiom for the broken pieces of rock on the hill." Though he gives no reason for his belief there may be something to this idea since one of several meanings of the word *iwi* is "remnants or pieces" of something (Pukui and Elbert 1971:98). It is possible then that *iwi* refers here to all of the pieces of adze manufacturing waste material--cores, flakes, and discarded adzes--that litter the surface. If such is the case then it is highly likely that this is a later name for this place, given sometime after the accumulation of all of the waste. Whatever its meaning and origin it is doubtful that this is the original name or the only name that was given to the cinder cone given the proclivity for place names to change through time (cf. Kamakau 1976:6-7) and for different groups of people to use different names for the same place.

I have adopted the orthography in the *Place Names of Hawaii* because I think the notation that *mo* is short for *moku* is one clue to the meaning of this place. *Moku* has many different meanings other than "cut", among which are "district, island, section" (Pukui and Elbert 1971:232). In his discussion of natural and artificial divisions of the land Malo (1951:16) wrote that "An island is divided up into districts called *apana*, pieces, or *moku-o-loko*, interior divisions." In the ethnohistoric literature there are references to lands that lie outside of the district, that in Lyons' words, were "independent, belonging to no Moku." (Lyons 1875:119). Lyons named several examples of these "anomalies" on Maui and included in the list one called Kamoku in the Hamakua district on the island of Hawai'i. He said that Kamoku was "[a] large tract of forest land...once cut off from a number of ahupuaas [sic] for the use of the whole district." (Lyons 1875:119; quoted in Hommon 1976:69). The name Kamoku [ka-moku --"the island or section"] suggests a generic term for such patches or sections of common land, which in effect were "islands" of free and open access within the larger territories where proprietary rights to resources were strictly enforced.

The idea that Pu'u Moiwi was a *moku*, a separate section of land set aside for common use, finds some support in one of the alternative meanings of the word *iwi*--"Stones or earth ridge marking land boundary" (Pukui and Elbert 1971:98). In his discussion of Hawaiian land terms and classification Lyon's wrote that

> *Kihapai's*, i.e., dry land patches, with their intervening ridges of small stones, or earth or weeds, had also their appellation. These ridges of cultivation, often rows of sugar cane too, were in cultivated sections very frequently the boundaries of the ahupuaa, called *iwi*, bone, --short for *iwi kuamoo*, back-bone,--and curving enough they are. (Lyons 1875:119)

This example of body symbolism, of which there are many other examples in Hawaiian mythology (Beckwith 1970:13), cultural geography (Malo 1951; Kamakau 1976; Lyons 1875) and in portable artifacts (Kaeppler 1982), is of particular interest given the backbone-like form of the low ridges (Fig. 5) that on current evidence were the primary sources of raw material in the Pu'u Moiwi adze quarry complex. It is not too farfetched in my view to suggest that these ridges [dikes or the tops of linear lava flows], like the artificial ridges in the gardens, may also have been called *iwi kuamoo* or just *iwi*. It is obvious in any case that *iwi* and *moku* are both polysemic--that the terms have multiple meanings--so that *iwi* might refer to both: (1) the spine or backbone-like form of the ridges and (2) to the fragments and pieces of material left after working the material into artifacts.

PREVIOUS ARCHAEOLOGICAL INVESTIGATIONS

Archaeological investigations of the Pu'u Moiwi adze quarry have been limited in both number and scope. The summary of previous work that follows is intended to present a general history of what has been done for the purpose of assessing the current state of knowledge. The discussion, which is organized chronologically, includes a general critique of the design, aims and methods of earlier work; some of the more substantive problems with individual site descriptions and interpretations are noted in the site descriptions [see pp. 60-118].

1913 and 1931 Surveys

John F. G. Stokes' work on the island in 1913 did not take him to Pu'u Moiwi and the adze quarry, which wasn't mentioned in print until 1933 (McAllister 1933), but Stokes was the first to describe what we now know to be a fairly common type of site in the interior uplands, many of which contain basalt flakes. In his notebook entry for February 26, 1913 Stokes wrote:

> In afternoon, walked to Puu o Moaula and then to Kanapou B. All the uplands have been blown away and the subsoil exposed. On the uplands, about an elevation of 1000 feet were scattered sparsely chips apparently from adzes, together with sea shells, Pechen [?], Cassis, Purapura, Cypraea, & on the Kanapou slope some of the cypraea were found prepared for squid hooks. Coral was also noticed. All these objects apparently had remained while the fine soil was removed by the wind. In [pg. 5] of a careful search, over the route travelled, nothing was found to indicate that the chips were actually from adze-making, although they seemed to have been artificially broken. [for a full transcript of Stokes; fieldnotes see Appendix 18 in Reeve 1992]

The uncertainty regarding the chips may reflect the limited time Stokes spent examining the material, but it may also point to a lack of experience and inability to readily distinguish humanly produced flakes from naturally occurring spalls.

The first known reference to the adze quarry at Pu'u Moiwi is in McAllister's monograph, *Archaeology of Kahoolawe*, where it is first mentioned in the context of a small group of miscellaneous sites that McAllister regarded as of negligible importance (McAllister 1933:13). McAllister refers here to the "alleged adz factory at Puu Moiwi (Site 29)." which he described thusly:

> This site, where there are thousands of sharp basalt flakes, undoubtedly due to natural weathering, has been mentioned as an adz factory, but similar flakes, though not so nearly rectangular in shape, are to be seen all over the bare uplands. Stokes (19) remarks: "On these uplands at an elevation of about 1000 feet were scattered chips apparently from adzes...In spite of a careful search over the route traveled, nothing was found to indicate that the chips were actually from adz making, though they seemed to have been artificially broken."
>
> Before 1931 no adzes had ever been reported or turned in to the Museum from Kahoolawe. Specimens may have been found and not reported, and it can be argued that Puu Moiwi was only a place at which preliminary work was done and not necessarily a site for completing and finishing the implement. If this is true the Hawaiian wasted a tremendous amount of time and effort, forming thousands of rough cores which were never used. It is possible, of course, that these undoubtedly naturally formed specimens constituted a source of supply and were used by the Hawaiians, but that they represent human labor and can be termed crude artifacts, does not seem plausible. (McAllister 1933:51-52)

McAllister's account, which incorporates Stokes' earlier description of upland sites with basalt flakes, is interesting for a number of reasons, not least is the reference to the "alleged quarry." That phrasing, coupled with the apparent confusion regarding the human versus natural origin of the flakes and "rough cores", tends to lend credence to an anecdote that Ed Bryan, McAllister's field assistant in the 1931 survey, gave me. According to Bryan, McAllister was just out of school and very inexperienced (Ed Bryan, personal communication 1976). It is difficult to imagine an experienced archaeologist, even one practicing in the 1930's when lithic technology was not a major interest, referring to the residues at Pu'u Moiwi as an "alleged" adze quarry or factory.

How much of the quarry was actually seen during the 1931 survey is difficult to determine from the published description. The few photographs of the quarry from that survey all appear to be of one well-known locality on top of Pu'u Moiwi, that was later designated site 108, Feature G (Hommon 1979). The photographs, which were taken by Bryan and are on file in the Bishop Museum Photo Archives, show a shrine which is not mentioned, however, in either Bryan's description of the photograph or in McAllister's description of site 29. The late Dr. Kenneth Emory was of the opinion that McAllister had missed the shrine. In a rough draft of what appears to be part of a speech or written testimony dated March 10, 1978 Emory wrote that:

> The Bishop Museum archaeological survey as reported by Gilbert McAllister (Bulletin 15, 1933) was the first attempt to take in the scant recorded history [sic] and a brief field survey. It covered this history quite well and gave a good preliminary idea of the extensiveness and nature of the archaeological remains. We knew from a filed [sic] trip of Jack Porteus t [sic] in 1939, that it missed an important shrine on top of the island of the Necker type, and its adjacent adz workshop. And we know fr [sic] from later field trips that the extensiveness of adz making sites large [sic] and produced adzes of a sub-triangular cross section not typical of those of the Mauna Kea quarries.

Emory wrote Kaho'olawe and the name of Jack Porteus on a number of photos in the Department of Anthropology at the Bishop Museum that were thought to have been taken about 1939. Included among these photos are several of this now well-known shrine [see description and illustration later in this report], which does bear some resemblance to what Emory called the "Necker type" (Emory 1928; 1943). Bryan apparently returned to Pu'u Moiwi in 1939, perhaps with Porteus, because there is a photograph in the Bishop Museum Photo Archives by Bryan of Dr. Gordon Bowles on the summit of the cinder cone picking up adze fragments that is dated 1939 (Fig. 6).

To McAllister's credit he did at least describe the adzes that had been collected on Kaho'olawe, though there were only three in the Bishop Museum collection in 1933. McAllister wrote:

> Only three very small adzes have been reported from the island. The largest, of compact basalt (fig. 13), is more carefully finished than the other two. A second, similar to the one figured, is quadrangular in cross-section. The front is flat and polished; the back is polished to the poll; the sides are also polished, but there are occasional rough places. There is no marked tang, but the upper end is rough. The edge is slightly convex. The third adz is smaller and very crude in finish. the maximum measurements are 1.3 by 0.7 by 0.4 inches. Only the edge has been finished and polished. All three are typical of the small Hawaiian adz. (McAllister 1933:32)

Fig. 5. Maka examining dike at site 108, feature E. Photograph by Patrick C. McCoy.

Fig. 6. Dr. Gordon Bowles in the quarry. Photograph by E. H. Bryan 1939 [Bishop Museum negative number CN 19828].

1976-80 Survey

The first substantive archaeological data on the Pu'u Moiwi adze quarry complex was obtained during the large-scale, systematic survey of the island undertaken between January 1976 and April 1980 (Hommon 1980a; 1980b). Hommon reports that:

> Thirty-two archaeological features are classified as lithic quarries and workshops (Table 3). Fourteen of these are termed basalt adz quarries and workshops. They consist primarily of large flakes of basalt and adz preforms, as well as outcrops and boulders of the basalt source material.(Hommon 1980b 7:47)

The fourteen adze quarries and workshops listed in Table 3 of the 1980 document are all located in the environs of Pu'u Moiwi and include sites: 108 [features A-F]; 208, 210, 211, 383 [features B-E] and 384 (Figs. 2-4).

The actual number of adze quarries and workshops that was recorded in the 1976-80 survey is unclear, however, for a couple of reasons. The first reason is related to ambiguities in the definitions of basic terms that were used in the survey:

> An <u>archaeological site</u> is a location with evidence of human activity in the past and consists of either a single feature or a complex of features. An <u>archaeological feature</u> is a spatially limited cluster of evidence of past human activities whose boundaries are determined by the extent of the evidence and/or by the boundaries of the artificial structure or natural land-form that contains it. An <u>archaeological complex</u> is a site composed of two or more features that appear to be related in some archaeologically significant way. (Hommon 1980b 7:37)

The definitions are not mutually exclusive because the distinguishing criteria are too general and vague. One of the unfortunate consequences of the poorly defined terms, which Neller (1982) and others (e.g. Rosendahl et al 1992:I-17; Carlson and Rosendahl 1989:3) have been quick to point out without noting that it applies to not only this project but to much of Hawaiian archaeology, past and present, is a predictable lack of consistency in their usage and, thus, a general lack of comparability. The magnitude of the problem can only be comprehended in a review and comparison of all of the site descriptions in the National Register Nomination Forms [see below].

The second reason for the uncertainty regarding the number of adze manufacturing sites and features is that *quarry* and *workshop* were lumped together in a single class of site--*quarry/workshop*--characterized by the presence of boulders or outcrops. At first glance there is nothing wrong with this definition and in fact it is a good definition of a *quarry* as: (1) comprised of *workshops* and (2) coterminous with the raw material source. The problem is that the confounding of quarry and workshop excludes concentrations of adze manufacturing debris where there is no evidence of a raw material source. While I would hesitate to call all such "isolated" concentrations *workshops* [see pages 52-53], it is clear that is what most of them represent. The definitional problem presumably explains the omission of site 108 [feature G], site 205, and site 383 [feature A] which are curiously missing from the above list. Somewhat more problematical, for reasons that will become clearer later, are sites 204, 209 and 250. On the other hand Site 108 Features A and F should not be included if an outcrop is an essential part of the quarry and workshop definition.

Apart from the inconsistency in site and feature designations, the site survey records are also of predictably variable quality in terms of the amount of information presented, both in the narrative description and on the accompanying sketch maps. Most of survey records are limited to very brief descriptions of the general location, approximate size and general contents of either the whole site or the individual features. The descriptions typically note the presence/absence of shell midden, but contain little or no information regarding the quantity or volume of adze manufacturing debris, the different classes of debris, or the specific adze types observed. There are several site records with no maps and those that do exist are on the whole not very useful, consisting for the most part of nothing more than outlines depicting the approximate shape and size of individual features. The best maps of the quarry sites from this survey are two sketch maps, one of a portion of site 108, Feature G and the other of site 208, prepared by Dr. Richard Gould in 1979.

Another problem with the survey records is that the locational data for several sites and features are wrong. At the time the survey was conducted there were no good base maps or low altitude aerial photographs to aid in plotting site locations. Sites were plotted on enlarged black and white aerial photographs and later transferred to the 1:25,000 scale photomosaic (Fig. 2) from which the UTM coordinates were then read (Hommon 1980b:5 and personal communication). Where the original site plots were in error, such as was the case for sites 210 and 211, the UTM coordinates were also wrong. Some of these problems were recognized soon after completion of the fieldwork but the corrections were not made on the photomap showing the locations of all of the known archaeological sites on the island. None of the reports on this survey explain the boundary determinations for sites 108 and 205 which partially overlap (see Fig. 2).

The acquisition of systematic artifact collections was not a primary goal of the survey (Hommon 1980b:37). The Sample Collection Record indicates that a total of 11 adze rejects were collected from two localities at site 108 on 23 November 1976: (1) six from a "streambed" [there is no streambed at site 108 but there is a gully at Feature F which is probably the correct provenience], and (2) five from site 108 [the feature designation is not noted in the catalog but these must be the five that were collected from the base of the upright on the shrine at Feature G; (Hommon 1979; McCoy 1976 field notes]. All of these artifacts are now housed at the Maui Historical Society.

Excavations in the quarry were limited to the partial excavation in 1976 of an eroding fire place at site 108, Feature A from which was collected a charcoal sample for dating, soil samples and a sample of fire-cracked rock (Hommon 1976 field notes; McCoy 1976 field notes; State Historic Preservation Office Sample Collection Record).

The first dates for the quarry complex were obtained during this survey. A total of 22 hydration-rind dates were obtained for three sites--108A, 209A, and 383A (Hommon 1980b: Appendix B). The dates are presented below in Table 1.

Table 1. Hydration-rind Dates for Sites 108A, 209A, and 383A.

108A	209A	383A
1417±17	1552±24	1442±27
1418±15		1447±29
1418±25		1450±27
1419±25		1452±25
1420±25		1463±29
1423±23		1465±30
1424±13		1487±23
1424±17		1490±29
1432±36		1497±30
1433±24		1500±31
1434±39		

The 1976-80 survey, despite the several methodological problems and other shortcomings, was at least successful in recording for the first time all of the major quarry sites and features which were determined, moreover, for the first time to be significant in terms of their relevance to several local and regional research questions. The artifact collections, though small and limited to unfinished adzes and volcanic glass cores and flakes from only three sites, are an important part of the database. The hydration-rind dates have been recently questioned (Rosendahl et al 1992), but given what I believe are substantial problems with the new set of dates it is my view that the dates from the 1976-80 survey cannot be categorically dismissed or rejected.

Post-1980 Research

After the completion of the island-wide survey the only field research undertaken at the Pu'u Moiwi adze quarry was carried out by PHRI, Inc. in 1983. The research, which was not part of the Scope of Work, consisted of a search for the raw material source and collection of petrographic samples for sourcing analyses (Rosendahl et al 1992:I-16). The account of this work is presented in two appendices (Rosendahl et al 1992: Appendix M; Halbig 1992: Appendix D):

> During a field trip in March 1983, the vicinity of Puu Moiwi, particularly the adze quarry/workshop sites were visited in an attempt to locate the source of the basalt scattered about the quarry/workshop sites. The source could not be found; it was felt that perhaps it had been covered by colluvium. (Rosendahl et al 1992:M-2)

> Although Hommon and others have regarded the Puu Moiwi area as a quarry site, there was no evidence at the time of field inspection of any excavation features or of the in situ basalt material which was being extracted. The most logical explanation to account for the inability to locate the basalt source is that it is presently blanketed by colluvial material which occurs on the flanks of the cinder cone. Stearns (1940: 141, 167) describes the source basalt for adze production as thin flows (a few inches to two feet in thickness) which are intercalated with cinders and which dip at an angle of about 45 degrees from the vent location. Most probably the basalt could be located by means of exploratory trenching. (Halbig 1992:D-2)

For reasons that are presented in more depth later in this report [see pages 154-155] I think that Halbig did in fact find and sample a portion of the source but, because he was perhaps looking for something resembling a "mine" from which subsurface material had been extracted, he was misled into thinking that the search had failed [see the earlier discussion of the quarry definition problem on page 22]. Halbig collected a total of 7 petrographic samples--4 adze reject fragments, 1 piece of "worked rock", and 2 residual boulder outcrops--from two sites: site 108 [5 samples] and site 383 [2 samples]. What areas of these two sites were sampled is unknown because there is no map and no feature designations are given in the petrographic descriptions (Halbig 1992: Appendix D).

One other research result was forthcoming after the 1976-80 survey. Following on Neller's (1981:25, 38) complaints of things that had not been done, the scope of work for the 1982-83 data recovery project was modified so that the radiocarbon sample collected from an eroding fire place at site 108, Feature A in 1976 [see above] could be processed. The date on this sample is presented in the final report but there is no discussion of its significance (Rosendahl et al 1992:V-2). Additional information regarding the provenience of the sample and the possible relevance of the date to several research questions is presented elsewhere in this report [see pages 82, 165, 172].

CULTURAL RESOURCE MANAGEMENT STUDIES AND PLANS

The 1976-80 site inventory identified a number of cultural resource management problems that led to: (1) a series of periodic field checks to evaluate and monitor the erosion of selected sites (Neller 1981); (2) the funding of several mitigation projects (Hommon 1981, 1983; Hommon and

Streck 1981; Rosendahl et al 1992), and (3) the development of a management plan (Ahlo and Hommon 1980). Relatively little attention has been given to the adze quarry sites as the following discussion illustrates.

The first data recovery project, at site 109, was undertaken in 1976 and 1978 by personnel of the State Historic Preservation Office and Hawaii Marine Research (Hommon and Streck 1981). Once the island had been placed on the National Register of Historic Places in 1980, the Navy developed an interim site management policy that included the funding of several data recovery and site stabilization projects. The first of the Navy sponsored projects was undertaken at site 633 by Hawaii Marine Research in 1980 (Hommon 1981) In 1981 Science Management, Inc. conducted test excavations of ten eroding fire places and stabilized the remaining deposits (Hommon 1983). The last and most comprehensive of these data recovery-site stabilization projects was undertaken at seventeen sites in 1982-83 by PHRI, Inc. (Rosendahl et al 1992).

A variety of short-term, management-oriented field studies were undertaken at the quarry beginning in 1980 and continuing intermittently up to the present time. Most of these have been periodic field checks conducted by Navy and State archaeologists aimed at evaluating the severity of the erosion at some of the more threatened sites. This largely unknown work is reported in a number of letter reports (e.g. Ahlo 1980), manuscripts (Neller 1981), and addenda to

National Register Nomination Forms [NRNF] in the form of what the Advisory Council on Historic Preservation referred to as "Preliminary Case Reports" (Neller 1981:31).

Preliminary Case Reports, comprised of a short site description, statement of the necessity of the undertaking and consideration of alternative mitigation measures, were prepared for sites 208 and 211 in 1980 (Rob Hommon, personal communication). These were followed by the preparation of an endangered sites list which included some of the quarry sites. Site 208, for example, was added to the list in 1981.

Sites 208, 211 and 383 have received the most attention (Neller 1981: Figure 1). The HMR 1980 trip report recommended monitoring site 211 every twelve months and for site 208 the recommendations were even more specific:

> Site 208 is an adze quarry/lithic workshop currently eroding from a hummock and endangered by rain impacts, personnel access and gully erosion. There is no single method of mitigating or preventing impacts to the site. A program of data recovery (collection and analysis of a sample of the extant surface scatter), installation of soil grabbers in the gully, limiting personnel access to the site and stabilization of the hummock face should be undertaken. This is a very important site and its treatment should be given high priority. (Ahlo 1980 in Neller 1981)

No action has ever been taken on these or any other recommendations concerning the quarry sites. There has never been any site stabilization work or mitigation of any kind undertaken at Pu'u Moiwi even though such work was presumably planned for site 208. A footnote in the recently completed PHRI, Inc. data recovery report indicates that this site was to be handled separately (Rosendahl et al 1992: Table I-1).

The latest work at the quarry, prior to the present study, was undertaken by PHRI, Inc. in 1988-89. PHRI, Inc. was contracted by the Navy to relocate and mark the locations of 211 sites as part of an interim management program. This work, which apparently has not yet been completed, is summarized in a short report (Carlson and Rosendahl 1989).

The most substantial planning effort to date [several other planning studies are currently in preparation but are not yet available], funded by the Navy to meet their management responsibilities, was the preparation of a management plan by Ahlo and Hommon (1980) at the conclusion of the 1976-80 inventory survey. This plan, which was conceived as a set of procedures that needed to be implemented to achieve various objectives, exists in draft form and was never accepted by the Navy (Rob Hommon, personal communication). The plan contains a useful discussion of research values and cultural values and other relevant issues, such as the concept of data redundancy using fire-cracked rock features as the most obvious example. Perhaps the most important item in the plan was the recommendation for the formation of a Historic Properties Advisory Committee (Ahlo and Hommon 1980:33) whose primary function would be to advise the Navy.

Apart from the removal of most of the larger ordnance and the goat eradication program, which has resulted in the revegetation of previously denuded surfaces on some sites, I think it would be fair to characterize the Navy's cultural resource management efforts in the case of the quarry sites as one of neglect. The Navy has failed to accept and then implement the various recommendations that have been made in the past with the result that there has been no active program to protect and preserve the quarry sites from further erosion, bombing and artifact collectors. Even the monitoring program begun in 1980 seems to have gone into abeyance. Though there may be more recent documentation which I have not seen, the last field checks appear to have been done some ten years ago, in 1982. The Kaho'olawe Trip Report for 5-8 January 1982 prepared by Neller contains information on sites 108, 205 and 211. In May 1982 Navy archaeologist, David Tuggle, took photographs of sites 108, 205, 210 and 211 and noted some evidence of "damage" at site 108 and an increase in grass patches at sites 210 and 211.

RESEARCH DESIGN

INTRODUCTION

Archaeologists differ on the matter of the appropriateness and utility of research designs, especially in the case of cultural resource management [CRM] studies. Some, like Dunnell (1984), argue that because contract archaeologists are not free to choose their study area the work they do cannot be problem-oriented and cannot therefore be regarded as research. Other archaeologists, such as Raab (1984) and Redman (1987) make no such distinctions and argue that all archaeologists are ethically obligated to develop and use research designs. I tend to side with Raab, Redman and many other archaeologists who share the view that:

> ...work in a project area--of whatever size--must be placed in a broad topical and regional context if there is to be any possibility of recovering maximum useful data. This awareness necessitates regional overviews and well thought through research designs. (McGimsey and Davis 1977:26)

To the requirement of regional overviews and carefully crafted research designs I would add the necessity of including in the research design a discussion of theoretical issues and reflection on current archaeological practice in the area of study.

THEORETICAL ORIENTATION

General Perspectives

In terms of general theoretical orientation, I am inclined to favor the historical and the interpretive as opposed to the evolutionary perspective as summarized by Peacock in the following passage:

> The evolutionary perspective tends to an "objective" positivist stance. This is partly due to the large scale of the evolutionary perspective, so that life is viewed from afar in order to see the whole panorama. Accordingly, life is viewed, not engaged...If humans are seen as aspects of a process, they are seen as worked over by such massive mechanisms as natural selection, the process through which the survival of traits is determined by the environment. The subjective viewpoints...are of little interest and, in fact, raise the spectre of what evolutionists term the "teleological fallacy" (the fallacy that subjective purposes affect the evolutionary process, which, instead, should be seen as governed by the law of natural selection regardless of any petty motives and purposes...)...Given the irrelevance of the actor's viewpoint, humans are treated as part of nature and analyzed according to natural laws. (Peacock 1986:98-99)

It is not that the evolutionary perspective is wrong, but that like all paradigms, including the ecological paradigm with which it is commonly linked in the New Archaeology, it is limited (Peacock 1986:96; Brumfiel 1992). Trigger summarizes the major shortcomings of the evolutionist perspective in the context of the current debate between the older "processual" and the newer "post-processual" archaeology:

> Yet, contrary to the predictions of processual archaeology, during the last fifteen years there has been a growing realization among archaeologists that there is more variation in the archaeological record, and hence in human behavior, than can be accounted for in terms of neo-evolutionism and ecological determinism. This calls into question the distinction that processual archaeologists drew between evolutionism and history, as well as their assertion that, because evolutionism is more generalizing, its study is superior to that of history, in the sense that all or most specific historical situations can be explained in terms of small number of evolutionary generalizations. Post-processualism denies that neo-evolutionary

> generalizations adequately account for specific situations. (Trigger 1991:66-67)

In favoring the historical approach I differ with many Hawaiian archaeologists who interpret the archaeological record in primarily evolutionary terms as a series of unilinear transformations. I share the view of a smaller number of archaeologists that "new configurations emerge continuously and not wholly predictably, as in a rotating kaleidoscope, and are the products of heterogeneous prior conditions and ongoing forces." (McC. Adams 1992:213)

Archaeology is in my view an interpretive social science. Wuthnow has put the matter so well that I have inserted the term archaeology in the following quote.

> The very business of sociology [archaeology] is assumed to be one of interpretation, not one of discovering objective facts from some Procrustean bed of empirical reality or of adducing lawful generalizations about the causal ordering of these facts...Whether the subject of investigation is "culture," the "state," the "means of production," or anything else, that object is itself a cultural construction, subject to the meanings we give it and interpretable in different ways. It could not be otherwise. (Wuthnow 1987:17)

Like sociology and other social sciences the goals of archaeology are both particularizing and generalizing. The necessary tension between the two (R. Watson 1991:400) can be seen in the in the processual-post-processual debate.

The archaeological record in my view must be understood in both materialist (ecosystem) and idealist terms (the conviction that ideas, beliefs, values, motives, intentions, etc. are of paramount importance in human life rather than epiphenomena). Humans, unlike other animals, do not simply adapt to the constraints of the external world; they also make their world--both physically, by changing it, and symbolically, by imposing a structure on nature. Moreover, humans give meaning to their actions which are based on individual and group interests, motives and intentions (Brumfiel 1992). I have argued elsewhere, for instance, that the Mauna Kea adze quarry represents something more important and meaningful than the adaptation to raw material scarcity (McCoy 1990). Rather, the quarry represents in my view a pre-eminent form of social action in the production of goods and reproduction of the social order, so that even though the primary activity was technological and economic, the underlying motives and intentions were in large part social and political, and encompassed societal as well as individual motives--the pursuit of personal careers (see Goldschmidt 1990) governed by the motivation to achieve a status, to seek prestige and honor (McCoy 1990).

As I have implied elsewhere (McCoy 1990:87), it is clearly time to move away from interpreting stone tool quarries in exclusively narrow utilitarian terms as: (1) adaptive responses to a pervasive environmental "selection pressure" in the uneven and oftentimes highly localized occurrence of tool-quality stone (Crabtree 1975:108), and (2) nothing more than "special purpose" sites related to the fulfillment of basic functional needs and "embedded" in the logistics of food-getting activities. Quarries should also be viewed from an historical perspective because in the words of Eric Wolf:

> What attention to history allows you to do is look at processes unfolding, intertwining, spreading out, and dissipating over time. This means rethinking the units of our inquiries--households, localities, regions, national entities--seeing them not as fixed entities, but as problematic: shaped, reshaped, and changing over time. Attention to processes unfolding over time foregrounds organization--the structuring arrangements of social life--but requires us to see these in process and change. (Wolf 1990:590)

The focus on process and change draws attention to the fact that quarries do not just exist but are socially constructed places. As one anthropologist has recently put it, "Places are not inert containers. They are politicized, culturally relative, historically specific, local and multiple constructions." (Rodman 1992:641).

Theory in CRM Archaeology

Discussion of theoretical issues in CRM archaeology is not commonplace and there has been little sustained effort to demonstrate why a consideration of theoretical issues is important. There are various reasons for this, including the nature, or what Watson below calls the routine, of the business

> Mutually beneficial communication between the theorists and the CRM groups will probably require the most care and effort because CRM routine is not conducive to sustained concentration on theoretical issues...So we have the quite undesirable paradox of those who actually do most of the archaeology being simultaneously the most distant from the theoretical pinnacles. (P. Watson 1991:273)

One reason that theory is indispensable to CRM and to an assessment study such as the present one is the increased recognition that significance evaluations are theory dependent. The need for a research design in the evaluation process is based on the view that:

> Although significance is based on the T & SK, [theoretical and substantive knowledge of the discipline] federal agencies and SHPOs need to know precisely what those important substantive or theoretical questions are in order to evaluate them and to make decisions based on the archaeologists' recommendations. Such questions are best presented in a research design. (Butler 1987:822)

> Decisions made by federal managers should be based firmly on clear, reasonable, and defendable statements of National Register significance that are based on research designs well-grounded in archaeological method and theory. (Butler 1987:828)

Finally, in answer to those who argue that we should forget about theory and just "get on the business with doing archaeology," there is no better reply than that offered by Shanks and Tilley:

> Ignoring philosophical and theoretical concerns is no way out. Such an approach, urging us to simply press on with the study of data without worrying about the niceties of theory, presumably inviting us to respond directly to that data, assumes that the lack of any systematic approach or procedure is somehow a miraculous guarantee of objectivity. Such a common-sense approach systematically evades any confrontation with its own premises, safeguards any methodology which is currently available and, in this manner, produces the very opposite of objective problem-free research. Empirical research presented as the obvious stuff of common sense is never called upon to guarantee its consistency, silences, and contradictions and hence is entirely unsatisfactory. (Shanks and Tilley 1987:33)

SCOPE OF WORK

Objectives

The project as initially conceived, prior to a review of the literature and first field trip, had four very general objectives that were stated as follows in the proposal to the Commission:

(1) To provide a general overview, in laymen's terms, of the Pu'u Moiwi adze quarry complex beginning with a discussion of previous research. The overview will also include, to the extent possible, a summary description of each site in the quarry complex in terms of its geographical location, overall areal extent, the number and size of physically discrete chipping stations and other surface features, and an inventory of the contents. This part of the research will involve a synthesis and appraisal of earlier work and addition of new information obtained in the reconnaissance survey [see below].

(2) The second objective is the determination of preliminary site boundaries. This part of the project will require a re-survey of the six known adze manufacturing sites. It is important to note that final boundary determinations are dependent on a more intensive survey in the future.

(3) The third objective is to make recommendations regarding the management and conservation/preservation of the quarry. The primary focus will be on identifying areas that should be avoided if and when the island is open to public use. Recommendations will also be made concerning stabilization of site surfaces to prevent further erosion.

(4) The final objective is to make recommendations for further research. There are a number of basic research

questions that need to be addressed if we are to ever be in a position to understand the economic and socio-political importance of this quarry at the time that it was in operation and from the broader historical perspective. We need to know more, for example, about the raw material source in terms of what variability exists in the texture and form of the stone and the effect this may have had on the manufacturing process, including the shape or form of the finished adze. Another research question that needs to be addressed is the relationship of the adze manufacturing sites to other local sites; are some of the non-quarry sites in this area camp sites that were occupied by adze makers on a seasonal basis?

These objectives were slightly revised following the first of two field trips that provided the first real opportunity to evaluate the adequacy of earlier work in an on-site review of the National Register Nomination Forms for all of the known sites in the immediate environs of Pu'u Moiwi. As expected, virtually all of the site forms were found to be inadequate in terms of what we not only wanted to know but needed to know to re-evaluate the significance of the individual sites and the site complex as a whole. The one exception is Hommon's description of site 108 which, though lacking in some respects, was far superior to the other site descriptions. The deficiencies of the existing data base, combined with the deteriorating condition of the sites, reinforced a growing sense of urgency to record as much data as quickly as possible given the uncertainties of how soon the sites could be protected from further erosion and vandalism. The result was a decision to reorganize the fieldwork, to concentrate on what were regarded as the most important sites from a research and interpretive perspective rather than proceeding with the original goal to resurvey and determine the boundaries of all of the known sites. The project was thus reorganized to meet the Commission's planning needs, CRM needs and research needs.

In determining that the National Register Nomination Forms were inadequate and that more information was needed, it became clear that site significance would have to be re-evaluated. The omission of this task in the original project proposal was an oversight. It should have been included because the original significance evaluations were based on limited data and because significance as a concept is dynamic rather than fixed (Tainter and Lucas 1983; Leone and Potter 1992).

As already noted, data recovery, as it is usually defined [the collection of artifacts, midden, etc.], was not part of the original research design. In keeping with the main purpose of this study and because of the red tape involved in obtaining the necessary collecting permits no artifacts were collected. This does not mean that I subscribe to the "no collection strategy" advocated by various public and private agencies (see comments in Butler 1979). I hold to the opposite view for several reasons, among which is that I think it is naive to think that the artifacts will always be there for study in the future (Butler 1979:796; Schaafsma 1989). At the same time I think that in the case of sites such as quarries and workshops we must also consider alternatives to collecting. The recording of attribute data in the field is one alternative.

The primary rationale for this particular kind of data recovery approach, which I first used in 1985 in the context of a data recovery project in the Mauna Kea adze quarry (McCoy 1986), is that it is a quick and efficient method of obtaining useful data for: (1) recognizing general patterns; (2) making informed interpretations, and (3) developing hypotheses for future work. It is necessary to emphasize that this method is *not* a substitute for permanent collections which can be studied over and over from new and different perspectives.

The revised project objectives, in abbreviated form, include: (1) an overview of the quarry complex based on a synthesis of existing survey records and analysis of the artifact data recorded in the field; (2) a re-evaluation of the significance of the quarry complex in terms of scientific values and cultural-social values, and (3) recommendations concerning the mitigation of existing adverse effects, the development of a management plan, and future research. The first objective, already partly satisfied in the summary of previous work, is concluded in the interpretation chapter at the end of the report.

The project as a whole does not conform exactly to any of the established types of cultural resource management studies, in the mix of general and specific objectives, but there are elements in the present project of three common kinds of studies.

> *Overview* This type of study involves the review of all known records available which concern the project area. Included are surveys of relevant literature and manuscripts, reviews of site survey records, and examinations of other existing field data and personal contact with informants. This report should summarize the present state of knowledge, evaluate the documentary base, and, insofar as available evidence permits, should utilize that information to discuss and predict the probable nature and distribution of the resources. Such a study is appropriate to an agency's initial regional or sub-regional planning and provides the sponsor with information appropriate to a general management or initial planning stage. (McGimsey and Davis 1977:47)

> *Archeological Assessment* Basically a document for planning future research, the archeological assessment is an extension of the overview...The results of such assessments are most appropriate to the preliminary planning stages and commonly appear as proposals for subsequent field survey or mitigation research. (McGimsey and Davis 1977:47)

> *Archeological Reconnaissance* This study requires an on-the-ground investigation of the surface cultural manifestations found in a portion of the project area. Such surveys are generally based on sampling designs, and are primarily used as a predictive device for estimating archeological potential. These supply information relating to numbers and types of sites...Study results are most appropriate to the preliminary planning stage... (McGimsey and Davis 1977:47)

Minimal Data Requirements

The project as originally conceived was not a problem-oriented study and the fieldwork thus had no specific data requirements. The requirements were instead all rather general and poorly defined. The definition of what constitutes an adequate data base to achieve the objectives of most archaeological projects is never a simple, straightforward matter. Redman has noted, for example, that:

> ...much of the fieldwork we do is designed to collect a common body of information that characterizes the site. I will refer to this as *baseline* information. Baseline information is the minimal set of information that most archaeologists agree must be retrieved from an excavation or survey. (Redman 1987:257-258)
>
> Realistically, there are two genres of minimal data requirements with which one must be concerned: those that provide adequate baseline information, and those that solve the specific problems one has chosen to investigate. (Redman 1987:259)

New data requirements were added with the decision to collect artifact data and evaluate some of Hommon's earlier hypotheses regarding the typological characteristics of the quarry artifact assemblages. The minimal data requirements required to address the revised objectives include: (1) sufficiently detailed survey data to permit the determination of preliminary site boundaries and (2) a statistically valid sample of artifacts to evaluate some of the existing hypotheses.

Limitations

Though too much is often made of the differences between CRM archaeology and so-called pure research, there is one aspect of the former that does seem to hold true:

> A fourth difference is that structural limitations are generally built into cultural resource management studies. That is, it may be that the research design, because of the sponsor's current planning stage, is restricted to a general assessment rather than an intensive survey which the archaeologist might like to see accomplished. Such limitations occasionally can be

> personally frustrating, however well the practical need for them may be understood. (McGimsey and Davis 1977:26)

The limitations of the present study have indeed been frustrating because there was insufficient time to develop a research design, to conduct background research prior to fieldwork, and to accomplish all of the goals that we set out. We were unable, for example, to record all of the sites at the level desired and in fact abandoned the use of two field forms because of the time required to complete them.

The project objectives were in retrospect too ambitious given the time, personnel and monetary constraints. It was unrealistic to think that we could accomplish so much in so short a time on a limited budget. Another limitation, pertaining especially to the objective of producing an overview of the quarry complex and its place in the prehistory of Kaho'olawe, is the lack of an annotated bibliography. The literature on the archaeology of Kaho'olawe, though not voluminous, is scattered and in some cases difficult to locate.

RESEARCH PROBLEMS

One of the substantive contributions made by the 1976-80 survey is that the survey results were analyzed in the context of local and regional research problems and used to develop a model of Kaho'olawe prehistory (Hommon 1980a, 1980b). The data recovery projects that followed have refined the model by testing some of the various hypotheses that were an integral part of the it.

The 1976-80 survey's investigations of the Pu'u Moiwi adze quarry, though limited, did lead to some tentative conclusions and the formulation of several hypotheses regarding the place of the quarry in the prehistory of the island. Most of the ideas were derived from Hommon's fieldwork at site 108 and his interpretation of basaltic glass dates for sites 108 and 383.

Hommon was struck with how different the quarry adze types were in comparison with those from other sites on the island. This one observation led to the formulation of three working hypotheses on matters relating to stylistic changes in Hawaiian adze types, Hawaiian origins, and the possibility that manufacture was organized as production for trade or exchange. He wrote in the NRNF for site 108:

> Most of the finished adzes and adz fragments that have been recorded on the surface of Kaho'olawe sites have been quadrangular in cross-section, just as are the vast majority of Hawaiian adzes in general. The predominance of unusual forms (for Hawaii) at site 108 remains, therefore, a problem, and a major research topic. Three hypotheses may help to explain the predominance of unusual adz preforms at site 108, though none is satisfactory.
>
> 1) The non-quadrangular adzes may have been earlier forms, produced before the quadrangular form achieved its later overwhelming popularity. This would suggest that site 108 was abandoned before such a shift took place.
>
> 2) The non-quadrangular adz may have been introduced from outside Hawaii. Alternately, the quadrangular adz may have been the introduced form. (The latter statement could be combined with number 1 above.)
>
> 3) The non-quadrangular adzes may have been manufactured for export to Maui or some other island. (Hommon 1979)

Hommon was careful to note that "none of the arguments can be supported with solid evidence and further research is clearly needed." (Hommon 1979).

The hydration rind dates for sites 108 and 383 were seen as providing support for the inland expansion hypothesis that was at the center of Hommon's demographic model of Kaho'olawe prehistory. He wrote, again in the NRNF for site 108, that:

> The basaltic glass dates indicate that the adz quarry was in use during the 15th century. A hypothesis testable through further study of absolute and relative dating data is that the use of the Kaho'olawe adz quarries (all of which are near the center of the island) coincided with the major inland expansion that is evident in the data from inland habitation sites. It is tentatively suggested that the dated basaltic glass samples from 108A represent the early period of adz quarry development on the island, since the early 15th century date range closely approximates the beginning of the general inland expansion. (Hommon 1979)

Elsewhere Hommon is even more specific in relating the quarry to the inland expansion hypothesis and other postulated socio-economic changes. He tentatively concluded that:

> The inland expansion, the development of large-scale agriculture and the origin of an economic exchange system during phase II seems to have been accompanied by the increase in the production of lithic tools, as indicated by the increase in the number of dated quarries and workshops around 1400 (Table 9). (Hommon 1980b:60)

FIELD PROCEDURES

Survey and Mapping Methods

The recording of each site consisted of a narrative description and a photographic record using Ilford black and white film and Fuji color slide film. Poor ground visibility hindered the mapping and site description at some sites. Vegetation was cleared only where absolutely necessary and then only to confirm the existence of cultural material, as at site 384. We did no excavation and only occasionally removed an artifact from an eroding bank to record its attributes. Concentrations of lithic residues were not given new feature designations.

Mapping was done with a Tamura prismatic telescopic alidade, plane table and a Mound City 7.6 meter fiberglass stadia rod. A Berol Filmographic EO plastic lead pencil was used on .005 mil matte acetate. The mapping began by shooting in the outer limits and major topographic or physiographic features [e.g. hummocks and gullies] and then the limits of major artifact concentrations, structural features and selected artifacts. Stake-wire flags, which show in some of the photographs, were used to mark site boundaries and the locations of individual artifacts during the mapping.

Two different methods were used to establish site locations. A military issue Magellan GPS-1000 [a satellite global positioning system] kindly loaned to us by Lt. Vernon Young was used to obtain UTM coordinates. Xerox copies of color aerial photographs made available through the courtesy of Rob Hommon and the Navy were extremely useful in plotting site locations. There are enough distinctive landmarks and contrasts in vegetation patterns to be confident that the site plots are accurate (Fig. 4).

We re-staked sites and in the case of multi-feature sites put in a stake identifying each feature so that they could be easily relocated. We did not mark the boundaries of the two large site complexes, sites 108 and 205, because the boundaries are unclear and in any case problematical [see discussion on page 24] We used 1″ x 2″ x 24″ wooden stakes that were pounded some 6-8″ into the ground for greater visibility. Aluminum brads were used to nail a 3/4″ X 3″ Scots metal tag to the stake with the site and feature designation and date. We are hoping that by nailing the identification tag to the stake there will be fewer problems than has been witnessed with the PHRI, Inc. method of tying the tag to the stake with a thin wire that appears to have frequently corroded and broken--with the result that the tag has become detached and blown or washed away. These are not permanent markers [this should be deferred to a time when many of the basic questions regarding site/feature can be clarified]. We also tied orange engineers tape around the top of each stake to enhance the visibility, though we don't expect it to last very long because of the combined effects of sun and wind. Where the stake makes contact with the ground surface we hammered in a short nail to mark present ground surface, though in a few instances [the erosion control grids] a notch was cut with a knife.

Artifact Sampling Design and Recording Procedures

The artifact recording "sampling design", which was dictated in large part by time and personnel limitations, was quite simple. We concentrated on the more exposed areas of each site because of the better ground visibility and the belief that the artifacts in the open areas were more likely to be taken by artifact collectors. The selection criteria varied from site to site. On sites with larger assemblages we were forced to make more choices; here we tended to pass over irregular-shaped, hard to classify specimens. Though the collecting conditions obviously varied from site to site, I am confident that the samples are representative in terms of such basic matters as the relative frequencies of adze types and blank types and thus the full range of reduction strategies.

Each of the three classes of artifacts that were sampled--adze rejects, cores, and hammerstones--were numbered consecutively 1...N for each site. Measurements were made with dial calipers and rounded off to the nearest millimeter. Weight was omitted from the list of measurements because of the time and difficulty of using a good set of scales in the field. Length, width and thickness measurements give a good, if not better, indication of tool size.

ANALYTICAL-INTERPRETIVE FRAMEWORK

Description and Classification

Description and classification can no longer be regarded as totally objective and purely methodological undertakings. In deciding what is important to record and why it is clear that description and classification are interpretive acts. The purpose of classification, moreover, is not to just organize the data and make them amenable to comparison, but to make comparisons meaningful. What is required then is theory to structure and organize classification. Shanks and Tilley write:

> Now, as all archaeologists know, or should know, there are a multitude of possible competing descriptions of an artifact, an assemblage, or any set of remains encountered in the archaeological record. The choice involved in the description of these remains is related to the theories used to understand them. (Shanks and Tilley 1987:109)

> As regards artefact classification, it has begun to be recognized that classification is not independent of theory ...and there is no such thing as a `best' classification. All classifications are partial and select from observed features of the data set. Attempts to create some kind of `natural' classification, good for all purposes, and dealing with all possible variation within the data set studied is simply unattainable...Classifications are dependent on and derived from theory; they are not in some sense independent formal schemes which may be considered to be more or less convenient or useful. An infinite number of different classificatory systems may be developed for the same data set and there is no automatic obligation for the archaeologist to model, or attempt to model, his or her taxonomic systems on the basis of those utilized by prehistoric artisans. (Shanks and Tilley 1988:83-84)

The necessary theory has not been developed and archaeological classifications are as a consequence largely ad hoc and intuitive. The site and artifact classifications that are employed in this study consist of a mixture of formal and functional categories that are in the main derived from other quarry studies (McCoy 1990, 1991).

Site Terminology and Definitions

The earlier review of the 1976-80 survey revealed some methodological problems in the definitions of such basic terms as site and feature, and in the boundary determinations for sites 108 and 205. Some of these problems, which are discussed in somewhat more depth here, carry over and constitute what is, perhaps, one of the most unfortunate legacies of that work. The definitions and boundaries are, of course, arbitrary and can be changed. My own view is that major changes are warranted but that this should be done in the context of an intensive site survey in the future.

Site and *Feature*. The site and feature designations employed in this study are those that were designated in the 1976-80 survey. Both of these terms have posed problems in subsequent work. For example, in the data recovery work at site 111, feature A (Rosendahl et al 1992) the excavations revealed a firepit which was also described as a feature, thus creating a situation of "features within features". There are several ways around this problem. The PHRI, Inc. crew resorted to calling newly discovered features, such as the firepit, "secondary features" (Rosendahl et al 1992: I-17). The approach I have opted for is to continue to use the 1976-80 survey site and feature designations, but to describe the individual sites in terms of the various activity components that comprise them. While most sites consist of nothing more than lithic residues, there are some that include one or more of the following: (1) lithic scatters, (2) structural remains [e.g. shrines], and (3) modern rock art. This site concept is adopted from my research at the Mauna Kea adze quarry (McCoy 1977) where site was defined as a constellation of functionally integrated activity remains.

Site Complex. The totality of sites so defined constitute a *site complex.*

Quarry and *Workshop.* As already noted in the critique of the 1976-80 survey [see page 22] there is a considerable amount of confusion surrounding these terms, particularly the word quarry, which to many people is synonymous with the word mine where material is excavated and removed from beneath the surface. There are few places in the Hawaiian islands, including the mammoth Mauna Kea adze quarry, where stone was mined or quarried. The most common and easiest method of obtaining raw material is to simply collect it from the surface [loose cobbles and boulders] or to extract it from lava flows or embedded boulders [boulder outcrops]. The places where this has taken place, where there is a raw material source, are quarries. The physically discrete areas within quarries are workshops, but workshops are also commonly found some distance from the quarry proper [the source] which means that the raw material and/or incipient tools have been purposively transported and the work resumed in a new location.

Lithic Scatter. This is a rarely used term in Hawaiian archaeology. I have used it in some of my recent work at the Mauna Kea adze quarry (McCoy 1989, 1991) where I was reluctant to use the more common term workshop for certain small concentrations of lithic residues. At a site interpreted as a ritual compound where there were only a small number of adze rejects and flakes I wrote:

> This term [*workshop*], though rarely defined in the literature, normally implies in the case of reduction technologies such as stone tool manufacture, a coherent structure amongst the various by-products of work [cores, waste flakes, rejected tools, etc.] that constitute this category of archaeological remains. *Lithic scatter* is a more appropriate field designation to use in situations such as this where the relationship between the various by-products and their behavioral meaning is unclear or ambiguous. (McCoy 1989)

Lithic scatter is used in the present report as a blanket term to refer to all concentrations of adze manufacturing by-products, large and small. These may represent either: (1) the *in situ* remains of adze manufacture [workshops], or (2) in several instances what may be special discard locations ["dumps"]. Because most of the workshops have been subjected to some varying degree of erosion and some portion of the remains redeposited, some of the lithic scatters represent a mixture of *in situ* workshop debris and redeposited material from a second workshop. The term lithic scatter thus refers to the present configuration, and without a knowledge of site formation processes cannot be equated with or used as synonymous with workshop. The varying degrees of mixture obviously pose interpretive problems, in addition to affecting research potential evaluations.

Structural remains. This term refers to what is sometimes called the "built environment" and includes in the case of the Pu'u Moiwi adze quarry shrines, *ahu*, platforms and pavements.

Artifact Terminology and Definitions

A brief description of each class and category of artifacts and other relevant terminology is presented below for the purpose of making the site descriptions and preliminary interpretations in the next section of the report more comprehensible. A more detailed analysis of the artifacts that were recorded in the field is presented in the following section.

Assemblage. The word assemblage is used here in two different ways: (1) to refer to the totality of artifacts from a locality [e.g. the site 210 artifact assemblage] and (2) to refer to all of the artifacts of a single kind or class [e.g. the adze manufacturing by-product assemblage].

Manufacturing by-products or debitage. These two terms are used interchangeably to refer to the exhausted cores, flakes and all of the other waste resulting from the manufacturing process.

Core. Crabtree (1972:54, 56) defined a core as a "Nucleus. A mass of material often preformed by the worker to the desired shape to allow the removal of a definite type of flake or blade...Cores can be embryonic--such as a piece of natural, unprepared, raw material with scar or scars, reflecting the detachment of one or more flakes." Some of the naturally occurring cores in the quarry are referred to in this report as *boulder cores.*

Adz/Adze and Chisel. In a classic methods paper by some of the most distinguished names in Oceanic studies adze, axe and chisel were defined as follows:

> An adze is a cutting-implement of stone, shell, or other resistant material, with the cutting-edge running transversely to the long axis of the haft. The motive power is supplied by a swinging blow...The term adze is restricted to the implement without the haft and lashings (Fig. 1). When attached to a haft it is referred to as a hafted adze (Fig. 2). (Buck et al 1930:175)

> An axe is a hafted cutting-implement with the edge running parallel or nearly parallel to the long axis of the haft. The power is supplied by a swinging blow. (Buck et al 1930:179)

> A chisel is a cutting-implement which is hafted with its long axis continuous with the long axis of the haft. The motive power is supplied sometimes by pressure and sometimes by mallet blows. It is not at present possible to draw a definite line between small adzes and large chisels. It seems probable that some implements were used both as adzes and chisels according to the convenience of the owner. (Buck et al 1930:179)

Though these definitions contain some ambiguities [for example, in assuming that the tool was hafted everywhere in the same manner} and could be improved, they have been adopted and used by generations of Polynesian archaeologists. These and the common dictionary definitions which mirror them are not universally applied throughout the Pacific, however. In a recent article titled "The Last Stone Ax Makers" the authors note the conventional method of distinguishing adze and axe, but opt for a definition based on use rather than haft design or method:

> An archaeologist would normally classify these implements as adzes, because in side view their ground edges assume an asymmetric, plano-convex shape rather than the symmetric shape typical of axes. Moreover, they are hafted with the

> working edge at right angles to their handles, whereas ax edges generally lie in the same plane as the handle. But we call them axes because they are used to chop wood and fell trees and because the literature has generally classified such implements according to their use rather than their design. In some other groups, adzes are commonly used not to chop down trees but to shape wood. (Toth et al 1992:88)

The Polynesian literature contradicts their assertion because it consistently refers to adzes classified according to their assumed haft design. The use is variable and in the case of Hawaiian adzes it is clear that they were primarily used to fell trees and shape wood. There are references in the Hawaiian literature to other, perhaps occasional or less regular, uses of stone adzes. The possibility that adzes were used in agriculture was noted by Kamakau (1961:237) who wrote, "With their hands alone, assisted by tools made of hard wood from the mountains and by stone adzes, they tilled large fields..." There is another reference to the use of adzes in digging a well:

> According to Mea Kakau (1902), while Kaiakea was the ruling chief of Molokai (in the time of Kamehameha I), a well was made at Kalaeokala'au; "This well was dug with *pahoa* adzes by the men of Moloka'i until they found water." (Summers 1971:54)

Ko'i pahoa are elsewhere described as "battle-axes" (Pukui and Elbert 1971:276). Lastly, there are Hawaiian legends that adzes were symbols of power (Beckwith 1970:49).

Adze reject. The term *adze reject* is used in place of *blank* and *preform* given the present confusion surrounding these terms (see discussion of this issue in McCoy 1986, 1991; Williams 1989; Weisler 1990). A major assumption of the present study and the quarry research as a whole is that all of the adzes that we find in the quarry, with only a few possible exceptions, were rejects that were intentionally discarded because of breakage or design flaws in the shape of the incipient tool. The primary example of the latter is asymmetry in the transverse and/or longitudinal sections or the length:width:thickness ratio.

Fabricator Fabricator, as I have used the term elsewhere (McCoy 1986, 1991), is a catchall term for a variety of manufacturing tools or implements. These include, in the instance of the Mauna Kea adze quarry, hammerstones, abraders, and implements with signs of use both as a hammerstone and an abrader.

Facility or Appliance. The one known adjunct to adze manufacture was a stone anvil that was used to support the incipient tool during the flake removal process. Items such as this are variously referred to in the archaeological literature as facilities or appliances.

SUMMARY OF WORK

FIELD INVESTIGATIONS

The fieldwork was carried out on two separate occasions. The first fieldtrip, February 21-23, 1992, was a reconnaissance aimed at relocating and assessing the quantity and quality of the existing information for all of the quarry/workshop sites in the Pu'u Moiwi area, and making a preliminary determination of what should be done in the next phase. On this first trip we also had a brief look at several probable camp sites with adze manufacturing by-products, sites 111, 214, and 248, located to the east of Pu'u Moiwi at the head of Kaneloa Gulch. In total we examined 14 sites and spent a good deal of time looking for site 384 which we could not relocate.

The second fieldtrip, March 17-23, 1992, was devoted primarily to mapping and data recovery at sites 108, 208, 210 and 211 that were judged during the first trip to be the most important from a research perspective. Data was recorded on a total of 328 artifacts [277 adze rejects, 54 hammerstones and 7 cores] from the four sites (Table 1). In addition to these four sites we re-surveyed sites 205, 209, and 383, and finally relocated site 384. On the last day of fieldwork we set up a 1-meter square at three sites [108, Feature F; site 209, Feature B and site 383, Feature A] as part of a pilot project to measure the amount of erosion over time. Photographs were taken of each square as a control or datum against which to compare future photographs.

Work was interrupted by rain squalls that stopped work for short periods of time on several days during the second fieldtrip. Jeep access to sites 208, 210 and 211 during the second fieldtrip saved a considerable amount of time, thus allowing us to accomplish more work.

Table 2. Numbers of Recorded Artifacts.

Site No.	Adze Rejects	Hammerstones	Cores	Totals
108	101	10		111
208	73	28		101
210	50	10	3	63
211	53	6	4	63
Totals	277	54	7	328

ARCHIVAL RESEARCH

Most of the archival research was undertaken after completion of the fieldwork. It involved an examination of Navy files and records at the State Historic Preservation Office and in the Department of Anthropology and Photo Archives at the Bishop Museum.

THE SITES

INTRODUCTION

The site descriptions that follow are based on earlier inventory records --the National Register Nomination Forms [NRNF's] prepared during the 1976-80 survey-- and observations made during the present project. The former, which are referenced in the text as Barrera 1978 or 1979 and Hommon 1979, are on file with the Navy and the State Historic Preservation Office. Included here are descriptions of all of the sites in the immediate environs of Pu'u Moiwi that we visited. There are several sites with no evidence of adze manufacture which does not necessarily preclude a relationship to the quarry complex, however.

There are certain predictable discrepancies in the two sets of site survey records. The earlier survey and our own were done under different conditions which is one reason for some discrepancies. Though the vegetative cover is denser now, the erosion of site surfaces has been nevertheless continuous so that we can expect a discrepancy in the maximal surface area calculations for some features and sites. Other discrepancies are not so easily explained, but such factors as differential knowledge, observer bias, and time constraints undoubtedly account for some differences.

Many of the inadequacies with the earlier descriptions also apply to those made during the current project because of time constraints. There is thus a certain degree of unevenness in the amount and types of information presented in the site descriptions that follow. I have attempted to include: (1) a general description of the topographic setting, physiographic features, elevation, and ground visibility; (2) maximal surface area of individual lithic scatters [it is important to note that this figure is not synonymous with workshop surface area because of post-depositional disturbances which have altered the original workshop configuration]; (3) structural remains; (4) midden (5) collections and disposition, and (6) for sites 108G, 208, 210 and 211 the size of the sampled artifact assemblages and some of their general characteristics.

The GPS readings, taken at the site datums, are given in brackets. Several abbreviations are used in the description of site and artifact dimensions: (1) m for meters [e.g., 13 m means 13 meters],(2) mm for millimeters, (3) m^2 for square meters, and (4) cm for centimeters.

SITE 107

This site, located on the northwest flank of Pu'u Moiwi at an elevation of c. 340 meters (Figs. 2-4), was first recorded during the 1976-1980 survey (Hommon 1979). It was described at that time as a complex of three dry-stone masonry wall terraces on a slope cut by a shallow gully. A sketch map shows the gully or wash emptying into a basin or depression that separates Feature A from Features B and C which are contiguous. The surface of Feature B, behind the retaining wall, appears to have been partially paved. No midden was observed and the only artifact seen was described as a flaked cobble of poor quality basalt. The paucity of cultural material and absence of diagnostic habitation site evidence, such as fire pits, led Hommon to consider several alternative functions. He remarked that

> Though these features may be ancient agricultural plots, the relatively good condition of the stone work and the absence of evidence of ancient use suggests that there [sic] may be soil-conservation structures of recent historical origin. It should be noted that these structures are built within 10m horizontal distance and only about 1m below the top of a ridge, where the advantages of flood-water irrigation, such as was practiced on the island by ancient Hawaiian farmers, were minimal. (Hommon 1979)

Hommon (1979) is even more specific in saying that the terraces "may have been constructed for the control of erosion during the ranching period." Though he is careful to note that the information gathered in the field was incomplete and that more background research was needed, there are reasons to question the inferred function and age of this site. First, there is no clear-cut evidence that such erosion control measures were undertaken during the ranching period. Second, the construction of three small terraces on a cinder cone the size of Pu'u Moiwi would hardly be an effective measure.

New evidence, based on observations made by Aki Sinoto on September 10, 1992, suggested to him the possibility that this site is a *ko'a uka*. Sinoto, who obtained a GPS reading of N 20 deg 32' 41"/West 156 deg 36'29", provided the following site description, together with a sketch map (Fig. 7) and photographs (Fig. 8):

It consists of three features; a semi-circular wall, a crude terrace, and a free-standing wall with a retaining wall. Seven upright slabs are firmly placed among the structure walls. No midden or basalt flakes were observed on the surface.

The primary feature is a semi-circular wall. It measures 7.5 meters in overall length with variable wall widths ranging from .30 to .80 meters and between .20 to .35 meters in height with three to four courses of stacked stone. The long axis is oriented 230 degrees magnetic. The central four meters of the wall is relatively straight with roughly 1.7 meters at both ends curving inward. Four upright stones occur in the central straight wall segment and range in height from .40-.65 m. The interior of the structure is grass covered dirt. The ground slopes to the southwest. A possible retaining wall 5 meters long, .35 meters wide, and 1-3 stones high, runs along a due north axis from the northwestern tip of the semi-circular wall. A grass and *kiawe* covered earthen berm occupies the northern side. A crude one stone high curved terrace, c. 4 meters in length is located north of the eastern terminus of the semi-circular wall. Circa 9 meters beyond that bearing 5 deg. is a free-standing wall of stacked stones 7 meters in length, .60 meters high, and 1 meter wide. Three uprights are located on this wall all within its western half. This wall is oriented 288 deg. At its western extremity is a stone retaining wall 4.3 meters long, .65 high, with 3-4 courses of stone. This terrace bears 220 deg. along its long axis. It retains a westerly slope of dirt.

The relationship of this site to the adze quarry is unclear.

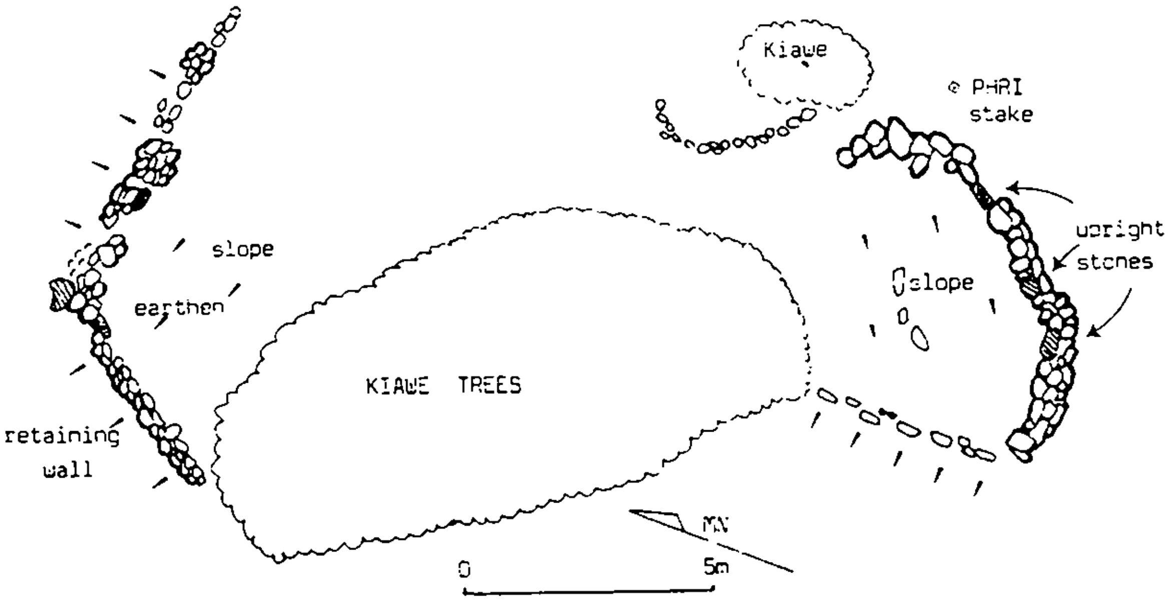

Fig. 7. Sketch map of site 107.

Fig. 8. Upright stones in the central wall at site 107. Photograph by Aki Sinoto.

SITE 108

General Description

Site 108 (Figs. 2-4) is the largest and best known of all the Pu'u Moiwi quarry sites. For many people this site is synonymous with the Pu'u Moiwi adze quarry. The site has become well known to a number of people since the Protect Kaho'olawe Ohana [PKO] appropriated the summit of Pu'u Moiwi as an "important" or "sacred" site and incorporated it into their annual Makahiki festivities. (Atwood Makanani, personal communication; Ivy Nishimura in Hommon 1980b).

As already noted, the first known descriptions and photographs of the site [originally designated site 29] were made in 1931 during a Bishop Museum survey (McAllister 1933; Bryan n.d.). The first sketch map and description of the individual remains that comprise this site were not made until 1976. A series of short term surveys appear to have been made between 1976 and 1979 when the NRNF was prepared (Hommon 1979). The surveys during this time period identified seven spatially discrete adze manufacturing locales on the summit and eastern flank of the cinder cone, designated Features A-G, which were calculated to cover a total area of approximately 4430m^2 (Hommon 1979).

The 1976-79 survey of site 108 was limited to the calculation of approximate surface area and preparation of three sketch maps on August 30, 1976 of: (1) the entire site depicting the locations and rough shape of all seven features; (2) Feature G, showing the locations of a possible shrine, a platform, a hummock with an intact deposit, and the limit of the flake scatter, and (3) the shrine uprights and the locations of five adze rejects ["preforms"]. The author returned with Rob Hommon, Farley Watanabe, and Maury Morgenstein on November 23, 1976 at which time they collected a charcoal sample from an eroding fire pit at Feature A (Fig. 9). Feature G was described and photographed and five adze rejects were collected from the base of an upright on the shrine on this same fieldtrip. The artifacts, which are listed in the State Historic Preservation Office Sample Collection Record, are now housed at the Maui Historical Society.

On February 8, 1979 Richard Gould made a count of all of the surface artifacts in the vicinity of the shrine. In an area measuring 13 m by 5.5 m he noted 166 flakes, 2 cores, 2 complete adze preforms and 9 end-shock adze fragments (Gould n.d.).

Portions of the site have sustained a certain amount of damage in the recent past. The summit of Pu'u Moiwi has been strafed during military training exercises, possibly on more than one occasion, although this is not certain. Some of the rocks that make up the shrine and adjacent outcrops are shattered and bruised.

Other changes to the site have taken place since the PKO began using the summit of Pu'u Moiwi for religious purposes. Atwood Makanani built a religious shrine [see description and illustrations below] and sometime in the late 1970's Richard

DeLeon made two petroglyph carvings on a rock adjacent to the prehistoric shrine that is part of Feature G (Atwood Makanani, personal communication). The construction of the shrine prompted an investigation by the State Historic Preservation Office which resulted in the cordoning off of the main site area on the summit to prevent trampling and to discourage the collecting of artifacts (Ono n.d.,1985).

Fig. 9. Rob Hommon, Maury Morgenstein and Farley Watanabe collecting a radiocarbon sample from the fire pit [at left] at site 108, feature A in 1976. Photograph by Patrick C. McCoy.

Feature A

In the NRNF this undescribed feature is noted as having an approximate area of 1800 m^2 (Hommon 1979). The datum stake [7-49-719E/04-22-73-847N] is 46 meters from the Feature B datum. We relocated the fire pit from which the charcoal sample was collected in 1976 [see above] but virtually nothing remains except for a few charcoal flecks. We also photographed and measured a broken reversed triangular tanged adze reject located in an erosional depression near the fire pit and then buried it at the datum. The fragment, a butt end section, is 245 mm long, 70 mm wide and 90 mm thick. This exceptionally well flaked specimen is an example of what is classified later in this report as techno-morphological type 4 [see pages 123-124] This specimen, which appears to have been ready to grind and polish before it broke, would have been an unusually large adze and is in fact the largest tanged reversed triangular adze I have ever seen in Hawaii.

A previously unrecorded lithic scatter was found to the south of Feature A. Time did not permit a thorough examination to determine the boundaries, and it is possible that there is more than one new scatter in this area.

Feature B

In the NRNF this undescribed feature is noted as having an approximate area of 100 m^2 (Hommon 1979). We relocated the scatter which is located on a low ridge [dike?] adjacent to a hardpan surface and placed the datum [7-49-740E/04-22-73-740N] stake on top of the ridge. The maximum linear dimensions are 10 m north-south by 21 m east-west which makes it somewhat larger than the earlier estimate; This may be due to the erosion that has taken place since 1979.

Feature C

In the NRNF on site 108 this undescribed feature was reported to have an area of approximately 170 m^2 (Hommon 1979). It is located on a ridge [7-49-821E/04-22-73-887N] in line with the southern ridge of Feature D. The source appears to be dikes exposed on the ridge top. The maximum dimensions of this feature are 28 m east-west by 11 m north-south. The largest concentration of material is on the north side of the ridge where there has been more extensive erosion.

Feature D

Feature D [7-49-759E/04-22-73-920N] is located c. 100m due south of the Feature E datum. The scatter, originally reported as covering an area of approximately 760 m^2 (Hommon 1979), is spread over two ridge tops and in planview is horseshoe shape. It has maximal dimensions of c. 26 m north-south by 30 m east-west which are close to the original surface area calculations Erosion is moving material downslope toward Feature C which may eventually result in the mixing of the two features.

Feature E

The NRNF indicates that this undescribed feature has an approximate area of 460 m^2 (Hommon 1979). We identified four physically discrete scatters or workshops on three knolls or ridgetops in a hurried survey. We put the datum [7-50-012E/04-22-73-941N] in the middle knoll and then took compass bearings and taped the distance from the datum to the approximate center of each of the other two knolls. Two concentrations were found on the middle knoll, on the north and south edges. Little cultural material was seen close to the datum. The primary source of raw material at this locality appears to be a dike (Fig. 5). Extensive erosion has taken place between the knolls.

Feature F

The NRNF indicates a surface area of approximately 460 m^2 for this undescribed feature (Hommon 1979). We placed the datum stake [7-49-581E/04-22-73-796N] 7.5m upslope (west-northwest) of the head of one of two gullies that are currently 13 meters apart. The head of the main gully is 5 m wide and 2 m ± deep at present. A comparison of photographs taken from the same location at the base of the gully in 1976 and 1992 shows the amount of erosion that has taken place in the intervening time period (Figs. 10 and 11). The maximum areal extent of the lithic scatter is 32 m ± east-west and 12 m north-south. Cultural material appears restricted to the surface; at least there is no indication of any depth in the gully profiles. Most of the raw material appears to be fairly fine-grained, but there is also some coarse "vesicular" material present. The flake debitage is primarily medium to large size flakes. We noted one bi-conical core and numerous small chisel-like rejects made on lamellar flakes similar to those at Feature G. We also found one *'opihi* shell (*Cellana sp.*) on the knoll and a cowrie shell fragment in one of the gullies.

Fig. 10. Gully erosion at site 108, feature F in 1976. Photograph by ıtrick C. McCoy.

Fig. 11. Gully erosion at site 108, feature F in 1992. Photograph by Patrick C. McCoy.

Feature G

The original survey described Feature G, located at the c. 350 meter elevation, as comprised of adze manufacturing debris, a stone platform and a possible shrine covering an approximate surface area of 730 m^2 (Hommon 1979). We re-described the various remains, made a plane table map and collected data on a sample of artifacts. The datum [7-49-588E/04-22-73-807N] is on the eastern periphery of the lithic scatter (Fig. 12).

Lithic Scatter

The lithic scatter is more eroded and deflated than in 1976 (Figs. 13 ,14 and 15) but the material has not moved too far horizontally because of the topography, which is a shallow bowl-like "depression" created in part by a natural rock rim on the eastern side of the summit. There is very little artifactual material on the slope below the shrine. Intact deposits are limited to a small knoll or hummock (Fig. 12) that currently measures 2.5 m in diameter and c. 50 cm high on the north side. The flake material in the hummock is limited to the top 5-10 cm of the deposit which is one to two layers thick at the maximum.

A second knoll on the east (Fig. 12), eroded down to a gravelly subsurface just above the hardpan, measures 5 m north-south and 8 m east-west. The cultural material, which includes an estimated 200-300 flakes and 5 or more adze rejects, is eroding off the knoll to the south and east.

Structural Remains

Shrine. This feature was described in the NRNF as a possible shrine for reasons that included: (1) the presence of an upright stone; (2) the occurrence of adze rejects interpreted as ritual offerings at the base of the upright; (3) a stone platform with an upright (see below); and (4) the prominent location (Hommon 1979). The remains were redescribed and interpreted by Neller a few years later. He wrote:

> On a prominence of Pu'u Moiwi (hill of the cut bone--an idiom for the broken pieces of rock on the hill) is a small shrine consisting of a terraced platform and a small irregular ahu, or rock platform. The platform is not in good condition, perhaps attesting to its antiquity and lack of recent maintenance, but it seems to contain a small upright stone. Along the terrace wall is a split upright stone, next to which were found a number of adz blanks, presumably placed there as offerings. The site does not contain marine shells, branch coral, or other kinds of archaeological remains, except for the ubiquitous basalt flakes. The ancient Hawaiians worshipped many different kinds of deities, and each profession had its own special *akua* (god). The shrine at site 108 was probably built and maintained by the adz makers. It would be worth investigating the possibility that the basalt quarries at Pu'u Moiwi were the exclusive *kuleana* (responsibility) of the men living at one of the nearby coastal settlements, such as the closest one at Ahupu Bay. (Neller 1982:17)

The front of the shrine, which is situated on the north edge of the "summit plateau" (Fig. 12), is an 8 m ± long, 50-75 cm wide and c. 50 cm high retaining wall. The slope below this wall is battered, varying between 2 m and 3 m in width from the base of the wall to the toe of the slope. The surface of the shrine, between the front retaining wall and the adjacent platform [see below], appears to be roughly paved. Some question exists regarding the number of uprights. Gould's 1979 sketch map shows a total of five uprights, two on either side of the oft photographed split rock upright (Fig. 13). The one unequivocal upright, a split rock, is located in the approximate middle of the retaining wall. The westernmost of the two halves of this stone measures 93 cm by 50 cm by 20 cm and the eastern half 95 cm by 42 cm by 27 cm.

Platform. This feature, which is only partly visible in the 1931 Bryan photograph (Fig. 13), was described in the NRNF thus:

> The platform is oval in plan, measuring about 4 X 3.6 m and is about 0.6 m high. The N and W sides are relatively well-faced, and the remaining sides are rubble. The top of the platform is paved with stones varying from 0.05 to 0.6 m in greatest dimension. One stone near the NW corner stands upright to a height of 0.4 m. Its base measures 0.55 m long. The structure's interior is partly earth, and it may have been constructed by placing a veneer of stones around a natural hummock. Its function is unknown, but it may be part of the possible shrine. (Hommon 1979)

There is little to add to this description except to note that the sides of the platform are battered, and the top, which measures 2 m x 2 m, is rectangular in plan. Prior to the collapse of the side walls the structure probably looked much like a flat-topped, truncated pyramid.

The upright, which measures 40 cm high, 42 cm wide and 21 cm thick, suggests that this is a religious structure of some sort, but its function as well as its relationship to the shrine is unknown; it may be part of the shrine as Hommon suggested or it may be a separate structure built at a different time and for a different purpose. Also unknown is the relationship of this structure to the adze manufacturing activity that took place at this locality. A quick examination of the eroded base of the platform indicates that the foundation rests on a red soil deposit containing adze rejects and flakes. The presence of artifacts in the sediments beneath the platform suggests that the platform is a somewhat later construction and might even post-date the use of this locale for adze manufacture. No artifacts that might be interpreted as offerings made by the adze-makers were observed on top or at the base of the structure.

The Bryan photograph (Fig. 13) is of considerable interest in gauging the landscape change that has taken place on the summit of Pu'u Moiwi in the last 60 plus years and its effect on the integrity of the archaeological sites. In 1931 most of the platform was covered with what appears to be a wind-blown deposit that would account for much, if not all, of the loose sediment that Hommon observed inside the structure. By 1976 the platform was fully exposed and much of the adjacent land surface extensively deflated.

"Maka's Shrine". This is a small oval-shaped rock outline containing a variety of objects, both natural and artifactual, from Hawai'i and other places in the Pacific (Fig. 16). The objects include various sea shells, coral, waterworn rocks, a ring poi pounder made by Maka and a small upright that is a piece of unworked tabular rock from Mauna Kea. There are other objects which are buried. Marking the

shrine location is an upright piece of *kauila* wood that Maka says he might later carve into an image.

Rock Art. Two sets of modern petroglyphs are located on the summit. One set, consisting of a dog and a man made by Richard DeLeon, are located on a rock between the split stone upright and the platform (Fig. 12). The second, which is part of Maka's shrine, is a single petroglyph of a rainbow man (Fig. 16). DeLeon's petroglyphs, which were not as deeply incised, have weathered to the point that they are hardly visible.

Midden

In 1976 I noted the presence of small quantities of *'opihi* (*Cellana sp.*). Small quantities of this, and more rarely other species, are present at other sites in this quarry and other quarries where I have suggested that the shells were offerings to the gods (McCoy 1976 fieldnotes).

Artifact Assemblage

The 1976 survey noted a predominance of reversed triangular and trapezoidal forms and rarity of quadrangular adze rejects at this locality (Hommon 1979; McCoy 1976). The data we recorded on a sample of 101 adze rejects indicates that the early impression was correct This is, moreover, the only locality with tanged adze rejects in the present sample from four sites, but even here they are rare [9.90% of the total]. There is a noticeable preponderance of smaller adzes and paucity of large specimens at this locality.

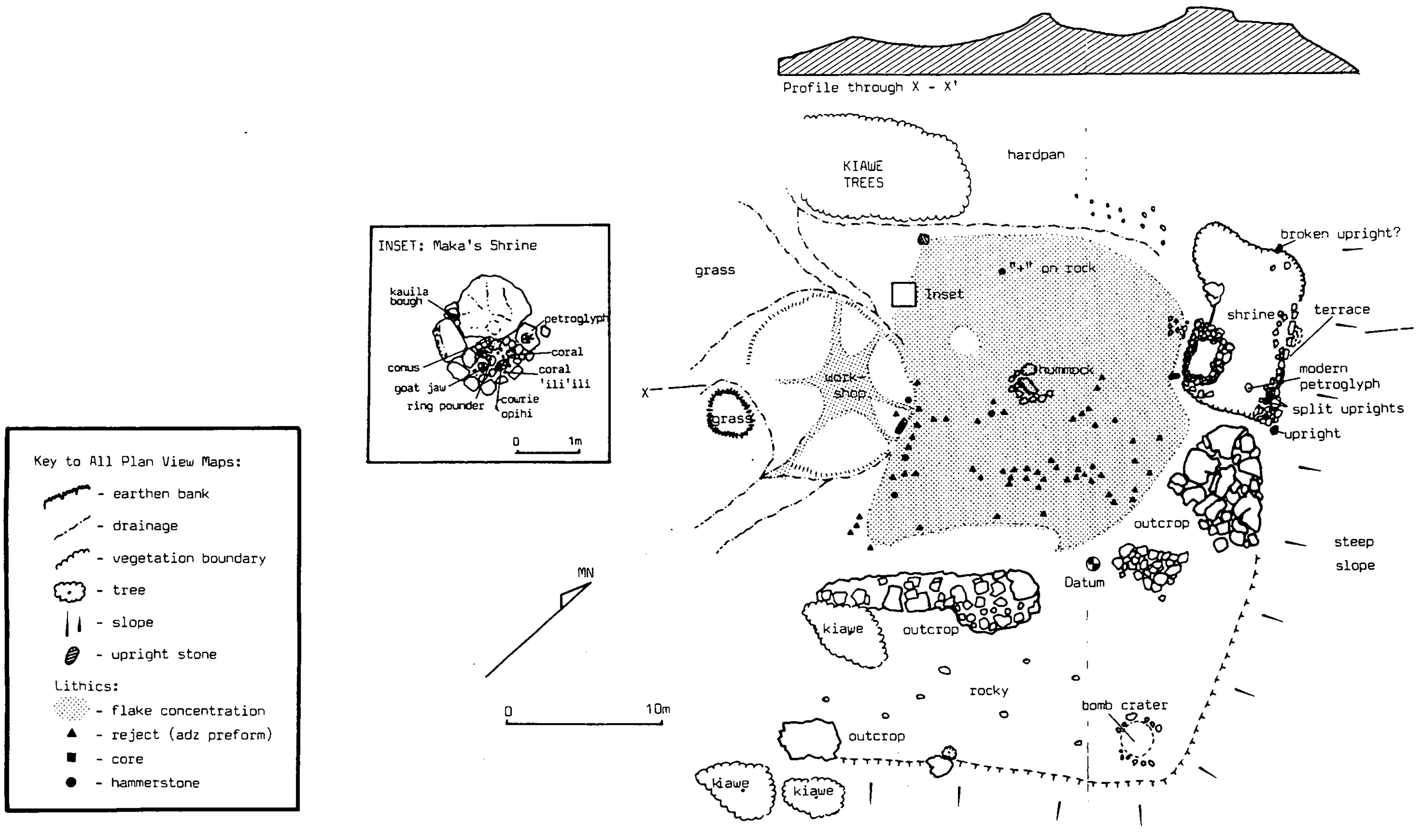

Fig. 12. Plan map of site 108, feature G.

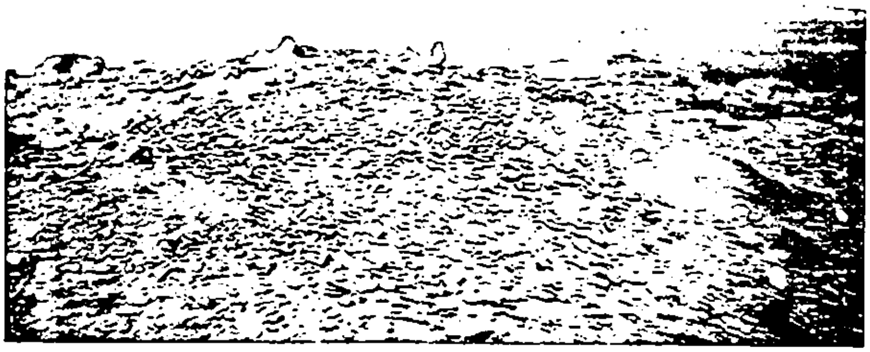

Fig. 13. Site 108 feature G lithic scatter, shrine and platform in 1931. The upright stone on the left is on top of the platform. The split upright associated with the shrine is to the right. Photograph by E. H. Bryan [Bishop Museum negative number CN 16602].

Fig. 14. Site 108, feature G lithic scatter and hummock in 1976. Photograph by Patrick C. McCoy.

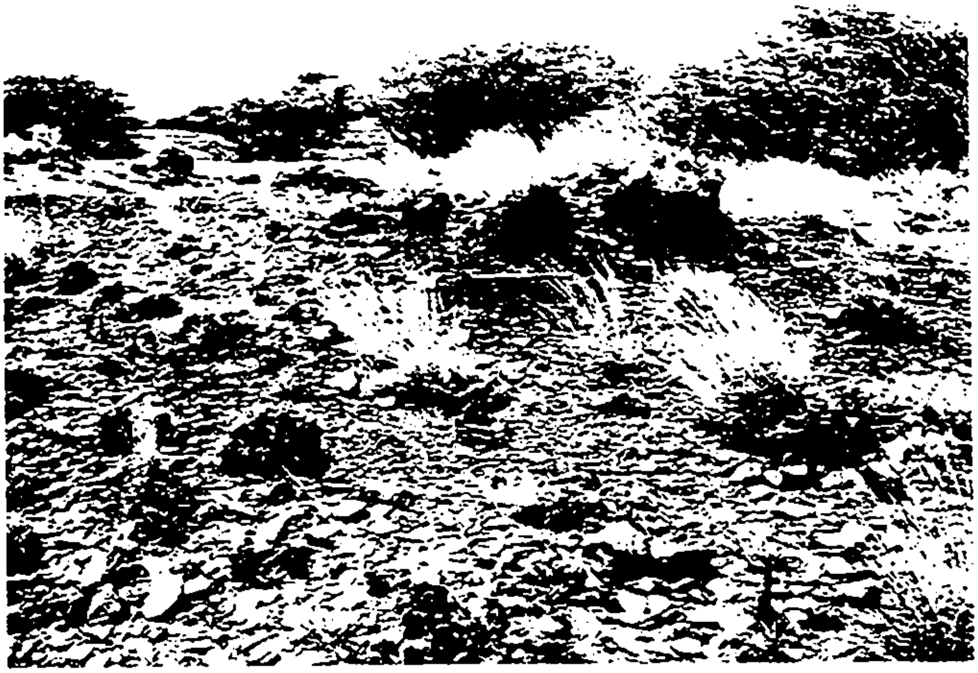

Fig. 15. Site 108 feature G lithic scatter and hummock in 1992.
Photograph by Patrick C. McCoy.

Fig. 16. Maka's shrine. Photograph by Aki Sinoto.

Dating

Eleven hydration-rind dates were obtained in 1976, all from pieces of volcanic glass collected from the surface of the hardpan at Feature A (Hommon 1980b: Table 3 and Appendix B). As already noted, a charcoal sample was later collected from an eroding fireplace at Feature A in 1976. The firepit, inferred to have been roughly 50 cm in diameter, was described as containing a stratified deposit of fire-cracked rock on top and a 2 cm to 7 cm thick charcoal lens below at the bottom of the pit. A soil profile description of the firepit is presented below. Adze manufacturing waste flakes and other angular rock fragments were located in the A3 horizon. The charcoal sample (Beta 7900), which was later processed (see Neller 1981:25, 38 for background behind the effort to date this sample) gave a radiocarbon age-determination of 580± 60 BP [calibrated calendric range AD 1250-1400] (Rosendahl et al 1992, Table 5-1). The age-determination provides an upper limiting date for adze manufacture at this spot. There is no lower limiting date and the age of the cultural material below the hearth is unknown.

Table 3. Soil Profile Description of Firepit at Site 108.

HORIZON	DEPTH [cm]	DESCRIPTION
A1	4-0	Yellowish red (5YR 4/6 dry) fine silty sand; weak, fine granular structure; slightly sticky, slightly plastic; many roots; clear smooth boundary
A2	4-13	Yellowish red (5YR 4/6 dry) fine silty sand; weak fine granular structure; slightly sticky, slightly plastic; many roots; abrupt smooth boundary
A3	13-16	Yellowish red (5 YR 4/6 dry) fine silty sand; weak fine granular structure; slightly sticky, slightly plastic; contains small to medium-sized angular rock above the fire pit; fewer rootlets; abrupt smooth boundary
B2	16-25 +	Dark reddish brown (2.5 YR 3/4 dry) fine silty sand; fine prismatic to columnar structure; sticky and plastic

SITE 204

Site 204, first recorded in 1978, was described as "an activity area covering an area of 25 by 30 meters [0.07 hectare] that includes evidence of food preparation and consumption, and the use of lithic tools" (Barrera 1978). It is located about 1300 meters east of Pu'u Moiwi at an elevation of approximately 340 meters (Figs. 2-4). The activity area interpretation and inference that the remains were probably those of an intermittently occupied campsite were based on the presence of a scatter of basalt flakes and cores, firecracked rock, a few pieces of cowrie shell and some fragments of waterworn rock. All of this material was found resting on a hardpan surface and it was also noted that there were no intact or *in situ* cultural remains (Barrera 1978).

We spent only a short time at this site, on February 22, 1992, just enough time to roughly define the maximum site area, which was done by taking compass bearings and taping the distance from the PHRI stake which is located, not in the center, but at the upslope southern end of the scatter. The scatter, which presently covers an area of roughly 40 m north-south by 20 m east-west, is larger than the area calculated in 1978. Material is eroding downslope to the north toward a prominent gully (Fig. 4). The artifact assemblage is quite small, thus raising questions about the assertions of food preparation, lithic tool use, and tool manufacture. The campsite interpretation is the most plausible nevertheless.

SITE 205

Site 205, located on the flat east of Pu'u Moiwi (Figs. 2-4) at the c. 330-350 meter elevation, was first recorded in 1978 as a constellation of seven dispersed features designated Features A-G (Barrera 1978). It is the second largest site in the Pu'u Moiwi area, but not all of the features are related to adze manufacture and the boundaries, which for some unexplained reason overlap with those of site 108 (see Fig. 2), give a false picture of the site's size which is in actuality much smaller. There are two features with no evidence of adze manufacture. Feature E was described as a firecracked rock scatter and Feature G as a scatter of bottles, metal fragments, pieces of wood and 'opihi shells located adjacent to an historic fence (Barrera 1978).

Despite several attempts we were unable to relocate, or more accurately distinguish, Features A and B. Apart from this futile attempt our fieldwork at this site was limited to putting datum stakes at Features C and F just before our departure on the last day. No GPS readings were taken because of the shortage of time.

SITE 206

This site (Figs. 2-4), an isolated scatter of fire-cracked rock located at the c. 320 meter elevation, was recorded in 1978 (Barrera 1978). There is no evidence of adze manufacture. The site was easily relocated even though it doesn't amount to much. The PHRI stake was found which we used as a datum to take a series of compass bearings and distances to define the outer limits and surface area of the scatter. It has maximal dimensions of 5 m by 7 m.

SITE 208

General Description

The initial recording of site 208, by Barrera in 1978, was limited to a brief description of its size [60 by 120 meters] and general contents [flakes, cores and adze blanks of both quadrangular and triangular form]. Barrera did not prepare a map or describe any individual features, but he did make a collection of carbonized plant remains from a stratified deposit on the bank of a gully. In the NRNF Barrera wrote that

> Stratification was observed along one side of a gully cutting through the site, and this indicates that the cultural materials are situated within the Ahupu Soil Horizon, stratigraphically above the Kaho'olawe Soil Horizon. This association is not certain, however, because of the possibility that these materials may have been re-deposited at a later date than the their initial deposition (Barrera 1978).

The research potential of the stratified deposits is highlighted in the Statement of Significance (Barrera 1978).

In 1979 Dr. Richard A. Gould, then a member of the Department of Anthropology at the University of Hawaii, prepared a very useful sketch map and description of the site which is located at the c. 300 meter elevation (Figs. 2-4). Gould's sketch map shows a site located at the confluence of two erosional gullies, the larger of which is labeled Ahupuiki Gulch. The smaller unnamed gully cuts through the site and divides it into two physically discrete parts here referred to as Area A and Area B (Figs. 17 and 18). A dike exposed in the bed of this gully shows signs of having been flaked, from which Gould concluded that this was an extraction area and primary source of raw material for not only this manufacturing locale but, perhaps, for other nearby sites as well. The dike is too small in my view to account for the large volume of debitage at this site. The major source, which Gould noted together with the dike in the gully bed, appears rather to have been cobble and small boulder size rocks like those littering the surface today.

In assessing the significance of this site Gould noted that it was important for two main reasons: (1) it contains at least two areas with *in situ* buried cultural deposits consisting of one or two layers of horizontally bedded flakes and adze rejects in which charcoal was also noted, thus providing an opportunity for radiocarbon dating, and (2) site 208 was the only known adze manufacturing locale on the island with evidence of both (a) raw material extraction and initial reduction and (b) fine finishing.

The site was noted as seriously threatened by erosion in 1978, but two years passed before a Preliminary Case Report was written by Scott Hamilton, then a planner with the Navy (Rob Hommon, personal communication). The Preliminary Case Report includes 9 photographs of various parts of the site showing the degree of erosion. A comparison of the photos taken in 1978 and 1980 with those we took in 1992 indicates that there has been a serious amount of erosion since the preparation of the Preliminary Case Report. Some of the erosion may be related to bombing. We found an embedded bomb upslope of fractured rock in the immediate vicinity of the mound in Area A (see Fig. 17). Bombing also provides the most likely explanation for the occurrence of isolated flakes and adze rejects across the main gully to the south, well beyond the site boundaries.

Area A

There are two physically discrete lithic scatters that can be safely regarded as workshops in Area A [7-48-901E/04-22-74-025N], which covers an area some 70 m long by 20 m wide. The actual area is, of course, much smaller as shown in Figure 17. The most peculiar and unnatural looking feature in this part of the site is a circular earthen "mound" that is 8 m in diameter at the base and roughly 50-75 cm above ground surface (Fig. 19). On the surface of the mound are small to medium-sized flakes [<100 mm long], adze rejects, hammerstones and unworked blocks of raw material on soil and adjacent hardpan. None of this material appears to be buried. Flakes are scattered up to c. 7 m downslope of the mound. Between the mound and the edge of the vegetation and boulder outcrop on the south is a small erosional channel that empties into the secondary gully (Fig. 17). This part of the site has been extensively eroded; the soil has been removed and the artifactual material dropped down onto the deflated surface.

Some 30 m downslope of the mound is the main scatter and workshop in Area A. The scatter, which has maximal dimensions of c. 30 m by 20 m, is situated on a hummock covered with grass and *kiawe* trees that obscures much of the material. The depth of the cultural deposit on top of the hummock is unknown, but some idea may be gained from two exposures or cut banks on the north and south sides of the hummock. Some caution is required, however, because as

Barrera originally observed, these may be secondary deposits. A general description of the two stratigraphic sections, labeled Profile 1 and Profile 2, follows.

Profile 1. A 5-10 cm thick deposit of well-bedded flakes, located 28-30 cm below ground surface and 75 cm ± above the bed of the gully, is exposed in this section on the north side of the hummock (Fig. 20). The section consists of from top to bottom: (1) a 28-30 cm thick red soil; (2) the 5-10 cm thick flake deposit; (3) a 5-10 cm thick pea gravel directly below the flakes, above and between cobbles; and (4) a red soil to the base of the bedrock base of the gully. The horizontal extent of this buried deposit is presently unknown, but could be easily determined by clearing the vegetation that covers the gully bank.

Profile 2. Two layers of cultural material are exposed in the upper 75 cm of this 2-2.5 m high cut bank on the south side of the hummock. The section consists of from top to bottom: (1) a red soil deposit; (2) a cultural deposit some 10 ± cm below ground surface; (3) a 10 ± cm thick colluvial deposit consisting of pea gravel and cobbles; (4) a 5 ± cm thick cultural deposit and (5) an underlying red soil.

In both sections there are indications of periods of slope stability and unstability in the past.

Area B

The archaeological remains in Area B [7-48-804E/4-22-74-020N] consist of one previously noted lithic scatter and previously undescribed structural remains, both situated on the top of a grass covered knoll or hummock that measures 35 m long and 15 m wide.

Lithic Scatter

The maximal extent of the scatter, first described and mapped by Gould in 1979, is roughly 50 m by 25 m (Fig. 17) Most of the visible material is on the south side of the hummock where it has eroded up to 10 m downslope from a cut bank. Within this larger area is a concentration of smaller flakes (Fig. 17) that is of particular interest because it constitutes one of the few indications in any of the Pu'u Moiwi sites of what might be manufacturing stage specific workshop areas. This concentration of small flakes, which Gould first remarked on [see above], appears to be exemplary of what is often times referred to as a "finishing area".

Also of interest is a buried cultural deposit exposed in the cut bank. This exposure, first mapped and described by Gould in 1979 and labeled Profile 3 in Figure 17, is presently 5 m long and 50 cm high. The cultural deposit, which is located 15-25 cm below ground surface, contains some charcoal flecking and flakes which are only one deep except for two pockets that are 10-15 cm deep.

Structural Remains

On a gentle slope along the eastern edge of the knoll we found a pavement (Fig. 17) that is largely hidden from view by grass and a 5 cm thick deposit of sandy soil. Removal of some of the grass revealed six contiguous *in situ* flat slabs resting on a loosely consolidated soil in an area 1.10 m long by 20-25 cm wide (Fig. 21). The pavement, which is visible over a distance of 4.8 m, appears to cover an area roughly 6.8-7.0 m long and 1-1.5 m wide. The downslope edge is eroded, so it is likely that the width was even greater. Several adze rejects were found on the eroded surface directly below the pavement.

It is difficult to interpret this feature without exposing more of the remains. On present evidence it appears to be a rather simple pavement, but it is possible that the pavement is only part of a more complex structure, such as a low platform or terrace. The location of these remains, on a high point of land physically separated from the main workshop areas, suggests that this pavement is part of a shrine. Some of the Mauna Kea adze quarry shrines, which have similar locational characteristics, are paved (McCoy 1981, 1989). The adze rejects found directly below the pavement may have been offerings to the gods. The stratigraphic position of these remains suggests that they are late in the site sequence. In contrast to the buried flake deposits, which seem to rest at the interface of two soil units, the slabs that comprise the pavement are set on top of and slightly into the upper surface of what appears to be a relatively recent aeolian deposit.

Artifact Assemblage

The artifact sample from this site consists of data on 73 adze rejects, and 28 hammerstones. One notable contrast between the two site areas was noted in the field. Large rectangular cross-section adze rejects, rare in Area A and almost everywhere else in the Pu'u Moiwi quarry complex, were comparatively more common in Area B.

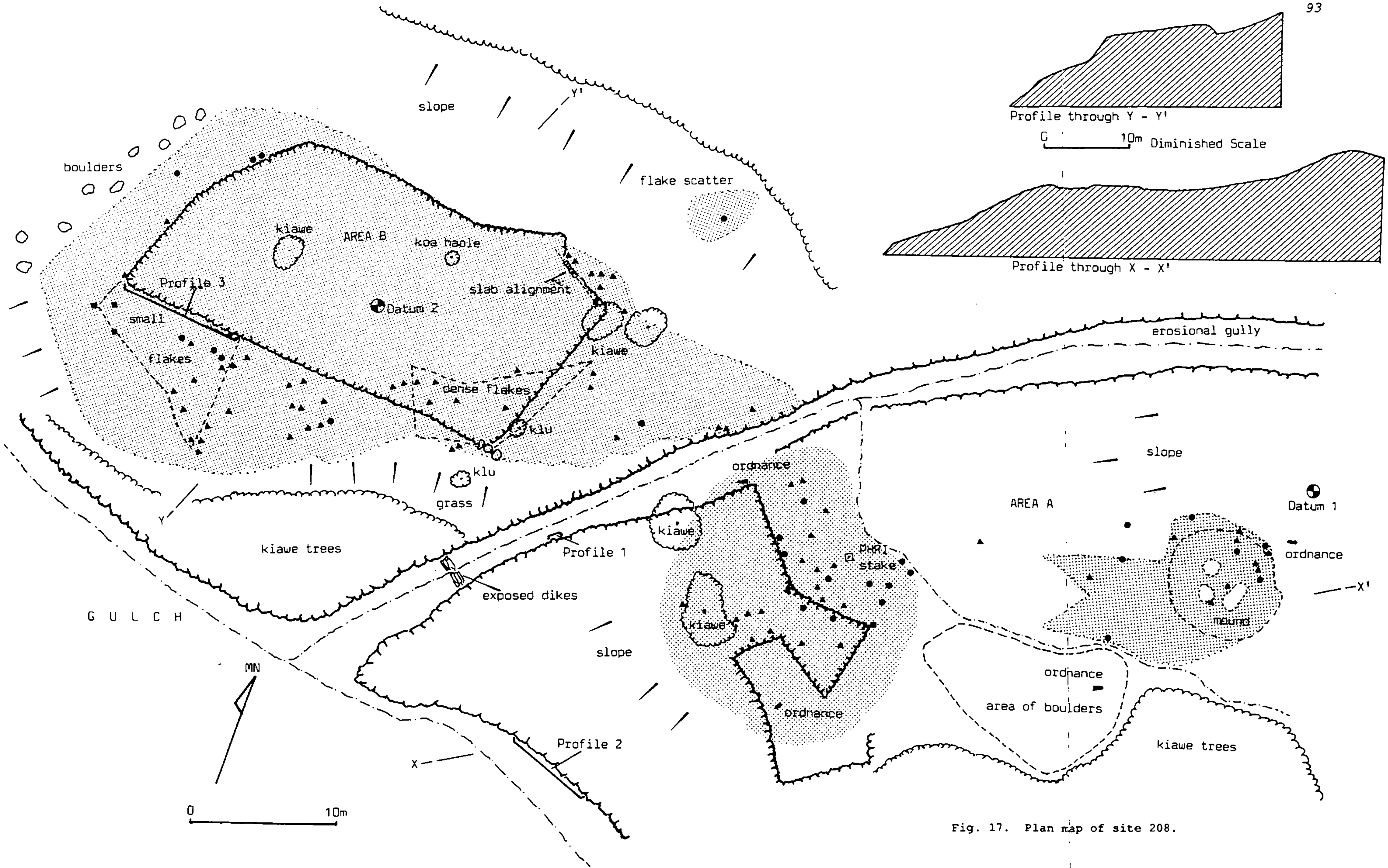

Fig. 17. Plan map of site 208.

Fig. 18. General view of site 208, Area A from Area B. Photograph by Patrick C. McCoy.

Fig. 19. Site 208, Area A "mound" [foreground] and hummock. The flags mark artifact locations. Photograph by Patrick C. McCoy.

Fig. 20. Site 208, Area A buried flake deposit in the wall of the secondary gully that separates Area A and Area B. Photograph by Patrick C. McCoy.

Fig. 21. Site 208, Area B pavement. Photograph by Patrick C. McCoy.

SITE 209

The NRNF for this site, prepared in 1978, describes a site comprised of two features [A and B] encompassing an area of 40 by 175 meters on a denuded surface on the north side of Pu'u Moiwi at approximately the 320 meter elevation (Barrera 1978; Figs. 2-4). Barrera described the two features as follows:

> Feature A
>
> This is a scatter of basalt flakes and cores covering an area of 9 by 12 meters. Seven basaltic glass flakes were collected, a basalt adze blank was found, and a few pieces of unidentified midden shells were noted. In contrast to most of the activity areas recorded thus far on Kaho'olawe Island, no firecracked rock was present.
>
> Feature B
>
> This is an activity area measuring 27 by 40 meters, consisting of a scatter of basalt flakes. Also found on the feature were four basalt adze blanks which exhibited both quadrangular and triangular cross-sections. No firecracked rock or midden shells were found.

The accompanying sketch showing the approximate size and relationship of the two features indicates that Feature A is located some 130 meters to the west of Feature B.

The resurvey of this site, first on February 22 and again on March 23, 1992, disclosed a problem with the NRNF sketch map in terms of the relative positions of the two features or what we think are the two features. The PHRI report (Carlson and Rosendahl 1989) indicates that the site is 30 m in diameter [we did not find their wooden stake], but this measurement doesn't agree with either the original NRNF description or what we observed.

We located a feature [7-49-189E/04-22-74-231N] measuring some 16 m north-south by 13 m east-west on the southern edge of the hardpan, some 20-30 meters north of the *kiawe* forest. On the southern and eastern edges of the scatter are low earthen hummocks with grass and salt bush. This scatter contains an estimated 20-30 flakes but only one butt fragment of a small thin semi-rectangular or trapezoidal adze reject, two cone shell fragments, and a broken fragment of a waterworn elongated beach pebble with an oval cross-section measuring 70 mm long and 35 mm in diameter. This pebble is reminiscent of cooking stones called *pohaku 'eho* that have been previously described for Kaho'olawe (McAllister 1933) and elsewhere (cf. Summers ms. and McCoy 1991:153-159, 177-178). The shell midden suggests this is Barrera's Feature A.

The second feature [7-49-125E/04-22-74-264N] is located 113 meters north of the first on a hardpan surface. It consists of an estimated 150-200 flakes in the small to medium size range [<100 mm maximum length] and several adze rejects scattered over an area that measures roughly 9 m NW-SE by 6 m in the other direction. The adze rejects include a complete untanged rectangular specimen and a reverse trapezoidal bevel fragment. No midden was observed. There is evidence of several direct bomb hits in bomb fragments and a bomb scatter of some 20-30 meters diameter. If this is Feature B then it has obviously been extensively disturbed because it bears little resemblance to what Barrera described.

SITE 210

General Description

When this site [7-48-517E/04-22-74-085N], was first recorded in 1978 it was described as a 25 m by 30 m scatter of flakes and adze blanks clustered around a hummock containing an *in situ* deposit of cultural materials (Barrera 1978). Barrera did not prepare a site map nor did he assign any feature designations. He did suggest that the site could be tentatively dated to the early to middle part of the 15th century based on the hydration-rind dates for site 108.

Site 210 is located on the south side of a deep gully at the c. 260 meter elevation (Figs. 2-4). The results of our survey indicate that the archaeological remains on this site are not restricted to the previously mentioned hummock, but are also found on a rocky eminence north of the hummock, across a small erosional gully (Fig. 22). Our survey also revealed the presence of structural remains and a more diversified artifact assemblage than described in the 1978 site records.

The hummock area of the site has been severely eroded, especially on the south and west sides where most of the artifacts now rest on a hardpan surface. Cultural material is also widespread on the north and east sides of the hummock, extending down to the cliff face on the edge of the gully (Fig. 22). Bomb damage has contributed to the deteriorating condition of this site. We found two filled-in bomb craters or impact craters (Fig. 22) in the main site area which are estimated to be c. 5 years old based on the condition of the burnt *kiawe* tree that was presumably set afire after the impact and the degree of revegetation. Bomb impact provides the best explanation for the curious sparsity of artifacts in the middle of the site. It may also explain the odd occurrence of two halves of a hammerstone/anvil stone some 20 meters apart (see Fig. 22-23).

There is no readily apparent raw material source on the site, but the most probable source(s), boulder outcrops upslope of the site, have been severely eroded. In any case, there is too much cultural material on the site to consider long-distance transport from another source. Small quantities of another raw material, similar to that at site 383 Feature E, were observed, but this too may be local.

Lithic Scatters

The lithic scatter located on the hummock encompasses an area of roughly 400 m^2 and has an estimated maximal depth of 15-20 cm where the cultural deposit is still intact. A smaller scatter downslope and east of the first covers an area of c. 3 m by 5 m.

Structural Remains

Three structural remains, all of which appear on present evidence to be religious features, were found.

The first set of remains consists of three elongated stones located on the south edge of the hummock (Fig. 24). The stones rest on top of the knoll in a loose soil matrix that appears to be an aeolian deposit. Two of the stones abut one another, forming a rough right angle. The largest of the three stones measures 95 cm by 30 cm by 13 cm. On the upper exposed surface are several shallow grooves and several oval-shaped smooth surfaces that appear to have been ground, thus suggesting one possible use as a grinding stone or sharpening stone. The second largest stone, the one that abuts the former, is 80 cm by 30 cm by 15 cm. One edge is slightly buried. Beneath the other edge are several small rocks that may have been foundation stones. The third stone is 63 cm by 19 cm by 11 cm. A series of flake scars along one margin (Fig. 25) suggests that it might have been an aborted attempt to make an adze. On the rounded end, which was probably the top, are several possible short, shallow grooves. The size and shape of these deliberately placed stones suggest that they were uprights on a small shrine. The location on a high point lends support to this conjecture.

The second set of structural remains, located on a separate knoll (Fig. 22), measures 1.27 m north-south, 1.48 m east-west and c. 25 cm [three courses] high. A probable upright measures 52 cm by 18 cm by 4 cm thick. The stone, which tapers to a pointed end, is clearly anthropomorphic, resembling uprights found on shrines throughout East Polynesia, including those in the Mauna Kea adze quarry (McCoy 1981, 1989, in preparation). We took a series of photographs of this stone in an upright position (Fig. 26), after which it was returned to its original position.

The third set of remains is a small, oval to circular shaped cairn *(ahu)* located 10 m north of the second structure (Fig. 22). The base measures 1 m north-south and 1.20 m east-west and consists of stones piled one to two courses high on top and along the edge of a boulder outcrop that projects some 72 cm above ground surface.

Artifact Assemblage

Sample data were collected on 50 adze rejects, 3 cores and 10 fabricators. The fabricators include hammerstones and the previously mentioned broken hammerstone/anvil (Fig. 23) which was found in two parts some 21.5 meters apart (Fig. 22). The hammerstones are of local material and imported beach cobbles. Most tend to be about the same size, though it is difficult to be certain because the bulk of them are broken. The narrow size range is interesting as is the lack of regular or standardized forms. Most are "discoidal"--roughly round and flat.

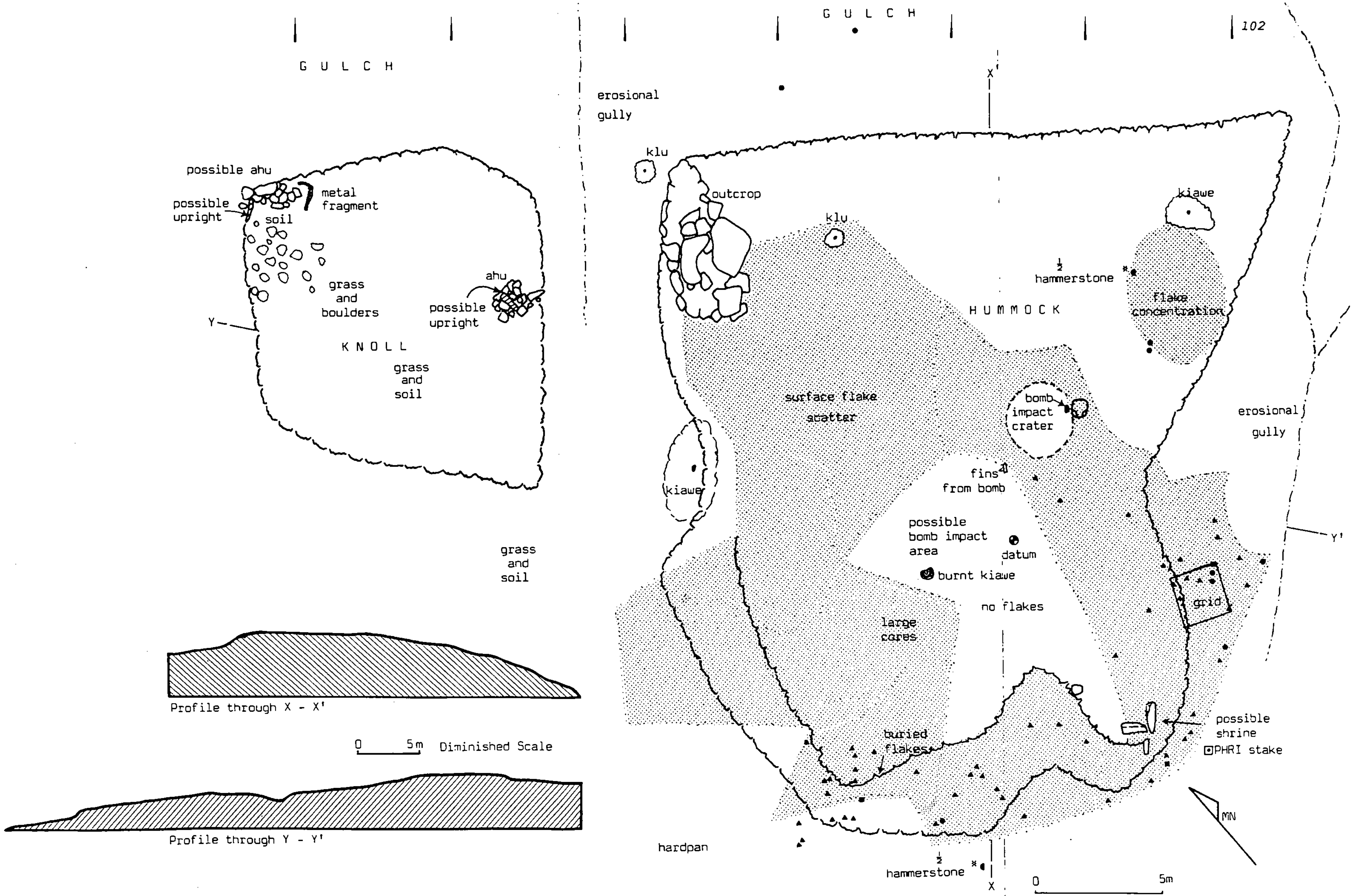

Fig. 22. Plan map of site 210.

Fig. 23. Rowland Reeve holding broken hammerstone/anvil at site 210. Photograph by Patrick C. McCoy.

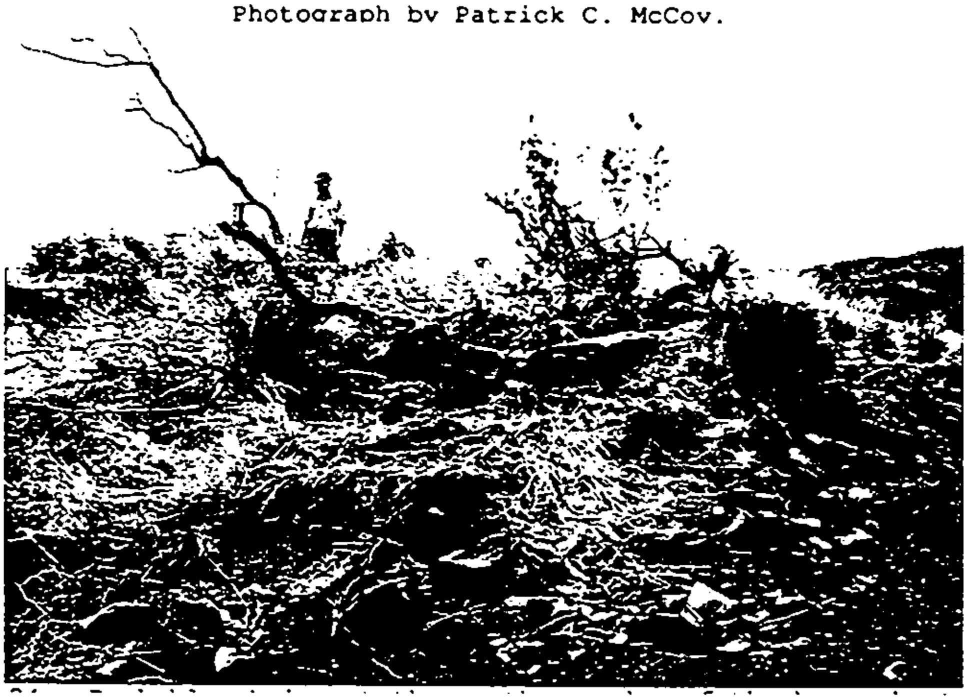

Fig. 24. Probable shrine at the southern edge of the hummock at site 210. Two of the three stones [center] are resting on the surface of the hummock. Photograph by Patrick C. McCoy.

Fig. 25. Close-up of worked stone in its possible original upright position. Photograph by Patrick C. McCoy.

Fig. 26. Site 210 shrine. The fallen, anthropomorphic-shaped upright, in its probable original position, was set up vertically for this photograph. Photograph by Patrick C. McCoy.

SITE 211

General Description

Site 211 [7-48-043E/04-22-74-300N], located at the c. 255 meter elevation (Figs. 2-4), is the most isolated of the major adze manufacturing sites. At the time this site was first recorded in 1978 it was described as a scatter of flakes, cores and adze blanks covering an area 50 m by 55 m on a northerly declining slope on which was exposed a dike that was inferred to have been the primary source of raw material (Barrera 1978). The south end of the site was described as denuded, in contrast to the north side where there existed a moderate vegetative cover of *kiawe* trees and an unidentified grass. As with many other sites he recorded, Barrera did not prepare a sketch map or identify any individual features. The site was inferred to date to the early to middle part of the 15th century based on the hydration-rind dates for site 108.

The 1978 survey records noted that the site had been severely eroded and that the only intact portion was a small knoll. The severity of the on-going, unchecked erosion was ostensibly the reason for a subsequent field check and preparation of an anonymous and undated "Preliminary Case Report" that consisted of a brief site description, reason for the undertaking and consideration of one and presumably the only alternative mitigation measure--"to take no action and monitor the site on an annual basis." The report included 15 photographs [dated 10-12-80] that documented the erosion. There is no indication that the site has been monitored on an annual basis since that time.

More intensive survey revealed the presence of two physically discrete lithic scatters some 25 meters apart. They are sufficiently far apart that I decided to divide the site into two parts, designated Area A and Area B, to facilitate the description of the site. The sloping terrain in Area A, on the south, appears to have become somewhat stabilized in the recent past; at least there is more vegetation [primarily *kiawe*, *koa haole*, and a moderate to thick tussock [red top ?] grass] than what showed in the 1978 and 1980 photographs. Area B in contrast is rapidly eroding.

Area A

The survey of Area A revealed the presence of structural remains, in addition to the previously noted lithic scatter which was found to include several physically discrete concentrations of adze manufacturing by-products. There is a dike outcrop at the mapping station (Fig. 27) that is a possible raw material source although we found no indication that it had actually been worked. A more likely source are the small boulders that may have at one time been part of a dike.

Lithic Scatter

This scatter, which encompasses an area of c. 1000 m^2, is located on a westerly declining grassy slope that is being actively dissected. Artifacts were found up to 50 m downslope of the upper end of the scatter, which is on the edge of a hardpan surface. Several small concentrations of material, some of them undoubtedly secondary erosional "features", were found within the boundaries of the larger scatter. The major concentration is located due south of a possible shrine [see below] on the hardpan surface and is comprised of adze rejects, hammerstones, cores, and predominantly small to medium-sized flakes that are primarily non-cortical. We also found a large flake that we were able to conjoin to a core. The artifacts that comprise this concentration appear to have been deliberately placed, thus suggesting a small-scale example of the small heaps of adze rejects found in the Mauna Kea adze quarry.

A second artifact concentration is located on the surface and in the wall of a narrow, shallow [1 m wide and less than 50 cm deep] gully on the south edge of the site (Fig. 27). The buried cultural deposit that is eroding out of the gully wall is probably a secondary erosional deposit from upslope. The artifactual material, which is buried to a depth of at least 15 cm, consists of primarily non--cortical and non-patinated flakes, including one nice long margin removal flake, and several adze rejects.

The third concentration that was observed is located along the lower margin of the larger scatter (Fig. 27) on a grassy slope with fair ground visibility. There may be some buried material here. The flakes here are somewhat larger than in other two concentrations. Shattered boulders in this part of the site are evidence of bomb damage.

Structural Remains

There is a possible shrine on the highest point, a small knoll that was chosen as a mapping station (Figs. 27 and 28). The "shrine" is an oval-shaped concentration of rock measuring 3 m by 2.5 m that projects roughly 30 cm above the surrounding ground surface. The northern end is stacked, two courses high. The downslope edge consists of stones laid into the slope. Two elongated stones [50 cm by 15 cm by 15 cm, and 40 cm by 12 cm by 6 cm] appear to be fallen uprights.

Area B

The second major scatter, on the northern end of the site, is located on a severely eroded slope on the east side of a ravine (Figs. 27 and 29). This scatter, which covers an area of roughly 6 m x 7 m, is comprised of cores, adze rejects and flakes. Most of the adze rejects are concentrated at the lower, downslope edge of the knoll. The adz rejects, which include several thick quadrangular specimens, are on the whole larger than those in the Area A. Adzes made on core blanks seem more prevalent here than in Area A, probably because naturally occurring slabs of tabular rock are more common in this area. There is a high proportion of adze rejects relative to the volume of flake debitage which is estimated at 1500-2000 flakes. The flake size range is quite variable, thus suggesting a full or complete manufacturing sequence. Small flakes are much more noticeable here because of the better ground visibility in the absence of a vegetative cover.

Artifact Assemblage

Attribute data was recorded on a sample of 53 adze rejects, 6 hammerstones and 4 cores. The sample derives primarily from the eroded areas because of the better ground visibility.

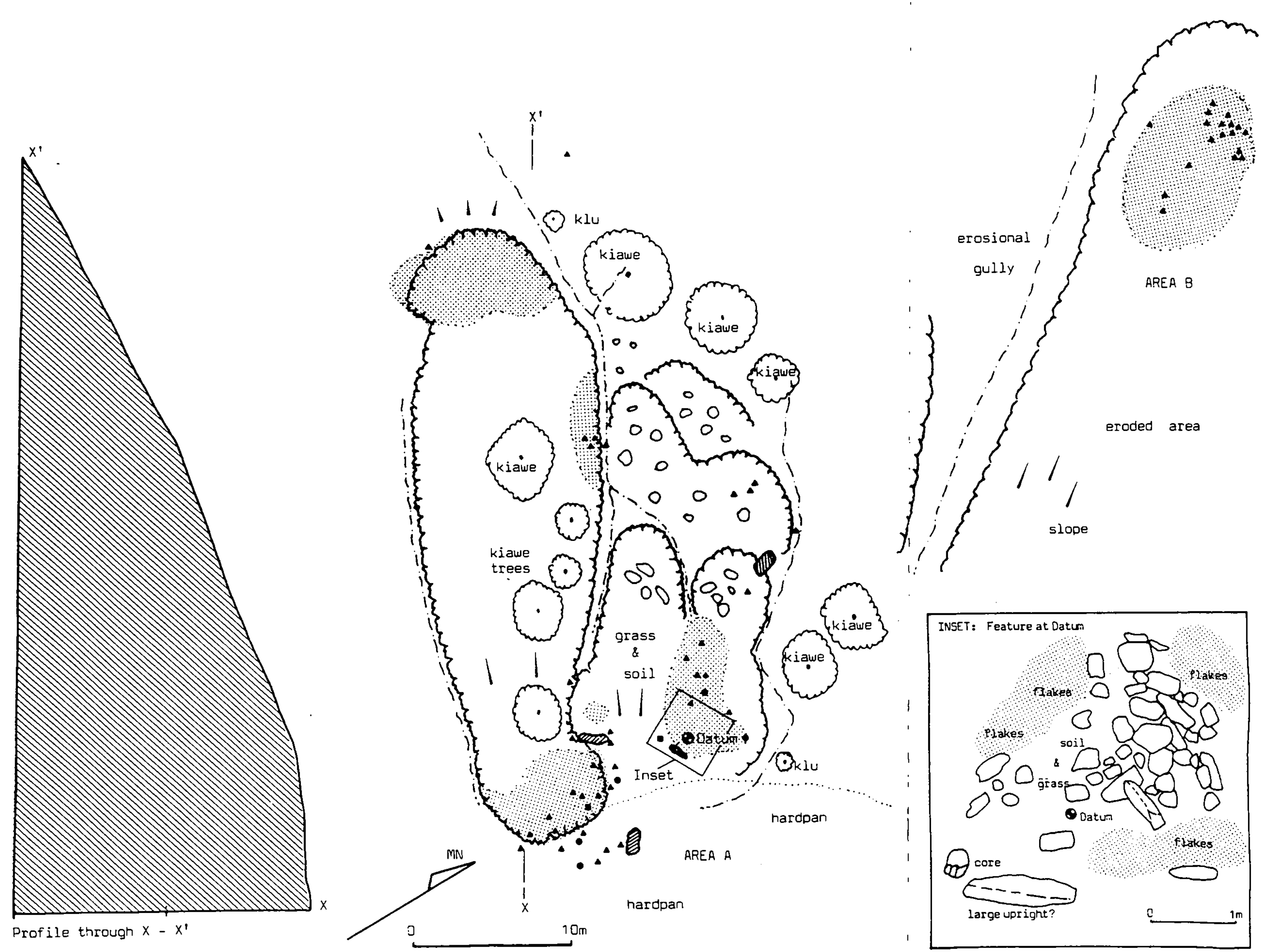

Fig. 27--Plan map of site 211.

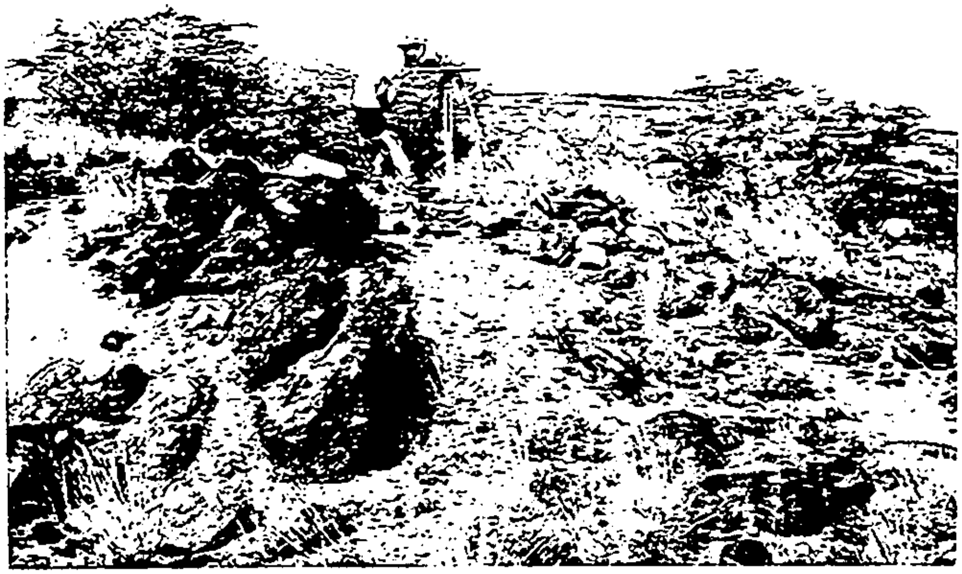

Fig. 28. General view of the upper end of site 211, Area A. The probable shrine is located just to the right of Aki who is mapping the site. Photograph by Patrick C. McCoy.

Fig. 29. Rowland Reeve and Maka recording adze reject attributes at site 211, Area B. Photograph by Patrick C. McCoy.

SITE 250

We spent a considerable amount of time relocating the several previously described features of this site, which was recorded by Barrera in 1978. The site, located at the c. 330 meter elevation, is farther east than the location shown on the photomap (Fig. 2). Feature A is located due north of the datum at site 204. A PHRI stake was found at Feature A which we used as a datum to plot the maximum areal extent of the scatter using the same method as at site 204. The identity of Features B and C is somewhat suspect. The distance from Feature A to Feature C is 150m and the compass bearing from C to A is 280 degrees. On this same bearing at a distance of 184 meters from the Feature A datum is a possible hammerstone. Feature C (?) measures roughly 4 m x 7 m and consists of nothing more than 4 to 5 flakes. At a bearing of 206 degrees and 30 m from the Feature A datum is a possibly new feature of 5 to 10 flakes and a few pieces of fire-cracked rock located 17 m north of the gully wall that separates sites 204 and 250 (Fig. 4). Feature B could not be confirmed, possibly owing to severe erosion since it was first recorded, or the location relative to Features A and C is incorrect on the NRNF sketch map.

SITE 383

General Description

Site 383 is located on the southwestern flank of Pu'u Moiwi at an elevation of c. 300 meters (Figs. 2-4). It was first recorded in 1979 at which time five features, encompassing an area of 50 m by 110 m, were briefly described and mapped (Barrera 1979). Ten basaltic glass hydration-rind dates, all in the 15th to early 16th centuries, were obtained for Feature A at this time (Barrera 1979; Hommon 1980b: Appendix B; Table 2).

We re-surveyed the site twice, on February 22, 1992 and March 23, 1992, and both times were able to locate only Features A, D and E. Part of the difficulty is that the 1979 survey records do not contain photographs with landmark features that would have aided in the relocation effort. The major problem, however, is poor ground visibility; high grass covers most of the site area except for the eroded surface at Features A and D and bedrock exposure at Feature E.

Feature A

Feature A [7-49-102E/04-22-73-906N] measures roughly 10 m, from the bank to the toe of the "hummock" and 7 m wide. There are two lobes of debitage at the toe of the hummock, the longer of which is now located on the surface of Feature D. That lobe is 4.6 m long and 80-90 cm wide at the maximum. The erosion measuring "control square" is located at the end of this lobe (Fig. 30). The surface is eroded down to bedrock at the base of the hummock or bank. A well-made awl or drill made on a lamellar flake was found on top of the hummock or knoll. The dorsal surface was unifacially flaked at the distal end of the flake. The tool, measures 95 mm long and 40 mm wide at the maximum. There were no obvious signs of use-wear on the tip, which does not preclude the possibility that awls and drills were both made and used in the quarry.

Feature D

Features A and D, shown as contiguous features in the 1979 sketch map of the site, appear to be mixed. Feature D is from all appearances a secondary feature. It measures 10.3 m downslope and 12 m wide, which corresponds to the breadth of the erosional gully. At the present time there is a total of four lobes of cultural material comprised of predominantly small to medium-sized flakes, at the upslope end of Feature D.

Feature E

Feature E [7-48-982E/04-22-73-929N] is located approximately 80m downslope of Feature A and 5-6 m below a denuded area and dike exposure that is inferred to have been the raw material source. The lithic scatter, which encompasses an area of c. 9 m x 9 m, consists of split cobbles in the 10-15 cm size range, cores and small to medium-size flakes of a distinctive coarse-grain basalt with white phenocrysts and some dark minerals. The raw material was clearly the broken up surface of a dike or lava flow located just upslope of the scatter.

Fig. 30. Site 383 features A And D. Aki And Maka are setting up an erosion measuring control square at the toe of one of the lobes of cultural material. Photograph by Patrick C. McCoy.

SITE 384

This isolated site (Figs. 2-4) was first described in 1979 as a basalt adze quarry and workshop covering an area of 10m by 21m located on a low-ridge top adjacent to a shallow gully at about the 325 meter elevation (Barrera 1979). The NRNF, which includes two photographs taken by Dr. Richard Gould on February 11, 1979; is more detailed than many of the other site forms. I think it is fairly safe to assume that Gould made many of the observations that were included in the narrative description:.

> The site consists of a moderately heavy scatter of basalt flakes, cores and adze blanks located in the vicinity of a basalt boulder outcrop. Many of the boulders evidence numerous signs of intentional flaking for the purpose of removing material for artifact manufacture. A notably heavy concentration of quite small [less than five centimeters in maximal dimension] flakes was observed eroding from a one-meter high mound, suggesting that this may have been the locus of final adze manufacturing activities.(Barrera 1979)

We had a great deal of difficulty in relocating this site and in fact made three attempts before we found it. We were not the first to experience the same frustration (Rob Hommon, personal communication). Neller wrote:

> Site No. 384. We spent two hours looking for this site, but couldn't find it. Subsequently, it was discovered that the location shown on the island map does not match the UTM coordinates given on the site form. Nor does it match the coordinates listed in the HMR memo of 25 September 1979, sent as a correction. Nor do the corrected coordinates match HMR's narrative description of 260 meters southeast of target alpha eleven. (Neller 1981:60)

Part of the difficulty is due to poor ground visibility. The 1979 photographs indicate that there was much less vegetation then.

The site [7-48-481E/04-22-73-425N] is located on the west side of a gully near the downslope terminus of a dendritic drainage pattern (Fig. 4) at about the 270 meter elevation [considerably lower than the elevation report in the NRNF]. Poor ground visibility hampered our efforts to add anything new to the description of this site. We found it impossible to determine the extent and obtain a better idea of the contents of the site without clearing the vegetation. We did not notice any of the flaked boulders or the one-meter high mound that was described in 1979, but we did notice a medium-sized reversed triangular adze reject and medium sized flakes. While questions remain about the presence/absence of a local source, there is in my view too much cultural material here to be a secondary workshop or discard area.

THE ARTIFACT ASSEMBLAGES

INTRODUCTION

The analysis of the artifact assemblages, already begun in the context of the site descriptions with a brief description of assemblage size and composition, continues here with a more detailed analysis of the field data. First, the major objectives of the artifact analysis are briefly outlined. This is followed by a discussion of analytical concepts, approaches and methods. Next comes a definition of each of the attributes selected for study and a brief interpretation based on summary statistics of single attributes and the relationship between several attribute pairs. The emphasis here is on the identification of meaningful patterns and inter-assemblage variability. This is a preliminary analysis and in no way exhausts the research potential of this set of data.

OBJECTIVES

The artifact analysis as first conceived had several specific and immediate objectives. The first was to examine the typological characteristics of the adze reject assemblages for the purpose of testing Hommon's earlier production for trade hypothesis. The second objective was to provide a good general characterization of the assemblages in terms of technological, functional and stylistic properties for the purpose of achieving an understanding of the manufacturing technology in terms of the skills, knowledge, and procedures that are the defining characteristics of all technologies (Merrill 1968:576).

ANALYTICAL CONCEPTS, APPROACHES AND METHODS

Technological Analysis and the Stage Concept

Technological analysis, which is primarily concerned with how artifacts are made, is fundamentally a behavioral study, founded on the assumption that an artisan's behavior is recorded on tools and manufacturing debris (Sheets 1975). The objectives and assumptions on which this kind of analysis rest are described by Sheets:

> A technological analysis attempts, among other things, to determine the procedures used to manufacture implements through the examination of both the implements and the manufacturing debitage. Lithic analysis of manufacturing procedures is based on two assumptions. First, manufacturing behavior is recorded on the implements and on the wastage of the lithic industry. Second, we as archaeologists can train ourselves to read that record-to recognize the procedures used in the past which resulted in the various morphological attributes in the collections. Our objective is to translate, with as high a degree of accuracy as possible, the attributes observed into past actions, and then to place those actions in a hierarchy of procedures and products which represents the original organization of that industry. (Sheets 1975:371-372)
>
> Because technological analysis is interpretive, and not purely descriptive, it must be based on a foundation of theory. As Phagan (1973:2) comments, the basis of a technological analysis is the "establishment of a theoretical framework or system within which various traits of flakes or implements can be seen to have technological significance." (Sheets 1975:372)

The focus of technological analysis is the lithic reduction strategy which has been operationally defined by Muto (1971) and others (e.g. Sheets 1975; Bradley 1975) as a continuum or sequence of manufacturing stages.

Adze Manufacturing Reduction Strategies and Sequences

There are, in the very simplest of terms, two adze manufacturing reduction strategies and sequences: (1) a core reduction sequence and (2) a flake reduction sequence which I have earlier referred to as a *core series* and a *flake series* to reflect what is in my opinion significant techno-morphological variability within the two "ideal types"(McCoy 1986:12). There is, for example, a significant difference in tabular and non-tabular core shapes and in lamellar flakes and side-struck flake blanks, so that there would be a lamellar flake blank reduction sequence and associated production code or grammar differing in some respects with adzes made on other flake types in the sense that the two produce different kinds of debitage assemblages.

The core and flake reduction sequence contrast is a useful analytical construct because it exists independent of "type" or "style", in addition to the fact that it helps to clarify the present confusion surrounding the widely used blank-preform stage terminology [see also Dye et al 1985] if we follow the lead of Crabtree (1972) and others (Shafer 1985) in using the term *blank* to refer to what is in fact raw material form [a boulder core or cobble vs. a flake] so that we have only *adze preforms* rather than a continuum comprised of adze blanks and adze preforms --a distinction that was both simplifying and obfuscating with respect to the "type" concept.

Attributes and Types

The present study is based on the analysis of attributes deemed to have technological, functional and stylistic significance. I hold to the common view that technology, function, and style are all integrally related. As Isaac noted in regard to the shape of a stone tool:

> On logical grounds it would appear that the morphology of a stone tool is governed by the interaction of (1) the *physical properties* of the stone being employed, and (2) the *'intentions'* (design concepts) and the *motor habits* of the craftsman. The design concepts themselves are presumably related in turn to two kinds of determining influences: firstly, the *functional requirements* of the tool will place limits on the range of forms that would be effective; secondly, systems of *transmission of traditions* provide a craftsman with a set of technical and morphological patterns that are functionally adequate and socially acceptable. (Isaac 1972:176)

Recording Methods and Data Presentation

Measurements were made with dial calipers and rounded off to the nearest millimeter and weights to whole grams. Data are presented in terms of both raw counts and percentages.

ADZE REJECTS

The first systematic attempt to conduct an attribute analysis of Hawaiian adze quarry tool rejects and debitage was based on an attribute list compiled by the author and Paul Cleghorn in 1975-76 (McCoy 1981; Cleghorn 1982:113). Subsequent studies have resulted in a number of modifications to the original study, including a re-evaluation of the attribute selection criteria and rationale (McCoy 1986;

Williams 1989). The revision process is unfinished for two related reasons. First, typologies are "mutable and always to some extent experimental" (Adams and Adams 1991:61). Second, because typologies are imposed constructs "they must be held open to continuous revision as new material accumulates" (Wylie 1992:487).

A total of nine attributes--six non-metrical and three metrical-- were recorded in this study. The attribute selection criteria and rationale are briefly set forth below for each attribute. The data are summarized in Tables 3-6.

Attribute Definitions and Statistics

(1) *Techno-Morphological Type*. This attribute was previously referred to as *Stage* in earlier analyses [see discussion in McCoy 1991:90]. The defining characteristics of the four types recognized are as follows:

Type 1 Front/back and sides not yet distinguishable. The longitudinal and transverse sections are by definition irregular.

Type 2 The front/back can be distinguished from the sides but the front cannot yet be distinguished from the back. Both profiles are more regular than the previous stage.

Type 3 The front and back and sides are all clearly distinguishable from one another. The profiles are more regular but the cross section does not yet fit an ideal geometric form and there is always some identifiable flaw or imperfection in the shape to explain why the incipient tool was left unfinished to enter the archaeological record as a tool reject.

Type 4 The front and back and sides are all clearly distinguishable from one another. The cross section fits an ideal geometric form and there is no obvious reason why the incipient tool would not have been ground and polished and then used. Such specimens are understandably rare in most quarry/workshop contexts.

Type 4 adzes are the objects that, saving breakage in the final finishing process, loss, or deliberate secreting away in caches as unfinished implements (see Weisler 1988), ultimately enter the archaeological record in a number of different contexts other that quarries and workshops where they are understandably rare or absent. The first three types by contrast are common in quarry/workshop sites.

There are no type 4 examples at any of the sites which is not surprising in the absence of evidence for the finishing of tools at any of these sites and for the reasons given above. What is rather astonishing is the high per cent total of Type 3 specimens-- 250 of the 277, or 90.25% of the total for all four assemblages. The range varies between 77.36% at site 211 to 96.04% at site 108. The difference between the two sites appears primarily related to blank type frequencies--at site 211 there is a greater number of cores and at site 108 there are more flake blanks and only a few cores.

(2) *Condition*. Specimens from archaeological sites are obviously found in either a whole or broken condition. In quarry sites there is a predominance of either broken and/or rejected tools. One of the primary reasons that tools are rejected in the manufacturing process is breakage due to such

factors as flaws in the material and human error in the calculation of the flaking angle and insufficient skill to solve technological problems.

Adze fragments include three diagnostic parts --butt end, mid-section, and bevel end (Fig. 31). The recording of section frequencies was done in facilitate the calculation of minimum numbers of incipient tools and to examine the relationship between part frequency and manufacturing stage as a means of testing the hypothesis that there is a higher incidence of breakage later in the manufacturing sequence. The use of part frequencies is similar to the method used by Foss Leach to calculate minimum numbers based on avian limb bone fragments (Leach 1979: Fig. 8.1). There is, of course, nothing inherent in the relative numbers or frequencies of whole and broken specimens. Breakage, for example, occurs during manufacture, but except for very small thin adzes few whole adzes would be expected to have been broken after they were discarded.

The per cent total of whole specimens is 52.71% for all four sites, but ranges from only 34.65% at site 108 to a high of 68% at site 210 (Table 4). The low figure at site 108 may reflect the fact that this frequently visited site has been more heavily collected and that the natural preference for complete artifacts has resulted in a skewed sample compared to less accessible sites like 210.

Butt end and bevel end fragments occur in nearly equal numbers in each assemblage and average 20.58% and 22.38%

respectively for all four assemblages (Table 4). Mid-section fragments are, perhaps, not unexpectedly rare.

(3) *Blank Type.* In the present study the term blank is used to refer to cores and flakes that exhibit more than a few flake scars. Adzes in the quarry were made on small boulders [*core blanks*] and flakes detached from boulder cores [*flake blanks*] where the ventral surface of the flake was almost invariably utilized as the face or front of the adze.

There is a need to go beyond determining the number of core blanks and flake blanks to considering the variability within each of these two classes. Blank type is particularly relevant to questions regarding reduction strategies, raw material procurement, and the influence of blank type on tool type and the resultant debitage. The present sample, though small, includes: (1) parallel-sided or lamellar flakes, which tend to have extremely flat ventral surfaces, and (2) "side-struck" flakes where the striking platform is on the side or lateral margin of the incipient adze as opposed to butt end of adzes made on the former. In Table 5 the first category is referred to as "Flake Type 1 and the second as "Flake Type 2." In some cases it is clear that the blank is a flake but because the reject is fragmentary there is uncertainty to the type of flake; these are referred to as "Flake Type Indeterminant."

A total of 239 specimens or 86.28% of the total were confidently classified as either core blanks or flake blanks (Table 4). In this sample of 239 adzes a mere 53 were made on cores. This is in sharp contrast to flake blanks which collectively [type 1, 2 and indeterminant] add up to 67.14% of the total. What these figures indicate is that, though both the boulder core and flake blank reduction strategies were both utilized, the manufacture of an adze from a boulder was relatively uncommon and hardly practiced at all at the workshop on top of Pu'u Moiwi where only three of the 101 adzes in the site 108 assemblage were made on boulder cores. While the site 108 sample may have been biased for reasons noted above, the more likely explanation for the rarity of this naturally heavier blank type, is that all of the material at this workshop was imported; there is no evidence of a raw material source at this locality. Flake type 1 or lamellar flakes are clearly the most common flake blanks everywhere except for site 210 where type 2 flake blanks are found in nearly equal numbers.

A plausible explanation for the large number of flake blank rejects, both whole and broken, is the low mass of the predominantly Type 1 [lamellar] flakes. The low mass of narrow, thin flakes means that there is relatively little room for error to make and correct a problem that causes the length:width:thickness ratio to deviate from the "norm."

A more general explanation has been given for the predominance of the flake blank reduction strategy. Helen Leach has argued that such a strategy is more efficient.

> Making an adze from a flake is a far more economical operation than reducing a large parent block down to the desired size. In the first case the waste consists of the outer decortication flakes and the small trimming

> flakes, plus any misshapen flakes unsuitable as adze blanks. In the second case everything is discarded except for the preform...The Riverton artisans seem to have blended both approaches for maximum economy, an indication perhaps of the scarcity of good-quality material. They appear to have visualized large triangular and quadrangular adzes within the best parent blocks and to have reduced these with bold strokes that detached suitable flakes for smaller adzes at the same time. Less regular parent blocks may have been broken down for flake adzes alone. (Leach 1984:114-115)

(4) *Cross-section.* Polynesian adze typologies are based almost exclusively on the cross-section at the shoulder of tanged adzes (Fig. 31) or the mid-section of untanged adzes (Buck et al 1930). The importance given to this one attribute in Polynesian adze studies is highlighted by Emory:

> For Polynesian adzes as a whole, the shape of the cross-section at the middle, or where the division between butt and blade is discernible, has proven essential to type designation. It has been equally important to note the presence or absence of a grip or tang, that is, the modification of the butt by reduction of its face or sides or both.
>
> If we sort Polynesian adzes according to the shape of this cross-section and separate the tanged from the untanged, we have gone a long way toward their useful classification. The associated features can then be described and those adzes which have such features in common may be grouped according to our needs in comparative studies (Fig. 1). (Emory 1968, 153)

The established convention for describing the cross-section rests on what is known regarding the orientation of the few hafted adzes that were collected prior to the replacement of stone adzes with metal counterparts. The established procedure is to orient the adze with the front or face always up and the back down (see Fig. 31); this explains the difference between a triangular and a reverse-triangular adze (Fig. 32). Strict adherence to this convention imposes obvious constraints on classifying unfinished adzes and especially fragments of broken adze rejects. Other difficulties are encountered in adhering to the established procedure for determining cross-section. For example, the cross-sections of early stage adzes are more irregular for the most part except in the case of some tabular cores where the cross-section is inherently quadrangular, so that even though the front and back may not be distinguishable the cross-section is nevertheless very regular.

The classification employed (Fig. 32) here follows Emory (Emory 1968: Figure 1) but because we took only one width measurement--the maximum width at the middle of both whole adzes and fragments--rather than the width of both the front and back, there are some specimens that should be properly classified as reversed subtriangular. In the case of reversed trapezoidal and reversed triangular adzes, the maximum width is the front width. Back width measurements would be necessary to make the quarry types conform to Emory's criteria, which were of course developed for finished adzes and are in any case arbitrarily imposed distinctions. Emory's classification is in some ways too rigid for use in the analysis of quarry assemblages, yet I agree that we should continue to classify adzes in terms of the cross-sections and to distinguish, for example, thick and thin, square, rectangular and trapezoidal.

Rectangular cross-sections consistently represent between 13% and 17% of the total at all sites except site 108 where they are rare (5.94%). The most common type is reversed trapezoidal which represents 44.40% of the total (Table 4). Rectangular and reversed trapezoidal cross-sections combined represent nearly 56% of the total. The reversed triangular type constitutes 33-36% of each assemblage except for site 211 where this type is only 22.64% of the total. Lenticular and reversed plano-convex types are rare. The first was found only at site 211 and the latter at only two sites--108 and 210. Irregular cross-section adzes are understandably present in all four assemblages.

The sample data indicate little inter-assemblage variability in terms of the variety of different cross-section types at each site. What varies is the proportion or relative frequencies of individual cross-section types.

(5) *Longitudinal Profile.* This attribute (see Cleghorn 1982:171 for a fuller discussion of this attribute) was recorded as (1) tanged (see Fig. 31), (2) untanged or (3) indeterminant in the case of some of the fragments. A few adzes made on curved flakes [Type 2--side-struck flakes] have natural "tangs."

Of the total 277 specimens in the present sample from four sites (Table 4), there are only 10 or 3.61% of the total that are tanged and all of these are from just one site (108). The small number of tanged adzes is consistent with the view based on other attributes that most of the adzes in these sites are early to middle stage rejects. The small number of tanged adzes is probably related in large part to the low mass of the relatively thin flake blanks, both in terms of the difficulty of further reducing the striking platform of the flake into a butt and the other problems of form and symmetry related to low mass.

(6) *Cortex.* Cortex, a term employed by mainly archaeologists to refer to the exterior weathered surface of rocks, is the result of natural processes that produces what geologists call a rind (Crabtree 1972:56). Cortex is an important attribute for determining blank type. Cores collected from the surface of the landscape or removed from the upper surface of lava flows are completely covered with cortex in contrast to flakes which by definition [a piece of a core] have cortex only on the outer or dorsal surface. In the present study the recording of this attribute was limited to recording cortex location rather than the more involved and time consuming quantification of the actual amount of cortex in terms of, for example, the percentage of the surface with cortex.

The combined totals for all sites show that cortex is present on 53.43% of the specimens (Table 4). What is perhaps more interesting is that there are 129 specimens or 46.57% of the total with no cortex. There is little variation from the mean except for the site 210 assemblage where 34 of the total 50 specimens, or 69.00% of the total, has cortex, a figure that is provisionally interpreted as indicating a higher percentage of earlier stage rejects.

(7-9) *Length, Width and Thickness*. Size measurements recorded in this study include length, width, and thickness. Measurements were taken on all specimens, whole and broken, but the summary statistics presented in Table 5 are limited to complete adzes. The size data for complete specimens are presented in terms of a range, an average and standard deviation for each of the three size variables--length, width and thickness. The data have been organized by cross-section to facilitate comparison between types (Table 5).

An examination of Table 5 indicates typically broad ranges in all three attributes and, thus, large standard deviations. There is a significant difference in the standard deviations of the three size attributes. Length is more variable than width and thickness, which tend to be more even, though some difference are apparent between adze types [cross-section]. Rectangular and irregular cross-section specimens are consistently larger than other types (Figs. 33 and 34).

Large adzes are comparatively rare (Fig. 33). There are several possible explanations. Helen Leach, in an important study of New Zealand adzes, concluded that thick quadrangular and large triangular adzes were underrepresented in the surviving sample because of two factors: (1) a higher success rate compared to other types, and (2) the purposeful reworking of broken specimens, [which is not generally possible in the case of thin adzes made on blades or flakes]. (Leach 1984:113).

The site 108 adze rejects are significantly smaller in all three dimensions than any of the other assemblages. The site 108 assemblage is also distinctive in the occurrence of a substantial number of long, narrow adzes that look more like chisels.

An examination of the relationship between blank type and cross-section indicates that a variety of adze types were made on each of the two kinds of blanks, but that lenticular and reversed plano-convex adzes were only made on flake blanks (Table 6). The data also show that few reversed triangular adzes were made on boulder cores and few rectangular adzes on flake blanks. If reversed trapezoidal adzes are considered together with rectangular adzes, as a larger group of quadrangular adzes, the picture is quite different. What the data seem to indicate is that blank type--redefined as raw material form-- was a constraint but not an absolute determinant of cross-section. The adze maker had a choice.

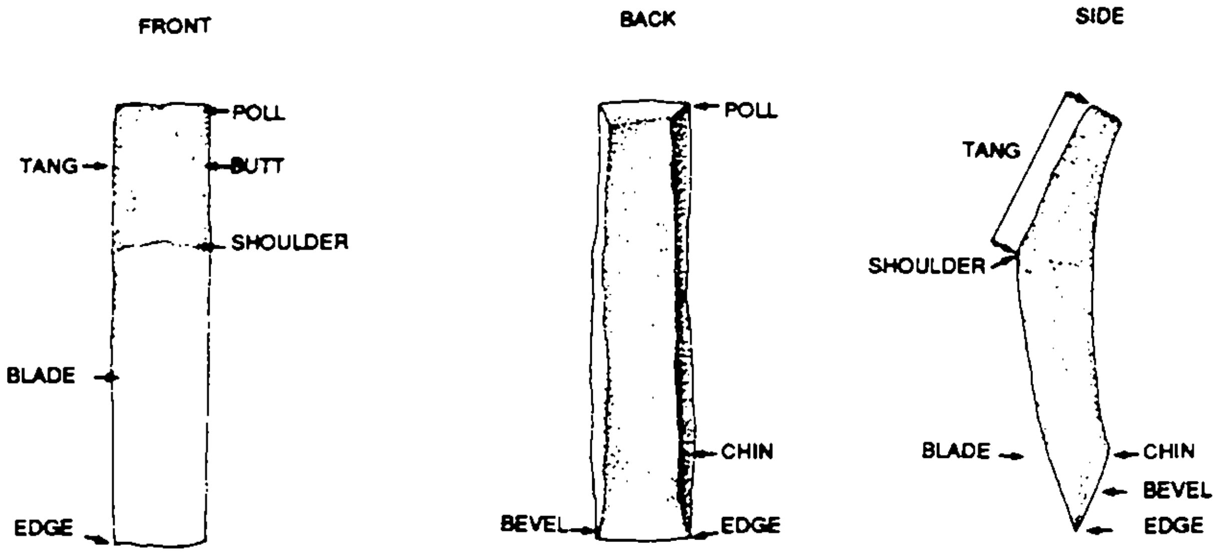

Fig. 31. Adze terminology. [from McCoy 1991 after Buck et al 1930].

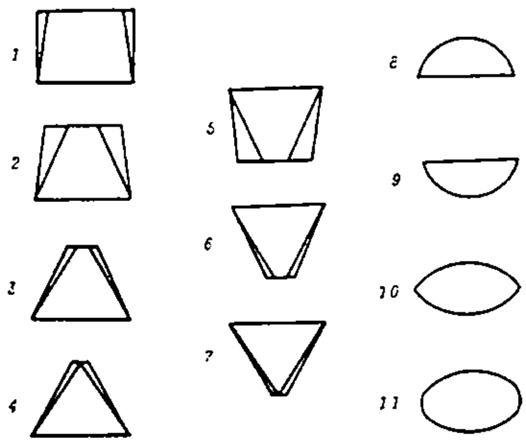

FIGURE 1—Classification of adzes based on form of cross section at shoulder or midway between cutting edge and poll. Cross sections shown base down. 1—Rec. or Quad., Rectangular or Quadrangular (face width 80-95 percent of base width, or vice versa). 2—Trap., Trapezoidal (face width 30-79 percent of base width). 3—Subtri., Subtriangular (face width 15-29 percent of base width). 4—Tri., Triangular (face width less than 14 percent of base width). 5—Rev. Trap., Reversed Trapezoidal (base width 30-79 percent of face width). 6—Rev. Subtri., Reversed Subtriangular (base width 15-29 percent of face width). 7—Rev. Tri., Reversed Triangular (base width less than 14 percent of face width). 8—Pl-con., Plano-convex. 9—Rev. Pl-con., Reversed Plano-convex. 10—Len., Lenticular. 11—Oval. To these suggested abbreviations can be added "T" for tanged, or "t" for incipiently tanged.

Fig. 32. Hawaiian adze cross-sections. [from Emory 1968].

Fig. 33. Site 208, Area B. Maka is holding a large thick rectangular adze reject. Photograph by Patrick C. McCoy.

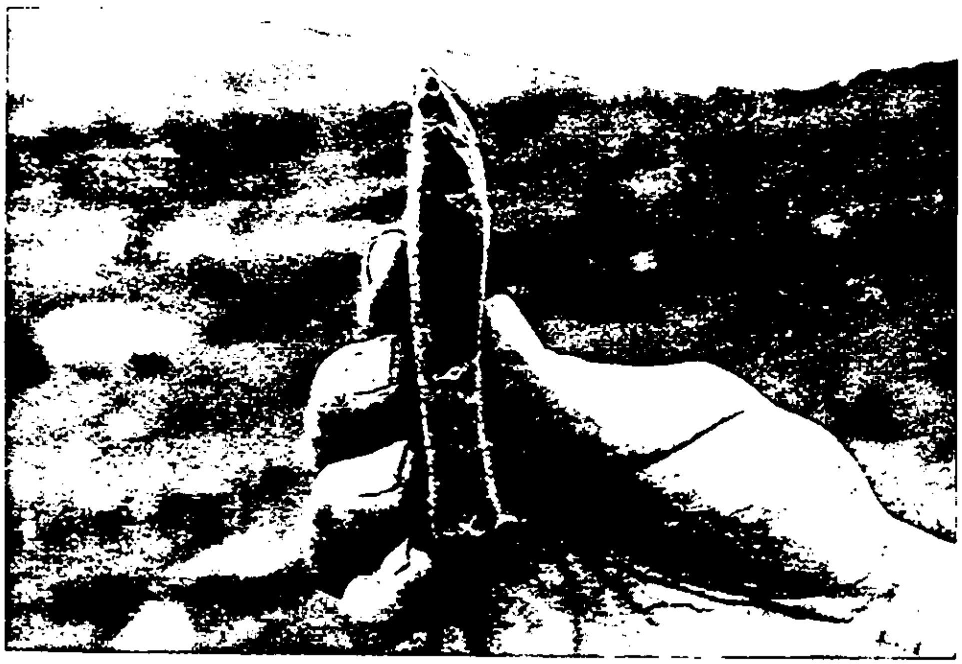

Fig. 34. Small adze reject made on a flake blank from site 211. Photograph by Patrick C. McCoy.

Table 4. Summary of Non-Metrical Adze Attributes

ATTRIBUTE	Site 108 [N=101]		Site 208 [N=73]		Site 210 [N=50]		Site 211 [N=53]		All Sites [N=277]	
	No.	%T	No.	%T	No.	%T	No.	%T	No.	%T
TECHNO-MORPHOLOGICAL TYPE										
Type 1	0	0.00%	0	0.00%	3	6.00%	0	0.00%	3	1.08%
Type 2	4	3.96%	4	5.48%	4	8.00%	12	22.64%	24	8.66%
Type 3	97	96.04%	69	94.52%	43	86.00%	41	77.36%	250	90.25%
Type 4	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
CONDITION										
Whole	35	34.65%	49	67.12%	34	68.00%	28	52.83%	146	52.71%
Butt End	30	29.70%	13	17.81%	8	16.00%	6	11.32%	57	20.58%
Mid-Section	4	3.96%	3	4.11%	0	0.00%	2	3.77%	9	3.25%
Bevel End	32	31.68%	8	10.96%	8	16.00%	14	26.42%	62	22.38%
Indeterminant	0	0.00%	0	0.00%	0	0.00%	3	5.66%	3	1.08%
BLANK TYPE										
Core	3	2.97%	16	21.92%	15	30.00%	19	35.85%	53	19.13%
Flake Type 1	50	49.50%	29	39.73%	8	16.00%	14	26.42%	101	36.46%
Flake Type 2	7	6.93%	4	5.48%	7	14.00%	3	5.66%	21	7.58%
Flake Type Indeterminant	26	25.74%	11	15.07%	17	34.00%	10	18.87%	64	23.10%
Indeterminant	15	14.85%	13	17.81%	3	6.00%	7	13.21%	38	13.72%
CROSS-SECTION										
Rectangular	6	5.94%	10	13.70%	7	14.00%	9	16.98%	32	11.55%
Reversed Trapezoidal	47	46.53%	32	43.84%	20	40.00%	24	45.28%	123	44.40%
Reversed Triangular	34	33.66%	25	34.25%	18	36.00%	12	22.64%	89	32.13%
Lenticular	0	0.00%	0	0.00%	0	0.00%	2	3.77%	2	0.72%
Reversed Plano-Convex	1	0.99%	0	0.00%	1	2.00%	0	0.00%	2	0.72%
Irregular	13	12.87%	6	8.22%	4	8.00%	6	11.32%	29	10.47%
LONGITUDINAL PROFILE										
Tanged	10	9.90%	0	0.00%	0	0.00%	0	0.00%	10	3.61%
Untanged	57	56.44%	67	91.78%	40	80.00%	34	64.15%	198	71.48%
Indeterminant	34	33.66%	6	8.22%	10	20.00%	19	35.85%	69	24.91%
CORTEX										
Present	48	47.52%	41	56.16%	34	68.00%	25	47.17%	148	53.43%
Absent	53	52.48%	32	43.84%	16	32.00%	28	52.83%	129	46.57%

Table 5. Summary of Whole Adze Reject Metrical Attributes

Site 108

SIZE VARIABLES	RECTANGULAR N=2	REVERSED TRAPEZOIDAL N=12	REVERSED TRIANGULAR N=16	IRREGULAR N=5	COMBINED N=35
LENGTH					
Range	93-125	75-133	71-142	105-171	71-171
Average	109	96.33	102.1	133.8	105.1
Standard Deviation	22.63	15.3	16.47	30.49	24
WIDTH					
Range	39-51	25-54	21-62	40-100	21-100
Average	45	39.75	41.31	56.4	43.14
Standard Deviation	8.48	8.41	12.5	24.7	14
THICKNESS					
Range	24-47	12-36	19-37	20-60	12-60
Average	35.5	26.92	28	34.4	28.97
Standard Deviation	16.26	7.64	6.4	15.63	9.07

Site 208

SIZE VARIABLES	RECTANGULAR N=8	REVERSED TRAPEZOIDAL N=23	REVERSED TRIANGULAR N=14	IRREGULAR N=4	COMBINED N=49
LENGTH					
Range	141-412	112-227	99-214	78-345	78-345
Average	227.3	158.6	144.9	175.8	167.3
Standard Deviation	97.34	33.29	33.37	116.6	61.88
WIDTH					
Range	52-135	40-95	35-87	26-190	26-190
Average	85.25	64.43	57.79	83	67.45
Standard Deviation	27.46	16.32	14.5	72.95	26.95
THICKNESS					
Range	15-97	30-80	25-70	19-80	15-97
Average	57.38	46.43	44.36	40.5	47.14
Standard Deviation	26.18	15.36	13.96	26.99	18.17

Table 5, cont'd.

Site 210

SIZE VARIABLES	RECTANGULAR N=6	REVERSED TRAPEZOIDAL N=10	REVERSED TRIANGULAR N=15	IRREGULAR N=3	COMBINED N=34
LENGTH					
Range	196-268	103-237	97-330	220-360	97-360
Average	232.3	171.7	180.8	267.3	194.9
Standard Deviation	30.55	45.93	63.14	80.26	61.51
WIDTH					
Range	50-115	33-113	39-128	115-170	33-170
Average	85	64.1	73.6	138.3	78.53
Standard Deviation	21.32	24.16	27.98	28.43	31.87
THICKNESS					
Range	44-116	23-110	29-145	105-130	23-145
Average	80.33	45.2	57.27	118	63.15
Standard Deviation	27.14	25.27	30.08	12.53	33.46

Site 211

SIZE VARIABLES	RECTANGULAR N=6	REVERSED TRAPEZOIDAL N=12	REVERSED TRIANGULAR N=5	IRREGULAR N=5	COMBINED N=28
LENGTH					
Range	108-290	97-244	89-248	130-310	89-310
Average	210	181.92	174.6	222	193.79
Standard Deviation	68.38	51.09	56.88	68.97	58.74
WIDTH					
Range	43-132	27-102	30-110	75-98	27-132
Average	76.67	71.25	63.8	84.6	73.46
Standard Deviation	32.4	23.18	29.04	9.89	24.44
THICKNESS					
Range	30-72	14-80	31-75	42-94	14-94
Average	55.33	45.5	52.6	65	52.36
Standard Deviation	19.33	16.36	16.26	23	18.66

Table 6. Adze Reject Blank Type and Cross-Section Relationships

Site 108

CROSS-SECTION	CORE SERIES		FLAKE SERIES						INDETERMMINANT		TOTALS	
			FLAKE TYPE 1		FLAKE TYPE 2		INDETERMINANT					
	No.	%T	No.	%T	No.	%T	No.	%T	No.	%T	No.	%T
RECTANGULAR	1	0.99%	1	0.99%	0	0.00%	3	2.97%	1	0.99%	6	5.94%
REV. TRAPEZOIDAL	1	0.99%	26	25.74%	3	2.97%	14	13.86%	3	2.97%	47	46.53%
REV. TRIANGULAR	0	0.00%	20	19.80%	3	2.97%	6	5.94%	5	4.95%	34	33.66%
LENTICULAR	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
REV. PLANO-CONVEX	0	0.00%	0	0.00%	0	0.00%	1	0.99%	0	0.00%	1	0.99%
IRREGULAR	1	0.99%	3	2.97%	1	0.99%	2	1.98%	6	5.94%	13	12.87%
TOTALS	3	2.97%	50	49.50%	7	6.93%	26	25.74%	15	14.85%	101	100.00%

Site 208

CROSS-SECTION	CORE SERIES		FLAKE SERIES						INDETERMMINANT		TOTALS	
			FLAKE TYPE 1		FLAKE TYPE 2		INDETERMINANT					
	No.	%T	No.	%T	No.	%T	No.	%T	No.	%T	No.	%T
RECTANGULAR	6	8.22%	1	1.37%	1	1.37%	1	1.37%	1	1.37%	10	13.70%
REV. TRAPEZOIDAL	7	9.59%	15	20.55%	2	2.74%	4	5.48%	4	5.48%	32	43.84%
REV. TRIANGULAR	1	1.37%	11	15.07%		0.00%	6	8.22%	7	9.59%	25	34.25%
LENTICULAR	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
REV. PLANO-CONVEX	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
IRREGULAR	2	2.74%	2	2.74%	1	1.37%		0.00%	1	1.37%	6	8.22%
TOTALS	16	21.92%	29	39.73%	4	5.48%	11	15.07%	13	17.81%	73	100.00%

Table 6, cont'd.

Site 210

CROSS-SECTION	CORE SERIES		FLAKE SERIES						INDETERMMINANT		TOTALS	
			FLAKE TYPE 1		FLAKE TYPE 2		INDETERMINANT					
	No.	%T	No.	%T	No.	%T	No.	%T	No.	%T	No.	%T
RECTANGULAR	5	10.00%	0	0.00%	1	2.00%	0	0.00%	1	2.00%	7	14.00%
REV. TRAPEZOIDAL	3	6.00%	2	4.00%	3	6.00%	12	24.00%	0	0.00%	20	40.00%
REV. TRIANGULAR	4	8.00%	5	10.00%	3	6.00%	4	8.00%	0	0.00%	16	32.00%
LENTICULAR	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
REV. PLANO-CONVEX	0	0.00%	0	0.00%	0	0.00%	1	2.00%	0	0.00%	1	2.00%
IRREGULAR	3	6.00%	1	2.00%	0	0.00%	0	0.00%	2	4.00%	6	12.00%
TOTALS	15	30.00%	8	16.00%	7	14.00%	17	34.00%	3	6.00%	50	100.00%

Site 211

CROSS-SECTION	CORE SERIES		FLAKE SERIES						INDETERMMINANT		TOTALS	
			FLAKE TYPE 1		FLAKE TYPE 2		INDETERMINANT					
	No.	%T	No.	%T	No.	%T	No.	%T	No.	%T	No.	%T
RECTANGULAR	8	15.09%	0	0.00%	0	0.00%	0	0.00%	1	1.89%	9	16.98%
REV. TRAPEZOIDAL	6	11.32%	7	13.21%	2	3.77%	8	15.09%	1	1.89%	24	45.28%
REV. TRIANGULAR	1	1.89%	6	11.32%	0	0.00%	1	1.89%	4	7.55%	12	22.64%
LENTICULAR	0	0.00%	1	1.89%	0	0.00%	1	1.89%	0	0.00%	2	3.77%
REV. PLANO-CONVEX	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
IRREGULAR	4	7.55%	0	0.00%	1	1.89%	0	0.00%	1	1.89%	6	11.32%
TOTALS	19	35.85%	14	26.42%	3	5.66%	10	18.87%	7	13.21%	53	100.00%

HAMMERSTONES

Attribute data were also collected on a sample of hammerstones, but the data are not as complete and uniform as the adze data because we did not use a recording form with a list of standardized attributes. The patina or varnish that is found on many surface artifacts posed a major problem in distinguishing some hammerstones from naturally occurring subrounded to rounded cobbles because the tell-tale marks of a hammerstone, such as pitted and abraded surfaces, have been obscured.

Attribute Definitions and Statistics

(1) *Condition*. This attribute was recorded as either whole or broken. Many of the fragments are sheared or split, often into half sections (see Fig. 23) that exhibit an extremely flat ventral surface. Most of these fragments are undoubtedly the unintended consequence of use, rather than post-depositional breakage. The frequency of sheared fragments is of great interest in terms of providing possible clues to raw material constraints and/or use. Some appear to have been used as anvils.

(2) *Shape*. This attribute was recorded as: (1) discoidal, (2) semi-discoidal, (3) spherical, (4) bladed and (5) rod-shaped (Fig. 35).

(3) *Raw Material Form*. The materials utilized for hammerstones include (1) recycled adze rejects, (2) waterworn cobbles, some of which are almost certainly imported beach cobbles, and (3) cobbles with rough exterior surfaces that

may have been imported and/or procured locally in the immediate environs of the quarry.

(4) *Raw Material Source.* Unlike the other attributes or tool properties, raw material source must always be inferred and the inference is based primarily on raw material form and, more specifically, the rounding and texture, especially the surface finish. Only a small number of the total could be confidently assigned to a geologic specific source or environment (Table 7) because of uncertainties regarding, for example, rounding which may be the result of wave or stream action or *in situ* weathering processes.

(5) *Edge and Surface Alterations.* The edges and surfaces exhibit a range of different types and degrees of alteration, inferred to be the result of use. These include battering and pitting. No attempt was made to distinguish the two or to quantify the actual degree of use-wear. The labels used here are obviously subjective. The sample does not include striations and abraded surfaces and indeed we saw no tools that could be called abraders.

(6) *Maximal Dimensions.* Because measurements are shape dependent and the shapes of the hammerstones so variable, I have resorted to maximal measurements labeled (a), (b) and (c) in Table 7. In the case of a discoidal shape hammerstone measurement (b) is equivalent to maximal diameter and (c) to maximal thickness. The maximal dimensions give a good and indeed better indication of the general shape of the tool.

Table 7. Hammerstone Attributes

Site 108

Specimen No.	Condition	Shape	Raw Material Form	Edge-Surface Alteration	Maximal Dimensions		
					a	b	c
1	whole	spherical			138	66	79
2	whole	discoidal			71	65	47
3	whole	discoidal			64	61	44
4	whole	discoidal			74	56	41
5	broken	discoidal			128	70	47
6	whole	discoidal			92	84	42
7	broken	discoidal			66	53	51
8	broken	-	possible 'eho		47	54	33
9	broken	-	flake		65	42	23
10	broken	-	flake		93	77	22

Table 7, cont'd.

Site 208

Specimen No.	Condition	Shape	Raw Material Form	Edge-Surface Alteration	Maximal Dimensions a	b	c
1	half-section	discoidal	boulder/ beach	-	145	139	78
2	half-section	discoidal	boulder/ beach	-	100	103	32
3	broken	semi-discoidal	local ?	-	145	132	85
4	split/ sheared	discoidal	local ?	-	120	82	52
5	whole	discoidal		-	63	53	46
6	half-section	spherical	boulder/ beach ?	-		68	33
7	half-section	discoidal	-	-	142	124	44
8	-	semi-discoidal	-	-	108	124	75
9	split/ sheared	discoidal	-	-	125	115	75
10	split/ sheared	discoidal	boulder/ beach ?	-	187	187	50
11	broken	spherical	-	-	81	73	55
12	whole ?	semi-discoidal	-	-	145	122	66
13	broken	discoidal	-	-	78	77	40
14	split/ sheared	semi-discoidal	-	-	165	115	70
15	split/ sheared	discoidal	-	-	141	105	60
16	split/ sheared	-	boulder/ beach ?	-	146	102	28
17	half-section	semi-discoidal	-	-	108	91	30
18	broken	rod-shaped	-	-	101	77	55
19	whole	spherical	-	-	94	90	69
20	split/ sheared	discoidal	boulder/ beach ?	-	150	121	32
21	whole	discoidal	-	-	80	82	45
22	whole	discoidal	waterworn ?	-	99	96	45
23	split/ sheared	discoidal	waterworn ?	-	100	75	22
24	whole	discoidal	-	moderate	90	86	42
25	whole	discoidal	-	-	125	102	51
26	whole	discoidal	-	moderate	115	76	47
27	whole	discoidal	-	light	160	113	50
28	split/ sheared	discoidal	waterworn	-	210	107	32

Table 7, cont'd.

Site 210

Specimen No.	Condition	Shape	Raw Material Form	Edge-Surface Alteration	Maximal Dimensions a	b	c
1	whole	discoidal			130	120	50
2	split/ sheared	discoidal			100	80	20
3	split/ sheared	rod-shaped ?		heavy	164	133	49
4a	split/ sheared	rod-shaped			235	150	75
4b	split/ sheared	rod-shaped			237	150	72
5	split/ sheared	rod-shaped			119	87	46
6	whole	spherical			100	97	73
7	broken	spherical		moderate	128		95
8	split/ sheared	discoidal		heavy	125	113	45
9	broken	discoidal	beach cobble	heavy	127	110	52
10	split/ sheared	discoidal		heavy	124	84	86

Site 211

Specimen No.	Condition	Shape	Raw Material Form	Edge-Surface Alteration	Maximal Dimensions a	b	c
1	whole	discoidal	-	heavy	120	102	55
2	whole	discoidal	-	heavy	107	96	63
3	whole	discoidal	-	light	105	100	75
4	-	discoidal	-	heavy	125	106	45
5	whole	irregular	adze reject	moderate	135	110	64
6	whole	discoidal	-	heavy	130	102	73

CORES

Cores are not common in the Pu'u Moiwi adze quarry sites, probably because most of them were reduced to a point where they are no longer recognizable as cores (Fig. 36). Some of the cruder techno-morphological type 1 adze rejects [see above] might be confused with a core. The collection of data on cores was not done as systematically as it was for adze rejects and hammerstones, so the lack of data for sites 208 and 108 (see Table 1) does not mean that there are no cores at these two manufacturing locales. Gould in fact noted two cores near the shrine at site 108 in 1979. The little data that was collected is too sketchy to warrant any kind of analysis at this time.

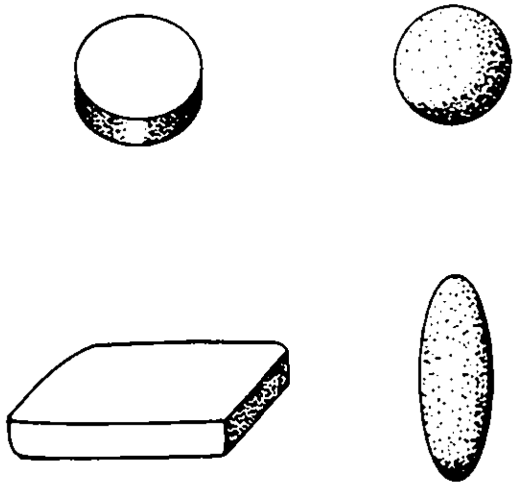

Fig. 35. Cobble shape categories [from Hassan 1978: Fig. 6]. upper left, discoidal; upper right, spherical; lower left, bladed; lower right, rod-shaped.

Fig. 36. Core from site 211. The long, parallel-sided flake scars indicate the removal of lamellar flakes similar to blades. Photograph by Patrick C. McCoy.

THE QUARRY COMPLEX: INTERPRETATIONS AND SIGNIFICANCE

While there is certainly much that is still unknown about the Pu'u Moiwi adze quarry, enough information exists to make it worthwhile to write a general overview based on a synthesis and interpretation of the site and artifactual evidence. The overview provides a convenient context for addressing some of the original research questions posed during and after the 1976-80 survey, and highlighting the archaeological significance or scientific value of the quarry.

GENERAL SITE CHARACTERISTICS

Site Types And Distribution Patterns

The Pu'u Moiwi adze quarry as presently understood is a site complex comprised of the *quarry proper* [sites on or adjacent to a raw material source containing cores, flakes, adze rejects and manufacturing tools] and *outlier sites* somewhat farther removed that contain some adze manufacturing by-products. Some of the latter sites, which are found only on the north and east slopes of Pu'u Moiwi, appear to be camps, while others contain so little cultural material to defy easy classification or explanation. In some classifications they would be labeled "find spots."

The site distribution pattern is obviously linked to the locations of tool-quality basalt, but when the outlier sites are included in the boundaries of the quarry complex then factors other than the local geology have to be considered.

The absence of camp sites on the south and west slopes is important to interpreting the camps and "find spots" on the north and east, of which there are even more in the direction of Ahupu and Hakioawa. The locations of these outlier sites is a clue, I think, to the production system and, more specifically, to the use-rights to the quarry and to the behavior of the social groups on their descent from the quarry to the settlements at Ahupu and Hakioawa. The occurrence of a few isolated waste flakes and an occasional adze reject on the north and east slopes of Pu'u Moiwi are reminiscent of similar "find spots" on the south flank of Mauna Kea beyond the adze quarry proper. Such remains suggest to me some kind of "symbolic action" related to, perhaps, the process of the adze makers removing the *kapu* of their specialist status and becoming "common" [*noa*] or free again (McCoy 1991).

Based on the admittedly circumstantial evidence pointing to two probable social groups, residing at Ahupu and Hakioawa, it is tempting to divide the quarry into western and eastern complexes. The western complex, which would include sites 208, 210, 211, 383, and 384, is characterized by the presence of individual shrines, a higher frequency of untanged adzes and generally larger adzes. The eastern complex, consisting of sites 108 and part of site 205, by contrast has a higher frequency of tanged adzes and more small adzes resembling "chisels." The unique workshop and shrine complex on top of Pu'u Moiwi may well have been a "central place" utilized by both of these postulated social groups.

The postulated use of the quarry by two different communities suggests that the quarry was a "common resource" rather than the exclusive property of one community or polity. Elsewhere I have speculated on the basis of archaeological data that the Mauna Kea adze quarry was in its later history, like Kamoku in the Hamakua district, common land (McCoy 1990, 1991; for other views on this see Withrow 1990, 1991). Unlike the *ahupua'a*, where there were proprietary rights to resources, "common lands" were open to exploitation by the masses. This alternative system of land tenure does not necessarily imply uncontrolled access or the lack of competition and conflict over access to the best quality material as Barrera's conclusions regarding Kaho'olawe land tenure patterns seem to indicate. Barrera wrote that

> There is no evidence that individual *ahupua'a*, land units stretching from the ocean to the mountains on which an extended family had the rights to a wide range of natural resources, ever developed on Kaho'olawe. Indeed, the evidence supports the conclusion that the residents of the island behaved opportunistically when exploiting the island's interior, rather than having been under the influence of any concept of land tenure. Thus the entire island appears to have been treated as an *ahupua'a*, probably as a result of its small size: by the time the concept developed on the other islands, there were very few resources to divide up. (Barrera 1984:43)

Site Components And Activity Patterns

One of the characteristics that distinguishes the quarry from other sites with adze manufacturing by-products is the absence of substantial midden deposits and earth ovens in the quarry proper. All of the quarry sites contain at least one workshop. Volcanic glass flakes and cores at several sites suggest the performance of other tasks in these workshops.

Remains described earlier as probable shrines were found at sites 108, 208, 210 and 211. At least several of these structures and probably all of them had an upright stone (*'eho*). Emory, writing about the shrines in the Mauna Kea adze quarry, noted that:

> The adze makers, clinging to the ancient form of shrine at which to approach their patron gods, have preserved a most important link with their ancestral home. Each upright stone at a shrine probably stood for a separate god. The Hawaiian dictionary describes *'eho* as "a collection of stone gods" and this is the term which the Tuamotuans, the neighbors of the Tahitians, used to designate the alignment of upright stones on the low and narrow platform at their maraes, or sacred places. (Emory 1938:22)

According to Pukui and Elbert (1971:35) *'eho* is a term for a single stone image as well as a stone pile, particularly of the kind used to mark land boundaries. This same word is also used in connection with cooking stones called *pohaku 'eho*, many of which are anthropomorphic or phallic-shaped as are some uprights (McCoy 1989). In both cases there is a clear connotation of power and potency (*mana*). The word *'eho* appears again in the context of district boundary markers. According to Kamakau "Boundary markers (*kukulu 'eho'eho*) of tall stones (*oeoe pohaku*) were set up to identify the boundaries." (Kamakau 1976:7).

While all four of the structural remains described in this report have been referred to as shrines, it is possible that some, especially those on site 210, were instead *kapu* markers of a kind called *rahui* [Hawaiian *lahui* ?] by the Maori of New Zealand. Firth's detailed description of this practice is quoted here in full because I believe it provides a possible analog to the function of the *ahu* and *'eho* on site 210.

> The object of the magic surrounding the establishment of a material *mauri* or talisman was to ensure the protection of the fertility of natural resources against unforeseen contingencies or the act of an enemy. Magic of an essentially defensive type was employed. But measures of a more active kind were sometimes taken in order to prevent interference with economic resources by unauthorised persons, and in this case the spells used were intended to be definitely offensive in their action. The procedure followed was to set up a *rahui*. This term applies to two types of prohibition, one being comparatively mild in its effects, while the other was believed to be destructive to the welfare of persons who interfered with it. We shall deal with the latter kind first.
>
> The essential process was this: a post was set up in the ground on the edge of the forest or the bank of the stream which it was desired to guard, and to it was attached a *maro*, a lock of hair or bunch of grass. This was termed the *rahui* post. The priest then proceeded by means of an incantation to "sharpen the teeth of the *rahui*, that it might destroy man". A kind of "conditional curse", as Westermarck calls it, was set upon the post, so that any person meddling with it, the forest, or the productivity thereof, either by practical or magical means, would be slain by the force of the spells associated with the *rahui*.
>
> On purely economic grounds, also, a *rahui* might be instituted. To save the resources of a shellbank or a patch of forest from becoming unduly depleted, the chief of the *hapu* might proclaim over it a *rahui*, in consequence of which no one would be allowed to take supplies therefrom for a time. He set up a post and perhaps hung an old garment thereon as a sign of the

> prohibition, but attached no magical spells. Sometimes these *rahui* were merely proclaimed by word of mouth. The institution of a *rahui* of this type was the privilege of a chief, and its observance was a tribute to his rank and status. As the Maori puts it, a person of *mana*, of influence, is needed to set up the *pou rahui*, the *rahui* post. At times the *rahui* seems to have signified simply the act of reservation of the food supply to the owners and not the entire prohibition of all use thereof.
>
> Many kinds of economic resources were temporarily preserved in this way. Thus streams were often protected by *rahui* to prevent the fish being taken out of season, while forest products, cultivated food plants, fern-root, flax, and the places where red ochre was obtained were all similarly guarded. (Firth 1959:258-260)

The reference to the protection of red ochre suggests that other kinds of lithic resources were also protected or guarded. I have elsewhere interpreted some uprights fronting a rockshelter in the Mauna Kea adze quarry as *rahui* posts or "stone guards" (McCoy 1990:102; cf. also Best 1982:185-191 on the Maori *rahui*).

Site Size and Deposit Characteristics

There are no large piles or mounds of manufacturing waste at any of the sites, even allowing for the flattening out effect of long-term erosion. The chronological sequence in this quarry is thus clearly horizontal rather than vertical. The available dates suggest, moreover, that the several different source areas, each differing in the quantity of material available, were exploited simultaneously, rather than in succession --a pattern of exhausting a single source before finding a new one.

Another salient characteristic of the site deposits is the adze reject:debitage volume relationship. There seems to be a disproportionately large number of rejects in relation to the quantity of debitage, especially in the site 108 workshop at the summit of Pu'u Moiwi. There are several possible "explanations" for this pattern, but the most likely is the inherently low volume of waste produced in the manufacture of adzes from flake blanks and the difficulty of solving technical problems in the case of this particular kind of tool blank.

THE ADZE MANUFACTURING TECHNOLOGY

Raw Material Sources and Physical Properties

The search for the source of raw material has been and continues to be a major preoccupation. The latest and only systematic effort to locate the source since Stearns described it over 50 years ago was undertaken by Halbig in 1983. As already noted at the beginning of this report [page 26] Halbig claims that his search was unsuccessful. He wrote:

> Although Hommon and others have regarded the Puu Moiwi area as a quarry site, there was no evidence at the time of field inspection of any excavation features or of the *in situ* basalt material which was being extracted. The most logical explanation to account for the inability to locate the basalt source is that it is presently blanketed by colluvial material which occurs on the flanks of the cinder cone. Stearns (1940: 141, 167) describes the source basalt for adze production as thin flows (a few inches to two feet in thickness) which are intercalated with cinders and which dip at an angle of about 45 degrees from the vent location. Most probably the basalt could be located by means of exploratory trenching. (Halbig 1992:D-2)

If Halbig's colluviation theory is correct and the source lies buried on the lower flanks of the cinder cone then all of the erosion that has taken place should have exposed some of the flows. Halbig, who does not seem to have spent a lot of time at the quarry, clearly didn't see, or at least he did not describe, any of the several different dikes and boulder strewn ridge tops where there is evidence for *in situ* adze manufacture. He also does not appear to have made any attempt to determine raw material form and, thus, geological origin based on an examination of core and adze reject characteristics such as shape and cortex. Such an examination indicates the use of both: (1) tabular blocks in which the shape of the adze is "preformed", and (2) subangular and subrounded cobbles and small boulders which have been split and flake blanks removed. It is clear that the predominant source was the weathered surfaces of dikes which, depending on the degree of weathering, often resemble boulder outcrops.

The degree of erosion has made the determination of raw material source for some sites a difficult problem. With regard to the antiquity of the rock strewn landscape, Shlemon concluded that "Several lines point to probable recent breakup and movement of many clasts." (Shlemon 1980:6). His findings, which are consistent with our own observations, help to explain the presence of unworked cobbles and slabs of tool-quality basalt on sites, such as 208, 210 and 211, that surely would have been utilized if they were available. The conclusion is that many of these perfectly suited boulder cores were buried until the onset of catastrophic erosion in the last century.

Raw Material Procurement and Reduction Strategies

The primary procurement strategy appears to have been the collection of surface material; at least there is no evidence at this time for subsurface mining or extraction. The artifact analysis demonstrated the influence of cobble form on reduction strategy and hence, tool type. There is a positive correlation between subangular to subrounded cobbles and small boulders and the predominance of reversed-triangular, reversed-trapezoidal and thin rectangular adzes, most of which were made on flake blanks.

The lamellar flake blank reduction sequence is essentially a blade technology in which the corner flakes [blades] were removed off of sheared or split cobbles (see Fig. 36). Boulder cores were demonstrated to be relatively uncommon in these sites.

The Tool Kit

The Kaho'olawe hammerstones tend to be more irregular and only roughly "discoidal" or "spheroidal" in comparison to most of those in the Mauna Kea adze quarry. The cursory examination of hammerstone shape, texture and rounding indicated the use of both local material and imported tools from alluvial stream deposits or boulder beaches.

Howard Powers brief description of the hammerstones found in the adze manufacturing workshops on Haleakala is of considerable interest with regard to their origins and selection for specific properties, such as porosity and shape. He noted that

> ...the stones used for hammers in shaping the adzes are always of tough, porous rock which shatters less readily. Most of the hammerstones were carried in by the workmen; some from deposits of stream gravel lower on the mountain; and some even from the sea beaches, as many of the hammers show remnants of the smooth rounded surface typical only of wave-rounded cobble stones. (Powers 1939:24)

Curiously absent in the Pu'u Moiwi tool-kit are the distinctive "abraders" found on Mauna Kea (Cleghorn 1982; McCoy 1986, 1991).

CHRONOLOGY

The chronology of the Pu'u Moiwi adze quarry complex is an open question. There is only one radiocarbon date and the first set of hydration-rind dates, all from surface contexts, are suspect. The first suite of hydration-rind dates for the quarry indicated that the dated sites were contemporaneous with other inland sites, which was thus taken as confirmation or verification of the inland expansion hypothesis (Barrera 1984; Hommon 1980a, 1980b). The new set of hydration dates and radiocarbon dates (Rosendahl et al 1992), which are consistently later, opens up the discourse on chronology again. The one thing that doesn't change, if the underlying assumption of association is correct, is that the quarry and many of the upland sites with basalt debitage were contemporaneous.

The one radiocarbon date from the firepit at site 108, Feature A of 580 $\pm$ 60 BP [AD 1250-1400], as earlier remarked, is provisionally interpreted as providing an upper limiting date for adze manufacture at this one locality. The date is difficult to interpret though because the firepit was not fully excavated, so questions remain concerning its time-stratigraphic relationship to the rest of the deposits at this workshop and to the Ahupu and Kahoolawe "soil formations".

Recent investigations concluded that most of the firepits in inland sites were dug into the lower Kahoolawe soil, which Shlemon (1980:9, 12) has described as a buried paleosol:

> The ability to recognize the stratigraphic relation of the sites examined to the Kahoolawe and Ahupu formations is largely limited to inland sites, because the coastal ones are usually situated within complex deposits of marine and terrestrial alluvium--deposits which are not readily assignable to the two formations. In general, pit features at inland sites appear to be excavated into the Kahoolawe Formation. It was suggested that at some sites (e.g., Sites 496 and 512) features may have been excavated into what is in this study referred to as an alluvial Ahupu Formation layer. Most inland sites are overlain by an aeolian Ahupu layer, and some are also overlain by one or more earlier alluvial Ahupu layers. (Rosendahl et al 1992, VI-12)

While the soil-stratigraphic provenience of the radiocarbon date is open to some question, there is some new evidence from the quarry to suggest the possibility that not all of the inland sites are buried by the Ahupu soil, which according to Rosendahl and his colleagues post-dates 1875. They write:

> It is clear that large-scale erosion has occurred on Kahoolawe. The evidence presented in this study suggests that the most extensive, virtually catastrophic erosion occurred historically, after 1875. The catastrophic phase of this erosion is marked by the onset of deposition of the largely aeolian, upper Ahupu formation layer. The materials comprising this layer are derived from further wind and water erosion of extensive areas of saprolitic hardpan. This layer post dates the occupation of all inland sites, several of which were apparently occupied at least until the mid-1800s. The earlier alluvial Ahupu layers lack evidence of significant quantities of aeolian deposited materials, thus it can be concluded, as earlier concluded by Stearns (1940) and as documented by Spriggs in this study (Appendix I), that the extensive hardpan areas are a late, post-occupational phenomenon attributable to overgrazing. (Rosendahl et al 1992, VI-14)

Spriggs (1991, 1992) is even more confident that there are no prehistoric sites in the aeolian Ahupu soil. He has written "On the basis of this study it is suggested that in fact no prehistoric sites truly belong within the Ahupu Formation, which dates to a period after the abandonment of sites identified as prehistoric." (Spriggs 1992:I-17).

At sites 208 and 210 the structural remains and some of the adze manufacturing by-products appear to be resting on the surface of the aeolian deposit. If true, it would mean that aeolian deposition was coeval with adze manufacture. The danger of conclusions based on hurried field observations is noted in Spriggs recent critique of the way the 1976-80 survey assigned sites to one of the two soil formations:

> The original survey techniques did not usually involve facing-off the eroding hummock edges or other sites where stratigraphy was observed. Stratigraphic details are often not clear without excavation and so the original survey designations should be regarded as tentative. The problem is compounded by the nature of the deposition of the Ahupu Formation. It is generally aeolian in origin and thus can be blown in among the

> stones of structures and oven features giving the impression that cultural features are on top of the Ahupu Formation rather than that this sediment has blown in around the features and covered them. (Spriggs 1992: I-17)

There are several lines of evidence to suggest the observations made at sites 208 and 210 may be accurate. First, I think it is highly unlikely that adze manufacture at Pu'u Moiwi continued into the middle of the nineteenth century; such is implied in the assertion that aeolian deposition post-dates 1875. Second, the buried cultural material at all of the quarry sites is not patinated, an observation which suggests that it must have been covered over rather quickly with aeolian silt; if true this would make the aeolian deposition coeval with adze manufacture. In any event the material does not appear to have been lying on an exposed surface for very long and/or the conditions responsible for the rapid development of the patina or varnish today have changed. Finally, there is the evidence described by Shlemon from a number of hummocks in the interior of the island:

> Several hummocks are protected from erosion by the presence of large basaltic boulders on their upwind and upslope sides. At least some of the boulders were placed on the hummocks after onset of regional landscape degradation and eolian deposition. (Shlemon 1980:1)

In summary, there are several reasons for believing that the quarry chronology spans at least several centuries and that the latter stages of adze manufacture were coeval with landscape change. Evidence for the prolonged use of scattered quarries on west Moloka'i, similar in some respects to the Pu'u Moiwi quarry sites (Dixon and Major 1992), was observed by the geologist Wentworth. He wrote that

> It is probable that the activity of the Hawaiian stone workers in this area extended over a period of many generations for some of the chips show at least two generations of etched surfaces. The first appears to have been developed on fragments of the adz rock which were dropped by the earlier carriers. Chips were then broken off these pieces as they were utilized by later generations for adzes. These chips are in turn etched by the wind-driven sand on the fresher surfaces (quoted in Summers 1971:44-45)

THE MEANING OF TYPOLOGICAL VARIABILITY

Introduction

We are now in a position to evaluate, but not necessarily test, Hommon's earlier observations and hypotheses [re-stated below] regarding the seemingly anomalous typological characteristics of the site 108 adze rejects and the possibility that the non-quadrangular adzes were produced for exchange.

> Most of the finished adzes and adz fragments that have been recorded on the surface of Kaho'olawe sites have been quadrangular in cross-section, just as are the vast majority of Hawaiian adzes in general. The predominance of unusual forms (for Hawaii) at site 108 remains, therefore, a problem, and a major research topic. Three hypotheses may help to explain the predominance of unusual adz preforms at site 108, though none is satisfactory.
>
> 1) The non-quadrangular adzes may have been earlier forms, produced before the quadrangular form achieved its later overwhelming popularity. This would suggest that site 108 was abandoned before such a shift took place.
>
> 2) The non-quadrangular adz may have been introduced from outside Hawaii. Alternately, the quadrangular adz may have been the introduced form. (The latter statement could be combined with number 1 above.)

> 3) The non-quadrangular adzes may have been manufactured for export to Maui or some other island.
>
> As indicated earlier, none of the arguments can be supported with solid evidence and further research is clearly needed. (Hommon 1979)

We now know that what Hommon had to say about the adze types at site 108 applies to all of the quarry sites. Also, when he says that none of the three hypotheses is satisfactory I think it is clear that he means they are not mutually exclusive propositions and/or they don't exhaust the range of possibilities. Hypotheses 1 and 3, for example, are concerned with chronology and production goals, respectively, and are therefore not mutually exclusive. To the discussion of Hommon's hypotheses, I have added a brief evaluation of the recent arguments that the appearance of standardized adze types and manufacturing methods is a marker of craft specialization and social complexity (Cleghorn 1982; Kirch 1990).

Chronology, Technology and Social Complexity

Hommon's statement regarding the predominance of the quadrangular form in Hawaii is supported by the results of an important study by Emory (1968) who examined a sample of 265 Hawaiian adzes [165 from various localities in the Bishop Museum collection and 100 from Maui in the Wong collection]. Emory concluded that:

> No place in East Polynesia exhibits such a steadfast adherence to one form of adz as Hawaii. Hawaiian adzes are usually quadrangular (or rectangular) in cross-section, and except for some small specimens and a few of medium size, are tanged. They range from wide and

> thin to narrow and thick with most of them of intermediate proportions. In profile the great majority are curved longitudinally along the base and the butt meets the blade at an angle. None show shaping by pecking. (Emory 1968:162-163)

> Our study of Hawaiian adzes has revealed the early existence of an islandwide uniformity in adzes. There is no reason to believe that there ever was a time in Hawaiian history when the tanged, quadrangular adz was not known. Therefore, the first settlers introduced this adz form. They may also have brought the plano-convex, the triangular, and reversed triangular at the same time, but only the quadrangular form survived. (Emory 1968:164)

When Emory's data on the frequency of Hawaiian adze types is examined (Emory 1968: Table 6) one of the first things that is noticed is that there are no trapezoidal or reversed trapezoidal adzes. The Pu'u Moiwi assemblages thus appear to be anomalous in the presence of a new and previously unknown adze type in Hawaii. Once known, Emory would probably have argued that the assemblages exemplified an evolutionary sequence which he had already described. He wrote that "The reversed trapezoidal tanged adz marks a transition in form from the quadrangular tanged adz to the reversed triangular." (Emory 1968:159). The Pu'u Moiwi assemblages do not appear anomalous given what we now know of other quarry assemblages, but there are several questions that are raised in interpreting the meaning of the reversed trapezoidal adze.

First, the comparison of quarry types and finished tool types from non-quarry contexts raises questions about the representativeness or bias in quarry assemblages because quarry assemblages are comprised of intended and unintended by-products. It is natural to expect more variety or diversity in a quarry context because of predictable failures and departures from norms. Isaac (1977:9, footnote 1) noted that quarry sites commonly deviate from what he called "regional-phase norms."

Second, it is highly likely that a significant proportion of the reversed trapezoidal rejects are early stage rectangular adzes (see Cleghorn 1982). Third, given the occurrence of this adze type in habitation sites from other islands (e.g. Kirch 1975), it is necessary to assume that some proportion of the reversed trapezoidal rejects were intentional and/or acceptable tool types. The seeming absence of non-quadrangular adzes from habitation sites on Kaho'olawe is still left unexplained, but since no finished Kaho'olawe adzes have been illustrated except for the line drawings in McAllister's monograph (1933: Figure 13)) and the photograph in one of Neller's reports (Neller 1981) it is difficult to know how quadrangular was defined since it could mean rectangular or even trapezoidal and reversed trapezoidal.

Emory's conclusion that only the quadrangular form survived to the end of the Hawaiian cultural sequence implies that all of the non-quadrangular adzes must date to the settlement period. A similar conclusion has recently been reached by Kirch who has written:

> A temporal pattern of some significance is the morphological variability evident in various artifact classes from assemblages dating to the Colonization and Developmental Periods. This is especially notable in

> basalt adzes, but also in fishhooks and various ornaments. In part, such variability reflects attempts to adapt technomic artifacts to local environmental constraints and conditions. Equally important, however, such variability may signal an early lack of technical specialization. In contrast to the early adze variation, for example, later Hawaiian basalt adzes display a *monotonous* uniformity. Cleghorn (1982), in his detailed study of the massive Mauna Kea adz quarry site (dating to the Expansion and Proto-Historic Periods), referred to the "tremendous amount of standardization," in form, size proportions, and reduction procedure, which he argues "supports the contention that [in later periods] the adze makers were craft specialists" (1982, p. 343) The increasing standardization of portable artifact morphology in the Expansion and especially Proto-Historic Periods thus implies increasing craft specialization, as well as the control of certain raw material resources (e.g. adz quarry sites) by particular social groups. Elite control of unevenly distributed resources (such as fine-grained basalt for adzes, pearly shell for fishhooks, or large *Acacia koa* trees for canoes) would imply some form of exchange between sociopolitical units. (Kirch 1990a:327 my emphasis)

Emory's and Kirch's conclusions regarding the homogeneity of late Hawaiian adzes is contradicted by recent evidence from several different sites. The one relatively early radiocarbon date from the Pu'u Moiwi quarry of c. AD 1250-1400 is in line with existing arguments regarding the antiquity of non-quadrangular adze types (e.g. Kirch 1985), but the reversed trapezoidal and reversed triangular types are known to have been made over a much longer time period at the Mauna Kea adze quarry (McCoy 1986, 1991) and probably elsewhere (Dye et al 1985). It is doubtful that the manufacture of non-quadrangular adzes was restricted to just the early part of Pu'u Moiwi sequence. The characterization of the Mauna Kea adze types and manufacturing technology as highly standardized is also somewhat misleading (see Figs. 37

and 38) and in need of clarification as I have noted elsewhere (McCoy 1990, 1991).

If Kirch's claims have any truth value to them it is odd that while adzes were becoming increasingly standardized other items were beginning to exhibit significant regional variability in style (Kirch 1990b). The literature indicates that Hawaiian adzes, though predominantly quadrangular in cross-section, were not all alike and hardly *monotonous*, although Kirch would probably claim that such matters are in the eye of the beholder. Brigham's and Bennett's descriptions of Hawaiian adzes are instructive in pointing to other aspects of variability that have been largely overlooked because of the preoccupation with cross-section:

> The Hawaiian peculiarity consists in the parallel sides and angular tang, but it is not to one definite shape that all Hawaiian adzes conform. For instance, the plates show that parallelism of the sides is not constant and in the larger specimens there is a wide departure, but all the while there is a strong family resemblance among them all. (Brigham 1902:74-75)

> The typical adze of Kauai differs in no way from the typical Hawaiian adz. It is rectangular in cross-section and has a tang at angle to the blade for hafting. Most of the adzes are ground and polished on the bit and the front of the blade, though in a few grinding is continued along the back and sides. The remaining parts are left rough. The cutting edge is usually straight. The sides are parallel in most adzes, though in some they diverge towards the front cutting edge, and in a few converge. (Bennett 1931:58)

> As shown by Emory...tanged adzes fall into three main classes...1. Broad, heavy adzes, with the width of the cutting edge more than 25 per cent of the length and the tang at a marked angle to the blade. 2. Narrow, heavy adzes, with the width of the cutting edge less than 25 per cent of the length. 3. Thin bladed adzes with tang at a slight angle. In class 1 the sides diverge towards the cutting edge, in class 2 they are parallel, or converge, and in 3 they diverge markedly. In Kauai

> thick bladed adzes, classes 1 and 2, are far more numerous than the thin bladed, or class 3. (Bennett 1931:58)

> There are so many adzes less than five inches long that it seemed worthwhile to group them separately. These small adzes show many deviations from the norm, but the variation is more likely due to the kind of material used than to the intent of the maker. Many chips were used for making these small adzes and the cross section of the adz depends on the shape of the chip. (Bennett 1931:58)

> Among the Kauai specimens there are a number of exceptional forms as regards polishing, shape and cross section. (Bennett 1931:60)

What is clearly in need of clarification is the concept of standardization and its putative relationship to social complexity. Cowgill has offered some useful suggestions on the subject of standardization which I think are worth quoting at length:

> Finally, I offer some suggestions about further concepts related to diversity...First, of course, is *richness*, the number of categories present. Second, is *evenness*, which expresses the extent to which the categories are represented by similar quantities of objects. A third concept is *range*, by which I mean the amount of difference between the most different categories...A fourth concept is *standardization*. This has been used too loosely, to mean several different things, including relatively low richness. I suggest that we distinguish between richness and standardization, and use the latter term to refer to low variation within categories. Fifthly, since some categories in a data set may show high standardization while other categories show low standardization, it seem worth defining *uniformity of standardization* as the extent to which some categories are more standardized than others. (Cowgill 1989:135)

> Low standardization, in contrast, as I urge we define it, means that there is considerable variation between different examples of a given category. There are at least three plausible reasons for low standardization. One is that there is simply little value placed on standardization by the culture. A second is relatively low skill, and/or conditions not conducive to uniformity of products or raw materials. A third is relatively high skill and control over techniques, which can be

> taken advantage of to vary monotony. Greater skill and greater control over materials and techniques doubtless appear when producers spend a higher proportion of their time in making ceramics (or lithics, or whatever), but low standardization, *per se*, may reflect low skill, high skill, or have little to do with skill. Even distinguishing richness and range from standardization is not enough. Studies of artifact production must take explicit account of more than this, such as sensitive indicators of skill. Unfortunately, many attempts to deal with craft production and specialization...have been seriously flawed by vagueness about some of the distinctions I have discussed. (Cowgill 1989:135)

Some of the problems that Cowgill has identified in attempts to interpret skill are evident in Kirch's characterization of the temporal changes in Hawaiian adze morphology. In saying that low standardization may signal the lack of technical specialization he is implying the lack of knowledge of local materials and requisite skill to control and thus "dominate" the raw material. Thus, for the first roughly 1100 years of Hawaiian prehistory [Kirch's Colonization and Developmental Periods] adze makers were dominated by the material and unable to produce standardized forms. One of the difficulties with this adaptationist argument is the underlying assumption that the raw material used for adze manufacture in Hawai'i was significantly different from that in the homeland to require a millennium of experimentation. As Cowgill noted, low standardization may have little or nothing to do with skill. Conversely, craft specialization is too complex an institution to be explained or identified archaeologically in terms of skill alone.

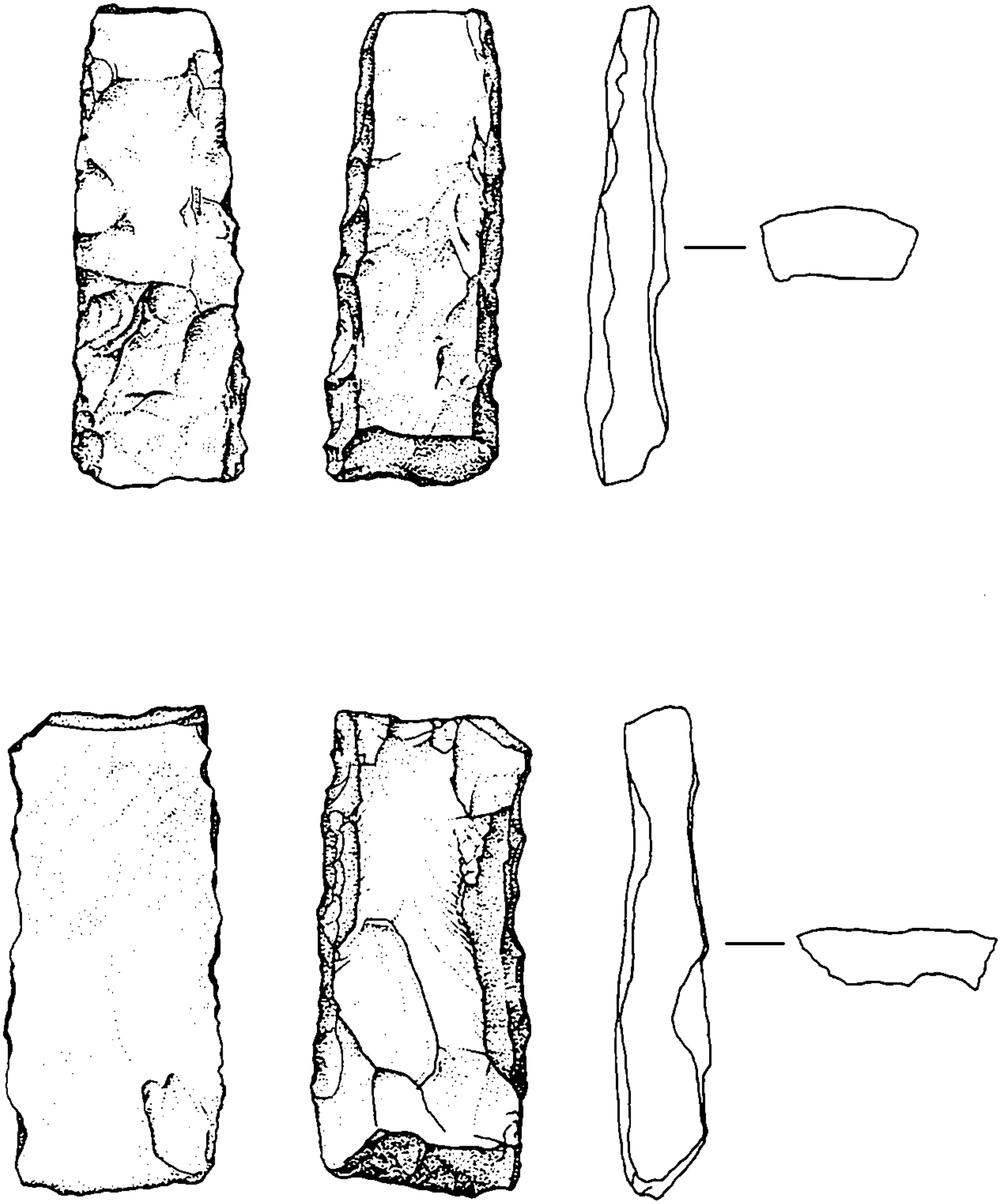

Fig. 37. Selected adze rejects from the Mauna Kea adze quarry (75% natural size).

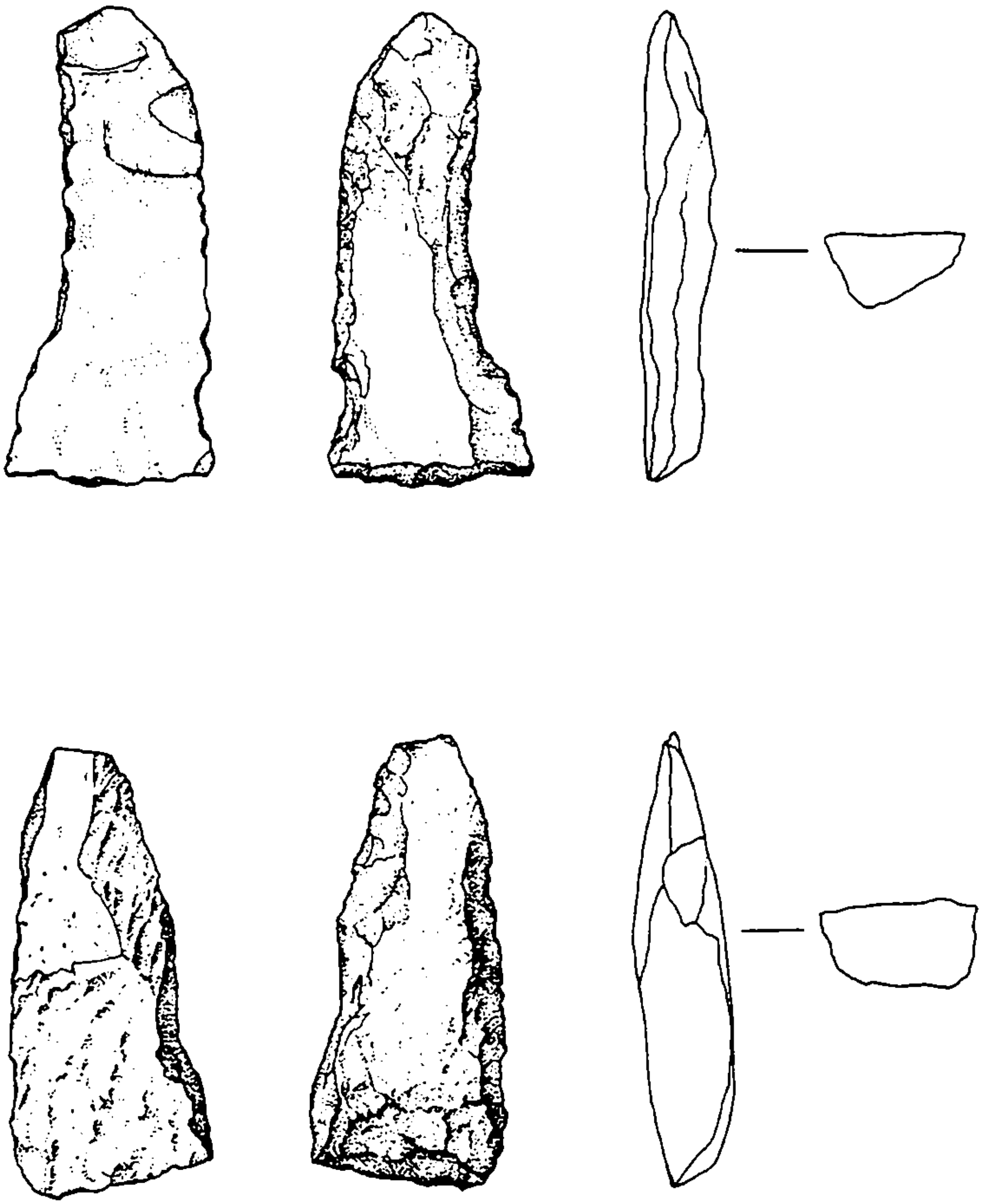

Fig. 38. Selected adze rejects from the Mauna Kea adze quarry. (75% natural size)

PRODUCTION FOR TRADE/EXCHANGE

Hommon was led to consider the possibility that at some time the manufacture of adzes at the Pu'u Moiwi quarry was organized to produce a surplus for trade or exchange. His reasons for entertaining this hypothesis and ideas about how it could be tested were put forth thus:

> As sourcing techniques for basalt are developed, it is possible that the adzes produced at the Kaho'olawe adz quarries may provide data for the study of not only intra- but also inter-island exchange systems. The Kaho'olawe adze quarries give the impression of being larger than necessary for the task of supplying adzes to the small population of this island. The rarity of adzes and adz flakes in comparison with other artifacts found on the surface tends to support this observation. Moreover, very few of the surface adzes are of the non-quadrangular forms that are common at quarry sit [sic] 108. Thus, it is possible that some portion of the output of the Kaho'olawe adze quarries were exported to other islands. (Hommon 1980b, 8:27)

> One approach to the question of export would be the attempt to support the impressionistic observation of superabundant production by studying quantifiable data such as size of the island, its population, the length of its occupation, probable size of original forests, and so forth. Obviously the most reliable evidence of inter-island adz trade would be to find Kaho'olawe adzes in archaeological contexts on other islands. The logical place to search for such evidence would be the vicinity of ancient Honua'ula district of east Maui. The legends indicate that Kaho'olawe was controlled by Maui chiefs for at least 400 years before Contact and Honua'ula lies directly across the narrow channel from Kaho'olawe. The inclusion of Kaho'olawe in the modern Makawao tax district, which includes the ancient territory of ancient Honua'ula district may be the modern expression of this ancient traditional link. If adzes were sent to Honua'ula, the settlement of Hakioawa may have served as an "export center" as well as a ceremonial and administrative center. (Hommon 1980b, 8:27)

In his overview of Hawaiian archaeology and prehistory Kirch echoes Hommon in saying that "It is likely that the preforms from these quarries were exchanged with groups on other islands, especially nearby Maui..." (Kirch 1985:150).

No sourcing analyses have been done to confirm or negate Hommon's production for trade hypothesis, although some people familiar with the "look" of the Pu'u Moiwi basalt are convinced that some adzes recovered in recent excavations on Maui are from Kaho'olawe. In the absence of sourcing analyses and a firm quarry chronology it is obviously difficult to evaluate the hypothesis. Dating is crucial since the impression of what Hommon called "superabundant production" seems to imply a short period of time or period of peak production. If that is what is implied I think the impression is mistaken given the earlier interpretation that the quarry sequence spans a period of at least several hundred years. A longer sequence implies the slow accretion of manufacturing waste, which does not preclude export of adzes to other islands.

SIGNIFICANCE

Earlier Evaluations

The Pu'u Moiwi adze quarry was clearly regarded as unimportant or marginally important in the earliest archaeological work on the island. McAllister (1933) obviously did not hold the quarry in high regard, lumping it together with several other sites in a miscellaneous category. The quarry sites were regarded as significant for the first time during the 1976-80 survey (Barrera 1978,1979;

Hommon 1980a, 1980b). Barrera emphasized the potential of the quarry sites to contribute to a general understanding of Hawaiian adze manufacture, while Hommon, who was obviously struck with the diversity of adze types and large quantity of manufacturing debris, focused on the culture-historical and possibly socio-political significance of the quarry in inter-island trade or exchange.

The Contingency of Value

The difference between McAllister's and Barrera and Hommon's significance evaluations illustrates the importance of concepts and the theory-ladenness of evaluation. The residues that comprise the quarry complex have not changed, only the importance given to them (Tainter and Lucas 1983:714). Whereas significance used to be regarded as inherent and fixed, it has become clear that it is neither, that it "is dynamic not static, and is assigned rather than revealed" (Leone and Potter 1992:139). Barbara Herrnstein Smith has put it even more forcefully:

> All value is radically contingent, being neither a fixed attribute, an inherent quality, or an objective property of things but, rather, an effect of multiple, continuously changing, and continuously interacting variables...(Smith 1988:30)

The present study has continued the evaluation process by assessing some of the original ideas about the quarry and presenting some new and different interpretations. The significance of the Pu'u Moiwi quarry sites has been variously assessed in the past and will be in the future because significance is to a large extent in the eye of the beholder (Leone and Potter 1992).

RECOMMENDATIONS

INTRODUCTION

In a 1978 report on the Mauna Kea adze quarry I remarked that "The lack of definitive boundaries, of substantive data on the quarry, and of recognition of special preservation needs has effectively precluded good management, with the result that the resource base has been largely neglected since its accord of national historic significance more than 10 years ago." (McCoy 1978:1). The same comments apply, I think, to the Pu'u Moiwi quarry complex.

The archaeological significance--research and interpretive potential-- of the individual sites that comprise the Pu'u Moiwi adze quarry complex obviously varies, but viewed as a collective whole there are great opportunities to simultaneously pursue research aims and educate the public regarding both the scientific and cultural values of this quarry. How long these opportunities will continue to exist is in my view largely dependent on the creation of a special management area and the successful development and implementation of a comprehensive management plan.

PU'U MOIWI ADZE QUARRY MANAGEMENT PLAN

The recommendation for a comprehensive management plan is not new; as noted earlier in this report, Ahlo and Hommon made a similar proposal some years ago for the whole island, but it was not accepted (Ahlo and Hommon 1980). The basis for such a plan is clear enough, especially since all of the sites are on the National Register of Historic Places. John Cleere has written in this regard that "Since the archaeological heritage is governed by legislation, which must be deemed to have been enacted in the public interest...it must be accepted as axiomatic that it should be managed in the public interest." (Cleere 1989:10)

The problem is that there are many different "publics" and thus different definitions of "public benefit" (Cleere 1989; McManamon 1991). As Cleere has noted, besides the general public, the taxpayers, whose money supports historic preservation, there is also:

> that public for whom archaeological sites and monuments are potent symbols of an indigenous culture that is threatened or submerged by an alien intrusive culture... the academic for whom the archeological heritage forms an essential resource base. The demands of these disparate groups on the archaeological heritage differ in quality and in degree, and not infrequently they come into conflict with one another." (Cleere 1989:10, 11)

The recognition that there are many different "publics", each with its own vested interests in the quarry, is the basis for recommending that the proposed plan be developed by a committee comprised of archaeologists and Native Hawaiians. The elements of this proposed plan are briefly outlined here, beginning with a discussion of the general purpose, rationale and goals of the plan.

Rationale, Scope and Goals

Though there is nothing to preclude the inclusion of a Pu'u Moiwi Adze Quarry Management Plan in other plans, the recommendation for the creation of a special management area and a separate CRMP for this site complex is based on two general considerations:

- Pu'u Moiwi is the only known adze quarry on the island of Kaho'olawe and one of relatively few known adze quarries in Hawai'i; it is for this reason alone deserving of special attention
- special preservation needs--openness, fragility [the small flakes that litter the surface are easily broken if stepped on or trampled], and susceptibility to destruction and other adverse effects, such as artifact collecting

One aim of the proposed plan is to avoid mitigation projects like the 1982 data recovery project (Rosendahl et al 1992)--to be in a position to not have to involuntarily undertake such projects. What is needed is a plan that goes beyond addressing immediate concerns--primarily the mitigation of existing adverse effects to maintain site integrity and thus the research and interpretive potential--to also include provisions for the future protection and use--both archaeological use and public use. The plan should thus address short-term and long-term concerns and advocate active rather than passive steps to ensure the protection of what many people regard as one of the most important archaeological site complexes on the island. Some of the short-term and long-term goals are:

- eliminate and reduce existing adverse impacts
- establish a program to monitor the progress of reducing and eliminating adverse impacts

- maintain site integrity and thus the research and interpretive potential of the quarry complex
- educate the public on the scientific and cultural values of stone tool quarries
- develop a plan for the modern cultural use --e.g. performance of rituals--that would avoid alteration of prehistoric remains

One function of the committee would be to consider alternative management methods, such as stewardship. Stewardship, unlike the normal governmental approach, is "an approach to land use that recognizes we are not absolute owners, but caretakers...that should not be diminished during our tenure." (Paddock et al 1988:7). There is, I think, in the case of the Protect Kahoolawe Ohana evidence of stewardship in the way it has been defined in another context as a clear sense of:

> ...connectedness--and indebtedness--in our bones; our ethical responsibility to the land then moves beyond the level of abstract idea to become a deep, emotionally based imperative. That is what land stewardship is about. At this point, an individual or a population group truly begins to care for land. Not before. (Paddock et al 1988:13)

The following remarks concerning the abysmal history of soil erosion in the United States and efforts to deal with it are germane, I think, to giving more thought to stewardship:

> Every ton of topsoil slipping seaward from its hillside home, beyond natural replacement levels, represents a failure of culture. Soil erosion is not a simple matter of poor practice or lapsed memory or bad luck due to an unlikely rain. It is the failure of us as people to comprehend that we have yet to discover America, that we have only colonized it. (Jackson 1986:ix)

> What we should have learned in the half century since the Soil Conservation Service was formed is that protection of our soil and water is not an engineering problem alone. To simply give water advice with terraces and grass waterways is an inadequate engineering trick. Applying biological methods on the

> farm alone won't do either. To the entire array of efforts already tried individually and together we now know that we must add the thoughts of those who have studied and listened to the human heart. We must add the missing content that, as Aldo Leopold said, will "change our loyalties and affections." (Jackson 1986:x)

MITIGATION

Mitigation, as it is normally defined in cultural resource management, takes three forms or approaches: (1) avoidance, (2) preservation, and (3) investigation. The comments and recommendations that follow are focused on preservation since avoidance is not a viable option and investigation is treated separately in the section on future research needs.

Preservation: Physical Maintenance and Protection

Preservation is normally defined as including both physical maintenance and protection. The difference between the two has been put thusly:

> Preservation is defined as active measures designed to avoid or reduce impacts through *physical maintenance* or *protection*. Physical maintenance prevents cultural manifestations from further deterioration or destruction; examples include stabilization and reconstruction. Protection implies long-term efforts to prevent further disturbance of archeological resources by or as a result of the project. Such measures can include covering sites with fill, asphalt, or other material, fencing, barrier construction, patrolling and monitoring, establishment of archeological preserves, and public education. (McGimsey and Davis 1977:30)

> A careful distinction must be made between site (resource) protection and preservation. For all practical purposes, the preservation of an archaeological property is not possible, since no technology exists that will arrest the natural aging process of some classes of data that a site contains. A variety of techniques are available, however, that will allow archaeologists to maintain the status quo of the

> physical setting of an archaeological property for various periods of time. They can protect a site's topographic features, they can protect the internal constituents of a site from bio-chemical degradation; and they can, with some difficulty, protect sites from vandalism and looting. Their focus then must be directed toward site stability. (Thorne 1991c:4)

Measures are needed to ensure the preservation and thus integrity of the few remaining intact deposits. The focus, as Thorne suggests, should be on stabilization.

> In an absolute sense, the preservation of archaeological sites is an unattainable goal, since the aging process of all materials is ongoing. Techniques are available, however, to retard losses to site integrity that are the result of natural and/or cultural processes. To the extent that the processes that cause these losses can be slowed, resources can be stabilized and protected, and in that sense, preserved. (Thorne 1991:1)

> Management of resources for future generations as well as the present is an objective of those mandates [local, state and federal statutory mandates], and preservation through site stabilization is a significant aspect of that process. (Thorne 1991b:1)

> Site stabilization efforts, if properly conceived, are not haphazard events but, rather, consist of a series of logically organized activities. Those efforts begin with resource evaluation and proceed through impact identification to stabilization technique selection and, finally, on to a series of monitoring and evaluation stages. (Thorne 1991c:4)

Stabilization Materials and Methods

There are any number of different materials and methods that can be used in the attempt to stabilize erosion. Some of the more popular ones are briefly noted below.

Filter Fabric

One of the newer materials used in site preservation are filter fabrics. The advantages of this material are that:

> As stabilizing materials, filter fabrics offer a number of advantages for an archaeological application. Most have sufficient elasticity to allow them to be molded to the irregular surface contours that characterize archaeological sites...Once in place, the fabric will add surface strength to an archaeological deposit and as a result, slope stability is improved. At the same time growth of surface vegetation can be encouraged (or discouraged) by selecting a material of appropriate weave, weight or porosity.(Thorne 1989:1)

Revegetation

Revegetation is a popular method of stabilizing site surfaces if for no other reason than "Budgetary constraints make the use of vegetation an especially attractive choice because of the lower cost of initial installation and post-placement maintenance." (Thorne 1990:2). The advantages of revegetation are summarized by Thorne as follows:

> The reintroduction of plants on or around an archaeological site can be one of the least visually intrusive stabilization techniques available...The use of vegetation as a means of achieving site stability can be viewed as a soft approach in comparison to the more traditional engineering approaches such as riprap or revetments...Vegetation can also effectively dissipate wind and water energy that can destroy a cultural deposit. (Thorne 1990:1)

> An assumption that must be accepted as part of most stabilization projects is that, since a significant resource is being lost, some negative effects resulting from the stabilization effort are acceptable and preferable to the continuing loss of the site. In a revegetation effort a small amount of additional site loss can be predicted before the plantings reach their maximum protection potential...The most frequently voiced objections to site revegetation center around the intrusion of roots into the cultural deposit. (Thorne 1990:3)

The contamination mentioned by Thorne has already taken place since there is and has been a grass and tree cover on these sites. The other potential "problem" with revegetation is the reduction of surface visibility. Intensive mapping and photographic documentation should be undertaken prior to planting if this method is employed.

Finally, as Thorne points out, stabilization entails continuous monitoring:

> Stabilization frequently is an intermediate step towards resource conservation. To ensure long term preservation, the effectiveness of the stabilization treatment must be checked regularly. A monitoring program must be established, and the responsibility for implementing it in a scheduled manner must be assigned to the appropriate personnel. (Thorne 1989:3)

Before choosing one or more of these alternative measures and before proceeding any further I would recommend:

- a review of the literature on site stabilization and contact with appropriate agencies and trying several different approaches to see which is the most effective

- hiring an expert consultant, such as Robert Thorne of the Center for Archaeological Research at the University of Mississippi, to work with local archaeologists and materials suitable to the local environment

Protection Measures

There are several routine protection measures that could be used. Their relative merits are briefly noted below.

Intentional Site Burial

Intentional site burial (Thorne 1991a) might be considered in the case of sites located on hardpan surfaces to prevent or slow down further erosion, but in general I am not in favor of it.

Fencing

Fencing is in my view a relatively ineffective measure in stopping vandals from looting sites.

Patrolling and Monitoring

Patrolling and monitoring may be necessary depending on the public access policy that is adopted in the future.

Archaeological Preserves

The creation of a special management area or preserve is one of the general recommendations (see above).

Public Education

The education of the public about the scientific and cultural values of the quarry is without a doubt one of the most important tasks. Some views regarding the importance of public education in cultural resource management are quoted below in support of the recommendation for the development of a public education program which is taken up again in the discussion of Public Programs:

> Of all these protective measures, public education is doubtless the most important, because it is, potentially, the most effective in the long run...(McGimsey and Davis 1977:30)

> Public education and its objective, public support, are a key to the whole undertaking. Without this, we don't stand much of a chance. (Lipe 1974:216)

> We must also convince a large segment of the public of the societal value of conserving archaeological sites. Since the passive value that the simple existence of archaeological sites entitles them to be preserved indefinitely is unlikely to appeal to large segments of the American public, we must stress the positive benefits to society that may flow from archaeological conservation. This positive approach requires that we

> convince the public that what can be *done* with archaeological sites is ultimately of value to society, and that therefore a large number of sites should be preserved now so that these activities can be continued well into the future. (Lipe 1974:216-217)

FUTURE RESEARCH

The physical condition of the quarry indicates a clear need to anticipate future needs and research questions and collect data now--even if there is no research design or set of guiding hypotheses and test implications. We can't afford the luxury of waiting and hoping that the sites won't be further eroded and collected until a management plan is developed and implemented (Schaafsma 1989:44).

Intensive Site Survey

The evaluation of previous work found it to be of uneven quality and inadequate in many respects. An intensive site survey is needed to correct deficiencies in the earlier work and bring it up to a higher standard for both management and research purposes. We need a better database in order to better interpret the meaning of the individual sites and to facilitate more meaningful inter-site comparisons. There is also a need to:

- develop a new site classification framework that makes more sense and is more workable
- experiment more with on-site data recovery and compare it with other approaches

Systematic, Representative Surface Collections

The great value of permanent collections, of course, is that they can be studied over and over from different perspectives and with new and different techniques. Representative collections of all the various classes of artifacts in the quarry [adze rejects, cores, waste flakes, and manufacturing tools] should be made using an appropriate sampling design or collection philosophy of the kind recently suggested by Sullivan, who has useful things to say as well about the matter of redundancy in sites such as quarries:

> Not only must individual collections possess characteristics that make them useful for continuing research, the aggregate sample of the archeological record preserved in collections must allow continuing study of the broadest possible range of research problems. (Sullivan 1992:4)

> While a certain level of redundancy in collected information is necessary for research purposes, excessive redundancy in collected materials may exist for some types of sites and projects. Sites with large and highly redundant sets of materials, e.g., quarry sites and brickyards, pose questions of trade-offs between large samples and costs of facility space...What constitutes a sufficient sample of material from these sites? Regional variation in the archeological record must be considered since redundancy at the regional level, e.g., regions with many quarry sites, may allow conservatism in sample size at the site level. Consideration of sample size and composition leads to a second key factor in ensuring a satisfactory database for future research--the overall representation of the archeological record in curated collections. (Sullivan 1992:4)

It is perhaps not too early to think about the curation of collections which, as Sullivan has recently been pointed out, is much more than a storage problem. It is rather a management problem:

> Because the focus of management and preservation efforts has been on intact sites, there is a tendency for archeologists and other professionals charged with management decisions concerning archeological resources, to regard curation as a "storage" problem rather than a "resource/data management" problem. (Sullivan 1992:2)
>
> As more and more of the archeological record takes the form of curated collections, these collections will need to contain the range of materials required for continued research." (Sullivan 1992:3)

Test Excavations

Test excavations should be conducted to:

- determine deposit depth, presence/absence of subsurface features, and to recover material for dating
- resolve questions regarding soil development and environmental change

Artifact Analyses

Analyses should be undertaken of existing collections, both public and private. In doing such analyses more attention should be given to problem-oriented research, such as the question posed by Torrence below regarding natural and constraints:

> What hypotheses can we generate to explain how the "nature, shape, amount" of raw material affects the way in which it could be knapped and subsequently used, how the degree of stratification of a society affects the demand for an item, in turn determining its mode of production, or how population increase affects a technology? (Torrence 1975:386)

Dating

Given the paucity of dates for the quarry and the controversy over the reliability of hydration-rind dates, more dating is badly needed to resolve many of the questions reviewed in this report. I would recommend the use of multiple dating techniques, including radiocarbon, hydration-rind, and varnish dating of surface artifacts (see Nobbs and Dorn 1993).

Sourcing Studies

Systematic mapping, description, and sampling of the lava flows and dikes in the quarry should be undertaken as the first step in resolving many of the existing questions regarding the sources of raw material. A geochemical analysis of the field samples should follow to document the degree of intra-site and inter-site variability.

Replicative Experiments

An unintended and positive result of recent catastrophic erosion was the exposure in some areas of the quarry of cobbles and small boulders of tool-quality basalt that must not have been available to the Hawaiian adze maker in the past. The cobbles and boulders provide a ready supply of raw material for replicative experiments. This material is a scarce and, thus, valuable resource and should be conserved and used in the wisest possible manner. In this regard, I recommend the formation of a committee or working group to develop a plan for the future use of this material.

PUBLIC PROGRAMS

The most direct and effective means of conveying the significance of the Pu'u Moiwi adze quarry to the public would be to develop educational programs, but considerable thought needs to be given to such a proposal. What I mean by this is conveyed in two recent thought-provoking statements on archaeological interpretation that provide what I think is a fitting conclusion to this study in the recommendation for more critical thinking about the relationship between archaeology and society:

> Archaeology's craft is to interpret the past. The archaeologist is one skilled in interpretation who provides systems of meanings between past and present which help orient people in their cultural experiences. This skill is the basis of the archaeologist's authority, for not everyone is equipped to deal with the past archaeologically. I see interpretation as a release of meaning which enables people to take the experience of the past as they wish. It is empowerment, giving people the opportunity to think through those aspects of the past which concern them, to discover new aspects, to locate these within their self-understanding. Interpretation is incitement to invent. (Shanks 1992:178)

> Many of the traditional approaches to the presentation of the past to the public are found to be constrained and limited. For example, many groups in society are alienated by archaeological representations in museums that appear too academic, analytical, descriptive, and distanced, and there is a shift from coded collections in museums to imaginative reconstructions in interpretive centers. The need to relate better to the public means we can no longer get away with throwing a fog of science over the past. We cannot limit ourselves to theories of ceramic abrasion and hunter-gatherer drop zones. And to produce piles of CRM reports with little or no analysis or interpretation cannot be publicly justifiable. Rather, we are forced to foreground interpretation and message. But as the emphasis changes from method to interpretation we are forced to ask "what message?" (Hodder 1991:40)

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GLOSSARY

Adz/Adze. "A cutting tool that has a thin arched blade set at right angles to the handle and is used chiefly for shaping wood." (Webster's Ninth New Collegiate Dictionary). The manner of hafting the blade distinguishes it from the ax/axe [see ax/axe].

Adze Reject. An unfinished adze that has been abandoned at some point in the manufacturing sequence, presumably because of breakage or some design flaw.

Assemblage. A variously defined term. In the present report it is used to refer to: (1) all of the artifacts from a site [e.g., the site 208 assemblage], and (2) all of the artifacts of a single kind or class [e.g., the adze reject assemblage]

Ax/Axe. "1: a cutting tool that consists of a heavy edged head fixed to a handle with the edge parallel to the handle and that is used esp. for felling trees and chopping and splitting wood." (Webster's Ninth New Collegiate Dictionary).

Blade. "Specialized flakes with parallel or sub-parallel lateral edges; the length being equal to, or more than, twice the width. Cross-sections are plano-convex, triangulate, sub-triangulate, rectangular, trapezoidal. Some have more than two crests or ridges. Associated with prepared cone [sic] and blade technique; not a random flake." (Crabtree 1972:42)

Blank. An ambiguous term defined in number of different ways. Crabtree (1972:42) gives two different meanings: "A usable piece of lithic material of adequate size and form for making a lithic artifact--such as unmodified flakes of a size larger than the proposed artifact...The shape or form of the final product is not disclosed in the blank. A series of objects in the early stages in the manufacturing process before the preform is reached." The term as used in this report corresponds to Crabtree's first definition and includes two kinds [cf. core blanks and flake blanks].

By-products. A general term for the waste, both deliberate and unintentional, that results from the manufacturing process. It includes cores, flakes and discarded broken unfinished tools [see debitage].

Core. "Nucleus. A mass of material often preformed by the worker to the desired shape to allow the removal of a definite type of flake or blade. Piece of isotropic material bearing negative flake scars, or scar. Cores can be embryonic--such as a piece of natural, unprepared, raw material with scar, or scars ..." (Crabtree 1972:54, 56)

Core Blank. One of two basic kinds of blanks [cf. blank].

CRM. Acronym for cultural resource[s] management.

Cultural Resources Management. "The development and maintenance of programs designed to protect, preserve and scientifically study and manage cultural resources (including evidences of prehistoric, protohistoric, historic, and recent remains) and the natural resources tat figured significantly in cultural systems. Developers of such programs may include governing bodies or agencies of government, academic and research institutions, and private corporations. The goal of such programs should be the conservation of cultural values and the maximum effective conservation and utilization of these resources for the public good." (McGimsey and Davis 1977:110)

Cultural Resources. "Districts, sites, structures, and objects and evidence of some importance to a culture, a subculture, or a community for scientific, traditional, religious, and other reasons. These resources and relevant environmental data are important for describing and reconstructing past lifeways, for interpreting human behavior, and for predicting future courses of cultural development."(McGimsey and Davis 1977:110)

Debitage. A term of French origin for manufacturing waste that is often used interchangeably with by-products [see above]. Crabtree (1972:58) defined debitage as "Residual lithic material resulting from tool manufacture. Useful to determine techniques and for showing technological traits. Represents intentional and unintentional breakage of artifacts either through manufacture or function. Debitage flakes usually represent the various stages of progress of the raw material from the original form to the finished stage."

Fabricator. A general and inclusive term for a variety of manufacturing tools, such as hammerstones and abraders.

Flake. Crabtree (1972:64) gave two definitions for this common term, but it is the second that is the most widely used and accepted: "Any piece of stone removed from a larger mass by the application of force--either intentional, accidentally, or by nature. A portion of isotropic material having a platform and bulb of force at the proximal end."

Flake Blank. One of two kinds of tool blanks [see blank].

Hardpan. "1. A hard, impervious, often clayey layer of soil at or just below the surface, produced by cementation of soil particles by relatively insoluble materials such as silica, iron oxide, and organic matter...4. A popular term used loosely for any hard layer that is difficult to excavate or drill." (Bates and Jackson 1984:230-231).

Lamellar Flake. Refers to thin, parallel-sided flakes similar to blades, but the length:width ratio is not 2:1 or greater [see blade].

NRNF. acronym for National Register Nomination Form.

Pahoa. "sharp, tapering natural stone sometimes used in ancient times as an adz blade; also a qualifying term used with *ko'i* (the general term used for all adzes)." (Summers 1971:xi).

Preform. A common but variously defined term in lithic technology. Crabtree (1972:85) used it to mean "an unfinished, unused form of the proposed artifact. It is larger than, and without the refinement of, the completed tool. It is thick, with deep bulbar scars, has irregular edges, and no means of hafting...Not to be confused with "blank." Other researchers have described stone tool manufacture as a progressive sequence from a blank to a preform to a finished product. The distinction between a blank and a preform can be a difficult matter and for that reason I have adopted the more general term tool reject, in place of preform and blank, which follows Crabtree's first definition.

Rill. "A narrow, steep-sided watercourse of small scale. It is an ephemeral feature, considerably smaller than a gully." (Whittow 1984:455).

Rill erosion. "The removal of surface material, usually soil, by the action of running water. The process creates numerous tiny channels (rills), a few centimetres in depth, most of which carry water only during storms." (Whittow 1984:455)

Saprolite. "A soft, earthy, clay-rich thoroughly decomposed rock formed in place by chemical weathering of igneous or metamorphic rocks, esp. in humid or tropical or subtropical climates. The color is commonly red or brown. Saprolite is characterized by preservation of structures that were present in the unweathered rock." (Bates and Jackson 1984:447).

Scientific Values. "The potential for using cultural resources to establish reliable generalizations about human behavior, particularly explanations of variability and change in societies and cultures. Generalizations and explanations require controlled comparison of relevant data concerning past human life. This includes such things as artifacts, settlements, food remains, and evidence for past environments. Scientific significance depends on the degree to which archaeological resources in the project area or program area contain data appropriate for answering substantive technical, methodological or theoretical questions. The value of these data should be determined in the regional context of the project or program an in relation to general anthropological problems." (McGimsey and Davis 1977:113)

Social Values. "Those values consisting of the direct and indirect ways in which society at large benefits from study and preservation of cultural resources. Benefits which should be described and included are: (1) the acquisition of knowledge concerning man's past and its potential use, (2) the acquisition and preservation of objects, sites, structures, etc. for public education and enjoyment, (3) education and economic benefits from archaeological exhibits, and (5) practical applications of scientific findings acquired through archaeological investigations." (McGimsey and Davis 1977:113-114)

Upright. An archaeological term for what the Hawaiians called *'eho* or *pohaku 'eho*, a term that was also used for boundary markers and bird cooking stones (cf. Brigham 1902; Buck 1957; Emory 1938; Summers ms.; McCoy 1991).