INTRODUCTION

Over the past two decades stratigraphic excavation in the South Point area on the Island of Hawai'i, has produced a wealth of archaeological data. Archaeological data from the South Point area have been the basis for seriation and relative chronology of fishhook types and subsequent theories concerning the origin and migration of Polynesians to Hawai'i. However, while several archaeological components were successfully dated by means of radiocarbon analysis, other important sites remained undated.

Problems with the radiocarbon dating for site H-1, and a reassessment of available dates was published by Emory and Sinoto (1969) followed by a publication by Green (1971). Both publications assigned approximate temporal chronologies, but they were not in total agreement. Sites at Mahana Bay, near South Point, remained undated; these sites contained artifact types indicative of a significant time-depth, and absolute dates were crucial in any synthesis of a prehistoric sequence.

The advent of hydration-rind dating of basaltic-glass artifacts in the Hawaiian Islands has provided an efficient, inexpensive, precise dating method. This method was applied by the author, who saw the beginnings of this project.

THEORY AND METHOEDOLGY

Glass is essentially a super-cooled liquid which, for the most part, is not in equilibrium with its environment. As a consequence, glass changes in state toward a more stable substance through a geochemical process known as hydration. The resulting product of the weathering of basaltic-glass is an amorphous, clay-like substance, palagonite.

With regard to the progressive palagonitization of basaltic-glass, Morgenstein and Riley (1974) have concluded that following occurs:

1. Water enters the glass structure via small capillary channels developing the "mist zone,"
2. an immobile product layer then develops from the mist zone, and
3. when there is an increased and sufficient quantity of water in the immobile layer it converts to a band of palagonite of the same thickness as the original mist zone.

Hydration is not interrupted during the process. A new mist zone enters the fresh glass, even as the original mist zone develops into an immobile product layer. Therefore, the palagonite band thickness is directly related to the period of hydration. The hydration rate of Hawaiian basaltic-glass has been established at 1.177 micrometers per 100 years (Morgenstein and Riley, 1974). A hypothetical rate was confirmed by measurement of palagonite bands of glass specimens from historic lava flows on the Island of Hawai'i.

In order to obtain archaeological dates, i.e. dates of human modification, basaltic-glass artifacts are cut perpendicular to the flaked surface and thin-sectioned so that the palagonite layer can be observed and measured under the microscope. All dates reported in this paper represent one standard deviation with no less than five measurements to no more than ten. Measurements were taken on more than one hydration layer when present. Basaltic-glass artifacts prepared and dated by this author were selected from significant levels of H-1 and the Mahana Bay sites.

BASALTIC-GLASS ARTIFACTS

Flaked basaltic-glass provides a sharp edge which could have served to cut hair, plant and fibrous materials. Barrera and Kirch (1973) suggest that these core and flake tool assemblages could have been utilized in food preparation, fine woodworking, or simply as a prehistoric "pocket-knife," to use a modern analogy. Further research of edge damage patterns on basaltic-glass artifacts must be undertaken in order to more fully understand the function of these ubiquitous tools.

EARLY PREHISTORIC CHRONOLOGY IN HAWAII

A tentative summary of prehistoric Hawaiian chronology must begin with a mention of the Bellows Beach site (018), on Windward O'ahu, currently the earliest known site in the Hawaiian Islands (see Kirch, 1974:111). The available dates, established by hydration-rind dating and radiocarbon age-determinations, place 018 within a temporal range of c. A.D. 400 to A.D. 900. The artifact assemblage recovered from 018 provides important implications concerning the origin of Polynesian settlers to Hawai'i, and incipient cultural adaptations to the Hawaiian environment. Although 018, most likely,
does not represent the earliest Hawaiian site, it is indicative of an assemblage closely related with the "archaic" Eastern Polynesian artifact types (see Sinoto and McCoy, 1975:143-186 and Kirch, 1975:65).

Data from Hālawa Valley, Moloka'i, site Al-3 have provided further evidence for the origin and cultural adaptations of early Polynesian settlers in Hawai'i, with earliest settlement at c. A.D. 600 in an ecologically-focal location (Kirch, 1971a, 1971b, 1974, and 1975). Significant discoveries at site Al-3 include a round-ended house and early or adaptational artifact types for the Hawaiian archipelago.

Two very important sites have been mentioned concerning early Hawaiian prehistory. Stratigraphic excavation has revealed relatively few early components, i.e. A.D. 400 to A.D. 1000. Kirch (1975:64) suggests that "under normal intrinsic rates of population growth, population size (and hence the total number of occupation sites) would remain low for 400 or 500 years following colonization." This demographic consideration explains the relatively numerous excavated sites with components dating c. A.D. 1000 to the post-contact period. Significant sites with early components include: Wai-'Ahukini Site H-8, c. A.D. 750 (Sinoto and Kelly, 1975), Kuli-'ou'ou Shelter Site 01, c. A.D. 1000 (Emory and Sinoto, 1961:14), Nihoa Island, A.D. 890±90, Hale-a-ka-lā Crater, c. A.D. 800 (exploitation of andesitic basalt for adz manufacture) (Kirch, 1974:117), and 'Anae-ho'omalu c. A.D. 900 (Barrera, 1971:102). The remainder of this paper provides new data which may be included in the correlation of early, or other wise significant archaeological components.

THE PU'U-AL'I SAND DUNE SITE, H-1

Site H-1 is located approximately 0.4 kilometers from South Point proper. Excavation of H-1 was undertaken throughout the 1950's and interpreted as a fisherman's workshop (Emory, Bonk, and Sinoto 1968). The cultural deposit yielded over 1,710 fishhooks, most of which were early types for the Island of Hawai'i, Emory, Bonk, and Sinoto (1968) provide an analysis of these recoveries.

Radiocarbon analysis of organic samples from H-1 produced inconsistent dates, which seem to indicate contamination. However, Emory and Sinoto (1969:13) established, from the radiocarbon dates, an estimated duration of occupation from c. A.D. 1250 to c. A.D. 1600. Emory and Sinoto conclude the following:

It is not possible to determine accurately the duration of the fisherman's establishment at H-1 from the radiocarbon dates alone. They do,
however, when viewed along with the cultural evidence, and when compared with radiocarbon dates from site H-8, allow for a minimum estimate of 200 years and a maximum of 400 years for its occupation.

It seems that the best we can do in the present state of our knowledge is to think of the fishermen at South Point as having set up their establishment not earlier than A.D. 1000, and having continued its occupation to about A.D. 1350.

Emory and Sinoto's suggested temporal chronology of H-1 is comparable to initial hydration-rind age-determinations, which provide evidence of occupation beginning c. A.D. 967±63 to abandonment, c. A.D. 1395±27 (Table 1.).

Table 1. Hydration-Rind Dates for South Point H-1

<table>
<thead>
<tr>
<th>Provenience</th>
<th>Depth (inches)</th>
<th>Date (A.D.) ± σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>H9</td>
<td>lowest 6</td>
<td>967±63</td>
</tr>
<tr>
<td>I3</td>
<td>lowest 5</td>
<td>1023±19</td>
</tr>
<tr>
<td>G16</td>
<td>6½-8</td>
<td>1154±50</td>
</tr>
<tr>
<td>L15</td>
<td>0-6</td>
<td>1395±27</td>
</tr>
</tbody>
</table>

MAHANA BAY SITES

The Mahana Bay sites, 4.5 kilometers northeast of South Point proper, are located in an environment adjacent to a rich maritime ecosystem. These sites are discussed in order of absolute chronology.

Mahana Bay site MB-1 comprises c. 47 square meters enclosed by a single course stone alignment, somewhat square in shape. Vertical excavation of c. 30 square meters has revealed coral pebble paving, hearths, postmolds, and stone working surfaces. The cultural deposit is between 20 to 35 cm in depth. The major midden component is that of edible molluscs, recovered at all levels of the site. Portable artifacts recovered are basically associated with exploitation of marine resources. In addition, post-European artifacts of metal and glass were recovered in the upper levels of MB-1. The earliest date for MB-1 was obtained from a square located directly outside of the enclosing
stone alignment, and probably represents the locus of an earlier structure, which has been eroded away by weathering and tidal action.

Table 2. Hydration-Rind Dates for Site MB-1

<table>
<thead>
<tr>
<th>Provenience</th>
<th>Depth (cm)</th>
<th>Date (A.D.) ± σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW60</td>
<td>34</td>
<td>935±50</td>
</tr>
<tr>
<td>NE72</td>
<td>12-14</td>
<td>1737±23</td>
</tr>
</tbody>
</table>

Mahana Bay site MB-4 comprises a rectangular area of c. 110 square meters enclosed by a stone wall ranging from a ground-level alignment to 1.50 meters in height. Vertical excavation has revealed a cultural deposit between 20 to 60 cm in depth, including features such as hearths, stone-slab paving, pebble paving, postmolds, wall storage vaults, and a feature best interpreted as a stone "anvil" working surface. Portable artifacts are primarily associated with procurement of marine resources. Diagnostic material-culture traits from MB-4 may be compared with other early sites in the Hawaiian Islands. These include: fishhooks with HT1 head-types, some of pearlshell, a type 1 pig-tusk pendant (Cox, 1967), and intrusive postmolds revealed at the lowest sector (in sterile volcanic-ash) of MB-4 could be interpreted as evidence of a round-ended house form, comparable to those discovered by Kirch (1971a, 1971b, 1975) at Hālawa Valley, Moloka'i. Post-European artifacts, such as bent-nail fishhooks and glass trade beads provide evidence of occupation into the historic period.

Table 3. Hydration-Rind Dates for Site MB-4

<table>
<thead>
<tr>
<th>Provenience</th>
<th>Depth (cm)</th>
<th>Date (A.D.) ± σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>NW49</td>
<td>32-24</td>
<td>981±105</td>
</tr>
<tr>
<td>NW48</td>
<td>24-26</td>
<td>1276±33</td>
</tr>
<tr>
<td>NW47</td>
<td>20-22</td>
<td>1419±27</td>
</tr>
</tbody>
</table>

Mahana Bay site MB-6 consists of a collapsed lava tube with a crude stone terrace at the entrance of the cave. Midden remains cover an area of about 10 square meters.
Cultural deposits have filtered down through loose stones of the terrace, making stratigraphic excavation impossible. However, the artifact assemblage from MB-6 indicates emphasis on procurement of marine resources. The salient attribute of MB-6 is water seepage in the interior chamber; here gourd fragments were recovered, which indicate that MB-6 served as a source of potable water for inhabitants of Mahana Bay. Currently, the earliest date for MB-6 is A.D. 1460±27, but MB-6 was undoubtedly exploited much earlier as a water source. A basaltic-glass artifact, dated A.D. 1649±24 was recovered with pig and chicken remains and, by inference, is associated with agricultural systems.

Table 4. Hydration-Rind Dates for Site MB-6

<table>
<thead>
<tr>
<th>Provenience</th>
<th>Depth (cm)</th>
<th>Date (A.D.) ± σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midden, cave entrance</td>
<td>---</td>
<td>1460±27</td>
</tr>
<tr>
<td>Midden, cave entrance</td>
<td>---</td>
<td>1649±24</td>
</tr>
</tbody>
</table>

Mahana Bay site MB-3 consists of a roughly square enclosure of c. 41 square meters with stone walls approximately 1 meter in height. Vertical and horizontal excavation has revealed large stone-slab paving, basalt pebble paving, post-molds, and a large square stone hearth near the center of the walled enclosure. Unfortunately, a complete quantitative midden analysis is not yet available for MB-3. However, a significant midden component is pig remains recovered from several levels throughout the site. The presence of pig, by inference, provides evidence of dependence upon agricultural systems.

The artifact assemblage is indicative of late prehistoric types. Several historic artifacts were also recovered, including large quantities of glass and metal fragments.

Table 5. Hydration-Rind Dates from Site MB-3

<table>
<thead>
<tr>
<th>Provenience</th>
<th>Depth (cm)</th>
<th>Date (A.D.) ± σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>NE72</td>
<td>40-42*</td>
<td>1680±41</td>
</tr>
<tr>
<td>NE42</td>
<td>38-40</td>
<td>1725±31</td>
</tr>
</tbody>
</table>

* lowest sector of cultural deposit
THE TEMPORAL SEQUENCE: TENTATIVE CONCLUSIONS

The establishment of an absolute chronology, correlated with archaeological data, provides a framework for a preliminary discussion of prehistoric subsistence, residence patterns, and cultural change.

Earliest settlement in the Hawaiian Islands has been characterized as permanent habitation restricted to choice locations focal to several microenvironments. It has been conjectured that these small permanent settlements were involved in a wide range of economic strategies.

Wai-'Ahukini Shelter site B-21-6 (H8), with an early radiocarbon date of c. A.D. 750, is within the period characterized as "early." But, in all probability, this date only represents initial sporadic occupation in the South Point area. The primary economic motive was exploitation of rich marine resources, most likely, no horticultural activities were undertaken within this earliest period.

The period of initial permanent or semi-permanent settlement within the area seems to have begun c. A.D. 900. Archaeological data clearly provide evidence for maritime exploitation throughout the South Point area sequence. From c. A.D. 900 to c. A.D. 1600, horticultural activities were marginal in nature*, possibly such as those mentioned by Handy and Handy (1972:562):

> Formerly in this whole seaward area.... there were coconut trees, taro, and sweet potatoe and gourd gardens maintained by the fishing families that dwelt there.

Conjecturally, early inhabitants at Mahana Bay were involved in maritime exploitation associated with marginal supplementary horticultural endeavor. From the early to the late prehistoric periods, the subsistence pattern at Mahana Bay seems to shift from a maritime to a terrestrial resource emphasis. This is the predominant pattern among several Polynesian settlements within physically diversified insular environments (Yen 1971; Tuggle and Griffin 1973; Kirch 1973b). The earliest evidence for agricultural activities and related animal husbandry associated with the Mahana Bay sites is A.D. 1649±24, i.e. using pig bones as indirect evidence of agriculture.

Under the conditions of intrinsic population growth, more sites (including those in coastal areas) should be

* Based on Mahana Bay data, synthesis of H-1 horticultural associations is not possible at this time; a complete report of excavation of H-1 is not yet available.
occupied in the late prehistoric periods. Although at Mahana Bay this may not be the case. By about A.D. 1600 some sites may have been abandoned as places of semi-permanent habitation, with only sporadic or seasonal occupation continuing. This abandonment, in all probability, could have resulted from dispersed residency to the upland areas of intensive cultivation and animal husbandry. Groups which continued to occupy coastal sites into the late prehistoric period had probably established trade relations with upland settlements. The ethnographic record suggests trade relations with the same non-unilineal descent group (ʻōhana).

The dispersed residency trend is documented not only at Mahana Bay, but also with the absolute date of A.D. 1523±15 (the earliest date currently known) from a habitation site in Wai-ʻōhinu Valley (Kelly and Crozier, 1972). In addition, the ethnohistorical accounts generally describe Wai-ʻōhinu Valley as the locus of dense population and intensive cultivation. It is not argued, however, that Wai-ʻōhinu is the specific location of agricultural associations for the South Point area, these data only serve to exemplify the model presented. The plains of Kamā'oa were, in all probability, under dryland cultivation, as were several upland slopes where temperature, soil, and precipitation allowed.

Site MB-3 (A.D. 1680±41 to c. A.D. 1900) was probably the permanent residence of a local high-ranking individual. The predominance of pig bones recovered from most levels throughout the site suggest economic differentiation and, by inference political status, or social ranking. Artifactual material supports this conclusion; e.g. a lei niho palaoa pendant (made of pig-tooth) was recovered.

In light of the data presented, three phenomena, subsequent to c. A.D. 1600, are correlated for Mahana Bay:

1. Advanced cultural adaptations to the terrestrial ecosystem with increasing emphasis on intensive cultivation and animal husbandry systems.
2. The development of economic and social differentiation.
3. Dispersed residency from maritime to terrestrial ecosystem according to specialization of labor, i.e. a portion of the population shifting from coastal to upland habitation.

This postulated model seeks only to synthesize the prehistoric sequence of Southern Ka'ū, specifically Mahana Bay; it is not an attempt at an all-embracing scheme for the Hawaiian Islands. As Kirch (1973a) reminds us, it is only through increased low-level synthesis that we will be able to discern the more general trends of cultural development in the Hawaiian archipelago.
Acknowledgements

It is indeed a pleasure to thank those individuals who made this project possible. I would especially like to thank Dr. H. David Tuggle for initial guidance and encouragement. My sincere thanks also go to Dr. Joseph B. Halbig and Mr. Larry Olson whose expertise allowed my work to commence and to Mr. William Bonk who kindly allowed access to archaeological material. I am also sincerely grateful to Drs. Patrick V. Kirch, Patrick C. McCoy, and Yoshihiko H. Sinoto for their valuable suggestions, guidance, and encouragement. I also wish to thank Dr. James F. Downs, Ms. Sabra W. Downs, Dr. Carol A. B. Link, and Dr. Michael McCrae for their valuable suggestions.

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