

# *Lā'au Hawai'i*

## TRADITIONAL HAWAIIAN USES OF PLANTS



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# The First Hawaiians and Their Plants

*Ke Kaa a Pele i Haawi ia  
Ka-moho-alii i ka Haalele ana ia Kahiki*

*Ku makou e hele me ku'u mau poki'i aloha,  
Ka aina a makou i ike ole ai malalo aku nei,  
A'e makou me ku'u poki'i, kau i ka wa'a;  
No'iau ka hoe a Ka-moho-alii;  
A'ea'e, kau ia ka nalu—  
He nalu haki kakala,  
He nalu e imi ana i ka aina e hiki aku ai.  
O Nihoa ka aina a makou i pae mua aku ai:  
Lele a'e nei makou, kau i uka o Nihoa.*

*Pele's Account to Kamohoalii  
of the Departure from Kahiki*

We stood to sail with my kindred beloved  
To an unknown land below the horizon;  
We boarded—my kinsmen and I—our craft,  
Our pilot well skilled, Ka-moho-alii.  
Our craft o'ermounted and mastered the waves;  
The sea was rough and choppy, but the waves  
Bore us surely on to our destined shore—  
The rock Nihoa, the first land we touched;  
Gladly we landed and climbed up its cliffs.

— from N. B. Emerson, *Pele and Hiiaka*

THE PEOPLES of Polynesia, including the Hawaiians, emerged from an earlier people known as the Lapita, who spread eastward into the Pacific from their homelands in northwestern Melanesia. Their journeys east through Melanesia started perhaps as early as 1600 B.C., reaching Fiji about 1400 B.C., Tonga between 1200 and 600 B.C., and Samoa between 1000 and 300 B.C. It is remarkable that this migration to western Polynesia, covering a distance of some twenty-five hundred miles and consisting of voyages from one isolated and unknown island group to another, was accomplished in such a short period.

Clearly the Lapita were a maritime people. Archaeological excavations along the route of their migration reveal that they preferred coastal sites, selected to facilitate the launching and beaching of large canoes.<sup>1</sup> They were expert navigators and canoe handlers, exploiting currents and seasonal winds to facilitate travel back and forth within their South Pacific domain. Two-way voyaging routes allowed exchanges among Lapita communities in Melanesia, as evidenced by recovery of obsidian artifacts from Lapita sites throughout the region. A volcanic glass that the Lapita treasured as a material for cutting tools, obsidian is rare in Melanesia, occurring naturally only in New Britain, northeast of New Guinea.<sup>2</sup>

Even more characteristic of the Lapita people is their reddish pottery, stamped with toothed implements, tem-

pered with sand or crushed shell, and fired at low temperatures in open fires. Decorated with horizontal bands, diamonds, scallops, circles, and chevrons, Lapita pottery is distinctive from other ceramic ware of the times and is the hallmark of the culture. A group of decorated shards, dredged from a lagoon in Western Samoa and dated ca. 1000 B.C.,<sup>3</sup> marks the easternmost point of known Lapita settlement.

Apparently the Lapita pottery tradition died out in Samoa and was eventually supplanted by undecorated pottery, for about one thousand years later,<sup>4</sup> makers of plain pottery traveled northeast from Samoa and settled the Marquesas Islands. Their descendants went on, in turn, to settle other parts of Polynesia during the next several hundred years, but they left their plainware at home. No pottery has been found in Polynesia east, north, or south of the Marquesas, though other Polynesian island groups, including Hawai'i, had clay suitable for ceramic uses.

While the direct reach of Lapita culture may be defined by its pottery, the influence of this founding people extended much farther and can be seen in many key aspects of later Polynesian cultures. The Lapita heritage is evident particularly in aspects of material culture common throughout Polynesia, notably in shell tools (adzes, chisels, and scrapers), tattooing instruments, and octopus lures. Remains of domesticated animals such as pigs and chickens, both creatures of Eurasian origin, are characteristic of Lapita excavations.<sup>5</sup>

so it seems safe to conclude that Lapita voyagers were responsible for introducing these species at least into western Polynesia, if not beyond.

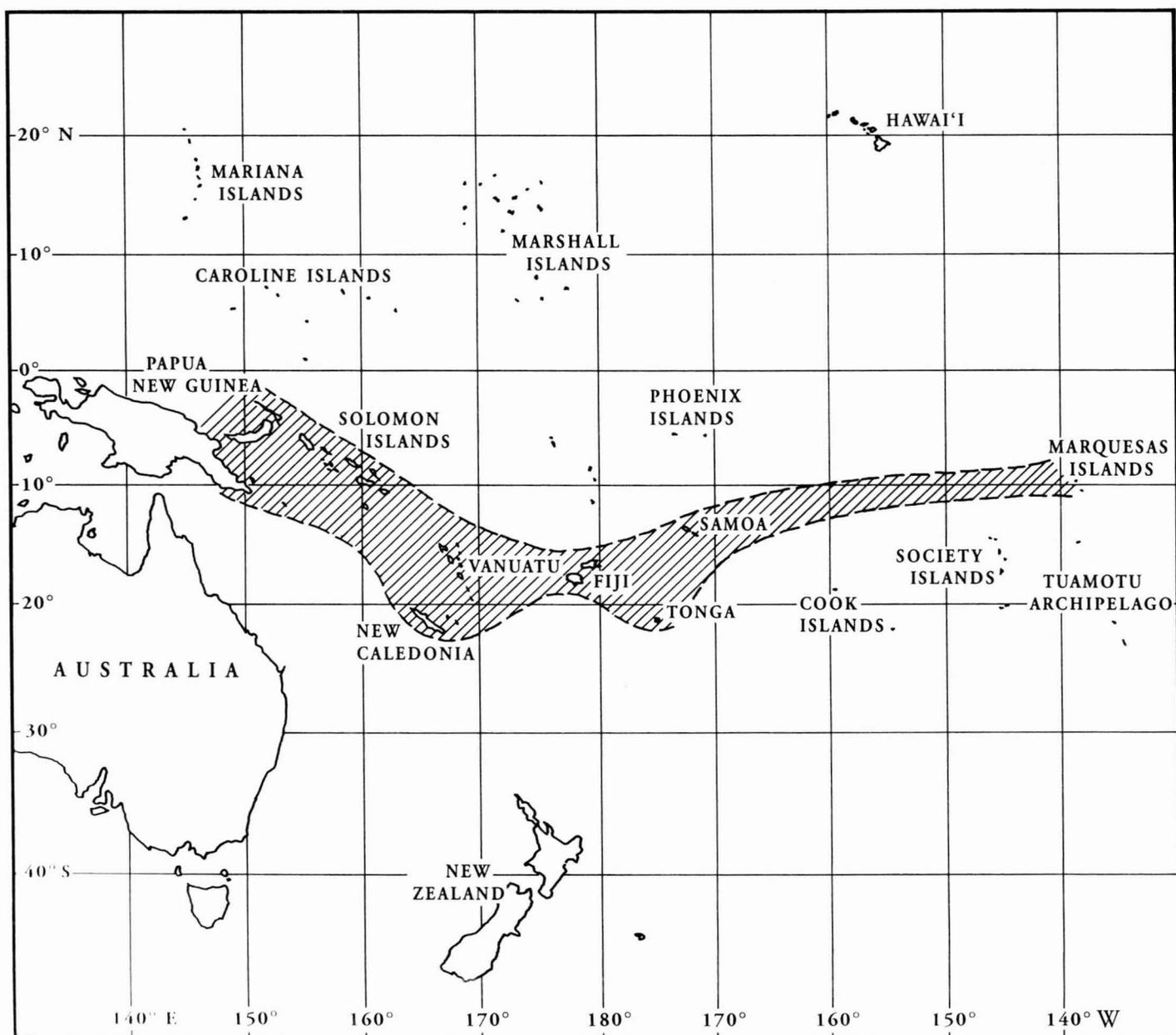
### Early Food Plants of the South Pacific

Unfortunately, the archaeological record for Melanesia and Polynesia contains little direct evidence of early food plants, since these tend to decompose swiftly and completely in tropical locales.<sup>6</sup> Artifacts unearthed at Lapita sites, however,

Fig. 1. The theoretical path of Lapita migration from the region of eastern New Guinea to Fiji, Tonga, and Samoa before eventual arrival in the Marquesas Islands.

furnish indirect information about commonly prepared foods. The presence of shell peelers and scrapers suggests the consumption of crops like taro and sweet potatoes, while pits found near habitation sites seem likely to have been used (as they still are today in some parts of Oceania) for the storage of fermented breadfruit, bananas, or taro.

The Lapita people probably foraged for some of their plant foods<sup>7</sup> and tended others — batches of yams, for example — where they occurred in the wild. The stone tools that they left behind also suggest that they practiced swidden or “slash-and-burn” cultivation, in which fires are lit to clear vegetation before planting or to take in the harvest. Over time, repeated burning results in declining yields, forcing a shift in location, but the advanced forms of swidden farming employed in pre-contact Hawai'i and in modern New Guinea



afford a very high crop output for each hour of labor.

Joining the archaeological data with botanical information about the geographic origins of Pacific food plants, one obtains a reasonably clear picture of the crops that the Lapita consumed and rooted in the soils and cultures of Polynesia. At a minimum, by 1000 B.C. they had carried as far as western Polynesia five food plants of Southeast Asian origin: taro, yam, breadfruit, bananas, and sugarcane. Other likely candidates are the twenty-nine plants listed in Table 1, which their descendants spread throughout the Pacific.

A number of these common Pacific plants had applications for clothing, containers, building supplies, and other uses, but most of them were food plants first and foremost. Like tropical food plants in other parts of the world, they are markedly different from their counterparts in temperate regions. The plants that served as abundant sources of carbohydrates for islanders of the tropical Pacific were all from plant families uncommon in colder areas. Taro, sweet potatoes, and breadfruit, for example, belong to the arum, morning glory, and fig families, whereas the staple crops of the temperate zone—wheat, corn, barley, millet, rice—all are members of the grass family.

### Polynesian Migrations and Plant Dispersal

No student of Pacific peoples would doubt that the Lapita and their descendants carried their most important plants along on the voyages of exploration and expansion that resulted in the settlement of Polynesia. It is conceivable that a few of the key species, such as *hau* (*Hibiscus tiliaceus*), established themselves in island groups without human assistance, but this set of plants could not have consistently colonized the Pacific islands by means of the winds, the currents, and other non-human agents. By the time Polynesian settlers made their longest trips, clearly they knew how to pack, tend, and propagate their basic plants, for those plants were established in even the most remote points of Polynesia—Easter Island and Hawai'i—when Westerners first arrived.

The transition from Lapita to Polynesian culture was well under way by the beginning of the Christian era, when settlers from Samoa landed in the Marquesas Islands, but a great deal remains to be learned about the evolution of Polynesian culture beyond that date. Migrations to other archipelagos continued during the next several centuries in a sequence that has not yet been agreed upon. In the course of this period, a distinctively Polynesian culture emerged and was dispersed, along with most of the basic Pacific plant stock, to all the islands now recognized as constituting Polynesia—a broad arc curving from New Zealand in the southwest to Hawai'i in the northeast.

Similarities in artifacts, skeletal traits, and language indi-

**Table 1**  
**Plants Introduced to the Pacific Islands**  
**by Early Human Migrations**

Common English/Hawaiian Name	Scientific Name
<b>Trees, shrubs, and vines</b>	
banana, <i>mai'a</i>	<i>Musa acuminata</i> hybrids
betel nut	<i>Areca catechu</i>
betel pepper	<i>Piper betle</i>
breadfruit, <i>'ulu</i>	<i>Artocarpus altilis</i>
coconut, <i>niu</i>	<i>Cocos nucifera</i>
gourd, <i>ipu</i>	<i>Lagenaria siceraria</i>
<i>hau</i>	<i>Hibiscus tiliaceus</i>
<i>kamani</i>	<i>Calophyllum inophyllum</i>
<i>kou</i>	<i>Cordia subcordata</i>
<i>kukui</i>	<i>Aleurites moluccana</i>
<i>milo</i>	<i>Thespesia populnea</i>
<i>noni</i>	<i>Morinda citrifolia</i>
<i>'ohi'a 'ai</i>	<i>Syzygium malaccense</i>
<i>'ohe</i>	<i>Schizostachyum glaucifolium</i>
sago palm	<i>Metroxylon</i> spp.
sugarcane, <i>kō</i>	<i>Saccharum officinarum</i>
paper mulberry, <i>wauke</i>	<i>Broussonetia papyrifera</i>
Tahitian chestnut	<i>Inocarpus fagifer</i>
<b>Tuber and root crops</b>	
<i>'ape</i>	<i>Alocasia macrorrhiza</i>
<i>awapuhi</i>	<i>Zingiber zerumbet</i>
kava, <i>'awa</i>	<i>Piper methysticum</i>
kudzu	<i>Pueraria lobata</i>
Polynesian arrowroot, <i>pia</i>	<i>Tacca leontopetaloides</i>
pulach	<i>Cyrtosperma chamissonis</i>
turmeric, <i>'ōlena</i>	<i>Curcuma longa</i>
taro, <i>kalo</i>	<i>Colocasia esculenta</i>
<i>tī</i>	<i>Cordyline fruticosa</i>
sweet potato, <i>'uala</i>	<i>Ipomoea batatas</i>
yams (5 main species)	<i>Dioscorea</i> species

Source: Adapted from Jacques Barrau, "Witnesses of the Past: Notes on Some Food Plants of Oceania," *Ethnology* 4 (1965), p. 288.

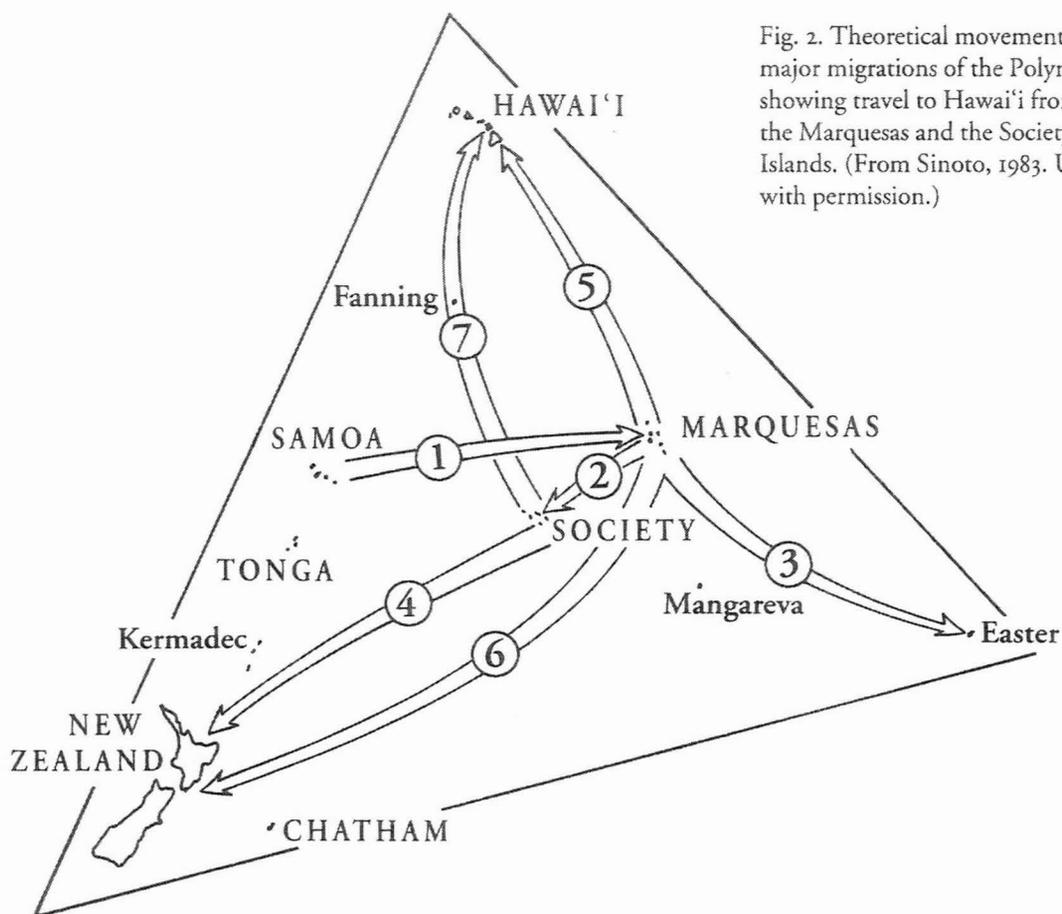


Fig. 2. Theoretical movements and major migrations of the Polynesians, showing travel to Hawai'i from both the Marquesas and the Society Islands. (From Sinoto, 1983. Used with permission.)

cate that Hawai'i and Easter Island were probably settled from the Marquesas, and it is not surprising that when Europeans first reached Easter Island in 1722 they found its people cultivating many of the same plants that Cook and his men would find in Hawaiian gardens sixty-six years later: sweet potatoes, yams, taro, bananas, sugarcane, gourds, and the paper mulberry tree.<sup>8</sup> Ships' records also show that the people of Easter Island had chickens but no pigs or dogs, though both were common introductions elsewhere in Polynesia.

### Arrival of Polynesians and Their Plants in Hawai'i

The Hawaiian archipelago is not only the northernmost point of Polynesian settlement but also the most isolated, about eight hundred miles from the nearest land (Johnston Atoll) and twenty-three hundred miles from the nearest continent. Micronesians of the Marshall and Line Islands are closer neighbors geographically than the Polynesians, but there is nothing in the archaeological record to suggest that

Micronesian canoes ever reached Hawai'i. This makes it all the more remarkable that Marquesan voyagers did so and perhaps as early as A.D. 300, a date established by carbon dating of materials excavated near Waimānalo on the island of O'ahu and at a site in Kawainui Marsh, a little to the north on the same island.

Over many million years, the isolation of Hawai'i resulted in a native flora and fauna spectacular for their uniqueness. Biologists divide native plants and animals into two groups — those that are endemic (found in one place only) and those that are indigenous (found in more than one locale but established in a given place without human intervention). Ordinarily, indigenous plants easily outnumber endemics, but in Hawai'i the reverse is true. Derral Herbst, co-author of the *Manual of the Flowering Plants of Hawaii*, calculates that of 957 species of flowering plants native to Hawai'i, 851 (89 percent) are endemic while 106 species (11 percent) are indigenous, which is one of the highest ratios of endemic to indigenous plant species anywhere on earth. Against this background of botanical uniqueness, Polynesian introductions can be reckoned with a great deal of confidence.

Of the twenty-nine plants that the peoples of Oceania introduced to the Pacific islands in prehistoric times (Table 1), only half a dozen were not established in Hawai'i prior to 1778.<sup>9</sup> The absent six were sago palm, betel nut, betel pepper, Tahitian chestnut, pulach, and kudzu. Of course, some or all of these may have been brought to Hawai'i but failed to take root in their new environs due to the stress of the long journey from the Marquesas or for some other reason. Thirteen additional non-native plants were counted at the time of Western contact,<sup>10</sup> but most of them were not useful, some qualifying as weeds.

Apart from species introduced accidentally, plants brought by the settlers must have been ones important to them in their previous home. If a plant had not proved its usefulness in the Marquesas, it is extremely unlikely that it would have been given space in canoes laden with people, pigs, dogs, chickens, water, and food stocks to be eaten en route. In Hawai'i, we have ample records of use for all but a few of the Polynesian introductions, namely, *'ape*, *'awapuhi*, and *pia*. *'Ape* is said to have been eaten as a famine food;<sup>11</sup> very few uses are recorded for the other two. Hawaiians, like other indigenous peoples all around the world, utilized a broad array of plants for herbal medicine, and these three species may have had some unknown use of that kind. Or perhaps they were brought along because they served aesthetic or ritual purposes now lost.

Of the thirty-six plants that are almost surely Polynesian introductions, only two — *kukui* and *hau* — now rate designation as invasive plants (weeds). In all likelihood, even these two have attained this status only because today they are not as heavily used as they were by the early Hawaiians. The *kukui* kernels were used for oil (especially for lights), paint, food, and medicine, and harvesting of seeds for all these uses would have served as a natural control on the spread of this plant, whose seeds have a germination rate of nearly eighty-five percent. *Hau* bark, likewise, had numerous uses — for rope, coarse nets, medicine, fire-making, canoe booms and floats, and cordage for *lei* — uses that would have led to a continuous thinning and cutting back of these densely branching trees.

The six woody tree species that the Polynesians are thought to have introduced — *hau*, *kamani*, *kou*, *kukui*, *milo*, and *'ohi'a 'ai* — and the vine *Lagenaria siceraria*, which produced their gourds, would have created no transportation difficulties, for their seeds could have been easily carried, as could the seeds (the fruit) of coconut and *noni*. The remaining species would all have had to come as vegetative propagules — the corms or *buli* of *kalo* and *'ape*; the underground rhizomes of *'awapuhi* and *'ōlena*; the underground tubers of the yams, *'uala*, and *pia*; the underground stems of *'ohi'a*; the root shoots of *mai'a*, *'ulu*, and *wauke*; the stems of *ti*, *ko*, and *'awa*.<sup>12</sup>

It was fortunate for the Polynesians that they brought

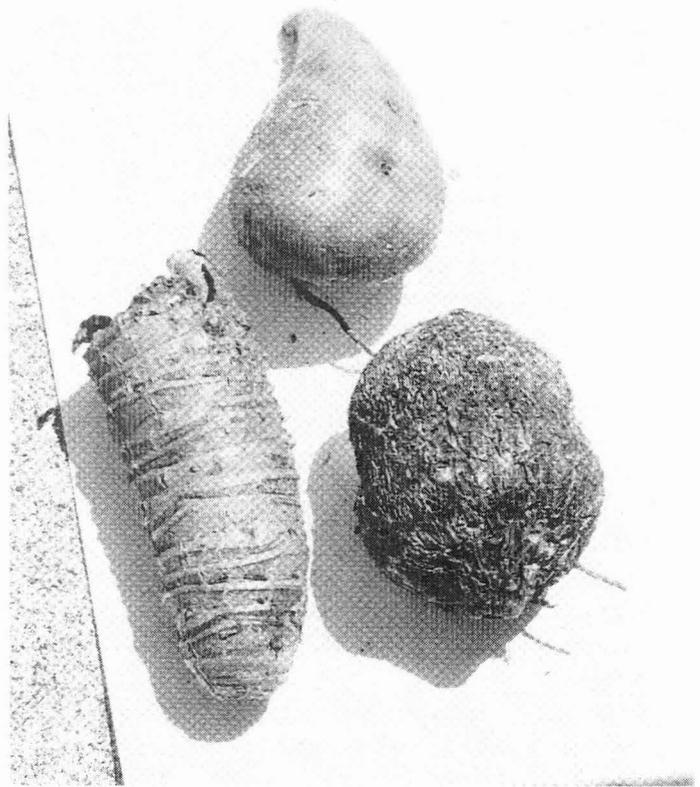


Fig. 3. Clockwise from the left: stems of *'ape* (*Alocasia maccorhiza*), *'uala* (sweet potato, *Ipomoea batatas*), and *kalo* (taro, *Colocasia esculenta*). It was in this form that Polynesian voyagers probably carried these plants to Hawai'i more than fifteen hundred years ago.

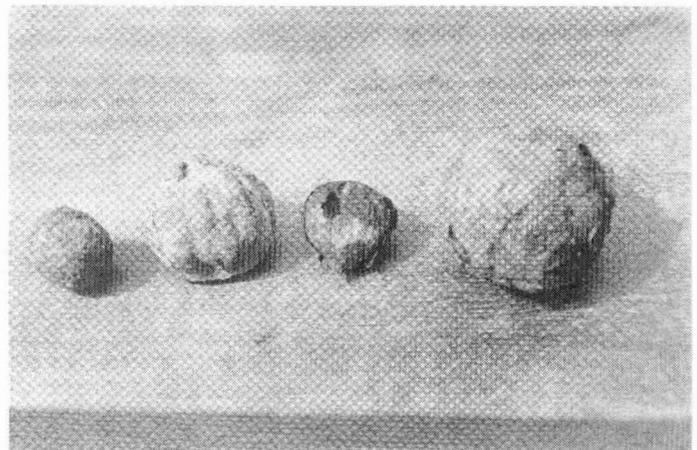


Fig. 4. Another group of plants was probably transported to Hawai'i as seeds. From left to right: seeds of *milo* (*Thespesia populnea*), *kukui* (candlenut tree, *Aleurites moluccana*), *kou* (*Cordia subcordata*), and *kamani* (Alexandrian laurel, *Calophyllum inophyllum*). I. Abbott photograph.

edible plants with them, for the indigenous and endemic flora of Hawai'i contain no plants suitable as dietary staples — that is, no plants high in carbohydrates and proteins. They perhaps would not have starved without the staple plants they introduced, but they would not have prospered, either. As it happened, they made extensive use of the native flora, but mainly for purposes other than food.

As a number of writers have pointed out,<sup>13</sup> the Polynesian introductions that can be treated as crops are common throughout Melanesia and Polynesia, with one exception — the sweet potato. How this plant, native to South America, reached the Marquesas and later Hawai'i is a botanical whodunit of the first order, which we will consider in due course. Otherwise, the only major difference that early shipmasters and expedition leaders noted in the crops of Tahiti, Samoa, the Marquesas, and Hawai'i were differences in levels of abundance, probably springing from local tastes or topography. The Marquesas Islands, for example, were famous for plentiful quantities of breadfruit,<sup>14</sup> as was Samoa, whereas Tonga was the only part of Polynesia that produced yams in quantity.

In this and many other ways, the pathways of the Polynesian societies forked and diverged to greater or lesser extents. The evolving tastes of Hawaiian culture, coupled with the uniqueness of the geographical and botanical setting, produced a flourishing and distinctive set of traditions in planting and in many other aspects of society.



Fig. 5. Rhizomes (underground stems) were the means of propagating 'awapuhi (shampoo ginger, *Zingiber zerumbet*), on the left, and 'ōlena (turmeric, *Curcuma longa*). I. Abbott photograph.

# An Evolving Relationship to Land and Crops

*E Kumokuhali'i,*  
*E Kupulupulu,*  
*E Kualanawao,*  
*E Kupa'aike'e,*  
*E Kubo'oholopali,*  
*Ke kua nei au i ke kumu o ka la'au,*  
*I ka eulu, i ka 'ala;*  
*E 'ike mai ia'u i kalai 'o'o,*  
*He kauila ka 'o'o mahi'ai au i ka*  
*'aina kula,*  
*He 'uala ka 'ai,*  
*He kalo malo'o ka 'ai,*  
*He uhi ka 'ai,*  
*He mai'a ka 'ai,*  
*He wauke ka 'ai,*  
*He ko ka 'ai.*  
*E 'ike mai ia'u, i ka mahi'ai nui,*  
*Ho'i i ka pulapula i ke ao,*  
*'Amama, ua noa.*

O Ku-who-spreads-greenery,  
 O Ku-of-the-thickets,  
 O Ku-in-the-mountain-regions,  
 O [Ku] Kupa-who-eats-defects,  
 O Ku-who-makes-slippery-the-pali,  
 I am hewing the trunk of the tree,  
 And cropping off the top with [an adz of] 'ala;  
 Look toward me as I carve an 'o'o,  
 An 'o'o of kauila to be used on kula lands,  
  
 To plant sweet potatoes for food,  
 Dry land taro for food,  
 Yams for food,  
 Bananas for food,  
 Wauke for "food,"  
 Sugar cane for food.  
 Look toward me, the mighty planter,  
 Turn to your offspring of this world,  
 'Amama, the kapu of the prayer is freed.

— from S. M. Kamakau,  
*The Works of the People of Old*

**F**OR MANY MILLENNIA before the Polynesians arrived, the waves and weather of the subtropical North Pacific were at work shaping the high volcanic islands of Hawai'i. When the settlers stepped ashore about seventeen hundred years ago, the shape and climate of the islands were much as they are today. Prevailing weather patterns drop plentiful rain on windward areas and mountaintops, while leeward coasts tend to be arid. On the youngest of the islands, Hawai'i, volcanoes pour forth lava, creating new land, while on the two oldest islands — Kaua'i and O'ahu — wind and rain have eroded each peak and range to form a myriad of valleys, many of them steep and narrow defiles like Nu'alolo on Kaua'i, others huge amphitheaters like Mānoa on O'ahu.

Such broad geological and climatic variation has made the Hawaiian Islands an intricate complex of macro- and microhabitats, and by the time the Polynesians landed their voyaging canoes, the plants and animals that preceded them to the archipelago had adapted to and radiated into diverse ecological niches, creating a wide spectrum of opportunities for the

human settlers. Archaeological discoveries enable us to see where the earliest Hawaiians made their first homes and to trace the spread of their descendants, temporally and spatially, throughout the islands. They also help describe how the Hawaiians of old used the ecological resources available to them, evolving a system of land use, patterns of gardening and gathering, a diet, and other cultural traditions in keeping with the environment.

## First Settlements and the Developmental Period

The earliest settlements now known in Hawai'i are on the northeast side of the island of O'ahu. Parts of this windward area, from present-day Maunawili north to Waikāne, are wet, receiving an average annual rainfall two to three times greater than do its northernmost end (Kahuku) or its southeasterly flank (toward Makapu'u). We have no reason to believe that the climate was much different in prehistoric times than it is

today, and it makes sense that the Polynesians would have chosen such a moist environment from the range of options open to them. All of the plants they brought with them would have done well in this area.

The oldest site yet excavated — its earliest parts have been dated between A.D. 300 and 600 — lies along this windward coast on land now occupied by Bellows Air Force Base.<sup>1</sup> The Bellows site gets only moderate rainfall, but a few miles inland the steep cliffs of Waimānalo catch more of the windward weather and feed a stream that flows past the ancient homesite to the sea. The available water could surely have supported *'uala* (sweet potatoes) and probably *kalo* (taro), although the banks and stonework usually associated with *kalo* fields are not in evidence. *'Ulu* (breadfruit) trees grow nearby now and may have grown in this locale previously.

The site would have been suitable for ongoing habitation,<sup>2</sup> but some archaeologists suggest that it received only temporary, discontinuous use, perhaps by people living in nearby settlements to the north.<sup>3</sup> The Bellows site has never been completely excavated or analyzed, but a number of interesting artifacts have been found there, including a coconut grater made of cone shell, similar to later ones and indicating, in all likelihood, that at least a few coconut trees had been established in Hawai'i by this early date.

Several other sites are known to have been occupied during the fourth to seventh centuries: Kahana and Kawainui, on O'ahu; Pu'u Ali'i and Wai'ahukini, on Hawai'i; Halawa,



Fig. 6. The variability of the Hawaiian environment is manifest here in an April snow in the crater of Haleakalā on the island of Maui, elevation 3,000 meters (10,000 feet). Courtesy of C. H. Lamoureux.

on Moloka'i; and Halele'a, on Kaua'i. Assuming that the climate in these places has not changed significantly in the last fifteen hundred years, only the two sites on Hawai'i lacked a ready water source, and one of them — Pu'u Ali'i — was clearly a fishing site rather than a house site. Obviously the first Hawaiians preferred locations that furnished ample water for their crops and for other uses.

Indeed the Kawainui site, a short distance north of Bel-

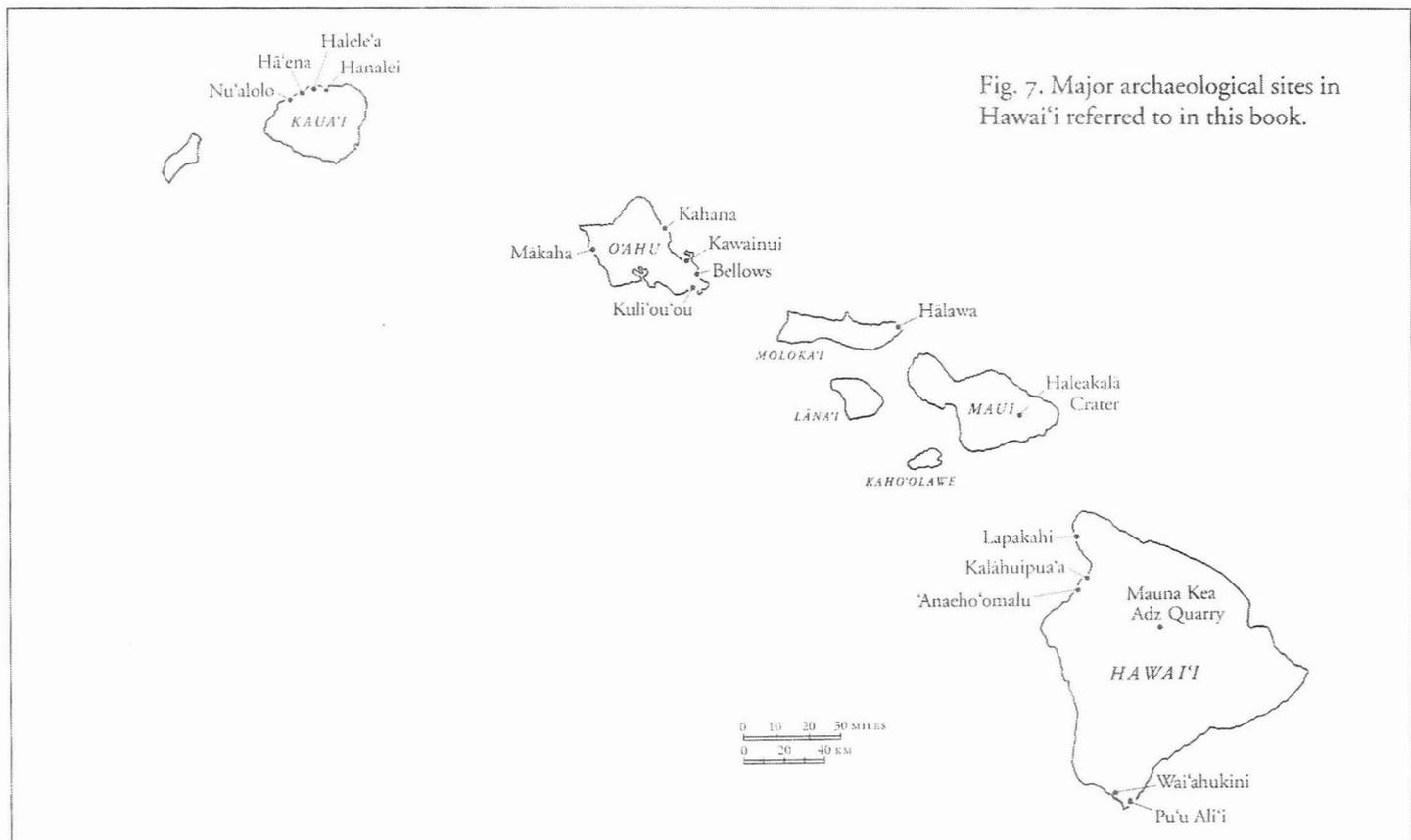


Fig. 7. Major archaeological sites in Hawai'i referred to in this book.

lows, sits in what is now a marsh.<sup>4</sup> The area once bordered an open bay, whose conformation may have changed during the early stages of Polynesian occupation, bringing changes to the habitat. The site remains incompletely studied, but at least part of it is certainly contemporaneous with the Bellows site,<sup>5</sup> and some of the excavated portions indicate crop cultivation. Recently uncovered walls of *lo'i* (pondfields) indicate that wetland *kalo* was grown on lands *mauka* (toward the mountains) of Kawainui.

Development of such *lo'i* is a major feature of other early habitations. At a site in Hanalei Valley, Kaua'i, that has been dated to approximately A.D. 610,<sup>6</sup> archaeologists have uncovered the first known instance of *lo'i* fed by an *'auwai* (irrigation ditch). This irrigation method became extremely important in later years as the population grew and spread throughout the islands. *'Auwai* ranged from simple to elaborate in construction, but all shared a basic design: at the head of the ditch, water was diverted into the *'auwai* from springs, streams, or pools and was led downhill to the *lo'i* very gradually, with the result that the water moved slowly and its passage did a minimum of erosive damage. The *'auwai* were lined with carefully fitted rock, at least near their heads, and were routinely maintained in order to prevent soil and debris from filling the ditch and thus impeding the flow of water.

The "engineering" of the *'auwai* was excellent. With only the simplest tools, Hawaiians modified natural stream flows and devised new routes that systematically exploited the slope of the terrain to carry water into their fields with great efficiency. These aqueducts, some of them very elaborate, are considered the finest in the Pacific islands. So well designed were they that in the latter part of the nineteenth century and the early part of twentieth century, when Western engineers planned irrigation flumes for commercial sugarcane production, they often followed these channels laid out by the Hawaiians of old.

Though *'auwai* were principally for irrigation, they also served to furnish water to some house sites. Since water belonged to the gods and was therefore valued beyond human terms, no one could claim its ownership or rights to its sole use. There are few records of quarrels over water use until foreigners came, bringing with them different concepts of water rights.<sup>7</sup>

At the windward, east end of Moloka'i is the Hālawā Dune Site, which was first inhabited sometime around the fifth to sixth century<sup>8</sup> and so originated at approximately the same date as the two O'ahu settlements just described. One of the most thoroughly and carefully studied archaeological sites in Hawai'i, it appears to have been steadily occupied for six or seven centuries before being abandoned about the end of the thirteenth century. In the course of excavation, both the water system and the soil were analyzed in detail.

This site offers an excellent example of an *'auwai* complex



Fig. 8. Kawainui Marsh, O'ahu, site of one of the earliest known Hawaiian settlements.



Fig. 9. *Auwai* (irrigation ditches) carried water from mountain sources into the valleys and circulated it among the *lo'i* (pondfields).

delivering water to a large network of *lo'i*. In a large valley such as Hālawā, a single *'auwai* served several families, irrigating a number of *lo'i* successively, as it wound down through the terraced fields. To grow effectively, wetland *kalo* must constantly be flooded with running water, so without *'auwai*, its cultivation would have been limited to natural waterways. The engineering and construction of *'auwai* significantly increased the acreage that could be used to grow *kalo*, supporting expansion of the Hawaiian population.

Under a classification scheme proposed by anthropologist Patrick Kirch, the earliest layers of excavated material at the Hālawā Dune Site, Bellows, and Pu'u Ali'i belong to the Developmental Period of Hawaiian culture (A.D. 600–1100).<sup>9</sup> In this period Kirch also places a rockshelter from the crater of Haleakalā on Maui; the Kuli'ou'ou rockshelter and a site in Kahana Valley on O'ahu; and Kē'e Beach at Hā'ena,



Fig. 10. Nu'alolo Valley, Kaua'i, was the longest continuously occupied site on Kaua'i, sheltering Hawaiian communities from approximately A.D. 1100 to the early historic period.



Fig. 11. Makaha Valley, O'ahu, is a dry, leeward valley that was first inhabited in the fourteenth century.

Kaua'i. Kirch believes, and I agree, that a uniquely Hawaiian culture had come into existence by the end of this period, distinguishing the Hawaiians from their Polynesian kin to the south.<sup>10</sup>

The end of this period also saw initial moves into leeward valleys, probably as a consequence of population pressures in the wetter windward areas. Sites at 'Anaeho'omalū on the leeward side of Hawai'i and on the island of Kaho'olawe are known to have developed at this time. Since water supplies adequate for *kalo* irrigation would have been available in only certain valleys on the leeward sides of the islands (such as Mānoa and Nu'uānu valleys on O'ahu), many of the leeward settlers would have had to make changes in their planting practices, reducing their reliance on wetland *kalo*, perhaps, and shifting toward less water-dependent crops. Handy's studies show that the ancient Hawaiians selected and developed varieties of *'uala* and *kalo* to suit rainfall conditions.<sup>11</sup>

### The Expansion Period

The population growth and dispersal apparent in the late Developmental Period continued and increased during the 550-year Expansion Period (A.D. 1100–1650). The population rose rapidly into the hundreds of thousands; historians argue over the correct figure, but Kirch's estimate of "several hundred thousand" seems safe.<sup>12</sup> Such population growth necessitated efficient use of arable land and water, and development of *'auwai* comparable to those at the Hālawā Dune Site occurred in many parts of the islands during the Expansion Period. Construction of fishponds also took place on a large scale during this period, providing another means to support the burgeoning populace. Accompanying these changes were major shifts in religious belief and ritual, social organization, and political structure. Kirch regards the Expansion Period as "the most significant period of cultural change in the entire sequence of Hawaiian prehistory."<sup>13</sup>

Nu'alolo Valley on Kaua'i, Mākaha on O'ahu, and Lapakahi and Kalāhuipua'a on Hawai'i were settled during this period, as were the interior of Hālawā Valley on Moloka'i, the leeward south slope of Haleakalā, and many smaller areas. In general, these were coastal sites, with some attempt to settle adjoining valleys or uplands. An exception was Mākaha, where apparently the valley was settled while the coastal area was used but not settled.<sup>14</sup>

Nu'alolo, in the Nāpali cliffs area of northwestern Kaua'i, dates from the end of the Developmental Period and the beginning of the Expansion Period and shows the longest continuous sequence of occupation on Kaua'i. The site seems to be especially well preserved owing to an overhanging cliff that afforded protection from the elements and to the occurrence of heavy sea spray, whose salt acted as a preservative. Excavation has produced numerous and diverse artifacts,

including cordage, fragments of decorated gourds, and bamboo tapa stamps.<sup>15</sup> This is the first clear archaeological evidence of the presence of bamboo and gourds before the time of Western contact.

One of the most extensively studied valley sites dating from the Expansion Period is Mākaha, on the leeward side of the island of O‘ahu, where a *lo‘i* complex in the upper valley was in use by the fourteenth century.<sup>16</sup> An ‘*auwai*’ led to the lower valley, where other kinds of plants, probably ‘*uala*’ among them, were cultivated as the population of the valley increased.

### *Abupua‘a*, the Mature Pattern of Hawaiian Settlement

The settlement pattern at Mākaha exemplifies an important development of the Expansion Period and an important difference between Hawaiian communities and those of their Lapita ancestors. Whereas the Lapita and perhaps the first settlers of Hawai‘i clustered their residences near the coast, going forth to work their fields and gardens, later Hawaiians customarily lived in dispersed communities, their houses scattered amidst the fields they tended.

A Hawaiian family belonged not to a village but rather to an *abupua‘a*, a land division usually extending from the mountain heights to the sea. Typically, an *abupua‘a* consisted of at least one valley and included the ridges on both sides of the valley as well as the offshore area to the depth of a man’s chest or to the reef crest. A rare exception was the *abupua‘a* of Kiao, in Ka‘ū, which does not reach the sea. *Abupua‘a* varied in size from large to small, but their typical inclusion of *mauka* and *makai* (seaward) lands assured their residents access both to the mountains, which supplied timber, cordage, food, and herbs, and to the sea and its resources.

While individuals could directly utilize both the *mauka* and *makai* resources and sometimes did so, the distance from one end of the *abupua‘a* to the other was often five or ten miles, making it inefficient for families to directly acquire all the domestic necessities. Instead, Hawaiians commonly relied upon an informal system of exchange known as “*kō kula ‘uka, kō kula kai*,” in which “those of the uplands” (*kō kula ‘uka*) exchanged food and other supplies with “those of the sea” (*kō kula kai*).<sup>17</sup>

Under this system, more accurately viewed as a form of gift-exchange than as barter, those living in the mountainous regions could, for example, exchange cordage they had produced for marine foods that their kinspeople living near the coast had caught. This arrangement served both parties, for mountain dwellers could not conveniently and regularly have access to the sea, and coastal residents needed the superior cordage from the uplands for their lines and nets. With its

various ecological niches and an active *mauka-makai* exchange, the organic unit of the *abupua‘a* provided everything its people needed and afforded the community a high degree of self-sufficiency.

The *abupua‘a* stands midway among the categories of land divisions known to the old Hawaiians, the largest being the island as a whole; prior to Western contact, there was no multi-island nation. Smaller divisions within an *abupua‘a* were the ‘*ili ‘āina*, strips of land worked by an individual or a family, and among these might be smaller, reserved parcels known as *koele* and *hakuone*. The former was reserved by the high chief of the *abupua‘a*, the latter by the *konohiki*, an *ali‘i* of lower rank who supervised the *abupua‘a*. The *maka‘āinana* in whose ‘*ili* the *koele* and *hakuone* were located were expected to grow useful plants and maintain them in these plots of land for the *ali‘i*.

Two other land divisions were observed at the same level as the ‘*ili ‘āina*: the ‘*ili kūpono*, which was a piece of land within an *abupua‘a* that was independent of the *konohiki* or the high chief of the *abupua‘a*, and the ‘*ili lele*, an arrangement under which several separate (discontinuous) pieces of land were treated as one. Mānoa, in the Waikiki *abupua‘a* of ancient times, had an ‘*ili lele* of three pieces, one on the slopes of the upper valley, a second where Punahou School is located (once the site of *lo‘i*), and a third at the seashore in Kaka‘ako.<sup>18</sup> Within ‘*ili*, areas were named for their principal crop — wetland *kalo*, dryland *kalo*, or ‘*uala*.<sup>19</sup>

### Basic Planting Methods

Except for *kalo*, Hawaiian crops were grown in small plots scattered about the house site in spots that best fit the ecology of the plant. Thus, *mai‘a* (bananas) were usually grown around the *lo‘i*, although taller varieties were grown in wet, upland valleys where they needed no tending. ‘*Uala* could be grown in small patches here and there, depending on the variety, and among them would be planted ‘*ulu* (breadfruit) trees. (Consistent with this pattern, when mangoes were introduced, in the last century, trees were planted around houses in the same way that the ‘*ulu* were, and to this day, in wet, rural parts of the islands, old house sites are marked by venerable ‘*ulu* and mango trees.) In the lower forests, Hawaiians planted yams and *pia* (Polynesian arrowroot), which did well in cool places and needed no tending.

The Hawaiians cultivated their crops using only one basic tool, the ‘*ō‘ō*, a hardwood stick that functioned as a spade, a hoe, and a rake. According to most sources, ‘*ō‘ō* were made primarily from a wood known as *kauiila*. Herein lies a puzzle, for two different endemic trees, *Alphitonia ponderosa* and *Colubrina oppositifolia*, have both been associated with this name. Such an overlapping of names was unusual in Hawai‘i, and a great deal of research in original Hawaiian texts will be

needed to sort out the nomenclature. The early literature reports many uses of the wood — at least twenty-four in addition to fabrication of 'ō'ō — but gives no ready indication of which species is meant.

Unfortunately, physical examination of the wood sheds little light on the problem. When the two trees are freshly cut, *Colubrina oppositifolia* has yellowish sapwood and light, reddish brown heartwood, whereas *Alphitonia ponderosa* is red throughout, light in the sapwood and dark in the heartwood.<sup>20</sup> After carving, use, and the passage of decades, however, the color differences may fade, leaving the two heavy, fine-grained woods visually indistinguishable. Microscopic analysis offers a means to tell the two apart, but that requires shaving specimens off rare artifacts, something that both scientists and museum curators are loath to do.<sup>21</sup> In this book, I will use "kauila" to refer to *Alphitonia*, but I believe it is possible that for Hawaiians of old, the name applied to the timber of both trees (meaning a dense, heavy wood)

Fig. 12. A kauila tree (*Alphitonia ponderosa*) growing on Kaua'i. This hardwood species furnished the material for many of the Hawaiian tools. Courtesy of Gordon Daida.



rather than to the tree species themselves and that it has been associated with the two trees as a result.

Today, living examples of both species are few in number. *Alphitonia ponderosa* may be found on all of the eight main islands except Ni'ihau and Kaho'olawe, but it is rare everywhere except on Kaua'i. *Colubrina oppositifolia* grows only in the Wai'anae Mountains of O'ahu and on the leeward side of the island of Hawai'i; it is rare in both locations. Whether these species have declined is unknown, but apparently in prehistoric as well as in historic times, they were not as common as their many reported uses would imply.

Scarcity of these trees may explain why Hawaiians sometimes substituted other hardwoods when they made 'ō'ō and other objects. They were experimenters and seem to have become expert in the qualities and uses of the native hardwood species, exploiting the native trees as well as the trees their Polynesian forebears had introduced. In making 'ō'ō, in particular, they found that the endemic *uhiuhi* (*Caesalpinia kavaensis*) and the indigenous 'alabe'e (*Canthium odoratum*) served satisfactorily in place of *kauila*.

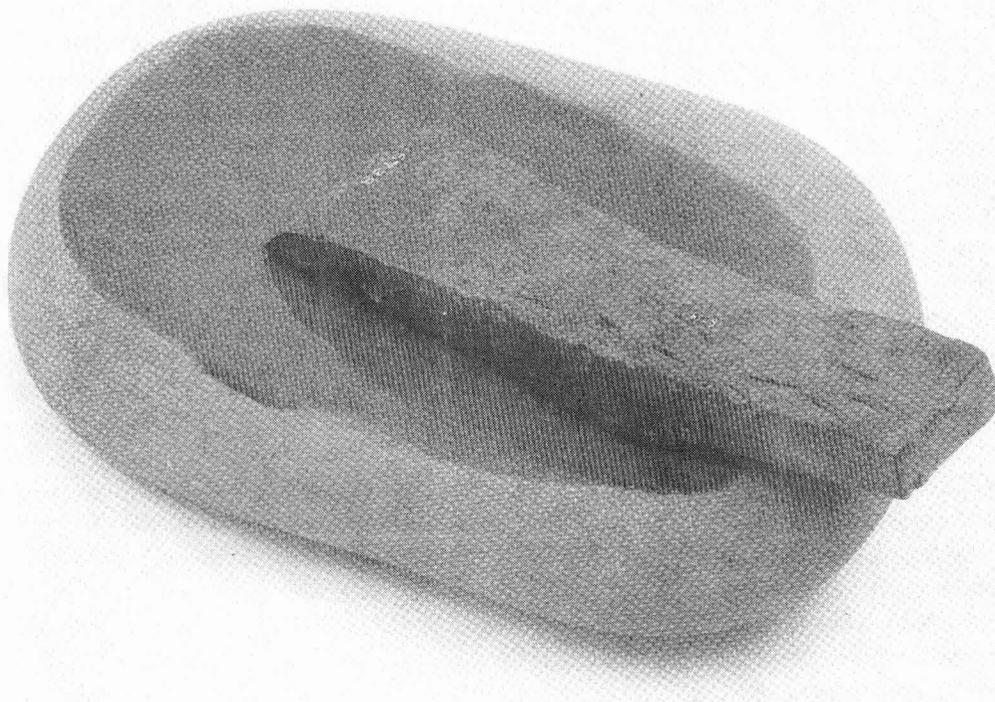
*Uhiuhi* is a leguminous tree seldom growing more than ten meters (thirty feet) tall and, like *kauila*, now rare. Indeed, it recently was placed on the federal list of endangered species, as there are only three extant populations known. The wood is dense and dark and takes a high polish. *Uhiuhi* was used for a number of other items that also required exceptionally hard wood, such as house posts, shark hooks, sled runners, spears, daggers, and clubs.<sup>22</sup>

At this time at least, if not in the past, 'alabe'e occurs far more commonly than *kauila* or *uhiuhi*, thriving on all the main islands except Ni'ihau and Kaho'olawe.<sup>23</sup> This hardy tree is indigenous not only to Hawai'i but also to Micronesia and islands of the South Pacific from the New Hebrides to the Tuamotus.

Being among the hardest woods available to the Hawaiians, these four species had obvious virtues for use as 'ō'ō, but carving them would have been arduous work, for the primary tools that the Hawaiians had for woodworking were hand adzes of stone. 'Ō'ō in the Bishop Museum collection take two shapes — with a point or with a blade. The more common 'ō'ō is about 1.5 meters (5.5 feet) long and 2.75 centimeters (1 inch) thick, slightly tapering to the handle at one end and to a dull point at the other. The second type has a handle about two-thirds as long, is slightly thinner in diameter, and at its working end comes to a sharp-edged blade about thirty centimeters (one foot) wide.<sup>24</sup>

Armed with this single, sturdy tool, the Hawaiians were able to pursue different planting strategies in wet and dry locales, as was revealed in thorough archaeological studies of Lapakahi, an arid site in leeward Kohala on the island of Hawai'i. Settled in the fourteenth century and inhabited for about four hundred years,<sup>25</sup> Lapakahi enjoyed a great abundance of marine life but was so dry that even in the uplands,

Fig. 13. Hand adze from Kona, Hawai'i, on a grinding stone. Hand adzes and hafted adzes were the Hawaiians' primary wood-shaping tools. Bishop Museum photograph.



developed to accommodate a growing population in the latter half of the fifteenth century,<sup>26</sup> only *'uala* and dryland *kalo* could be grown. In this case, the same *maka'ainana* may have done both the fishing and the planting.

### Social Change in the Expansion And Proto-historic Periods

The growth of the Hawaiian population led not only to the settling of such marginal cropland as Lapakahi but also created political territoriality among chieftains and contributed to a stratification of the social structure. In any society, as the competition for land and aquatic resources increases, definition of borders and social identity becomes increasingly important, and in Hawai'i, as the Expansion Period wore on, this dynamic produced a degree of social hierarchy unequalled in Polynesia.

Hawaiian religion changed at this time also and played an important part in the creation and maintenance of the new social order. The priest Pa'ao arrived "from Kahiki," introducing the practice of human sacrifice in the *luakini* type of *heiau* (temple), dedicated to the god Kū.<sup>27</sup> The annual Makahiki celebration in recognition of Lono, god of plants and planting, was initiated, along with a ritual system for the *maka'ainana*.

Many features of Hawaiian society that Westerners would observe in the late eighteenth century were thus in place by

the end of the Expansion Period, and in the next cultural period, which Kirch terms "Proto-historic" (A.D. 1650–1795), high chiefs each gathered around themselves a kind of court composed of the priests, soldiers, craftsmen, and the several wives that had become the chiefly norm. *Kauhale*, housing compounds for the high chiefs and their retainers, were established in certain *ahupua'a*, usually in coastal areas, and a number of famous leaders, whose names are now memorialized on highways and government buildings, came into prominence, among them Kamehameha, Kalaniopu'u, and Kahekili.

Perhaps the best description of Hawaiian life at this time comes from a detailed survey of Hawaiian plants and settlements that Handy conducted in the 1930s, investigating nearly every valley and small indentation of the coastline. Recording the *lo'i* terracing and stone wall boundaries that had survived and interviewing Hawaiian inhabitants of the various districts, he ferreted out a tremendous amount of information, *ahupua'a* by *ahupua'a*.<sup>28</sup> He draws a picture of the islands comfortably settled in terms of population, with the necessary plants for food and clothing flourishing in each *ahupua'a*.

In a subsequent book, he and Mrs. Pukui more closely examine pre-contact and early post-contact life in the *ahupua'a* of Ka'ū, Hawai'i, describing it as one of *'obana* (kinship), with family bonds constantly reaffirmed through the exchange of goods.<sup>29</sup> Other students of Hawaiian life have suggested that people were consciously encouraged to

marry within their own *ahupua'a* in order to keep land within a family.<sup>30</sup>

The image of life in the *ahupua'a* that emerges — stable, productive, close-knit — is probably correct in its main outlines, but it may also be somewhat idealized. Archaeological research reveals sudden abandonment of some *ahupua'a*, which would seem to indicate at least occasional failures of their social systems or of self-sufficiency. Short of such collapses, *maka'āinana* were at the beck and call of chiefs to fight their battles or help with major projects such as the erection of a temple. The quiet life of the *ahupua'a* was not without its adversities and interruptions.

## The Historic Period

After Cook's arrival in 1778, other ships began to call, and by 1820, ships involved in trade, exploring expeditions, and whaling began to arrive in increasing numbers. The introduction of exotic (alien) plants and animals as well as Western concepts of government, trade, money, and taxation began a series of large and extremely rapid changes. Of course, Hawaiians continued to use and regard plants in ways conditioned by their own culture, but after 1820, the course of their relationship with plants was affected by so many external influences and took such a new direction that it became another matter altogether. This book is devoted to the plants and practices that prevailed prior to 1820, with later developments sketched briefly in the Afterword.

## The Hawaiian Character and Diet

In a final book published shortly before his death, Dr. Handy and his wife proposed that the Hawaiians' relationships with their plants had a critical formative role in Hawaiian culture:

"It is generally assumed that an oceanic people such as the Hawaiians lived mainly by fishing. Actually fishing occupied a very small part of the time and interest of the majority of Hawaiians. For every fisherman's house along the coasts there were hundreds of homesteads of planters in the valleys and on the slopes and plains between the shore and forest. The Hawaiians, more than any of the other Polynesians, were a people whose means of livelihood, whose work and interests, were centered in the cultivation of the soil. The planter and his life furnish us with the key to his culture.

"It was the practice of systematic agriculture more than anything else that produced qualities of character in the Hawaiian common people that differed markedly from those typical of other Polynesians. The common people of Hawaii were a peace-loving people. The glorification of fighting prowess existed only amongst the chiefs of Hawaii, whereas

amongst the Marquesan and Maori tribesmen every man thought more of fighting than of subsistence. Prestige, status, and village politics engrossed the ruling caste of *ali'i* in Samoa. The hospitality of the Hawaiians toward the first white men who visited their shores was in marked contrast to the avarice of the Samoans in like circumstance. In Hawaii the labor and responsibility of systematic cultivation of taro, which entailed routine and regular work, much of it hard work, produced a physique and a temperament which found uncongenial the disruptive climate of vendetta which was characteristic of the tribalism of the Marquesas, Cook Islands, and New Zealand."<sup>31</sup>

This appraisal comes from a man who was not only the foremost student of useful Hawaiian plants but who previously had taken part in the earliest anthropological studies of the people of the Marquesas and the Society Islands.

Whether or not one accepts the view that Hawaiians differed from other Polynesians due to the intensive cultivation of crops, it is certainly true that their diet differed. Though similar to other Polynesian diets, it was unique in its heavy reliance on *kalo*, particularly in the form of *poi*. It is essentially correct to describe the Hawaiian menu as "fish and *poi*," except that the "fish" included a great number of species of shellfish and that they were complemented by terrestrial protein sources, namely, a number of native birds and the pigs, dogs, and chickens that the settlers brought to the islands. The protein and fats of fish and shellfish were necessary especially for the women, who were prohibited from eating pork, the major meat available, and could eat dog only under certain circumstances, if at all.<sup>32</sup>

On the plant side, to *kalo* must be added not only the alternate staple *'uala* and the other crops already mentioned but also a large number of *limu* (seaweeds, algae). No Polynesian people is known to have gathered or eaten as many species of *limu* as Hawaiians did, and they served as a major source of vitamins and minerals in their diet. Together with *pa'akai* (sea salt), *limu* also played an important role in flavoring Hawaiian food, offsetting the blandness of *poi* much as salt and pepper increase the palatability of the potato or as Japanese pickled vegetables and Korean *kimchi* relieve the monotony of rice.

## Religious Dimensions of Hawaiian Agriculture

*E Kane auloli ka honua!*  
*Honu nee pu ka aina.*  
*Ulu nakaka, kawahawaha ka honua.*  
*Ulu ka ai hapuu, e Lono.*  
*Ohi maloo, kupukupu.*  
*Ohi aa na uala o na pali.*  
*Pali-ku kawahawaha ka ua,*  
*Ka ua haule lani,*  
*He haule lani ka uala.*  
*He aweu ke kalo,*  
*He lauloa pili kanawao.*  
*O wao-akua ka ai, e Kane!*  
*E Kane! e Lono! na akua mahiai,*  
*Hoola i ka aina!*  
*A poho ka ai,*  
*A ulu kupukupu,*  
*A ulu lau poo-ole;*  
*A o ka nui ia o ka ai*  
*Au, e Kane a me Lono.*  
*Amama. Ua noa.*

O Kane, transform the earth!  
 Let the earth move as one piece.  
 The land is cracked and fissured.  
 The edible fern yet grows, O Lono.  
 Let kupukupu cover the dry land.  
 Gather potatoes as stones on the side-hills.  
 The rain comes like the side of a pali,  
 The rain falling from heaven.  
 The potato also falls from heaven,  
 The wild taro is the only taro now,  
 The taro of the mountain patches.  
 The only food is that of the wilds, O Kane!  
 O, Kane and Lono! Gods of the husbandmen,  
 Give life to the land!  
 Until the food goes to waste,  
 Until it sprouts in the ground,  
 Until the leaves cover the land;  
 And such be the plenty  
 Of you, O Kane and Lono.  
 The burden is lifted. We are free.

— from David Malo, *Hawaiian Antiquities*

HAWAIIAN USE and understanding of plants was thoroughly and profoundly religious, based in the strong, polytheistic tradition that was the backbone of Hawaiian culture until 1819. The land, the sea, the sky, and their creatures were suffused with meaning. Religious beliefs and practices pervaded daily life, structuring society and influencing the behavior and decisions of people from one end of the social spectrum to the other. They governed, among other things, the use of land, plants, and animals; the foods people could eat; and the time and methods for planting. Subsequent chapters will treat rituals associated with specific crops; this one provides an overview of the religious dimension of Hawaiian life and of plant use in particular.

### The Presence of the Gods and Goddesses

Hawaiians believed that *ali'i* (chiefs) of the highest ranks, the *nī'auipi'o* or *pi'o* ranks, were earthly representatives of the gods.<sup>1</sup> As such, their principal function was to take care of

the land (*mālama 'āina*), in both the physical and political senses, and to protect it for the *maka'āinana*. In doing so, it was recognized, they were serving all people, from the highest elites to the lowliest slaves, the *kauwā*, from whom individuals were chosen for human sacrifice. Natural disasters were considered clear manifestations of the gods' displeasure, so it became the duty of the *ali'i* to correct the damage ensuing from them and to offer comfort to the people. *Ali'i* could be banished or put to death if they oppressed the *maka'āinana* or neglected their welfare.<sup>2</sup>

Hawaiians also believed that many natural objects — geological formations, rocks, plants, and animals — were *kinolau* (body forms) of the gods. Each of the four major gods had more than one *kinolau*, in which they dwelled simultaneously. *Kalo*, *kō* (sugarcane), and *'ohe* (bamboo) were known as bodies of Kāne, the great life-giver. Kanaloa, who among the four principal deities was most closely associated with the sea, was held to be present in *mai'a* (bananas), octopus, and many of the marine mammals and large fish.<sup>3</sup> *Kinolau* of Kū, a god associated with building and with war,



Fig. 14. Ruins of a *heiau māpele* near Kailua, O'ahu.

were *niu* (the coconut), some marine animals, and many forest trees. Lono, now regarded as the god of peace, planting, and fertility,<sup>4</sup> was embodied in rain clouds, *'uala*, *'ipu* (gourds), and *pua'a* (the Polynesian pig).

Of the four principal gods, those uppermost in the minds of the *maka'āinana* were probably Kāne and Lono, the source and the deliverer of water, respectively, and Kū, who was known in numerous aspects such as Kūikaha'awi (Kū the giver), Kūmauna (Kū of the mountain), and Kūkeaoho'oihamihaikalani (Kū of the clouds that dot the sky). Kū is closely associated with the forest as protector of its plants, and his approval was asked before removing any forest vegetation, whether it be a huge tree for woodworking or tiny herbs for medical use. Permission to remove certain plants was also sought from the forest goddess Hina and the volcano goddess Pele.

In this polytheistic religion, any of the gods or goddesses could be called upon for help, and often several of them together were invoked. Every family and some individuals could also look for assistance to *'aumākua*, personal gods or deified ancestors, that took the form of animals. Among the common *'aumākua* were *manō* (shark), *pu'eo* (owl), *honu* (turtle), and *'alae* (mudhen).<sup>5</sup> Even after the infrastructure of the Hawaiian religion was dismantled in 1819 and Christianity was introduced in 1820, many accepted the new god but also continued to honor their *'aumākua* and some members of the traditional pantheon—deities like Pele and her consort Kamapua'a, who did not demand sacrifices.

Some of the lesser gods were close to the *maka'āinana* as

favorite subjects of folklore and as deities associated with particular fields of endeavor. *Mo'olelo* (stories) recount the cleverness of the demigod Maui; the kindness and helpfulness of Hina; the power and wrath of Pele. One or more deities were specifically linked with each specialized occupation—dancing, chanting, fishing, canoe building, healing, and ministry—and were the focus of its ceremonies, *kapu* (taboos, prohibitions), practices, training programs, terminologies, and artistic forms. If two or more deities were associated with one of these specializations, often they were regarded as rivals and disputants for the loyalties of the practitioners.<sup>6</sup>

### Temples and Other Religious Sites

Before 1819, Hawaiians of all walks of life prayed every day to a number of gods and for a variety of reasons. Since plants, animals, the landscape, and society itself were deeply imbued with religious significance, many prayers were offered in the field or the forest, but many others were raised in places and structures specifically dedicated to religious purposes. These ranged from household altars found in every *hale mua* (men's house) to *heiau* (temples) where *maka'āinana* never set foot and priests presided over matters as grave as war and human sacrifice.

On the domestic end of the scale, the most common focus of religious practices was the altar in the *hale mua*, which held wooden figures of one or more gods. There an *'umeke* (calabash) stood, containing food for the day, part of

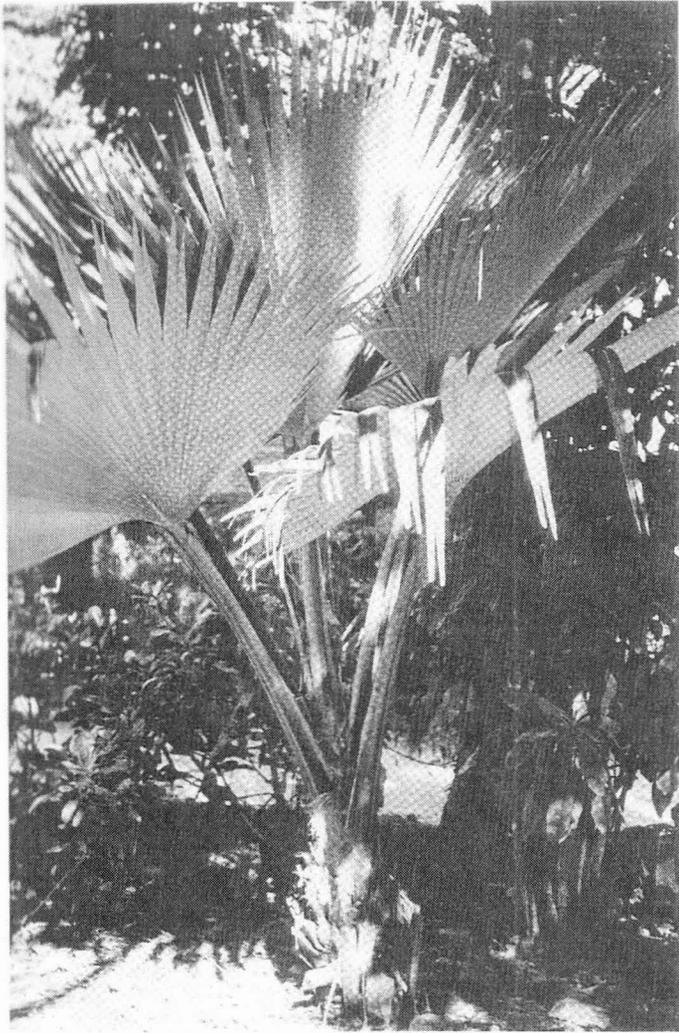


Fig. 15. *Loulu* palm (*Pritchardia* species), used to construct *heiau loulu*, where gods of fishing were seasonally propitiated.

this being offered to the gods by the men who ate in that house. Other places of worship for individuals or families were also widely available,<sup>7</sup> including simple upright rocks called *pohaku o Kāne*. These columnar stones, ranging in height from less than thirty centimeters (one foot) to more than three meters (ten feet), have a phallic character and served as places of refuge and ritual purification.<sup>8</sup> Similarly shaped stones and pieces of coral, generally no more than sixty centimeters (two feet) tall, stood near the shore or on headlands and received prayers and offerings of fishermen.

*Heiau* were erected and maintained to meet the larger needs of society and were tended by special priests. Of the two major types, *heiau māpele* were by far the more numerous, and most of the *heiau* remnants now seen in Hawai'i are of this type. Though they were built at the behest of major or minor *ali'i*, *heiau māpele* belonged to the

*maka'āinana* and were used principally for prayers and offerings to Lono, beseeching him for adequate rainfall and good crops as well as giving thanks for harvests. They were more common in dry leeward areas, where need for rain was a frequent concern and an important reason for prayers.

A variant of the *heiau māpele* was the *heiau-ipu-o-Lono* or *Hale-o-Lono*, where prayers were constantly directed to Lono for rainfall, rich harvests, and protection from drought and famine. Although there were apparently a few minor agricultural gods, Lono clearly was the focus of the worship connected with crops. Some of the chants still known to us can be interpreted as rain-making incantations and may have been used as prayers.<sup>9</sup>

*Heiau māpele* also had a role in ensuring the other part of the fish and *poi* diet. Seasonally, within their precincts small *heiau loulu* were erected, using the large fronds of the endemic *loulu* palm (*Pritchardia* species). Here, the gods who presided over fishing were propitiated.<sup>10</sup> These temporary, special *heiau* were in addition to the fishing shrines mentioned above.

The second and more powerful type of *heiau*, dedicated to Kū, was the *heiau luakini*. As noted previously, this sort of *heiau* is thought to have developed during the Expansion Period, through the influence of a newcomer named Pa'ao. It was from their walls that white *kapa* (tapa, barkcloth) flags heralding the start of annual Makahiki ceremonies would fly. Priests in these *heiau* also held the power to command human sacrifice and to announce the beginning of warfare during a five-month period that, in terms of our present calendars, stretched roughly from January through May.<sup>11</sup>

*Heiau luakini* belonged to the foremost *ali'i*, and the presence of such a *heiau* within an *ahupua'a* indicated that a paramount chief either lived there or commanded the loyalty of its people. *Heiau luakini* were, therefore, never as numerous as *heiau māpele*. There is evidence that, with time and changing political circumstances, some *heiau māpele* grew to become *heiau luakini*; apparently this occurred with a *heiau* in Mākaha Valley, O'ahu,<sup>12</sup> and the Hiki'au *heiau* at Kealakekua, Hawai'i.

Whereas priests of *heiau māpele* were recruited from the populace, those of *heiau luakini* inherited their positions and held a rank and power nearly equal to those of the high *ali'i*. The former were called *Kahuna pule o Lono* (priests who pray to Lono), the latter *Kahuna pule o Kū* (priests who pray to Kū). In line with their greater rank and responsibilities, *Kahuna pule o Kū* received more extensive training. The ceremonies over which they presided were complex and strict, often requiring elaborate preparation and precisely tendered offerings at one or more of three kinds of altar: *po'okanaka* for human sacrifices; smaller *waihau*, where pigs were offered; and still smaller *unu*, where *mai'a*, *niu*, and *'awa* were the usual offerings.<sup>13</sup> These latter offerings were made in place of human sacrifices.

Muku	Hilo	Hoaka	Kū Kahi	Kū Lua	Kū Kolu	Kū Pau	
<i>offshore fishing</i> mai'a	<i>reef fishing</i> 'uala, gourds, kalo, mai'a	<i>night fishing</i> 'uala	<i>day reef fishing</i> no planting	<i>low-tide fishing</i> no planting	<i>canoe and pole fishing;</i> <i>gather limu, crabs, sea</i> <i>urchins</i>	<i>reef fishing</i> 'uala	
			← Sacred to Kū →				
'Ole Kū Kahi	'Ole Kū Lua	'Ole Kū Kolu	'Ole Kū Pau	Hūnā	Mōhalu	Hua	
<i>fish schooling</i> 'uala	<i>torch fishing</i>	<i>torch fishing</i>	<i>poor fishing,</i> <i>rough seas</i>	<i>good fishing</i> gourds, hala, yams	<i>poor fishing</i> plant flowers	<i>deep-sea fishing</i> 'uala, gourds	
			← Sacred to Kāne →				
Akua	Hoku	Māhealani	Kulu	Lā'au Kū Kahi	Lā'au Kū Lua	Lā'au Pau	
<i>reef and deep-sea</i> <i>fishing</i> mai'a, niu	<i>good fishing</i> 'uala, kalo, weed plants	<i>deep-sea fishing</i> plant anything, weed kalo	<i>deep-sea fishing;</i> <i>good limu</i> weed mai'a	← <i>fishing only fair</i> →		<i>gather herbal medicines</i> no vine planting	
				← Sacred to Kū →		<i>no vine planting</i>	
'Ole Kū Kahi	'Ole Kū Lua	'Ole Pau	Kāloa Kū Kahi	Kāloa Kū Lua	Kāloa Pau	Kāne	
← cultivate soil →		← <i>no planting these days</i> →		← <i>poor fishing at sea;</i> <i>good shellfish</i> mai'a, bamboo →		← <i>reef fishing, sea urchins</i> no planting →	
				← Sacred to Kāloa →		← Sacred to Kāne →	
Lono							
← <i>pole and torch fishing</i> no planting →							
← Sacred to Lono →							

Fig. 16. A typical month in the Hawaiian lunar calendar, beginning with Hilo, the night of the new moon. Each day has a specific name, some of them linking the day to a particular god (e.g., *Kū Kahi*, the first of four days *kapu* to Kū.) Work was suspended on days *kapu* to one of the gods; particular kinds of planting or fishing were recommended on other days in the lunar cycle.

## Religious Prohibitions

Since *ali'i* of the top ranks, both male and female, were tantamount to gods, both their persons and their belongings were sacred and under *kapu* that no one, even lower-ranking *ali'i*, could violate without punishment by death. A *kapu* which barred members of the two sexes or people of different ranks from eating together was universal, strictly enforced, and also punishable by death.<sup>14</sup> This *kapu* is said to have been invoked by Wakea, the primordial sky god and male principle, and to have derived from the sacred *kalo*.

*Kalo* was one of many foodstuffs that, in this male-dominated religion full of phallic symbolism, were *kapu* for women to handle, even to prepare for food. Only men could cultivate and harvest *kalo*, this body of Kāne, and make it into *poi*. *Mai'a*, sacred to Kanaloa, were also forbidden to women, except for three varieties which Wakea had declared *noa*, free of *kapu*. The coconut,<sup>15</sup> an embodiment of Kū, was *kapu* to women as well; they never made *'aha* (coconut cordage or rope), although women made all other kinds of cordage. The *pua'a* (pig), a *kinolau* of Lono, was forbidden to women, too. The punishment for a woman eating a food *kapu* to her sex is not spelled out, but the rationale for these restrictions appears to have been religious: that women should not consume foods that were used sacrificially.<sup>16</sup>

Overall, women's lives were governed by many more *kapu* than men's were. The places a woman could go and what she could do were in many respects tightly circumscribed. *Kapu* effectively excluded her even from the central religious practices, for women were not permitted to go where images of the gods were — to enter either the *heiau* or the *hale mua*, where the family altars were kept and the daily offerings presented.

Men or women who violated major *kapu* had no recourse but to flee to *pu'uhonua*, places of refuge, that were maintained on each island, occasionally occupying whole *abupua'a*. *Pu'uhonua* were a third variety of *heiau* specifically for this purpose, and their priests were charged with caring for those who sought protection within their walls. The *Pu'uhonua o Honaunau* in Kona, a national historical park, is the most famous of these places of refuge.

## The Seasonal Calendar

Hawaiian religion regulated the timing of many events, including planting and fishing, according to a lunar calendar. The lunar, or synodic, month started and ended with the new moon, lasting the roughly four weeks that it takes the moon to go through all of its phases. Each day had a specific name, often linking it to a particular god. Nine of the days, comprising four periods during each lunar month, were dedicated to worship of the four principal gods — Kū, Kāne,

Lono, and Kanaloa. During these periods, planting and certain kinds of fishing were disallowed, as were some other forms of work such as beating *kapa*. It is not clear what sort of work was permissible.

The remaining days were held to be propitious for various purposes, such as planting particular kinds of fruits or vegetables.<sup>17</sup> For example, the interval preceding the nights of Kāne was thought to be a good time to plant *mai'a*. At the full moon, planting *'uala* and *kalo* was recommended, as was weeding and mulching *kalo*. These activities were to be coupled with prayers to Kānepua'a,<sup>18</sup> one of the lesser gods associated with Lono and, secondarily, with Kāne.

## Rituals Related to Crops, Including Makahiki

Prayers for the crops were offered not only during the four *kapu* periods but also at the time they were planted, at intervals during their growth and maturation, and at the harvesting.<sup>19</sup> The first yields of any crop were offered to the gods, primarily the god most revered by the individual who had raised it. During a period *kapu* to that god,<sup>20</sup> the food was cooked in a ritual fire,<sup>21</sup> and one portion became the offering, while another was eaten by the *maka'ainana* and members of his family. After this ceremony, the food was *noa* and could be eaten with no more than the customary daily offering.

The large ceremonies associated with crops, one writer has observed, attained a scale of size and a level of organization and cost (in terms of energy and material goods) that qualifies them to be labeled "state religious cults."<sup>22</sup> Certainly this holds true for the annual *Makahiki na o Lono* (time of the coming of Lono), particularly as it was celebrated at the Hiki'au *heiau* on the shores of Kealakekua Bay, on Hawai'i. Though now marred by the presence of two Christian monuments at its entrance, this stands as one of the best preserved of the old Hawaiian *heiau*, and it was here that the annual observance of Makahiki started and ended.<sup>23</sup>

Makahiki was a religious occasion, welcoming the return of Lono as the bringer of rain and winds.<sup>24</sup> The observance occurred during the season when southerly (*kona*) cyclonic storms start in Hawai'i, watering the islands' leeward slopes. Its beginning was set at the first new moon after the constellation Makali'i, known in the West as the Pleiades, was seen rising in the eastern sky at sunset. The date of this celestial phenomenon varies from year to year, but in Hawaiian historic time, it has always fallen between mid-October and mid-December. The Makahiki lasted about four months for the *ali'i* and priests involved in preparing and carrying out its elaborate ceremonies,<sup>25</sup> but it lasted only half as long for *maka'ainana*.

The ceremonies centered on a procession around each island. Three nights before the start of the procession, the

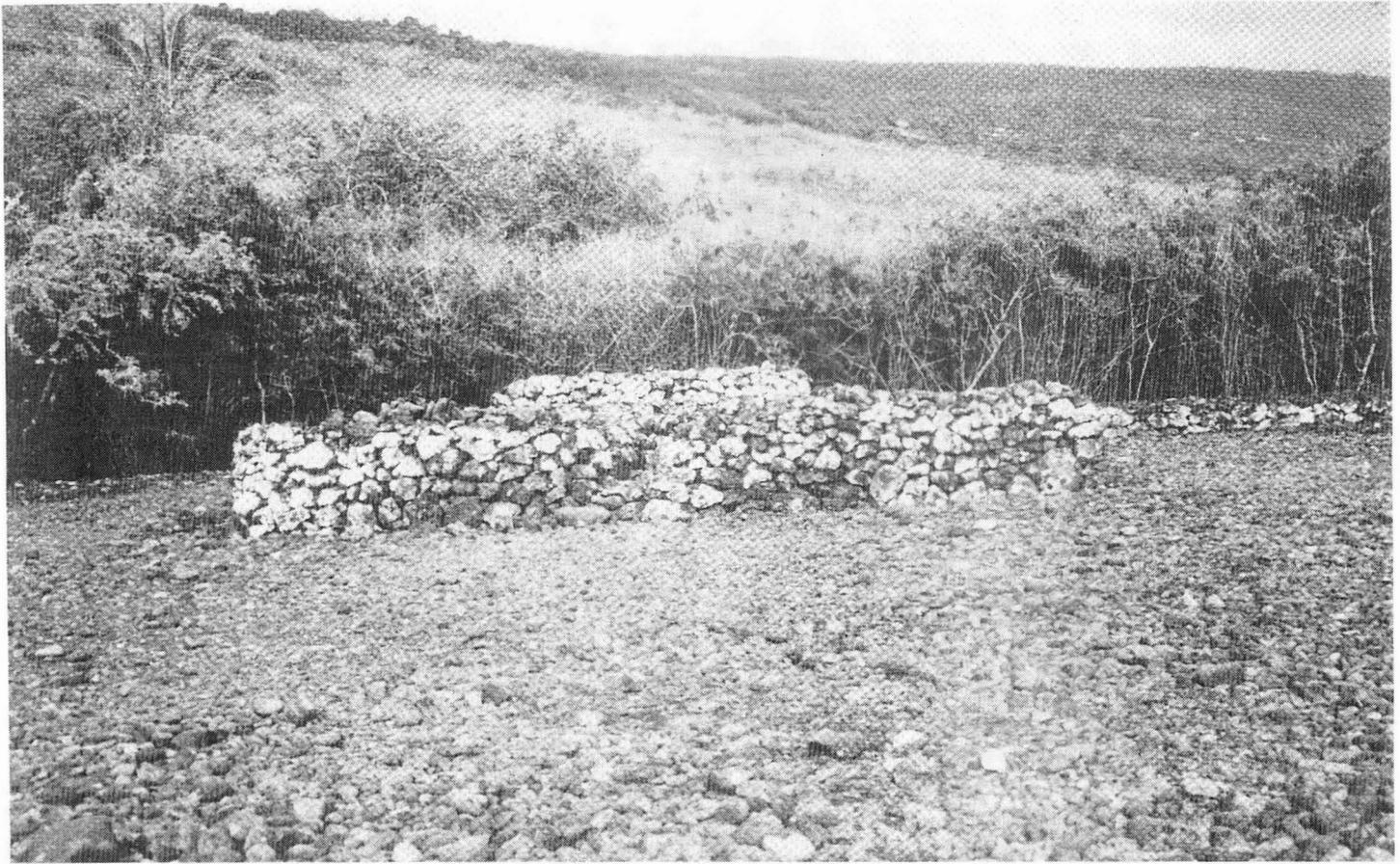


Fig. 17. [ABOVE] Altar enclosure, the only remaining structure on the platform of *Hiki'au heiau* at Kealakekua Bay, Hawai'i, which played a key role in Makahiki ceremonies.



Fig. 18. [LEFT] Image of the god Lono at the top of the *akua loa* staff, which headed the procession to each *abupua'a* during the Makahiki. Collection of Bishop Museum. Bishop Museum photograph.

feather gods were worshiped, and on the final night, priests prayed all night long before wooden images of the gods. The following day, a very sacred day, priests prepared the *akua loa* (lit., the "long" god), a pole about eighteen or twenty centimeters (seven or eight inches) in diameter and two or three meters (six or nine feet) long which bore at its tip a head of Lono. One or more white pieces of tapa hung from a crosspiece below the head, with the result that, from a distance, the *akua loa* resembled a sail. The crosspiece also held a feather *lei* and, as symbols of starvation or famine, skins of the *ka'upu* (a native bird) and fronds of the *pala* fern, which Hawaiians resorted to as a food in times of hardship.<sup>26</sup>

That night everyone feasted and celebrated, and toward midnight they bathed in the sea, a custom of purification

that preceded all major religious observances.<sup>27</sup> The following day, the *akua loa* was brought out and exhibited, formally beginning the Makahiki. The *akua loa* symbolized Lono during the Makahiki and would be the ritual center for most of the ceremonies during this period. The staff was made of *kauila*,<sup>28</sup> perhaps selected because its name means "lightning," and lightning was considered a *kinolau* of Lono.

With the Makahiki, many special *kapu* came into force, as Fornander describes in ringing, poetic language:

"And Lono had decreed that man was forbidden to kill; war was prohibited, there was to be no fighting; the ocean was *kapu*, not a canoe was to sail; the *kapa* anvil was *kapu*, and no cloth was to be beaten; the drum was *kapu*, not to be tapped; the conch shell was *kapu*, not to be blown; the land was *kapu* to Lono, the earth, life, the mountain, the ocean, the raging surf, the family, the sailing canoe was *kapu* to Lono."<sup>29</sup>

Simultaneously, the usual *kapu* of the lunar cycle were set aside, *heiau* closed, and religious services were suspended.<sup>30</sup>

The *akua loa* procession, consisting of the *mō'i* (ranking chief), other *ali'i*, and priests, set off the next day to visit each *ahupua'a* in turn, circling the island counter-clockwise. At the entry to each *ahupua'a*, the procession stopped at a stone altar topped with a block of *kukui* wood representing a pig. It was these altars that gave rise to the designation *ahupua'a*, for the word "*ahu*" refers to an altar, and "*pua'a*" means pig. The pig being another of Lono's *kinolau*, these altars were places full of import, and it was there the procession received *ho'okupu* (offerings) from each *ahupua'a*. *Ho'okupu* consisted mainly of food—live pigs and dogs, dried fish, salted sea urchins, and containers of *poi* and other prepared foods—but also non-food items such as plain *kapa*, bundles of feathers, and decorated loincloths and bedding (*kapa moe*).

The word *ho'okupu* means "to cause to grow." In keeping with the Hawaiian conception that the *mō'i* was the scion and living embodiment of Lono, these contributions were understood as *mōhai* (ceremonial gifts), fruits of the land and the sea and of human labor, tendered to those who were the very source of nature's productivity.<sup>31</sup> In this context, it is completely inappropriate to think of *ho'okupu* as the Hawaiian equivalent of taxes, as many recent writers have. Monetary offerings made to churches today are not regarded as taxes; neither should the material *ho'okupu* of Makahiki be considered as such.

Once the *ho'okupu* were accepted as sufficient, the *akua loa* procession continued to the next *ahupua'a*, and a group of bearers took the offerings back to the home district of the *mō'i*. This returning group followed a second symbol known as the *akua poko* (the "small" god). As the name indicates, this staff was shorter than the *akua loa*, little more than a yard long. It was decorated with the figure of a man in a feather

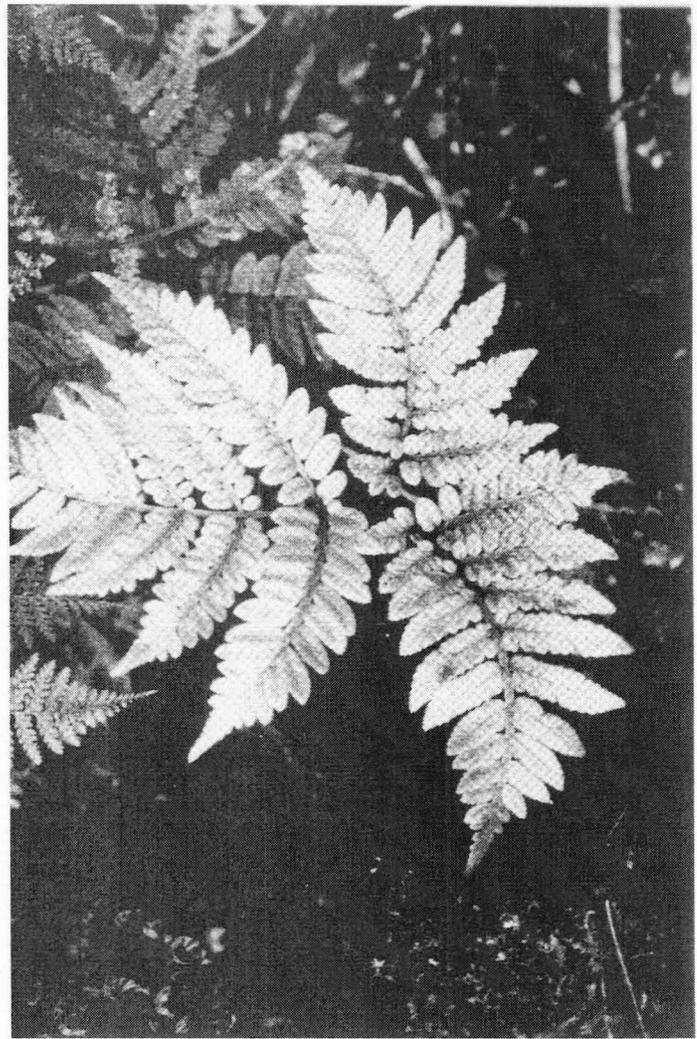


Fig. 19. Pala fern (*Marattia douglasii*), used as a sign that the Makahiki *kapu* had been lifted from an *ahupua'a*. Courtesy of Florence Wagner.

helmet, had no crosspiece, and was sharpened at its lower end so that it could be placed in the ground.

When the *akua loa* and *akua poko* had departed, *maka-āinana* gathered *pala* fern to carry on their backs as a sign that the land had been released from *kapu*.<sup>32</sup> Worshipers of Kāne gathered *kalo* leaves, roasted them, and displayed them on the sides of their houses, showing that the *kapu* on labor in their *lo'i* had been released. At the same time, the *ali'i* sent out canoes to fish, indicating *ahupua'a* by *ahupua'a* that the *kapu* on the sea was ended.<sup>33</sup>

After the *akua loa* procession had finished its circuit of the island and just before it returned to the house of the *mō'i*, people from every *ahupua'a* and district gathered for boxing matches (*mokomoko*), wrestling, games of skill, and *hula*. Boxing and wrestling commemorated the legend that Lono killed his wife in a fit of jealousy, traveling thereafter from

place to place and engaging in boxing matches in a display of grief and regret. Boxing was a cruel, punishing sport in prehistoric times.<sup>34</sup>

Several other ceremonies were held to honor Lono, including one in which the *akua loa* and *akua poko* were dismantled and stored again in the *heiau luakini*. This indicated that the close of Makahiki was at hand and perhaps was the concluding event on some islands, but at least on Hawai'i, at Kealakekua Bay, the final ceremony entailed putting *ho'okupu* to sea in an unpainted canoe—Lono's canoe. With a large basketful of foods between its outriggers, the canoe was sailed back and forth across the bay to signify that all *kapu* had been lifted from the land and sea; then the canoe was headed into the open ocean and set adrift.

For four decades after Western contact, certain ceremonies of the Makahiki continued to be observed.<sup>35</sup> In Kona, during the time of Kamehameha I, the accumulated *ho'okupu* were divided by the *mō'i* and distributed to the priests, specialist craftsmen, members of the court, lower-ranking *ali'i*,

and those who served in battle. After Kamehameha's death, with abolition of the old Hawaiian religion and especially with the destruction of images and *heiau* that began in 1819, Makahiki ceremonies as described above no longer were practiced.

I have recounted the elaborate ceremonial of the Makahiki in detail because I believe that it shows how deeply their religion penetrated the lives of both *maka'āinana* and *ali'i*. To pass off this annual celebration as unimportant (or as a subject that has been given too much emphasis) is to overlook what it tells us about Hawaiian society. Makahiki was much more than a gesture of thanksgiving and a break from routine; it gave form to the belief that maintaining a right relationship with the gods and the earth is humanity's basic spiritual challenge. It is also important not to ignore Makahiki's biological significance: a two-month period when the land could rest, plants could grow without being harvested, and the ocean could replenish itself.

## The Staple Crops, *Kalo* and *‘Uala*

*E Ku-ike-olo-walu-e,  
I olowalu ka huli i ka makalua a kaula.  
I olowalu ke kalo i ola au ka mahi‘ai,  
I ola ka hono hale,  
I ola ka ‘ohua  
I ola ka ‘ohana,  
I ola na malihini kipa mai,  
A i ola ia‘u ia (ka inoa o ka mahi‘ai).  
‘Amama. Ua noa.*

O Ku-ike-olo-walu,  
May the taro top in our planting hole grow large.  
May they grow large that I the planter may live,  
The dwellers in the house may live,  
That the dependants may live,  
That the family may live,  
That the visiting stranger may live,  
That I (the name of the planter) may live.  
‘Amama. It is free of tabu.

— from June Gutmanis, *Na Pule Kahiko*

**K**ALO (taro, *Colocasia esculenta*) and *‘uala* (sweet potato, *Ipomoea batatas*) were the most important crops for the ancient Hawaiians. They furnished not only the carbohydrate base of their diet and goodly amounts of high-quality vitamins and minerals but also were *kinolau* of the gods Kāne and Lono, respectively. One sign of their cultural importance lies in the large number of varieties of the two species that developed and the even larger number of names that were applied to them: interviewing in the 1930s, Dr. Handy gathered 342 names for *kalo* varieties and 230 for *‘uala*.<sup>1</sup>

All Polynesian societies probably started out with a set of four or five food plants that could provide the carbohydrate base of their diets — taro, bananas, yams, breadfruit, and in most cases sweet potatoes, too.<sup>2</sup> In each island group, one of these came to predominate, though others were grown as well. Social factors may have affected Polynesian dietary preferences to some degree, but geography was probably the controlling force. The Marquesas Islands, for example, are mountainous, with few coastal plains that could accommodate a large taro crop. Breadfruit became the Marquesan staple because the trees could be grown on steep ridges and in narrow valleys, which is exactly where they were placed and can be found now. Seventy names were known for breadfruit in the Marquesas,<sup>3</sup> but only one in Hawai‘i.

Hawaiian geography presented an opposite situation, favoring the emergence of *kalo* as the principal staple. Breadfruit grows successfully here but does not produce as well as it does in the Marquesas, which lie ten degrees closer to the equator and have a slightly warmer climate. The broad, flat valleys of Hawai‘i (particularly of Kaua‘i, O‘ahu, Maui, and

Moloka‘i) afforded the Hawaiian planter excellent acreage for *kalo* and adequate-to-abundant supplies of cool water necessary to cultivate wetland *kalo* varieties.<sup>4</sup>

### *Kalo* Traditions and the Ancestry Of the Hawaiians

The myth of the origin of the Hawaiian people is known in several versions, but all of them begin similarly and give *kalo* a prominent place.<sup>5</sup> When the sky principle Wakea coupled with the earth principle Papa, their first child, Hāloanaka, was stillborn,<sup>6</sup> but a *kalo* plant sprouted from the place where the fetus was buried. Their second child was a daughter, *Ho‘ohōkūkalani*, by whom Wakea later had a human son named Hāloa, the ancestor of the Hawaiian *ali‘i* and thus of all Hawaiians.<sup>7</sup> In order to make a union with his daughter possible, Wakea established the social code that separated the sexes, including the *kapu* requiring that they eat separately — the first *kapu* — and the *kapu* isolating women during menstrual periods and childbirth.<sup>8</sup> This creation story, the *Kumulipo*, set the foundations of Hawaiian society such that, in the nineteenth century, when King Kalākaua felt constrained to demonstrate his rightful claim to the throne, he authorized a genealogical search that traced his family line all the way back to Hāloa, and the *kalo* leaf appears on the crown he wore during his reign.

Biogeography may also have shaped the Hawaiians’ affinities for their gods. It appears that the Polynesians who settled the islands were followers of Kāne, or Tāne as he is known in

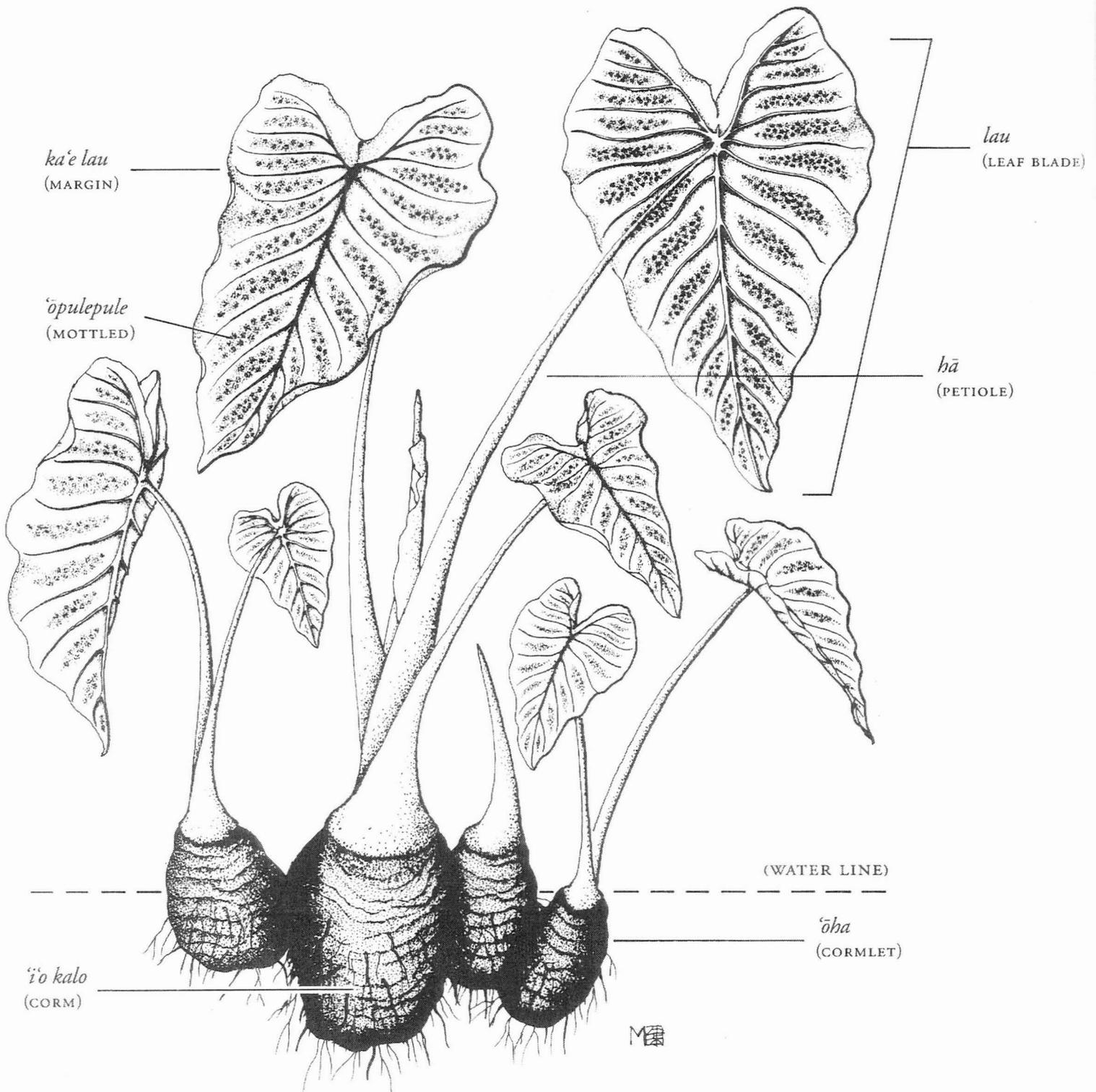


Fig. 20. Diagram of the 'elepaio variety of *kalo*, which has green-and-white mottled leaves. Hawaiian and English terms for important parts of the plant are indicated.

southern Polynesia, and they came to populate areas that had the water necessary for growing the crop that is his *kinolau*. During the Expansion Period, however, as population pressure drove some people into drier lands, more suitable to 'uala crops, the traditions of Lono seem to have strengthened correspondingly.

### The Biological Origin and Diversity of *Kalo*

Although controversy remains about where taro originated and was domesticated, anthropologist Douglas Yen, a student of early plants in the Pacific islands, believes it was under cultivation in the New Guinea highlands between five and ten thousand years ago.<sup>9</sup> Before they started tending the plant, people must have discovered by a protracted and probably painful trial-and-error process that long cooking is necessary to make it edible. Taro is full of needle-like and knob-like crystals of calcium oxalate that make it very painful to eat raw but which can be dissolved and rendered harmless by exposure to heat.

Once taro's usefulness as a food was known, the ancients evidently studied its preferences, learned to raise the yield by cultivating it, and then began to share the crop with neighboring peoples. Genetic analyses of taro varieties show that, early on, two distinct varietal lines developed, with different chromosome counts. The telltale genetic evidence has enabled researchers to conclude that both lines were carried from mainland Asia through the Ryukyus to Japan and China as well as southward through Timor in present-day Indonesia and on to New Caledonia.<sup>10</sup> Only one of the pair was established in northern Melanesia (New Guinea, the Solomon Islands, and the New Hebrides) and passed on from there to Polynesia. Prior to Western contact, the second line was not grown anywhere in Polynesia, with the possible exception of New Zealand.<sup>11</sup>

Of the 342 names for *kalo* varieties that Handy recorded in the 1930s, only about half could still be matched to particular plants. Handy himself was later able to confirm sixty-seven varieties, using the same characteristics Hawaiians had used in developing their *kalo* classifications: the color of the corm or stem (which is also known as "*kalo*"), the petiole (*hā*), its base (*kumu*), its margin (*lihi*), the color of the junction of the petiole and blade (*piko*), the color of the blade (*lau*) and any markings on the surface, differences in lobing, color of the margin, the veins, and differences in color of the top and bottom surfaces.<sup>12</sup> The great difference between the number of varieties that Handy could identify and the number of names he compiled suggests that some *kalo* varieties had been lost. It is impossible to determine how many varieties had disappeared, however, since many of the 342 names he gathered were surely duplicates, resulting from one variety receiving different names in different places.

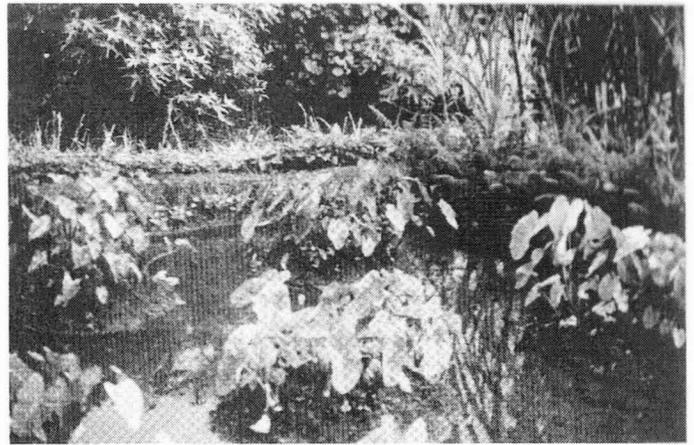


Fig. 21. *Kalo* growing in mounds, which was the method the old Hawaiians used for cultivating "wetland" *kalo*. I. Abbott photograph.

### *Kalo*-Growing Practices

Both wetland and dryland (also called "upland") *kalo* probably were grown in each *ahupua'a*, with different varieties planted to ensure a stock of *kalo* for *poi* all year-around. Wetland varieties could be grown on stream banks, in marshy areas of freshwater springs, or in the "patches" or pondfields that the Hawaiians called *lo'i*. Its name notwithstanding, dryland *kalo* also favors very moist climates, doing best in shady areas where the annual rainfall exceeds 127 centimeters (50 inches).<sup>13</sup>

Forest land was frequently cleared for dryland *kalo*, and two centuries ago, such *kalo* beds in upland Kona earned Hawaiians an excellent reputation as farmers in the eyes of the early European explorers.<sup>14</sup> In the rainy zone *mauka* of Hilo and along the Hāmākua coast, similar beds of dryland *kalo* are still commonly seen today. In upland Kona, at Hāna, Maui, and in other places where there are few streams, good planting practices and adequate rainfall usually permitted growth of dryland *kalo* sufficient to support large populations. In these forest plantings, one of the steps Hawaiian planters took to protect *kalo* beds was to use fern fronds as mulch during periods of bright sunshine and to remove the fronds during rainy spells.

In contrast, wetland *kalo* came to occupy much of the flat, arable land in each valley in Hawai'i. Dr. Handy's careful exploration of *ahupua'a* in the 1930s revealed that even small valleys, now thought to be too dry for *lo'i* farming, had *kalo* terraces in them.<sup>15</sup> Demonstrating the extent of prehistoric wetland *kalo* cultivation was one of Handy's most meaningful contributions to Hawaiian ethnobotany and to our knowledge of Hawaiian culture in general.

While maintaining existing *lo'i* was a routine and relatively simple task requiring little more than releveling the

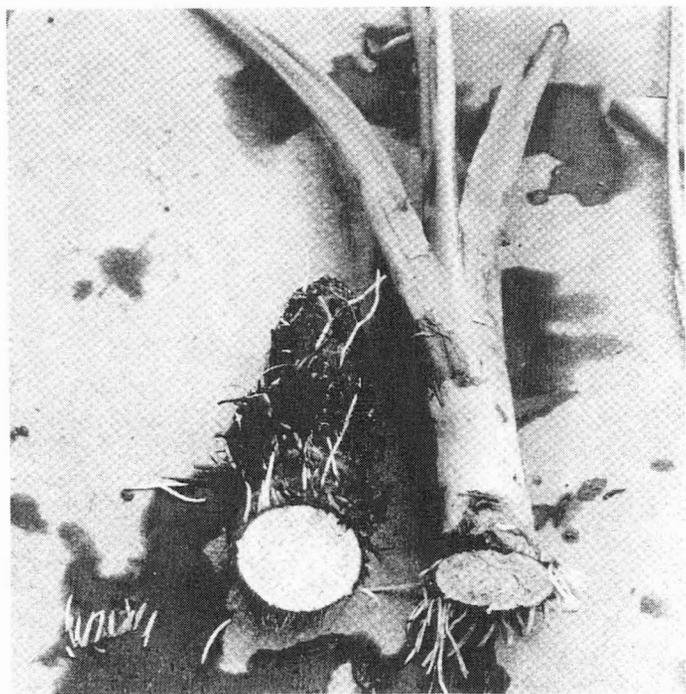


Fig. 22. The *huli*, a cutting including the top of the corm and the stem tip enclosed in the petioles, used as the vegetative means of propagating *kalo*. Courtesy of Calvin Hirai.

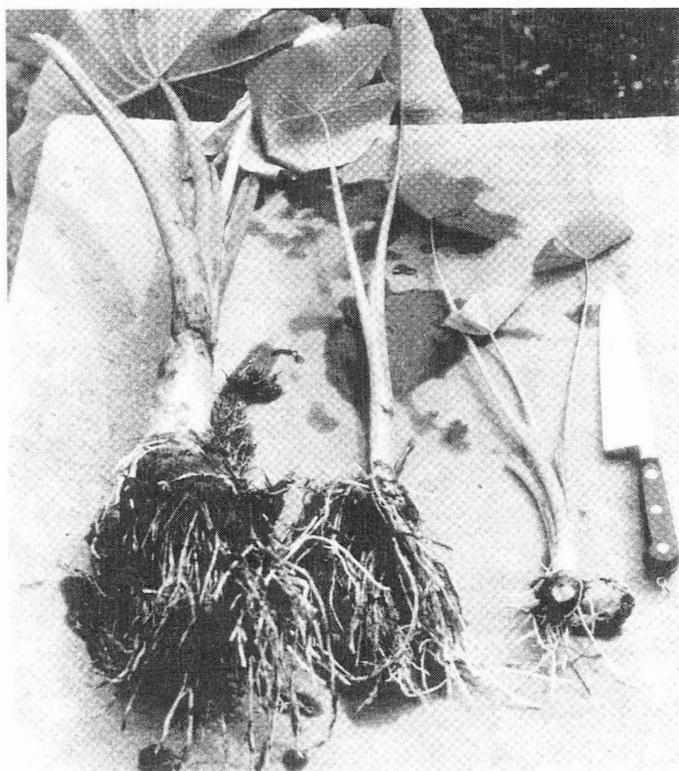


Fig. 23. 'Ohana (cormlets of *kalo*), formed by adventitious roots issuing from the parent plant. They may be left in place after the parent plant is removed to start new plants, but often they are harvested first. Courtesy of Calvin Hirai.

soil and shoring up the banks, making new *lo'i* must have been a major undertaking, probably carried out just once in a generation. The initial work usually involved all the men of an *ahupua'a*—men only, since *kalo* was a sacred plant of Kāne and *kapu* to women—and consisted of burning off the vegetation, then using *ō'ō* to remove roots, dislodge boulders, and loosen the soil. After the dry soil had been removed, water was run into the *lo'i* several times until the bottom was roughly level, and a treading or stamping party was held to pack the soil. For this final step in the project, men, women, and children were all invited into the *lo'i*, "and no chief or chiefess held himself too *tabu* to tread in the patch."<sup>16</sup> A feast followed this event.

After the soil had settled, *pu'epu'e* (mounds) were made about three feet apart in straight rows, and the *lo'i* was ready to inundate and plant. Since *kalo* rarely produces seeds, it is always propagated in one of three other ways. The most common is to take *huli* (vegetative cuttings) from the upper six to eight centimeters (two to three inches) of the corm, containing the stem apex, and the lower ten to twelve centimeters (four to five inches) of the *hā*. The alternative methods are to plant buds borne in the axils of the leaves<sup>17</sup> or to plant 'ohā, which are outgrowths produced by adventitious roots of the parent plant.<sup>18</sup> In modern times, 'ohā have usually been harvested for family consumption, leaving the main plant to mature further.

Cutting off the tops of the *kalo* corms to make *huli* was accomplished with a *palau*, a tool with convex cutting edges at each end. This wooden implement was approximately twenty centimeters (eight inches) long and about three centimeters (one inch) thick at the blade ends, which were finely honed.<sup>19</sup> It was grasped in the center with one hand and the ends used alternately to make the cuts. These traditional *kalo* cutters were replaced in the post-contact period by knives, particularly machetes.

*Huli* were made well in advance of the planting date and left immersed in water or in a damp place to encourage development of abundant adventitious roots. These were then set out three to a mound. The water level in the *lo'i* never reached the bottom of the *huli*; contrary to the popular impression, the mounds were never submerged. Weeds were removed as they appeared during the first six months but thereafter were mostly shaded out by developing plants. Except for regulating the flow of water, the grower left his *lo'i* undisturbed until harvest.<sup>20</sup>

In experiments with eight varieties of *kalo*, all maturing in six to twelve months, Dr. Handy found only one that needed to be harvested promptly at maturity. The other varieties could remain in the flooded *lo'i* for two to twenty-four months after reaching maturity. This feature of the plant makes *kalo* a very flexible crop and allowed a *lo'i* to double as a storehouse. The planter could harvest what he needed, perhaps a little at a time.

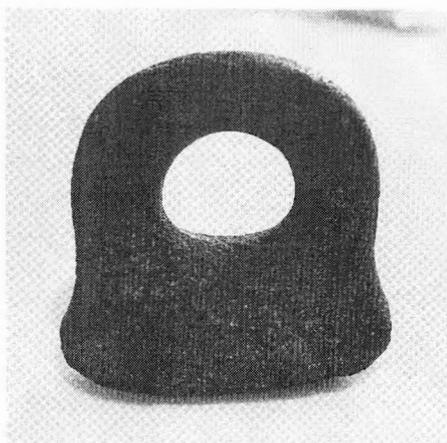
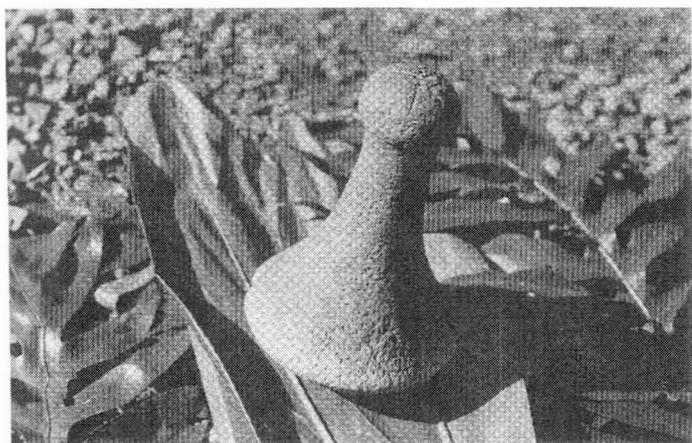


Fig. 24. Stone pounders for mashing *kalo*. The stirrup-shaped pounder is from the island of Kaua'i.

Dryland *kalo* was grown in much the same way as the wetland varieties, also being planted in mounds.<sup>21</sup> Today, where Hawaiian families hold land in moist regions, small dryland patches are frequently seen. Dryland varieties take a little more time to mature than wetland *kalo* — eight to twelve months. Depending on the variety, they may remain in the soil three to twelve months beyond maturity,<sup>22</sup> or even longer. The La'aloa variety, Mrs. Pukui's family favorite, can be left growing indefinitely.<sup>23</sup>

### Preparation and Consumption of *Kalo*

*Kalo* corms were sometimes eaten in chunks after being baked, but the most important way of eating them, of course, was in the mashed form known as *poi*. Making *poi* in olden days was strictly the province of men, but Mrs. Pukui learned how to do the pounding when she was young, with the justification that women needed to know this skill in case an emergency called the men of the family away.<sup>24</sup> I, too, learned the process, by watching and helping as my great-uncle made *poi* each Friday for my family on Maui.

For us, the process began with my great-uncle's bringing *kalo* from the high valley of Kahoma where he lived and planted to my grandmother's house on the beach in Lahaina. He set the *kalo* to boil in a clean, five-gallon kerosene can while he fished or went into town to buy a few groceries. After he returned, he let my brother and me help peel the hot *kalo*, then laid out his *poi* board on *lauhala* mats and began pounding the *kalo*. His *poi* board measured about one meter (three feet) in length and was slightly hollowed out, like a shallow tray. He periodically dipped his fingertips into a bowl of water as he worked, adding several cups of it, bit by bit, to the mass. He constantly turned the mass as he mashed it with the pounder. The *lauhala* mats beneath the board cushioned the blow of his stone.

As the *poi* gradually became a smooth, somewhat sticky, grayish-red paste, my brother and I were frequently scolded



Fig. 25. Cooked *kalo* being mashed on a *poi* board made of 'ōhi'a *lehua* wood. I. Abbott photograph.

for trying to steal fingersful before it was properly finished. Freshly made *poi* has something in common with freshly made bread; few things are quite as enticing. By my great-uncle's standards, *poi* was "finished" long before it reached the consistency of the *poi* sold in supermarkets today. He stopped at the state called *pa'i'ai*, when the mass was smooth and solid. It ferments less readily in this condition and is lighter than ready-to-eat *poi*, an important consideration since my great-uncle would carry his portion back to the high valley.

Apart from the fact that he cooked the *kalo* in a metal can instead of an *imu* (earth oven), my great-uncle made *poi* just as our ancestors did a thousand years ago. His pounder

(*pōhaku kū'i*) was a smooth lava rock fashioned with a knob on top (*pōheoheo*), a handle or *kū'au*, and a flaring base (*mole*). I am not sure what wood his *poi* board was made of, but most were 'ulu or 'ōhi'a lehua wood, and some were large enough for two men to use at once, about two-thirds larger than a one-man board like my great-uncle's. Most of the upper surface was recessed to a depth of about eight centimeters (three inches), with a rim to contain the *kalo* and the water being added as the pounding went on. These were highly valued tools. I remember my great-uncle, in those magical days of my childhood, washing his *poi* board carefully after each use and keeping it covered when stored.

Portions of the *pā'i'ai* that he left us were mixed with additional water each day, as needed for our meals. I watched my mother perform this procedure (called *ho'owali'ai*) countless times in our Honolulu home. Turning the mash with her hand in a rotating motion (*'owai*), she added very small quantities of water and made certain it was entirely absorbed before adding more. As she did so, she used her middle and index fingers to wipe (*kahi*) the inside rim of the bowl above the *poi* so that the sides were clean. When the *poi* was mixed to her liking, she strained it through a kind of cheesecloth thicker and denser than any I can now find. In earlier times, the straining was done with 'a'a'a, the fibrous cover of developing *niu* fronds. Further details of *poi* preparation are given elsewhere by Mrs. Pukui.<sup>25</sup>

As for eating *poi*, some prefer it fresh and others like it two or three days old—slightly fermented or “sour”—and no doubt this question of taste is very old, indeed. Certainly there is no doubt that *poi* was at the heart of the traditional Hawaiian diet, routinely eaten at every meal except in times of shortage. Though *poi* was sometimes made from other ingredients, namely, 'uala or 'ulu, Hawaiians of old unquestionably preferred *poi kalo* to any other. It was their carbohydrate of choice probably to an even greater extent than bread and other baked wheat products are for North Americans today.

In the 1930s, when *poi* was consumed in larger quantities than currently and could still be found in five- and ten-pound bags in the grocery stores, it was not rare to find a Hawaiian man who could consume the contents of a five-pound bag at one sitting. Probably his ancestors would have eaten *poi* in such portions, too, and large, old storage containers for *poi* now in museum collections indicate that it once was prepared in very big amounts. *Maka'ainana* probably made *poi* for themselves every few days in smaller quantities.

*Kalo* was prepared and eaten in other ways besides as *poi*. Its leaves (*lū'au*) were cooked, wrapped in *tī* (*Cordyline fruticosa*) leaves, and baked in an *imu*. When the *lū'au* were combined with fish or pork and baked in such a wrapper, the dish was called *laulau*; after Western contact, chicken and beef were often substituted for the fish or pork. Whatever its

exact ingredients, to this day the *laulau* remains a favorite dish in the islands, popular with many ethnic groups other than Hawaiians.

Another Hawaiian use of cooked *kalo* is *kulolo*, a dish in which the fresh corm is grated, mixed with coconut cream, wrapped in *tī* leaves, and steamed in an *imu*. The origin of this dish, now used as a dessert, is not known, but if it was eaten prior to 1819, it must have been reserved strictly for men. Consumption of coconut was forbidden to women.

## 'Uala, the Second Staple

Sweet potato, or 'uala, ranked second only to *kalo* in providing carbohydrates and minerals in the Hawaiian diet. 'Uala were cultivated and eaten throughout the islands but were important especially in settlements on leeward coasts too arid even for “dryland” *kalo*. The hardiest varieties of 'uala will tolerate habitats with less than thirty inches of rainfall annually, and the plant will grow successfully in almost any kind of earth except a sticky, clay-like soil. Even pockets of semi-disintegrated lava can support 'uala,<sup>26</sup> and at Keone'ō'io, Maui, 'uala are being grown today in soil-filled depressions on the dry lava fields of southern Haleakalā.

A vine with large, underground tubers, a single 'uala plant often covers a sizable area. The leaves may be eaten either raw or cooked, but the crop was raised principally for its tubers, which are enlarged storage roots. 'Uala vines tend to produce tubers quite prolifically; with some varieties, as many as three crops can be harvested from the same bed annually.

## The Mysterious Origins of 'Uala

The origins of 'uala are even more tangled than those of *kalo*. There are three separate lines of sweet potatoes, known vernacularly as the Kumara, Batata, and Camote lines, and all of them entered the Pacific region at relatively early dates.<sup>27</sup> The three are genetically unstable, so their prehistoric dispersion cannot be reliably traced by analyzing the sort of chromosomal patterns that help clarify the travels of taro, but documentary, archaeological, and linguistic evidence offers reason to believe that it was the Kumara line that reached Hawai'i and that it did so without European assistance.

The three lines of sweet potatoes all originated in South America, and at least two of them, the Batata and Camote lines, were established in Central America before European explorers arrived. Columbus carried the Batata line from the Caribbean to Europe, and from there it was spread rapidly eastward, reaching Yunnan province in southwestern China by 1525. By the early seventeenth century, it was growing in

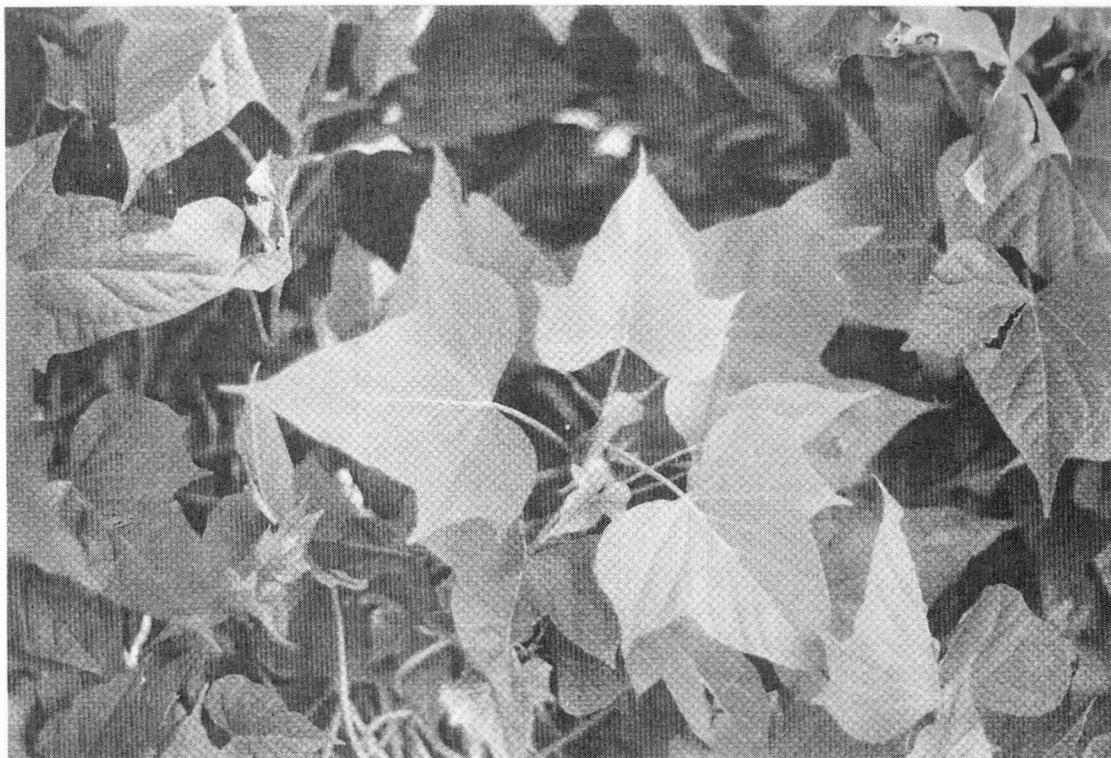


Fig. 26. An 'uala plant of the *mobihī* variety. Courtesy of Virginia Smith.

the Ryukyu archipelago, south of Japan, and it was introduced to western Melanesia as well, either by the seafaring Chinese or by Europeans.<sup>28</sup>

It could also have been the Batata line that British seaman Will Adams, the "Anjin-san" of the book and television drama *Shōgun*, carried to Kyushu in the 1620s. It appears to have spread from there into the northern islands of Japan and is said to have saved the country from starvation in 1733, when the rice crop failed due to severe drought.

The Camote varietal line is thought to have taken a more direct route to Asia, being carried across the Pacific from western Mexico to the Philippines by Magellan in the sixteenth century. This line could have been transferred to the Ryukyus, then to Japan about the same time as, or in place of, the Batata line.

None of these pathways jibes with Polynesian cultivation of sweet potatoes. Carbonized sweet potato remains from Easter Island and the island of Hawai'i both predate Western contact, those from Easter Island being carbon-dated to A.D. 1526 and the Hawaiian specimens being placed between A.D. 1465 and 1725.<sup>29</sup> Even if sweet potatoes had somehow been introduced to Hawai'i through European voyagers who preceded Cook, it is highly unlikely that 'uala could have so swiftly attained the prominence they held in Hawai'i when Cook's ships arrived. Both the extent of 'uala cultivation re-

corded at the time of contact and the advanced level of Lono worship manifested by the Makahiki celebrations of 1778 make it unlikely that 'uala were a recent introduction.

An independent introduction of the Kumara line to Polynesia seems more plausible, particularly because the South American name for sweet potatoes, *kumar*, is so close to the name *kumara*, by which they are known in the Society Islands. It would be a remarkable linguistic coincidence if the two cultures had devised these names separately. The Kumara line of sweet potatoes is thought to have arrived first in the Marquesas and passed from there to the Society Islands, Easter Island, Hawai'i, and other destinations as migrations and two-way voyaging occurred.

Thor Heyerdahl's successful trip on the raft *Kon-Tiki* from Callao, Peru, to Raroia in the Tuamotu archipelago demonstrated one avenue by which sweet potatoes might have reached Polynesia, and it is also plausible that Polynesians, being superb sailors and navigators, could have reached the shores of South America, bringing the Kumara line back with them when they returned. Yet if such contact occurred between the peoples of South America and the islanders of Polynesia, why did it leave no other traces? Why did no other South American crops enter Polynesia by this means? Why would the Polynesians not have acquired such useful technologies from the peoples of South America as

weaving? Why would they not have held onto samples of Indian metalwork? And conversely, if they visited South America, why would they have left no trace behind — no coconuts or other crops, no gourds or fishing tools? The mystery remains to be solved.

### Varieties of 'Uala

However 'uala came to Hawai'i, it prospered in the hands of Hawaiian planters. As in the case of *kalo*, breeding or selection for desirable qualities appears to have brought a proliferation of varieties. According to Handy, Hawaiians distinguished among the many varieties by observing a number of botanical features: the color of leaves both top and bottom, the shape of the leaves, colors of the leaf veins, the color of the tubers both inside and outside.<sup>30</sup>

If the more than 230 cultivars (cultivated varieties) that Hawaiians named in Handy's survey were critically analyzed, many duplications would undoubtedly be discovered, and perhaps only forty or fifty varieties would stand, but even that number would be a great botanical treasure. One hundred years ago, varieties that tolerated cool or high temperatures, light or moderate rain, poor or good soil were all recognized, isolated, and used to good advantage.

Today, fewer than two dozen Hawaiian varieties of 'uala may be found, and of these, only a small number are grown for trade. The principal varieties found in Hawaiian markets are introduced commercial varieties: the orange-fleshed "yam" (not a true yam), the yellow-fleshed sweet potato, the cream-fleshed sweet potato, and the purple-fleshed "Okinawa sweet potato." This last cultivar, a recent introduction, has many common names, including the Hawaiian name *poni*.

### 'Uala Planting Practices

In early times, 'uala were grown in *pu'e* (mounds) that formed a *māla* (patch), usually surrounded by stone walls. Since the best, irrigated land was reserved for *kalo* and since 'uala is a much hardier plant, it usually occupied areas marginal for gardening, such as the arid slopes of 'Ulupalakua, Maui, and of Kealakekua, Hawai'i. The hot, dry flats from Wailupe to Waikiki on O'ahu, currently some of the most expensive real estate in Hawai'i, were noted for their sweet potato fields by Archibald Menzies in 1792. There were famous 'uala fields in Ho'olehua, Moloka'i, too, and in the 1930s the stone walls that marked the *māla* could be readily seen near Kahualewa, Moloka'i.<sup>31</sup>

In preparing 'uala fields, the Hawaiians called on the pig boy Kamapua'a or the pig man Kānepua'a. These mythic figures, associated with the great gods Lono and Kāne and

sometimes considered gods in their own right,<sup>32</sup> were invoked with prayers such as this:<sup>33</sup>

*E Kama-pua'a,  
'Eia ka māla a kaua;  
Ma'ane'i 'oe 'e 'ēku — ai,  
Mai kela ika 'a kala 'ika  
A hiki 'i ke'ia kuaiwi.  
Mai hele — aku 'oe mawaho,  
O pa 'oe — i ka pohaku!*

O Kama-pua'a,  
Here is our garden;  
Here is where you should dig,  
From one edge of the patch to the other  
Until you reach this boundary-wall of piled stones.  
Do not go outside,  
Lest a rock should strike you.

Pigs' rooting in the *māla* softened the soil and made planting easier.

'Uala were usually planted on the first to sixth days after the new moon — the nights designated as Hilo and Hoaka, plus the four Kū nights — and at full moon. The Hawaiians followed their planting calendar closely in growing 'uala because this crop was substantially, if not wholly, dependent on rain; irrigation was not feasible in the areas where it was planted. No wonder 'uala growers developed close ties to their god Lono, who brought the rain that the god Kāne provided.

Though 'uala, like most plants, grow better in moist soil than in dry, they do not flourish in soil that is continually wet, and this fact was taken into account both in siting *māla* and in deciding when to plant. In dry localities, Hawaiians waited until a period of rain had started before planting 'uala, while in wet areas, they waited until the rainy season appeared to be over. The geography of the islands and the mountain-to-sea expanse of the *ahupua'a* meant that appropriate locations for 'uala could be found throughout the year. Access to moisture-tolerant and dry-tolerant varieties also ensured success with this crop.

'Uala rarely set seed, and it is believed that this source of tasty carbohydrates came to Hawai'i in tuber form and at first was propagated in that way. Though the tubers root very easily, in general practice the Hawaiians started new plants from slips (vine cuttings). Development of roots was sometimes promoted by first enclosing bundles of slips in damp *tī* (*Cordyline fruticosa*) leaves. Much of the work was done at night or before dawn, as Hawaiian planters believed that slips cut when the sun was up produced dry, stunted tubers and that slips planted when the sun was high formed plants with many leaves and few tubers.

Two or three slips were placed in each mound, in holes



Fig. 27. Thomas Heddington, "Village of Macacoupah, Owhyee," ca. 1790. The stone walls in the background indicate 'uala fields. Engraving. Collection of Bishop Museum. Bishop Museum photograph.

six to eight inches deep made with an 'ō'ō, and the earth was pressed down around them. Mounds were then covered with a mulch to hold the moisture. In time, when growth appeared to be vigorous, the branches of each vine were twisted together around their own bases and covered with earth to induce each plant to produce larger tubers rather than more leaves. In the event of heavy rains, maturing or already mature vines were pulled back over the tops of the mounds to dry the foliage and to allow sun and wind to dry the soil beneath the vines in order to prevent mildew and rot. About a month after a newly planted field got its first good rain, some young tubers were dug out by hand and offered as a sacrifice to Lono, the god of the crop. With that, a *kapu* was laid on the *māla*, and no one was permitted to enter it or to disturb the plants until harvest time, perhaps one to several months later.<sup>34</sup>

Being much less water-sensitive than *kalo*, 'uala is a far

easier crop to grow, and since both men and women could cultivate 'uala (but only men *kalo*), supplies of 'uala could be assured even at times when the men's services were commandeered for war or other purposes. Moreover, two or three crops of 'uala could be harvested from a single field each year if it were planted in the quick-growing varieties that mature in four to six months. This contrasts to one crop of *kalo*, which takes between nine and eighteen months to mature.

### Preparation of 'Uala

'Uala were usually cooked in an *imu* since this underground oven was used nearly daily. In places that lacked steady sources of running water necessary for the best *kalo* cultivation, and elsewhere when *kalo* was in short supply, chunks

were mashed and eaten as *poi*. In such arid areas as Nānākuli and Lualualei on O'ahu, *'uala* replaced *poi kalo* as the staple carbohydrate.

*Poi 'uala* is not as sticky or cohesive as *poi kalo*, so it was prepared and served differently. In my family, *'uala* were mashed with a basalt *poi* pounder that was lighter in weight and smaller than the standard *kalo* pounder. In post-contact times, it was mixed with a tool made of sticks instead of with one's fingers, and coconut shell scoops were employed to serve it.<sup>35</sup> Similarly, elliptical pieces of coconut shell (*kio'e palau*) were used to spoon down the *poi 'uala*, making it the only Hawaiian food customarily eaten with a utensil, as far as is known. *Poi 'uala* ferments rapidly, so presumably it was

made in smaller quantities than *poi kalo* and consumed fresh for the most part.

Mrs. Pukui described to Dr. Handy a way in which people in Ka'ū dried and used surplus tubers.<sup>36</sup> After the *'uala* were baked in the *imu*, they were placed in open baskets and air dried. The preserved *'uala* were taken to fishing sites during the summer to serve as food for those fishermen who might be away from their fields for a month or more.<sup>37</sup>

Hawaiians are also known to have eaten *'uala* leaves.<sup>38</sup> These were cooked in an *imu* in *ti* leaves, as we could today prepare *ung choy* (swamp cabbage, *Ipomoea aquatica*), a related plant that was introduced to Hawai'i by Chinese immigrants in the nineteenth century.