

CHAPTER I

The First Hawaiians and Their Plants

*Ke Kaao 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.¹ 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.²

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.,³ 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,⁴ 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,⁵

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

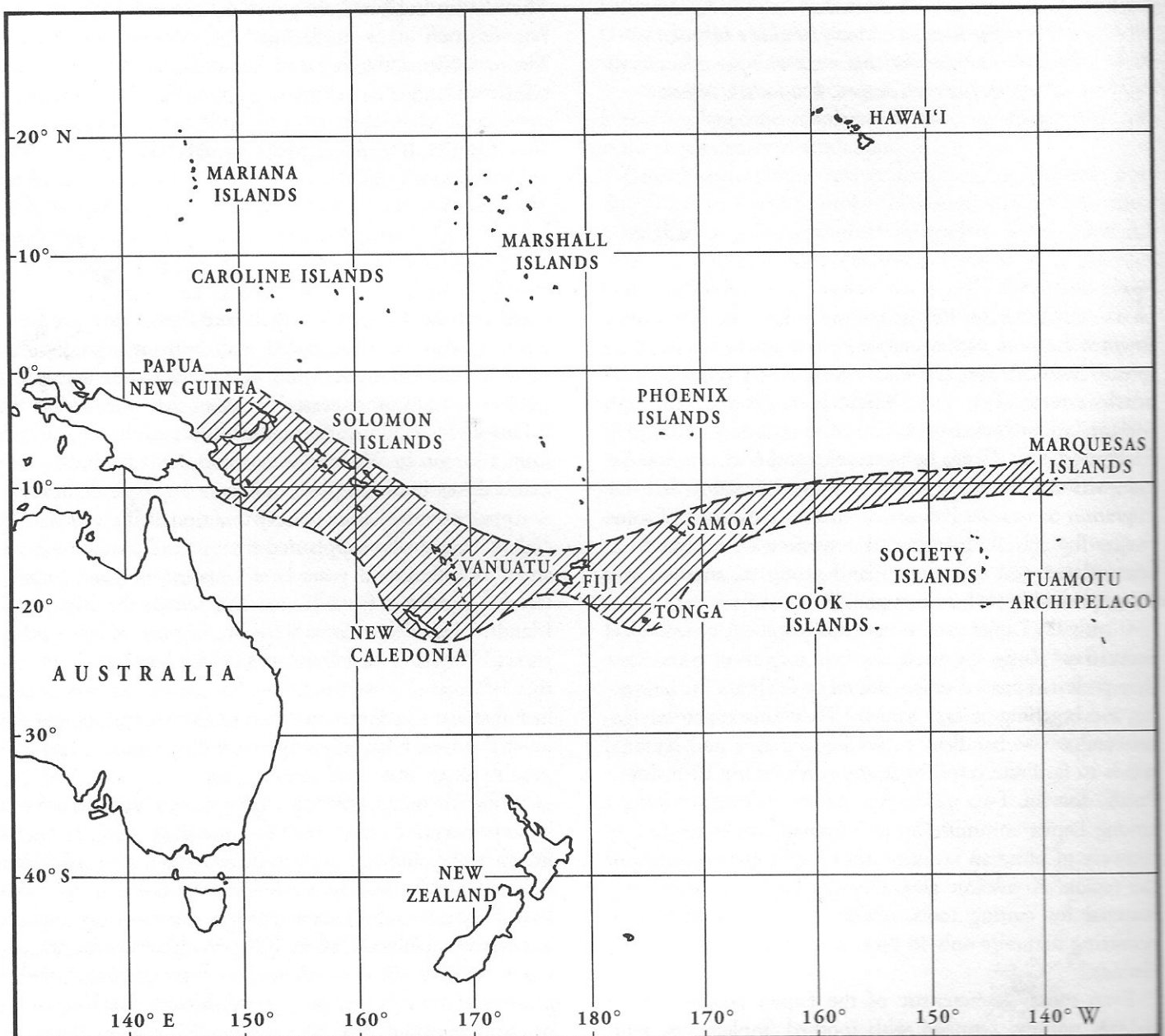
Early Food Plants of the South Pacific

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.⁶ 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 foods⁷ 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
Trees, shrubs, and vines	
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>
Tuber and root crops	
<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.

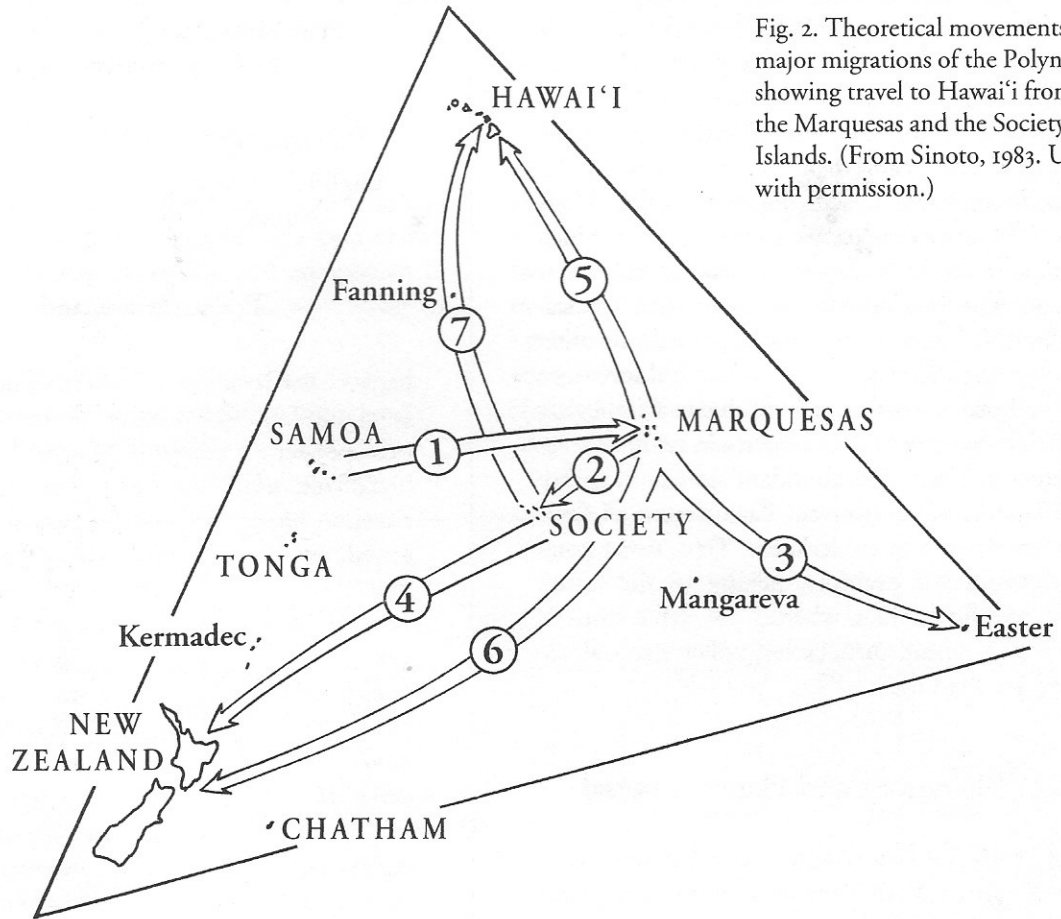


Fig. 2. Theoretical movements and major migrations of the Polynesians, showing travel to Hawai'i from both the Marquesas and the Society Islands. (From Sinoto, 1983. Used with permission.)

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.⁸ 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 1778.⁹ 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,¹⁰ 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;¹¹ 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 *huli* of *kalo* and *'ape*; the underground rhizomes of *'awapuhi* and *'olena*; the underground tubers of the yams, *'uala*, and *pia*; the underground stems of *'ohi'e*; the root shoots of *mai'a*, *'ulu*, and *wauke*; the stems of *ti*, *kō*, and *'awa*.¹²

It was fortunate for the Polynesians that they brought

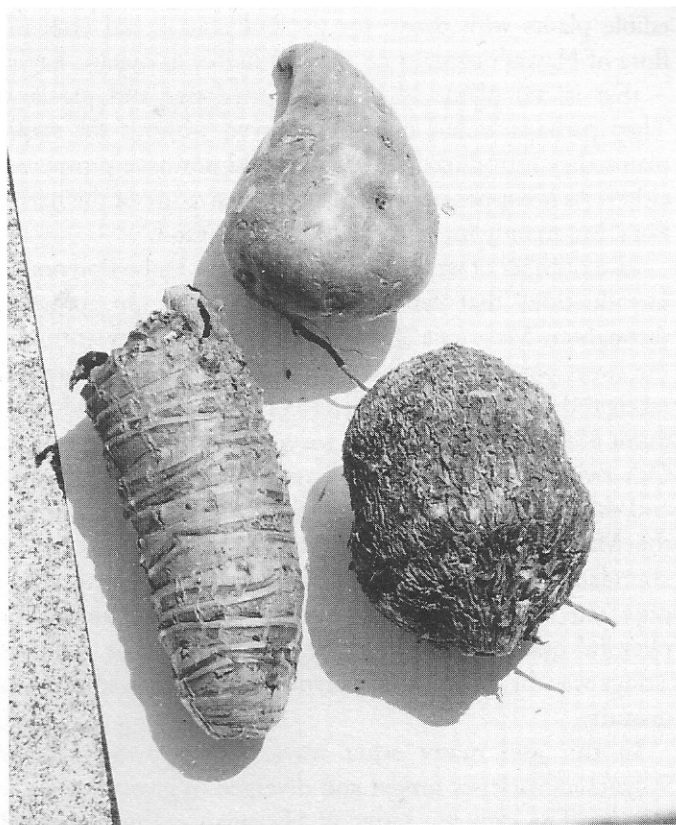


Fig. 3. Clockwise from the left: stems of *'ape* (*Alocasia macrorrhiza*), *'uala* (sweet potato, *Ipomoea batatas*), and *kalo* (taro, *Colocasia esculenta*). It was in this form that Polynesian voyagers probably carried these plants to Hawai'i more than fifteen hundred years ago.

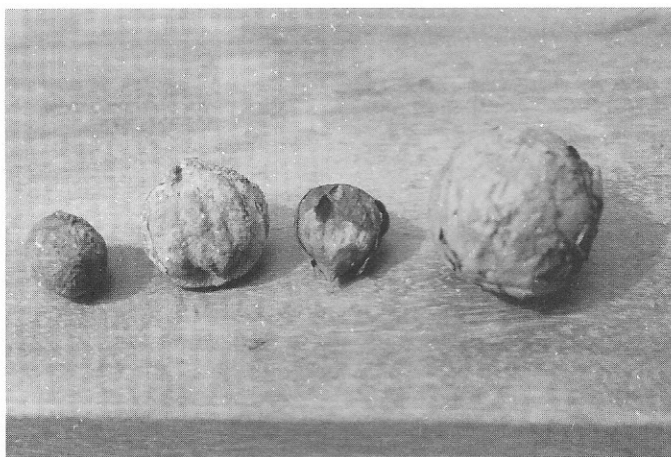


Fig. 4. Another group of plants was probably transported to Hawai'i as seeds. From left to right: seeds of *milo* (*Thespesia populnea*), *kukui* (candlenut tree, *Aleurites moluccana*), *kou* (*Cordia subcordata*), and *kamani* (Alexandrian laurel, *Calophyllum inophyllum*). I. Abbott photograph.

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,¹³ 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,¹⁴ 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.

CHAPTER 3

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 *ni'angō'o* or *pi'o* ranks, were earthly representatives of the gods.¹ 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.²

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 *'ohē* (bamboo) were known as bodies of Kane, 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.³ *Kinolau* of Kū, a god associated with building and with war,



Fig. 14. Ruins of a *heiau mapele* 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,⁴ 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'ainana* 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).⁵ 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'ainana* 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.⁶

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'ainana* 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,⁷ 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.⁸ 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.⁹

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.¹⁰ 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.¹¹

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,¹² 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.¹³ These latter offerings were made in place of human sacrifices.

Muku	Hilo	Hoaka	Kū Kahi	Kū Lua	Kū Kolu	Kū Pau
offshore fishing ma'i'a	reef fishing ‘uala, gourds, kalo, ma'i'a	night fishing ‘uala	day reef fishing no planting	low-tide fishing no planting Sacred to Kū	canoe and pole fishing; gather limu, crabs, sea urchins	reef fishing ‘uala
‘Ole Kū Kahi	‘Ole Kū Lua	‘Ole Kū Kolu	‘Ole Kū Pau	Hūnā	Mōhalu	Hua
fish schooling ‘uala	torch fishing	torch fishing	poor fishing; rough seas	good fishing gourds, hala, yams	poor fishing plant flowers	deep-sea fishing ‘uala, gourds Sacred to Kāne
Akua	Hoku	Māhealani	Kulu	Lā'au Kū Kahi	Lā'au Kū Lua	Lā'au Pau
reef and deep-sea fishing ma'i'a, niu	good fishing ‘uala, kalo, weed plants	deep-sea fishing plant anything, weed kalo	deep-sea fishing; good limu weed ma'i'a	ma'i'a, ‘uala	fishing only fair gather herbal medicines no vine planting	no vine planting
‘Ole Kū Kahi	‘Ole Kū Lua	‘Ole Pau	Kāloa Kū Kahi	Kāloa Kū Lua	Kāloa Pau	Kāne
cultivate soil	no planting these days cultivate soil; mulch beds	mulch beds	poor fishing at sea; good shellfish ma'i'a, bamboo	night fishing kō, bamboo Sacred to Kānaloa	reef fishing, shellfish, limu ‘uala, kalo, weed plants	reef fishing, sea urchins no planting Sacred to Kāne
Lono						
pole and torch fishing 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 *kapa* to *Kū*). Work was suspended on days *kapa* 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.¹⁴ 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,¹⁵ 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.¹⁶

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 *ahu-pua'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.¹⁷ 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,¹⁸ 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.¹⁹ 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,²⁰ the food was cooked in a ritual fire,²¹ 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."²² 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.²³

Makahiki was a religious occasion, welcoming the return of Lono as the bringer of rain and winds.²⁴ 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,²⁵ 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

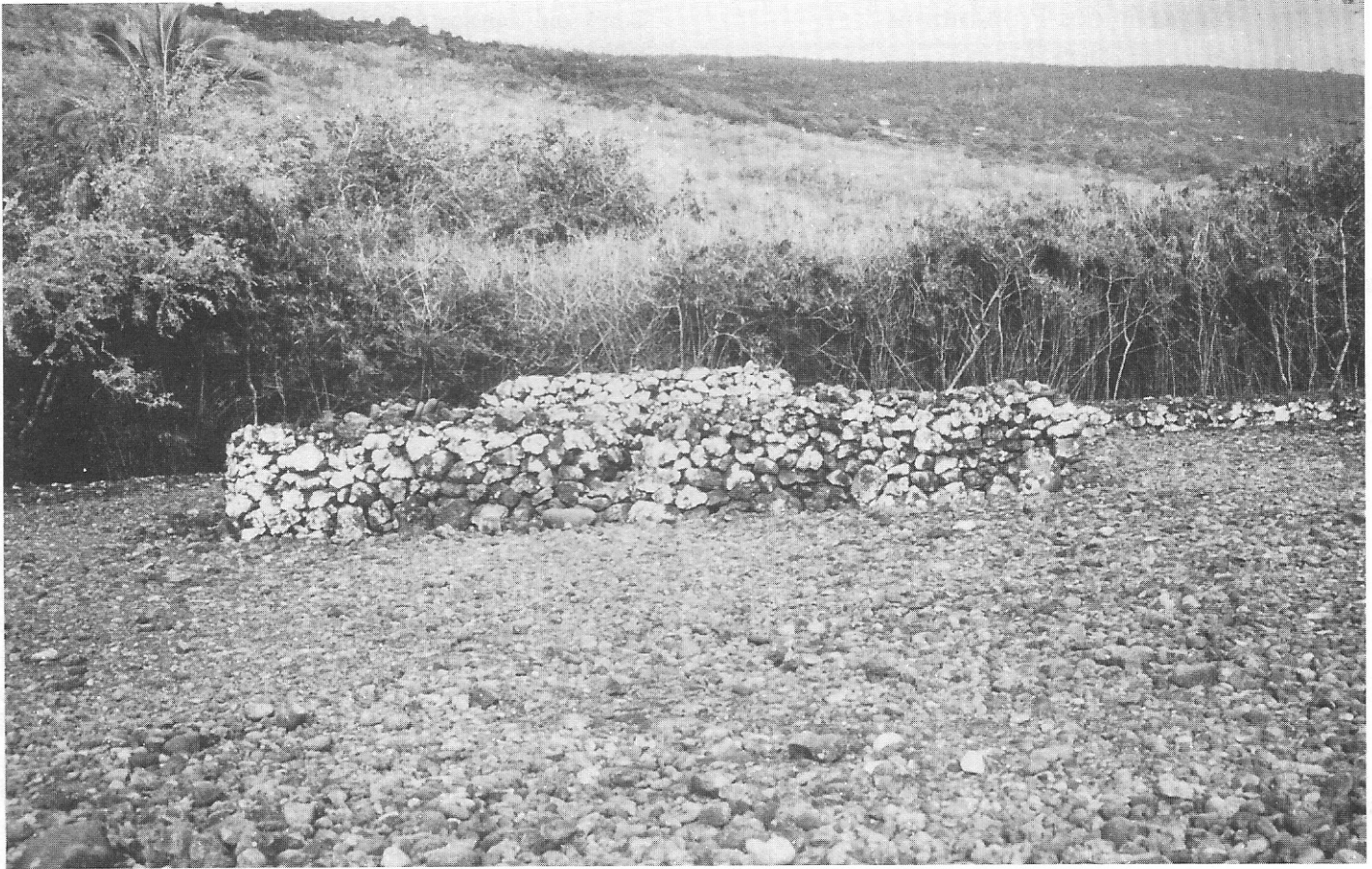


Fig. 17. [ABOVE] Altar enclosure, the only remaining structure on the platform of *Hiki'au heiau* at Kealakekua Bay, Hawai'i, which played a key role in Makahiki ceremonies.



Fig. 18. [LEFT] Image of the god Lono at the top of the *akua loa* staff, which headed the procession to each *ahupua'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 cross-piece 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.²⁶

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

that preceded all major religious observances.²⁷ 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*,²⁸ 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."²⁹

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

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.³¹ 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*.³² 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.³³

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.³⁴

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 Kealahou 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.³⁵ 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 *ʻUala*

*E Ku-ike-olo-walu-e,
I olowalu ka huli i ka makalua a kaua.
I olowalu ke kalo i ola au ka mahiʻai,
I ola ka hono hale,
I ola ka ʻohua
I ola ka ʻohana,
I ola na malihini kipa mai,
A i ola iaʻu ia (ka inoa o ka mahiʻai).
ʻAmama. 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.
ʻAmama. It is free of tabu.

— from June Gutmanis, *Na Pule Kahiko*

KALO (taro, *Colocasia esculenta*) and *ʻuala* (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 *ʻuala*.¹

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.² 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,³ but only one in Hawaiʻi.

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 Hawaiʻi (particularly of Kauaʻi, Oʻahu, Maui, and

Molokaʻi) afforded the Hawaiian planter excellent acreage for *kalo* and adequate-to-abundant supplies of cool water necessary to cultivate wetland *kalo* varieties.⁴

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.⁵ When the sky principle Wakea coupled with the earth principle Papa, their first child, Hāloanaka, was stillborn,⁶ but a *kalo* plant sprouted from the place where the fetus was buried. Their second child was a daughter, *Hoʻohōkūkalani*, by whom Wakea later had a human son named Hāloa, the ancestor of the Hawaiian *aliʻi* and thus of all Hawaiians.⁷ 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.⁸ 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

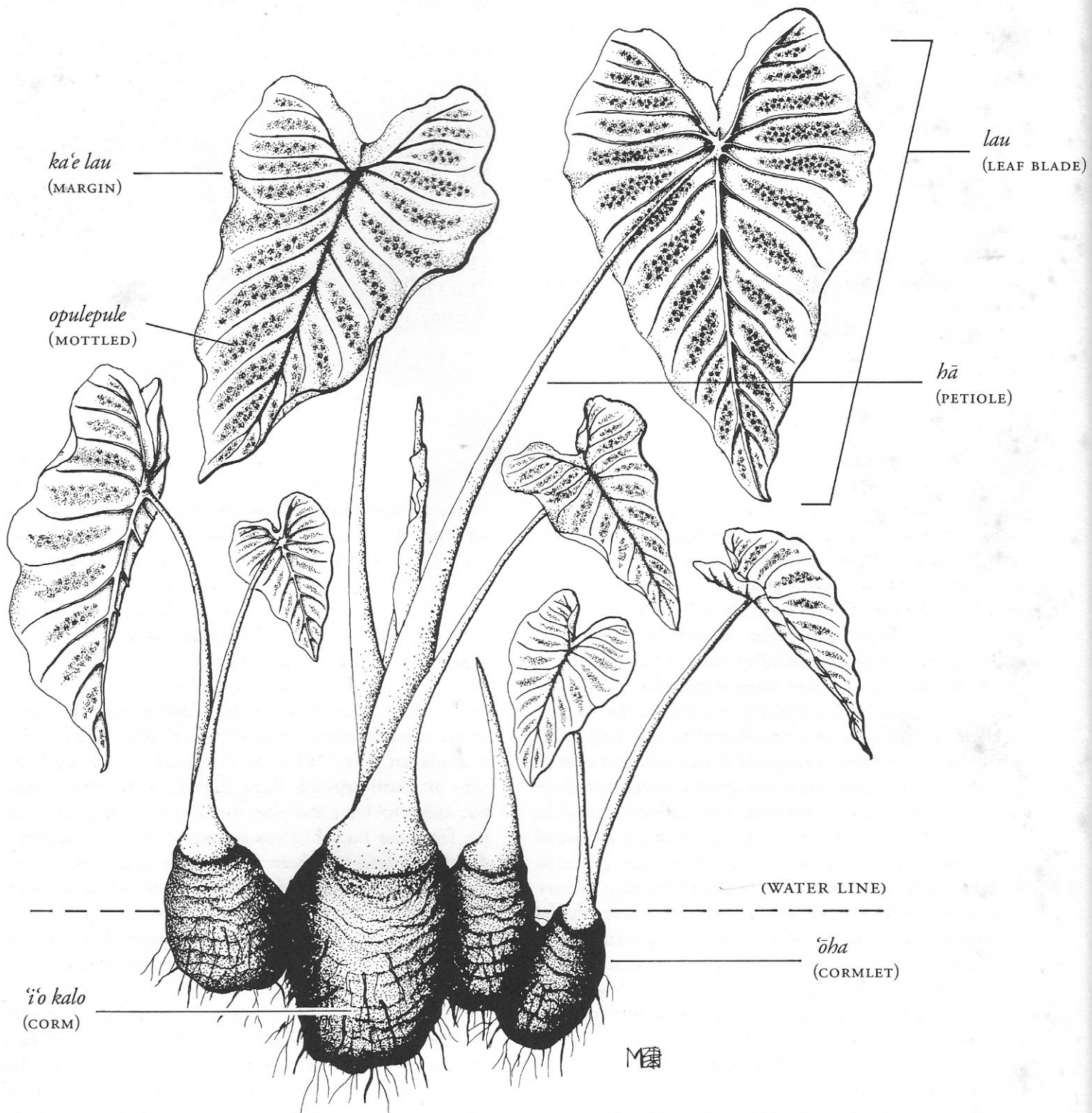


Fig. 20. Diagram of the 'elepaio variety of *kalo*, which has green-and-white mottled leaves. Hawaiian and English terms for important parts of the plant are indicated.

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.⁹ 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.¹⁰ 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.¹¹

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.¹² 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).¹³

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.¹⁴ 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.¹⁵ 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

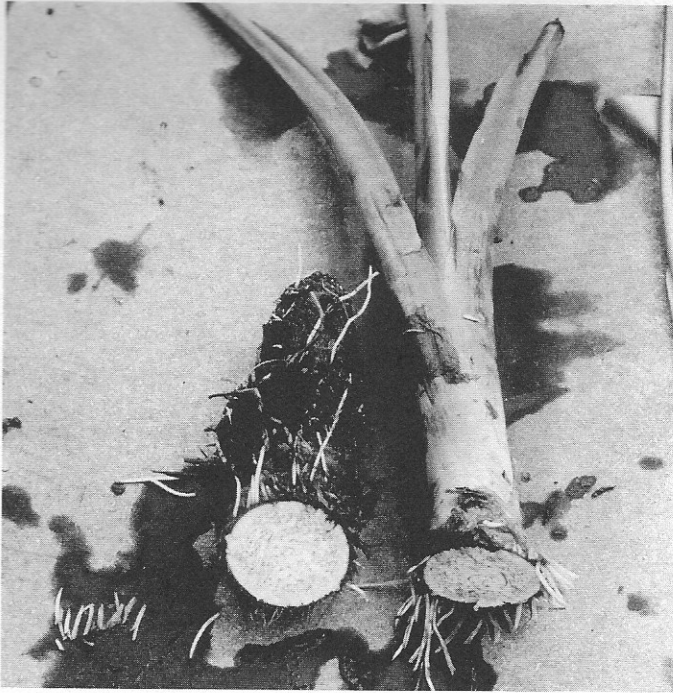


Fig. 22. The *huli*, a cutting including the top of the corm and the stem tip enclosed in the petioles, used as the vegetative means of propagating *kalo*. Courtesy of Calvin Hirai.

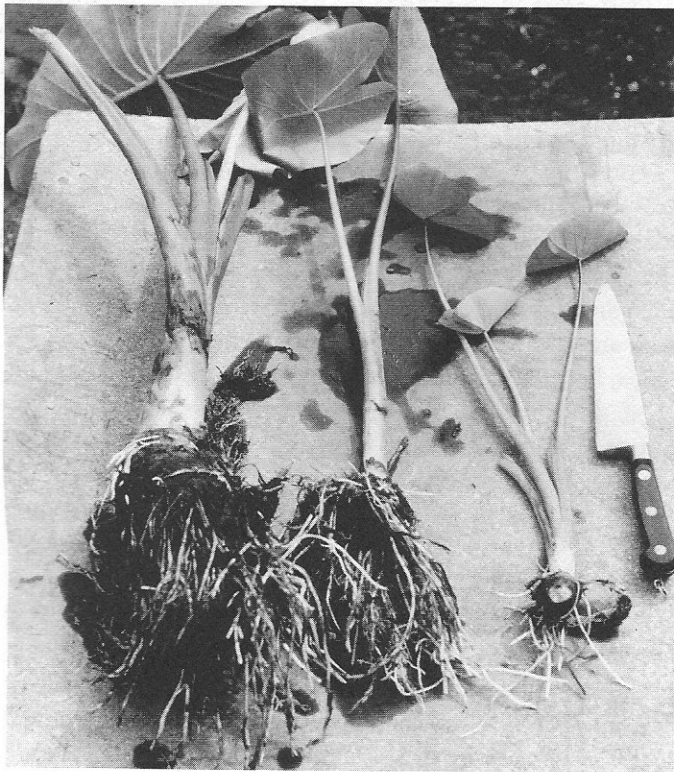


Fig. 23. 'Ohana (cormlets of *kalo*), formed by adventitious roots issuing from the parent plant. They may be left in place after the parent plant is removed to start new plants, but often they are harvested first. Courtesy of Calvin Hirai.

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."¹⁶ 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 leaves¹⁷ or to plant 'ohā, which are outgrowths produced by adventitious roots of the parent plant.¹⁸ 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.¹⁹ 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.²⁰

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 function as a storehouse. The planter could harvest what he needed, perhaps a little at a time.

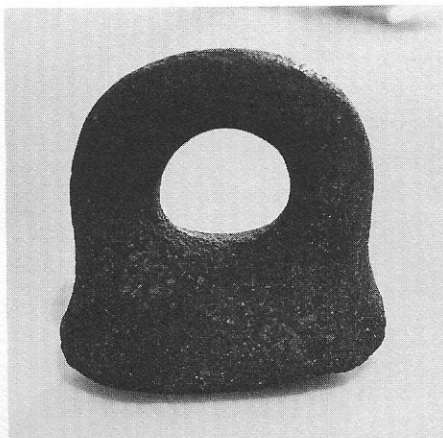
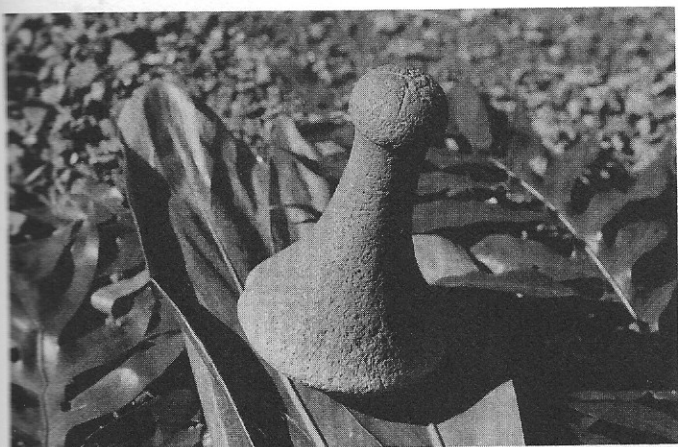


Fig. 24. Stone pounders for mashing *kalo*. The stirrup-shaped pounder is from the island of Kaua'i.

Dryland *kalo* was grown in much the same way as the wetland varieties, also being planted in mounds.²¹ 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,²² or even longer. The La'aloa variety, Mrs. Pukui's family favorite, can be left growing indefinitely.²³

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.²⁴ 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 *pa'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.²⁵

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*,²⁶ 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.²⁷ 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

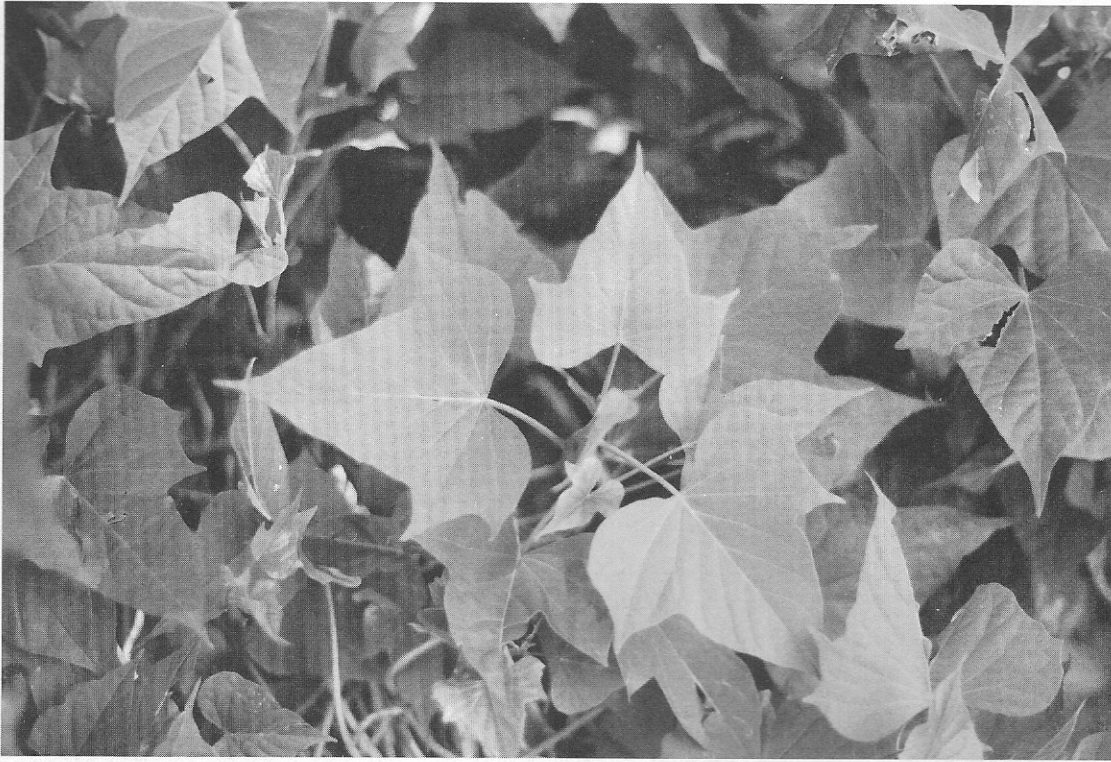


Fig. 26. An 'uala plant of the *mohihi* variety. Courtesy of Virginia Smith.

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

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 1725.²⁹ 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.³⁰

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.³¹

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,³² were invoked with prayers such as this:³³

*E Kama-pua'a,
'Eia ka mala a kaua;
Ma'ane'i 'oe 'e 'eku — 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 situating *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

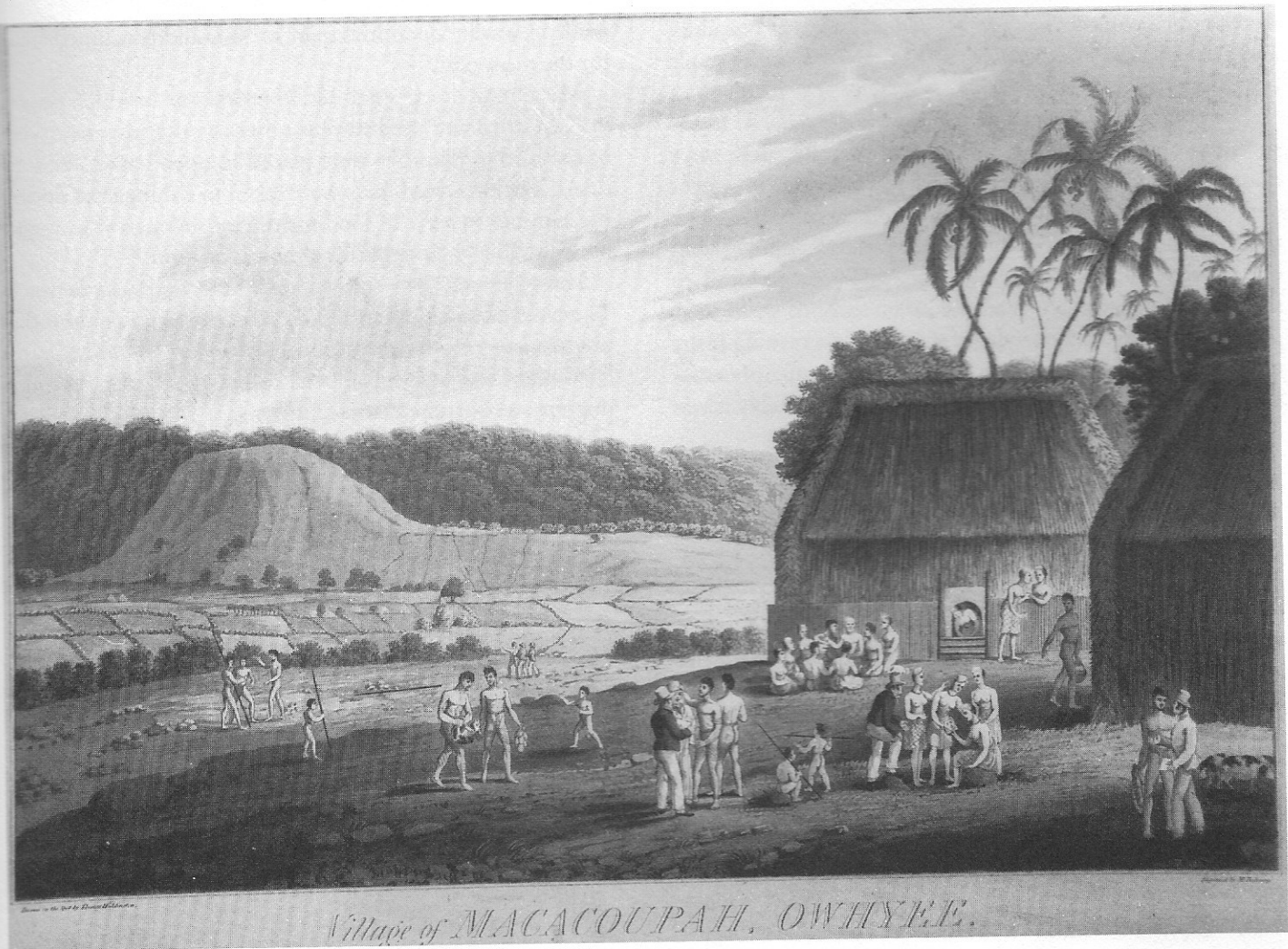


Fig. 27. Thomas Heddington, "Village of Macacoupah, Owhyee," ca. 1790. The stone walls in the background indicate 'uala fields. Engraving. Collection of Bishop Museum. Bishop Museum photograph.

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.³⁴

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.³⁵ Similarly, elliptical pieces of coconut shell (*kīo'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.³⁶ 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.³⁷

Hawaiians are also known to have eaten *'uala* leaves.³⁸ These were cooked in an *imu* in *tī* 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.

Other Land Plants Used for Food and Drink

*E Kūmokuhalii, Kūpulupulu,
Kūlanawao, Kūpa'aikē,
kua i ke kumu, kua i ka
elau, kua i ka lala,
e ike, e nana mai i ke
kalai ana o ka oo,
he lapa ka oo a'u
a ke kanaka mahiai;
mahi au i ka aina kula,
he uala ka ai,
he uhi ka ai,
he kalo maloo ka ai,
a me na ai kupono e ae
ia'u ke mahi a kanu
i ka aina maloo.*

O Kūmokuhalii'i, Kūpulupulu,
Kūlanawao, Kūpa'aikē,
Cut down the trunk; cut off
the top; cut off the branches.
See and watch the
fashioning of the 'ō'ō,
A quick-working 'ō'ō for me
[one of your farmers;]
[I will cultivate on the plains]
sweet potatoes for food,
yam for food,
dry land taro for food,
And all other food plants
suitable [to cultivate and
plant in the] dry lands.

— from E. S. Craighill Handy and
Elizabeth Green Handy,
Native Planters in Old Hawaii

HAWAIIANS supplemented their diet with a number of plant foods, including coconut (*niu*), breadfruit (*'ulu*), bananas (*mai'a*), three species of yams (*uhi*), and sugarcane (*kō*). Some were used regularly to lend variety to their meals, while others were only consumed on occasion — when encountered in the wild, in times of hardship, or when seasonally available. The only drink commonly prepared was *'awa*, a mildly narcotizing beverage which apparently took the place of food on occasion, when it was used to bring sleep to an aching body.

In comparison to *kalo* and *'uala*, these foods did not constitute a substantial portion of the Hawaiian diet, but they are important to recognize nonetheless. They not only broadened the range of available food choices, but also contributed nutritional elements to the diet and helped the Hawaiians survive times when their staple crops were, for one reason or another, available only in reduced quantities.

Niu, Coconut

Several legends tell how *niu* came to Hawai'i. One story from the island of Hawai'i credits the tricksters Aukele-nui-aiku and his brother Kane-Apua:

"The first time Apua and his brother come from Kahiki they do not bring slips of food plants because they expect to find them growing here. Being almost famished, they return to Kahiki after plantings, and appear off Kaula-(u)ka's place in Kahiki with a load of pretended food in the shape of coral rock. Their not landing is laid to the rough surf. Of each plant they are shown they declare that it 'germinates, sprouts, bears leaves and fruits in Hawaii,' and hold up a piece of coral resembling the shape of the plant. The owners of the food plants cast all away as worthless and the voyagers gather them into the canoes and carry them back to plant in Hawaii. The first coconuts in Hawaii are planted at Kahaualea (where stands the heiau of Wahāula) and at Kalapana in Puna district, Hawaii."¹

O'ahu has a conflicting story attributing the deed to Pōka'i, an early voyaging chief from faraway "Kahiki," who is said to have brought *niu* and planted it in the region of Wai'anae now known as Pōka'i Bay.²

This member of the palm family has been in the Pacific islands for a long time, with fossil records dating to 3000 B.C. in Melanesia and slightly later in New Guinea. The plant has played a tremendous role in Polynesian society, and it

seems likely, as these tales indicate, that early settlers brought this useful tree with them to Hawai'i in seed form. The unearthing of *niu* cordage and of a coconut grater at Waimānalo, one of the earliest known sites of Hawaiian habitation, firmly establishes the plant's antiquity in the islands and its early use, but questions about its history remain unanswered.

It is possible but not likely, I believe, that the ocean itself carried the coconut to the shores of Hawai'i. Experiments have shown that coconut seeds can develop after having floated at sea for periods of up to 110 days and can germinate in seawater so long as the water is undisturbed.³ Little water is absorbed by an intact husk, and only if its natural waxes are removed — by the abrasion of rocks and sand, perhaps — does a husk grow waterlogged and sink. Even then, water does not necessarily penetrate the shell, and the seed remains viable, but after such treatment, it will germinate effectively only if it lands in mud or at least in muddy sand; pure sand inhibits sprouting.

It is less the complexities of this process than the pattern of Pacific Ocean currents that incline me to think that Hawaiians themselves were responsible for introducing *niu* to the islands. The cool currents that predominate in the North Pacific circle in a clockwise direction west, north, and east of Hawai'i and, in any case, are poor candidates to transport a tropical species like the coconut to a new habitat. To the south, the equatorial currents flow east and west, creating formidable odds against any plant, plant raft, or seeds drifting northward to Hawai'i. It is significant that the Pacific mangroves, known to disperse readily by sea and long ago widely distributed throughout the Pacific, failed to colonize Hawai'i; mangroves were not introduced to the islands until the twentieth century.

Working without benefit of the present archaeological data, Handy and Handy speculated that *niu* was a late introduction to Hawai'i, arriving sometime after the first voyages.⁴ Though the archaeological evidence contradicts their conclusion, it is worth noting their line of reasoning: by comparison to the other Polynesian island groups, Hawai'i is poorly endowed with coconut trees; the fruit was not eaten as much as it was in societies to the south; nor were the plant's fronds, wood, or oil extensively used. In addition, Hawaiians apparently did not develop highly effective *niu* graters as other Polynesian cultures did. They got their grating edges from the same source — mollusc shells — but, unlike other Polynesians, did not fix their graters to stools so that they could sit and use their body weight while operating them. It is also true that only two varieties of *niu* grew in the islands until modern times, in contrast to the dozens recognized in Tahiti, for example.

Explanations for all these instances of seeming cultural and biological discontinuity cannot yet be offered, but geography again surely provides some important clues. The only

places in Polynesia where coconuts were traditionally used less than in Hawai'i are Easter Island and New Zealand.⁵ Apparently trees never got established on Easter Island, while in New Zealand air temperatures are too cool for this tropical plant. Coconuts grow satisfactorily in Hawai'i but not as abundantly as they do in the Polynesian and Melanesian islands to the south and southwest. It may be that the climate in Hawai'i borders on being too cool for the coconut, and that the Hawaiians decided to give their land and energy to plants that afforded a greater return.

Since early times, two varieties were established and well used in Hawai'i — *niu hiwa*, which has a dark green husk and a black shell when mature, and *niu lelo*, which has a reddish yellow exterior and a yellowish shell when mature.⁶ Both are easily sprouted on soft, wet soil and require little tending. For a short period, the germinating seed is filled with a fluffy converted endosperm, which looks like cotton candy and has

Fig. 28. A mature *niu* (coconut) tree, variety *niu lelo*, with fruits in various stages of development.



a sweet, coconut flavor. As the erect leaf emerges, the enlarging root within the fruit uses up this material, and in about three months, the young tree is ready to plant.

In their first four or five years, the trees tend to be top-heavy with leaves, but by the end of this period, with trunks two meters (six feet) tall or more, they begin to assume their mature appearance and to produce fruit. Under good conditions, *niu* trees grow to heights of about thirty meters (one hundred feet) and bear fruit every month until approximately their twenty-fifth year, when growth slows and fruit production declines.

Separate male and female flowers appear on the same branch, but when the male flowers have mature pollen, the accompanying female flowers are not ready to be fertilized. Receptive female flowers must, therefore, be available on a different branch or on a different tree if pollination is to occur. While there are thousands of male flowers on each branch, there are only a few female flowers, and hence only a few fruits are formed on each stalk.

These fruits — the coconuts — are actually drupes rather than nuts. In botanical terms, a nut is defined as having a hard shell (surrounding the nutmeat) that is not itself surrounded by other structures. In a *niu* fruit, as in a mango or peach fruit, the shell is covered by other layers — the husk in the case of *niu*, the flesh and skin in the case of mango and peach. The *'i'o niu* (copra or "meat" of the coconut) is equivalent to the seed inside the mango or peach pit.

Anthropologist Catherine Summers distinguishes two types of coconut by their fruit and their uses — *niu kafa* and *niu wai*.⁷ She suggests that both types were brought to Hawai'i by voyaging Polynesians, the former for making cordage, the latter for drinking purposes. *Niu kafa*, whose name is Polynesian but not Hawaiian, she describes as having long, angular fruit that is roughly triangular in cross-section. The proportion of husk to drupe is high, up to almost seventy percent of the weight of the fresh fruit, while the amount of *'i'o niu* is small. Thus the fruits were more useful for making cordage than for consumption.

Niu wai, on the other hand, she describes as having nearly spherical fruit and a thin husk that constitutes as little as thirty-five percent of the fruit's total fresh weight. Its name is Hawaiian, and Summers indicates that, as the name implies (*wai* means "water"), this was the preferred fruit for consumption, for it contains more than half a liter (two cups) of liquid. Due to its shape, thin husk, and heavy contents, it does not float well.

Botanically, neither the types Mrs. Summers has identified nor *niu hiwa* and *niu lelo* are recognized. These are culturally based distinctions; from a scientific perspective, all *niu* are members of one species, *Cocos nucifera*. Whether the two Summers types correspond to *niu hiwa* and *niu lelo* is unknown, but it seems possible that *niu kafa* equates with *niu lelo*, since that was the coconut used for cordage in Hawai'i.

Since *niu* was revered as the body of the god Kū, planting it was men's work, and with few exceptions, trees and their fruits were *kapu* to women. *Niu hiwa*, which was used for ceremonial and medicinal purposes as well as for food,⁸ was *kapu* to women in its entirety. *Niu lelo* was forbidden to them as food,⁹ but its fronds and trunk were free for other uses.¹⁰ Women, who were the expert cordage makers, were not permitted to make *'aha* cordage from *niu* husk; all such cordage was manufactured by men.

Grated *'i'o niu* was used for food in two ways, either as an ingredient in cooked dishes or to make the sweet, milky liquid commonly known as "coconut cream." The latter was produced by soaking grated *niu* meat in the fluid from the fruit (*wai niu*) and removing the gratings afterward. The solids could be strained out by pouring the "cream" through the clothlike *niu* leaf sheath (*a'a'a*). Alternatively, they could be removed by stirring the liquid with prepared fibers from the sedge *'ahu'awa* (*Mariscus javanicus*); remnants of the *'i'o niu* cling to the *'ahu'awa* fibers and can thus be extracted.

Some of the most common Polynesian preparations of coconut were unknown in Hawai'i. For example, there is no record that Hawaiians made the pudding of coconut cream and cooked breadfruit that is a feature of Samoan traditional cooking. Similarly, in all the Polynesian groups where I have conducted interviews (and in some Melanesian cultures as well), grated coconut is used on raw seaweed, but as far as I have been able to determine, the old Hawaiians never utilized this combination.

The known Hawaiian preparations of *niu* are *kulolo*, *ko'elepala*, and *haupia*, which blend coconut cream with cooked and grated or mashed *kalo*, *'uala*, and *pia* (Polynesian arrowroot), respectively. There is no early documentation on these dishes, but they are presumed to have originated in ancient times and, if so, would have been consumed only by men, owing to the *kapu* on *niu* as a food for women.

'Ulu, Breadfruit

As has already been mentioned, *'ulu* (breadfruit, *Artocarpus altilis*) does not fruit as abundantly in Hawai'i as elsewhere in Polynesia. It grows quite satisfactorily, however, and is found on all the islands, so I have been surprised to find that many of my students have never tasted it. Eaten mature but firm, the fruit has a mild, slightly sweet flavor that can be likened to varieties of *'uala*. A single mature fruit, weighing between two and seven pounds, is large enough to feed several people.

That *'ulu* had an important place in the Hawaiian diet may be seen from its mythology. Legend traces the origin of *'ulu* to the god Kū, who turned himself into an *'ulu* tree during a period of starvation in order that his wife and children could live. This story, similar to a tale from Tahiti,¹¹

also explains why 'ulu was regarded as one of the *kinolau* forms of Kū. It was not used sacrificially and was not *kapu* to women.

'Ulu appears in several other Hawaiian legends as well. In one, the graceful tree represents Haumea, one of the goddesses worshipped by women.¹² In another, a story well known among Hawaiians of the Lahaina district, the son of a ruling chief of Maui was banished to the island of Lāna'i for pulling up the breadfruit trees around Lahaina. On Lāna'i, the mischievous youth, whose name was Kaululā'au, was beset by man-eating spirits, but he proved himself cleverer than his pursuers. After outfoxing them by hiding in 'ulu trees and using 'ulu gum to blind them, he was finally allowed to go home to Lahaina.¹³

A member of the Moraceae or fig family, 'ulu grows to be a tall tree, frequently with a single, relatively straight trunk. Elsewhere in the Pacific, especially in the small coral atolls just north and south of the equator, breadfruit trees often stand taller than anything else and thus are treasured for the safety they afford during typhoons.¹⁴ In those same islands,

the wood of these large trees is cut into planks for use in canoes.

'Ulu leaves are large, deeply lobed or cleft, and have such a rough surface that dry leaves can serve as a kind of natural sandpaper. Trees bear separate heads of male and female flowers, the male consisting of numerous stamens around a club-shaped structure ten to twelve centimeters (four to five inches) long and the female having hundreds of flowers fused around a solid core that constitutes a fruit. The spherical fruit may grow as large as twenty-five centimeters (ten inches) in diameter, and in Hawai'i most of them ripen between May and October.

The only variety of 'ulu grown in Hawai'i prior to Western contact was seedless, so propagation was necessarily vegetative. Even in the Marquesas,¹⁵ however, breadfruit is never raised from seed.¹⁶ Instead they are raised from erect root shoots, today generally known as "suckers," which sprout from the underground roots, and roots are sometimes cut in order to stimulate the production of root shoots. Once they sprout, the shoots must be severed carefully from the parent tree and replanted in an open area large enough to accommodate the tree's growth. New trees begin to bear fruit in three to five years and continue producing fruit for more than thirty-five years.

Handy reports that a tool known as the *lou* was used to pick 'ulu.¹⁷ We have no record of the kind of wood that was used to make this implement, but it is described as consisting of a long pole with a shorter piece of wood fastened obliquely near its end like a hook. Ripe fruit were pulled off the ends of branches and caught by someone below. Hawai-

Fig. 29. [UPPER] Male inflorescence of 'ulu (breadfruit). [LOWER] The female inflorescence of 'ulu, a multiple flower head that becomes, at maturity, a spherical fruit.

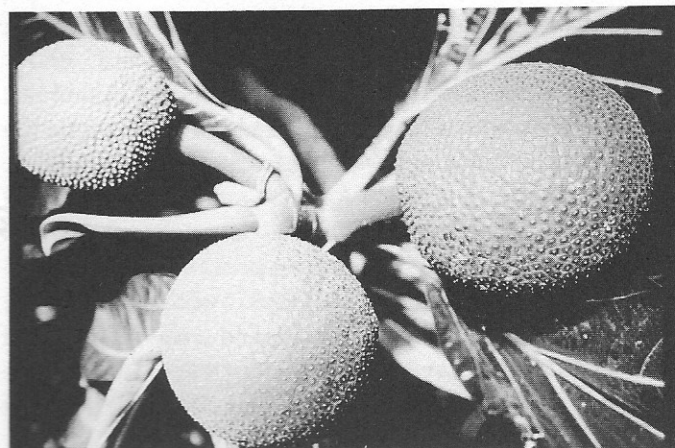


Fig. 30. An 'ulu root shoot (sucker) arising from a root of the parent plant. Removing and replanting these shoots was the principal method of propagating 'ulu.



ians did not use 'ulu which had fallen, for if the fruits were ripe, they would smash, and if they were unripe, they were relatively tasteless and did not make good poi.¹⁸

The fruit was prepared in several ways. After baking in the *imu* (or nowadays after boiling), it was used for poi—pounded and mixed with water in nearly the same way as *kalo*. Like poi 'uala, poi 'ulu was consumed in many coastal areas where poi *kalo* often fell into short supply. In the Puna district on Hawai'i, poi 'ulu is still eaten by many Hawaiians, and I remember that in my childhood summers in Lahaina sharing poi 'ulu with relatives was a great treat.

In another Hawaiian preparation called *piepiele 'ulu*, very ripe, soft, uncooked 'ulu were peeled, mashed, mixed with coconut cream, wrapped in *tī* leaves, and baked in an *imu*. This dish is similar to *koele palau*, which is made with 'uala and coconut cream. The simplest means of fixing 'ulu was to bake it in the *imu* or cook it on the coals of an open fire (*pulehu*), then eat it in chunks. As in the case of *kalo*, Hawaiians seem to have felt little need to embellish the basic carbohydrate with other tastes or ingredients.

Throughout most of Polynesia and Micronesia, breadfruit was preserved in pits against such threats as drought, famine, or raids. Edward Robarts, who lived in the Marquesas between 1797 and 1810, described the construction of these pits and the preservation of the fruit.¹⁹ He was told that the preserved food could last forty years in these pits and that a single pit could contain enough of the preserved breadfruit, called *mā*, to feed the community for three years. Samoans also store breadfruit and bananas in pits, intended to last for about one year.²⁰

Although pits that may have been used for food storage have been found at Mākaha on O'ahu,²¹ they are smaller than those described in the Marquesas and Samoa, and since 'ulu were never so plentiful in Hawai'i,²² it is unlikely that these pits were used for *mā*-type preservation of the fruit. Moreover, there seems to be no Hawaiian word for storing food in this fashion, whereas *mā* or some variant thereof is common throughout most of Polynesia and Micronesia. In western Micronesia, *mar* made from pulach (*Cyrtosperma* species) was common as a form of insurance against famine caused by typhoons.²³

Mai'a, Bananas

Unlike 'ulu, which for religious purposes was a "neutral" plant since it was not used in offerings to any god, mai'a plants and fruit were understood as *kinolau* of the god Kanaloa, nominally the god of the ocean and of most marine life. Thus a set of *kapu* surrounded mai'a, expressing three main beliefs and determining how the fruit was used:²⁴ first, the gods Kāne and Kanaloa were believed to have originally planted all mai'a, so the fruit was offered in the *heiau* and all



Fig. 31. *Iholena* (*Musa acuminata* hybrid), one of three banana varieties that Hawaiian women were allowed to eat. Courtesy of Brien Meilleur.

other houses of the gods; second, under certain conditions, specific varieties such as the *maoli* variety could be substituted for a human sacrifice to Kanaloa or to Kāne; and third, according to *mo'olelo* (traditional stories), the sky principle Wakea set aside three kinds of mai'a—the varieties *pōpō'ulu*, *iholena*, and *kauualau*—for his opposite, the earth principle Papa, so these were available for women to eat, while all other varieties were forbidden to them.²⁵ All three of these bananas continue to be grown in Hawai'i, though not as commercial varieties.²⁶

Hawaiians did not cultivate mai'a on a large scale.²⁷ Apart from growing them around the *lo'i* and in other moist places near their homesites, they frequently planted them in *mauka* gulches where rainfall was sufficient to meet their needs and they could be left to grow and propagate untended. These patches probably were harvested on an occasional basis, particularly during times of drought when *kalo* and 'uala were failing. They would have been of most importance in

ahupua'a in dry areas such as the southern coast of eastern Maui (Kaupō) and south and southwest Hawai'i (Ka Lae, Na'alehu).²⁸

All edible bananas are hybrids of *Musa acuminata*, in the plant family Musaceae. Though a mature banana plant resembles a tree, in botanical terms it is actually an oversized herb. The pseudostem ("trunk") of the banana plant consists of layered leaf sheaths, while the stem or corm lies underground and is a large, irregular mass of tissue. Roots radiating from the stem produce erect shoots known to Hawaiians as *mai'a keiki* or *pōhuli*. These suckers serve as the main propagative device of the banana, as very few edible bananas have seeds.²⁹ The corm or stem itself may be used as a vegetative means of propagation and was probably the portion taken along on the long canoe voyages of Polynesian discovery and migration.

In planting *mai'a*, Hawaiians followed the lunar calendar carefully.³⁰ Six phases of the moon were regarded as ideal for planting *mai'a*, increasing the chances that a plant would bear large clusters of well-shaped fruit. *Pōhuli* are formed within a few weeks or months after a mature plant produces its fruit and falls, and they can be transplanted at that point or as long as six months later, by which time they develop a basal corm.³¹ Thus a planter had a relatively long period in which to replenish his *mai'a* holdings and could have fruit most of the year.

The Hawaiian folk taxonomy for *mai'a* was not as extensive as for *kalo* or *'uala*, but it is easy to see traits of the plants and the fruits that furnished a basis for classifications. Among

Fig. 32. Young *mai'a keiki* or *pōhuli*, the root shoots of banana plants, the principal means of *mai'a* propagation.

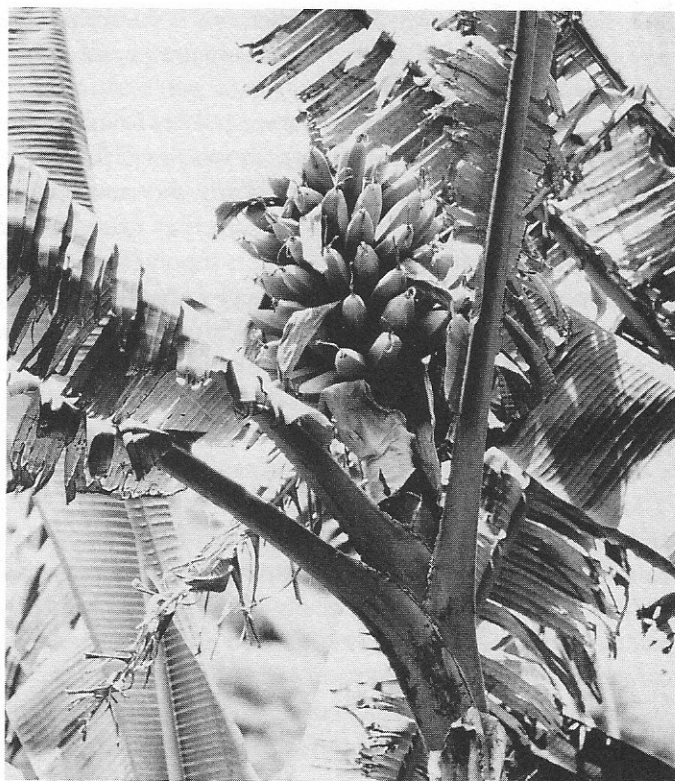


Fig. 33. The *polapola* variety (*Musa troglodytarum*), a banana that bears its stalk of fruit erect instead of hanging down.

the features Hawaiians observed were the color of the sheaths, the petioles, and the surfaces and margins of leaves; the external and internal colors of the young and mature fruits; the shape of the fruit; and the size of the fruit bunches. The Hawaiian varieties are much more diverse in color, shape, and flavor of fruit than today's commercial bananas, so differentiating among them was a less subtle but more multi-faceted exercise.

Botanists do not know how many *mai'a* varieties Polynesian settlers brought to Hawai'i or how many new ones developed before Cook's arrival. At least two dozen Hawaiian varieties are known,³² and some of them are thought to be growing in wet gulches, especially on the islands of Maui and Hawai'i.³³ James Pang recently found that on O'ahu more than a dozen varieties and subvarieties could be named.³⁴

Hawaiians apparently did not depend on *mai'a* as a major source of carbohydrates, but it was the sweetest, most accessible fruit they had and no doubt was greatly enjoyed. Some varieties were always cooked, but Hawaiians made no distinction in nomenclature between cooking bananas and those that could be eaten raw. The variety known as *lā'wa* was preferred for the dish called *piepiele*, made by mixing the fruit with coconut cream and baking it. Of the three varieties women could eat, *iholena* and *pōpō'ulu* are edible either raw

or cooked, while the third variety, *kaualau*, is a plantain or cooking banana.³⁵ On occasion, consumption of certain varieties was restricted to male *ali'i* and priests.³⁶

Polapola (*Musa troglodytarum*), a species of banana that belongs to another subgenus, was steamed in an *imu* and then pounded to make *poi mai'a*. *Mo'olelo* place this species among the *mai'a* brought by the Polynesians, but it is recorded as a post-Cook introduction from Tahiti,³⁷ where it is called *fei* and where many varieties of the species have been developed that produce erect stalks of fruits. The Hawaiian name *polapola* probably refers to Bora-Bora Atoll in the Society Islands.

Uhi, Yams

Yams (*Dioscorea* species) belong to the plant family Dioscoreaceae and should not be confused with the orange-colored tubers so often labelled as yams in grocery store displays. The latter are actually a variety of sweet potato (*Ipomoea batatas*) and belong to the family Convolvulaceae. *Uhi* is the general Hawaiian term for yams,³⁸ although Puku'i and Elbert confine this name strictly to the species *Dioscorea alata*.³⁹

Uhi were introduced to Hawai'i by Polynesian settlers but, like *'ulu* and several other Polynesian-introduced plants, did not become as important in the diet here as they did elsewhere. More species of yams were grown and larger quantities of them eaten in other Pacific societies, especially in Melanesia. In Polynesia the center for yam culture is Tonga,⁴⁰ where yams became a staple food.

Fig. 34. An irregularly shaped tuber of *uhi* (yam, *Dioscorea alata*). I. Abbott photograph.



Fig. 35. Portion of a vine of *hoi* (*Dioscorea bulbifera*), a bitter yam that bears small aerial tubers on its stems. I. Abbott photograph.

Polynesian migrants appear to have established three species of yam in Hawai'i.⁴¹ *Uhi* proper (*Dioscorea alata*), distinguished by angular, winged stems, appears to have been the species that Hawaiians preferred to cultivate. Its tubers vary in size and shape (ranging from long and cylindrical to compact and irregular) as well as in color. Hawaiians named several of the cultivars according to the color of the tubers and among them, the variety known as *ke'oke'o*, which is white both outside and inside, was used only for food, whereas the variety *'ula'ula*, whose tubers have white flesh but red skin, was used not only for food but also for medicine.⁴²

Of the three Polynesian introductions, only this species was cultivated near Hawaiian habitations, either along hill-sides or in bins,⁴³ so presumably this was the yam that entered history as the islands' first export. Ship captains favored yams over sweet potatoes because they did not germinate as readily and therefore could remain in the ships' stores for a longer period. Explorers Cook and Portlock both provisioned their ships with yams from the island of Ni'ihau, Portlock on one occasion procuring a load of twelve tons!⁴⁴ Many early visitors remarked on the quantity of yams available on nearly every Hawaiian island.⁴⁵

A map of Honolulu created by cross-referencing many sources of information indicates that in 1810 the growing city included a very large yam field, *pā'uhi*, bounded by what are now Beretania, King, Nu'uau and Alakea streets. About three blocks square, this field was an enterprise of Kamehameha the Great, explicitly intended for provisioning visiting ships.⁴⁶ One of the early ship captains noted that on O'ahu, "yams were grown for the supply of shipping."⁴⁷

The other two yam species were planted in the lower forests and used during times of drought when *kalo* and *'uala* crops were affected. *Pi'a* (*Dioscorea pentaphylla*) has palmate leaves—that is, leaves with five lobes—and its tubers range from bulbous, somewhat turnip-shaped, to more elongate.⁴⁸