THE HAWAIIAN PLANTER

VOLUME I

HIS PLANTS, METHODS AND AREAS OF CULTIVATION

BY

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The Hawaiian Planter—Volume I

His Plants, Methods and Areas of Cultivation

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FOREWORD

This is an ethnologist's study of the cultivated plants introduced by the Hawaiians before the discovery of the islands by Europeans, of their horticultural methods, and of the extent to which they utilized their resources of soil and water. A second volume will follow, devoted to description and interpretation of the planter's economic, social, and political principles and life, and the traditional, ritualistic, mystical, and mythological ideology which his mind patterned after that life.

This research was motivated by a desire to come down to fundamentals in the study of Polynesian culture, coupled with the conviction that the subsistence economy offers a direct, concrete, and completely dependable approach to consideration of a culture in its relation to physical environment. It is a phase of the native culture which should be studied systematically throughout Oceania by ethnologists. This survey was conceived and planned to serve as an example of scope and method applicable in other islands. If this monograph presents a creditable picture of the old horticulture in Hawaii it should encourage others with similar interests and liking for field research to go out and study native horticulture. I was profoundly ignorant of this subject when I commenced the work in 1931. The problem itself and the value and need of such study elsewhere determined my schematic approach: a definite study of the plants in terms, not of systematic, but of Hawaiian botany; the investigation of Hawaiian horticultural knowledge and methods; an areal survey of planting localities; and the whole cultural superstructure built upon food production.

So much, perhaps, may be characterized as relatively "pure science" or research untinged by utilitarianism. But two frankly utilitarian motives have played their parts from the outset: first, a concern for the welfare of Hawaiians and Polynesians, an interest that is, happily, almost universal among ethnologists in our field and in no way detrimental to scientific work; and second, my conviction, which has steadily grown through nearly twenty years of ethnological study, that humanity is neglecting one of its richest endowments in failing to record, utilize, and conserve systematically the

knowledge of indigenous agriculturalists who have dwelt with their native soil and plants through millennia. This is especially true in the Pacific, for Oceanic peoples in general, particularly the Polynesians, have knowledge of a sort that can be accumulated only through centuries, if not millennia, of experience. That they were skillful, ingenious, and intelligent farmers is amply proved by study of their horticulture presented in this monograph.

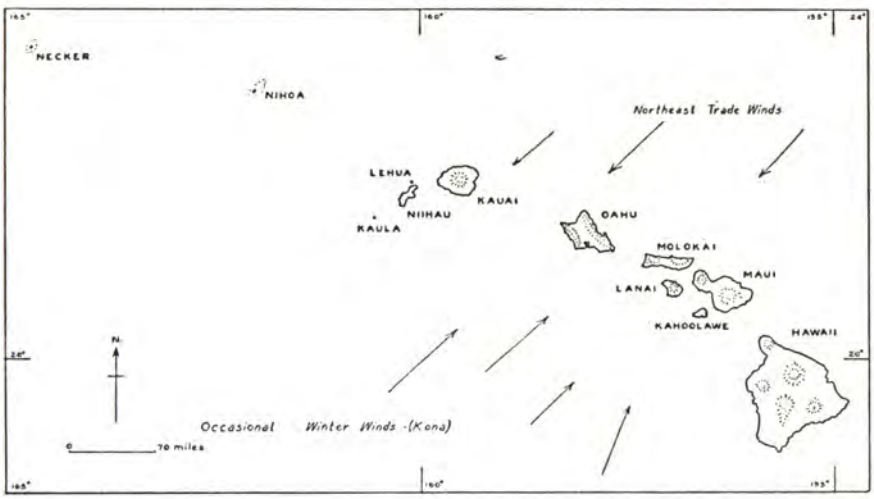

FIGURE 1.—Map of Hawaiian islands showing winter and summer prevailing winds.

About 18 months of study in the field were devoted to this research, the results of which are condensed into two volumes. Yet the subject was not exhaustively covered. Even today, with native culture disintegrated, it would be possible to devote a lifetime to native Hawaiian horticulture alone without completely covering the field. My investigation of taro and sweet potatoes was as thorough as possible for a single worker, in the time available. I had the voluntary assistance of my wife and the constant help of the most able Hawaiian collaborator. As for the other plants described, I consider my knowledge relatively superficial. Nevertheless all the plants are included in this report, as they were included in the field study, so that a comprehensive picture of the subsistence economy might be presented.

From the point of view of comparative and historical ethnography, Polynesian horticulture has a special significance. The sweet potato was limited in pre-Columbian times to the Americas and Polynesia (16)[1], while taro, breadfruit, bananas, sugar cane, the paper mulberry, and various other plants and trees that were of Asiatic or Malaysian origin must have been brought into the Pacific by Polynesians, but never reached the Americas. The coconut

[1] Numbers in parentheses refer to Bibliography, p. 216.

and the gourd must have been distributed largely through human agency; while other plants important in all Pacific cultures, such as the ti, awa and pandanus, are indigenous to the Pacific.

To many who helped me with their interest or extended courtesies, I tender my cordial thanks: to Dr. H. E. Gregory, former Director of Bishop Museum, who supported my work; and to Albert F. Judd who favored me with a critical reading of the manuscript; to Mr. and Mrs. George Cooke and Alice P. Brown on Molokai; the Misses Elsie and Mabel Wilcox, the late Judge and Mrs. Hofgaard, Joel Cox, Mr. and Mrs. Fred Wickman, Sheriff Lota, Joseph Huddy and his father, and Walter Sanborn on Kauai; to Edwin Baldwin, D. T. Fleming, K. W. Kinney, and Sheriff Wahihako on Maui; to Thomas P. Wight, William Rickard, Police Officer Williams, Reverend Stephen Desha, Sr., Robert Pahau, Thomas K. Maunupau, George Tucker, James Kekela, Dan Kamelamela, Samuel Kaaekuahiwi on Hawaii; to Lahilahi Webb, Kenneth Emory, John K. Jones, Oscar Cox, Louis Warren, Judge Rathburn, Thomas R. L. McGuire on Oahu; to the Robinson family on Niihau.

In addition it is a pleasure to record my indebtedness to many Hawaiians, most of them planters, who have gladly contributed their knowledge to this work. A few of these are mentioned above. So many were consulted that a complete list would read like a directory of residents in different localities; only those who contributed most in words and plants can be named here:

On Niihau, Edward Nahele.

On Kauai, Keahi Luahine, Robert Kali, Mileka Kahele.

On Oahu, Makea Napahi, David Keaau and K. Kakulu, Eli Crabbe and Dan Paea Hoe, Naihe Mahoe, Solomon Kapule, John Wise, Mrs. Keahipaka, John Kaleo, Joseph Kekuku and Keaau (at Laie), George Roberts, Mary Kanakaole and Maria Kahawaii, William Kaioe, Kaaoaoloa Kukahiko, William Kalani and his wife, David Kaapu, Kamalolo (at Hauula), Edward Niaupio.

On Molokai, Charles Kaanoi and David Kalaau.

On Maui, Henry Ikoa and George Akiu, old Mawai (at Nahiku), Lono (at Honokalani), Kaleo (at Hana), Hopii, Kaaawa and Kaiwiae (at Kipahulu), Frank and Joe Marciel, Kapualena at Keoneoio, William Kahalekai, Leopold Kalaukini, Henry Kauhaahaa, Henry Hoewaa, Frank Hoopii, David Kapaku.

On Hawaii, Moses Kuamoo, Katherine Hekekia, Charlie Akuna in Puna; Emily Kaouli Pahio in Hilo; Keliihui Kamali, George Kawaha, old Kuaana (at Kiolokaa), in Kau; Lakalo (at Hookena), Kalokuokamaile (at Napoopoo), in Kona; Leone Naiheauhau in Waimea; Louisa McDougall, Thomas

Solom in Kohala; Kalili Kahimoku in Waipio, and Mrs. Jennie Saffrey and Hattie Saffrey Reinhardt at Kapulena.

To my wife, Elizabeth Green Handy, co-worker in active and oft-times arduous field trips of 1934 and 1935, this record owes its comprehensiveness, for the mass of detail reported in field notes could not have been gathered by a single person working alone.

Lastly, abundant recognition is here gratefully recorded for the unfailing contributions and assistance of my colleague in Hawaiian research, Mary Kawena Wiggin Pukui, and her mother, Paahana Wiggin. Their assistance has doubled the value of this report and that to follow; and consultation and checking with them on almost every point and at every juncture of the research and writing enables me to say to readers that on the whole what they find reported here of Hawaiian planting is and will remain authentic.

The Museum Editors, Frances E. Williams and Eloise Christian, deserve warm thanks for their helpful cooperation in editing a somewhat complicated manuscript; and I thank the Assistant Curator, Edward Y. Hosaka, for his cordial interest in and accurate preparation for publication of my pencilled maps and figures.

SOIL

The Hawaiians seemingly had few terms for soil. For example, they appear to have had no word for humus. The following terms apply to different clays and soils. Those best for horticulture are mentioned in the discussions of planting and planting localities.

lepo: any kind of earth
lepo ula: red earth or clay; that of the kula[3] slopes is good for dry taro and potatoes
lepo palolo: grayish clay which clings to a digging stick, not good; used medicinally
lepo ulika: black clay, poor for planting
lepo ukele or kele kele: mud in general
papa'a kea: whitish, occurring in flat slabs as on Waianae (Oahu) flats, becomes powdery when decomposed, poor for planting
pahulu: worn out soil in a taro patch which needs fertilizing
a'a: disintegrated lava soil (as in Kona, Hawaii)
lepo oneone: sandy or cindery
one: sand, cinder
wela: virgin soil
alaea: red haematite occurring in pockets or veins

The Hawaiians recognized the value of green manure in enriching their taro soil. In preparing ground for planting, after it had lain fallow, they flooded the soil, softened it with the digging pole, then pulled up the grass and weeds, and stamped them deep into the mud. The same thing was done at each weeding and when old leaves were stripped off the taro plants. When

[3] Hawaiian words currently used are listed in the Glossary, with translations, p. 226.

a piece of ground was exhausted (*pahulu*), quantities of hau and kukui branches and leaves were pressed into the mud and allowed to rot before final digging and leveling for planting. Animal or human manure, seaweed, or fish were never used as fertilizer.

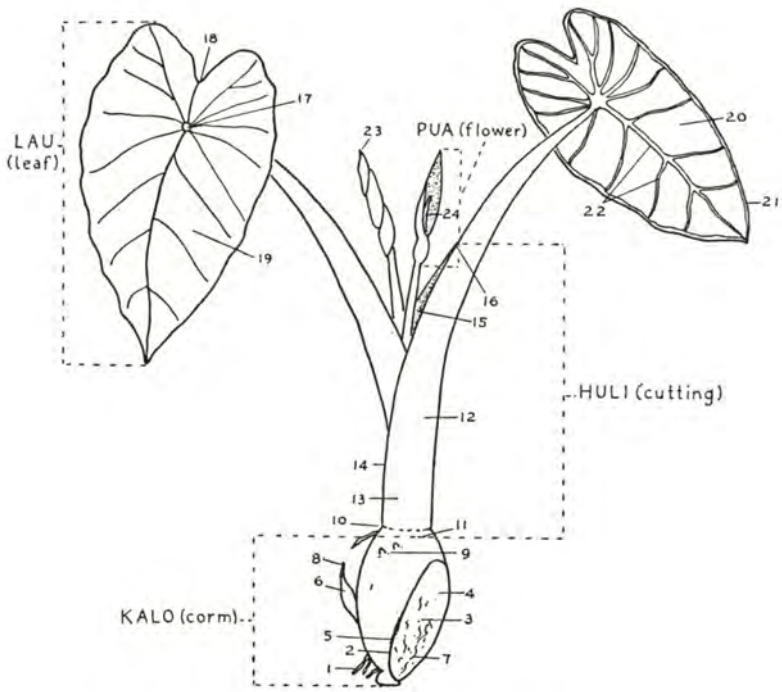

FIGURE 2.—The taro plant showing habit and terms for parts.

Kalo: corm
1. Huluhulu: roots
2. ili kana: cortex
3. iho kalo: core of corm
4. i'o kalo: flesh of corm
5. ili kalo: skin of corm
6. oha: bud of corm
7. a-a'a: vascular bundles
8. omuomuo: bud stalk
9. makamaka: buds

Huli: cutting
10. a'a: root
11. kohina: line of cutting
12. ha: petiole
13. kumu ha: petiole base
14. ili ha: epidermis of petiole
15. mawae: petiole sheath
16. lihi mawae: margin of petiole sheath

Lau: leaf
17. piko: junction of petiole and blade
18. mahae: basal indentation
19. ke alo o ka lau: upper surface of leaf
20. ke kua o ka lau: lower surface of leaf
21. ka'e lau: edge of blade
22. a'a lau: midrib and veins of leaf
23. ao lu'au or mohola: unexpanded leaf blade

Pua: inflorescence or flower
24. iho or ikoi-pua: spadix

TARO

The habit and parts of the taro plant are shown in figure 2. Descriptive terms and colors applied to the taro are given in the following list:

Root:	kohu kalo	sap of plant, latex of corm
	ala	fragrant
	kaumaha	heavy
	loliloli	weak, sick, watery
	loloi	shriveled
	ohaha	vigorous growth with many oha (bud of corm)
	oluolu	soft
	pala	rot
	palahe	rotten
	palalalo	rotten at bottom
	paakiki*	hard
	popo	watery
	uaua	tough, viscid, glutinous
Stalk:	ha'aha'a	low, short
	loa	long
	maloo	dry
	manamana	branching
Leaf:	ae	juice
	api'ipi'i	crinkled
	apuapu	cup shaped
	la alo	old
	la ele	dead
	palahalaha	flat
	pihapiha	ruffled
	lola	drooping
	ponalo	yellowing
Flower:	opuu pua	bud
	ehu pua	pollen
Colors:	eleele	dark, black
	hinahina	gray, silvery
	kahakaha	striped, streaked
	kea, keakea	white
	hakea, hakeakea	whitish
	ke'oke'o	light or whitish green
	hake'oke'o	whitish
	kikokiko	speckled
	lenalena	yellow
	halenalena	yellowish
	melemele	amber, buff
	oma'oma'o	green
	onionio	mottled, variegated, with patches
	poni	purple
	ulaula	red, pink
	haulaula	reddish, pinkish
	uliuli	dark, dusky, deep green or blue
	hauliuli	darkish

* *Pa'akiki.* The glottal closure or hamzah (') in the Hawaiian dialect represents the dropped letter *k*. The hamzah always should separate double vowels.

Wild Taro

Throughout the islands, along streams and in damp forest areas, is found the common wild taro, the character of which is constant everywhere. On Kauai, it is called *Ahe,* and on the other islands *Aweu* or *Aweuweu.* Its corm and base of stalk are white, foliage light green throughout with a white spot at the juncture of the petiole and leaf blade.

This ubiquitous wild taro is unpigmented in contrast to the cultivated taros, which, with but two exceptions, have in some part of their structure pigmentation other than the pure green chlorophyl. The two exceptions are the pure green *Ha-o-kea* (wet) and *Ha-a-kea* (dry) which are unquestionably the same plant. The *Ha-o-kea* is definitely known to be domesticated *Aweu,* for when short of cuttings for planting, growers of wet taro on Oahu plant *Aweu* cuttings which become *Ha-o-kea* in the next generation.

Cuttings from the common *Aweu* are hardiest of all cuttings, being adaptable to shade or hot sun, to swamp, forest, or the dense red soil of *kula* lands between the forest and the lowlands. *Aweu* leaves make good greens when cooked but the corms are small and tough.

There can be little doubt that this unpigmented wild taro represents a reversion to primitive type. But this does not mean that it is the form originally introduced by the early Hawaiian settlers, for in all likelihood they brought with them cultivated varieties. Growth along shaded streams and in the forest where the plant has little direct sunlight causes loss of pigment. Highly colored taros growing in shady places lose much of their coloring even in a single generation. This is well known to all planters, and I have proved it to my own satisfaction by experiment.

However, all taros growing wild and in shade do not revert to a primitive state of pure chlorophyl coloring. On Kauai, where the clear, green, wild *Ahe* is found (called *Ahe-keʻokeʻo,* white *Ahe*), there is also *Ahe-ulaula* (red *Ahe*), which runs through various degrees of reddish shading from very faint reddish flecks and lines to distinct reddish or maroon coloring throughout (indicating, perhaps, pigmented sap), and red to black *piko* (junction of petiole and blade). It is interesting to note that in some highly pigmented, cultivated taros, the pigment is distinctly in the skin, while in other varieties it is in the sap as well. In the dark *Lauloa* it is in the dusky-colored skin of the petiole, while the sap is relatively colorless. But it is the deep purplish red sap of the *Poni* taro that gives its petiole the beautiful translucent color.

On Oahu, besides the universal green *Aweuweu,* there are a wild taro named *Maʻauea* (or *Manauea, Mamauea*) which has a dusky reddish stem with yellowish shading and a long narrow leaf; a clear red petioled wild variety which informants say is not the cultivated *Kumu* gone wild; a green-petioled taro with faint pink corm and *piko*; and an unnamed, strikingly

distinctive variety with black and white petiole. I am told that *Lauloa, Lehua,* and other well-known domesticated taros that have gone wild may be found on the western end of Oahu.

Upland localities on eastern Maui, that were formerly planted, support wild taros varying from pure white and green in corm and foliage to light pink and red.

On Hawaii the *Aweu* is universal; and in various localities in Puna, Kona, and especially between Waipio and Pololu may be found many domesticated varieties (*Ala*—probably the same as *Kai—Ulaula, Lauloa,* and *Lehua*), that have persisted in abandoned planting localities.

The characteristics of all genuinely wild taros are small corms and long, vigorous rhizomes which push out many feet under ground, sending up shoots which produce foliage and develop into distinct plants. Wild taros do this both in stream bed and forest. The true domesticated taros do not, either in *loʻi* (wet taro patches) or *waena* (forest clearings). Wild taros such as *Aweu* and *Maʻauea,* introduced into terraces and cultivated, tend to abandon this habit, presumably because abundant sun draws their energy into foliage production, and later, on replanting the cuttings after the foliage matures, into filling out the corm at the expense of the rhizome. As to how quickly domesticated taros gone wild in shady places develop the habit of spreading by rhizomes I have no information, beyond the fact that Hawaiians say that they do develop this habit.

TARO SPREAD BY RATS

MacCaughey and Emerson (46, vol. 10, p. 350) give a note on the sprouting of wild taros in strange places which offers an explanation of the fact that small wild taros sometimes grow on ledges inaccessible to human beings, in pockets on cliffs, and other places where it seems unlikely that they were planted by man and where there is little likelihood that they could have been washed from above. On Kauai the name *Mimi-iole* (rat's urine) is applied to various taros growing under special conditions. According to native belief, wild rats come down to the fields or to patches of wild taro and carry away some of the smaller corms to their holes in the trees. Fragments of these, after the taros are eaten, take root in notches and knot-holes of the trees, and are fertilized by the rats. It is recorded that "the varieties *Ahe ulaula* and *Ahe keʻokeʻo* have been found growing in this unique manner."

TARO ALONG STREAMS

The presence of wild taro along streams in the inland and upland is easily explained by the custom of planting along the courses of streams as well as in the forests as insurance against famine. Some taro growing wild in stream

beds has obviously been washed from patches or forest plantings at some higher point.

SEEDING

The fact that some taros reproduce by producing fertile seeds may explain the presence of wild plants in unlikely places. One of my most trustworthy informants on Hawaii, Kalili Kahimoku of Waipio, told me that he had observed *Mana eleele* taro propagating itself from seed falling in the mud of the *lo'i*. The plants sprouting from seed were too weak to produce large corms, but cuttings taken from the seedlings grew to an edible corm. Gerrit Wilder told me that he had reproduced taro from seed.

Cultivated Taro

METHODS OF PLANTING

The following was probably the course of development of ancient Hawaiian taro culture. The first planting was around springs, along stream beds, and in marshy places watered by springs which kept the water fresh. On the more level ground around the springs and along the lower courses of the streams the beds were gradually widened and leveled, and water was diverted by ditches from springs and streams upon small prototypes of the later-elaborated terraces with complicated ditch systems. Planting in marshy places was extended until the methods (p. 10) were developed for using such lands on a large scale. Upstream, where the valleys become narrow and are bordered by rain-drenched forests, planting up the banks of the stream or in pockets above the stream inevitably led to forest planting. The cultivation of *kula* lands under an artificial mulch to hold in the moisture naturally followed forest planting, for the use of the mulch is obvious in the lower, less watered forest zone bordering the upper *kula* lands. The powers of observation and discrimination typical of all Polynesians plainly led these early Hawaiian planters to differentiate between variants or mutations and to consciously select, as they do now for all vegetables they plant, the varieties that grew best under given circumstances and those prized for size, quality, color, or other characteristics. Through this selection a great many varieties were created. The number of centuries required to attain the degree of variation represented in these islands, where variation is accentuated in all forms of life, is a problem for the botanist.

It is difficult now to estimate the number of varieties known at the time of European discovery. In 1913, when there were more qualified informants and more different varieties of taros than at present, MacCaughey and Emerson (46, vol. 10, pp. 280-288, 315-323, 349-358) compiled a list of over 250

native names for different varieties. Allowing for synonyms, they estimate that the old Hawaiian "habitually recognized as distinct forms at least 150 to 175 kinds." I have in my own lists many names not included in that of MacCaughey and Emerson. In the course of three brief seasons of field work, in which only a fraction of my time was given to taro, I assembled living specimens of over 80 distinct varieties—and this at a time when Hawaiian taro planting is believed to be verging on extinction because only a few natives are planting, in a very few localities. It seems reasonable to suppose that at the time of discovery, with taro universally planted on six islands, in *loʻi*, streams, swamps, forests, and on *kula* land, there were probably about 250 varieties known and cultivated. The list on page 32, compiled from my own field notes and all other available lists, contains 346 names.

Wet and Dry Taro

According to native parlance, there are two types of cultivated taro and two general types of planting. "Dry" taro (*kalo maloo*) is grown in rain-watered localities without natural or artificial irrigation. "Water" taro (*kalo wai*), commonly termed "wet" taro, is planted along streams or ditches, or in artificially leveled terraces called *loʻi* in which the plants are kept flooded under a few inches of water, or in marshy land watered by fresh springs. It is so customary in the islands to speak of taro as "wet" or "dry" (despite the facts that even the unirrigated taro will die if the earth around its corm and roots dries out and that it cannot be cultivated by what in America is called "dry farming") that it seems best to retain these terms in this discussion.

Taro Along Streams

Taro is now seldom planted along the edge of streams, as it is said to have been formerly planted; but wild taro is found along the upper courses of most streams, rooted in banks, on islets, and between rocks.

Taro in Ditches

Wet taro is still commonly planted along the sides of irrigation ditches, where some varieties flourish with great luxuriance. In 1935 there was an abundance of such taro in ditches in the gardens planted by those on relief at Palama in Honolulu, in various parts of Kaneohe, and other wet taro sections along the windward coast of Oahu.

Taro in Spring-watered Marshland

An old method of planting in hillocks or little mounds (*puʻepuʻe*) was being used on Oahu in 1935. Below the road near the old church at Hakipuu was a patch of wet taro planted in sizable mounds heaped up in rows in the

marshy land which is watered by springs (pl. 2, *B*). The mounds were 3 or 4 feet apart, and from four to seven cuttings were planted in each mound. The tops of the mounds on which the taro stood were clear of the surrounding water. I am told that the same method of planting was common in the swampy land of Ewa.

Kamakau (40) gives a picturesque description of old swamp-land planting:

> First the planter gathered wild *ilima* shrubs, grass, morning-glory leaves, castor-bean bushes, and other plants. He lashed these into bundles with morning-glory vines and deposited them at the edge of the swamp. He had to wait for a clear day so that rain would not increase the natural wetness of the soil. Then, wrapping bulrushes around his head as protection against the sun and mud and naked except for loin covering, he waded into the swamp and set the *ilima* bushes upright in circles measuring "ten fathoms more or less" [in circumference?], and bound them all together with four or five lengths of morning-glory vines. Within these circles he piled the bundles of trash to make a foundation, and on top of the trash he heaped mud, thrown in over the side. This required great skill, for he had to raise mud up from the swamp bottom with his feet, seize it in his hands before it dissipated in the water, and then toss it into the circle. The result was a firm mound basketed in a circle of *ilima* bushes. Upon this the cuttings were planted. Such swamp planting was termed "muddy back" (*kuawehi*) tillage.

Another method followed in swampy areas that were covered with bulrushes (*akaakai*) was to bend down the tall rushes and heap mud on top of them, digging ditches for drainage and irrigation between the small patches so made. This type of patch was called a *lo'i akaakai.*

At Hilo, Hawaii, in the swamps of Waiakea another method of wet planting, termed *kipi kalo,* was developed. This, I am told, consisted in heaping up, above the surface of the water, long mounds (*kipi* or *kipikipi*) of soil upon the tops and sides of which the cuttings were planted. This method of planting is now abandoned at Hilo; but at Waialua, Molokai, in 1931 I saw what apparently was the same thing, except that taro was planted only around the sides of the mound while sweet potatoes were planted on top. An account of this type of planting on Molokai is given in Kuokoa (26):

> The soil is deep and made into rows of large mounds in the patch called *pu'epu'e hou.* Other plants grow on the mounds, such as sugar cane, bananas, sweet potatoes, onions, and around it, in the water, the taro. The work is more laborious than that of other wet lands, but the people there were accustomed to it from olden times down to the present and their poi excels all in deliciousness according to them.

Kona people, accustomed to fragrant humus-grown upland taro, dislike swamp-grown taro because they say that it and its poi smell swampy. But fine taro can be grown in swampy soil if the swamp is ditched so that the water circulates, or if the swamp is due to spring water or active seepage. Taro rots in stagnant swamps or upland bogs.

Taro in Sandy Soil

Mounding is also the proper way to plant in sandy soil. In a region south of Laie on windward Oahu, *lo'i* are made in relatively sandy soil near the sea. Here the cuttings are planted in little hillocks (*pu'epu'e*) like sweet potato hills. After thoroughly clearing the ground, the soil is moistened (*hooma'u*) by letting in a little water from the ditch; then the hillocks are made about 2 feet apart in straight lines. A little water is again let in and left standing for two days, while the sandy bed of the *lo'i* hardens. Then water is allowed to flow in again slowly, the planter continuing to hoe up soil around his hillocks while the water rises around them. The water is cut off before it covers the hillocks. The planter sets from five to eight cuttings in each hillock, according to its size. Thereafter very little water is let in until the cuttings show a first leaf (*liko*). This is the sign of firm rooting. At this time it is proper to cultivate gently and to press down the cutting into the earth. Then water is let in a little more freely, while the planter makes sure that the earth around the mounds remains heaped up. When the foliage shows strong growth (about 3 weeks after planting) he weeds thoroughly, heaps up the earth well around the mounds again, and lets in water sufficient to immerse the mounds. Thereafter the growing plants are not cultivated or weeded. In this soil, maturing time is about the same as in any *lo'i*; but taro may be left long in the ground without deteriorating, provided the *lo'i* is kept continuously moist (to prevent the taro's drying), but not wet (*hoopulu*) enough to rot the corms. In sandy soil the growing plants are not affected by root rot as in most present-day *lo'i*, but the taro produced is small.

CULTIVATED VARIETIES

Today there is little localization of taro varieties. There was undoubtedly more in ancient times, though I feel sure that the popular taros such as *Lehua* and *Pi'i Ali'i*, of which the chiefs were fond, and medicinal and ceremonial taros like *Lauloa* and *Ha-o-kea*, were cultivated throughout Hawaii.

Most taros are distinguished only by variations in coloring and combinations of shades in corm and petiole. A few are easily recognized by a single character and are often named after this character. Among these the *Lauloa* (leaf long), with a long leaf, has a tall petiole and hence is also called *Ha-loa* (petiole-long); *Poni* (purple) has purplish coloring; *Ha-o-kea* is white (*kea*) throughout; *Eleele* (dark) is blackish; and *Ulaula* (red) is reddish; *Ala* (fragrant) is the term very generally used for the *Ka-i* and other taros that are sweet smelling when cooked. A few varieties are named for localities, where presumably they originated (*Punaluu, Kalalau*), but such naming is rare. The *Piko* group is so named because the posterior edge of the leaf is cut down to the *piko*, the point at which the petiole joins the leaf-blade. *Api'i*

has a ruffled (*apiipii*) leaf; *Lola* a drooping (*lola*) leaf; and *Apuwai* a cup-shaped (*apu*) leaf which catches and holds water (*wai*). *Haehae,* with a leaf cut to the *piko,* is said to have originated in the Kaanapali region of Maui where the wind tears (*haehae*) the leaves. The *Mana* taros are so called because their corms reproduce by branching (*manamana*). A taro named *Hekili* is said to have been the favorite of a king of Maui named Hekili (46, vol. 10, p. 288). The two taros belonging to the uplands of Hawaii, *Uahi-a-Pele* (Smoke-of-Pele) and *Pa'u-o-Hiiaka* (Skirt-of-Hiiaka) are so called because the smoky coloring of their foliage associates them with Pele and Hiiaka, the volcano goddesses. *Lehua* is named after its reddish corm and bright red *piko,* suggestive of the crimson bloom (*lehua*) of the *ohia*[3] tree. *Ieie* has a glossy leaf and orange bloom resembling in color the leaf and bloom of the *ieie* vine. *Elepaio* has a splotched leaf said to suggest the markings of the *elepaio* bird.

Another interesting category of names is that which refers to fish whose coloring the taros resemble: *Kumu* with brilliant red petiole is named for the red *kumu* fish; *Humuhumu* with light corm, blackish petiole, and dark leaf markings, for the *humuhumu* fish, with light tail and dark body; the *Manini* taros, which are striped, for the striped *manini* fish. This cross-naming on the basis of observed resemblances was rationalized by the famous Kamapua'a legend, as given by Joseph Emerson (46, vol. 10, pp. 287-288):

> Kamapua'a, fleeing from Pele, took refuge first in the sea, then in the *kalo lo'i,* and finally in the forests, in each region passing through five transformations in order to elude Pele. These transformations were: *hee, manini, pue'o,* and *kala.* So there are five kinds of fish, of *kalo,* and of forest trees known by these respective names. (Pele could not follow Kamapua'a into the *kalo lo'i* because her eyes were bleared with salt water.) *Hee* means squid. Squid was an acceptable offering to the gods. If a squid could not be obtained, the *huli* of the *Hee* taro, divided into eight parts, might serve as a substitute.

In the list of taro varieties (table 2) the number of months to mature is given for some varieties. But the efforts to record the maturing period were unsatisfactory on the whole for two reasons. The time varies with locality, exposure, season, and altitude; obviously dearth of water and high elevation retard growth. Also, nowadays when taro is grown primarily for sale, planters think, not of the period of growth to full maturity of the corm, but rather, of the earliest month or shortest period of most rapid growth of leaves, which means semi-maturity of the corms, eliminating the period of slow filling out of the corm which follows maturity of the foliage. (See p. 45.)

The following list of 67 varieties (table 1) with brief descriptions represents a selection from my own records of specimens observed, collected, and identified in native gardens. Only the names of those I was convinced were

[3] See Glossary p. 226, for scientific names of plants, birds, fish, etc., designated in the text by Hawaiian names.

correct are here included. Less than a third of the complete records in my notes is presented[4].

In my list, *Paua* alone is from verbal description, and it is included because it was the most popular taro in Kau and I feel sure the description, from Keliihue Kamali, is accurate. Many Hawaiian planters today are ignorant of names, and many others who know general names are careless in indentification. On the other hand, a few white planters are dependable. I have met no Oriental planter who knows anything whatever about naming: to them a taro is a kind of large rice with a big root to sell. Many descriptions of taro recorded in different localities in different years correspond in every detail. Other descriptions of what is unquestionably the same variety of taro vary considerably in coloring or marking in different localities. The many varieties described in my notes, but not included here, and verbal descriptions from old planters not checked with specimens are reserved for further study.

[4] A botanical and horticultural study of varieties was published by the Hawaii Agricultural Experiment Station (Bull. 84, 1939). The taros studied are partly, if not largely, descendants of the 80 or more varieties that I sent to the Station for planting during my field work in 1934 and 1935. This was done in the hope of stimulating taro culture which has been neglected since MacCaughey and Emerson's study in 1913-14. I wish to emphasize the fact that all my descriptions were made in the field, in consultation with local gardeners, and based upon plants growing in their native habitat. Many of the plants sent to the station were from flooded *lo'i*; others, from Puna for example, were growing in rich humus; others in disintegrated lava soil; a few in red earth of *kula* lands. All specimens in the Experiment Station garden bave been cultivated "dry", in reddish soil on the slopes of Punchbowl in Honolulu. This has undoubtedly modified many varieties. My descriptions and key were trustworthy and workable for me and for my wife and Mrs. Pukui, who have used them with me in the field. If others find the key difficult on first trial, I recommend patience and practice: it took two seasons in the field to familiarize my mind and eye with the varieties of this interesting plant.

TABLE 1.—TARO IDENTIFICATIONS: KEY TO DESCRIPTIVE LIST

NAME	JUNCTION OF PETIOLE AND BLADE	PETIOLE MARGIN	BASE
Api'i	greenish	white	white
Elepaio (Hawaii)	greenish	white	white green
Ha-a-kea (haokea)	greenish	white	light green
Kalalau	greenish	white	white
Maea	greenish	white	greenish white
Manini	greenish	white	light green
Paua	greenish	white	white
Mo-i ke'oke'o	greenish	white green	white
La'a loa	greenish	white and green	green
Hapu'u hauliuli	greenish	white, pink lines	pink
Hapu'u ke'oke'o	greenish	white, pink lines	faint pink
Hapu'u ulaula	greenish	white over pink	pink
Pa'akai	greenish	white, red fleck	green
Uaua eleele (Piko)	greenish	green	pinkish
Uaua ke'oke'o (Piko)	greenish	green	pinkish
Ku loa	greenish	pink	red
Mana uauahi	greenish	pink	white green
Mo-i	greenish	pink	clear pink
Mana ke'oke'o	greenish	pink and white	white green
Ohe ke'oke'o	greenish	pink and white	pink to white
Nawao	greenish	pink and white	pink
Humuhumu	greenish	pink and white	reddish pink
Elepaio (Maui)	greenish	pink, white, red	faint pink
Haehae (Piko)	greenish	red	white
Ka'i ke'oke'o	greenish	red	white
Le'o	greenish	red	white green
Piko kea	greenish	red	white
Piko uli	greenish	red	white
Kuoho	greenish	red and white	pink and white
Nuku-manu	greenish	black	white
Papa-pueo	yellowish	white	deep pink
Lihilihi-molina	yellowish	white and green	white
Mana uwele	yellowish	red to white	black on green
Ala-o-Puna	yellowish	red to white	purple and green
Uaua molina (Piko)	yellowish	dark green (broad)	pink
Uaua piko (Piko)	pinkish	white and green	pink
Nohu (or Eleele)	pinkish	white and pink	red
Papa kole koa'e	pinkish	white, red, green	pink, white (stripes)
Wehiwa	pinkish	green and pink	pink
Ka-i	pinkish	pink	pink
Makohe	pinkish	pink	pink
Pi'i ali'i	pinkish	pink	pink
Palai'i	reddish	white	purple
Mana lauloa	reddish	white and pink	pink
Mana ulu	reddish	pink	pink
Uahi-a-Pele (Puna, H.)	reddish	pink and green	white
Lehua	reddish	pink and red	red

TABLE 1.—TARO IDENTIFICATIONS: KEY TO DESCRIPTIVE LIST—Continued.

NAME	JUNCTION OF PETIOLE AND BLADE	PETIOLE MARGIN	BASE
O'opu kai	reddish	pink and red	red
Hele-mauna	reddish	red and white	red
Hinapu	reddish	red and white	red
Ka-i uliuli	reddish	red and white	red
Welowelo-la	reddish	red	red
Ka-i ulaula	reddish	red (broad)	red
Kumu	reddish	deep red	red
Lauloa eleele	reddish	black to red	red
Mana opelu	purplish	pink and white	white
Mo-i eleele	purplish	red	dusky pink
Pa'u-o-Hiiaka	purplish	black	grayish white
Ipu-o-Lono (Maui)	blackish	white green	red
Naioea	blackish	white green	purple and green
Mana eleele	blackish	white and pink	red
Mana piko	blackish	white and pink	white
Uahi-a-Pele (Kona, H.)	blackish	white and pink	purple and pink
Manini kea	blackish	pink	white
Manini uliuli	blackish	pink	white
Hinupua'a	blackish	red and white	grass green
Lauloa ke'oke'o	blackish	red and white	red to pink
Mana ulaula	blackish	red and white	reddish
Lauloa ulaula	blackish	maroon and white	red to pink
Ohe ulaula	blackish	red	pink
Palili	blackish	red	pink
Ulaula	blackish	red	bright red
Maka'opio	blackish	red, pink, green	red
Palakea	blackish	black red (broad)	white
Ieie	blackish	purple	pink

In table 2, "M-E" indicates that the statement so marked, not the description, is taken from MacCaughey and Emerson (46). The descriptions in their article, based upon observations of John K. Jones, are almost all incomplete; some are dependable and some are not.

The key to descriptions (table 1) preceding the list of full descriptions has been worked out to serve as an aid to identification of living taro plants. The *piko* (junction of petiole and blade), the *lihi* (petiole margin), and the *kumu* (base) are not in themselves sufficient to identify any taro, but these three characters are most easily observed and will serve as indexes to variety descriptions in table 2. There may be variation in these three characters as in all characters; it is the whole combination of characters despite minor variations, giving a distinctive appearance, which the planter must know before he can recognize varieties with certainty.

TABLE 2.—TARO IDENTIFICATIONS: DESCRIPTIVE LIST

NAME	PLANTED	KALO (CORM)	KUMU (BASE)	HA (PETIOLE)	LIHI (MARGIN)	LAU (LEAF)	REMARKS	MONTHS TO MATURE
Ala-o-Puna	dry	pink; purple under skin	purple to green	yellow green below, with black flecking midway, shading to white-green above	red and white green	piko yellow to red, edge white, veins yellowish	fragrant (ala) when cooked, like Ka-i. Grows wild and is cultivated dry in Puna. Same as Welowelo-la, according to some	12
Api'i or Apu wai	wet	pure white; pale yellow under skin	pure white	white, shading midway to green with dusky flecking, light or white green above	white	stiff, crinkled, yellowish green, piko light green, cupped, edge and veins light green	its two names refer to the crinkled (api'i) cup-shaped (apu) leaf which holds water (wai). M-E describe as two distinct varieties, a red and white Api'i and red and white Apu wai. Reserved for chiefs and offering	10 to 12
Elepaio (Hawaii)	dry	white; green under skin	white green	green with white stripes, clear green above	white	surface white-splotched, piko light green, edge and veins white	Elepaio is the name of a bird (see p. 13) whose coloring the taro (splotched leaves) is supposed to resemble	12
Elepaio (Maui)	wet	pure white; dirty white under skin	very faint pink	white, shading midway to dusky green with dark red flecking, and grass green above	pink, white, and red	surface white-splotched, piko light green, edge and veins white	Rare	14
Ha-a-kea or Ha-o-kea	dry wet	white; yellow under skin; hard, small	light green	light green with green flecking midway, and white green above	white	surface dark with golden sheen; piko white extending into veining; edge white	domesticated wild Aweu or Ahe. M-E give Haokea haulaula, "white-stalk- red dish stalk", which is perhaps the Aweu with pinkish tinge; used as offering	12 dry See p. 7 for wet
[illegible]	wet	white; pink	pink	yellow green streaked	white with	piko white,	favored by commercial plan-	10 to

TABLE 2.—TARO IDENTIFICATIONS: DESCRIPTIVE LIST.—Continued.

NAME	PLANTED	KALO (CORM)	KUMU (BASE)	HA (PETIOLE)	LIHI (MARGIN)	LAU (LEAF)	REMARKS	MONTHS TO MATURE
Hapu'u ke'oke'o	wet	white, large	faint pink to white	white green becoming yellow green midway and light yellow green above	white with pink lines	piko white, edge and veins white	grows also dry (M-E)	12
Hapu'u ulaula	wet	pinkish; pink under skin, large	pink	pink to red with fine black lines midway, grass green above	white over pink	piko light green, edge and veins light green		
Hele-mauna	dry	white; red under skin	red	reddish black to black with green flecking midway, becoming green with black lines on top and white green underneath	red and white	piko reddish, edge and veins green	rare; Hawaii	
Hinapu	dry	white	red	pink, becoming green flecked with black mid way and dusky green above	red and white	piko reddish, edge and veins green	rare	
Hinupu'a	dry	white; green under skin	grass-green	grass green streaked with white above, becoming dusky green on top and white-green underneath	red and white	surface very dark, piko black, edge and veins green	name refers to the appearance of the stalk which shines as though greasy with pig fat (hinu pua'a)	
Humuhumu	wet	pink; white under skin	reddish pink	pink becoming purple black midway and green above	pink and white	piko green, edge purple black, veins green	Humuhumu is a fish (*Balistes capistratus*) with light tail and dark body	
Ieie	dry	red; white under skin	pink	dark purple becoming lighter purplish above	purple	dark green and glossy, piko black, edge and veins purplish	the name is given because the leaf is dark and glossy like that of the ieie vine, (see p. 13), and the blossom[8] is red like the ieie blossom;	12

[8] All other taros have yellow blossoms

TABLE 2.—TARO IDENTIFICATIONS: DESCRIPTIVE LIST.—Continued.

NAME	PLANTED	KALO (CORM)	KUMU (BASE)	HA (PETIOLE)	LIHI (MARGIN)	LAU (LEAF)	REMARKS	MONTHS TO MATURE
Ipu-o-Lono (Keanae, Maui)	wet or dry	pink; red under skin	red	light pink becoming black midway and white above; inner channel pink with black veining	greenish white	piko black, edge black, veins white	ceremonial taro sacred to Lono; M-E describe "white" and "red" Ipu-o-Lono	12 wet
Ka-i	wet	white; pink under skin	pink	pink to light pink, midway becoming white green with sparse green stippling and white-green above	pink	piko pink, edge and veins pinkish	fragrant (ala) when cooked; native to Ewa, Oahu, being sometimes referred to as Ka-i-o-Ewa; sends off long rhizomes and hence is called Ka-i koi (koi—to pierce)	12
Ka-i ke'oke'o or kea	wet dry	white	white	white to green with green flecking midway; white green above	red	piko white, edge white, veins pink-tinged	corm yellowish when cooked; sometimes called Ala (fragrant); reserved for chiefs (poi ali'i)	8 wet 12 dry
Ka-i ulaula	wet	purplish white; reddish purple under skin	red	green with black streaks, becoming light green and pink above (young petiole yellow-green)	broad, red	piko red, edge and veins red		
Ka-i-uliuli or eleele	wet	white; lavender under skin	red to pink	white to dusky green midway, becoming white green above (young petiole tinged red)	red and white	piko slightly red	M-E describe as being like Ka-i kea except that when cooked its corm turns dark gray (eleele) instead of yellowish (melemele)	
Kalalau	wet	white	white	grass green with fine stippling of darker green midway, becoming white green under-	white	piko light green, edge and veins white green	probably originated in Kalalau, Kauai	10–12

TABLE 2.—TARO IDENTIFICATIONS: DESCRIPTIVE LIST.—Continued.

NAME	PLANTED	KALO (CORM)	KUMU (BASE)	HA (PETIOLE)	LIHI (MARGIN)	LAU (LEAF)	REMARKS	MONTHS TO MATURE
Ku loa	wet dry	pink; white under skin	red	pinkish yellow becoming dusky green midway and light green above	pink	piko green, edge and veins pinkish	name refers to the tall (loa), upstanding (ku) stalk; possibly a form of Lauloa	
Kumu	wet dry	white	red	dusky red becoming purple-red midway and green with red shading above	deep red	broad leaf with deep red piko and dark red edge; veins red to green	Ieie is sometimes wrongly called Kumu ulaula (M-E). As an offering, used as a substitute for kumu fish, which it resembles in color, hence its name	10 wet
Kumu eleele	wet	white; pink under skin	pale pink and white	black on green, becoming purplish to white above	pink	piko green, edge brownish maroon, veins green	M-E list Kumu kea, Ulaula, Poni, and Kumu welowelola (q.v. below); Poni is a distinct variety, with petiole and base a beautiful purple-red, rare; Welowelola (q.v.) is also a distinct variety	
Kuoho or Kuohu	wet dry	pinkish white; pink under skin	pink and white	grass green with darker shading midway, becoming white green above; inner channel green with criss-cross veining	red and white	piko white, edge and veins white	Hawaii	8 dry
La'a loa	dry	white; yellow under skin	green	black over red and green, becoming heavy black midway and blackish maroon to green above	white and green	piko green extending into surface veining, edge green and veins white	Hawaii only	12
Lauloa eleele (=Ha-loa)	dry	white; pink under skin, red outer skin	red to pink	dusk green, becoming white green at base of leaf	black and red	piko red, veins green, reddish at base	name refers to characteristically long leaf (lau loa). Also called Ha-loa (long-petiole); tallest of taros; grows wild and extensively cultivated dry on Hawaii and Maui; favored for medicine and offerings	

TABLE 2.—TARO IDENTIFICATIONS: DESCRIPTIVE LIST.—Continued.

NAME	PLANTED	KALO (CORM)	KUMU (BASE)	HA (PETIOLE)	LIHI (MARGIN)	LAU (LEAF)	REMARKS	MONTHS TO MATURE
Lauloa ke'oke'o	dry	white; pink under skin	red to pink	grass green with green flecking below, dusky green midway, with red shading above; under petiole white green at leaf base	red to white	piko dusky, edge green, veins white	channel of petiole marked by criss-cross green veining	12
Lauloa ulaula (or haula)	wet dry	white; pink under skin	red to pink	green with darker green flecking below and red black shading midway becoming maroon above; under petiole white at leaf base	maroon to white	piko black, edge green, veins white	variations in name—Haloa, Launui, Kuloa, Panae. M-E give also Lauloa Hauliuli, Manini (q.v.), and Onionio (probably same as Kanio)	12 dry
Lehua	wet dry	pink; red outer skin	red	pink below, light green midway and green above; under petiole white green at leaf base	pink to red	piko red, veins white, pink at base	makes red poi; Lehua-ku-kuahiwi is the wild Lehua also known as Ku-i-ka-wao. Its leaf is ruffled; poi alii	8 wet 9 dry
Lehua eleele	dry	white or slightly pinkish; pink under skin	pink	greenish yellow cast with brown flecking below and black shading midway; green above	white	piko green, edge white, veins white	identified in Puna by two experienced planters; unless it is a sport, it seems not a true Lehua	
Lehua ke'oke'o	dry	pink; red under skin	red	yellowish green below with green shading midway, becoming white green above	black and red	piko red, edge white, veins white with some pink	called also Waiakea in Kona; M-E mentions Lehua onionio	
Le'o	dry	white; green under skin	white and greenish white	yellow green with dusky red flecking below; dusky red on green midway; white green above	red	piko white, edge and veins white	Hawaii only	

TABLE 2.—TARO IDENTIFICATIONS: DESCRIPTIVE LIST.—Continued.

NAME	PLANTED	KALO (CORM)	KUMU (BASE)	HA (PETIOLE)	LIHI (MARGIN)	LAU (LEAF)	REMARKS	MONTHS TO MATURE
Lihilihi-molina	dry	purplish center within white	white	yellowish green, with green shading midway, becoming white green above; young stalks show purplish flecking	white with green splotches	surface dark, piko yellowish, edge yellow, veins white	shows black and white streaks when cooked	
Maea	dry	white; grayish pink under skin	Greenish white	dusky green below; light green midway with dark green flecking, becoming white green above	white	piko white, edge white, veins white	Hawaii only	
Maka'opio	dry	white; red outer skin	red	green, becoming black midway and continuing all the way; white under-petiole at leaf base	green, red and pink	piko black, edge black, veins red to green		
Makohe (Makohi, Makihi)	wet	pink	pink	pink below, becoming dusky midway with green shading, and clear green above with pink tinge beneath at leaf base	pink	piko pinkish, veins pink	makes pink poi; said by Kamakau to be same as Pi'i ali'i; Kalokuokamaile says leaves are longer than Pi'i ali'i	10–12
Makoko (Waipio, Hawaii)	wet	red; white outer skin	red	pink below, becoming deep purple midway and purplish green above	green	piko green-white, veins slightly pinkish	sap very red, and taro makes exceptionally red poi; koko means "blood", hence the name	
Makoko (Kona, Hawaii)	dry	red; red outer skin	red	pink below, becoming black midway and dusky green above, with white under-petiole at leaf base	varied: some bright green, some green-white with black flecks, some pink	piko pink or brownish, edge black, veins pink to white		

TABLE 2.—TARO IDENTIFICATIONS: DESCRIPTIVE LIST.—Continued.

NAME	PLANTED	KALO (CORM)	KUMU (BASE)	HA (PETIOLE)	LIHI (MARGIN)	LAU (LEAF)	REMARKS	MONTHS TO MATURE
Mana eleele	dry	white; red under skin	red	red black throughout, with under-petiole running maroon to whitish green at leaf base; inner channel marked by crisscross black veining	pink to white	surface dark, piko red black extending into surface veining, edge black, veins red blackish to white	so named because the Mana propagates by branching (mana) from the top of the corm. One planter has seen weak taros grow from seeds of Mana eleele	12
Mana ke'oke'o	dry	white; pink-yellow under skin	white-green	dusky green, becoming light green above	pink with white splashes	piko white extending into veining, edge white, veins white	should not be mixed with other varieties for poi, because consistency tough	
Mana lauloa	dry	white; pink under skin	pink	pink on green below, green with dusky shading midway, becoming white green above, slightly dusky on top and purplish at leaf base	pink and white	surface dark, with piko a tiny red dot, edge green, veins green	in Mana taros coloring of piko runs into base of veins: a trait not typical of taros in general; leaf-blade of Mana taro is tough and leathery	
Mana opelu	dry	white	white	green with white streaks below, dark shading midway becoming maroon above; inner channel marked by faint green and white streaks	pink and white	piko purplish, color extending into surface veining; surface splotched light and dark green; edge green, veins white with maroon shading	opelu is a variety of fish (mackerel)	

TABLE 2.—TARO IDENTIFICATIONS: DESCRIPTIVE LIST.—Continued.

NAME	PLANTED	KALO (CORM)	KUMU (BASE)	HA (PETIOLE)	LIHI (MARGIN)	LAU (LEAF)	REMARKS	MONTHS TO MATURE
Mana piko	dry	white	white	grass green below, with dark green shading midway; light green above with purple leaf base	white	piko a purple-black splotch, color extending into surface veining. Edge white, veins white		
Mana uauahi	dry	white	white-green	light green with green flecks below, becoming darker midway, and light green above	pink	piko white, edge white, veins white		
Mana ulaula	dry	white; bright pink under skin	reddish	pinkish white below with dark flecks and black red shading over white midway; above, dull maroon on top and whitish at leaf base	red and white	piko black red and spreading, edge red, veins red to white		
Mana ulu	dry	cream; white under skin	pink and white	pink below, with yellowish green shading midway and clear pink above	pink	leaf leathery; piko red on a white splotch, white extending into surface veining, edge white, veins pink to white	so called because its flesh is color of ripe breadfruit (ulu). Mana Owene is the same except that the petiole is pinker. M-E list owene eleele, keokeo, lenalena, melemele, and ulaula. Owene eleele was planted to run wild for use in famine time	
Mana uwele	dry	white; purplish black under skin	purplish black on green	dusky green below, lighter midway with dusky shading, clear green above	red to white	surface velvety; piko yellow green edge green, veins green		
Manini	dry	lemon-white; white under skin	light green	light green with faint white stripes; green flecking midway; white green above	white	surface white-splotched; piko green, edge white veins green	taros grow unusually large; petiole striped like the manini fish, hence the name. Nini means "anger of the gods," hence Manini taros were never used as offerings	12

TABLE 2.—TARO IDENTIFICATIONS: DESCRIPTIVE LIST.—Continued.

NAME	PLANTED	KALO (CORM)	KUMU (BASE)	HA (PETIOLE)	LIHI (MARGIN)	LAU (LEAF)	REMARKS	MONTHS TO MATURE
Manini kea	dry	white	white	white with pinkish stippling below, becoming white green above, and maroon at leaf base	pink	piko blackish red, veins white and pinkish	M-E list Manini-ha-kikoki-ko, kakau, and Lau kikoki-ko. Manini kakau is said to have been used for medicine and offerings (M-E)	
Manini uliuli	dry	white	white	black red, striped with white below, pink midway and with green above; maroon at leaf base	pink	piko blackish red, edge black-red, veins white, slight pink tinge		
Mo-i	wet dry	strong pink	clear pink	pale pink throughout, with light green cast to under side and white-green at leaf base; short and stocky	pinkish	yellowish surface with piko white-green, edge yellow, veins white green	a characteristic of the Mo-i taros is its short stocky growth (ne'ene'e)	14 wet 8 dry
Mo-i eleele (or ne'ene'e)	dry	pink	dusky pink	green with dusky pink shading below; dusky green midway and clear green above, short and stocky	red	piko purple-red, edge red, veins pinkish		
Mo-i ke'oke'o (or ne'ene'e)	dry	white	white	light green, flecked with green below, shaded with darker green midway; clear light green above; short and stocky	white green	surface mottled with dark green; piko white, edge white, veins white	Mo-i ula is the same, with somewhat redder coloring	
Naioea	dry	pinkish; purple under skin	purple and green	black, with green sheen midway; becoming blackish green, and then green above	white and green	surface dark, piko brownish, edge green, veins green	some say this is a Pi'i ali'i (M-E). M-E give Naioea and Naioea ulaula	12

TABLE 2.—TARO IDENTIFICATIONS: DESCRIPTIVE LIST.—Continued.

NAME	PLANTED	KALO (CORM)	KUMU (BASE)	HA (PETIOLE)	LIHI (MARGIN)	LAU (LEAF)	REMARKS	MONTHS TO MATURE
Nawao	dry	slightly pinkish white; pink under skin	pink	green becoming blackish, then black midway becoming black green; upper part white green	pink and white	piko white, edge white, veins white	called also Ipu-o-Lono, Makaopio and Lehua ku-i-kawao in Puna, Hawaii	
Nohu (=Eleele)	dry	pinkish; red under skin	red	green with reddish flecks, becoming dark red over green midway and above; white under leaf base	white to pink	piko pinkish, edge white, veins pinkish	grows also wet (M-E). Makes dark (eleele) poi, but another form of Nohu makes light poi (M-E)	8
Nuku-manu	wet	white	white	dusky green becoming light green midway and white green above	black, dotted with red near base of petiole	piko white, edge white, veins white	corm is said to be pointed like a bird's beak (nuku manu). Kauai only	
Ohe ke'oke'o	dry	white; red or pink under skin	pink to white	green flecked with black, becoming clear green above and white-green at leaf base	pink and white	piko white, veins pinkish	Ohe means bamboo; Hawaii	12
Ohe ulaula	dry	pinkish white; pink under skin	pink	pinkish below with black red flecks, becoming yellowish with black red shading midway, and maroon over green above; white-green beneath leaf base	red	piko maroon-black on dusky surface, veins white		
O'opu kai (Puna, Hawaii)	dry	white; purple under skin	dark red	pink, becoming yellow-green with blackish flecks midway and white green above; maroon at leaf base	red and pink	piko red, edge green, veins red to white	markings suggestive of the salt water o'opu (gobey) fish explain the name	

TABLE 2.—TARO IDENTIFICATIONS: DESCRIPTIVE LIST.—Continued.

NAME	PLANTED	KALO (CORM)	KUMU (BASE)	HA (PETIOLE)	LIHI (MARGIN)	LAU (LEAF)	REMARKS	MONTHS TO MATURE
O'opu kai (Keanae, Maui)	wet	pink; red under skin	red	deep pink below, becoming green and pink with dark stripes and flecks midway, and dark red above; pink beneath leaf base	pink below, red above	surface velvety dusky and mottled; piko dark red, edge dark red, veins dark red		12
Pa'akai	dry	white	green	green with black flecks below, becoming dusky green midway and clear green above	white with black red flecks	piko white, edge white, veins white touched with brown	Hawaii	
Palai'i (=I'i)	wet dry	purplish white; purple under skin	purple; tall	dusky green, washed with red below and with some red shading midway; becoming white green above	white	piko reddish, edge green, veins pinkish	takes name from supposed resemblance to palai'i fern. Little "bite", hence good for kulolo. Pala means "luscious" (M-E). M-E give also Palai'i eleele	
Palakea	dry	white	white	light green with green flecks, becoming black with green shading midway, and maroon above; pink to white beneath leaf base	black red; very broad	light surface veining, piko black, edge green, veins maroon to white	taro very large; especially good for kulolo. M-E say this is Lauloa haeleele planted dry	12
Pali'i (I'i)	wet	white; pinkish under skin	pink	maroon over green with black flecks midway, becoming maroon above; white beneath leaf base	red	piko maroon to black, edge green, veins maroon to white	M-E give Palili ulaula	

TABLE 2.—TARO IDENTIFICATIONS: DESCRIPTIVE LIST.—Continued.

NAME	PLANTED	KALO (CORM)	KUMU (BASE)	HA (PETIOLE)	LIHI (MARGIN)	LAU (LEAF)	REMARKS	MONTHS TO MATURE
Papa kole koa'e	dry	white	pink and white striped	green with dark red stripes below and faint red stripe midway; becoming white green above	white, red and green	piko whitish with red marks, edge white, veins whitish, with red streaks at leaf base	a Kona and Kau (Hawaii) taro	
Papa pueo	wet	pink; yellow pink under skin	deep pink	pale pink below shading into pale green; darkish green midway becoming light green above; buff at leaf base	white	piko yellow, edge yellow, veins buff		12
Paua	dry	white	white	dark green, becoming light green above, whitish at leaf base	white	piko white, edge green, veins white	from description only; now extinct in Kona and Kau, Hawaii. M-E mention it on Kauai. Was especially liked for its keeping qualities	
Pa'u-o-Hiiaka	dry	white; gray under skin	grayish white	grayish white with maroon flecks, becoming maroon with darker flecking midway, and white above with maroon lines	black	surface velvety blackish green with light green splotches and grayish veining; piko purplish, edge grayish, veins white streaked with maroon	petiole and leaf have a smoky look, hence its name, meaning "skirt of Hiiaka" (volcano goddess)	
Pi'i ali'i	wet	pink	pink	grass-green with faint stippling, becoming dusky green midway and light above; white green beneath leaf base	pink	piko pink, edge pink, veins pink	M-E list Pi'i ali'i eleele, ke'oke'o, and ulaula. Poi Ali'i. Takes a year to mature fully (M-E)	6 to 8

TABLE 2.—TARO IDENTIFICATIONS: DESCRIPTIVE LIST.—Continued.

NAME	PLANTED	KALO (CORM)	KUMU (BASE)	HA (PETIOLE)	LIHI (MARGIN)	LAU (LEAF)	REMARKS	MONTHS TO MATURE
Piko kea	wet dry	white	white	white green below becoming dusky green midway and light green above, white green beneath leaf base	red	piko white, edge white, veins green	all so-called "Piko" varieties have leaf cut down at base as far as the piko, where leaf joins the stalk. The name also refers to the knobs on the corm, according to Mr. A. F. Judd. Piko kea is the only Piko that grows well dry. It also flourishes wild	9 wet
Piko uli	wet	white; yellow under skin	white	dusky green with red pencilling, becoming grass green midway and light green above	red	piko green, edge green, veins green		
[Piko] Haehae	wet	white	white	green with black lines and dots below, lighter green midway, and white green above	red	surface dusky, with white piko, edge white, veins white, leaf blade cut at base	belongs to "Piko" group, leaf cut to piko. Haehae means torn, and is said to have originated in Kaanapali, Maui, where strong winds tear the leaves; hence, say Hawaiians, the torn leaf [cut at base]. (M-E)	
[Piko] Uaua eleele	wet	black; white under skin	blackish red	black green below, clear green midway and above	green	piko whitish, edge light green, veins green, leaf blade cut	Uaua is generally used instead of Piko on Hawaii. The name refers to the fact that these taros have a large corm and root system that make them hard to pull up (uaua), and tough to pound	
[Piko] Uaua ke'oke'o	wet	white	pinkish	green throughout	green	piko set on dark spot in old leaf; young leaf not split to piko, edge green.	all piko can remain long in the ground after maturing without rotting	

TABLE 2.—TARO IDENTIFICATIONS: DESCRIPTIVE LIST.—Continued.

NAME	PLANTED	KALO (CORM)	KUMU (BASE)	HA (PETIOLE)	LIHI (MARGIN)	LAU (LEAF)	REMARKS	MONTHS TO MATURE
[Piko] Uaua molina	wet	white	pink	light green, to white green above	broad dark green streak, red toward base	piko yellowish, edge light green, veins white green, leaf blade cut		
[Piko] Uaua piko	dry	pinkish-white; pink under skin	pink	white green throughout with light green flecking midway	white to green	piko pinkish, light surface veining, edge white, veins white, leaf blade cut	corm tough when cooked. This is presumably the Piko kea planted dry	12
Uahi-a-Pele (Puna, Hawaii)	dry	white; purple under skin	purple, black-lined	black with greenish sheen below; dusky green with black shading midway, becoming lighter, and finally clear green above	white to red	surface light, darker toward rim, with light veining; piko red, edge green rimmed with brown, veins green	taro smoky-colored (uahi) when cooked, hence name, "Pele's smoke." Dusky foliage also suggests smokiness. Called also Ualehu (M-E)	12
Uahi-a-Pele (Kona, Hawaii)	dry	white; red under skin	white	light green below, black midway and dark red above; white beneath leaf base	bright green below, pink above	piko red, edge black, veins red to white	Hiwa, Wehiwa and Uahi-a-Pele are probably the same. Used medicinally and as offering	
Uahi-a-Pele (Waipio, Hawaii)	wet	white	pinkish and purple spotted	dusky pink below, becoming dusky purple midway and white pink above with purple lines at leaf base, purple on top and white beneath	pink white	piko purple black, veins white		

TABLE 2.—TARO IDENTIFICATIONS: DESCRIPTIVE LIST.—Continued.

NAME	PLANTED	KALO (CORM)	KUMU (BASE)	HA (PETIOLE)	LIHI (MARGIN)	LAU (LEAF)	REMARKS	MONTHS TO MATURE
Ulaula	dry	white; pinkish under skin	bright red	bright red below; yellowish red with dark red flecks midway; maroon above; white beneath leaf base with dark red to pink flecks	red	piko black, edge red, veins maroon to white		12
Wehiwa	dry	white; red under skin	pink	red black over green below; green midway, with darker green flecks and red black shading; white green above	green and white below, green and pink above	piko pinkish, edge red, veins pink to white	might be used as a substitute for Pua'a hiwa (black pig) as Mohai akua (sacrifice to a god)	8
Welowelo-la	wet	pink; white under skin	red	pink below, light green midway, pinkish above; pink beneath leaf base, and white on top	red	surface upturned; piko red, edge green, veins pink	also dry. Welowelo-la means "setting sun", so called because coloring of petiole was considered suggestive of sunset	

The following list of 346 names of taro varieties is compiled from my ow field notes and other available lists: MacCaughey and Emerson (46), Henr ques (28), Kalanianaole (37), Kalokuokamaile (39), and Wight (72) Occasionally there is duplication in naming, as in *Ahe* and *Ahe ke'oke'o,* fo the common *Ahe* is always whitish green (*ke'oke'o*). On the other hand, thi does not always imply duplication. I know from personal observation, for example, that the normal deep red *Kumu ulaula,* generally referred to simply as *Kumu,* differs in color from *Kumu kea* and *Kumu eleele,* which represent variations from the norm. I know that most of the many *Mana* varieties are distinct in coloring, for I have seen most of them. On the whole, I am inclined to think there is far less duplication of names than might be expected.

The taros are more uniform in coloring than the sweet potatoes. Their cultivation was an all-year science, while sweet potato planting was spasmodic. The taro planter was a systematic gardener, the sweet potato planter a casual farmer. Furthermore, taros are less easily transported for replanting than sweet potatoes. Hence there was great exactitude in nomenclature and less renaming—when the original name was unknown or forgotten—by the giving of a new descriptive name or the name of the person who brought in a new variety or created one from bud mutations.

List of Taro Names

A'a
A'e
Ahe
Ahe ke'oke'o
Ahe ulaula
A-iwi-kea
Akaka
Aki-lolo
Akohi
Ala eleele
Ala ke'oke'o
Ala opelu
Ala-o-Puna
Alele
Aoia-o-Kalalau
Api'i
Api'i kea
Api'i ulaula
Apo
Apowale
Apu kea
Apu wai
Apuwai ulaula
Apuwai ke'oke'o
Auau-leo-nui
Aweoweo
Aweu (Aweuweu)

Ehe
Eka-eka
Eleele
Elekai
Elepaio
Eleua
Eulu-ke'oke'o
Eulu-kohu-uauahi

Ha-a-kea
Haehae
Haehae ke'oke'o
Haehae ulaula
Hahu-ko-kai
Ha-loa
Ha-o-kea haulaula
Ha-o-kea ke'oke'o
Haole luahine
Hapu'u eleele
Hapu'u hauliuli
Hapu'u kea
Hapu'u ke'oke'o
Hapu'u lena
Hapu'u ulaula
Hapu'upu'u eleele
Hapu'upu'u ke'oke'o
Hapu'upu'u maoli

Hekili
Hele-mauna
He-nele
He-owa-hulunui
Heuele
Hinale
Hinali'i
Hinapu
Hinupua'a
Hiwa
Ho'eke
Hokea
Hona
Ho'ole-na-wao
Ho'ole-i-na-wao
Ho'ole-ke-kalo-po'o-hone [honu]
Houa
Huli pu loa
Humuhumu

Ieie
Iheihe
Iheiheilie [Iheihe-lei]
Ihi-lani
I'i (Palai'i)
Ili-a

List of Taro Names—*Continued.*

Ipu-o-Lono ke'oke'o
Ipu-o-Lono ulaula

Ka'awelu-i-ka-pali-o-Awakea
Kaena-ke-kana [kanaka]
Kahalu'u
Kahu-ko-kai
Ka-i
Ka-i eleele (uliuli)
Kai ho'okia
Ka-i kea (ke'oke'o)
Ka-i koi
Kaina-i-ke-kanaka
Kaina-i-ke-kaua
Kai nele ueue
Kai nenenene
Ka i'o aweawe
Ka-i pala
Ka-i ulaula
Ka-i uliuli
Ka-i weloeka
Kalalau
Kalaponi
Kalo-i-ku
Kanaio
Kapai o akea
Kapuhili
Kepoe
Kauani'o
Kaue
Kawele ole
Kihi paua pala
Ki'i hekeke
Kiki panapala
Koa'e eleele
Koa'e ke'oke'o
Koa'e ulaula
Ko'i aweawe
Kuamu (Kuapapa)
Kokoko ke uhi
Kueha
Kukae-iole
Ku loa
Kumaka'u
Kumu
Kumu eleele
Kumu kea (ke'oke'o)
Kumu ku loa
Kumu poni
Kumu ulaula
Kumu welowelola
Kuoho (Kuohu)

La'a loa
Laho-loa
Lapa
Lauloa haeleele (eleele)
Lauloa haula
Lauloa hauliuli
Lauloa ke'oke'o
Lauloa koko
Lauloa manini
Lauloa oni'oni'o
Lauloa panae
Lauloa poni
Lauloa ulaula (haula)
Launui
Lehua
Lehua eleele
Lehua hoole
Lehua ke'oke'o
Lehua ku-i-ka-wao
Lehua ku-kuahiwi
Lehua makai'i
Lehua oni'oni'o
Le'o
Liapu
Lihilihi-molina
Lili lehua
Lola

Ma'auea (Manauea, Mamauea)
Ma'awe
Maea
Mahaha
Mahaha ulaula
Mahakeo
Mahamaha ke'oke'o
Mahuna
Mai ahua
Ma-i'i'i
Ma-i'o
Maka'opio
Makaua
Makohe (Makohi, Makihi)
Makohe ulaula
Makohi eleele
Makoko
Makuku
Malihini-a-ka-wai
Mamane
Mana eleele
Mana hua
Mana ke'oke'o

Mana lauloa
Mana melemele
Mana ohe
Mana opelu
Mana owene
Mana piko (pipiko, piko eleele)
Mana uauahi
Mana uha pua
Mana ulaula
Mana ulu (eulu)
Mana uwele
Mana wai
Mana-wai-ke-ohe
Mana wea
Manini
Manini eleele
Manini ha kikokiko
Manini hauliuli (uliuli)
Manini kakau
Manini kea
Manini lau kikokiko
Maninini
Manuia
Melemele
Moana
Moano
Mo-i (Ne'ene'e)
Mo-i eleele
Mo-ike'oke'o
Mo-i ula
Mokihana
Mokohi (Makihi)

Nahi'olea
Naio
Naioea
Naioea ulaula
Na-kalo-i-ku-e
Naliliko'i
Nana
Nana-i-puhene-na-kalo
Nana-peko
Nao
Naua
Nawao
Ne'ene'e
Nina
Nohu
Nohu eleele
Nuku e'ehu

List of Taro Names—*Continued.*

Nuku kau
Nuku-manu

Oalu
Oalu nui
Ohe eleele
Ohe kea
Ohe ke'oke'o
Ohe ulaula
Ohi'a
O-ka-he'e-ko-kai
Ola'a loa
Onihi nihi
O'olu
O'opu kai
O'opu kai ke'oke'o
O'opu kai ulaula
Opelu
Opelu-haoe'e
Opukai
Owa owa
Owau
Owene eleele
Owene ke'oke'o
Owene lenalena
Owene melemele
Owene ulaula

Pa'akai
Pa'akai mikomiko
Pa'akea
Pa'apa'a-ina
Pae
Pa'ele-hili-manoanoa
Pa'iaha
Pakea
Pala (Palakea)
Pala
Palai'i (I'i)
Palai'i eleele
Palakea
Palakea eleele
Palakea ke'oke'o
Pala mahiki
Palau
Palili
Palili ulaula
Pani-kohe
Papa kole ka wa'a
Papa kole koa'e
Papala kea
Papamu
Papa pueo
Paua
Pau-iole
Pa'u-o-Hiiaka
Pehua
Pelu ha'ele
Pelu haole
Peu
Pia
Piapia
Pi'i ali'i eleele
Pi'i ali'i ke'oke'o
Pi'i ali'i ulaula
Pi'i halawai
Piko (Haehae, Uaua)
Piko eleele
Piko ke'oke'o (kea)
Piko nui
Piko uauna
Piko uli
Pilimai
Pohina
Po'i pulana
Po'i pulaua
Poni eleele
Poni kea
Poni-ula-uea
Poni uliuli
Po'o honue [honua]
Popolo
Pua-kai mikomiko
Pua ka waihae
Pueo-halenalena
Pueo ke'oke'o
Pulani
Pu'u konane
Pu'u nana
Puwalu

Uahi-a-Pele
(Uwahi a Pele)
Uahi-a-Pele ulaula
Ua lehu
Ua lehua
Ula maui
Umi
Uaua (Piko)
Uaua eleele
Uaua ke'oke'o
Uaua Molina
Uaua piko
Uia
U-laia
Ula li'i
Ula maui
Ula mau
Ula-nui (Ula-mani)
Ulaula
Ulaula ahiu
Ulehu
Umiumi

Waiakea
Wai-anae
Wai-anuenue
Wehiwa
Wehiwehi
Welehu
Welowelo-la
Wewehiwa
Wolu

WATER

The importance of water in the life of taro planters is evident in the words of their language used to denote "wealth" and "law." "Wealth" in Hawaiian is simply a reduplication of the word for fresh water: *waiwai,* literally "abundance of water." And "law" is *ka-na-wai,* meaning "of the water" or "that which pertains to regulation of waters", showing that the fundamental concept of law was associated with water rights. The existence of these terms implies, I believe, that irrigation was practiced by the ancient ancestors of

the Hawaiians and was merely adapted to local conditions when they settled Hawaii.

Stream systems definitely determine the major division of territory into *ahupua'a* (small division of a district) on Kauai, Oahu, Molokai, and western Maui. Eastern Maui and Hawaii are not comparable because they are too little eroded generally, and too roughly cut by deep gulches on the windward slopes. It may be argued that since streams cut valleys, leaving ridges between, *ahupua'a* sectioning was really a matter of topography. But that it was definitely and simply streams with their dependent *lo'i* (flooded terraces) that determined *ahupua'a* bounds is clear in the following localities. Open and continuous taro lands between lower ridges and sea would suggest single and inclusive major land divisions as logical, but actually the sectioning was strictly according to stream systems:

Kauai: the *ahupua'a* of Hanalei, Waioli, and Waipa
Oahu: the *ahupua'a* of Kahaluu, Waihee and Kaalaea
Maui: the *ahupua'a* of Waihee and Waiehu

The religion of the ancient taro planters likewise evidences the paramount importance of water in their lives. Among *akua* (gods) worshipped in these islands Kane was chief, and of his numerous epithets that of *Kane-i-ka-wai-ola,* Kane (Procreator)-in-the-waters-of-life, appears most frequently in invocations. (The significance of water in religion will be discussed in detail in volume 2 of "The Hawaiian Planter.") This epithet simply refers in a figurative sense to fresh water, particularly stream water, as a life-giving agent. In other words, the Hawaiian venerated as an attribute of his supreme god the stream water which was life to his staple of life, his taro. (The sweet potato, watered by rains, was dependent upon Lono, the rain god, in the form of Kamapua'a.)

The following story from Hawaii, given me by Mrs. Pukui, well illustrates the attitude of a planter in a dry locality toward water as a veritable treasure to be hoarded and hidden:

On the southern side of the hill of Akahipuu in Kona, Hawaii, lived Koamokumokuohueia. He came from Koolau and lived at Akahipuu with his wife, two daughters, and his son, Makalei. He was a farmer and raised sugar cane, taro, sweet potatoes, bananas, and awa. He was told by the natives that this was a waterless land and if any one dared to steal water from any of the natives who had a little, that person would be killed by them. He dug a hole in the rock and when the rains fell the hole was filled with water.

One day Makalei went behind their house to answer the call of nature; he felt a sharp gust of wind under him, and when he looked he saw that it came out of a small hole. He told his father, who removed some of the stones around the hole. They thus found a big cave with water dripping from the top, and were glad to have a water supply. None of the natives knew of the existence of this cave, and these two did not mention it to the rest of the family. Later they went down into the cave and saw that it was very large, enabling them to walk upright. Koamokumokuohueia took some *ohia* and

wiliwili logs into the cave at night and there he made boat-shaped troughs to hold the water that dripped from the roof, until he had covered the floor with troughs. The natives wondered at the way his plants thrived, but he never told them that he watered them at night from his secret cave. The water of this cave is very cold and the cave itself has been named Makalei's cave.

When Mr. McGuire went to Huehue to live he built a tank in the cave and laid pipes from the cave to the house.

The subject of water rights will be discussed in The Hawaiian Planter, volume 2. Briefly, the Hawaiian system was built upon the inalienable right of wet gardens to waters utilized in time past. The quantity of water, measured by time permitted for flooding, was proportional to the time spent by the cultivator and his family in building and maintaining the ditch and dam furnishing the water. In other words, water rights were regulated not by the area of land cultivated but by the amount of work done to promote and maintain the water supply. The labor expended on the ditches by a planter was of course governed by the amount of land he wanted to irrigate. The building and maintenance of dams and ditches (*auwai*) and the periodic clearing of the ditches to keep the flow unobstructed, were communal activities directed by the land supervisors (*konohiki*).

Normally, the irrigation ditch is a simple channel with earth sides and bottom, hardened by wetting and treading. Stones are often used to line ditches, especially where the water is likely to wash away the dirt or at points where ditches divide or enter terraces.

The dams (other than those built with mortar or of concrete, which were unknown in old Hawaii) seen today at the waterhead (*po'o-wai*) are invariably of loose stones, with or without clods of sod or other material to close interstices. Presumably dams were never built for permanency, as were walls of terraces and fishponds, for no dam built without mortar can withstand the floods during winter rains. Large bamboos were used formerly to carry water over open spaces, where today plank channels or pipes serve.

Bennett (4, pp. 21-22) describes as follows old ditches observed on Kauai:

The ordinary ditch line structure was a ditch banked with dirt walls. Some of these approached fairly large sizes such as the one near Kealia homesteads. This ditch is interesting because of a deep cut made through a low ridge. The sides of the cut are over 10 feet high. Even when running around a curve on a slope these ditches are dirt terraces banked on the outside. The accuracy in grading is remarkable, some of the water being conducted for several miles along a slope. Some of the ditches on level ground, and also those terraced, are lined with stones. The outside of many ditch terraces is faced with stones much like an ordinary taro terrace. In Kalalau Valley there were two ditches that led to intermittent stream beds to utilize even the occasional rains.

. . . On the Koaie ditch line in Waimea Canyon the problem of carrying the water along a perpendicular cliff was increased in complication. In order to carry the runway around a corner the thickness of the base was often buttressed 4 feet in width with stone. Flat stones at the top slanting in and overlapping on the down grade were an improvement on the plain dirt and grass calking. . . .

In Kalalau Valley there are several places where a stone retaining wall had to be built to carry the ditch around the base of a jutting wall of rock, requiring a fill 6 feet high and 6 feet across, large stones being used at the base and smaller ones above. The famed Menehune ditch at Waimea, Kauai, solved the problem of carrying water at a height of over 20 feet around the corner of a jutting cliff whose base sank into the river itself, necessitating the construction of a foundation under water firm enough to withstand the wash of flood water. The stone facing here consisted of long, smoothly cut lava blocks, some of them with interlocking joints. (For details of construction, see 4, pp. 105-107 and pl. 3.) An equally interesting experiment and achievement in irrigation engineering is that at Waiapuka, in Kohala, Hawaii, where tunnelling was used to bring water from a sunken stream bed to an adjoining valley (p. 120).

In small *loʻi* water flows from one terrace into the next below. But each large *loʻi* in flat land requires a separate ditch, which enters through openings (*puka wai*) in the *loʻi* bank. Separate small runnels from the main ditches are typical, for instance, of Manoa on Oahu, and of Keanae on Maui, where the level of the terraces over a large area is almost constant. Even on a hillside, as in Waiehu and Kahakuloa on Maui, each terrace is watered, if possible, through separate little ditches, though many terraces depend on overflow from those at a higher level. But in places where high terraces are stepped up on steep slopes, as at Koalii, Maui, the lower *loʻi* must depend entirely on overflow and percolation from the higher. The area of the several terraces is small, however, so that the freshness and coolness of the water is not exhausted as it is in the broad patches of the lowlands. This arrangement was observed by Bennett (4, p. 22) on the steep slopes of Kalalau Valley on Kauai.

MAKING FLOODED TARO PATCHES

The new piece of land selected for making a terrace was flooded for several days, until the earth was thoroughly water soaked. The dimensions, shape, and required degree of terracing were determined by the contour of the land. As described by Kamakau (40), the men with their *oo* (digging sticks) lined up inside the limits of the banks of the projected terrace. Throwing up the earth along the line of the proposed embankment, they dug down until they struck firm subsoil. Sometimes little stakes (*laʻolaʻo laʻau*) were put down to hold the bank. After the soil had thus been piled on the banks to the required level, the sides of the embankment facing the water were stamped down with the feet, and edges and lines were straightened. Sugar-cane leaves were then beaten into the surface of these inner faces of the banks with logs (*laʻau*) or the butts of coconut leaves (*kuʻau*). Coconut leaves were then laid on the surface and pounded in with large flat stones. On this, moist earth

was laid and pounded until the surface was smooth; finally the bank was covered with fine soil, on top of which were put trash and leaves to prevent the new bank from drying and cracking in the sun. This completed the making of the earth bank for low terraces in valley bottoms. Some earth banks were reinforced inside by veneering with stones. A. F. Judd told me he had observed in banks ploughed up, a core of stone surrounded by mud, packed so hard that it had to be broken through to be leveled.

When a high terrace was built to offset a steep slope, such as those at Koali, in the district of Hana, Maui, a stone retaining wall had to be constructed. This required digging away top soil at the base line of the wall until the bottom stones could be laid in firm subsoil. This top soil was thrown up on the slope above the excavation to serve as fill for the terrace. For the foundation, the largest stones that could be handled, available on the hillside, in a stream bed, or on the beach, were pried, rolled, and slid into place. Some stones so used weighed tons. The wall sloped slightly inward toward the top so as to increase stability. The old Hawaiians were expert in laying rough stone without mortar, as is shown in the construction of the famous trail to Kalalau along the cliffs of the Napali coast on Kauai. This trail was made by Hawaiian workmen under the direction of William Kinney who has told me of the skillful work of the older Hawaiians there. That the high stone terraces were carefully and solidly built is evidenced by the fact that many are intact today despite the destructive effects of guava and kukui groves, of cattle and pigs. Bennett (4, p. 20) found that some high terraces on Kauai were faced with a double thickness of stone. In these terraces, after the retaining wall had been completed, the hillside at the back of the enclosed area was dug away to complete the fill.

As the first step in building up a new terrace, it was necessary to make a hard floor so that there might be a minimum of seepage of the precious irrigating water. It is said that anciently the bottom of a terrace was pounded with logs and heavy stones. This work was termed *paluku* or *pakui*. But the usual method, followed until recent times, was "treading" (*hehi*), described by Kamakau (40):

> The day chosen for treading was a holiday. Men, women and children attended. The owner of the patch provided beforehand an abundance of vegetables, pork, and fish. On the day of treading the patch was filled with water. No chief or chiefess was held too sacred to tread in the patch. It was a festival day; and every man, woman, and child decked himself with leaves and worked with all his might, tramping here and there, stirring the mud with his feet, dancing, rejoicing, shouting, reveling and indulging in all sorts of sport. This was done so that the water would not sink into the soil, and to allow the taro to grow. The next day the taro was planted, for by then the mud had settled to the bottom.

The banks (*ku'auna, ika, kaika,* or *kuaio*) of the old terraces were not the mere grass-covered retaining walls and footpaths that they are today.

On the banks the wet taro farmers planted important subsidiary crops: bananas, sugar cane, arrowroot, and ti plants the leaves of which had many uses and the roots of which appeased hunger in famine times. Kamakau says that the old planters took great pride in the planting of their banks.

It is said (46, vol. 11, p. 22) that in Kohala, banks were formerly wide but were narrowed by Chinese planters. In Waimea, Kauai, they were evidently quite narrow, for Vancouver (71, vol. 1, p. 375) says that they "would be infinitely more commodious [for the pedestrian] were they a little broader, being at present scarcely of sufficient width to walk upon."

On the steep slopes of Kalalau Valley, Bennett (4, p. 20) found that some banks were "just a row of large stones." In general, the banks of terraces built in steep places must be as narrow as they can safely be made and were certainly never planted.

Not only did the flooded terraces raise the staple of life for the old planter, while its banks supported his secondary crops, but in the semiliquid slime of the patch itself fish were raised. Fish may still be seen in some *loʻi* today. Kamakau (40) writes that the varieties of fish bred in the *loʻi* were the *awa,* mullet, *oʻopu* and *aholehole.*

CUTTINGS

Taro seeds of some varieties are fertile and produce weak plants; but propagation is accomplished by means of cuttings (*huli*), consisting of the crown of the corm around the crest of which roots bud, with the petiole shaft cut just above the upper ends of the channels in the petioles (pl. 1). Cut below this point, the immature leaf, still furled within the base of the petiole shaft, is apt to be exposed or its apex cut off. These cuttings are extremely hardy and, if cut with a generous portion of the crown of the corm attached and kept in a damp place, will remain alive for months. The inference seems justified that the early Polynesian settlers carried their taro as cuttings to all parts of the Pacific for planting—to Hawaii, to Rapa, and to New Zealand.

Half the secret of healthy wet taro lies in the selection and handling of the cuttings. An eighth to a quarter of an inch of the crown of the corm should be left on the base of the stalk where the *huli* is cut. Native planters consider that the cutting of the *huli* too close to the base of the petiole, a practice typical of the Oriental planters, is conducive to root rot. The following is quoted from the directions for handling cuttings given by a Molokai planter in a Hawaiian newspaper (65):

> All kinds of *huli* are not suitable for planting in wet patches. If the corm has been too closely cut off from the bottom of the *huli* and the *huli* itself is too small, it is not good for planting. If the taro has rotted and only a third remains good, the *huli* should not be replanted in the patch, for it will rot again and you will not get a good taro. So it is with a *huli* that has blossomed, if it is found on an old parent stalk. The *huli* of

wild taro are not good, nor are those from some other varieties. These are good ***huli***: the kind that is called ***wae*** [selected]. This is the term applied to the first [generation of] offshoots of taro irrespective of variety. The old parent stalk is called ***muo***. Each variety has a name, and the ***wae*** of each should be planted in the center of the patch and the ***muo*** along the borders; that is, if it is not very good; but if it is healthy it can be planted in the middle. [In other words, the ***huli*** cut from the corm in harvesting should be planted along the sides of the terrace, while the new bud taros broken from the corm are given the middle, as they are the sturdiest and least affected by rot.]

The old Hawaiian planter marked with a cross the base of every cutting from a diseased taro. This was not replanted but was stuck in fresh ground with other diseased cuttings, to be used after they had regained their strength.

The "root-rot" which affects the corm was and is the chief enemy of taro grown under water. The exact nature of this disease has not been wholly determined but I am told that it is probably partly bacterial and partly due to a fungus. Hawaiians call the disease *pala* or *palahe*. Exhausted or stale soil fosters this disease in taro. Fertilizing and letting the terraces lie fallow between plantings remedy this condition. The natives used to fertilize their terraces by burying in the ground the foliage and branches of hau or kukui and allowing these to rot thoroughly before planting the cuttings. Present-day planters also throw back into the patch all the stalks and leaves from the cuttings. While the taro is growing they throw out grass and most weeds but stamp into the mud certain weeds that are regarded as desirable fertilizers, particularly the ***kohekohe*** which grows abundantly in wet patches. The following measures are recommended by Henry Kauhaahaa of Kahakuloa, one of the most experienced planters on Maui, for freeing a *loʻi* from root rot:

1. Drain and dry the *loʻi* and leave it fallow for one year.
2. Replant with healthy ***huli*** of different variety and from a different locality. From this planting two crops may be harvested.
3. Repeat no. 1.
4. Repeat no. 2.

Stale water is also said to be conducive to taro rot. Formerly waterheads, ditches, and the circulation of water in the *loʻi* were carefully tended, so that the water might be fresh and circulate freely. Nowadays, because there is no systematic supervision (p. 36) and because planting is on an individualistic basis, few ditch systems are properly tended. Ditches become sluggish through clogging with grass and weeds. Introduced grasses, especially Hilo grass and wandering-jew, grow luxuriantly along wet banks. The *loʻi* banks themselves are often poorly tended, intakes become clogged with grass, patches are poorly weeded, and the fresh water is run through only one part of the *loʻi,* while stagnant sun-warmed water lies over the rest. For taro to thrive, the water should be both fresh and cool, one reason why *loʻi* in the upper reaches of cool, deep valleys are especially good.

Generations of Cuttings

The cutting from the crown of a corm is termed *huli makua,* or parent cutting. After planting, as the new corm develops, suckers bud from its sides, pierce the soil around the parent plant, and form a cluster of small taros—a second generation of offshoots, termed *oha.* When this growth is prolific it is referred to as *ohaha.* These suckers, broken off and left in the soil when the parent taro is harvested or transplanted, are termed *huli oha.* In their turn, the new corms formed by the *huli oha* produce suckers, which may be replanted and produce a fourth generation, and this a fifth. Even the hardiest taros in the richest soil of Kona are too small beyond the fifth generation to be worth replanting and harvesting. In *lo'i,* three generations mark the limit for replanting. Beyond the second generation the terms used vary slightly as follows:

TABLE 3.—TARO GENERATIONS

LOCALITY OR REFERENCE	1	2	3	4	5	6	7
Waipio, Hawaii	kalo makua	oha	pu'u				
Puna, Hawaii	kalo	oha	a'e	kokole	pahupahu		
46, vol. 11, p. 47	huli makua	huli oha	huli pu'u wele wa'e, a'e				
41, p. 152	kalo	mu'u	a'e	onihinihi	kokole	pu'u	pahupahu
Hilo, Hawaii		oha	pilimai	kumau			

An anonymous writer (18) gives the following interesting notes on terms applying to stages of growth. It is not known of what locality he writes.

> Terms applied to taros are many depending on growth, use, stage, etc. A few months after planting when the leaves appear, the taro is called *lau pa'i,* that is the time when they have two or three leaves. When it has grown into a large plant it is called *puhili,* that is the time when the corm has developed and the leaves are large. Where dry land taro is grown the young plant (*oha*) left in the ground is called *aae* and the larger one that is pulled up is called *onihinihi.* After it is cooked it is called *kuala* or *kalopaa* or *ne-u* and by other terms also. A taro that grows up of itself is a *kele*; the *owene* taro comes from a *kele,* a delicious taro eaten whole or pounded up (*omao*). After it has been pounded with a little water and wrapped in ti leaves, it is called *pai* or *omao* and if put into the calabash while the poi is hard it is called *kumau.* After it is pounded and mixed soft, it is known by its famous name of poi, a favorite food of Hawaiians.

Kepelino (41, p. 152) describes the way in which crop after crop was procured from a single planting in Kona by breaking off and leaving the offshoots at each "pulling":

The taro in wet lands is rather small, although in Waipio on Hawaii the taro grows large. The marshy land can be quickly harvested, one pull and all comes out of the water. Not so with dry land. The taro comes first, then the young sprouts, called *muu*, then the still later sprouts, called *ae*, then those still later, called *onihinihi*, then sprouts still later than these, called *kokole*, then the next sprouts, called *pu'u*, then the last sprouts, the *pahupahu*. In the one patch there will be a yield for five or six years. Not so in marshy lands. After each planting, at one pull all is gone.

Wet Taro Planting

It is important that the cuttings put out a vigorous growth of rootlets (*huluhulu*) around the base of the stalk before they are planted. After cutting, therefore, they should be tied in bundles and laid in a shady place for a week or 10 days. If they are to be kept for a longer period they may be stuck in the ground in compact lots in a corner of the patch, in soil that is damp but not flooded.

Some Hawaiians say that the method of planting cuttings in lines, which is prevalent today (pl. 2, *A*) was introduced by Chinese rice planters; others say it was one old Hawaiian method. When this method is followed, the cuttings are stuck in soft mud exactly as though they were rice seedlings, and the mud is pressed lightly around them before flooding. When the first two leaves have unfolded, the patch is drained and left for 2 weeks, during which time the soil is kept damp either by rain or brief irrigation. This allows the roots to consolidate themselves in firm soil. Then the terrace is again flooded and remains so until the crop is pulled. When the foliage shows strong growth the patch should be weeded and the taros pressed firmly into the soil. Thereafter the plants should be left strictly alone. Curling and yellowing of the leaves (*ponalo*) and loss of their freshness is a sign of maturity. But the corm continues to fill out for some months after the foliage passes its prime. After maturity and until the taros are pulled, the patch must be kept continually flooded. The old Hawaiian method termed *aulai* is described as follows (40):

> Sometimes rows were laid true by stretching a line (*aho*), the distance between plants being about 2 feet. Groups of cuttings were then planted in small heaps of dirt made before planting, and only a little water was allowed to run in so as not to wash out the roots. This method is still used where irrigation depends on spring water which must be conserved and in fresh-water marshes.

An interesting picture of taro planting as taught at Lahainaluna School on Maui in the nineteenth century is given in the following account by Kalokuokamaile (38). This seems to indicate that planting in mounds was the true old Hawaiian method of wet planting.

> I learned to make wet patches for four years at Lahainaluna. If it was desirable to convert a piece of dry land into a wet patch, they looked to see how water could be brought to it, because water was important. If water could not reach it, then it was useless to make it, for it was important to have water run in. If the patch was 20 fathoms

long and 10 fathoms wide, we made them with shovels and the few pickaxes that we had. The soil near the banks was tossed up on them. The banks were made well, they were solid and thick. In digging with the shovel from the upper to the lower end and from one side to the other there was no part of the patch that was not dug. It looked level and even. Then the water was run into it and then the uneven places were seen, some deep, some high. The deep places were filled in. When it was seen that it was level then water was allowed to run in. We brought the oxen, that pulled the carts over the plains, and put them into the newly made patch and the oxen trampled on the earth up and down, to-and-fro. If we wanted some fun like the oxen, we increased the water in which to play.

I have told you how a new patch was made, by chasing the oxen up and down and here and there in the water. This was done every day until the soil was no longer loose through the trampling of the oxen, horses or mules. The patch was left to dry until needed for planting, then enough water was run in for the making of mounds [*pu'epu'e*] for planting.

The mounds were evenly spaced, not too close, about 3 feet apart. Mounding in wet patches was the same as in dry patches. The mounds were in even rows, not one out of place. That was the way it was done by those who observed the rules for farming. So it was on dry lands the holes were dug in even rows, none were uneven except when a stone obstructed the way.

Planting in wet patches was the same as for dry patches, each mound had two or three stalks. At the time of planting, the water reached below the places where the stalks were planted. The water did not reach the part of the stalk that was cut off from the corm [*kohina*]. Great care was taken at the time of planting to have the proper amount of water, so as not to go over the mounds.

When the stalks had put forth two or three leaves, the work needed for the wet patches was the same as for the dry patches. [See pp. 42, 49.] Great care was taken to remove any weed that appeared. If one did not watch out, the taros would not grow.

The procedure developed after the introduction from China of water buffalo for plowing, and of commercial fertilizer, is described in detail by MacCaughey and Emerson (46, vol. 11, pp. 44-45), a brief abstract of which is given here:

The *lo'i* is ploughed dry, or wet with water buffalo, or is dug up with a mattock. Before planting, the ground should be limed; burnt bone may be applied with the lime. Fertilizer recommended for *lo'i* is: per acre 300 lbs. ammonium sulphate; 450 lbs. superphosphate; 400 lbs. sulphate of potash. (Fertilizer tests were made by the U. S. Agricultural Experiment Station in 1910.) The fertilizer is turned into the soil and the ground left to aerate. The *lo'i* is then flooded, ploughed, and dragged to soften the mud. Larger returns per acre are said to result from the method adopted by Chinese planters of sticking the cuttings in rows, instead of in little mounds as the Hawaiians used to do. Until the first leafing the cuttings grow in soft mud, which is not flooded. After they are rooted and show their first leaves, the planter cultivates between the rows and then floods the patch. After flooding, the taros are kept until maturity under water that is continuously circulating. The patch should be cultivated and weeded at intervals during the first 6 months, and the weeds and old taro leaves stamped down into the soil. After the first 6 months there should be no more weeding or cultivation, lest the taro be injured. After 6 or 8 months the foliage luxuriates, and after that the taro fills out rapidly.

The handling and planting of the cuttings, the care of the plants, and principles regulating proper irrigation are the same, whether the patch is planted according to old or new methods. Pule (65) gives the following advice about planting the cuttings:

Do not stick them [new cuttings] in deep lest they do not bear well, and be long, thin and yield poorly. If the *huli* is one that has been transplanted (*hehu*), it can be thrust in deeply. . . This kind matures quickly. When they have commenced to grow well . . . in working over the taro thrust each *huli* down deeper, and if any are dead replace them with others. The *kohekohe* grass should also be thrust down deep, for it makes the soil of the patch rich for the taro. If there are any yellow stems on the growing stalks, remove them in order to insure a healthy growth. . . . From the time of planting until there are two or three leaves on the stalks allow only a little water to flow in; and from the time there are a few leaves until the taro sends out new shoots, allow more water to flow in. After the offshoots have grown, let the water fill the patch.

REGULATION OF WATER

After planting the cuttings there are four periods of growth, requiring irrigation as follows:

1. Irrigation: Until the first leaf (*lau awa*) is unfurled, ample irrigation is required, but not flooding. Care must be taken to prevent the water from washing out the soil around the new cuttings.
2. Drying: After first leafing the cuttings are pressed down firmly; the surface of the terrace should be kept damp but not flooded until the first two leaves (*lau pa'i*) appear.
3. Moderate flooding: After the first three leaves are unfurled, water should again be let in, the degree of flooding being slowly increased until the new shoots (*oha*) have grown around the parent plants.
4. Full flooding: After this, until maturity, the terrace should be fully flooded with fresh water in constant slow circulation, the water standing about three fingers deep around the taro stalks. Maturing of the plant is indicated by yellowing (*ponale*) of the leaves. The stage of filling out the corm is termed *haehu*.
5. Reduced flooding: After the corms are mature, the plants may stay in the ground for some months before being pulled. During this time the patch must remain under fresh water, but only a little water is required.

WEEDING

According to old practice, weeding (*au lo'i*) was done systematically until the foliage flourished and shoots appeared. But during the period of the maturing and filling out of the corms, while the patch was fully flooded, the old planter left the *lo'i* strictly alone. The abundant foliage prevented new weeds from flourishing; the corm with its full foliage, root system, and budding offshoots grew best undisturbed; and the soil around the plant was not to be trodden or displaced.

PULLING

When the taro is "pulled" (*huki kalo*), the mud is pressed down and away from the firmly rooted base of the stalks with the foot, and the hand is thrust deep into the mud to grasp the corm. In marshy land the whole plant may be pulled out by the stalk. The whole plants are tossed (*hoomahaha*) in heaps on the bank, while the weeds and small refuse (*palili*) are thrown up along the sides of the patch. On the bank the leaves of the taro are chopped off

and the corms are cut from the *huli.* The old leaves (*laele*) are thrown back into the patch to serve as fertilizer (*kipulu*). Nowadays the corms are put in bags; but the old practice, which still prevails where bunches of raw taro are sold in the market for home cooking, was to tie the taros with their stalks still on them but leaves chopped off, in bunches (*huihui kalo*) of fours (*kauna*). Taros were therefore counted as follows:

4 kalo: a kahi kauna (one four) kalo
20 kalo: a lima kauna (five fours) kalo
40 kalo: anahulu kauna (ten fours) kalo

Cuttings were tied in fours and counted in the same manner. Piled up on the bank they are termed *anihihihi* or *onihihihi* (46, vol. 11, p. 50).

One advantage of taro as a staple food is that the patch in which it grows serves as the storehouse for the mature corm, which, if kept flooded, will remain alive in the soil in a state of suspended growth for months after it matures. If left unflooded the corm dries up and cracks. In old Hawaii it was not customary to harvest the whole patch at once as is now done by commercial planters; only enough was pulled to meet the current need. This is still the economy of those who grow their taro for home consumption.

Varieties differ in length of maturing time and length of time they may be allowed to remain in the flooded patch. The following table gives these periods for the taros now most generally grown in flooded ground.

TABLE 4.—WET TAROS AT ABOUT SEA LEVEL, WINDWARD OAHU[6]

VARIETY	MATURING TIME MONTHS	TIME LEFT IN FLOODED LO'I MONTHS
Piko	9	9
Hapu'u	10	2
Ka-i	12	12
Ha-o-kea	8	10
Apu wai	6-8	4
Pi'i-ali'i	6-8	4
Lehua	8	4
Api'i	12	12-24

In the old, careful gardening, after the corm had matured, its shoots were bent gently outward (*oha kula'i*) to enable them to grow more freely; and when a taro was pulled, the shoots, now called *huli oha,* were pried off and sunk into the mud to grow into a second crop. Nowadays, in the wasteful exploitation of the plant and the soil, the whole plant is jerked out so that the ground may be immediately replanted with cuttings from the parent taro and large *huli oha.* In Waipio, Hawaii, three generations of corms used to

[6] Information from William Kalani, Heeia, Oahu.

be raised from a single original planting. First, the parent taros (*kalo makua*) grown from the original cutting, were pulled; second, the shoots (*oha*) which had been broken off when the parent corms were taken, came to maturity and were eaten; and the third crop grew from the second generation of shoots (*pu'u*) that sprouted from the *oha* and were left in the *lo'i* until they matured and were harvested. Then the *lo'i* was dried and allowed to lie fallow for some months before replanting. MacCaughey and Emerson (46, vol. 11, p. 22) say: "According to Mr. E. C. Bond, the natives of Kohala, Hawaii, in former times allowed the *lo'i* to remain fallow for two or three months after each crop—long enough to allow the grass, weeds, and other rubbish thrown into the *lo'i* to rot. Sometimes they added fresh soil to the *lo'i*."

BLOOMING

After the foliage matures, a new taro plant blooms (pl. 3, *A*); a plant blooms but once. Blooming is regarded as a sign of maturing. But often a small plant blooms as a result of the early harvesting and replanting of the crown of a corm grown from an *oha* or new shoot before that plant had bloomed. The immature bloom is hidden in the stalk of the cutting thus detached from the immature corm and appears soon after replanting. Cuttings that are in their vigorous prime and are yet to bloom should be selected for replanting; those detached from plants that have already bloomed have run their cycle of growth, and though they will produce new corms, they are weak and likely to rot. In other words, *huli makua*—cuttings detached from the corm, in contradistinction to offshoots—are good for replanting only if detached before they bloom.

Dry Taro Planting

Wild taro (*Aweuweu*) and taros planted to run wild in the lower, uncleared forest were regarded as belonging to the gods of the forest, for this section of the upland was the jungle of the gods (*wao akua*). On the slopes of northern and eastern Hawaii, natives used to plant the varieties called *Ala, Manauea, Lauloa, Ulaula,* and *Eleele,* intending them to run wild. Such taros gone wild are generally called *mahaoi* (bold or rude), a term which refers to the fact that they are characterized by strong *mane'o* ("itch", irritating, because of development of calcium oxalate crystals). This characteristic, making wild taros in general unpalatable to man, was regarded as a trick of the gods of the forest, who resented man's use of their taro. When a man went about this sort of planting the proper procedure was to dig small holes in the humus and then toss cuttings in and press them down with the foot in a careless manner as though he had no interest in the matter, in fact as if it were a favor, marked by some condescension, to the forest denizens. Then

the gods, not realizing that the planter intended to use the taro himself, would not bother to put "itch" into the plants.

Because wild taros belonged to the gods, transplanting of the cuttings to cultivated ground was believed to excite the gods' resentment. Hence it was that cuttings of this sort were planted only around the outer edges of patches in clearings, where they might be said to half belong to the forest. This explains, too, the general feeling that to plant wild taros in the vicinity of a dwelling is to incur ill-luck, due to enmity and trickery of the upland spirits and sprites, the forest denizens who are myriad (*kinikini o na 'kua*).

FOREST CLEARINGS

The upland plantations in clearings in the forest zone in Puna, Kau, and Kona on Hawaii, are termed *waena,* from *wa-ele-ana* (*wa* or *wahi,* place; *ele,* to clear; *ana,* participial suffix).

The use and handling of cuttings in dry planting is the same as in planting in flooded terraces. Root rot, however, rarely affects dry taro, and the elimination of cuttings from affected taros is not as important as in planting in the valley bottoms.

In upland forest clearings where there is deep humus, as in Kona and at Olaa and Malama in Puna, Hawaii, planting is done as follows. The patch is first cleared and cleaned. Holes about 9 inches deep are dug in the soil just large enough (9 to 12 inches across) to take two cuttings. With rootlets already sprouting, the cuttings are dropped into the holes and left uncovered until they have begun to root vigorously. The holes are then filled with earth and the taros are straightened when the first two leaves (*lau pa'i*) have unfurled. Then the whole field is covered with a mulch of fern leaves (preferably of *ama'u* or *hapu'u*), ti, ginger, or banana leaves, or rubbish in general (except *honohono* grass which will root and choke the taro). Weeding is done at intervals as needed.

In Puna and Hilo, where it rains during all seasons, planting may be done at any time. In Kona or Kau it should be done at the very beginning of the rainy season, namely in late spring and early summer. The ancient method of planting in Kona was to start the cuttings in the lower taro zone just before the summer rains, and when they had developed vigorous foliage (during the rains) to transplant them to the higher altitudes where, in the cool rainy atmosphere and in the rich forest soil, they developed mammoth taros.

The following excerpt from the story of Kamiki (69) throws interesting light on the custom of planting two cuttings in a hole, and of mulching with *akolea* and *ieie*:

> Planting the taro singly will result in large corms and there will not be many offshoots. When these have attained their full growth a man could be hidden among them.

Planting by twos and threes results in offshoots that retard the growth of the parent and so there is not much taro. It is no trouble to clear the field of weeds, for we are accustomed to mulching with *akolea* fern and *ieie* leaves.

A forest clearing in a region of intermittent rains requires constant attention, for the mulch should be drawn away from the plants when it rains and restored when the sun is bright. Hence the common saying referring to the mulch of *hapu'u* fern: "I luna ka ua, wehee (or waele) ke pulu o lalo" (Overhead the rain, clear away the mulch beneath).

PLANTING IN KONA

Kepelino (41, pp. 152-156), a native of Kona, writes the following detailed notes about planting in that section. The planting in forest clearings described above, is evidently that termed *umoki.*

There are many ways of planting taro. One way is called "prodding" (*ohiki*), another "steering" (*okupe*), another "covering" (*paeli*), another "mounding" (*pu'epu'e*), another "stopping-up" (*umoki*), another "leaf-filling" (*pakukui*).

The prodding method consists of prodding up the earth with a sharpened stick or *oo* until it is very soft, then planting the tops.

The steering method is similar, but in this case the earth is pushed up to one side and the plant inserted in the hole.

The covering method consists in making two large holes and softening well the earth within, before putting in the plants.

The mounding method consists in piling up the earth into good-sized mounds, in which the cuttings are planted. Taro thus planted is really a beautiful sight.

The stopping-up method is employed in planting taro in the uplands where tree ferns grow. The sharp stick is thrust into the soil, the hole widened, then the plant is thrust into the hole made.

The leaf-filling method consists in digging large holes and filling them with candlenut leaves and covering them with soil. After some weeks the leaves are decayed and the taro is planted. A plant thus handled may grow to seven feet and over and the taro may weigh twenty pounds and over. According to the depth of the fertilizer, so is the height and size of its growth. . .

When the taro began to grow and the leaves were a little developed, then the work of covering was begun. Three or four days, perhaps, of hard work, then the patch was covered. This meant filling in the holes into which the plants were set close up to the plant with trash. Good trash for filling is the *aeki* fern, the *mana* fern, the tree-fern, the ginger leaf and the coarse grass called *kukaepua'a* or "pig's dung." These are the best kinds of trash for fertilizing; they produce food. Other kinds are also of some value.

This was the work of covering. If the trash used was from the tree-fern there would be no more trouble, nor would there be from the other kinds, none of them would sprout except the grass. If that was used for filling during the rainy season, it must be pulled and cleaned after two days. In the dry season it would make no trouble.

Here is another caution. It was not good to cover the patch with soil without letting the hole dry. It should be allowed to dry first and then covered over, throwing all bad trash elsewhere. The *honohono* is a bad weed; one cannot kill it and it will kill the taro. Such was the method of taro planting. . .

Weeding, called *aili,* consists in pulling the grass in order to let the plants grow and prevent the choking of the growth of the shoots.

The cultivator must separate the main plant from the first sprouts. He must break them apart from the parent plant so that they may become as large plants as their parent

plant or perhaps bigger. These make the second crop of taro which follows the first, after that comes the third crop, and so on.

The cultivator must also loosen the leaves from the stem in order that they may not sheath the stem too tightly.

The following account of planting methods on the island of Hawaii by Kalokuokamaile, himself a planter of experience, deserves quotation in full (38):

There were two sides to dry land farming. 1. Weeding by hand in the olden days, because the [introduced] Hilo grass was not found in those days. I have seen only the *kukaepua'a* grass growing in those days. If there was a new patch fifteen fathoms long and ten wide it would be weeded before noon, because no other weeds grew with the *kukaepua'a* grass.

A man could easily weed the patches. If there were Hilo grasses then they would cling fast like the rain in the sky.

There were three ways of working in the *kihapai* (garden patches). 1, the *ke'ehau;* 2, the *ka'elehua;* 3, the *ilihelo.* The *ke'ehau* farming was done after sunset, during the bright moonlight nights of *Akua, Hoku,* and *Mahealani.* Farming could be done at any hour of the night and the work ended only when the sun rose. This kind of farming was called *ke'ehau.*

2. The *ka'elehua* was done from early morning to 11 a.m. and on to noon. Because the work was done without the excessive perspiration of the body it was called *ka'e-lehua* (the-border-of-the-*lehua*-grove) by the ancients.

3. The *ilihelo* was the kind done from early morning till sunset and because there was much perspiration, the soil clung to the skin. This way of farming was given two names, *ili-helo* (dirty-skin) and *ili-pilo* (stinking-skin).

This was the second way of farming in the olden days and that was by setting the patch on fire.

Here are the rules: weed the borders all around the patch, leaving a wide margin; burn the patch twice. If the burning is done in the day time that is all right and if at night that is all right too. The writer is very well acquainted with the old ways of farming, as my grandparents and parents taught me.

These are some of the things my grandparents and parents taught me, the ways of preparing the holes in which to plant the stalks, each having a different name. The ancients had five different names for these holes (*makalua*) for planting stalks and these are their names: *ho'o-wa, okupe, pu'epu'e, paeli* or *pahu, pakuikui.*

1. The *ho'o-wa* was the type of hole made with only one thrust of the *oo,* after which the stalk (*huli*) was put in. The hole was as big around as the stalk and anyone who saw it for the first time wondered how the planting was done. "The soil isn't softened, my grandfather, how would you expect the taro to grow for the soil is hard?" "Hush and listen well to my instructions."

The work did not end with the planting of the stalk, no indeed. When the weeds appeared they were rooted up till the taro stalks had put forth from three to four leaves. The earth was softened around each plant at the same time pulling apart the stems that stick tight to the stalk to separate them. If a shower fell water could be seen settled in the stalks. Then the stalks began to grow vigorously. If this was not done, the stems would cling so tightly together that taro would not develop well. There was one thing to watch out for, weeds—not one should be spared to grow among the taro. The plants were cared for like children till they grew big enough to mulch with the leaves of the tree ferns. A planter could take a trip to California for a year and still there would be no weeds. Correct and accurate were my grandfather's teachings for I have practiced and know that way of planting.

2. In the *okupe* method, with one or two thrusts of the *oo* digging implement, from two, three up to five stalks of taro were put into the one hole. The method was also

called *kukini*. Thus it was called because there were so many stalks. If they were planted according to the rule of two or three stalks to a hole, the patch would be filled before all the stalks were planted. The remaining stalks would rot and be thrown away. My grandfather told me that not a single stalk should be thrown away, lest some day the taro would stare at you. The taro had eyes. That was why they were planted five or six to a hole. As long as the end that was cut off (*kohina*) was hidden in the earth, the gods (*aumakua*) who made the food plants productive would not be annoyed. These words of my grandfather's are true. I have done it this way. Sometimes there were too many taro stalks with a limited patch so I planted them four, five, or six to a hole. I remembered the sayings of the old: do not dry out the cut end of the taro stalk in the sun lest the taro stare at you.

3. The *pu'epu'e* method was used in rocky places where there was not much earth. Bring some soil from somewhere else and take it where you want it and then build mounds. If you do not do this, your taro will be planted on the *pahoehoe* lava and be withered by the sun. I have used this method, as my grandfather had taught me how and the taro grew vigorously after the rainy season. The stalks that were planted at Waioea bore taro in five or six months' time when the showers fell constantly.

4. The *paeli* method was done by first softening the earth around the holes and then the stalks were planted. This method is commonly used by taro growers of today, all over the land wherever you go.

5. In *pakuikui* planting there were big holes, nine feet or less in circumference, according to the wish of the worker. The depth was from finger tip to armpit and from finger tip to elbow [a little over a yard] more. It was filled with kukui leaves till the hole was filled, then covered over with soil. Four kukui branches were also buried in the holes with the leaves down and the stems up.

These branches were used so that one knew whether the leaves had rotted away in the hole by pulling up one of the branches to see. If, upon pulling up a branch, the leaves had not rotted then it was left alone until another time. If they had rotted, the stalks were planted. The stalks which I used frequently were the *Apowale,* using one or two stalks only and no more.

In the beginning the taro grew out of their holes like young banana plants. At the time that they were grown up they were not like those of other dry patch or wet patch taros, these surpassed them in growth.

When the taros had developed in both the parent stalk and the offshoots, then the offshoots were pulled away from the parent and the space between stepped on with the feet to separate them from the parent. These would not be the only offshoots for the parent would send out more, each with fully developed corms.

They were cut into pieces before they could be cooked. I think there are no foreign professors that could raise huge taros like those of Hawaii nei.

It was also true of sweet potatoes for the ancients had medicines to make them bear big tubers. I know and have used them in some of my potato mounds, just as my grandfather had taught me. It is only when one heeds and uses his hands that one gains knowledge. We have come to the end of *pakuikui* holes. There was no other medicinal leaves used except the kukui.

In preparing an *eki* (ti leaf) patch in the olden days when ti leaves grew from one end to the other and from the upland to the sea, the work was lovely and delightful. The ti plants were hewn down and the leaves left where the holes were. The stems were cut up into sections and gathered up in one place. Then the [taro] stalks were planted. One could go to the beach or anywhere else he chose, no weeds grew up for the ti leaves were thick. The only weed that grew was the milkweed (*pualele*).

If the *Ulaula* and the *Palakea* were the taro stalks selected and at the time the taros were formed, you, the farmer, would be delighted with the result when they were pulled up. There would be no fine roots, only the plain corms.

In patches where the *ma'u* tree ferns were used as mulch, the method used was the same as for ti leaves only it required a little more work. The planting was the same.

The writer has forgotten something about dry land farms, that is in the *kihapai* patches. The long and wide *kihapai* were called *koele*. They were used because they were large. In the *ahupuaa* here in Kona, there is not a one that lacked a *koele*.

[1. Omitted in original article (evidently refers to *koele*).]

2. *Poepoe* gardens were so called by the ancients because they were round.

3. *Ili-loa* were patches that were long and narrow and hence were called *ili-loa* (long strip) by the ancients.

4. *Ka-aoao* was a kind of patch that was wider than long and so it was called *ka-aoao* (bulge-on-the-side).

5. *Kipohopoho* was the kind of patch that had lava beds on some sides and earth on the others. It was shut in on the upper and lower side and on one side and the other. All sorts of patches were used by the ancients from the hills to the beaches.

6. The *ke-a* resembled the *kipohopoho*.

[Other names for kinds of patches were]: 1, *ama'u*; 2, *eki*; 3, *pahee*; 4, *apaa*; 5, *alone*; 6, *palakei*; 7, *ko'olau*; 8, *lokoulu*; 9, *kula*; 10, *kupinai* which was close to the backs of the houses. These are all the farming places.

Menzies (49, pp. 75-76), gives a good picture of "dry" planting in Kona in the eighteenth century:

But the taro being naturally an aquatic plant, required in this dry soil a very different treatment. There were generally two or three of them planted together in a hole about nine inches below the surface of the ground. These holes were about four feet apart, and as the plants grow up, the earth is gathered round their stems in the form of a basin to retain the water, either from rain or otherwise, about their roots. The whole field is generally covered with a thick layer of hay, made from long, coarse grass or the tops of sugar cane, which continually preserves a certain degree of moisture in the soil that would otherwise be parched up by the scorching heat of the solar rays. In this way they rear up these roots to very great perfection even on a dry elevated situation.

These are the directions given by a planter on Hawaii for growing taro in very hard (lava) soil (58):

If the soil is too hard and it is practically impossible to soften it, the planter digs a hole about six inches deep and five wide and he works the bottom of the hole until it softens. Then he plants the taro top in the center of the hole and fills the hole with rubbish. The roots of the planted taro top work their way into the hard soil; and this is how the planter gains his livelihood from the tops planted in the hard soil and mulched by rubbish. The hole is not filled with soil for several months after the growth of the cutting. If the growing plant is a thrifty one the top of the corm and the rootlets appear above the hole. At this stage the ancients were accustomed to heap the soil around the plant, six to nine months after the planting of the tops. It is said that the size of the mature taro was the size of the hole in which it was planted. . . One important thing in taro cultivation is that the hole must be dug obliquely, the mouth opening toward the right to prevent the top from withering when planted[7]. In the olden days, weeding the patch after planting was done by hand by some people, and with a pearl shell (*iwi pa*), *opihi* [cowrie] shell or stone by others. There were not many bad weeds in those days and weeding was not a burdensome task. Now there are many bad weeds and it requires much work to remove them, therefore the hoe is the only thing to use around the border of the taro patch. . . The customary space between each plant is from 24 to 30 inches on every side.

[7] Evidently "toward the right" means the same as the recommendation (p. 53): "by pointing the *huli* to the north the sun is not so liable to injure them."

PLANTING ON UNFORESTED KULA LAND

On slopes covered with grass, like those of Hamakua on Maui and Hawaii and Kohala on Hawaii, the grass was formerly burned off and the ground cleared (*waele*) of brush and stubble. This was also done in Puna and elsewhere on land covered with staghorn fern. The field then had to be dug over (*ohiki*) and the stubble thrown out. The open soil was left for a few weeks, or until the small rubbish had decayed. On the windy slopes of Kohala the whole field was covered with cut grass to keep the moisture in. In planting, small holes were made in the soft earth several feet apart and a cutting dropped into each. The old procedure, termed *okupe*, was to thrust the digging stick into the soft earth with the right hand, lift the soil to one side, and drop the cutting into the hole with the left. The cuttings were left uncovered until the rootlets showed vigorous growth; then each cutting was straightened and soil pressed down around it. Kamakau (40) advised burning over the whole field again when the plants showed four or five leaves, weeds, taro leaves and all, after which he says the taro springs forth so luxuriantly "that a man could be hidden among the leaves."

CLEARINGS IN KUKUI FORESTS

In localities where planting was done along the edges and within the borders of old kukui forests, notably on the lower slopes of the Hamakua coast of Hawaii before the forests were cleared for sugar-cane plantations, taro was planted in clearings termed *pa kukui*. The trees were felled and allowed to decompose. The kukui rots very quickly when wet, and wood, bark and foliage make rich humus. Large holes were then dug in the soil and filled with kukui leaves, and when these were decomposed the taro was planted. The plants are said to have grown luxuriantly in such localities, to a height of 7 feet and with corms weighing 20 pounds.

PLANTING IN FERN FORESTS

Equally luxuriant is the growth in the fern-forest zone. This type of planting is still occasionally done on eastern Maui, and on eastern Hawaii. Clearings called *pa pulupulu* used to be made by prying over the tree ferns with the aid of *oo* leverage and by pushing and pulling. The planting in the holes left by uprooted tree ferns, and in between, was termed *ohiki*. A hasty procedure termed *umoki* consisted in thrusting the *oo* into the soft earth, moving it around to make a small hole, and then sticking in a cutting and pressing the earth around it. Holes for the taro might be made quite large and filled with leaves to decompose, after which the taro was planted and covered with soil. Weeding was not necessary in the forest zone, but the

upland morning-glory had to be watched, as it would twine itself about the petioles and deform or choke the taro. When the corm had grown to half size, earth was heaped around it as in lowland planting. Because of the richness of the soil and the plentiful moisture, the cuttings could be planted much closer together in these forest clearings than on the lower slopes. They used to be planted in pairs or triplets in the holes (25, vol. 6, p. 160). Taro so grown is called *akaka* and is said to have a flavor and odor like that of the tree fern.

PLANTING IN PANDANUS FORESTS

In the wet, lowland forests of Puna, taro used to be planted under the pandanus trees, which were felled and cleared to let in the sun after the taro had rooted and put forth the first growth of leaves. It is said that here the cutting was planted wrapped in a roll of dry pandanus leaf to keep it moist and give it nourishment in the stony ground of the lava-covered lowlands.

MODERN FARMING METHODS

MacCaughey and Emerson (46, vol. 11, pp. 44-51) give precise directions as to the proper planting of dry taro in modern commercial taro farming as formerly taught at the Hilo Boarding School. These directions may be condensed as follows:

> The field is ploughed, harrowed, limed, and manured with stable manure. After allowing a month for the sod to decompose, the ground is again gone over with the harrow, and furrows 40 to 48 inches apart are opened. The bottom of each furrow is then widened with a hoe and the tops of the ridges between furrows are flattened. The furrows are softened to a depth of from 3 to 6 inches with the hoe, and stable manure is sprinkled in the bottom and mixed with the soil. Then the cuttings are dropped in pairs in the furrows one foot apart and "dibbled in", burying the bottom of the cutting 2 or 3 inches deep. When the stalks of the *huli* point slightly northward, the sun is less likely to injure the plant after rains. Grass or banana leaves should be spread on the surface as mulch. One month after planting, the field should be hoed, and later it should be gone over with a cultivator, after which the soil is banked around each taro. After the plants begin to mature, the field should be left strictly alone.

Several experienced taro planters on Hawaii have told me that the use of stable manure as fertilizer for taro has been found unsuccessful, but I have made no careful inquiries into this matter. It will be noted that the modern procedure quoted above recommends cultivation throughout the period of growth, whereas Hawaiian planters disturb the soil as little as possible after the foliage is full and while the corms are filling out.

Maturing Time

As shown by comparing *Piko* and *Lehua* with *Ha-a-kea* (*Ha-o-kea*) in tables 4 and 5, dry taro takes a little longer to mature than wet, because it

grows somewhat more slowly even where there is plenty of rain, and the corms and the whole plant grow much larger and hence take longer to complete their cycle. Its slow maturing is due to the fact that dry taro is grown in cooler places, at altitudes up to 3,000 feet. In general, dry taro may be left longer in the ground after maturing. In some localities with poor soil and little rain, taro may take as long as 4 years to mature.

TABLE 5.—DRY TAROS AT ABOUT 1,000 FT. ELEVATION IN KAU AND OLAA, HAWAII[8]

VARIETY	MATURING TIME MONTHS	TIME LEFT IN GROUND MONTHS
Kuoho	8	4
Mana	12	6
Lauloa	12	6
Ohe	12	6
Wehiwa	8	4
Eleele	8	4
Lehua	9	4
Naioea	12	6
Ieie	12	
Ha-a-kea	12	
Ala-o-Puna	12	12
Palakea	12	3
Uaua piko	12	3
Mo-i	8	4
Elepaio	12	3
Manini	12	
Ulaula	12	
La'a loa	12	indefinitely

USES OF TARO

COOKING

Hawaiians, cooking in the old style, steam the taro corms in the cooking pit (imu or *imu lua*). In a hole in the ground about 18 inches deep is laid fuel that will burn long enough to heat the cooking stones (*pohaku imu*) to almost the temperature of red-hot charcoal. On the fuel are laid the cooking stones which are roundish stream or beach boulders of porous lava that will not explode or crumble under intense heat. These stones are called *eho*. When the fire is burned out, the unburned wood and embers are prodded out with a stick and the stones are leveled (*ho'ohane'e* or *ho'ohiolo*). Ti or banana leaves, *kukaepua'a* grass, *ilima ku kula,* or seaweed is laid on the hot stones, and on this are placed the unpeeled but washed corms as they come from the patch. (Other foods—sweet potatoes, yams, arrowroot, fish, pig, chicken, and so forth, wrapped in ti leaves with or without accompanying greens—may be laid in with the taro.) Over the food to be cooked are laid coarsely

[8] Information from Rebecca Puuheana Jansen, Olaa, Puna, Hawaii.

woven mats and banana and ti leaves to keep in the heat. Sometimes a little water is poured on the food before the covering (*ka poi*) is laid on, unless the leaf covering on the hot stones will make ample steam. According to Mr. A. F. Judd, the quantity and nature of the food to be cooked in relation to the temperature of the stones was carefully considered and water was sometimes poured in to temper an oven that was too hot. Depending on size of imu, variety of taro, and size of corms, the steaming may take from 2 to 6 hours. Wild taros, the corms of which contain much calcium oxalate crystal, must be steamed long to dissolve the little prickly spikes which are responsible for "itch" (*mane'o*) caused in the throat by coarse taros; mild taros like *Lauloa* need be cooked only a couple of hours. Nowadays most Hawaiians boil the corms in a kerosene tin and peel with a knife. Taro so cooked is apt to be soggy and lacks the rich flavor imparted by the leaves and stems.

The old method of peeling was with a large *opihi* shell, the back of which was filed off and was sharpened on a stone, or with a sharp stone or piece of shell. The steamed corm (*kalo mo'a*) will keep for some time. After peeling, it is termed *ai paa*. When eaten, the peeled, cooked taro is called *ai kupaa*. At this stage it used to be sliced and dried in the sun, and so prepared it served as provision for long voyages; this was called *a'o*. Raw taro, grated and steamed, is termed *pie piele*; grated taro cooked with coconut milk is *kulolo*.

When prepared for making poi, the steamed or boiled corms are first broken, then mashed with a stone pounder (*pohaku ku'i*) on a heavy board slightly hollowed out on top (*papa ku'i poi*). At intervals the taro is lubricated to prevent sticking by dipping the left hand in water and passing it under the mass of taro or over the lower face of the pounder.

In mashing taro one precaution has to be observed. Soft taros of different varieties may be combined, or hard taros of different varieties, but the two should not be pounded together, for their different consistencies make difficult the production of the even texture and smooth eating quality that is the test of good poi. Making poi is a science in itself, a description of each stage of which will find its proper place in the study of native food preparation.

The firm mass produced by pounding is termed *ai pa'i*. This, dried and wrapped tightly in ti-leaf packets like small bricks, is *pa'i ai*. For purposes of transportation, this stiff paste used to be wrapped in larger cylindrical packets (*holo ai*) covered with ti-leaf wrappings, sometimes protected by pandanus leaf (*lauhala*) over the ti-leaf wrapper. In early trade in inaccessible Waipio Valley, Hawaii, a score or more of large *holo ai* were lashed together to form a raft and towed to ships at sea (46, vol. 11, p. 116).

To made poi, the *pa'i ai* is mixed with water to the consistency desired, kneaded, and squeezed or strained (*kanana*) through a cloth to take out lumps.

(In the old days there was no way to strain the poi, for there was no cloth.) The term *mahumahu* refers to *pa'i ai* that has been exposed to the air, which dries it hard as a brick. From this state it is salvaged by steaming and repounding.

Thin poi is likely to ferment rapidly, hence it is kept thick, except when actually prepared for eating. *Ai pa'i* is stiff poi, *ai wali* is soft, and *ai hehee* is very soft. Poi when fermenting should be stirred to release the gas bubbles. Consistency is a matter of taste and convenience. The expressions "one finger poi", "two finger poi", and "three finger poi" are modernisms. To eat poi with three fingers was piggish. For a woman it was proper to eat with two fingers. Men ate with one or two as they pleased. Old Hawaiians were very particular about keeping their poi in covered containers of calabash or wood or, in later days, in clean flour sacks.

Poi made from grassland taro is said to be yellow in color; that from fern forest tastes of the fern; that from land where *kukaepua'a* grass grows is said to be "dark and bubbly" and of poor quality (25, vol. 6, p. 160), while the poi made from marsh-grown taro tastes of the swamp and ferments quickly.

Connoisseurs know the variety of taro by the appearance of the poi. *Lehua,* with deep pink corm, makes a deep pinkish poi, rich in texture and flavor. *Pi'i ali'i,* with lighter pink corm, also makes pink poi which is lighter in color and in consistency. Both of these were *poi ali'i,* reserved for overlords in old Hawaii. *Piko Kea,* the corm of which is white when raw, turns bluish in cooking and makes bluish, rather coarse poi. *Kuoho* makes whitish, thin-textured, and tasteless poi. *Ka-i* is tough in consistency but rich in taste. The "red poi" which is now prized and was formerly reserved for the alii comes from those varieties which have a reddish corm. Some say that the quality of poi, and the rapidity of its fermentation, is determined more by how it is made and who pounds it than by the variety of taro used. MacCaughey and Emerson (46, vol. 11, pp. 116-120) give further details about poi, including description of the modern poi mill, and the experiments in commercializing taro in the form of "Taroena" or taro flour.

The tender young leaves of any taros, or the whole leaf of certain varieties (*lu'au*), are eaten as greens; they are wrapped in a ti-leaf packet (*laulau*) with fish, chicken, or pork and steamed in the imu. The wild taros, the leaves of which are light colored because they have relatively little sunlight, are valued for their *lu'au.* Leaves of cultivated taros are valued as *lu'au* in accordance with the degree of calcium oxalate present; those that develop least of this are of course best for *lu'au* and require less time to cook. In picking *lu'au* for eating, planters break off only the upper half of the immature leaf, leaving the basal part to unfurl and grow. If the whole leaf is

plucked the plant suffers, they say. The reason for this is obvious: the next leaf is growing within the petiole sheath of the plucked leaf; if the whole leaf is plucked the petiole will wither around the new leaf and it may die.

The stalks of the petioles are also peeled and cooked as greens. These were once especially favored in the diet prescribed for a woman approaching the end of pregnancy.

Taro "flowers" are especially relished because of their delicacy. When Hawaiians speak of eating the *pua* (flower) they refer to the spadix only, for the florescent spathe with its hard base is removed and thrown away. The "flowers" are cooked like greens.

RITUAL

The main function of taro in ritual is based upon the theory of relationship between marine and land forms of life. Where a particular fish or animal is required in a rite, it is permissible to substitute a taro which, by reason of similar coloring, has the same name and is regarded as being an embodiment (*kinolau*) of the same god. Thus the red *Kumu* taro might be substituted for the red *kumu* fish as an offering to be placed beneath the main post of a new house; the dark *Wehiwa* or *Hiwa* taro might be substituted for the black pig as an offering. The striped *manini* fish and the striped taro of the same name were not acceptable as offerings, for the word *nini* (or *lili*) refers to anger of the god, hence the use of either fish or taro of this name would have had an effect contrary to that of propitiation, so I am told. Yet MacCaughey and Emerson report that *Manini kekau* was used for offerings, with a view to appeasing the anger (*nini*) of the gods (46, vol. 10, p. 349).

The ritual significance of other varieties of taro is not so obvious. The name *Ipu-o-Lono* (Gourd-of-Lono, symbolic of the bounty of the rain god) is given to quite distinct varieties of taro in different localities: on Maui it is a taro with reddish coloring; on Oahu one *Piko* is called by this name; and on Hawaii the wild *Lehua,* the *Maka'opio* and the *Piko* all seem to have been referred to by this name. Evidently all these varieties were suitable as offerings to Lono on occasion.

Emerson (48, p. 208) records a prayer in which *Mana* taro is referred to as an offering to Kane. One would expect "white" taros like *Ha-o-kea,* to serve as offerings to this god. MacCaughey and Emerson (46, vol. 11, p. 214) mention *Ha-o-kea* used as offerings by kahunas, and also the following other varieties: *Lauloa haeleele,* a taro named *Ka-hee-ko-kai* (the marine squid) used as a substitute for squid, *Pia,* and *Mahakeo.*

MEDICINE

Many therapeutic uses of taro are ritualistic, but genuinely therapeutic uses are determined by physicial attributes. We have innumerable references

to taros of different varieties in our collection of herbal prescriptions. A few typical uses are here mentioned by way of illustration. Raw grated or scraped taro, combined with other elements, is a common constituent in tonic prescriptions used for pulmonary complaints, including consumption. When the uncooked corm is used for this purpose, *Lauloa* or some other variety which will not irritate the throat (because relatively free of calcium oxalate) is called for. An interesting therapeutic use is the following, recorded by MacCaughey and Emerson (46, vol. 10, p. 315):

> One variety of taro called *Hoene* (literally, bamboo or gourd syringe used for administering enema) was so called because small, properly shaped pieces of the dark, hard corm were used as suppositories, being effective no doubt by reason of their sliminess (all taros are slimy when fresh cut) and their irritating quality. *Hoene* is said to have been cultivated extensively for this purpose; it was never eaten.

Raw taro was mixed with the ash of burnt coconut meat and smeared in a child's mouth in treating thrush. The rich red juice of the *Poni* taro, which has a beautiful purplish red petiole, was formerly used as pigment for dyeing tapa.

Planting Localities

Kauai (fig. 3)

With respect to the utilization of agricultural resources in general on Kauai, the following quotations are significant. Dole (17, p. 3) writes of irrigation on Kauai:

> . . . . great engineering enterprises were undertaken, such as the irrigation systems of Wahiawa, Kapaa, and Kilauea on the island of Kauai, . . . The antiquity of some of these is so great that even tradition fails to account for their origin, as in the case of the parallel irrigation ditches at Kilauea, the digging of which is attributed by the Hawaiians to the fabled *moo,* or dragon. . . .

In an archaeological report, Bennett (4, p. 21) says about terracing on Kauai:

> The impressive feature of the agricultural terracing is its tremendous extent. In the valleys in which little disturbance has gone on, particularly the Napali section, the maximum of tillable soil was utilized. Even a 10 foot square of soil among a great mass of lava rock will be cultivated. On the sides of the valleys the terraces run almost to the base of the great cliffs, where the nature of the talus slopes is not too rocky. Though all these terraces were not irrigated, a great proportion of them were, and the ingenuity of the engineering is remarkable.

Napali Coast

Haena. Extensive areas of small terraces (*lo'i*), now abandoned and used only for pasture, fill the lower part of Limahuli Valley. The sloping and flat lands east and west of Limahuli Stream between the sand dunes and the mountain sides were developed in terraces, irrigated by ditches from Lima-

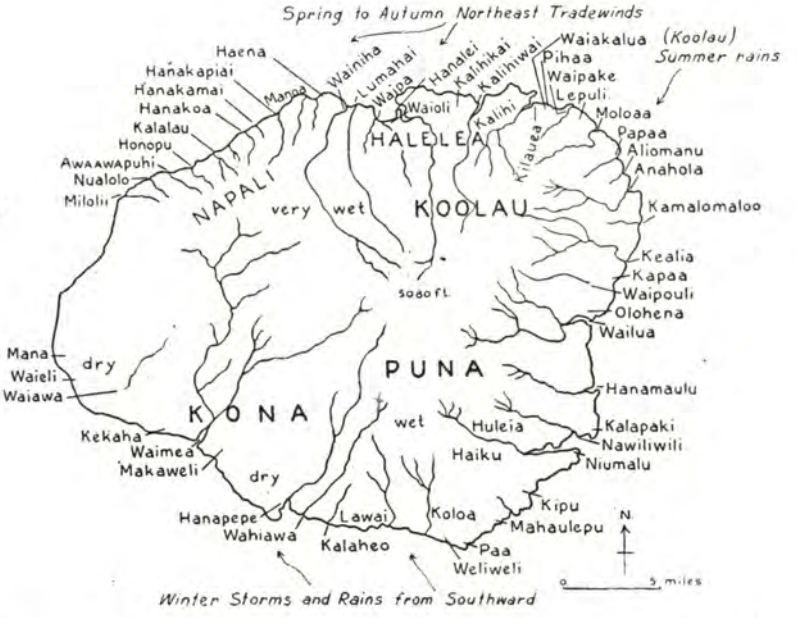

FIGURE 3.—Map of Kauai, showing districts, planting localities, wind directions, and climate.

TARO. **Terraces:** high terracing in Napali valleys and in great stream valleys such as Wainiha, Hanalei, Hanapepe, and Waimea; low terracing and leveling and irrigation of flats in valley bottoms and deltas throughout. **Kula lands:** developed only where water could be diverted for irrigation; little if any dry taro planted. **Stream planting:** along small streams. **Forest planting:** little if any. **Swamp planting:** in Mana; lowland swamps watered by springs uncommon.

SWEET POTATO. Coastal throughout; on high land in valleys and on inhabited valley rims from Wahiawa to Waimea; the staple on kula lands and plains from Mahaulepu to Mana.

YAM. Found only in Wainiha, but described elsewhere.

BANANA. Wet valley slopes, lowlands, and coasts where not too windy; apparently little upland forest planting.

SUGAR CANE. In almost all taro and banana plantations.

BREADFRUIT. Mainly in valley bottoms and on protected slopes of gulches on eastern coast where there is warmth, abundant moisture, and protection from wind; far into interior of Wailua.

COCONUT. Near sea level throughout; on coastal flats of Kealia and Wailua; in valley bottoms in Hanamaulu, Nawiliwili, and Huleia, and on plains and along the coast from Waimea to Mana; rare in Napali.

WAUKE. Inner valley slopes, especially Koolau, Puna, Kona.

OLONA. Wet median forests from 1,000-2,000 feet elevation; Koolau and Puna.

AWA. Wet valleys and slopes northwest to northeast; interior valleys southeast to southwest.

GOURDS. At sea level in south and southwest.

ARROWROOT. On banks of wet taro patches and in lower forests.

huli Stream. About a dozen of these terraces are now under cultivation in taro. The rest are used as pasture or abandoned under brush and grass. The swampy area commencing a few hundred yards east of the stream used to be planted.

There were many small terraces in lower Manoa Valley and on the flatland immediately adjacent to the hills. All this land is now unused.

Hanakapiai. The terraces begin a few hundred yards inland on the southwest side of Hanakapiai Stream and by means of small terraces, some elevated as much as 8 feet with stone facings, utilize all irrigable land for a distance of more than a mile inland. On the northeast side of the stream, low, relatively level areas were similarly utilized. Presumably there are more terraces of the same sort in the interior of the valley up to the falls, but this was not explored beyond a point about a mile inland where the valley becomes narrow and precipitous. Wild taros grow in the gulches and on several of the abandoned terraces. In one place a kukui tree with a trunk at least three feet in diameter is growing on an old terrace, indicating that it has been abandoned for a very long time. The valley is now used only for pasturing cattle.

Hanakoa. This valley has a good deal of gently sloping land extending for more than a half mile inland on either side of the stream. Bennett (4, site 158) indicates house sites and terraces.

Kalalau. This valley was one of the most intensively cultivated in the Hawaiian islands. One of its striking features is the sloping sea wall built of heavy stones, running along the edge of the broad shore and protecting extensive flat terraces on the level land facing the sea. From this flatland the terraces continue up the slopes behind and up the talus slopes. At the top are the remains of an old irrigation ditch which once carried water from a small side valley to terraces farther along the west side of the main valley. Terraces run down the west slope of the knoll at the foot of the valley. On the west side of the valley the terraces on the flat (presumably filled) land behind the sea wall are very large, the farthermost measuring 225 feet along the front by 150 feet deep (4, site 167). The terraces above Kalalau Stream on the west side are remarkable for their heavy dirt walls without stone facing. A ditch lined with large stones runs for 600 yards or more along the bank of the stream, and below this ditch run two others which used to carry water, the lowest for a distance of more than 900 yards (4, site 172). On the east side of the valley, above the stream where the topography is precipitous, rocky, and broken, Bennett (4, site 173) notes that "the irrigating ingenuity is astounding." Every 10-foot square of suitable land is utilized. One small depression contains two terraces.

Ascending the stream, the terraces continue on the sloping land on both sides. Where the stream divides, "on the land between the two branches. . . . the taro terraces are everywhere" (4, sites 175-176). House sites and terraces are found farther up this central ridge. Along both the west branch and the east branch of the stream there are terraces wherever possible and house sites on the ridge. One terrace on the west branch has a wall 50 feet long and 6 feet high (4, site 180). Wild taros were found in abundance when I visited the valley in 1931, but the terraces are no longer cultivated. Kalalau is today used for ranching only.

Honopu. The valley is said to contain extensive terracing. Of this area Bennett (4, site 182) remarks that "the extent of the irrigating is a tribute to Hawaiian engineering."

Awaawapuhi. Terraces fill the cultivable lower valley, until the valley becomes too narrow (4, site 184). On the west side of Awaawapuhi Stream the terraces, measuring 3 to 5 feet high and 8 feet broad, extend as high up as the steep slopes would permit of irrigation. Above the agricultural terraces are the house sites (4, site 186). Along the west side of the stream the irrigation ditch was built up as much as 15 feet in places, leading to a series of seven terraces along the bluff (4, site 187).

Kona

Nualolo (ancient name Nuololo). The west side of this isolated valley is described by Bennett (4, site 192) as being "one mass of taro terraces." There is a large kukui grove in which are numerous house sites and terraces (4, site 193). Toward the shore there is extensive terracing, with house sites on the slopes above. "The terraces run to the edge of the sea bluff" (4, site 194).

Milolii. Here, Bennett says, "terracing with some 8 foot facings is said to be fairly extensive" (4, site 201).

Mana and Waieli. The fresh-water marshes of Mana and Waieli (which no longer exist since the Kekaha Sugar Company drained the swamps), famous for their mirages were presumably planted in wet taro. Within the memory of living residents wet taro has been grown at the northern end of the Mana swamp, near the Barking Sands.

Waiawa. A mile or more inland from the road no evidences of old terraces were seen in this rocky and dry valley. Apparently the flow in the fairly large stream bed was not constant. Probably there were some small terraces farther up, in Hoea and Kahoana Valleys. Bennett reports terrace lines associated with house sites in lower Waiawa, where, on the western side, the low ground is somewhat swampy (4, site 15).

Kekaha. There were marshy or springy localities on Kekaha plain where wet taro was grown. The site where the wife of Kalalau, the leper, raised taro for her fugitive husband is just beyond Kekaha town, marked by a group of mango trees south of the highway. Of Kehaka, which he calls "A Tappa", Dixon (1789) writes (15, p. 125):

> A Tappa is a pretty large village, situated behind a long row of cocoa-nut trees, which afford the inhabitants a most excellent shelter from the scorching heat of the noon-day sun. Amongst these cocoa-nut trees is a good deal of wet swampy ground, which is well laid out in plantations of taro and sugar cane.

Waimea. In upper Waimea Valley the terraces are now abandoned, except for a group below the pumping station used for growing taro to feed the men who work at the station. Downstream, between the station and the end of the macadam road, most of the terrace areas are unused, but a few near the end of the macadam road are used by Japanese farmers for growing truck and dry taro. The canefields of the Waimea Sugar Company extend for a considerable distance beyond the end of the macadam road upon old terrace ground. West of the stream at the very end of the macadam road, two small terraces are now cultivated, and not far below, a narrow strip of terrace on the west side is planted in taro. About one mile below this, on the west side of the stream, are a few large terraces intensively cultivated by the Japanese owner of a poi mill. All the rest of the old taro land is planted in sugar, rice, bananas, and truck, while in the lower part of the valley, near Waimea town, dwellings and gardens occupy old taro ground. The business part of Waimea is all on old terrace ground west of the stream.

In lower Waimea, on the east side of the stream up to the junction of the Waimea and Makaweli Rivers, the old terrace lands are planted mostly in rice and cane, with some truck and Chinese bananas. Where the Waimea and Makaweli Rivers join there are extensive flatlands below the cliffs and above the junction of the streams; here most of the old terraces are still intensively cultivated in wet taro, thanks to the enterprise of Oriental poi millers.

Bennett (4, site 38) describes an irrigation ditch on the north side of the Koaie River, which is well over 8 miles in the interior. This ditch runs for about 400 feet around a cliff and is elevated from 3 to 20 feet above the stream bed, constructed with undressed but carefully fitted stones, the channel lined with overlapping flat stones. This indicates the development of irrigated cultivation far up into Waimea Canyon. Presumably, tillable land on the valley floor was used as far up as was practicable.

Cook (1784) was the first of several early observers of Waimea to describe the careful cultivation of this valley (12, vol. 2, pp. 225, 244):

[The] moist ground, produces taro, of a much greater size than we had ever seen [in southern Polynesia]; and the higher ground furnishes sweet potatoes, that often weigh ten, and sometimes twelve and fourteen pounds, very few being under two or three.

What we saw of their agriculture, furnished sufficient proofs that they are not novices in that art. The vale ground has already been mentioned as one continuous plantation of taro, and a few other things, which have all the appearance of being well attended to. The potato fields, and spots of sugar cane, or plantains, on higher ground, are planted with the same regularity; and always with some determinate figure; generally as a square or oblong; but neither these, nor the others, are enclosed in any kind of fence.

Vancouver (1792) describes the valley cultivation in detail, as follows (71, vol. 1, pp. 374-77):

I proceeded along the river-side and found the low country which stretches from the foot of the mountains toward the sea, occupied principally with the taro plant, cultivated in much the same manner as at Woahoo; interspersed with some sugar-canes of luxuriant growth, and some sweet potatoes. The latter are planted on dry ground, the former on the borders and partitions of the taro grounds, which here, as well as at Woahoo, would be infinitely more commodious were they a little broader. Being at present scarcely of sufficient width to walk upon. This inconvenience may possibly arise from a principle of economy, and the scarcity of naturally good land. The sides of the hills extending from these plantations to the commencement of the forest, a space comprehending at least one half of the island, appeared to produce nothing but a coarse spiry grass from an argillaceous soil, which had the appearance of having undergone the action of fire. . . .

Most of the cultivated lands being considerably above the level of the river, made it very difficult to account for their being so uniformly well watered. The sides of the hills afforded no running streams; and admitting there had been a collection of water on their tops, they were all so extremely perforated, that there was little chance of water finding any passage to the taro plantations. . . . A lofty perpendicular cliff now presented itself, which, by rising immediately from the river, would effectually have stopped our further progress into the country, had it not been for an exceedingly well constructed wall of stones and clay about twenty-four feet high, raised from the bottom by the side of the cliff, which not only served as a pass into the country, but also as an aqueduct, to convey the water brought thither by great labour from a considerable distance; the place where the river descends from the mountains affording the planters an abundant stream, for the purpose to which it is so advantageously applied. This wall, which did no less credit to the mind of the projector than to the skill of the builder, terminated the extent of our walk; from whence we returned through the plantations, whose highly improved state impressed us with a very favorable opinion of the industry and ingenuity of the inhabitants.

Portlock (63, pp. 191-192) and Menzies (49, pp. 28-31) also furnish descriptions of lower Waimea.

The famous Peekauai (Menehune) ditch, described by several early voyagers and studied by Bennett, was constructed to carry water to terraces on the west side of lower Waimea Valley. Bennett's description is quoted on page 36.

Makaweli. At the end of the road up the east side of the Makaweli River about 2 miles from the highway, there are terraces completely cultivated extending for about a quarter of a mile along the east bank. Crossing the stream and ascending on the west side, a terrace area, still intensively

cultivated in taro, extends for about a third of a mile along the stream bank. Above this point and as far as the junction of the Olokele and Mokuone Streams, all the flatlands on both the east and west sides of the river are covered with abandoned terraces. Bennett speaks of terraces in Olokele Canyon, which branches off from Makaweli Valley at the juncture of their streams. The topographic map (U. S. G. S., 1912) shows a house and adjoining flatland about 1.5 miles above the juncture of the Olokele and Kahana Streams. About 3 miles up Kahana Stream, at a point at least 8 miles inland, the map shows two houses in a flat area. Presumably, these flat home sites with water accessible meant the presence of terraces.

Hanapepe. Next to Waimea, Hanapepe Valley must in ancient times have supported the largest population in the Kona section of Kauai. Flatlands along the large streams offer ideal locations for wet taro for 6 miles or more inland. A map of the valley, available in the land office in Honolulu, shows some 20 named localities along the stream below the junction of Manuahi Valley with Hanapepe Valley. These were evidently all taro sites. Above this point I am told, there were a number of taro plantations in both valleys. Bennett, who explored Hanapepe for some distance inland, reports that "the taro terraces are everywhere that the land is irrigable" (4, site 60). In the interior, where the slopes are steep, stone supporting walls were used, but in the flatlands the terraces are broad and flat and separated by earth partitions as in lower Waimea. The flatlands of the lower valley are now largely given over to sugar, with some rice, while half a dozen small taro patches still hold their own. In the upper valley I have observed one small group of terraces still in use (pl. 3, *B*) and am told that there are others farther up.

Wahiawa. Above and below the highway in Wahiawa Valley there are house sites, and below the bridge there are abandoned terraces now used as ranch land. The water which used to flow in Wahiawa Stream is now taken by the Eleele Ditch. According to Keahi Luahine, the terraces extended all the way down the valley to the *muliwai* (inlet). A short distance above the highway bridge was a spring named Kaulupaniau, which watered a small group of terraces. Inland from this was Kawaikapulalo and here were terraces and *wauke* (paper mulberry) plantations. Above this was *kula* land named Kawaikapuluna, on which were the houses and sweet potato plantations. Continuing upstream to a point opposite Puu Aukai there were other terraces in the stream bed, with houses and sweet potato plantations on *kula* land above. *Palaha* was the variety of taro that grew best in Wahiawa. It had a dark stalk, and dark flesh which was round and pointed at the bottom, making purplish poi. According to Bennett (4, site 61), "the remains of terraces"

were observed to be "remarkable in places for their number on a small area of land."

Mrs. Pukui adds this interesting note, based on information given by Keahi Luahine:

> At Wahiawa on Kauai was a stone called Kauai-iki which stood in a taro patch also called Kauai-iki. The taro that grew there was the finest and the largest on the island, said to be made so by the stone. When the paved road was built, Alexander McBride removed the Kauai-iki stone so that it should not be blasted and ground up by the road workers. He took it to Maialoa and later to Kukui-o-Lono Park where it is to this day.
>
> In ancient times people used to say that even though you had seen the entire island of Kauai and had not seen Kauai-iki, then you had not seen all of Kauai. This small taro patch and stone were much visited in the olden days.

Lawai. On the flats just above the sea there are a few terraces still cultivated in taro. For a mile or more inland from here the flats which were formerly terraces and the sides of the valley are planted in sugar cane. Beyond this, the old terraces in the narrow part of the valley are abandoned or used for pasture. The map (U. S. G. S., 1912) shows flat land in the valley of Lawai Stream for some 3.5 miles inland. Below the pineapple cannery on the old highway the level land was presumably planted in wet taro, although the old terrace levels are no longer clear. Above the old highway bridge a small terrace area is discernible, now under pasture. Beyond this point, for more than a mile upstream, there are many patches of relatively level lowland that could easily have been irrigated from the stream; but apparently upper Lawai Valley was never in terraces, for no evidence of old terracing is discernible today. No terraces were observed in the valley of the small stream which enters Lawai Stream from the northwest below the old highway bridge, with the exception of a small patch just below the bridge.

Koloa. The stream of Koloa at its seaward end was named Waikomo (hidden waters) indicating that it was probably once an underground stream. It is now dry. Upper Koloa has three streams, Poeleele, Omau, and Waihohonu, all of which presumably watered terraces, as they are sizable streams flowing through relatively level tracts of land. So far as Judge Blake knows, however, there were no terraces along these upper streams. The terrace areas of Koloa were as follows: Maenui, and Kahukini, watered from Wailana Stream; Niihau (upper Waikomo, near the Catholic church) and Keaku watered from Maulele Stream. Now these areas are not used for taro, because the water is taken by the sugar plantation. There were extensive terraces on the land now under sugar cane west of the highway and in the neighborhood of Kuhio Park, to seaward of the valley.

Weliweli. This area seems to be dry throughout, though there may have been some taro in the gulches at the upper end. Just east of Weliweli, near Koloa village, Bennett found "a walled enclosure with three terraces and an unmistakable ditch line at the back, which would indicate that the whole was used for taro." This plantation covered an area of 75 by 90 feet (4, site 78).

Paa. Some taro may have been grown formerly in the gulches at the upper end of Paa, but the rest of the land was probably always as dry as it is now. Keahi Luahine thinks there was no taro except that growing wild in the gulches where breadfruit, yams, and bananas were also planted.

Mahaulepu. This is a broad, rich valley with relatively level bottom. It must have had some area in terraces at its upper end, although no terrace lines can be seen today under the plowing for sugar cane. There is no evidence of a stream of any size. According to Keahi Luahine the only terraces were below Puu Keke, where taro was planted in semi-brackish spring water. The cuttings were planted on mounds (*pu'epu'e*) and the roots were light and watery like yams.

Puna

Kipu. This *ahupua'a* was watered at its southwestern end by several small streams which join to form Puakukui, whose shallow valley opens into Huleia. Two miles east of this section there are several small streams flowing out of a marshy area. In both these sections there were undoubtedly terraces. I was told that there is one Hawaiian still planting somewhere in this region but I could not find him. The entire district is now under sugar cane so that no traces of old terraces are to be found. Kipu Kai is a small pocket of coastal land in the southeast corner of Kipu, with one small stream which perhaps once watered a few terraces.

Haiku. This *ahupua'a* contains the broad delta plain of the Huleia River, 1.5 miles long and about a half mile wide at its widest point. This area was all in terraces. One large section is now in rice, and four small terraces belonging to four Hawaiian taro planters are in wet taro. The rest of the old terraces grow flourishing crops of bulrushes or grass. A few are used for pasture. There were formerly small terraces up Papakolea Stream and possibly a few very small ones in shallow Puhi and Hoinakaualehua. Far up Hoinakaualehua Stream, above the point where the highway crosses it, there are old mango trees on small flats, suggesting *kuleana* (farming sites) now abandoned. Small terrace areas existed along the course of the Huleia for at least 2.5 miles above the delta area. This part of the valley is mostly filled with wild plum trees. Where the highway crosses the Huleia River

at Halfway Bridge, there are groups of old terraces, old breadfruit, and mango trees, indicating that here was a group of *kuleana* something over 6 miles inland from the mouth of the river. The Halenahu is a small stream flowing into the Huleia below this point, but too narrow to have contained terraces.

Niumalu. Niumalu is a tiny *ahupua'a,* a mere wedge between Nawiliwili and Haiku, but it was, and is, one of the most important fishing localities on Kauai, and contained a fairly large area of terraces along the lower mile of Puali Stream. There were a few terraces at the lower end of Halehaka Stream where it joins the Puali about 1.5 miles inland.

Nawiliwili. For 3 miles inland from the sea the Nawiliwili River twists (*wiliwili*) through a flat valley bottom which was formerly all in terraces. Inland, just above the bay, three Hawaiian taro planters cultivate wet taro in a few small terraces. Most of the land is in pasture. There are one small cotton plantation and several small garden plots. For about a half mile below and a half mile above the mill the valley is mostly filled with plantation camp and other structures, with many small clumps of bananas, some garden plots, and a few old breadfruit trees. The old terrace area extended half a mile up into the small valley that opens out northwest just above the mill. Approximately the last mile of flat valley bottom, before the river bed becomes a narrow gulch, used to be in terraces but is now pasture and ranch land.

Hanamaulu. Hanamaulu River, rising below Kilohana Crater, winds its zigzag way to the sea through a relatively broad gulch, which had many small terraces commencing at a point about 2.5 miles up from the sea and continuing down to the delta of the river which begins about a mile inland. The small terraces inland from the highway are unused. The delta region is a continuous area of flatland now mostly under sugar cane and house sites. Formerly this must all have been planted in taro. The small valley (Kapaia?), opening out northwest from Hanamaulu about 2 miles inland, has a number of small terrace areas.

Wailua. Along the lower 2 miles of Wailua River, above the sandy coastal plain, are many broad, open, level areas, formerly in terraces, now mostly in sugar. Opaekaa Stream, which flows into tidewater Wailua River, watered many terraces both above and below the falls. The large area of terraces below the falls is now planted mostly in rice, a few of the upper terraces being used for sweet potatoes, while the uppermost are pasture. There are terraces in the canyon of the north fork of the Wailua River; presumably there are terraces also in the flatlands along Kawi, Keahua, and Iole Streams, which form the headwaters of this fork of the river. There were sizable terrace

areas on both sides of the south fork of the river above the junction with the north fork. Extensive areas of terraces fill the valley immediately above Wailua Falls and along the river for 3 miles above Waikoko. Iliiliula, Waiaka, Waiahi, Kaulu, Palikea, and Halii Streams, which form the headwaters of the south fork of the Wailua River, undoubtedly all had small terraces along their lower courses. The flatland between the sea and Kalepa Ridge shows no traces of terraces, though it is probable that the swampy areas watered by springs were once used for wet taro.

Waipouli. Waipouli is watered by Konohiki Stream, in the bed of which are sizable flats where wet taro undoubtedly used to be planted. The level, swampy land of this *ahupua'a,* south of Kapaa by the sea, shows evidences of old terraces.

Kapaa. Bennett says (4, site 110): "In the foothills of the mountains [back of the homesteads] are many little valleys which contain taro terraces." There are extensive terrace areas on the flatlands below the mountains, watered by Kapahi, Makaleha, and Moalepi Streams, where the upper Kapaa homesteads are located. Kapaa River is formed by the union of these three streams. For 4 miles or more along the course of this river the pockets of flatland along the river bottom were built into terraces. A little way up Kaehulua, there were small terrace areas which are now either in cane or under grass. The flatlands of Waianuenue and coastal Kapaa, which are now mostly planted in sugar cane, were presumably terraces anciently, except perhaps the marshy sections.

Kealia. Homaikawaa and Kumukumu are shallow gulches in *kula* land like Kamalomaloo. There were probably small terraces in these gulches, although no terraces are evident today. The 1881 Index of Land Claims (31, p. 215) indicates one *kuleana* grant in each gulch.

Mimino was a sizable stream emptying into Kealia, before its waters were taken for the power house and irrigation purposes. There were a few small *kuleana* with terraces up its valley.

In its upper part Kealia Stream runs through a course too narrow for terraces. Below Kaohe, however, as far as its junction with Kapaa Stream, there is a mile of sizable flats along the meandering watercourse which must have been utilized as terraces. This ground is now all under sugar cane. There are old mango trees here and there indicating *kuleana.* Below the junction of Kapaa and Kealia Streams the flatland on either side of the river was formerly all in terraces. A small section below the junction is now in sugar cane. Between this and the broad flats above Kealia Bay old terrace land is now under pasture or planted with bananas, corn, and other crops. The broad flatland above bay and town is now in sugar cane; formerly it must have been

in terraces throughout. There were a number of *kuleana* grants here, the location of some of which are still indicated by clumps of old coconut and mango trees. Halaula is a small stream emptying into these flats from the northwest. In upper Kealia the topography indicates that there were probably small terraces in Waipahi, Maiakii, and Waiawaawa, which are at the headwaters of the Kealia River.

South of Kealia and somewhat inland is an irrigation ditch described by Bennett (4, site 111) as follows:

> A large, simple dirt ditch about 6 feet in width and of varying depths, which is traditionally referred to as a Hawaiian ditch. The interesting part is a deep cut about 100 feet long made through a low ridge alongside of which the ditch ran. The lands to be irrigated were on the other side of this ridge and so the cut was made to a depth of 10 or 15 feet through loose rock and subsoil.

Bennett also remarks that in the inland part of the valley are old terraces and that on the level land at the seaward end of the valley (4, site 117) wet taro is still planted.

Kamalomaloo. The *ahupua'a* takes its name from a small stream which meanders seaward through a shallow gulch in *kula* land. Its name, "dry (*maloo*) Kamalo", indicates that it was generally dry, as it is now. The stream, however, had constant flow and probably there were small terraces in the flats up the gulch.

Koolau

Anahola. Anahola is the largest river of Koolau. It is said that there are old terraces on flats along its banks far into the interior, as at Waimea. These are found here and there along its course from 2 to 4 miles inland, as they are along Kaupaku Stream, which empties into the river from the southwest 2.25 miles from the sea. Kaalua Stream enters Anahola from the southwest, 1.5 miles from the sea, but its bed is too narrow for terraces. Below Kaalua Stream, on sizable flats on either side of the river where it meanders through its wide gulch, are old, unused terraces. The delta of Anahola is a rich flatland three quarters of a mile wide. On the inland portion are now four small areas in rice and about 20 sizable terraces in taro; other old terraces are now used mostly as pasture, though several are watermelon patches.

Aliomanu. This small *ahupua'a* is watered by Aliomanu Stream and has a few small terraces which are now unused.

Papaa. This *ahupua'a* was named after Papaa Stream, a sizable, meandering watercourse through *kula* land, fed by a number of small streamlets arising on the northern slopes below Puuehu. Within a district extending several

miles inland along the stream there are old, small terraces. Papaa had an upland section separated from its seaward portion by the upper end of Moloaa (like an *ili lele*—a detached plot of a small land division). Within this forest line on one of the northern branches of Papaa Stream, Bennett observed terraces grouped around a heiau (4, site 122). One ditch seems to have come from a small stone reservoir measuring 25 by 15 feet.

Moloaa. Moloaa Stream watered a considerable area of small terraces along its 3-mile course. The half mile of flatlands along the stream inland from the bay is now planted in rice. Near the seashore the soil is composed of sand mixed with humus and is especially suited to sweet potatoes. Several terraces under cultivation in taro were observed below the highway about a mile upstream from the little bay (pl. 6, *B*). The rest of the old *kuleana* are abandoned to scrub and wild plum. A few breadfruit grow in an abandoned *kuleana* near the highway. The whole upper valley, which used to be famous for its taro, appears to be very dry now.

Lepeuli. This was a narrow *ahupuaʻa* with several small streams arising from springs. The larger of these streams watered a number of small terrace plantations near the sea which are now planted in rice.

Waipake. The stream from which the *ahupuaʻa* takes its name is quite sizable; it had numerous terraces along the lower mile and a half of its course. A compact group of terraces just below the highway bridge is now a rice plantation. Below and above the bridge are other *kuleana* now unused, on one of which are a number of old breadfruit trees.

Pihaa. This *ahupuaʻa,* famous for its great kukui forest, was watered by Pihaa Stream, which had several small terraces along its lower course. There were other small streams east of the main stream, arising from springs and watering a few small terraces.

Waiakalua. Waiakalua-iki (west Waiakalua on the U. S. G. S. topographic map, 1912) is a very small *ahupuaʻa* watered by Puuoa Stream. Waiakalua-nui (east Waiakalua) is another small but distinct *ahupuaʻa* watered by the Waiakalua streams, which arise half a mile inland from springs and which used to irrigate small terraces near the sea. These terraces now serve only as pasture. Bennett observed that in both the east and west valleys of Waiakalua the old terraces were well preserved and taro still grew along the edges of the streams; near the beach the terraces were no longer used (4, site 130).

Kahili. Kahili *ahupuaʻa,* named after the mountain marking its southwest boundary, has three small streams at its seaward end, emptying into Kilauea River, which forms the boundary line between Kilauea and Kahili below the

lower falls of the river. Punananoa Stream flows into Kilauea River a third of a mile below the falls. A group of terraces, named Kupai, along Punananoa Stream was formerly planted in taro but is now neglected. A quarter of a mile below Punananoa, Kanoa Stream flows into Kilauea River, and a quarter of a mile below this is Kaluakala. The two last-named streams are said to have had no terraces in their upper courses, but they watered terraces along the Kilauea River. It is because of this, presumably, that the terraces on the south side of Kilauea River belong to Kahili *ahupua'a.*

Kilauea. The terraces on the north side of the lower Kilauea River were in Kilauea *ahupua'a.* These flats are now planted in rice, with only a little taro. A mile upstream was another small area of terraces, now planted in rice. Beyond this point there were no terraces for, although the stream was large, it flowed in a narrow gulch and the *kula* lands on either side apparently were too high for Hawaiian methods of irrigation. There were no terraces in Puukaele Stream. Through the large swampy area about 3.5 miles inland in Kalihiwai and Kilauea, flowed Pohakuhonu Stream and Halaulani and Kahiliholo Streams which form the headwaters of Kilauea River; this area and the streams themselves were never utilized in any way in planting, according to old Mr. Huddy.

Halelea

Kalihiwai. Kalihiwai has an extensive terrace area on the flatlands through which Kalihiwai River meanders to the bay. This whole area is now planted in rice. Where the valley becomes narrower, a mile inland, there were small terraces. Two miles inland, and again 2.75 miles inland, in sharp bends of the river, there are small flatlands where wet taro was formerly grown. Just east of Kalihiwai Bay, Puukumu Stream flows in a shallow valley. A quarter of a mile below the road there is a small area of old terraces.

Kalihikai. The small valley of upper Anini Stream is now pasture land but still has scattered pandanus growing in it. It is so broken and narrow that it is doubtful whether taro was ever raised in it, although it had a constant flow of water. From the highway one sees no evidence of terraces along the small streamlets draining the rolling uplands of Kalihikai. The flat coastal strip was almost entirely developed in terraces along the base of the low hills and up into the little valleys, these terraces being watered by four small streams descending from the *kula* land above through small gulches on the seaward slope. Rice is now raised on several sizable terrace areas, but most of them are used for pasture.

Hanalei. The swampy land below the hills at the west end of Hanalei next to Waioli is unused. The land between the highway and the bay on the west side of the river, much of which used to be terraces, is now given over to pasture and home sites. The land named Paele in the great bend of the river east of the bay, which used to be in rice or taro, is now used for pasture. The broad area inland from the river, named Kahanawai, is now planted with rice, except for the flats adjoining the base of the hill. According to Sheriff Lota, this area was only partly developed in terraces in ancient times. In the 1880's, the land just above the highway was planted in sugar cane, which gradually extended far up Hanalei Valley. Subsequently much of this land, which had not previously been in terraces, was cut up by the Chinese into paddy fields. It was only in the flats of Hanalei Valley proper that terraces were continuous in the old days. At present, rice paddies are continuous for 1.3 miles from the highway bridge where the Hanalei River turns east; another sizable rice patch lies four tenths of a mile beyond, the land between being neglected. Beyond this farthest rice plantation the Hawaiian homesteads commence. A few Hawaiians and other homesteaders plant a little taro for home consumption. It is said that there are numerous areas of abandoned small terraces farther in the interior. In lower eastern Hanalei, Mr. Sanborn is successfully growing taro in flats that have been used for rice for over 30 years.

Far up in Hanalei Valley, Bennett observed taro terraces watered by a ditch half a mile long leading water from upstream. He says (4, site 143): "The water comes through a big rock which is conveniently cracked. The legend runs that Pele sent lightning to split the rock so that the people could get the water down to the fields."

Waioli. Mauka of the highway and of the Mission and school grounds, Waioli is planted in rice up to the base of the hills. Smaller terraces up the valley are now unused.

Waipa. Waipa Stream irrigates a sizable flatland on the southwest side of Hanalei Bay. Almost all this land is planted in rice. One and a half miles upstream from shore is an area of flatland where three small streams join to form Waipa Stream. Presumably there were terraces here.

Lumahai. Lumahai River must have had many small terrace areas along its upper course. From a point 1.5 miles inland the river meanders to the sea through a delta area from a quarter to a third of a mile wide (considerably broader than lower Wainiha) which must have been almost covered with terraces. Now the upper part of this broad valley bottom is covered with hau and guava jungle, with old mango trees marking former home sites. For approximately three quarters of a mile inland from the bay, rice

is now grown west of the stream on the broad terrace lands a quarter to a third of a mile wide. East of the stream the broad flats at the lower end of the valley are planted in elephant grass and used as ranch lands.

Wainiha. In upper Wainiha, I am told, there are terraces wherever there is suitable ground along the stream. About one quarter of the larger terraces in the flatlands of lower Wainiha are now in use. Just below the power house, which is about 1.5 miles inland, some dozen large terraces are under taro cultivation. Half a mile below this, in the large area of flatland between the two branches of the stream, there are several sizable plantations intensively cultivated in taro. Just above the highway on the northwest side of the stream there are about 40 old terraces planted in rice and about a dozen small terraces in taro. On the southeast side of the stream close to the highway a number of terraces are being plowed. A quarter of a mile inland near the poi mill, a large section of terraces southeast of the stream is filled with taro. Bennett saw old terraces about a mile above the Wainiha power house on the intake trail; he says: "This interesting taro section is high on the side of the valley, utilizing a little stream and a small flat area" (4, site 152). He also mentions many house sites and terraces in the upper valley (4, site 153).

Lydgate (43, pp. 125-127) gives an interesting account of the population of the valley in early times:

> At a time as late as the reign of Kaumualii, the local konohiki making a careful census of the valley by villages from the sea mauka returned upward of 2,000 souls. Enumerating in detail all the communities, he gave the exact quota from each—Naue, Pa-ie-ie, Maunaloa, Pali-eleele, Maunahina, Pohakuloa, Opaikea, Homai-ka-lani and ending with Laau, the hamlet farthest mauka in the depths of the mountains, where the valley contracts to a narrow gorge, with a brawling stream running white in the bottom. . . . . All along up the river, wherever the encroaching palis on either side leave the least available space, the land has been terraced and walled up to make "lois." And so the whole valley is a slowly ascending stairway of steps, broad in the tread and low in the rise, all the way to Laau, where the last available space was won, if not by the dwarfs, at least by someone who understood this kind of agricultural engineering. These artificial lands have long since reverted to the wilderness from which they came, and it is only by chance that the traveler stumbles upon them, beating his way through the jungle. But they bear witness to a large population; and so perhaps we do not need to discredit the old chronicler by more than the "65 men of Laau" [listed as Menehunes].

OAHU (FIG. 4)

Kona

Kuliouou. Portions of the flatland about a half mile inland show low elevated ridges of soil in squares which look like old terraces, but I am told that they are probably where Andrade formerly experimented with growing alfalfa. In one place on the western side of the valley there is a sizable flat with a facing of small stones about a foot wide along the lower side.

All the land is now dry, and I am told that it is too porous to hold water even were water available for terraces. Presumably in earlier times there was a steady flow from the stream leading down from the verdant gulch or from springs.

Niu. Two sizable gulches are included in Niu. They are dry today, but marshy land on the flats above the highway seems to indicate springs or underground flow and the probable presence of terraces in the old days.

Wailupe. Wailupe Stream formerly had a larger volume than at present, and there may have been *loʻi*. John K. Clarke says that the ground below the mouth of the gulch is too porous to hold water and that the stream seeps away underground. He has never seen any sign of terraces nor heard of taro being grown in this area.

Waialae. The *ahupuaʻa* takes its name from the stone-encased spring, which may be seen today just above the highway. From the spring runs a stream which watered terraces that are now largely covered with grass raised for dairying and by the golf links. Three moderate-sized gulches having streams of constant flow (U.S.G.S. topographic map of Oahu, 1917) are included in this *ahupuaʻa*. In the lower portion of one of these gulches which was examined no terraces were seen. According to Mr. A. F. Judd, some seaward holdings in Waialae had inland plots (*lele*) located in Palolo.

Palolo. Palolo Valley had extensive areas of low terraces throughout its lower portion on the land now covered by houses and golf links, running along both sides of Palolo Stream. Above the junction of Waiomao and Pukele Streams, which form Palolo Stream, there are many high terraces on the hillside to inland, and there were a few terraces on the outer sides of the streams. Some of the upper terraces between the streams are now under cultivation by a Hawaiian planter. Farther up the valleys of Waiomao and Pukele Streams there are a few terraces, and wild taro is said to grow abundantly in the upper reaches.

Waikiki. The extensive terrace areas that covered the level land between what are now Kalakaua Avenue, Kapiolani Park, and Moiliili were watered by Palolo Stream and Manoa Stream, the lower courses of which formerly met in the midst of this area. In former days this was one of the most extensive single terrace areas on the island. It was developed by the chief, Kalamakua. Some of the area has been filled in for fair grounds and building sites, while the remaining terraces now in cultivation are in rice. (In 1931 these were all in Chinese bananas.) Of taro cultivation in Waikiki in 1865 a correspondent of the Hawaiian-language newspaper "Kuokoa" writes (33):

FIGURE 4.—Map of Oahu, showing districts, planting localities, wind directions, and climate.

TARO. **Terraces:** high terracing in interior valleys rare; broad terraces in valley bottoms, on lower slopes, and in lowlands, irrigated from streams and springs, from Waialae to Ewa, Waianae-kai and Waianae-uka, Makaha, Keawaula, Kaena, Kawaihapai, Mokuleia to Waimea, Helemano, Wahiawa, and throughout Koolau from Kahuku to Waimanalo. **Kula lands:** developed only where water could be diverted for irrigation as at Wahiawa; little if any dry taro planted. **Stream planting:** throughout. **Forest planting:** not systematic or extensive. **Swamp planting:** Keawaawa, Waikiki, Kapalama, Moanalua, Waipahu, Ewa, Waialua and Paalaa, Kahuku, Hakipuu, Waikane, Kaalaea and Waihee, Heeia, Kailua, Waimanalo.

SWEET POTATO. Coastal throughout, especially from Maunalua to Makiki, Ewa, Honouliuli and Waianae, Wahiawa, Helemano, Paalaa, Kamananui, and northwest coast from Kaena to Laie; on *kula* lands in Kaneohe, Kailua, and Waimanalo.

YAM. Little planted; forest planting in Waimano and presumably in other similar areas.

BANANA. In damp lowlands, gulches, and valleys throughout; Koolau, Kona, and Waianae forest zones.

SUGAR CANE. On banks of wet taro patches, around homes, and presumably in forest gardens.

BREADFRUIT. Interior valleys in Kona, Waianae-kai, and all Koolau valleys.

COCONUT. Coastal in Waialae, Waikiki, Kahauiki and Moanalua, Waianae-kai, Waialua and Paalaa, Hauula to Kailua.

WAUKE, MAMAKE, and ALOKEA. Moderately damp lower *kula* lands of Kona, Waianae, and Koolau.

OLONA. Information poor; forest planting in Waimano and presumably in other similar areas.

AWA. Wet gulches and uplands throughout.

GOURDS. Information poor; *ipu manalo* grows wild in Waianae-kai today.

ARROWROOT. On banks of wet taro patches, on slopes, and in inland forest gardens.

Farming was one of the principal duties of the chiefs, and the land [in Waikiki] was rich under cultivation. It was planted from the upper part to its entering the cocoanut grove [along the shore] . . . Water courses were made throughout the land, thereby feeding the taro patches and fishponds . . . A good chief was Kalamakua, who was well-known for his farming. He constructed the large taro *lo'i* of Keokea, Kalamanamana, Kualualu and others at Waikiki.

The first description of Waikiki by a foreigner was given by Vancouver in 1792 (71, vol. 1, pp. 360-365):

On the shores [of the bay] the villages appeared numerous and in good repair; and the surrounding country pleasingly interspersed with deep, though not extensive valleys; which, with the plains near the seaside, presented a high degree of cultivation and fertility. . . To the northward through the village . . . an exceedingly well-made causeway, about twelve feet broad, with a ditch on either side. This opened to our view a spacious plain, which . . . had the appearance of the open common fields of England; but on advancing, the major part appeared divided into fields of irregular shape and figure, which were separated from each other by low stone walls, and were in a very high state of cultivation. These several portions of land were planted with the eddo or taro root, in different stages of inundation; none being perfectly dry, and some from three to six or seven inches under water . . . Near a mile from the beach . . . was a rivulet five or six feet wide, and about two or three feet deep, well banked up and nearly motionless; some small rills only, finding a passage through the dams that checked the sluggish stream, by which a constant supply was afforded to the taro plantations . . . At the termination of the causeway the paths of communication with the different fields or plantations were on these narrow stone walls; very rugged and where one person only could pass at a time . . . The sides of the hills, which were at some distance, seemed rocky and barren; the intermediate valleys, which were all inhabited, produced some large trees, and made a pleasing appearance. The plains, however, if we may judge from the labor bestowed on their cultivation, seem to afford the principal proportion of the different vegetable productions on which the inhabitants depend for their subsistence. The soil, though tolerably rich and producing rather a luxuriant abundance, differs . . . from that of . . . Otaheite.

Menzies, surgeon and naturalist with Vancouver on board H.M.S. *Discovery* writes (49, pp. 23-24):

. . . The verge of the shore was planted with a large grove of cocoanut palms, affording a delightful shade to the scattered habitations of the natives . . . We pursued a pleasing path back into the plantation, which was nearly level and very extensive, and laid out with great neatness into little fields planted with taro, yams, sweet potatoes, and the cloth plant. These, in many cases, were divided by little banks on which grew the sugar cane and a species of *Draccena* without the aid of much cultivation, and the whole was watered in a most ingenious manner by dividing the general stream into little aqueducts leading in various directions so as to supply the most distant fields at pleasure, and the soil seems to repay the labor and industry of these people by the luxuriancy of its production.

In 1831, the voyager Meyen (50) writes of this part of Oahu:

At the village of Waititi, where running and standing water is at hand, the tarro fields and valuable coconut plantations begin, and stretch along the shore of the ocean until they become quite thick; beneath the poor shade of these trees stand the neat huts of the Indians.

Manoa. In upper Manoa the whole of the level land in the valley bottom was developed in broad taro flats. The terraces extended along Manoa Stream as far as there is suitable land for irrigating. Some of the lower portion of the old taro area, inland from the slightly elevated land southwest of Rocky Hill, is now covered by streets and houses. But except for this, the extensive terrace area is still intact and could be replanted. Most of it is under grass and unused. About 100 terraces are still being cultivated, but these do not constitute more than one tenth of the total area capable of being planted.

There was a famous terrace area below Punahou School which was watered by the spring from which the school takes its name. Nakuina (54, p. 104) gives the following note about this area:

> . . . Kauawaahila afterwards made some *kalo* patches, and people attracted by the water and consequent fertility of the place came and settled about, voluntarily offering themselves as vassals to the twins. More and more *kalo* patches were excavated and the place became a thriving settlement. The spring became known as Ka Punahou [The New Spring], and gave its name to the surrounding place.

Bennett (3, vol. 1, p. 203) describes the upper valley as "checquered with taro patches."

Honolulu. Of the specific section in early days known as Honolulu, Meyen (50) writes:

> If one were to visit the great plains of Honoruru and see all the beautiful cultivated land in the transverse valleys, that extends onto the plains of Honoruru, and also the tremendous quantity of food plants that are cultivated in the valley of the Pearl River, one might perhaps be persuaded to believe that a great excess of food prevails here, although it is not the case. The tarro plantations occupy a great deal of space and yield far less nourishment than our potato and grain fields. In fact, the high price of fresh supplies at the market of Honoruru we might directly ascribe to inadequate cultivation.

Kotzebue, traveling in the islands from 1815 to 1818, was more impressed. He writes (42, vol. 3, p. 236):

> Woajoo is the most fertile of the Sandwich Islands, from which Owhyee receives a part of the taro necessary for its consumption. The cultivation of the valleys behind Hanarura is remarkable; artificial ponds support, even on the mountains, the taro plantations, which are at the same time fish ponds; and all kinds of useful plants are cultivated on the intervening dams.

Elsewhere Kotzebue describes the method of taro cultivation in greater detail (42, vol. 1, pp. 340-341):

> The artificial taro fields, which may justly be called taro lakes, excited my attention. Each of them forms a regular square of 160 feet, and is enclosed with stone all round like our basins . . . In the spaces between the fields, which are from three to six feet broad, there are very pleasant shady avenues, and on both sides bananas and sugar cane are planted . . . I have seen whole mountains covered with such fields, through which the water gradually flowed; each sluice formed a small cascade, which ran through avenues of sugar cane, or bananas, into the next pond, and afforded an extremely picturesque prospect.

Makiki. Between Kalakaua Avenue and Kakaako there were extensive terrace areas in the swampy land. A few terraces are now planted in rice, others are filled in and used as house sites, rights of way for streets, etc.

The cinder slopes of what are now called Round Top and Makiki Heights did not support taro, but have always been famous for sweet potatoes.

Pauoa. The flatland in the bottom of Pauoa Valley above Punchbowl was completely developed in terraces. About half of the old terrace area is now covered by streets and school and dwelling houses. Of the upper portion a considerable area is still under cultivation. Below Punchbowl, between Pacific Heights and King Street, there must have been more or less continuous terraces on the ground now covered by the city.

Nuuanu. In upper Nuuanu there are many small valleys which open into the main valley on either side of the stream. Traces of ancient terraces have been discovered in several valleys on the steep slopes above the stream beds, below the falls, and on small flat areas along the sides of streams. Probably all these small valleys were used for planting taro in ancient times; Luakaha doubtless had many inland gardens; but there were no wet terraces that far up. In the Dowsett Tract below Nuuanu Stream there were formerly terraces. How far terraces extended up Waolani, in the Oahu Country Club area, is difficult to determine: according to Mr. A. F. Judd there are traces of terraces on land now cultivated by a dairy. From Waolani to Kapalama the terraces were continuous on the level and gently sloping land between the Nuuanu and Waolani Streams, past Wyllie and Judd Streets and throughout the section on the north side of the valley, down what is now Liliha Street. In many vacant lots, yards, and gardens above and below Judd Street traces of terraces may still be seen.

Hanai-a-ka-malama (Queen Emma's place) and the area inland from Puiwa Road, which runs north and south off Nuuanu Avenue, were formerly all in terraces, watered by ditches. Terraces were common from Mr. Wight's place on the seaward side of Dowsett Tract, along the hillside and stream below Puiwa Lane (which runs at right angles to Puiwa Road), and on the south side of Nuuanu Stream as far as Laimi Road, and extended all the way down the valley from the stream. Of this section Meyen, continuing his Oahu observations, says (50):

> Scarcely had we left the gardens of the capitol, which were for the most part planted with beautiful flowers, when we arrived at broad fields of *Arum macrorrhizon*, which are known by the name of "tarro patches" here. What a sight for us to view such large fields of this valuable economic plant . . . Near by lie fields planted with sugar cane, which is only used for eating here, and whose bluish green makes a vivid contrast with the bright green of the banana leaves and the velvety color of the tarro plants. How beautiful is the sight of these tropical plants in their own country!

High up in the valley Meyen noted (50) "a few small but very neat Indian huts," and remarked that "only very small tracts of land in the vicinity of these huts were cultivated."

The following reference to Nuuanu occurred in the newspaper "Hoku-o-Hawaii" for June 4, 1914 (35):

> . . . Pua-a-Nuuanu is located in a place called Nuuanu in the upland of Moeauoa to this day. There is a sharp ridge there and a Pride of India grove grows there. Kapahu-a-lo'i is a bathing pool that is up there where the tree ferns grow, and Lele-a-hoe was a large taro patch. It is still to be seen in the upland below the spring. That was the largest taro patch on the island.

The lower district, extending from Nuuanu Avenue to Alakea Street and from Hotel Street to the sea is said by McAllister (44, site 66) to have been anciently known by the name Kou; he quotes Westervelt as stating that the name Honolulu now given to the city was that of a high chief of "a very rich district of farm land near what is now . . . the junction of Liliha and School Streets, in the time of Kakuhihewa." The name Honolulu is said by Westervelt to mean "abundance of peace" or "sheltered hollow."

The newspaper "Kuokoa" of June 22, 1865 (32) has this reference to a famous taro terrace in the district:

> I turn to view Kamanuwai [near the junction of Nuuanu and Beretania Streets]. This is an ancient taro patch said to have belonged to Keopuolani or to someone earlier. The food from this taro patch is the food of the sow belonging to the chief. Kupanihi was the name of the sow, so named for the father of the redeyed chief Kahaoi.

Kapalama. Kapalama had two streams watering its terrace area, which was almost continuous from Iwilei up to the foothills above School Street, an area measuring about three quarters of a mile both in depth inland and in breadth.

Kalihi. Extensive terraces covered all the flatland in lower Kalihi Valley for approximately 1.25 miles on both sides of the stream. Above this the valley is too narrow for terraces for a mile or more; but in upper Kalihi there are numerous small areas that were developed in terraces. Bennett (4, vol. 1, p. 202) says of this valley: "Human dwellings and cultivated lands are here very few, or scattered thinly over a great extent of probably the finest soil in the world." McAllister (44, site 72) notes that "on the *ewa* side of the stream the home site is still to be seen at a place called Kupehau where the chiefs of Hawaii resorted because of the delicious *poi* and tender taro tops to be had there. Kamehameha the first was one of the chiefs who visited the spot."

Kahauiki. Kahauiki Stream irrigated a moderate-sized area of terraces extending from the sea inland for about half a mile.

Moanalua. Inland of what is now Moanalua Park is a moderate-sized area of terraces. Mokumaia (53) writes that Moanalua took its name from two taro patches watered by Iemi Spring:

> The name Moanalua came from two taro patches close to the road taken by travelers from Ewa. They were very close to the spring of Iemi. When the travelers came to the place just mentioned, they found the taro leaves so large that the keepers groped in the dark for taro for the chiefs. The taro and oha grew close together and that is how it [Moanalua] got its name which has remained famous to this day. . .
>
> . . . The writer saw these patches. They weren't much to look at, but were peculiar in that a spring came up in them. They were kept for the chiefs. It was said that the taro and young taro leaves were delicious. They lay in the level with the land till Iemi was reached.

These terraces are now planted in wet taro by Chinese, and are irrigated with water from Kalou Stream, which empties into Moanalua Stream three quarters of a mile inland. The large area southwest of lower Moanalua Stream, which is now partly park and partly planted to bananas, was formerly all taro terraces. Most of this area to seaward is still planted in flourishing taro grown by Chinese. There are also extensive irrigated patches east of the lower course of the stream which presumably used to be taro beds but are now partly planted in rice and partly unused.

Up Moanalua Stream above Kalou Stream there was a little terrace land, but most of the ground bordering Moanalua along the highway and up through the present golf course is too high and too irregular for irrigation. Informants say there were no terrace areas so far as they know in upper Moanalua Valley but that quantities of semi-wild taro were planted along the stream and on the hillsides.

On December 18, 1815, Kotzebue (42, vol. 1, pp. 343-4) records in his diary the following comments upon what he termed "Mounaloa, Oahu", and the "Mouna Roa River, Oahu":

> Our way led us through a romantic valley, where we seated ourselves under shady breadfruit trees, on the banks of a salt lake . . . We again ascended a high mountain and were, soon afterwards, in a beautifully cultivated plain, among taro fields, sugar plantations, and banana trees.

Ewa

Halawa. The broad flatlands extending 1.5 miles below the highway along Halawa Stream are now under cane but were formerly terraces. The terraces also extended up the flats along the lower courses of Kamananui and Kamanaiki Streams which join to form Halawa, and I am told that there were small terraces farther up both streams. Four and 5 miles inland, dry taro was planted on the banks of gulches.

Aiea. The small area of low flatland covered by plantation camp, railroad, etc., below the old highway, was formerly in terraces. According to McAllister (44, site 146), Mathison made the following observations on this region in 1821-22:

> . . . The adjoining low country is overflowed both naturally and by artificial means, and is well stocked with tarrow plantations, bananas, etc. The land belongs to many different proprietors; and on every estate there is a fishpond surrounded by a stone wall. . . . The neighborhood of the Pearl River is very extensive, rising backwards with a gentle slope toward the woods, but is without cultivation, except around the outskirts to about half a mile from the water. The country is divided into separate farms or allotments belonging to the chiefs, and enclosed with walls from 4 to 6 feet high, made of a mixture of mud and stone.

Kalauao. The lowlands seaward of the highway and for a short distance inland, now mostly under cane with a few banana groves, were all formerly terraces irrigated from Kalauao Stream. Kalauao Gulch was too narrow to have terraces inland.

Waimalu. The extensive flats between East Loch of Pearl Harbor and the present highway were formerly developed in terraces irrigated from Waimalu Stream and Waipi spring, which is east of Waiau pond. There are banana groves here now. Terraces also covered the flats extending three quarters of a mile above the highway into Waimalu Valley, and there were small terrace areas several miles upstream beyond these flats.

Waiau. The *ahupua'a* takes its name from Waiau spring and pond, south and west of which are small terrace areas now planted mostly in truck.

Waimano. Waimano Stream irrigated small terrace areas east of what is now called Pearl City.

Manana. This narrow *ahupua'a* was called Manana-iki in its lower portion and Manana-nui in the mountains where it broadens and includes Manana Stream, which flows into Waiawa. There were a few terraces seaward, irrigated by Waiawa Stream.

Wahiawa. According to Oscar Cox there were terraces at Kanaku and at Kuaikua, both of which are somewhere in the vicinity of Kukaniloko. According to old Mahoe there were numerous terraces on the level uplands in the vicinity of Wahiawa town, irrigated by a ditch bringing water from Helemano Stream. However, this is impossible, since Poamoho Stream intervenes. The chiefess, Lanikaha, built terraces inland in Halemano. There were small terraces in all the inner valleys.

Wahiawa Stream irrigated extensive terraces on the flats both immediately above and below the town and also about 2 miles inland. Some of these terraces are planted in truck now, but most are neglected. It is said

that there were numerous small terrace areas from 3 to 4 miles upstream in Wahiawa and its tributaries, Waimano and Manana.

At Kaniula, where the waterworks are now, Hawaiians had a dam from which ditches led to Wahiawa terraces, some of which were near the site of the present radio station.

Waipio. Between West Loch of Pearl Harbor and Loko Eo the lowlands were filled with terraces which extended for over a mile up into the flats along Waikele Stream. The lower terraces were formerly irrigated partly from Waipahu Spring, which Hawaiians believe came all the way through the mountains from Kahuku. It is said that terraces formerly existed on the flats in Kipapa Gulch for at least 2 miles upstream above its junction with Waikele. Wild taros grow in abundance in upper Kipapa Gulch. Of Kipapa Stream Fornander (25, vol. 5, pt. 2, p. 274) records the following in the story of Namakaokapaoo:

> . . . Pokai then assented and went to live with her husband Pualii, and resided at the plains of Keahumoa [the plain below Kipapa Gulch]. They lived there tilling the soil. Pualii had two large taro patches which remain to this day. They are called Namakaokapaoo.

Waikele. In the flatland, where the Kamehameha Highway crosses the lower valley of Waikele Stream, there are the remains of terraces on both sides of the road, now planted to bananas, beans, cane, and small gardens. For at least 2 miles upstream there were small terrace areas.

Hoaeae. This *ahupua'a* had a moderate-sized area of terraces watered by springs inland from West Loch of Pearl Harbor.

Honouliuli. Large terrace areas are shown on the U. S. Geological Survey map of Oahu (1917) bordering West Loch of Pearl Harbor, the indication being that these are still under cultivation. I am told that taro is still grown here. This is evidently what is referred to as "Ewa taro lands." Of the Honouliuli coral plains McAllister (44, site 146) says:

> . . . It is probable that the holes and pits in the coral were formerly used by the Hawaiians. Frequently the soil on the floor of the larger pits was used for cultivation, and even today one comes upon bananas and Hawaiian sugar cane still growing in them.

Vancouver (71, vol. 3, p. 361) anchored off the entrance to West Loch in 1793 and made the following observations:

> . . . The part of the island opposite to us was low, or rather only moderately elevated, forming a level country between the mountains that compose the east [Koolau] and west [Waianae] ends of the island. This tract of land was of some extent but did not seem to be populous, nor to possess any great degree of natural fertility; although we were told that at a little distance from the sea, the soil is rich, and all necessaries of life are abundantly produced.

Waianae

Nanakuli. On the south side of the stream, about a quarter of a mile inland from the main coastal road, there is a broken platform (*paepae*) built of small rocks with apparently a small paved area below, close to the stream bed. Extending inland along the south bank of the stream bed for about 75 yards there is a rough stone facing from 1 to 2 feet high in general level along the top. This might be judged to be a terrace area were it not that the ground behind the stone facing is not level; however, that might be due to washing out when the stream was in flood. According to Ernest Rankin, a rancher in this and other valleys for years past and now living on a homestead on the ridge north and above this site, the stonework just described was not terracing for taro patches but was built by a man named Whitney 40 years ago when he located a house and cattle shelter at that point. Behind the terrace there are six large old monkeypod trees, indicating earlier habitation. On the north side of the stream at this point, there is a fairly recent habitation site, with several large trees, also papayas and traces of sugar cane plantings. Nearby are a tiny stone paving and the remains of an old Hawaiian house.

According to Rankin there are no terrace remains anywhere in Nanakuli Valley, nor any available water for irrigation, except at the very head of the valley, far up in the mountains. High in the small gulches at the valley's head, there are some abandoned terraces, stone platforms, and orange trees marking the sites of ancient Hawaiian habitations. But as long ago as 1890, when Rankin first frequented the valley as a cowboy, there was not one Hawaiian living there.

Lualualei. According to Mrs. Hanakahi, living on a Nanakuli homestead, there is a place far up in Lualualei, "the Navy place", called Kapuhawai, where the sacred spring was used to water carefully tended terraces; she says that in these neglected terraces, taro still grows wild from the ancient plantings, thriving in such rainfall as there is, and people go up into the hills to gather it, as it is regarded as "fine eating."

Waianae. Vancouver (71, vol. 3, pp. 355-6) describes the village and valley of Waianae as follows:

> . . . From the commencement of the high land to the westward of Opooroah [Puuloa] was . . . one barren rocky waste, nearly destitute of verdure, cultivation or inhabitants, with little variation all the way to the west point of the Island. Not far from the south-west point is a small grove of shabby cocoanut trees, and along those shores are a few straggling fishermen's huts. Nearly in the middle of this side of the Island is the only village we had seen westward of Opooroah. In its neighborhood the bases of the mountains retire further from the seashore, and a narrow valley, presenting a fertile cultivated aspect, seems to separate and wind some distance through the hills. The shore

here forms a small sandy bay. On its southern side, between the two high rocky precipices, in a grove of cocoanut and other trees, is situated the village, and in the center of the bay, about a mile to the north of the village, is a high rock [Mauna Lahilahi], remarkable for its projecting from a sandy beach. At a distance it appears to be detached from the land . . . . The few inhabitants who visited us from the village, earnestly entreated our anchoring, and told us, that if we would stay until morning, their chief would be on board with a number of hogs, and a great quantity of vegetables; but that he could not visit us then because that day was *taboo poory*. The face of the country did not, however, promise an abundant supply; the situation was exposed.

In ancient times Waianae Valley had extensive systems of terraces along its various streams, in what is now forest and water reserve, and well down into the broad area now covered by sugar cane. Names were obtained for 14 distinct terrace sections, watered by Olahua Stream, extending as far down as the site of the present power house. The section named Honua, including the group of terraces farthest inland, belonged to the alii of the valley. At the upper end of the water reserve road, at the site of the houses that belonged to Mr. Widdeman, the abandoned terraces covered with bush growth are still plainly marked; this is true of the other localities that were examined down to and below the power house. A short distance below the power house a few terraces are still cultivated by Hawaiians. The names of four terrace sections formerly watered by Kikoo Stream were recorded, also four names for terrace sections watered by Kumaipo Stream.

Makaha. MacAllister (44, p. 119, site 171) reports taro terraces about halfway up Makaha Valley and on the Honolulu side of the stream:

. . . The terraces average from 20 to 50 feet in width and are of varying lengths, sometimes several hundred feet long. Rock facings from 1 or 2 feet to 6 feet in height separate the terraces. The stones of these facings are evenly piled at a slight slope with the upper side flush with the earth. Water was brought by irrigation ditches now destroyed. It is probable that the plantation flume which is just above the last terrace followed the old Hawaiian ditch. These terraces have been used up to recent years.

Keawaula. According to Tom McGuire, there are a few terraces below the pali, indicating a former small wet taro site.

Waialua

Kaena. This *ahupua'a* must have grown sweet potatoes exclusively, except for one group of about 20 taro patches, terraced with rock facings, on the slopes below Uluhulu Gulch. These terraces were irrigated from Uluhulu spring on the hillside west of the gulch. Besides the terraces (now dry and abandoned) there were clearings which were used presumably for sweet potatoes. David Keaau of Kawaihapai says that no taro was grown between these terraces and Kaena Point. Although high up in several gulches there are green spots, indicating the presence of springs, there is

evidently not enough level ground surrounding them for any planting. Kaaimoku Kekulu, native of the district, says that the name of the spring and the terrace section noted above is Kaaiea.

Kealia. The large area of lowland terraces between the cliff and the elevated coral, though mostly in Kawaihapai, extends a short way into Kealia. Otherwise this small *ahupua'a* offered little opportunity for cultivation, unless for sweet potatoes.

Kawaihapai. There is a sizable area of terraces in the lowlands (now surrounded by sugar cane), watered by Kawaihapai Stream. These terraces have evidently been lying fallow for some time, though several were being plowed for rice or taro in the summer of 1935. At the foot of the cliffs, watered by a stream the name of which was not learned, are several small terraces in which taro is grown by David Keaau. He says that taro cannot be grown in the lowlands, as salt water seeps in and sometimes flows in, mingling with the fresh water in the terraces and spoiling the taro. Above his inland terraces, along the base of the cliff and above the talus slope, grow three varieties of wild taro—all called *Aweu*—one white, one red like *Kumu,* and one striped black. I saw the first two varieties under the cliffs where the waterpipe intake begins, and I saw the third, said to have come from there, in the grounds of the Andrew Cox School.

Mokuleia. There are two extensive old terrace areas in Mokuleia on the flatland near the sea. One is just below the Dillingham Ranch, watered by an underground flow from a gulch west of the ranch house. This area of old terraces is now entirely planted in Chinese bananas. The other large area, which is now planted mostly in bananas but partly in cane, is seaward of Makaleha Stream. Wild taro grows in Makaleha Valley and its subsidiaries. Kamakau (40), speaks of the "abundance of food grown in Makaleha, of the *kihi* and *lapa* varieties of taro, of sweet potatoes, *awa,* bananas . . . "

Kamananui. Formerly there were large terrace areas along the flatlands between the junction of Helemano and Poamoho Streams and the flatland west of Poamoho. There were also small terrace areas up in the lower flats of Poamoho and Kaukonahua Valleys. There were small flats in the bottom of Kaukonahua Canyon for several miles above its junction with Manawai Stream. Poamoho is probably too narrow for taro terraces. It is likely that in these gulches, as at Waimea, sweet potatoes and bananas were planted around home sites along the ridge and near taro patches at the bottom of the gulch. Wild taro and bananas grow in Manawai Valley and presumably also in the other five valleys that run up toward Puu Kane.

At Kamananui are the remains of what McAllister describes as "the longest irrigation ditch of which there is any memory" among modern Hawaiians. He says (44, site 208):

> . . . The intake was from the Kaukonahua stream, just before it issues from the gulch, about two miles inland from the mill. According to Tom Low, the ditch could be traced as far as the intersection of the Mokuleia, Honolulu and Haleiwa roads. The most distant land watered surrounded the site of the old mill one and one third miles away. This ditch was for many years used by the plantation. The cemented intake and portion of the rebuilt walls are still to be seen. Along part of its course the ditch flowed along the side of a hill about fifty feet high. According to Low, the old ditch was made by piling stones on the lower side, with a rubble fill. Consequently there was much seepage and loss of water. Aside from following the old course, the plantation had practically to reconstruct the walls.

Waianae-uka. This *ahupua'a* ran from the crest of the Waianae Mountains south of Mount Kaala, across the plateau area on which Schofield Barracks stands, and up to the crest of the Koolau Range. On the Waialua side, I am told, there were terrace areas watered by Kioea and Waikoloa Streams. Kalena Gulch had some terraces; I have no information about Mohiakea. On the Koolau side three large streams join to form Kalakoa Stream. The configuration of the land suggests that there must have been some terraces here.

Paalaa. Paalaa includes Helemano Stream and extends north as far as Opaeula Gulch. There are said to have been many small terrace flats in the bottoms of the gulches, extending inland 4 or 5 miles. The map of lower Paalaa drawn by Francis Gay (dated 1874) indicates that there were terraces both above and below the "Twin Bridges."

Kawailoa. This *ahupua'a* included the extensive terrace areas north of the Waialua River, along the level land north and south of Anahulu River, in the lower part of Anahulu Gulch, and in the swampy land east of Puena Point. (This swampy land apparently gave the district its name.) In Anahulu Gulch small flats with old mango trees, indicating *kuleana,* were observed several miles inland, and I am told that small areas were cultivated far up the gulch. Wild taros were seen in the side gulch at least 5 miles inland. The dry gulches between Anahulu and Waimea Streams probably never watered taro.

Koolauloa

Waimea. The level land in the lower valley was in terraces on both sides of the stream prior to the great flood of 1894. The "Index of all claims awarded by the Land Commission" (31), published in 1881, gives the land names of 13 *kuleana* in Waimea. A few of these were probably beach sites and some others were on the elevated tableland west of the stream and about a mile inland.

It is evident that the low, level land along the west side of the stream for half a mile to a mile inland was once in terraces, but there are no evidences of former terraces on the broad elevated land. Above Waihi Falls the canyon is narrow and steep and filled with tumbled boulders for about a mile, then it broadens somewhat. Here on the east bank and extending for several hundred yards is a narrow strip of old terraces. Mrs. Keahipaka, native to the valley, identified the first terrace group above the falls as the site known as Puulu; she said that there were formerly many terraces above here, in the broadening valley along the stream bed, with house sites on the ridge. However, she said the largest terrace area was that known as Kailiili which lies below the falls by the monkeypod trees, on land elevated above the stream bed. It was irrigated from a ditch along the base of the cliff. Farther upstream, toward the falls but down in the gulch, was another large continuous area, known as Honoawa and Kaula. Throughout the valley in old days there was a great abundance of every kind of cultivation, including sugar cane, bananas, breadfruit, coffee and awa.

The left-hand stream branching off beyond the first grove of mango trees divides into two gulches known as Kamananui (right) and Kamanaiki (left). The land where this branching occurs is called Waikakalaua; there were no terraces here, I am informed, but there were some farther upstream. In Kamanaiki there is a fresh-water spring in the rocks, called Punakai, near which were a few terraces, according to Lihau Kuewa. The branch stream that enters the main Waimea Stream from the Waialua side just below Waihi Falls is called Kukuiee, but I have no information as to terraces along its narrow course.

McAllister (44, site 247) speaks of the "agricultural terraces of Waimea River" as follows:

> On both sides of the river for a distance of two miles or more are to be seen the remnants of terraces used for agricultural purposes. They vary in size according to the available land. In height they average about 2 feet. Most are faced with stones. Some appear to have been irrigated. Many old breadfruit trees are to be found far up the gulch. Some remains suggest house sites or larger structures. The valley is said to have been thickly populated until the disastrous flood in the latter part of the nineteenth century.

Pupukea. Pineapples and avocado orchards now extend over the high level uplands as far back as the Pupukea-Paumalu Forest Reserve, but there is evidence that this land was suitable for taro cultivation in earlier times. Judge Rathburn says that there were no terraces in the gulches either along Pupukea or Kuaikala Streams or in the vicinity of Waipi Spring, inland from Kuaikala Stream.

Paumalu. This *ahupua'a* has much the same topography as Pupukea. About 2.5 miles inland over the high pineapple fields one can look into Kaunala Gulch. Inland, on the southern slope above Paumalu Stream, is a spring called Waikou, but according to Judge Rathburn there were no terraces in this region.

Kaunala. There are not sufficient flatlands along this stream for taro cultivation under the old system.

Waialee. There is a small group of terraces formerly known as Kanealii, now abandoned for lack of water, around the house of Mrs. John Baker, just east of the Boys' Industrial School and inland of Kamehameha Highway. The large terraces now cultivated seaward of the Industrial School are of recent construction.

Pahipahialua. According to Judge Rathburn there were no terraces along this stream.

Opana. Touching Opana and extending into Hanakoae was a small spring-watered terrace area, named Kawela (same name as the bay). McAllister (44, sites 258, 259) says that according to legends told him by his informants there was "formerly" no fresh water at Kawela Bay (in Opana), but that the gods Kane and Kanaloa struck water from a rock now "known as Waikane, and at the foot of the cliff in the land Hanakoae", and that water "continued to flow up to the time the plantation built a pump just below the rock."

Hanakoae. According to Judge Rathburn there were no terraces along the Hanakoae, Oio, or Kaalaea stream beds in this *ahupua'a;* the only terraces were those watered by the springs, mentioned under Opana.

Kahuku. Inland from the Kahuku ranch house is Kaainapele Spring. Terrace symbols are shown south of the ranch house (U.S.G.S. topographic map, 1917), but Judge Rathburn says that these flats were built by Chinese before 1890 for rice paddies. They were irrigated with artesian water, but the water turned brackish and the paddies were abandoned. They were never used for taro. The 1917 map shows extensive terrace areas in the swampland seaward of the Oahu Railway, stretching 1.5 miles south of Kukio Pond. These were originally terraces, were later planted to rice, and are now under sugar cane. According to John Kaleo, there is a small group of terraces, south of this swampland, named Kaukaha. North of Kukio Pond was also a small area. It is reported that there were no terraces up Kahuku Stream or Kaohiaae, its upland branch. Kaleo named 11 localities where terraces were formerly cultivated.

McAllister (44, site 262) remarks that it scarcely seems possible that this barren Kahuku plain was ever other than at present, "a rather desolate, windswept area," but he says that one of his informants "remembers the time when trees now found only in the mountains" covered it. King (12, vol. 3, p. 115) recounts that "nothing can exceed the verdure of the hills, the variety of wood and lawn, and the rich cultivated valleys which the whole face of the country" on this northern end "displayed." In 1838 Hall (as quoted by McAllister, 44, site 2) observed that "much taro land now lies waste because the diminished population of the district does not require its cultivation."

Keana. There are said to have been no terraces up this stream, and Kaleo knows of none on the level land below.

Malaekahana. There were terraces in this *ahupua'a,* irrigated by Kaukanalaau Stream.

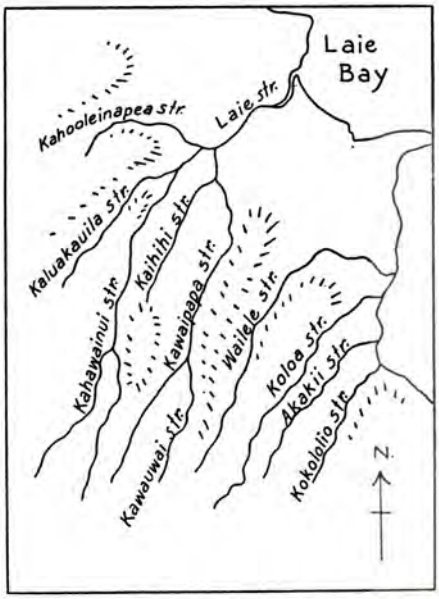

FIGURE 5.—Detail map of streams in Laie, Oahu.

Laie. There are many streams in this *ahupua'a* (fig. 5). Kahooleinapea is the first stream reached after leaving the *ahupua'a* of Malaekahana. Here terraces are still in use. The old terrace area named Waieli, along the lower reaches of Kahawainui Stream, is now under cane cultivation; it was once watered from a spring. Farther up Kahawainui Stream there were formerly many terraces, according to Kakela Kalua. About 2.5 miles up Wailele Stream there are evidences of old taro terraces.

Along Koloa Stream, beginning at a point about 2 miles inland on its twisting course, there are abandoned groups of terraces at intervals, many of them now half hidden in the jungle growth. Just below the old water gates, on the south side of the stream, there is a group of about 15 small terraces, all with stone facings, and nearer the gates, on the north side, a smaller group of five or six. Immediately beyond a sharp curve in the stream bed, and evenly spaced at intervals on either side of the stream, are 15 or more very old mango trees planted in lines. At this point, on the left bank, going upstream, the valley widens into a beautiful flat area which was evidently an extensive dwelling site. There are about eight old breadfruit trees on the hillside and more huge old mangos. This flat area, extending upstream to the sheer cliff wall at the next stream bend, is terraced with low stone lines. Here there are 11 terraces, from 15 to 40 feet wide and from 20 to 30 feet long, now partly overgrown but very distinctly outlined. They could not be replanted unless the mangos were destroyed, as the whole surface of the soil is webbed with a network of tree roots. The stream makes a horseshoe bend at this point, and beyond are more mangos planted in lines for a distance of several hundred yards; and at the upper end of the site is a small house platform. Around the next curve is an area of three small *loʻi;* beyond this there is no further evidence of planting, the stream becoming more and more winding and the valley more and more narrow. Kakela Kalua of Laie says that this was formerly *konohiki* land, and now belongs to the Mormons.

The comparatively flat land between the hills and the seacoast in Laie was divided into many clearly named small districts in the old days—a considerable portion of it, back from the beach strip, having been planted in wet taro. Kekuku, 75-year old *kamaaina* of the place, says that one of the largest single areas formerly under taro cultivation was the land, over 60 acres in extent, lying back of the present Mormon Temple, and known as Kapuna (the spring) because it was watered by one large and several lesser springs. Kekuku's family owned much of the Laie land for generations. McAllister (44, site 282) says that the flat lowland on the Hauula side of the Mormon Temple, now drained and planted in cane, was "formerly a famous taro land. The old Hawaiian name for the land is now lost, and it is known as Kanaana, an adaptation of Canaan, the Land of Promise of the Israelites. In with the taro were extremely large fish. . . . About this taro land the old Hawaiian settlement was located."

According to Kekuku, there was another terrace area in the flatland named Kaholi, seaward of Kapuna, now abandoned. There is also a large area farther seaward known as Kuamoo, which is now planted in wet taro. Naueluli, more seaward still, had terraces formerly, as did Makalii to the west. Inland

and west of Kapuna, the largest old terrace plantation is Poohaili, a mound where mango trees stand, surrounded by terraces, eight of which are still cultivated. Mahanu, inland from the Mormon Temple is marked by old coconut trees and is the upper end of the terrace area; here the *kula* begins.

Kaipapau. Kaipapau was a large stream giving this *ahupua'a* its name. The level land opening out below the valley, now in cane, was presumably all in terraces. Hauula natives say that there are old taro flats along the stream up the valley, which is very narrow and steep.

Hauula. The flats along the coast in Hauula were once all in terraces, irrigated by the valley's five streams: Hanaimoa, Kawaipapa, Makua, Papale, and Punaiki. The courses of these streams are all very narrow and steep. There are the remains of a few small terrace sections in the interior of Makua. A number of small wet taro plantations are still under continuous cultivation between Papale and Makua Streams. Some of the old terraces between these streams, just inland from the highway, were being rehabilitated in 1935. McAllister (44, site 288) records that "on the low level land below the sites [enclosures inland from Hauula town on the land known as Makao, at the mouth of Kapoho Valley] are traces of old taro patches that are being plowed for cane."

Kaluanui. The level lowlands of Kaluanui, now all in cane, must formerly have been in terraces throughout, irrigated mostly by Kaliuwaa Stream, but also by two smaller streams, Waimanamana north of Kaliuwaa and Kuumi south of Kaliuwaa. The terraces extended well up into the mouth of Kaliuwaa (now called "Sacred Valley"), but the interior of the valley is too narrow and the sides are too precipitous along the stream to support any terraces.

Punaluu. In the upper valley, reached by forest reserve trail, and above the water gate (about 2.5 miles from the sea) there is a level area beside the stream, now covered with *puhala* and hau, which was once planted in taro. Beyond this point, where the stream winds back into the mountains, are similar flatlands by the stream side. A quarter of a mile below the water gate, broad flats begin on alternate sides of the winding stream; at first these are only about 100 yards wide but gradually widen to 300 or 400 yards before the valley opens into the broad coastal plain of Punaluu. These flats were terraced. On the steep western hillside above the upper flats there are old breadfruit trees. At the lower end of the valley on the southern side is a flourishing plantation with about 25 terraces now in taro. From here the valley becomes increasingly broad for about three quarters of a mile and is planted in cane, with some grasslands along the stream

and on the hillsides, and a few banana groves. All the way to the sea the grasslands and the canefields, when cut over or newly planted, show clearly the outlines of old terraces. This, then, was formerly a continuous area of terraces, watered by Punaluu Stream, widening from a quarter of a mile above to half a mile at the base of the valley and spreading out like a fan on the coastal plain over an area four tenths of a mile long and eight tenths of a mile wide. McAllister (44, site 297) records a legend in which the god Kanaloa is displeased at the sight of two men far up Punaluu Valley planting taro in uneven rows.

Kahana. In Kahana, according to Ernest Rankin now of Nanakuli, there were terraces up the main stream only. A trail follows upstream, and some of the terraces are still planted. Thirty-three years ago, when Rankin was on the Kahana Ranch, a man named Kenui planted extensively in the interior. There were then also plantings along the shore. Nick Peterson, in charge of the Foster Estate lands (Kahana) confirmed Rankin in the statement that there were no old terraces up the valley of the left-hand stream. Following the trail up the broad main stream, the most inland planting area observed was a large level area of about 30 acres east of the ridge trail and about 2.8 miles upstream from the sea. It is now under hau and guava, though it was undoubtedly in terraces formerly. About a quarter of a mile below here is a V-shaped, level area of perhaps 10 to 12 acres, now covered with *honohono* grass and rushes. This is Hanaiwi, according to Mrs. Kanakaole, and was a taro plantation. A spectacular clump of huge *ape* grows in one corner, and the whole area can be viewed advantageously from the ridge to westward, where old breadfruit trees and Hawaiian bamboo, growing among the wild forest verdure, indicate that the locality was once a well-settled dwelling place. On the western slope of this narrow ridge there are breadfruit trees also; a small flatland which may have been planted borders a rivulet below.

Just below Hanaiwi is Puulena, a considerable swampy area along the main stream (Kahawainui). Anciently this swamp was planted in taro by the *pu'epu'e* method of mounding in marshland. On the dry land above this swamp and leading to the ridge, more old mangos, breadfruit trees, and Hawaiian bamboos indicate another ancient dwelling place, with the main stream flowing along its western border.

The broad lower part of the valley, about a half mile wide, must have had a terrace area comparable to that of Manoa Valley. This area is now under sugar cane. Where the canefields end, about 1.25 miles inland along the trail up the main stream, there is an old taro flat, now plowed up but with some taro still persisting; it is surrounded by bananas. Nearer the sea, a group of small terraces, apparently watered by springs, is under cultivation

between the highway and the mountain east of Huilua Pond. From this point up the mouth of the valley for some distance there appear to be terrace flats under the guava and remains of cane plantings. Along the base of the western side of the valley, from a quarter to a half mile up from the sea, the old terraced levels are plainly marked under the grass and cut cane.

According to Mrs. Kanakaole and Mrs. Maria Kahawaii, *kamaaina* of Kahana, the point farthest up Kahawainui Stream, where old Kenui used to cultivate terraces, was named Paaku. They knew the names of eight other terrace areas up the main stream, including Hanaiwi and Puulena. At the upper end of the level land on the western side of the valley was a terrace area known as Halii, next it a terrace section called Akaka. According to Mrs. Kanakaole, in the lower valley there used to be a fishpond on what is now the site of Nick Peterson's house, and south and east of this pond were two terrace plantations formerly known as Aiea and Kapaloa. Near these, and extending to what is now Tanaka's place on the eastern side of the valley, was another terrace area named Kaluakanaka. Three other land sections both above and below this were in terraces. There were also terraces on the land called Pahanahou, where the church now stands, and a small plantation named Puuohua beside the highway east of the bay. Kukuiula is a small gulch running eastward from the fishpond on this same side of the bay, and according to Mrs. Kahawaii there used to be terraces up this gulch.

Kaaawa. At the upper end of the valley, where cattle are now pastured, there are slopes and vales of boggy land which presumably were once planted to forest taro. There is no sign of terracing. Wild taro was found in the stream bed about 2.5 miles inland from the highway. About half a mile below this there is much level, boggy land on both sides of the stream. At another point, perhaps a mile inland, much wild taro was found. In a gulch on the north side of the valley, less than 2 miles up from the sea, an old coconut tree still stands, indicating the former existence of a *kuleana* home site. There were probably terraces here and in other small gulches seaward of this point. Beginning about 1.5 miles inland where the valley broadens and flattens and continuing to the shore, there are traces of extensive terraces on either side of the stream, now overgrown with guavas, kukuis, and *ape*. About eight tenths of a mile inland the level land broadens out along the stream and there are large terraces where bananas and garden truck are now raised. Close to the sea and north of the main marsh, in the land formerly called Makaua, there are remains of old terraces covering a considerable area of the broad swampy lands between the highway and the mountains.

Koolaupoko

Kualoa. This narrow *ahupua'a* against the mountains and fronting the sea, unsuitable for taro, used to be a famous *wauke*-growing place, according to Mr. George Roberts. East of Molii fishpond, on the flatland named Apua near the south end of Kualoa, is Koholalele pond, which is described in detail by McAllister (44, pp. 167-168). Mr. A. F. Judd told me that his father, Dr. G. P. Judd, told him that he remembered when the pond was excavated and that it had originally been a taro *lo'i*. Mr. Judd noted the similarity of this excavation to the taro pits excavated and filled with humus on islands in central Polynesia.

Hakipuu. In 1935 there were about a dozen taro flats cultivated in the swampy land along the stream seaward of Kamehameha Highway, and about the same number inland of the road. This planting area originally extended over half a mile southward from Molii fishpond. It was about one third of a mile wide in its broadest part where the stream runs through it. All the level land along Hakipuu Stream was once in terraces. There were two terraces at Kealohiwai.

An interesting series of abandoned terraces runs in an S-curve filling a small valley bottom, from Molii fishpond to a point above the highway. This area was formerly watered from Kailau Spring on the hillside above the fishpond.

There is a small terrace area between the fishpond and the spur running from Kanehoalani Ridge to the sea, marking the boundary between Kualoa and Hakipuu. Several of these terraces were planted in 1935. Extending slightly into Kualoa the old terraces ran around the northern bend of the fishpond and were watered by springs in the swampy soil. Here, in 1935, just below the road southwest from the Hawaiian church, was a marshland patch cultivated in the old mounding method, planted by an energetic Hawaiian—the only swamp plantation of this type found on Oahu (pl. 2, *B*).

Waikane. Between the highway and the sea is a broad area of terraces where large crops of taro are raised to sell to poi factories. This section, with the terraces (also still planted) just inland of the road, made up a continuous area of terrace land covering almost the entire seaward end of this *ahupua'a,* watered by Waikane Stream. Terraces were built on the level land up the valley along the stream. About half a mile inland, where broad flats flank a wide curve in the stream, is a beautiful plantation of about 40 terraces, all planted in taro grown for milling (pl. 5, *B*). Following the road toward Na Puu Koiele, small abandoned terraces are to be seen here and there along the stream. Just beyond the juncture of the two streams forming Waikane several small terrace sections were being cleared by Hawaiians in 1935. About

2 miles inland on the north side of the stream below Na Puu Koiele, is a *kuleana* with half a dozen terraces planted with young taro. Above this point are other small abandoned *kuleana*.

In the southern part of Waikane Valley, divided from the larger northern section by a low ridge, there is a gulch containing old terraces (now partially cultivated, but not in taro), small and narrow for the most part. This area begins about one mile above the highway, where the contour trail crosses the gulch, and extends to seaward and for about half a mile or more inland from the trail as well. It is watered by Waikeekee Stream.

Waiahole. There were formerly terraces throughout the seaward lowlands of Waiahole, some in swampy lands but most of them irrigated from Waiahole Stream. Groups of terraces adjoining Waikane were planted in 1935. The land south of the stream and inland from the highway has reverted to swamp. Some *kuleana* a short way up the main stream, beyond its junction with Waianu, are cultivated by Hawaiians living in the lower valley; there was also a sizable terrace section planted in taro about half a mile up Waianu in 1935. Formerly taro was planted in terraces at least a mile farther inland along both the north and south branches of Waianu; and small terraces used to extend along Waiahole up into what is now forest reserve.

Kaalaea. Just south of the ridge separating Kaalaea from Waiahole is a small hill facing the sea, named Puu Kahea (Hill of Calling), where Hiiaka, the sister of Pele, is said to have chanted. Below the hill is a spring and pool named Hiiaka. This spring watered the fine group of terraces still owned and cultivated by Mrs. Kaaoaoloa Kukahiko, who lives with her family on Puu Kahea, from ancient times the home site of her forbears. The flats to seaward were also irrigated with water from this spring. Above Hiiaka pool were other terraces. There were a few small terraces watered by springs between Puu Kahea and the sea.

Farther up the main valley on the north side is a spring named for the god Kanaloa (to whom, with Kane, is attributed the opening of many springs throughout these islands). Near this spring is another named Ka-houpo-o-Kane (The-diaphragm-of-Kane). These springs were the sources of water for irrigating terraces north of the main stream below the ridge toward Waiahole. Below this, also north of the stream, was another terrace section irrigated from a spring named Keahue.

The main stream, Kaalaea (fig. 6), watered the extensive flats from the seashore to the lower hills, about a quarter of a mile inland. Much of this land is still cultivated. Terrace sections, up to 1.5 miles inland, were watered by this stream.

Kuana-auwai is a small stream (ditch?) said to flow eastward into Kaalaea Stream in its upper course. Its name suggests that it was an artificial irrigation ditch (*auwai*), perhaps tapping a spring. I infer that this watered terraces called Kawailoa, inland of Kanaloa.

Haiamoa is a small stream which rises in Waihee and passes through south Kaalaea to the sea. This was the source of water for the terraces on the seaward flats in southern Kaalaea *ahupua'a* and northern Waihee.

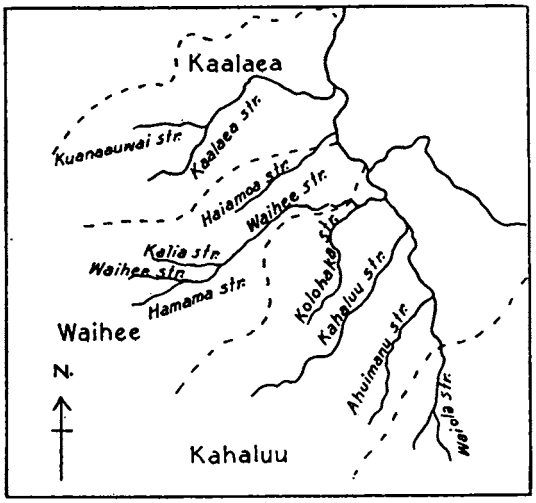

FIGURE 6.—Detail map of streams in Kaalaea, Waihee, and Kahaluu, Oahu.

Waihee. The broad flats of Waihee from the seashore inland are continuous with those of Kaalaea to the north and Kahaluu to the south (fig. 6). These contiguous flats, all sectioned with terraces, make one of the largest single areas of wet-taro land on the Koolau coast. Waihee *ahupua'a* included the terraces watered by Waihee Stream which has its headwaters in the Koolau Range where the small mountain stream (called (Waihee) is joined by Hamama Stream and waterfall and, lower, by Kalia Stream. The old terraces, now abandoned, ran back into these valleys for about 1.5 miles. From there on they were developed, when level land permitted, down the main valley.

The land section at the eastern corner of the district inland of the stream named Paele, into which the main stream empties, was named Waihee; it is said that the entire district took its name from that terrace, which presumably belonged to the alii in the old days. This parallels the situation in Kahakuloa and Keanae on Maui where the entire valley took the name of a small tapu terrace.

Kahaluu. Kahaluu Stream, after which the *ahupua'a* is named, is joined a quarter of a mile from the sea by a small stream named Kalohaka; about three quarters of a mile from the sea it is joined by Ahulumanu, which in its turn, is amplified three quarters of a mile farther inland by Waiola Stream. It was from all these streams that the water was taken to irrigate the lower flats of Kahaluu which are continuous with those of Waihee. Kahaluu Stream extends back to the Koolau Range through a broad valley. There must have been terraces throughout the broad part of the valley for several miles inland. Some of those in the lower portion of the valley are cultivated now; most of them are neglected.

Dry taro now flourishing on the *kula* land between Kahaluu and Ahuimanu Streams is all planted by Orientals. There was no planting of this sort here in the old days.

On either side of the valley of Waiola Stream is an area of broad level terraces, the most extensive now cultivated, which in 1935 were all planted in wet taro for commercial purposes. Beginning about seven tenths of a mile along the road from the sea, and extending beyond for about half a mile, the terraces are continuous along broad level flats on either side of the stream up to Ahuimanu; most of them are now under grass. One old Hawaiian has several large terraces under cultivation in interior flats watered by Ahuimanu Stream.

The terrace sections of Kahaluu are tucked away in pockets of land watered from the several streams; there are few large continuous areas, but the total area under cultivation in ancient times must have been very considerable.

Heeia. The extensive salt marshes of Heeia inland from the fishponds (*loko*) were not cultivable, but fringing them on the south and flanking both sides of Heeia Stream, from which they are irrigated, lie the vast terraced lowland flats of this *ahupua'a,* still largely planted in commercial taro. The southern portion of these terraces is irrigated from Kalimukele Stream, which turns southward and flows into Kaneohe. The small stream named Puolena supplements Heeia Stream for irrigation on the north. The terraces extend up the main stream to the junction of Haiku Stream and Iolekaa (fig. 7). A small stream named Kaiwikee flows into Iolekaa from southwestward in the Koolau Range. Up all these valleys are old terraces, now abandoned.

Kaneohe. Kaneohe is one of the most complicated terrace areas in the islands. It can be comprehended only in the light of its stream system (fig. 7). It is still one of the most active communities in planting commercial taro, and a goodly portion of its lowland terraces, tucked away in pockets flanked and often hidden by low hills or by the town itself, are still planted

in taro (for milling) by Hawaiians who own the land and by Orientals who lease land or are hired.

This *ahupua'a* was described in glowing terms a century and a half ago by Portlock (63, p. 74):

> . . . The bay all round has a very beautiful appearance, the low land and valleys being in high state of cultivation, and crowded with plantations of taro, sweet potatoes, sugar-cane, etc., interspersed with a great number of coconut trees, which renders the prospect truly delightful.

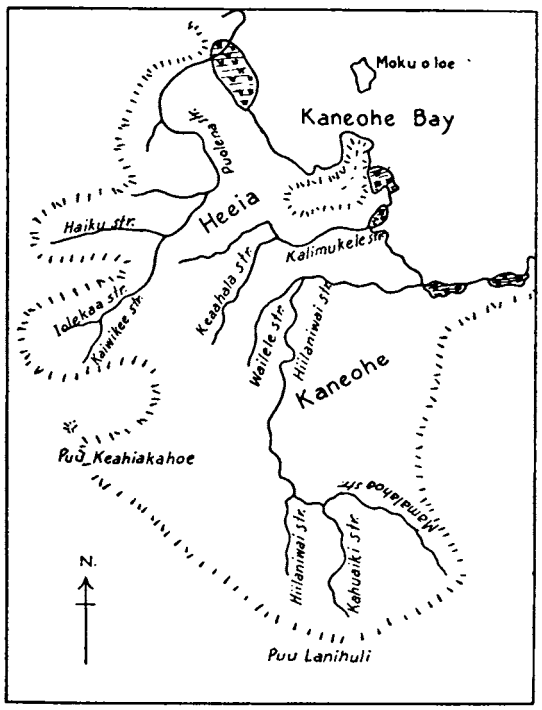

FIGURE 7.—Detail map of streams in Heeia and Kaneohe, Oahu.

The flatlands of Kaneohe are broken up between hills into chains of pockets connecting along its stream channels. On the north side of the *ahupua'a*, near the boundary of Heeia, Keaahala Stream flows into Kalimukele, coming out of Heeia. Some of the best terraces now in use are inland of the highway and are irrigated by Keaahala; a large old terrace system extends downstream below the highway. An elaborate system of water rights prevailed in ancient times throughout these sections irrigated by Keaahala.

Wailele (formerly Paniohelele) Stream, and Hiilaniwai, which joins it just above the highway an eighth of a mile east of Kaneohe town, watered terraces both above and below the highway; these terraces are now used mostly

for truck gardening. There were formerly a few terrace sections farther up Wailele, which, however, was but a short stream. Hiilaniwai is a very long stream running back to the slopes draining Puu Lanihuli. There were only a few small terrace sections along this stream above Wailele. There was no systematic terracing along the upper course of Hiilaniwai and along the joint stream formed by Kahuaiki and Mamalahoa Streams, because here the hillsides rise too steeply from the stream beds. The lowland terrace areas of Wailele and Keaahala were so extensive that it was evidently found unnecessary by the old Hawaiians to terrace the interior slopes to the degree that this was done in Waianae Valley.

The *kula* lands between the streams were planted in pandanus, *wauke,* bananas, and sweet potatoes. The dry-taro plantations now seen west of the highway on lands adjacent to Hiilaniwai are all in Oriental taro. Hawaiian *kalo maloo* was not planted here. The number of names of *ili* and *kuleana* on *kula* lands along the Hiilaniwai and its tributaries, however, indicates intensive cultivation of products other than taro.

Kailua. This *ahupua'a* must formerly have been very rich, having one of the most extensive continuous terrace areas on Oahu, extending inland 1.5 miles from the margin of Kawainui Swamp. The lower terraces are now swampy, though a few are used for truck growing; those in the main section are under intensive cultivation for experimental purposes by the Hawaiian Sugar Planters' Association; the upper terraces are unused. I am told that small terrace sections extend up each of the stream courses which water the main flats (fig. 8).

There were five small *kuleana,* with terraces watered by springs and a small stream from Puu Olomana, along the base of the western slope of the ridge southeast of Kawainui Swamp. East of the seaward end of the ridge was a sizable terrace area, watered from the stream joining Kawainui and Kaelepulu Ponds. South of the swampy land bordering Kaelepulu Pond at its southwest side was a small area of wet taro. There were also terraces north of the pond bordering the broad stream that empties into Kailua Bay. Two terrace *kuleana* flanked Kaelepulu Pond at the base of the ridge to the east of the pond.

Taro is no longer grown in Kailua. The main body of old terraces are more useful for experimental purposes in sugar. Much former taro land has reverted to swamp and would be expensive to reclaim. As for other lands, there is now too little water, due to deforestation of the lower levels under grazing.

Omitting the inner stream terrace names, which he did not remember, the last surviving *kamaaina* of Waimanalo, Edward Niaupio, gave me in 1934

the Hawaiian names of 21 terrace sections in the several localities where wet taro was formerly planted, representing that many distinct proprietary plantations in the lower flats. There were many inland that he would not name for me, because he was not sure of remembering them correctly.

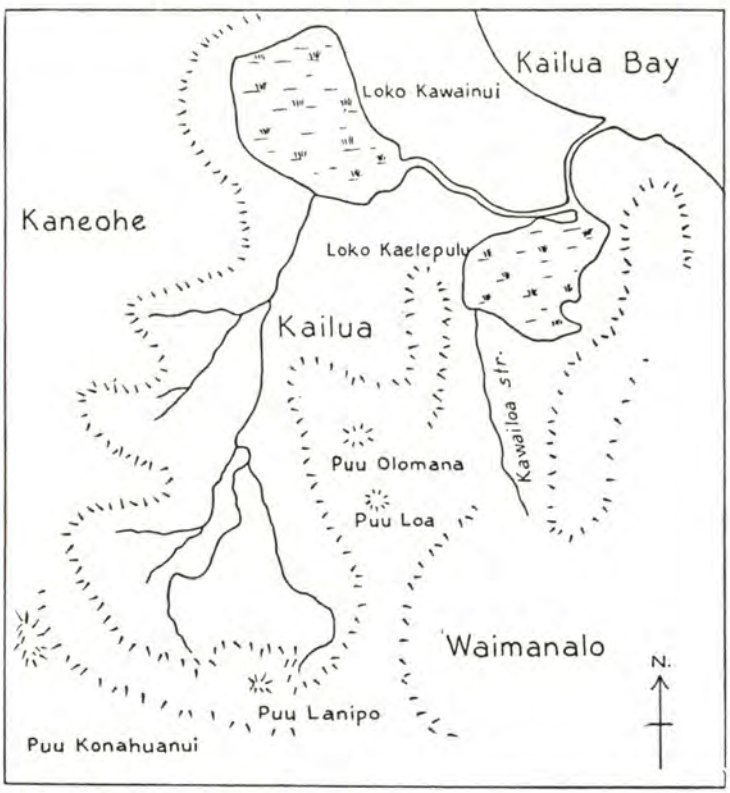

FIGURE 8.—Detail map of streams in Kailua, Oahu.

Waimanalo. This *ahupua'a* has only one large stream, from which it takes its name, the water of which irrigates the sugar cane now grown on the lower slopes and lowlands. Much of the lowland now under cane was formerly in taro. But wet taro was by no means limited to the lowlands irrigated from the main stream. The old *kamaaina* mentioned above named nine terrace sections whose water came from small streams and springs flowing out of the high mountain range. These sections ran for 1.5 miles in a semicircle at the foot of the mountains round the broad base of Waimanalo Valley, from below Puu Loa well toward Puu o Kona. Several of these, now covered with brush, were examined and found to be well preserved. The only taro grown in the district in 1934 was that planted by Edward Niaupio.

Hahaione Valley. From the road which follows the base of the hill behind Kuapa Pond back into the valley, can still be seen the embankment which separated the terrace area from the fishpond. This entire area back of the pond and along the curve of the hillside (now swampy ground under grass and rushes) was formerly in taro terraces, according to Mrs. Makea Napahi who was born there. The springs which watered these terraces are still visible from the valley road and now flow into the fishpond. There is said to have been a small stream flowing from farther up the valley. Mr. A. F. Judd told me there were old gardens at the upper end of the small valley west of Hahaione, known to him as Kealakei.

MOLOKAI

Before the days of ranching, forests covered much of the uplands around Maunaloa on western Molokai. Probably some dry taro was planted here. Dry taro is known to have been planted on the southern *kula* lands of eastern Molokai, from Kamalo to the eastern end of the island. On the western half of the island evidences of wet-taro cultivation were found only in the swampy lands below Manawainui Gulch, about 3 miles northwest of Kaunakakai. Probably there were small terraced areas upstream.

Formerly the small streams on the southeastern coast carried more water than they do now, and it is certain that in many of the interior valleys there are small sections of terraces. Wet taro was seen at Keawanui, Pukoo, Kawaikapu, Waialua, Honouliwai, and Pohakupuli. My short visit to Molokai in 1931 did not allow time for any exploration. It is quite certain that formerly taro was cultivated on flats and in gulches all the way from Kamalo eastward. In ancient times Waialua, with its two streams and extensive flats, was the largest terraced area on Molokai's south coast.

At Kamalo I observed and photographed a method of taro cultivation said to have been common along this coast in ancient times. In flat swampy ground earth is heaped up into long mounds 3 or 4 feet high and about 3 feet broad on top, each mound surrounded by water left standing in the ditches created by digging out and heaping up the earth. The taro is planted around the lower margins of the mounds near the water; sweet potatoes are planted on top. This method of swamp-land planting finds its counterpart in the old style of mounding (termed *kipikipi*) practiced in Waiakea, Hawaii.

At the eastern end of Molokai the beautiful valley of Halawa with its broad flats is one of the few localities where taro is cultivated intensively by Hawaiians today. In 1931 only the lower terraces were planted, the taro being grown partly for subsistence and partly for sale. Since that time events have transpired which favor a revival of subsistence planting and perhaps the rehabilitation of the abandoned terraces.

The northern cliff-lined coast of Molokai westward from Halawa has a number of deep valleys with flatlands and sloping sides where anciently terraces were constructed. Wailau, with its two streams, has extensive terraces in the seaward lowlands and back in the lower valleys of Kahawaiiki and Wailau Streams. In 1931 all were abandoned.

Pelekunu is a picturesque deep valley the seaward lowlands and lower valley slopes of which are corrugated with compact terraces, now unused. Here and at Wailau there is said to be high terracing of valley sides comparable to that on the Napali coast of Kauai.

There were a few small wet-taro sections in Waikolu. On the slopes of Kalawao, watered from Waileia Stream, are extensive terraces, cultivated for subsistence by the people living in the Kalaupapa Leper Settlement. There must formerly have been wet patches below Waihanau Valley, the stream of which empties near Kalaupapa Settlement.

Southwick Phelps, who made an archaeological survey of Molokai in 1937, reports the following as wet taro areas: Halawa, Halawa uplands, Wailau, Pelekunu, Waikolu, Honouliwai, Moanui, Waialua, Kamalo, Mapulehu, and Kahananui.

The following account of taro localities on Molokai is given in Au Okoa for September 26, 1867 (59):

> Waialua. This is one of the largest tracts of land or ahupuaas of Molokai facing Maui. It is a land of taro patches that are seen on every side from the shore and far inland.
>
> Poniuahua and Puelelu. These lands lie on the western side of Waialua. They are kula lands. There is a ridge on the mountainward side but not like Waialua in having divided streams. The wet patch taro and dry land taro are in the upland. It is a good place for sweet potato cultivation. It was here that taro patches were built with the water coming in from springs in the patch itself. Here the wet patches extend from Waialua and toward the upland, like those of Palolo. The patches of Poana are ordinarily tilled; and bananas, sugar cane, sweet potatoes, onions, etc. are planted. The taro is planted below them where there is moisture all around the mounds. One of these mounds produced enough to fill an imu. These are the only patches on these lands until one came to Kawela, twenty miles away. . .
>
> Honomuni. Kamanoni and Honomuni are the richest of lands in that district. They were well known in the olden days and were much liked by the governor-chiefs of Molokai, that is, by Haalou, father of L. Haalelea and T. Haalilio. . . and also by Naea. In this place Honomuni was one of Haalou's largest taro patches. Word was sent to the men all around Molokai to come and work in it. It was named Paikahawai. The patch is destroyed by those who wished to use the land it contained [for other purposes], by Kanakaokai and others who leased it. I heard that it was not entirely gone when Ilae Napohaku was tax assessor. There are also ponds there. . .
>
> Kuliula. This is also a good land. There are fish ponds and sweet potatoes and taro. This is also true of Ahaino 1 and Ahaino 2. All of these lands are very good and rich, and cultivated plants flourish.
>
> Ualapue. Below Kaluaaha lies the land of Ualapue. It is a fine land with many wet land taro patches and some ponds. . .
>
> The lands of Kaamola. These are six small pieces of land belonging to the one land of Kaamola nui, lying close to Puaahala, a large pond belonging to Kaamola. There

are some taro patches there. The sea comes very close inland, and so there is not much level land. The level land for patches is about one chain away. Mostly thorny weeds grow on these lands on both sides of the government road. . .

LANAI

Emory, who made an archaeological survey of Lanai in 1921-22 (24), says that taro had a very small place in the old native horticulture. So far as is known, dry taro was not planted at all. Wet taro was cultivated throughout the upper valley of Maunalei district, and in a small area midway up from the sea in the deep valley running down the Kaunolu side of Kalulu district (24). Both these valleys are on the wet (or less dry), northeast, windward side of the island. A little wet taro was grown in one spot in a small valley in the uplands of Kalulu, southeast of Koele.

MAUI (FIG. 9)

Lahaina

Ukumehame. Above the Pioneer Plantation reservoirs, terraces cover the flatland just below the entrance to Ukumehame Canyon. Only a few of these are now under cultivation. The upper terraces have been long abandoned, and those just above the reservoirs are only half used—that half unsuccessfully, because of insufficient water for flooding. The terraces used to extend well down over the land below the valley, but, with the exception of one tiny taro plantation standing like an island in the midst of the cane, all vestiges of the ancient cultivation have been plowed under. This is excellent wet taro soil.

Olowalu. Olowalu is the largest and deepest valley on the southwest side of Maui and used to support extensive terraced cultivation. The lower ranges of terraces have been completely obliterated by canefields; but just where the sugar cane ends and the valley begins there is a little spot where five Hawaiian families, all of them intermarried, raise several varieties of taro in flourishing wet patches. Some of it is sold, but most is pounded by hand for family poi. There are said to be abandoned terraces far up in Olowalu.

Launuipoko. Although there is a sizable stream bed and deep valley here, there is no visible evidence of wet taro cultivation, and the Hawaiian planters at Olowalu say that *lo'i* never existed in Launuipoko. It is possible that there may have been a few terraces on the level land at the base of the valley, but this is wholly arid land now and covered with dense brush.

Kauaula Stream. In Kauaula Gulch above Wainee there are wet patches still cultivated by Hawaiians.

Kanaha and Kahoma. The large streams named Kanaha and Kahoma, flowing out of the westward valleys of Kahoolewa Ridge, the eastward slopes of which drain into Iao Valley, formerly irrigated the most extensive plantations on this side of the island. All this land is now in sugar.

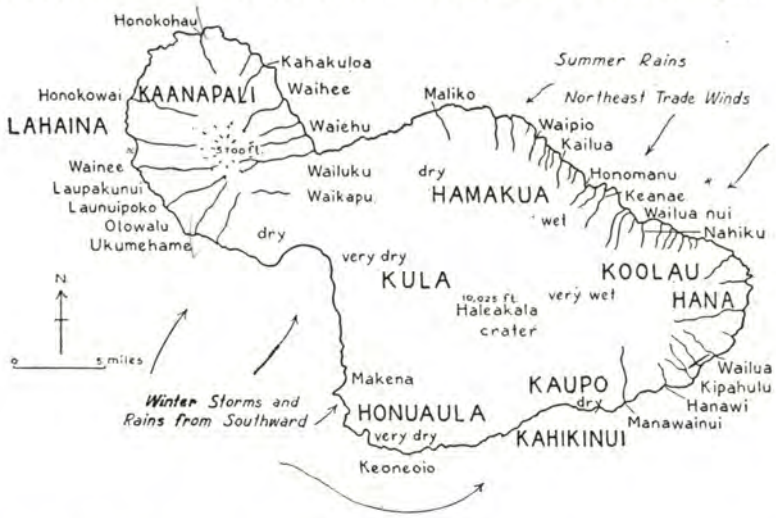

FIGURE 9.—Map of Maui, showing districts, planting localities, wind directions, and climate.

TARO. **Terraces:** Honokohau to Ukumehame; Kahakuloa to Waikapu; Maliko; Waipio to Nahiku; Wailua to Hanawi. **Kula lands:** Hamakua, Koolau, Hana; **Stream planting:** western Maui, Hamakua, Koolau, Hana, Kaupo. **Forest planting:** Hamakua, Koolau, Hana, Kaupo, Kahikinui, Honuaula, up to about 3,000 feet elevation.

SWEET POTATO. Coastal throughout; lower Wailuku and Waikapu; the staple in Kula, Honuaula, Kahikinui, and Kaupo; up to 3,000 feet elevation.

YAM. Forest land from Hamakua to Hana.

BANANA. Valleys and wet coasts throughout; median forest zones up to 3,000 feet elevation.

BREADFRUIT. Western coast and valleys; valleys of east coast; gulches, valleys, and protected lower slopes in Hamakua, Koolau, and Hana, up to 500 feet elevation.

COCONUT. Waihee to Wailuku; valley bottoms near sea, coves and flat coastal land from Maliko to Hanawi; about sea level only.

WAUKE. Valleys and damp *kula* lands in western Maui; Hamakua to Kaupo; lower forest in Kula, Honuaula, Kahikinui.

OLONA. Median forest zone throughout.

AWA. Interior wet valleys and lower forest zones throughout.

GOURDS. Coastal on western Maui and from Hana to Honuaula.

Descriptions by early visitors to Lahaina give vivid pictures of the appearance of these well-cultivated slopes at the time of the first contact of Europeans with the islands. Menzies (49, pp. 105, 112), always appreciative, writes in glowing terms:

[Lahaina, 1793] Here our conductors importuned us to dine, and a pig being killed and got ready, together with yams and sweet potatoes, we partook of a hearty meal, after which we continued our journey, and soon entered the verge of the woods where we observed the rugged banks of a large rivulet that came out of the chasm cultivated and watered with great neatness and industry. Even the shelving cliffs of rock were planted with esculent roots, banked in and watered by aqueducts from the rivulet with as much art as if their level had been taken by the most ingenious engineer. We could not indeed but admire the laudable ingenuity of these people in cultivating their soil with so much economy. The indefatigable labor in making these little fields in so rugged a situation, the care and industry with which they were transplanted, watered and kept in order, surpassed anything of the kind we had ever seen before. It showed in a conspicuous manner the ingenuity of the inhabitants in modifying their husbandry to different situations of soil and exposure, and it was with no small degree of pleasure we here beheld their labor rewarded with productive crops.

March 17. On the forenoon of the 17th, I accompanied Captain Vancouver and a party of officers, with the two Niihau women, to see the village of Lahaina, which we found scattered along shore on a low tract of land that was neatly divided into little fields and laid out in the highest state of cultivation and improvement by being planted in the most regular manner with the different esculent roots and useful vegetables of the country, and watered at pleasure by aqueducts that ran here and there along the banks intersecting the fields, and in this manner branching through the greatest part of the plantation.

These little fields were transplanted in a variety of forms, some in rows, in squares, in clumps and others at random; some according to their nature were kept covered with water, while others were with equal care kept dry by gathering earth around them in little hills. In short, the whole plantation was cultivated with such studious care and artful industry as to occupy our minds and attention with a constant gaze of admiration during a long walk through it, in which we were accompanied by a numerous group of natives that continued very orderly and peaceable the whole time.

Arago (2, pp. 119-120) though less carefully observant, was likewise entranced by the scene which was evidently still idyllic in 1819:

The environs of Lahaina are like a garden. It would be difficult to find a soil more fertile, or a people who can turn it to greater advantage; little pathways sufficiently raised, and kept in excellent condition, serve as communications between the different estates. These are frequently divided by trenches, through which a fresh and limpid stream flows tranquilly, giving life to the plantations, the sole riches of the country. Hollow squares of the depth of two, three, and sometimes four feet, nourish various sorts of vegetables and plants; amongst which we distinguish the Caribee-cabbage, named here *taro*; double rows of banana, bread-fruit, cocoa-nut, *palma-christi*, and the paper-mulberry trees, intercept the rays of the sun, and allow you to walk at mid-day. Every cabin has its enclosure, and every enclosure is well taken care of; it seems to suffice for the wants of the family. Here the father turns the ground with his long staff of red or sandal wood; there, the son clears the soil of weeds, and prepares the dinner; farther off the mother is seated at the door of her hut, and weaves the stuff with which she clothes herself; whilst her youthful daughter, unencumbered with drapery, is seated by her side, and tempts you by her unsophisticated caresses.

The space cultivated by the natives of Lahaina is about three leagues in length, and one in its greatest breadth. Beyond this all is dry and barren; everything recalls the image of desolation.

Arago speculated as to why the neighboring country presented "the image of desolation", concluding that it was native indolence that was to blame, and failing to realize that the bounds of cultivation on this side of Maui were strictly drawn by limitation of water for irrigation.

According to legend (25, vol. 5, pp. 540-541) Kekaa, north of Lahaina, was once an area of intensive cultivation. This implies continuous cultivation of the coastal region along the northwest coast.

> Kekaa was the capital of Maui when Kakaalaneo was reigning over West Maui. . . Many houses were constructed and people cultivated a great deal of potatoes, bananas, sugar cane, and things of a like nature. I have been told that the country from Kekaa to Hahakea and Wahikuli—that country now covered by cactus, in a northwesterly direction from Lahaina—was all cultivated. This chief (Kakaalaneo) also planted bread fruit and *kukui* trees down at Lahaina. Some of these trees southwest of the Lahaina fort, were called the bread fruit trees of Kauheana.

Kaanapali

Honokowai, Kahana, Honokahua, and Honolua. I did not explore these valleys, but D. T. Fleming writes, in response to inquiries:

> In all three valleys which you mention—Honokowai, Honokohua and Honolua, as well as Kahana, there was considerable taro raised in olden times; as a matter of fact, a great deal was raised in Honokowai, where there must have been 30 or 40 acres under cultivation at one time. A detailed map of the *kuleanas* in that valley is available, and a fairly accurate estimate of the area could be made from that. Honokohua did not have much taro land, but Honolua and Kahana had several acres each.

Honokohau. This valley—watered by a large rivulet the flow of which never ceases, even today when much of its water is piped off in the upper valley—was, and still is, an area of intensive cultivation of wet taro in flooded terraces (pls. 2, *A*; 4, *A*). In 1931 a larger proportion of the patches were under taro cultivation in Honokohau than anywhere else on Maui with the exception of Kahakuloa. In 1934 I observed that one or two considerable areas had been abandoned and that a number of patches had been planted to rice instead of taro, because of root rot affecting the taro. Only one old Hawaiian *kamaaina,* David Kapaku, still cultivates his own wet taro. The rest of the planting is done commercially by several small proprietors, Hawaiian and Chinese, and by laborers employed by D. T. Fleming, to whose enterprise largely is due the continued utilization of so many old terraces.

Anakaluahini, Poelua, and Honanana. These are three sizable gulches eastward from Kanounou, the northern tip of Maui, in each of which, I am told, wet taro used to be grown in small patches.

Waihali. In this small valley, just east of Kahakuloa, there are a few old terraces no longer planted because the stream now flows only after rains. Anciently there were numerous settlements, primarily of fishermen, along this cliff-lined coast between Honokohau and Kahakuloa, but it is now barren and deserted along its dry and windy length.

Kahakuloa. Kahakuloa, one of the most genuinely native communities still extant in the islands, has a population of about 20 families, all Hawai-

ian and all taro planters. In the lower valley, at least half the terraces are under cultivation. Most of the taro is for private consumption, although one enterprising member of the community raises taro commercially. More than a dozen varieties of taro are regularly grown. There are said to be a few terraces that were formerly cultivated somewhere in the uplands above Kahakuloa.

Kahakuloa takes its name from a small and reputedly very fertile, but now unused, taro patch about half a mile inland on the southeast side of the valley bottom. This *loʻi* was the property of the chief (*haku*) of the valley, known, because of his isolation, as the "far-away master" (*ka haku loa*). This little patch beside his house also served as a place of refuge (*puuhonua*) for the western end of Maui. Any tapu-breaker who could evade his pursuers and take refuge in it was immune from the wrath of the kahunas or other aliis.

Waiolai and Makamakaole. There are said to be abandoned terraces in these two gulches on either side of Puu Ola, both seaward of the highroad and high up toward the mountains.

Kukuipuka. This *ili,* between Makamakaole and Waiehu, has several small gulches in which water flows in rainy weather, but there is no evidence that it ever supported taro. Pineapples now flourish on the upland slopes.

Na Wai Eha

Waihee. Waihee is the northernmost of "The Four Streams" (Na Wai Eha) of the Wailuku district (*moku*). From Waihee to Wailuku Valley, in ancient times, was the largest continuous area of wet taro cultivation in the islands. Today the northern and southern slopes and the mouth of Waihee Valley are well cultivated, about a third of the old patches being used as commercial plantations, some worked by Hawaiians, some by Japanese, some by Portuguese. Waihee, like Kahakuloa, takes its name from a historic *loʻi.* This patch, named Waihee, formerly belonged to the alii and is a large patch near the sea.

An elderly *kamaaina,* William Kahalekai, says there are numerous abandoned terraces at Eleile, far up in the valley beyond the end of the road and above the new reservoir. He says that in ancient times the terraces were more or less continuous in a belt between the sand dunes and the present irrigation ditch. The section is now mostly under sugar cane, which has obliterated the terrace lines, though the canefields are in many places broken by *kuleana* still held by Hawaiians who have preserved the old terraces. In many of these isolated plots taro is still grown by Hawaiians or Japanese; and a number of the terraces, dry or irrigated by little ditches, are now used by enterprising Japanese for growing vegetables: lettuce, beans, onions, egg-

plant, and some Japanese and Chinese taro. The old terraces are satisfactory for truck farming except in a wet season, when they do not drain.

These terraces, interspersed through the canefields, are numerous between Waihee Valley and Waihee town. South of the town, the canefields are continuous on the lower slopes all the way to Waiehu.

Waiehu. This is the second valley of the famous Na Wai Eha of western Maui, and it is watered by twin streams. The canefields now extend throughout this region, continuously from Waihee on the lower slopes; but above Waiehu and Puakala from the upper roads following the irrigation ditches well toward the upper limits of the cane, a few old plantations still persist. Some are used for raising wet taro, some for truck gardening. However, except for these few patches the old terraces of the upper slopes are entirely ploughed under.

Wailuku. This is the third of "The Four Streams", the great torrent that drains the highest cloud-capped uplands of western Maui through deep Iao Valley. Much of the upper section of what is now the city of Wailuku is built on old terrace sites. Along the broad stream bed of Iao Valley, extending several miles up and inland, the carefully leveled and stone-encased terraces may be seen. In the lower section of the valley these broad terraces now serve as sites for camps 10 and 6 of Wailuku Sugar Plantation, being utilized for house sites, gardens, playgrounds, and roads. A little farther up, neat private homes and vegetable and flower gardens cover these old taro terraces; while at their upper limit the terraces are submerged in guava thickets. Here a few wild taros were found, but I saw no terraces in Iao or Wailuku being used as flooded taro patches. It is significant that here, as at Waihee, the old terraces are adapted to market gardening (Chinese bananas, vegetables, and flowers) by Japanese and Portuguese gardeners.

Waikapu. This section, with its abundant stream that has cut its canyon deep into western Maui's second highest range, gives its name to the last of "The Four Streams." Spreading north and south from the base of Waikapu to a considerable distance below the valley are the vestiges of extensive wet plantations, now almost obliterated by sugar-cane cultivation; a few here and there are preserved in plantation camps and under house and garden sites along the roads. Among these gardens there are a few patches of dry Japanese taro. Far on the north side, just above the main road and at least half a mile below the entrance to the canyon, an extensive truck garden on old terrace ground shows the large area and the distance below and away from the valley that was anciently developed in terraced taro culture. On the south side there are likewise several sizable *kuleana* where

terraces are now used for truck gardening. In the largest of these a few old patches are flooded and planted with Hawaiian wet taro, and there is some dry Japanese taro. Several terraces are used as ponds planted to lotus for their edible seed. There were probably once a few small terraces on the narrow level strips of valley bottom in the lower canyon.

Hamakuapoko

Maliko Stream. The deep gulch of Maliko Stream widens at its seaward end into a flat-bottomed valley which, in pre-sugar days when the stream had constant flow, harbored a number of terraces. The gradually rising land of Hamakuapoko in earlier times would have been suitable for dry taro but not for wet. It was probably well populated and cultivated, for the *kula* land east of Maliko was a small patchwork of *ahupua'a*.

Hamakualoa

Shallow Kuiaha Gulch was not explored, but its stream must have watered a few taro patches on flats near the sea. According to Henry Ikoa and George Akiu, there were small terraced areas watered by Hoolawa, Waipio, Hanehoi, Hoalua, Kailua, and Nailiilihaele Streams. These all have abundant water, but flow in deep gulches having practically no flatland suitable for terracing. Presumably stream taro used to be planted along the beds of these watercourses well into the uplands, and forest taro throughout the lower forest. The minute *ahupua'a* characteristic of this coast indicates a dense population.

Koolau

Oopuola Gulch marked the northwestern boundary of Koolau. Its stream, and likewise Waikamoi, Puohokamoa, and Haipuena Streams watered small patches.

Honomanu. This valley anciently supported a large population, having a fishing bay of first rank, and a deep, flat valley bottom watered by a large stream. Only one family still raises taro in the old patches near the sea, but abandoned terraces extend up into the valley as far as the level land goes, a little less than a mile. Above Honomanu on elevated flatlands there used to be some terraces and houses.

Nuuailua. This smaller, flat-bottomed valley between Honomanu and Keanae, now uninhabited, was formerly the site of a settled community which raised wet taro in terraces.

Keanae Valley. In the extensive confines of Keanae Valley, now a water reserve with no inhabitants, the old Hawaiians planted a great deal of

dry- or forest-land taro; but it was only in the lower part of the valley, on the eastern side, that wet patches were developed, although a vast area in the remainder of the valley might have been capable of such development. Brief inspection of the land in the neighborhood of the road, however, gave no evidence of terracing. It would seem that the greater part of the valley was, until recent times, boggy forest.

Keanae Peninsula. It is on the broad flat peninsula of lava that extends for nearly a mile into the sea from the western line of the valley, that Keanae's famed taro patches are spread out in striking evidence of old Hawaii's ingenuity (pl. 5, *A*). Polaukulu Stream, which breaks through the gap at the northwestern corner of the valley, gives an abundant supply of water to the many wet patches (about half those once cultivated) which are still used for raising wet taro. When it is well tended, the taro now growing is as healthy as any I have seen, indicating that there is ample water. But I am told that there has been taro disease in some of the patches and that some of the lower terraces have been abandoned because the earth bottoms, which rest on rough lava, break through in spots and allow the water to drain out. Above the peninsula, but below the highway, there are a few cultivated patches watered by the small stream midway between Keanae and Wailua.

The story of the founding of the Keanae *lo'i* area is highly interesting. Anciently, according to Henry Ikoa, the peninsula was barren lava. But a chief, whose name is not remembered, was constantly at war with the people of Wailua and determined that he must have more good land under cultivation, more food, and more people. So he set all his people to work (they were then living within the valley and going down to the peninsula only for fishing), carrying soil in baskets from the valley down to the lava point. The soil and the banks enclosing the patches were thus, in the course of many years, all transplanted and packed into place. Thus did the watered flats of Keanae originate. A small *lo'i* near the western side of the land formerly belonged to the chief of Keanae and has the name Ke-anae (the big mullet); it is said that the entire locality took its name from this small sacred *lo'i*. Here, as at Kahakuloa, the taro that grew in the sacred patch of the alii was reputed to be of great size.

Wailua. Wailua-nui has even more extensive terracing than Keanae, sloping seaward from the base of the cliff around which the road winds. About half the terraces are still cultivated by Hawaiians. On the whole, Wailua is today richer agriculturally than Keanae.

Wailua-iki, Waiohue, and Hanawi Streams supported small terraces on diminutive flats near the sea.

Nahiku. Nahiku has a number of terraces, some still under cultivation, below the village. The people of this genuinely Hawaiian community also cultivate dry taro patches about their houses.

Throughout wet Koolau, the wild taro growing along the streams and in the pockets high on the canyonlike walls of the gulches bespeaks former planting of stream taro along the watercourses, on the sides of the gulches, and in the forest above. The same is true of the wild taros seen here and there in the present forest above the road and in protected spots on what was formerly low forest land, now used as pasture.

Eastward from Nahiku there are no large streams or gulches in Koolau. The shore is low and the terrain gently sloping and jungle-like. From Ulaino to Hana extends a hala forest, growing upon recent lava flows which cover the coast from Ulaino to Hana Bay. At Ulaino and Honomaele there are a number of places where dry taro is still planted by Hawaiians together with other small subsistence plantings. Formerly there was scattered planting all along the coast and forest plantations inland, between Ulaino and Nahiku, which are connected by an old trail crossing the lowlands near the coastline.

Hana

North Hana. North Hana is a gently sloping land covered by a recent rugged lava flow; hence there are no constantly flowing streams and no terraces. Dry taro flourishes, however, in the rich soil composed of a mixture of humus and decomposed lava, which is plenteously watered by rain except during occasional periods of drought. Above the sea cliffs and the fresh-water lava caves of Waianapanapa is Honokalani, a sizable native settlement, where some dry taro is grown. On the moderately sloping forest land called Helani, inland from the road just north of Hana town, a number of Hawaiians have patches of dry taro. In the forest zone above Hana town, at an elevation of about 1,500 feet, is a small valley below Olopawa Peak where taro was formerly cultivated during the dry seasons. Hamoa, on flatlands by the sea beyond Hana town and the cinder cone of Kauiki, has no taro, the present-day dry taro plantations being in the lowland forest zone about 2 miles inland. Formerly the men of Hamoa planted their dry-season taro in the valley named Opae-kui, an offshoot of the vast marshy Waihoi. The name, according to K. W. Kinney, commemorates the fact that at these planting times the Hamoans subsisted in their upland huts on shrimps (*opae*) that were mashed (*ku'i*) and stored in gourds.

South Hana. South of Hamoa the land is less rugged and streams more plentiful. The Hawaiian homesteads at Makaalae, Waiohonu, Puuiki, Pohue, Pukuilua, Haou, Hulihana, Muolea, and Koali have extensive planta-

tions but only a small proportion of the cultivation is devoted to dry taro. There is no evidence of wet taro cultivation in Hana district north of Koali. Here, however, both above and below the road, there are small groups of terraces, some of which are still used for wet taro. The group nearest Wailua is a picturesque example of high terracing with stone facing on a steep slope.

Wailua. Beyond Koali the deep little valley of Wailua, plenteously watered by three converging streams falling from the slopes of Kaumakani, harbors the most extensive wet plantations on the eastern end of Maui. Altogether there are about as many old terraces as at Keanae, though fewer are now under cultivation (pl. 4, *B*). The wet patches at Wailua are at four levels. Now abandoned are groups above the falls between the two main streams. Immediately below the falls, behind the small rocky hill in the center of the valley, is an extensive plantation of well-watered terraces in which taro flourishes today. At a slightly lower level, beneath the southwest wall of the central hill is a group of half a dozen patches which were brought back into cultivation in 1934. In the valley bottom, almost at sea level, is the most extensive area of terraces in Wailua, extending from the beach to the mountain and up into the little valleys on either side. These patches are no longer used and are covered by heavy brush and trees.

Kahalawe Stream. Beyond Wailua the coast is high and steep, cut only by occasional narrow streams, unfavorable alike for fishing and planting. On the steep slopes of Paehala above the sea is a small group of picturesque terraces watered by Kahalawe Stream. These are partly cultivated, some flooded but others now planted in dry taro. Dry taro is rarely seen in unirrigated terraces, but here the slope on which the stone-encased terraces stand is so steep that the taro gets sufficient aeration in the thick *lo'i* soil without running water.

Kipahulu

Kipahulu was a *moku* (district) with rich and diverse but scattered agricultural resources. Its great valley and lower fringing forests nourished forest taro and other native food plants, as did the lower *kula* lands above the sea, where the native homes are today. Formerly sugar plantation, this land is now a cattle ranch.

Kukuiula Stream. This stream, where the rugged ridge-and-valley trail to Kaupo begins, waters several small groups of terraces which are still in use.

Lolokea. This small valley once had a few small terraces, no longer cultivated.

Hanawi. There are a few small terraces watered by Alelele Stream as it flows down through Hanawi Valley to the sea. These terraces were being replanted in wet taro in 1934.

Kalepa. There are a few dry terraces which I believe were used for wet taro in ancient times.

Nuanualoa. Nuanualoa, the last valley before one sights the plains of Kaupo, traveling westward, had a handful of houses with a few cultivated terraces.

Kaupo

Kaupo, with its land falling away from steep uplands in vast gentle slopes covered with late lava flows, is relatively arid along the seacoast but moderately watered 3 or 4 miles inland where, at an elevation of about 2,000 feet, anything may be grown in the rich volcanic soil. There were a few small terraces in Waiha and Punaluu, above the present homesteads.

Manawai-nui. This large stream drains the higher slopes east of Kaupo Gap, one of the two great breaks in the wall of Haleakala Crater; but the valley of this stream is so canyonlike that it would have been impossible to build terraces in it. Indeed, no taro is grown in Kaupo except for a few dry taro plants around home sites; but formerly great quantities of dry taro were planted in the lower forest belt from one end of the district to the other. Now the district is almost wholly ranch land.

Kahikinui

Kahikinui is a vast arid waste covered with what is probably the most recent lava flow from the now extinct crater of Haleakala. It is now uninhabited. Fishing is comparatively good along its rugged shores, and in former times Hawaiians lived in isolated communities on the broken lava scattered from one end of the district to the other, close to the sea or slightly inland wherever potable water was to be found in some brackish well or submarine spring offshore. I am told by an old informant, born at Kanaio in the next *moku,* that the Hawaiians formerly living along the coast of Kahikinui had their plantations of dry taro and other edibles inland in the forest zone, where the forests along the southern wall of Haleakala came much lower and where rainfall was more plentiful than it is today.

Honuaula

In Honuaula, as in Kaupo and Kahikinui, the forest zone was much lower and rain more abundant before the introduction of cattle. The usual forest-

zone plants were cultivated in the lower upland above the inhabited area. Despite two recent (geologically speaking) lava flows which erupted from fissures below the crater and only a few miles inland and which covered many square miles of land, the eastern and coastal portion of Honuaula was thickly populated by Hawaiian planters until recent years. A few houses are still standing at Kanaio where the upper road (traveling eastward) ends, but only two are now occupied. A number of Hawaiian families whose men are employed at Ulupalakua Ranch have homes near the ranch house. About these native homes a little dry taro is cultivated. Formerly there was much dry taro in the forest zone.

Kula

Kula was always an arid region, throughout its long, low seashore, vast stony *kula* lands, and broad uplands. Both on the coast, where fishing was good, and on the lower westward slopes of Haleakala a considerable population existed. So far as I can learn Kula supported no Hawaiian taro, and the fishermen in this section must have depended for vegetable food mainly on poi brought from Waikapu and Wailuku across the plain to supplement their sweet potato staple diet. In recent times, however, Chinese taro has been raised at a considerable elevation.

HAWAII (FIG. 10)

Kona

In early times there appears to have been a marked contrast in the degree of cultivation between North and South Kona. Ellis writes in 1823 (20, p. 95):

> . . . The northern part, including Kairua, Kearake'kua and Honaunau, contains a dense population, and the sides of the mountain are cultivated to a considerable extent; but the south part presents a most inhospitable aspect. Its population is thin, consisting principally of fishermen, who cultivate but little land, and that at the distance of from five to seven miles from the shore.

In North Kona dry taro flourishes only in the uplands, which are now largely given over to ranching, though some Hawaiians still have plantations above Kalaoa. The way taro flourishes in the rich humus of the lower rainy zone is demonstrated at the Federal Experiment Station at Kainaliu, above Kailua (pl. 7, *A*). Ellis (20, p. 28) speaks of the country above and south of Kailua in 1823 as being,

> . . . quite a garden compared with that through which they had passed on first leaving the town. It was generally divided into small fields, about fifteen rods square, fenced with low stone walls, made of the fragments of lava which had been gathered from the surface of the enclosures. These fields were planted with bananas, sweet potatoes, mountain taro, tapa trees, melons and sugar cane, flourishing luxuriantly in every direction.

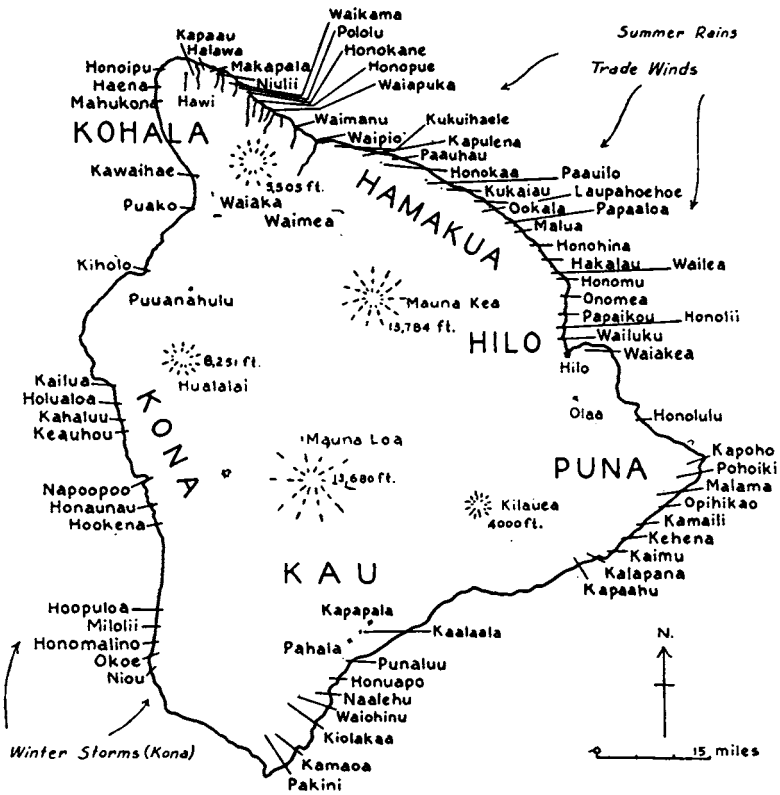

FIGURE 10.—Map of Hawaii, showing districts, planting localities, wind directions and climate.

TARO. **Terraces:** on windward coast of Kohala, Hamakua, and Hilo in valleys with flat bottoms and constant stream flow; little terracing of valley sides; few elevated patches on *kula* lands in Kohala and Hamakua; inland terraces above 2,000 feet watered by Waimea and Waiaka Streams in Waimea; few terraces at Waiohinu, Kau; elsewhere absence of streams and prevalence of lava precluded terrace development. **Kula lands:** in red soil grasslands in Waimea, Kohala, and Hamakua; on lava and humus fern lands in Hilo and Puna; on upland humus-covered slopes not overlaid with lava in Puna, Kau, and Kona; on old lava-covered slopes of Kona. **Stream planting:** windward coast throughout, Halawa to Wailuku. **Swamp planting:** Hilo. **Forest planting:** Waimea and Kohala; in kukui forest clearings and glades in upland Hamakua; in fern forest clearings in Hilo and Puna; in *ohia* forest clearings in Puna, Kau, and Kona; in pandanus forests in Puna.

SWEET POTATO. Coastal throughout; the staple on Kau *kula* lands, dry sections of Kona, Waimea, western Kohala, and western Hamakua.

YAM. Hamakua, Hilo, Puna, Kau, lower forest zones especially.

BANANA. Gulches and lower forests of windward coast; lowlands of Hilo and Puna; on sandy shores of bays from Milolii to Kawaihae.

SUGAR CANE. Warm, damp or wet valleys, forests, *kula,* and plains, wherever there were taro terraces, fields, clearings, or house sites.

BREADFRUIT. Near sea level in protected gulches of windward Kohala, Hamakua, and Hilo; coastal lands of Hilo, Puna, and Kona.

COCONUT. In several valleys of windward coast; on coastal lowlands of Hilo, and especially Puna; on sandy shores of bays from Milolii to Kawaihae.

WAUKE. Damp, warm, lower slopes, especially Kau and Kona.

OLONA. Wet median forests of Kohala, Hamakua, Olaa, Kau, and Kona.

AWA. Gulches and lower forest zones, Kohala, Hamakua, Hilo; lower forests, Puna, Kau, and Kona.

GOURDS. Hot damp lower coastal lands, Kau and Kona especially.

ARROWROOT. Damp slopes, Kau and Kona especially.

In the uplands above Kahaluu, Keauhou, and Kailua, was a vast plantation named Kuahewa (huge), belonging to Kamehameha I. To protect these lands, which were cultivated for his people in the section, Kamehameha established the law that anyone who took one taro or one stalk of sugar cane must plant one cutting of the same in its place. Weary of war in 1812, Kamehameha went to Kuahewa and worked as a farmer. "This land that Kamehameha farmed is in the upland of Kailua, in Kaopua . . . on Honuaula, on the hill called Paoloa and by the spring called Waiakauhi" (27).

In the uplands northeast of Kealakekua, Menzies (49, pp. 167-168) saw rich plantations (1793):

> We came to a village among the upper plantations, where we took up our residence for the night about nine or ten miles north-east of Kealakekua Bay, and where we were surrounded by the most exuberant fields of the esculent vegetables of these islands, which for industry of cultivation and agricultural improvements could scarcely be exceeded in any country in the world, and we were happy to find their labor here rewarded by such productive crops of these vegetables.

In the time of intensive native cultivation, South Kona was planted in zones determined by rainfall and moisture. Near the dry seacoast potatoes were grown in quantity, and coconuts where sand or soil among the lava near the shore favored their growth. Up to 1,000 feet grew small bananas which rarely fruited, and poor cane; from 1,000 to 3,000 feet, they prospered increasingly. From approximately 1,000 to 2,000 feet breadfruit flourished.

Taro was planted dry from an altitude of 1,000 to approximately 3,000 feet. An old method of planting taro in Kona, described to me by Lakalo at Hookena, was to plant the cuttings in the lower, warmer zone where they would start to grow quickly and then to transplant them to the higher forest zone where the soil was rich and deep and where moisture was ample for their second period of growth, in which their corms are said to have developed to an average of 25 pounds each.

At an altitude of about 2,300 feet in Kealia I saw an old-style upland taro plantation corresponding exactly to descriptions by the early voyagers, with the flourishing taro planted in twos and threes in holes in even lines, spaced about 4 feet apart, the surface covered with a mulch of dried *ama'u* fern. The borders of the patches were marked by zones of rock thrown up out of the field, on top of and along the sides of which were clumps of native sugar cane. Hawaiian bananas were planted here and there between the taro fields.

Above Kaawaloa some of Cook's officers saw the plantations in the intermediate zone. Cook (12, vol. 3, pp. 106-107) says that their plantations were divided from each other by thick, low walls of lava and that there

they found the breadfruit trees, plantains, taro root, sweet potatoes, ginger root and sugar canes. The following quotations are given in full in order to picture the cultivation in this section of Hawaii in early times. Ellis, surgeon with Captain Cook in 1778, writes of the country above Kealakekua (19, pp. 91-96):

> . . . After ascending part of the hill, which was covered in every direction with plantations of sugar-cane, sweet potatoes, tarrow, plantains, and breadfruit trees (which were by far the largest they had seen) they arrived at a spot of land entirely uncultivated, and overrun with long grass and ferns . . . they arrived at a long tract of plantain-trees, which far exceed the cultivated ones in size; they produce fruit like them, but it never arrives at perfection . . . but they took a different route to their former one, proceeding nearly in a W.N.W. direction, through innumerable plantations of the paper mulberry-tree, breadfruit, and plantain trees, which formed an extensive garden.

The same region is described in detail by Menzies who accompanied Vancouver in 1793 (49, pp. 74-76):

> . . . The tract which extended along shore, if we might judge from its appearance and our knowledge of that which we had already traveled over, we were ready to pronounce a dreary naked barren waste, if we except a few groves of cocoa palms here and there near the villages. But that which stretched higher up along the verge of the woods from the manner it was industriously laid out in little fields, exhibited a more pleasing and fertile appearance . . . On leaving this station, we soon lost sight of the vessels, and entered their breadfruit plantations, the trees of which were a good distance apart, so as to give room to their boughs to spread out vigorously on all sides, which was not the case in the crowded groves of Tahiti, where we found them always planted on the plains along the sea side. But here the size of the trees, the luxuriancy of their crop and foliage, sufficiently show that they thrive equally well on an elevated situation. The space between these trees did not lay idle. It was chiefly planted with sweet potatoes and rows of cloth plant. As we advanced beyond the bread-fruit plantations, the country became more and more fertile, being in a high state of cultivation. For several miles round us there was not a spot that would admit of it but what was with great labor and industry cleared of the loose stones and planted with esculent roots or some useful vegetable or other. In clearing the ground, the stones are heaped up in ridges between the little fields and planted on each side, either with a row of sugar cane or the sweet [ti] root of these islands (*Dracena* . . .) where they afterwards continue to grow in a wild state, so that even these stony, uncultivated banks are by this means made useful to the proprietors, as well as ornamental to the fields they intersect.
>
> The produce of these plantations, besides the above mentioned, are the [*wauke*] cloth plant . . . taro and sweet potatoes. The latter are here planted three or four feet apart and earthed up around the stems much in the same manner as the common potatoes are treated in England. When they dig up any, we remarked that, after stripping off the potatoes, they carefully put the old plant back again in the ground for the ensuing crop. But the taro being naturally an aquatic plant, required in this dry soil a very different treatment. There were generally two or three of them planted together in a hole about nine inches below the surface of the ground. These holes were about four feet apart, and as the plants grew up, the earth is gathered round their stems in the form of a basin to retain the water, either from rain or otherwise, about their roots. The whole field is generally covered with a thick layer of hay, made from long, coarse grass or the tops of sugar cane, which continually preserves a certain degree of moisture in the soil that would otherwise be parched up by the scorching heat of the solar rays. In this way they rear up these roots to very great perfection even on a dry elevated situation.

The walls (*pa aina*), seen today in Kona lowlands running across old boundary lines, were built to keep cattle out of the planting areas after they became a pest early in the nineteenth century.

Kohala

For 1.4 miles along the southern base of Puu Hokuula terraces are visible under pasture and house sites, presumably formerly watered by a ditch from Waikoloa Stream. These evidently used to be more or less continuous down to and below Waiaka Stream where the road now crosses. Here a Hawaiian planter still cultivates taro in a few terraces irrigated from Waiaka Stream flowing out of the Kohala Mountains. On the Kawaihae side of the road numerous old terrace lines may be seen. There are places in the pasture south of the road that may be traces of old terraces, lines of old walls, or ridges surviving from the era of experimental planting of cane at Waimea.

Between Waikoloa Stream and the Kamuela-Kona highway a few hundred yards beyond Parker Ranch store there are flats, some of which were evidently terraces irrigated by ditches taking water from the large ditch which used to tap Waikoloa Stream just below the junction of the Kona and Kawaihae roads. This large ditch does not look old and presumably was made when cane was planted below Kamuela. Waikoloa is a sizable stream with constant flow of water which was undoubtedly used for irrigating terraces scattered on the plains southwest of Kamuela. But a little over a mile east and west of Kamuela its channel is too deep and the bordering ground is too high and irregular for practicable irrigation by Hawaiian methods. The ground bordering its upper course shows no evidence whatever of leveling and terracing. The same is true of the stream along its course through the pastures below the junction of the Kawaihae and Kohala Road.

Dry taro used to be planted along the lower slopes of the Kohala Mountains on the Waimea side, up the gulches and in the lower forest zones. Dry taro was planted also along the slopes toward Honokaa, and is said to have been grown on the plains south and west of Kamuela. Ellis (20, p. 196), says of the valley of Waimea:

> The soil was fertile, the vegetation flourishing, and there was considerable cultivation . . . a number of villages appeared on each side of the path, surrounded with plantations, in which plantains, sugar-cane, and taro, were seen growing unusually large.

After another trip Ellis says (20, p. 217):

> . . . to Waikoa, Waikala, Pukalani and to Puukapu, 16 or 18 miles from the sea-shore, and the last village in the district of Waimea . . . the soil over which he passed, was fertile, well watered, and capable of sustaining many thousand inhabitants. He had numbered 220 houses, and the present population is probably between eleven and twelve hundred.

Menzies (49, p. 56) in his earlier observations of Waimea (1793), says:

> A little higher up, however, than I had time to penetrate, I saw in the verge of the woods several fine plantations, and my guides took great pains to inform me that the inland country was very fertile and numerously inhabited. Indeed, I could readily believe the truth of these assertions, from the number of people I met loaded with the produce of their plantations and bringing it down to the water side to market, for the consumption was now great, not only by the ship, but by the concourse of people which curiosity had brought into the vicinity of the bay.

Brigham (7) writes that between Kawaihae and Kailua "a few streams make their way to the surface near the shore and furnish water for *kalo* ponds." If this statement is based on anything but hearsay it probably refers to Makahuna, Palihae, and Makeahua Streams immediately south of Kawaihae and to Waikui, Waiulaula, and the three small streams between here and Puako. (All these streams are shown as intermittent on the U. S. Geological Survey topographic map of Hawaii, 1916.) From Puako to Anaehoomalu at the southern end of Kohala and from Kapalaoa, at the northern extreme of Kona, to Kailua there are no streams whatever, and certainly there were no terraces.

South Kohala produced much dry taro in the lower forest zone which formerly extended far down over what is now open pasture. In 1823 Thurston was told that between Kawaihae and Upolu Point, "the inhabitants of the plantations, about seven miles in the interior, were far more numerous than those on the seashore", which was then, as now, rocky and barren (20, p. 217).

North Kohala, in old Hawaiian times, was intensively cultivated in wet, dry, and forest taro, sweet potatoes, bananas, and cane, as well as *wauke* and *olona*. Landing on the north coast in 1779 King explored the country mountainward. He reports (12, vol. 3, pp. 106-107):

> . . . The country, as far as the eye could reach, seemed fruitful and well inhabited . . . [3 and 4 miles inland, plantations of taro and potatoes and *wauke*] neatly set out in rows. The walls that separate them are made of the loose burnt stone, which are got in clearing the ground; and being entirely concealed by sugar-canes planted close on each side, make the most beautiful fences that can be conceived. [The exploring party stopped 6 or 7 miles from the sea] at the second hut they found among the plantations. . . . To the left a continuous range of villages, interspersed with groves of coconut trees spreading along the sea-shore; a thick wood behind this; and to the right, an extent of ground laid out in regular and well-cultivated plantations, as far as the eye could reach.
>
> [In a footnote to the above statement King says:] Both the potatoes, and the tarrow, are here planted four feet from each other. The former are earthed up almost to the top of the stalk, with about half a bushel of light mould; the latter is left bare to the root, and the mould around it is left in the form of a basin, in order to hold the rain-water, as this root requires a certain degree of moisture . . . indeed, we all remarked that the tarrow of the Sandwich Islands is the best we had ever tasted.
>
> [Returning out of the forest belt the party again encountered plantations, and observed] As they passed along, they did not observe a single foot of ground, that was capable of improvement, left unplanted; and indeed it appeared, from their account,

hardly possible for the country to be cultivated to greater advantage for the purposes of the inhabitants, or made to yield them a larger supply of necessaries for their subsistence. They were surprised to meet with several fields of hay; and on inquiring to what use it was applied, were told, it was designed to cover the young tarrow grounds, in order to preserve them from being scorched by the sun.

Pololu. As a wet taro valley, Pololu in North Kohala ranked first in that section, having a flatland area, about one mile long and about a third of a mile at its widest point; this area used to be entirely covered by terraces except for the section immediately inland from the seashore which is under very high sand dunes and another portion in the lower valley on the west side which is made up of fishponds and swamp. The upper terraces are now all under kukui and guava. Hau and guava cover some of the old terraces along the side of the valley, and the central area of the lower valley is now used for pasturing horses. Water formerly used for irrigation has been taken by the Kohala Ditch for sugar plantation purposes. Ellis (1823) remarks (20, p. 211):

> Pololu is a pleasant village situated in a small cultivated valley, having a fine stream of water down its center, while lofty mountains rise on either side not less than 500 feet high. The houses stand principally on the beach. . . . The face of the country (after having ascended out of the valley to the northwest) was as beautiful and fertile as any they had seen, except Waiakea, and seemed populous, though the houses were scattered over the whole face of the country, and more than three or four seldom appeared together. The streams of water were frequent, and a considerable quantity of ground was cultivated on their banks and in their vicinity.

Kohala was unique in the development of terrace areas on *kula* lands, a mile or more inland, wherever water could be brought from streams or springs. One such area is the group of terraces, now under cane below the old Bond homestead, which was formerly cultivated by Kamehameha I. Another group of terraces, a quarter of a mile above the road in Waiapuka, is still cultivated by a Hawaiian family. Just above this is a large area of old terraces, now under cane, which was cultivated in the latter part of the reign of Kamehameha I by Samuel Parker, founder of the Parker Ranch. This was observed by Ellis and Thurston in 1823 (20, p. 211). This particular group of terraces is especially interesting because it was irrigated by means of a ditch from Nene Stream conducted through a tunnel in the ridge. Williams (73, pp. 122-123) describes as follows the construction of this tunnel:

> The drift through the ridge is only about 200 feet long from entry to discharge, and the depth of the floor of the tunnel below the surface of the ground does not exceed at any point more than twenty feet. From all indications the first work done was the sinking of no less than nineteen wells or shafts from nine to ten feet apart on a line laid out on the surface of the ground, these shafts or wells are about four feet in diameter, and were sunk to the level of the bed of the stream or a little lower, and after this had been accomplished the tunnel was completed by driving both ways from the bottom of these shafts or wells until they had been all connected and the waterway completed. The

material evidence that this was the method adopted in carrying out this work is plainly to be seen on the ground at the present day, and the writer has spent some time in looking over the ground, making measurements and generally examining this remarkable piece of construction. [See fig. 11.]

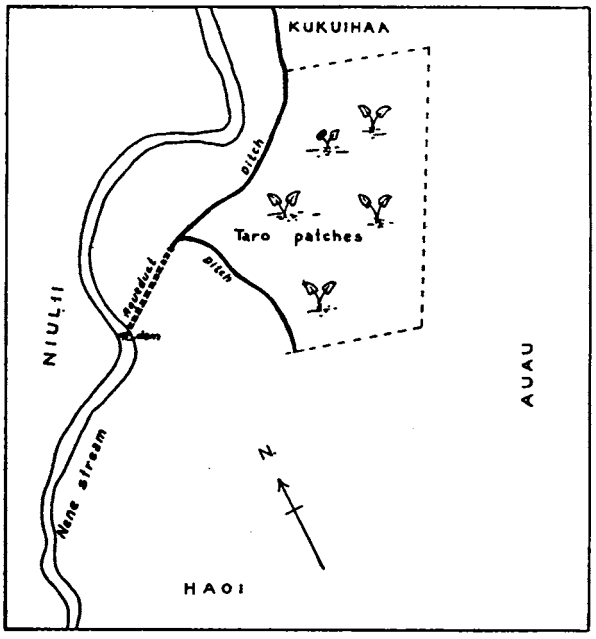

FIGURE 11.—Sketch plan showing Waiapuka ditch, carrying water from Nene Stream, and taro terraces irrigated by it (from J. N. S. Williams, 73, p. 123, 1919).

According to local tradition (told to me in 1935) this tunnel was started by the Menehunes and completed by Kamehameha I. However, Williams (73, pp. 125-126), who inquired carefully about the time of building, concludes that the tunnel was excavated by Hawaiians using metal tools and blasting powder between 1823, when Ellis visited Kohala without mentioning the tunnel, and 1849, when Metcalf surveyed the plot and sketched the tunnel as it is today. I think Ellis' failure to mention the tunnel does not prove that it was built after 1823, for there are many "sites" in Hawaii far more interesting to Hawaiians than this hole (*puka*), which Ellis apparently did not see. Polynesians live vividly in the present; probably the natives would not mention the tunnel unless the subject of irrigation or wet taro happened to come up in conversation, and in 1823 there was but little taro culture in Kohala. Also if the tunnel were built in the nineteenth century it is hard to understand why the Hawaiians in Kohala two generations later have forgotten all details about its construction and have built around it a Menehune tradition. I have found that generally old Hawaiians, born and

bred in a particular locality, are well informed about events occurring during the lifetimes of their parents and grandparents. At Waiapuka Williams was told that Menehunes built the tunnel, and I was told that they started it. To me the fact that the land is named Waiapuka (Water-from-hole) implies antiquity. If legendary sources can be found to prove that this name for the land antedates 1823, it will prove to me that the tunnel was made in old Hawaiian times or at least before Parker's time. The ancient Hawaiians could have built it without metal for it lies through soft lava. Stones at Honaunau of vesicular lava were squared, undoubtedly with dykestone adzes, and in Tahiti and the Marquesas, lava and even basalt were commonly cut in making building blocks and images.

Honokane. East of Pololu is Honokane-nui, which, though a narrow valley, was developed in terraces for about 1.5 miles inland. Honokane-iki and Honokea, which formed the eastern boundary of Kohala, are too narrow for terraces.

Waikama (or Neue). Waikama is a small gulch between Niulii and Pololu in which there are half a dozen small terraces at the seaward end, now planted in taro and irrigated from Waikama Stream. At several places in the flat area of the winding gulch, trees indicate the presence of old *kuleana*. These flats, now covered with guava, presumably used to be terraces.

West of Waikama the following gulches were developed in terraces, both seaward and inland wherever topography permitted: Niulii, Waikani (misspelled Waikane on the U. S. Geological Survey map, 1916), Puwaiole and Aamakao (these two names are in reverse position on the U. S. G. S. map, 1916), Walaohia, Halawa, Wainaea, and Akamoa. Beyond this point the gulches had insufficient water for the development of terraces.

Much dry taro is said to have been grown on the heights above Makapala and Niulii. Of Halawa, Ellis writes (20, p. 213):

> A large country in the neighbourhood was divided out into fields of considerable size, which he [Kamehameha I] used to keep in good order and well stocked with potatoes, or other vegetables. One of these was called by his name. He used to cultivate it with his own hands.

Apparently dry taro was planted fairly continuously over the *kula* lands of Kohala from Pololu to Hawi. This land was formerly grassland, and the ground was prepared for planting taro by burning over the grass and digging in the stubble, allowing it to rot in the ground before planting. A modern Hawaiian taro planter who cultivates terraces near Waiapuka starts his cuttings thus in dry land and then transfers them to his terraces.

Upland forest plantations were developed in the clearings (*waena*) in the forest zone as in Kona.

Hamakua

The wet taro section of the Hamakua coast extended from Honokaa to Kukuihaele. At Kukuihaele there is a succession of small terraces with high retaining walls, watered by Waikoekoe Stream. Several of the upper terraces have been converted into small reservoirs, while the lower ones are still used for raising wet taro.

Waipio. The greatest wet-taro valley of Hawaii and one of the largest planting areas in the entire group of islands was Waipio. This vast, flat valley floor was completely developed in terraces for an area about 3 miles long and 1 to 0.75 mile wide. Some artificial fishponds took the place of terraces behind the sand dunes flanking the beach. The two large present-day fishponds west of the bay are said to have been one great terrace in the time of King Umi. This terrace was called *umilo'i,* according to Jenny Saffrey, the most eminent living authority on local history. The taro planted in *umilo'i* by the alii was tapu and was used by the people of the valley only when there was a dearth of food.

Besides the main body of terraces on the flat floor of the valley there were terraces up Hiilawe Valley; beyond the area of flatland in the main valley for several miles up Waipio Stream; and in the side valleys of Waima, Kuiawe, Alakahi, and Kawainui. In 1935 many more terraces were planted in taro than in 1931, when previously visited. During the era of rice growing the lower flatlands of Waipio Valley proper were devoted mainly to rice culture by Chinese. At present, perhaps a quarter of the lower valley produces taro; many old terraces serve for pasturing horses, and the rest are neglected. The interior sections of the main valley and of the inner valleys are now a jungle of guava, kukui, and other wild growths.

In 1823 Ellis (20, p. 199) writes: "The bottom of the valley was one continued garden, cultivated with taro, bananas, sugar-cane, and other productions of the islands, all growing luxuriantly."

In 1855 Bingham (5, p. 379) writes of Waipio's "numerous garden-like plantations of bananas, sugar cane, potatoes, the cloth plant and the *kalo,* in different stages of advancement" and estimates that there were from 1,200 to 1,500 inhabitants.

Waimanu. Waimanu was second only to Waipio as a wet-taro valley. The flatland of the main valley averages about a third of a mile wide and 1.5 miles long and is said to have been completely developed in taro patches. Beyond this, terraces extended 1.5 miles farther up the valley of Waimanu Stream and into the section known as Kealai, where three small streams come down the western slope of the valley and enter Waimanu. I am told that the terraces extended a mile up Waihilau Valley, which opens into Waimanu from the southwest.

Coastal strip, between Waimanu and Pololu. A little over a mile northwest of Waimanu is the tongue of land at the base of the cliffs known as Laupahoehoe. Here, I am told, there were a number of terraces which are now unused. Just beyond Laupahoehoe is a narrow strip of land named Nakooka where there were terraces (between Paopao and Kukui Gulches). Less than a mile beyond this there were terraces on a narrow strip of land named Apua between Waimaile and Waikaloa Streams. Continuing westward there was another group of terraces between Ohiahuaea and Oniu Streams on land named Kawaikapu. Just east of Honopue Valley, on flats below the cliffs were terraces on land named Makakiloia. The valley of Honopue which has flatland in its lower part—about a quarter of a mile wide and three quarters of a mile long—was developed in terraces. Beyond this the terraces continued wherever practicable for about half a mile up the narrower portion of the valley.

In the forest zone on the slopes between Pololu and Waipio and in the gulches and upper valleys grows the usual light green *Aweu* wild taro. In addition to this *kamaaina* informants say that the following varieties are found today, having run wild from early planting in the forest area: *Ulaula, Kumu, Lauloa, Poni, Mana ulu, Mana pikipiki* (having white corm and petiole) *Palaʻi, Wewehiwa,* and *Ieie.* In the forest zone of the Hamakua coast east of Waipio, taro used to be planted and presumably may be found growing wild today.

Dry taro was planted on the open *kula* lands up to the border of the old forest zone and is said to have flourished under a mulch of grass, ti leaves, and other rubbish heaped around it in the red soil. Small patches so growing today seem to flourish. I am told that taro was planted in kukui forests which used to cover the slopes of much of the land that is now planted to sugar cane; for this planting the kukui trees were not felled. Presumably such planting was successful only in relatively open glades. A method of upland planting peculiar to this section was that of felling kukui trees, allowing them to rot, and then planting taros, which are said to have grown to great size, in the decayed refuse (25, vol. 6, pp. 160-162). Another method consisted in digging sizable holes in the ground, filling them with kukui leaves and allowing these to decay completely, after which taros that had been started from cuttings planted in plain soil were introduced and grew to great size.

Menzies gives his impression of the appearance of the *kula* lands of this area "laid out into little fields" (49, p. 51):

> The land we passed in the forenoon rose in a steep bank from the water side and from thence the country stretched back with an easy acclivity for about four or five miles, and was laid out into little fields, apparently well cultivated and interspersed with the habitations of the natives. Beyond this the country became steeply rugged and woody, forming mountains of great elevation.

Concerning upland Humuula in 1823 Ellis writes (20, pp. 193-194):

> The high land, over which we passed, was generally woody, though the trees were not large. The places that were free from wood, were covered with long grass and luxuriant ferns. The houses mostly stood single, and were scattered over the face of the country. A rich field of potatoes, or taro, or large plantations of sugar-cane and bananas, occasionally bordered our path. Though the soil was excellent, it was only partially cultivated.

Hilo

In the great district of Hilo there were taro terraces in and below Laupahoehoe Gulch, watered by the stream of that name and extending onto the land now utilized as school grounds. The other streams along the North Hilo coast, whose valleys were terraced for wet taro were Maulua, Hakalau, Wailea, Honomu, Kapehu, Kawainui, and Aalakahi; they empty into Onomea Bay, Pahoehoe, and Honolii.

In lava-strewn south Hilo there were no streams whose valleys or banks were capable of being developed in terraces, but cuttings were stuck into the ground on the shores and islets for many miles along the course of the Wailuku River far up into the forest zone. In the marshes surrounding Waiakea Bay, east of Hilo, taro was planted in a unique way known as *kanu kipi*. Long mounds were built on the marshy bottom with their surface 2 or 3 feet above water level. Upon the top and along the sides of these mounds taro was planted. Flood waters which occasionally submerged the entire mound are said to have done no harm, as the flow was imperceptible. This swampy land is now abandoned to rank grass. *Kipi* (mounds) were also formerly made along Alenaio Stream, above Hilo. I am told that farther seaward in Waiakea, taro is still grown by the ingenious method of heaping up around a taro, which is submerged in water, and held upright by chunks of lava; the stones presumably accumulate refuse enough to nourish the taro, along with the food taken in by the roots from lava and water.

On the lava-strewn plain of Waiakea and on the slopes between Waiakea and the Wailuku River, dry taro was formerly planted wherever there was soil enough. There were forest plantations in Panaewa and in all the lower fern-forest zone above Hilo and along the course of the Wailuku River. As descriptive of this section of South Hilo in 1823, Ellis writes in his diary (20, pp. 186-187):

> The face of the country in the vicinity of Waiakea is the most beautiful we have yet seen [he had come via Kau and Puna], which is probably occasioned by the humidity of the atmosphere, the frequent rains that fall here, and the long repose the district has experienced from volcanic eruptions. The light and fertile soil is formed by decomposed lava, with a considerable portion of vegetable mould. The whole is covered with a luxuriant vegetation, and the greater part of it formed into plantations, where plantains, bananas, sugar-cane, taro, potatoes and melons, come to the greatest perfection. Groves of cocoa-nut and bread-fruit trees are seen in every direction, loaded with fruit, or clothed with luxuriant foliage.

On the wet *kula* lands of North Hilo, in the lower forest and along streams, unirrigated taro was planted. Ellis describes the appearance of this country (20, p. 191):

. . . [leaving Waiakea]: The face of the country by which we sailed, was fertile and beautiful, and the population throughout considerable. The numerous plantations on the tops or sides of the deep ravines, or vallies, by which they were frequently interspersed, with the meandering streams running down them into the sea, presented altogether a most agreeable aspect.

Puna

Throughout northern Puna there is ample rainfall for raising taro wherever soil permits, and taro used to be planted along the coast as far as Hilo. In 1935 I was told of a large plantation somewhere near Honolulu, northwest of Kapoho. Of this section of Puna Ellis writes (20, pp. 172-174):

[From Kahuwaii] we walked on, in an inland direction to Honoruru, a small village situated in the midst of a wood. . . . traveling toward the sea-shore, reached Waiakaheula . . . [proceeding thence] the country was populous, but the houses stood singly, or in small clusters, generally on the plantations, which were scattered over the whole country. Grass and herbage were abundant, vegetation in many places luxuriant, and the soil, though shallow, was light and fertile . . . they reached Kaau, the last village in the division of Puna [going toward Hilo]. It was extensive and populous, abounding with well-cultivated plantations of taro, sweet potatoes and sugar-cane, and probably owes its fertility to a fine, rapid stream, which, descending from the mountains, runs through it into the sea. It was the second stream they had seen on the island [proceeding from Kona].

The fern-covered plains between the forest and seacoast in northeast Puna used to be planted in taro by the burning over, digging up, and planting process described on page 52.

On the outer slopes of Kapoho Crater there were a few dry taro patches in 1935. Inside the valley made by the craters are now many old breadfruit trees and a few Oriental truck farms. Ellis (20, pp. 166-167) gives an interesting picture of Kapoho in 1823:

. . . A cluster, apparently of hills, three or four miles round, and as many hundred feet high, with deep indented sides, overhung with trees, and clothed with herbage, standing in the midst of a barren plain of lava, attracted our attention. We walked through the gardens that encircle its base, till we reached the southeast side, where it was considerably lower than on the northern parts. Here we ascended what appeared to us to be one of the hills and, on reaching the summit, were agreeably surprised to behold a charming valley opening before us. . . .

The sides of the valley, which gradually sloped from the foot of the hills, were almost entirely laid out in plantations, and enlivened by the cottages of their proprietors. In the center was an oval hollow, about half a mile across, and probably two hundred feet deep, at the bottom of which was a beautiful lake of brackish water, whose margin was in a high state of cultivation, planted with taro, bananas, and sugar-cane. The steep, perpendicular rocks, forming the sides of the hollow, were adorned with tufts of grass, or blooming, pendulous plants; while, along the narrow and verdant border of the lake at the bottom, the breadfruit, the *kukui*, and the *ohia* trees, appeared.

The wet and sometimes marshy pandanus forests from Kapoho through Poho-iki to Opihikao used to be planted with taro in places, following the methods described on page 53.

Several miles inland from Kapoho through Malama to Kamaili, there are steep slopes largely covered with rich soil. These slopes are now mostly in sugar but anciently were planted with taro throughout. That this was ideal taro land is demonstrated by the flourishing plantations still maintained by several Hawaiian families in the Malama homestead area. In this section of Puna lava flows have destroyed much fine agricultural land that was in use until relatively recent times. Concerning Malama and other adjacent districts Ellis writes (20, pp. 163-164):

> . . . then resumed our walk through the district of Malama, the inland part of which was inundated by a volcanic eruption about 35 years since. The part over which we passed being nearer the sea than that which the lava had overflowed, was covered with soil, and smiling with verdure. . . .
>
> A most beautiful and romantic landscape presented itself on our left as we travelled out of Pualaa. The lava was covered with a tolerably thick layer of soil, and the verdant plain, extending several miles toward the foot of the mountains, was agreeably diversified by groups of picturesque hills, originally craters, but now clothed with grass and ornamented with clumps of trees. The natives informed us that these three groups, Honuaura, Malama, and Mariu, being contiguous, and joined at their base, arrested the torrents of lava which, in the days of Taraiopu, the friend of Captain Cook, inundated all the country beyond them.

Taro is still grown on homesteads in Opihikao and Kamaili, and beyond them in upper Kaimu, Makena, and Kalapana, as far as the forested slopes behind the village of Kapaahu. One energetic Hawaiian of Kapaahu has cleared ohia forest, at a place called Kahoonoho about 2.5 miles inland, and has a good stand of taro, bananas, and sugar cane in two adjacent clearings (pl. 7, *B*). According to this planter, there used to be some planting in the forest southwest of Kapaahu, but the coast is too dry. However, the whole forest land northeast of Kapaahu, with the exception of sections destroyed by lava flows, is capable of supporting taro and used to be covered with plantations.

According to information received in that locality, Kahoonoho and Walaohia were the two great forest planting areas in Kahaualaea *ahupua'a*. Kupahua, now a homesteading area, formerly supported taro, as did upper Kalapana and upper Kaimu. Makena and lower Kaimu supported sweet potatoes but not taro, and Kikala and Keakea supported neither, being mostly pahoehoe lava. Homesteading areas in Keauohana, Kehena, Keekee, Kamaili, Kaueleau, and Opihikao used to be planted more or less throughout their inland sections in dry taro; and in all these *ahupua'a* some taro is now grown by Hawaiians for home consumption.

Ellis traveling from southwest Puna along the coast toward Kapoho, describes the country as beginning "to wear a more agreeable aspect" after they passed Panau, 6 or 7 miles southwest of Kapaahu. Groves of coconut trees and clumps of *kou* are mentioned. Kupahua is described as "a pleasant village, situated on a rising ground in the midst of groves of shady trees, and surrounded by a well-cultivated country" (20, p. 154). Continuing along the coast, the missionaries came to Kaimu:

> . . . Kaimu is pleasantly situated near the sea shore, on the southeast side of the island, standing on a bed of lava considerably decomposed, and covered over with a light and fertile soil. It is adorned with plantations, groves of cocoanuts, and clumps of *kou* trees. It has a fine sandy beach, where canoes may land with safety; and according to the houses numbered today, contains about 725 inhabitants. Including the villages in its immediate vicinity along the coast, the population would probably amount to 2,000. . . . The extent of cultivation in the neighborhood, together with the decent and orderly appearance of the people, induce us to think they are more sober and industrious, than those of many villages through which we have passed.

Kamaili is described (20, p. 163) as "a pleasant village, standing on a gently sloping and verdant valley" where the people were "employed on their plantations", and where they [the travelers] were given potatoes and taros.

One of the most interesting things about Puna is that Hawaiians believe, and their traditions imply, that this was once Hawaii's richest agricultural region and that it is only in relatively recent time that volcanic eruption has destroyed much of its best land. Unquestionably lava flows in historic times have covered more good gardening land than in any other district. But the present desolation is largely due to gradual abandonment of their country by Punans after sugar and ranching came in.

Kau

Kapapala. Between Kapapala and Kilauea there was never any cultivation, so far as I can learn. Below Kaoiki Pali the country is covered with lava, and in the forests above the pali from Kapapala to Ohaikea the bird snarers or feather hunters had their huts, but no taro was grown. On the land flanking Kapapala Ranch, which is now in sugar cane, dry taro used to be grown on the sloping *kula,* on the steep hillsides of gulches, and in the forest lying behind. Forest taro was here referred to as *ulu laau* (forest growth), that on steep slopes as *piina* (climbing).

The same type of planting was typical of Makakupu and Kaalaala, notably in and on the slopes of what is known as Wood Valley, which is now a homestead area. Concerning this section Ellis writes (20):

> After travelling about an hour, we came to Kapauku, a pleasant village, belonging to Naihe. As we passed through it, we found tall rows of sugar-cane lining the path on either side. [p. 105]

. . . We . . . resumed our journey over the same verdant country, frequently crossing small vallies and water courses, which, however, were all dry. The land, though very good, was but partially cultivated, till we came to Kaaraara, where we passed through large fields of taro and potatoes, with sugar-cane and plantains growing very luxuriantly . . . we passed on through a continued succession of plantations, all in a high state of cultivation. [p. 115]

The lava is decomposed to a considerable depth, and is mingled with prolific soil, fertile in vegetation. . . . The road by which we returned, lay through a number of fields of mountain taro, which appears to be cultivated here more extensively than the sweet potato. [pp. 120-121]

From Kaalaala through Punaluu, Ninole, Hilea, and Honuapo, as far as Waiohinu, dry taro was cultivated on the high *kula* lands as low as rainfall permitted, and well back into the forest above. Hilea was famous for its *Mamaki.*

Waiohinu. This is the only place on southeast Hawaii that boasted any terraces. The stream named Ka-wai-o-Haao, rising in the spring named Haao, had along its banks seven terraces, lying between Waimalino and Kahuaolihue and extending up to the rear of the present Catholic church. We were told by *kamaaina* that these terraces were abandoned in the 1880's when the upland springs were tapped for sugar plantation use.

Ellis (20, pp. 103-105) describes this country:

Our path running in a northerly direction, seemed leading us toward a ridge of high mountains, but it suddenly turned to the east, and presented to our view a most enchanting valley, clothed with verdure, and ornamented with clumps of *kukui* and *kou* trees. On the south-east it was open toward the sea, and on both sides adorned with gardens, and interspersed with cottages even to the summits of the hills. A fine stream of fresh water, the first we had seen on the island [they had landed at Kailua, in Kona], ran along the center of the valley, while several smaller ones issued from the rocks, on the opposite side, and watered the plantations below . . . then continued our way along its margin through Kiolaakaa, walking on toward the sea until we reached Waiohinu. . . .

Our road, for a considerable distance, lay through the cultivated parts of this beautiful valley. The mountain taro, bordered by sugar-cane, and bananas, was planted in large fields on the sides of the hills, and seemed to thrive luxuriantly. On leaving the valley . . . along the foot of the mountains . . . the country appeared more thickly populated.

Kaalualu. In lava-strewn lowland sections of Kau—such as Kaalualu, below Waiohinu—which were too dry on the surface to support taro, there are here and there what Hawaiians call *kipuka* (holes). Some of these are small areas surounded by lava where the surface soil was spared by a flow, others in places where lava has caved in and the bottom has become filled with decayed vegetable refuse, making rich humus. Being beneath the surface of the surrounding land, protected from wind and partially shaded, some of these *kipuka* made good taro beds. They were all named. The *kipuka* below Pakini, named Ke-a-maka-hiolo, Ohua-nui, and Huli-alii, were planted with both taro and

sweet potatoes; that named Mohoae was planted with taro only. Taro was also planted in *kipuka* named Waiopua and Keaa.

Evidently the following description by Menzies (49, pp. 185-186) refers to Waiohinu and its vicinity. Kioloku is doubtless Kiolakaa, the land west of Waiohinu Valley.

> . . . The economy with which these people laid out and managed their ground and the neatness with which they cultivated their little fields made the whole valley appear more like a rich garden than a plantation. A stream of water which fell from the mountain through the middle of it was ingeniously branched off on each side to flood and fertilize the most distant field at pleasure. . . . We set off early in the morning . . . and ascended a steep verdant hill on the eastern side of the valley, from the summit of which we had a charming prospect of the country for a long way before us, presenting extensive and rich plantations industriously cultivated. As we passed on through them, the natives pointed out one which they said the king had given to Kualelo soon after we left him on the island. This was further confirmed to us by the vassals on it readily owning Kualelo as their chief. We found the people everywhere busily employed in their little fields, many of which were here cropped with plantains and bananas that had a ragged appearance from having little or no shelter, yet they bore fruit tolerably well. We seldom observed these vegetables cultivatd so low down on the western side of the island, where they generally occupy the verge of the forest, a situation which for shelter seems more congenial to their tender feelings. We observed here that they suffer many of their fields here and there to lie fallow, and these in general were cropped with fine grass, which they cut down for the purpose of covering their new planted fields of taro or yams to preserve them from the powerful heat of the sun.

Kiolakaa. West of Waiohinu in upper Kiolakaa are a number of homesteads in the lower forest zone at elevations of 1,500 to 2,000 feet where taro flourishes in clearings in the forest or bush. There is one walled enclosure, which is evidently a plantation of some antiquity. Walled enclosures where taro used to be grown, on what is now ranch land, may be seen both above and below the road as far as Pakini.

Pakini. This flatland, at about 1,500 feet altitude on the slopes above Kaalualu, was formerly covered with taro. It is now neglected pasture land with no taro. That this was an especially famous taro section is attested by the existence here of the Heiau Hoouluuluai (Shrine To-cause-food-to-grow), named Pakini and dedicated to Kane-apua. This heiau and its use are described in volume 2. The best-liked taro grown on this land was a variety named *Paua* (p. 15), now apparently extinct, which had the reputation of staying good in the ground "till moss clung to the stalks."

Kalehu. Kalehu, which is said to have been inland from Ka Lae (South Point), was described by Ellis (20) as having dry taro growing in "sandy soil." The quotation is interesting as it indicates the use of soil in Kau for *kalo maloo,* similar to soil used for *kalo wai* at Laie on Oahu. The description indicates sickly taro, but it was evidently edible.

SWEET POTATO

Terms Applied to the Sweet Potato

The habit and parts of the sweet potato are shown in figure 12. The following list gives descriptive and color terms applied to parts of the potato plant.

Root:	loloa	long
	pokopoko	short
	poepoe	round
	palahalaha	flat
	awaawaa	grooved, ridged, channeled
	nemonemo	smooth surfaced
	paakiki	hard
	palupalu	soft
	momona	sweet
	manalo	sweetness
	punapuna	mealy
Vine:	loloa	long
	pokopoko	short
	lupalupa	vigorous
	poko'u	short
	a'ana li'i	stunted
	keiki	sport, bud-mutant
	holili	underdeveloped
Leaf:	poepoe	round
	kihikihi	with sharp points (corners)
	manamana	divided (fingered)
	hoiki	narrow
	akea	wide
	nunui	large
	nui	many leaves
	ponalo	yellowing
Colors:	kea	white
	hakeakea	dirty whitish
	ke'oke'o	whitish green
	uliuli	dark, dusky
	hauliuli	darkish
	poni	purple
	ulaula	red
	akala	pink
	haulaula	reddish, pink
	eleele	black
	maku'e	dark red
	melemele	yellow, pumpkin color
	lenalena	bright yellow (like turmeric, olena)
	halenalena	yellowish
	oma'oma'o	green

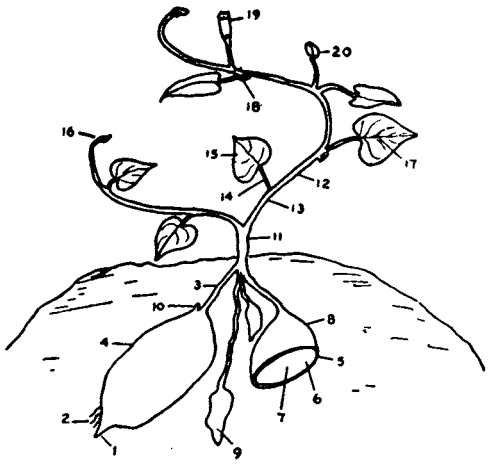

FIGURE 12.—The sweet potato plant showing habit and terms for parts.

1. mole: tap root
2. huluhulu: rootlets
3. a'a: root
4. uala: tuber
   5. ili kana: cortex
   6. i'o: flesh
   7. iho: core
   8. ili uala: skin of tuber
   9. hua uala: seed potato
   10. maka: bud
11. kumu: stalk
12. ka: vine
    13. ili ka: skin of vine
14. ha: petiole
15. lau: leaf
    16. muo: leaf bud
    17. a'a lau: veins, midrib
18. maka: root buds
19. pua: flower
20. hua: seed

WILD VARIETIES

SWEET POTATOES WHICH RUN WILD

In various places—as for example in Waimanalo and Punaluu on Oahu, in several localities on eastern Maui, and at Malama in Puna, Hawaii—old sweet potato vines are found running wild on sites that were once cultivated. The variability of leaf form (fig. 16, *i*) in the vines running wild in Punaluu Valley on Oahu suggests the possibility, recognized by botanists, that cultivated sweet potato vines, when left to run wild, may revert to ancient type. If such reversion is taking place, a study of wild plants may reveal better evidence bearing upon relationships of old Hawaiian sweet potatoes to other Polynesian and to American varieties than the study of highly specialized varieties still under cultivation. In upland localities that were formerly planted on Hawaii, some potato vines may have survived the grazing of cattle.

WILD SWEET POTATOES

Even more interesting are the possibilities of studying wild sweet potatoes said to be growing in various localities. I have made numerous unsuccessful attempts to collect, or to procure through natives, specimens of wild plants that have been described. In Kau, Hawaii, it is said that Hawaiians used to dig up in the forests, from great depths what was called the *Paha* or *Koali uala* (sweet potato morning-glory), which had a heart-shaped leaf like the wild morning-glory but tubers like the sweet potato. During normal times this was used as pig feed but during famines was eaten by human beings. It is possible that this *Koali uala* may still be found, if cattle have not completely destroyed it. E. H. Bryan, Jr., tells me that he has seen what was evidently a wild potato of this description growing on the island of Kahoolawe. On eastern Maui it is said that the variety named *Kupa* (fig. 14, *g*) grows wild in the uplands; and vines, which may be *Kupa,* growing wild above Nahiku, have been described to me. In Kaupo I was told that the variety named *Aehaukae* (fig. 13, *a*) is actually a wild potato, which was found in many localities before the days of ranching. Cattle relish sweet potato leaves and vines, consequently there is small chance of collecting vines running wild or native to forest or *kula.*

CULTIVATED VARIETIES

By selection in the field and in collected specimens and with the aid of information given by old native planters, the following varieties still planted are judged to be ancient Hawaiian:

Aehaukae	Kihikihi poepoe	Pala'ai
Apo	Ku'i popo	Panini
Heawe	Kupa	Pa'u-o-Hiiaka
Huamoa	Mahina kehau	Pia
Kala	Mohihi ke'oke'o	Piko ha'o
Kawelo	Mohihi ulaula	Piko nui
Kawowo	Onohinohi	Pohina
Kihe	Pakeke	Uahi-a-Pele

The above varieties, and a number of others now commonly planted, some of which are known to have been introduced, are shown in figures 13 to 16. Many doubtful specimens, names recorded without specimens, a good many descriptions, and recent American, Japanese, and Portuguese introduced varieties are omitted. Probably not an eighth of the specimens I collected are reported in this paper. There are many Hawaiian varieties still planted on Kauai (where I devoted relatively little attention to potatoes), probably on Niihau, and certainly on Hawaii and on Maui that I have never seen. Sweet potatoes are more difficult to study thoroughly than taro because they are seasonal, shorter lived, and more variable, and also because of the psychological

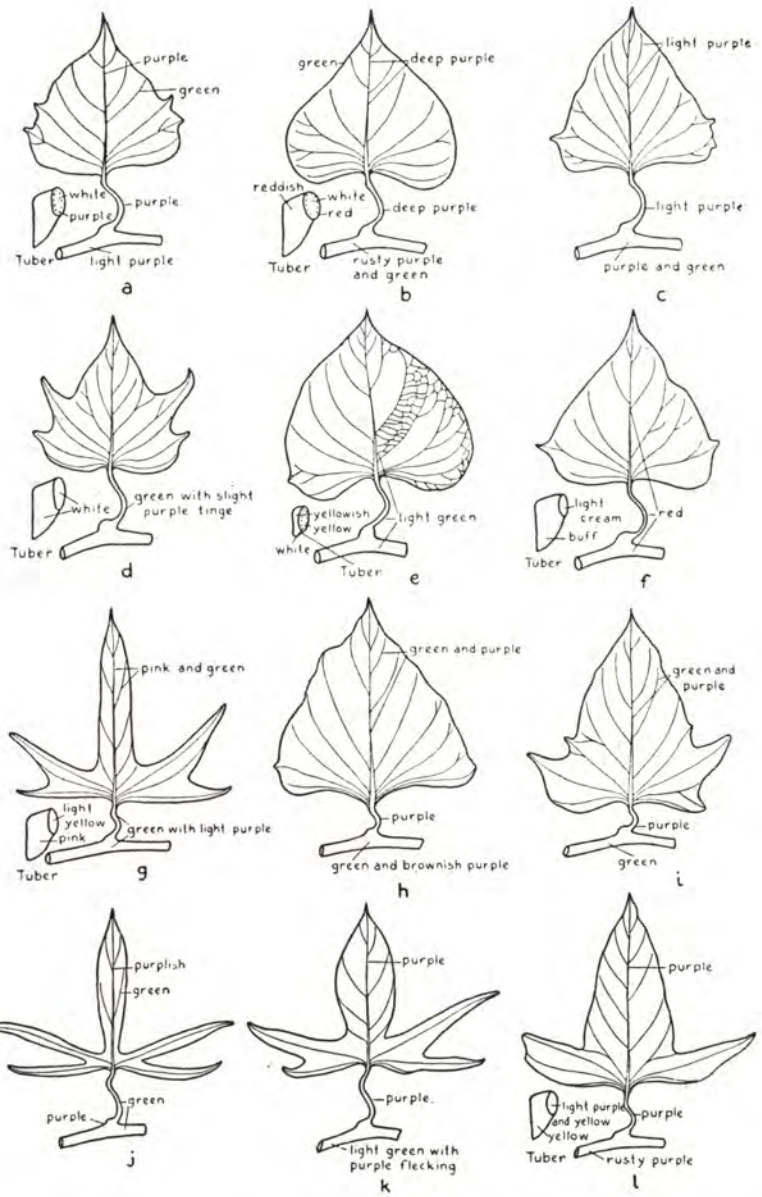

FIGURE 13.—Leaf and tuber characteristics of sweet potato varieties: *a, Aehaukae; b, Apo; c, Eleele; d, Heawe; e, Huamoa; f, Kahului; g, Kala; h, Kalia; i, Kamalino; j, k, l, Kaneohe.*

effect these characteristics have on the planters, whose knowledge of potatoes is much less dependable than that of taros.

Hawaiians identify varieties by color of skin or flesh of the tuber, color of vine and veins of leaf, and by leaf form. They recognize variation in size, form, and surface of tubers, and sometimes this determines naming. Thus the *Piko nui* (great navel) with its flattish round tuber suggests a giant, swollen human navel. *Huamoa* is so called because in size and coloring the cooked tuber suggests the yellow of a hen's egg, and it is said, when raw, to have the odor of an egg. *Kihikihi poepoe* (round with corners), and *Kala* (pointed) take their names specifically from the shape of the leaf. *Uahi-a-Pele* (Pele's-smoke) and *Pa'u-o-Hiiaka* (Skirt-of-Hiiaka) are named after or associated with these sister volcano goddesses because of their dusky, smoky foliage. *Pia* is so called because its pure white tuber resembles in color and consistency the *pia* or arrowroot.

Varieties differ in the number of months they require to mature and the length of time they may remain in the ground. Thus *Kihe* matures in 4 months, *Pa'u-o-Hiiaka* in 4 to 6 (depending on locality), and *Kawelo* in 6 to 8 months. *Piko ha'o* is slow, taking a year in dry places, but is very hardy and so is recommended for such localities. Of course rainfall and soil affect the length of time it takes to mature as well as length of time the tubers may be left in the soil after maturing. For this reason it was impossible to record satisfactory data on these points in the course of collecting in various localities in different seasons. To compare varieties it will be necessary to observe them under cultivation in an experimental plantation.

LOCAL TRANSFERS

There are certain varieties locally known by the name of the place in the islands or the foreign place from which they have been transferred. Thus, *Lahaina* and *Kahului* (towns on the island of Maui) are recognizably the hardy introduced *Mauna pohaku*; and this same variety I found called *Maui* in Kona, Hawaii. On the other hand, at Ulupalakua, Maui, *Lahaina* is said to be the same as *Ka'e,* an introduced variety with deeply indented 5-point leaf, with purple and green coloring on veins, petiole, and vine, and tuber with brownish skin and yellow flesh. (Compare *Ma'ihui* below.) Here the tuber resembles *Mauna pohaku* (called *Lahaina* on Molokai) but the leaf does not. On Niihau the variety named *Wailua* (presumably introduced from Wailua, Kauai) appears to be ancient Hawaiian (fig. 16, *h*).

The most deeply indented of all leaf forms occurs on a potato frequently seen and generally called *Kaneohe* (fig. 13, *j-l*). In 1931 in Kaupo, Maui, two sub-varieties of this leaf were collected, *Kaneohe ke'oke'o* (white Kaneohe) with foliage and vines light green throughout; and *Kaneohe ulaula* (red

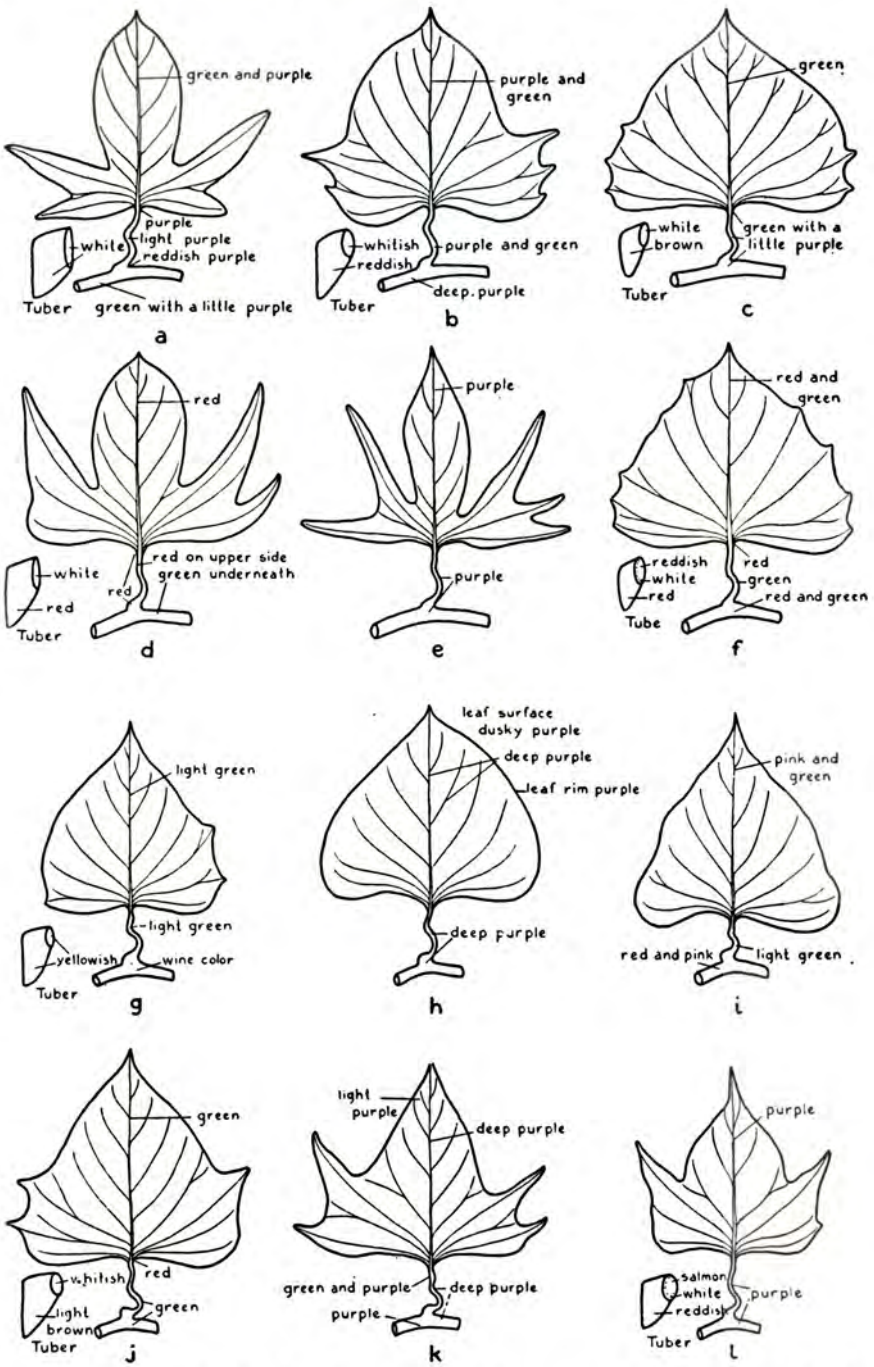

FIGURE 14.—Leaf and tuber characteristics of sweet potato varieties: *a, Kawelo; b, Kawowo; c, Kihikihi poepoe; d, Kihe; e, Kome ulaula; f, Ku'i popo; g, Kupa; h, La'i-o-Kona; i, Likolehua; j, Mahina kehau; k, Ma'ihui (ke'oke'o,* white; *ulaula,* red); *l, Manu.*

Kaneohe), having some purplish coloring on vines and foliage. The tuber was not seen. In 1934 I was given in Kaupo, Maui, a quite different leaf said to be *Kaneohe* (fig. 13, *l*) whose tuber is long, yellow-skinned, with light purple and yellow flesh; at Ulupalakua, Maui, still another leaf (fig. 13, *k*) was called *Kaneohe*. Kaneohe is the name of a district on Oahu which has been intensively cultivated by Orientals in recent times; thus the transfers from that locality may have been introduced varieties. On the other hand the *kula* lands of Kaneohe were intensively planted with sweet potatoes by the ancient Hawaiians, which may indicate that one of the above plants is old Hawaiian.

FOREIGN VARIETIES

The most common of the introduced foreign varieties is the hardy *Mauna pohaku* (Rocky Mountain) which is universally planted and favored by Hawaiians because of its vigor, adaptability, and productivity. The tuber is large and has a brownish skin and yellowish flesh, the vine is very thick and so vigorous that when planted in rainy localities and new soil it grows to great length, covering the ground completely; the foliage is often used as pig food. The vine, petiole, and veins are purple, and the leaf large and heart-shaped (fig. 15, *a*). The name "Rocky Mountain" is used by Hawaiians to refer to Utah; I infer that this potato was introduced from Utah, presumably by Mormon missionaries. *Mauna pohaku* is sometimes called *Lahaina* and *Kahului* on Molokai; and *Maui* on the island of Hawaii. *Kuluehu,* collected at Ulupalakua, Maui, appears to be the same.

A potato resembling the above and having a leaf of the same shape, but with more green in the petiole and vine, is sometimes called *Kaleponi* (California) on Maui. (There was an old Hawaiian potato named *Kala poni* "purple kala.") What appears to be the same variety was also referred to once in Kaupo, Maui, as *Nukilani* (New Zealand). Here I was told that this was also called *Neki* because it was introduced by Ned Wilcox who lived at Makena, and that it was sometimes called *Oliva* (olive), and also *Aehaukae* (running wild), the name of an old Hawaiian variety with leaf similar to that of the introduced variety.

The *Nukilani* just referred to had a heart-shaped leaf like the *Mauna pohaku.* But later, also at Kaupo, I was given a heart-shaped leaf having two points on either side (fig. 15, *f*) which is identical in shape to the *Aehaukae* collected in Kona; and this was called *Nukilani* in Kaupo. This seems to indicate identity in leaf form of an old Hawaiian variety with an introduced New Zealand variety. The New Zealand variety, however, has yellowish skin and white flesh, while the Hawaiian potato has purple skin, white cortex, and purple flesh.

Several varieties said to have been introduced by Portuguese (the Portu-

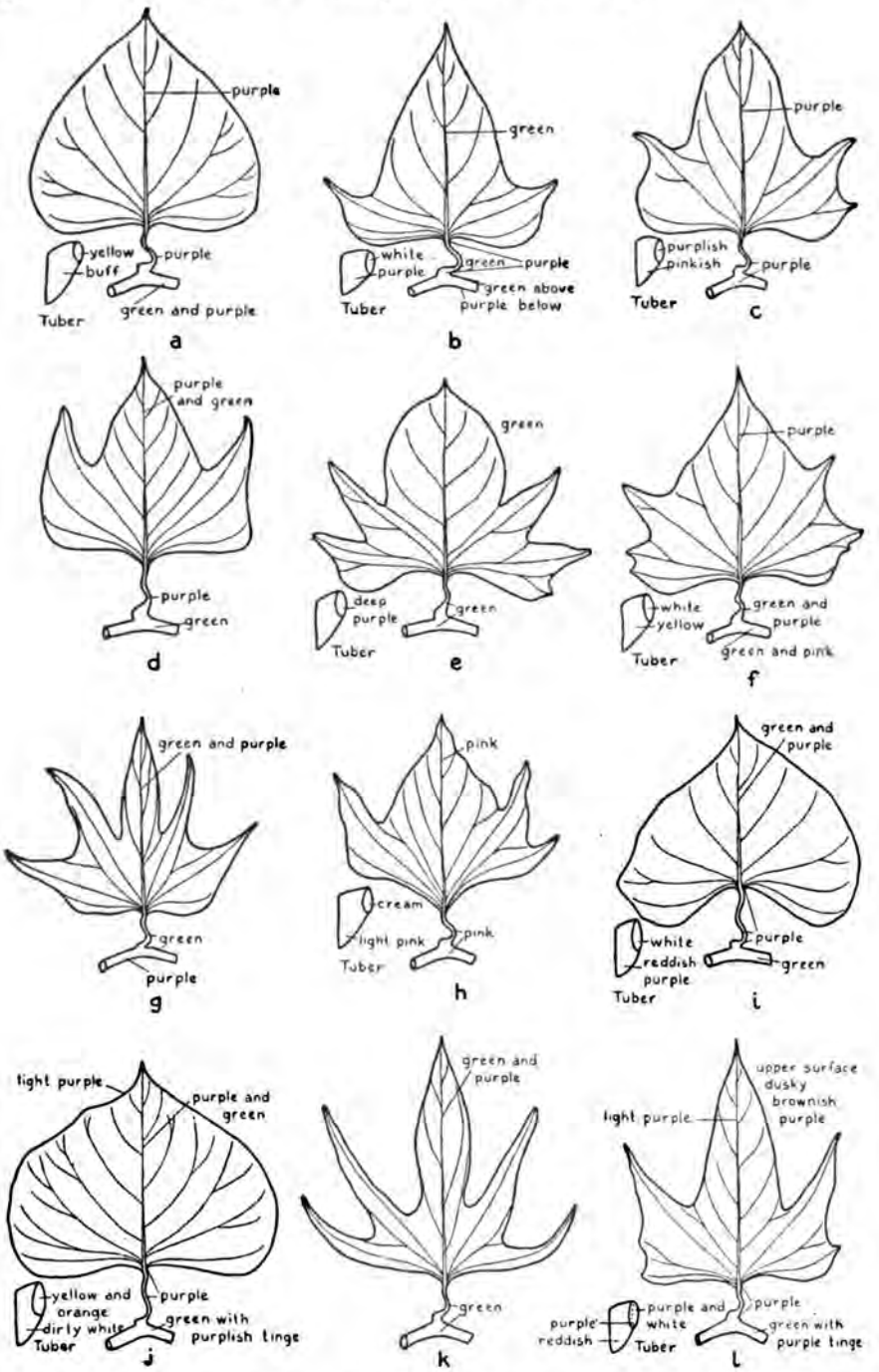

FIGURE 15.—Leaf and tuber characteristics of sweet potato varieties: *a, Mauna pohaku; b, Mohihi ke'oke'o; c, Mohihi ulaula; d, Molokai; e, Nika nui; f, Nukilani; g, Oheohe; h, Onohinohi; i, Pakeke; j, Pala'ai; k, Papa'a kowahi; l, Pa'u-o-Hiiaka.*

guese in Hawaii came from Madeira and the Azores) are planted by Hawaiians and called *Pukiki* or *Pokiti*. One of these found at Kaupo, Maui, has a deeply indented 5-point leaf with petiole and veins from purple to green, and purple vine. Another, collected at Honokaa, Hawaii, has a very deeply indented 3-point leaf with purple veins, petiole, and vine. The potato of this variety has a brownish purple skin and white, hard flesh.

Several Japanese varieties are planted by Hawaiians. Two of these, both called *Okinawa* (the name of the Japanese ethnic group who are plantation workers along the Hamakua coast), were collected at Honokaa, Hawaii. One of these has a long, narrow, pointed leaf with two wide, flaring points at the base, with purple and green veins and petiole, reddish purple vine, light skin, and white flesh; the other has a narrow, pointed, heart-shaped leaf with small, irregular points toward the base, green and purple veins and petiole, purple vine, purple skin, and white flesh. Another variety seen in North Hilo, said to be Japanese, has a green, hairy vine.

A variety which I believe to be introduced, grown extensively by Hawaiians, is called *Pu* (pumpkin) because of its whitish skin and yellow flesh which resembles the pumpkin in color and in consistency when cooked. It has a broad, heart-shaped leaf with points at irregular intervals along its margin (fig. 16, *e*), white veins, red margin on young leaves, red and white petiole, and red vine. A trustworthy informant on Molokai from whom I first collected this variety told me that it was introduced from Madeira about 35 years ago by an old Portuguese named Luce Ferreira, who lived at Kaapaha, Hamakua, Hawaii.

A number of introduced varieties are named descriptively. *Nika* (nigger) is applied to several varieties whose tubers are very dark when cooked. *Nika nui,* found at Kaupo and Ulupalakua, Maui, so called because its potatoes are large (*nui*), has a broad, moderately indented, 5-point leaf (fig. 15, *e*), green veins and petiole, and purple vine. What is called *Nika* in Kona, Hawaii, has a broad, deeply indented, 5-point leaf with green veins, purple margin and petiole, purple and green vine, purple skin, and white flesh when uncooked but dark when cooked.

Kalika (silk) is a name given to several presumably introduced varieties on Maui and Molokai. One collected at Kaupo, Maui, has a 5-point leaf deeply indented, with purple veins and purple leaf-base, and rusty purple and green petiole and vine. Another collected at the same place and termed *Kalika ulaula* has a long narrow leaf with two wide points at the base, purple and green veins and petiole, and purple vine. *Kalika* collected on Molokai has a moderately indented 5-point leaf, purple veins, leaf margin, and petiole, red vine, brownish skin, and yellow flesh. The name "silk" has reference to the glossy appearance of the leaf (fig. 16, *m-p*).

Wai aniani (window pane), collected on Molokai, is so called because of the transparency of its white flesh. The skin is white, vine and foliage light green throughout, and the leaf is long and narrow with two or more wide

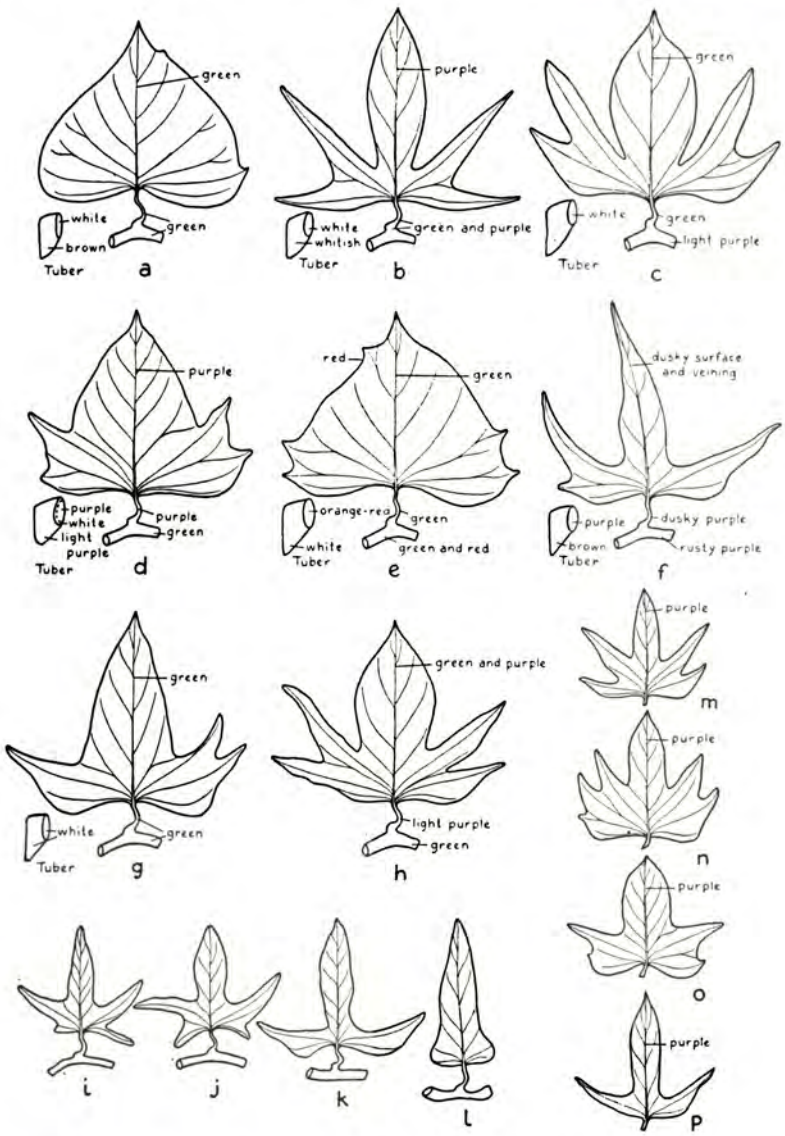

FIGURE 16.—Leaf and tuber characteristics of sweet potato varieties: *a, Pia; b, Piko ha'o; c, Piko nui; d, Pohina; e, Pu; f, Uahi-a-Pele; g, Wai aniani; h, Wailua; i, j, k, l,* variability characteristics of leaves of sweet potato vine running wild, pigmentation green throughout; *m, n, o, p, Kalika.*

flaring base points (fig. 16, *g*). As with *Kalika* and *Nika* the recently introduced term used as a name implies that the variety is probably not old.

In Kaupo, Maui, I collected two varieties that were introduced into this district by a Hawaiian named Mai Hui. The varieties are called after him, *Ma'ihui ke'oke'o* (white *Ma'ihui*), and *Ma'ihui ulaula* (red *Ma'ihui*). Informants here and at Kipahulu say these are foreign potatoes. Both have the same leaf shape (fig. 14, *k*). The so-called white variety has light purple veins, greenish purple petiole, and purple vine, while the so-called red has deep purple petiole, veins, and vine. I have not seen the tuber. One informant said that another name for these is *Pu'u lani,* which suggests that it may be old Hawaiian. Another said that the old man (Maihui) who planted it was toothless (*ka'e*), and that consequently the potato was nicknamed *Ka'e*.

In Kona, Hawaii, several varieties are called *Kome* and were presumably introduced by someone named Tommy. One of these appears to be identical with the potato called *Kawelo* on Maui. The other, termed *Kome ulaula,* has a deeply indented leaf (fig. 14, *e*), and may be old Hawaiian.

The list of variety names is compiled largely from my own notes, with a few additional names from Rooke (65a) and other lists.

The naming of sweet potatoes is far less consistent than that of taros, consequently there is much more duplication. The plant itself is very plastic, mutates rapidly, and is easily carried from one locality to another. New varieties created by selection or old varieties brought into a new locality are commonly given the name of the person bringing them, the place brought from, or the place first planted. A sport or mutant is termed *kahuli.*

List of Sweet Potato Names

Aehaukae
Alala
Alamea
Aliolio
Apala
Apauakeoe
Apo
Aumakiki
Auona
Auono
Awapuhi

E'epu'u
Eleele
Eleele kohola
Eueu

Ha'ae
Ha'awapuki
Ha'elelepo
Halonaipu
Hamo
Haoe'e
Haue'elani
Hawai
Hawai'i
Heakeaiule
Heawe
He'eua'u
Hei
Hekili
Helapa
Helelei
Helemalie
Hepa'a
He'unaheuhu
Hiiaka
Hilo
Hokeo
Holei
Holue'e
Ho'okano
Ho'okeo
Ho'olulele
Ho'omau
Hualani
Huali'ili'i
Huamoa
Huaono

Ihunui or Piko nui
Ipu-o-Lono

Ka'e
Ka'eumu
Kahiki (Irish potato)
Kahuli
Kahului
Kake
Kakaka-o-Keawe
Kakake-ili-pohoe'e
Kala
Kala ke'oke'o

List of Sweet Potato Names—*Continued.*

Kala poni
Kalia
Kalika
Kalika lau ke'oke'o
Kalika ulaula
Kamalino
Kaneohe
Kaneohe ke'oke'o
Kaneohe ulaula
Kanepua'a
Kaniala
Ka-nika
Kaniko
Ka'omealani
Kapani'a
Kapena-keoe
Kauaheahe
Kauka'ele
Kawao
Kawelo
Kawelo-kupa
Kawowo
Ke'au mahina
Kehikehi
Kekake
Kekake eleele
Kekawowo
Kekoha
Ke-koko-a-Keawe
Keoe
Kepoe
Keponi (Japanese)
Kihe
Kihikihi poepoe
Kihi lau manamana
Kihi lau nui
Kihi poepoe
Kihi poipoi
Ki'ihekeke
Kiokio
Kipapa
Kipawale
Koali
Kome ulaula
Kona pakeke
Ko'oka
Koumi
Kuamalou
Ku'i popo
Kuluehu
Kupa
Ku'unahawela

La'ela'e
Lahaina
Lahaloa
Laholile
La'i-o-Kona
Laloloa
Lanai
Lapa
Lau ulaula
Lawelawe
Lehelehe nui
Lehilehi nui
Lihau
Lihilihipalu
Likolehua
Lilimolina
Lima-wiwi

Mahina
Mahina kehau
Ma'ihui ke'oke'o
Ma'ihui ulaula
Mai'o
Makakila
Makanui
Malihini-a-ka-wai
Manamana
Manamana ke'oke'o
Manana
Maniania
Manini
Manu
Maoli
Mapela
Mapala ke'oke'o
Maui
Mauna pohaku (rocky mountain, i.e. Utah)
Mauui
Moe ahua
Mohihi
Mohihi ke'oke'o
Mohihi ulaula
Mokeawe
Molokai

Nakulehua
Nanani eneene
Nanani ke'oke'o
Nau
Ne'ene'e
Nenewai
Nihi popo
Nika ("nigger", old name paele)
Nika eleele
Nika ke'oke'o
Nika nui
Nukilani (New Zealand)
Nukukau
Nukulehu

Oheohe
Okilipi
Okinawa (Japanese)
Okohola
Onohinohi

Pa'apa'aina
Pa'auhau
Pa'ele
Pa'ele-hili-manoanoa
Pa'i kukui
Paiowea
Pakeke
Palà
Pala'ai
Palakaia
Palama
Palamahiki
Palani
Palikea
Pani-kohe
Panini
Panioe'e
Papa'a kowahi
Pau
Pa'u-o-Hiiaka
Pa'u'u
Pehu
Pia
Piapia
Piko ha'o
Piko manamana
Piko nui
Pilimai
Poe
Pohe
Pohuehue
Pohina
Pokiti (Portuguese)
Pukiki ke'oke'o
Poni
Pu
Pua-Kawaihae
Puehuehu
Pu-hei
Puhi
Pula-ka-maka

List of Sweet Potato Names—*Continued.*

Punana	Uhanui	Wailaulau
Pu'u	Ulu	Wailua
Pu'u Anahulu	Unahihu	Wainiha
Pu'u ke'oke'o	Unahi-uhu	Waipalupalu
		Wehiwa
Uahi-a-Pele	Wahakale	Welowelo la
Uhalula	Wai aniani	

Planting and Cultivation

Season and Weather

Although taro has a greater adaptability to both sunlight and moisture (too little sun or too much rain quickly spoils the potato), the sweet potato is the more valuable of the two staples in three ways: it can be grown in much less favorable localities, both with respect to sun and soil; it matures in 3 to 6 months (as against 9 to 18 months for taro); and it requires much less labor in planting and care in cultivation.

The time factor regulating the planting of sweet potatoes is one of somewhat variable cycles of weather rather than of regular seasons. The following simple principle has universal application among Hawaiian planters and may be regarded as summarizing the relation of potato planting to season and weather.

> In dry localities wait until the ground has had several good soakings, then plant your slips and pray for more rain after they root; in damp localities wait until it is obvious that a rainy period has drawn to a close, then plant and hope for a season of light showers and plenty of sun. The Kona storms from December to February drench all windward localities which are generally dry in summer; hence late winter is a planting time in these places, but a time avoided elsewhere. However, the situation may be reversed, as recently at Ulupalakua and Makena on southwestern Maui, where, after continued drought unbroken even in the winters of 1932, 1933, and 1934, heavy rains came in late spring of 1934, bringing conditions favorable to planting. At Kaupo on southeastern Maui planting is begun in August, when showers generally start, and no planting is done after April, when drought usually begins; but in 1933-34 the winter months were dry and rains came in the spring and summer of 1934. At Kipahulu on eastern Maui, just beyond the genuinely wet windward coast, there is normally one planting in September when winter rains begin in moderation and another in March when the heavy winter rains end and summer showers follow. In Kona, Hawaii, a great sweet potato country, currents of air set up by the trade winds pouring round the slopes of Mauna Loa make the summer months showery, although the general precipitation on this coast is low as on all leeward exposures. The summer is therefore better for planting than winter when there is less steady hot sun, which potatoes need.

Season of planting is also related to variety. *Mauna pohaku,* quick-growing, very hardy under dry or moist conditions, can be grown almost any time, anywhere, with careful tending. Quick-growing *Mohihi* requires good rain. Slow-growing *Piko ha'o* matures in dry places.

Preparation of Land for Planting

Clay appears to be the only soil to which sweet potatoes cannot adapt themselves. They grow wild on eastern Maui in forest-land humus, and are planted on top of mounds of swamp humus on Molokai, and in high hillocks of swamp humus in Hilo. They are planted in dried terraces on western Maui. They flourish in the red soil of the *kula* on all the islands. In Hana (Maui) and Kona (Hawaii) they grow luxuriantly in the rich earth made up of decomposed lava and humus; in Kaupo (Maui) and Kona (Hawaii) in the gravelly semi-decomposed lava; on the lower slopes of Makiki behind Honolulu (Oahu) in volcanic cinder (black sand) mixed with humus; and at Makena (southwestern Maui) in white coral sand mixed with red soil.

In preparation for planting, the patch (*mala*) must be cleared by burning off grass and shrubs, then dug over thoroughly (after a good shower softens the ground in dry localities) and all the stubble thrown out. The patch is then ready for planting, if the soil is regularly moist or if dry soil has had a good soaking from showers. The patch with fresh-turned soil is termed *wela,* while an old patch replanted is *pahulu.* Slow-growing varieties should be planted in new rich soil, but vigorous quick-growers may be planted in an old patch which has lost some of its richness. The patch that is to be replanted should be dug and weeded between plantings.

Sweet potato patches in stony places, like many in southern Maui (Kaupo, Kahikinui, etc.) and in Kona, Hawaii, were called *makaili* (25, vol. 6, p. 164). Even small pockets of semi-disintegrated lava are utilized and potatoes are grown by fertilizing with rubbish and by heaping up fine gravel and stones around the vines. Such cultivation produces inferior potatoes; they are said to be rather tasteless and ridged (*awa'awa'a*) or wrinkled.

Irrigation

Mrs. Nakuina (54, p. 82) says that: "In good seasons when there was plenty of water in summer, surplus water was sometimes led on to *kula* land and a second crop of potatoes planted, but this was never done if any *lo'i* . . . should be needing the water."

Presumably in ancient times as well as today the leveled terraces intended for wet taro were occasionally planted with sweet potatoes. In a dry season when water became insufficient for taro growing, the taro was certainly pulled and eaten. Undoubtedly sweet potatoes were sometimes planted in place of the taro and irrigated with what water continued to flow or might come intermittently from rains. So far as has been ascertained, however, sweet potato culture was never practiced in arid regions with systematic irrigation as it was in Peru.

VINE CUTTINGS

Sweet potatoes are propagated in Hawaii always from cuttings (*lau uala*), never from "seed potatoes" or from seed, although some varieties bear seeds which germinate. I have grown puny *Mohihi ulaula* from seed. It is quite possible that the original introduction was in the form of seed.

Slips or cuttings are taken from old vines and from the aftergrowth of small potatoes and broken tubers left in the ground. In dry regions a first shower brings up this aftergrowth into sturdy vines; after a second shower the cuttings are taken for planting a new patch or replanting the old. The cuttings are vine ends broken off from 12 to 20 inches from the tip. An old Hawaiian's advice is: Take the "short insignificant looking" vines in preference to long runners growing luxuriantly, for these latter will go "more to roots and very little potatoes." All the leaves are plucked off except three or four at the end, and care must be taken not to break the leaf bud (*mu'o*) at the tip.

In dry planting the slips should be gathered in the evening, preferably after a shower, bundled up and left on the ground to be planted very early next morning or the next evening if the sun is hot. However, if rain can be counted on, it is best to leave the slips bundled and protected from the sun for two or three days, until the "eyes" (*maka*) or tiny rootlets on the vine below each petiole show sturdy growth. The cuttings may be kept bundled, with leaves stripped off, for several weeks if kept fresh and damp in ti leaves. Old Hawaiian planters believed that slips plucked when the sun was up were dry and stunted; and that cuttings planted when the sun was high ran to leaves and had few tubers.

PLANTING

From notes made in different localities come these directions as to planting time:

> The beginning of the dark phase of the waxing moon is most favored for planting; by many *Hilo* (the first appearance of the moon at evening in the west) and *Hoaka* (2d night moon); and universally the four Ku (3d, 4th, 5th, and 6th nights) which are said to be good, "because tubers of slips planted then will grow erect (*ku*) and sturdy. *Huna* (11th night) is favored by some, for tubers of slips planted then will grow deep, hidden (*huna*) in the soil as the fish in that phase are said to hide in the ocean depths. Tubers of slips planted in *Mahealani* (full moon, 16th night) will be so numerous that they will question, "Where (*mahea*) shall we find place under the sky (*lani*)?" *Akua* (14th night) used to be favored, for it is the phase sacred to the god (*akua*, presumably Kane-puaa), and therefore induces large tubers. Some planters simply say, plant in "the four *Ku*" and from *Huna* through *Kulua* (17th night). There is general agreement that slips should not be planted in "the four *Ole*" (7th, 8th, 9th, 10th nights) of the waxing moon, or "the three *Ole*" of the waning moon (21st, 22d, 23d nights), for cuttings put down then will be barren, without tubers (*ole*); nor in "the *Kaloa*" (24th, 25th, 26th nights), in the dark of the moon, for they will run to long vines (*ka loa*).

The ancient Hawaiians planted potatoes in mounds (*pu'e*). Where soil is powdery and dry, as at Ulupalakua and Makena on Maui, the earth is heaped up carelessly into low mounds spaced with no particular precision or care. The slips are planted two or three in a mound, being placed vertically in holes made with the digging stick (*palau*). The base of the cutting is stuck 6 to 8 inches into the ground and the earth is pressed down around it. After the entire field is planted, the mounds are covered with mulch to hold the moisture. The potato leaves are not covered. In an old patch where after-growth of old vines and roots is growing, the shoots from old stock are covered with earth, as they bear along with the new slips.

High mounding (*pu'epu'e*), often with careful symmetry, is characteristic of the planting in localities where ample aeration of the root system is needed, either because of heavy rainfall on the windward coasts of the islands or because of continuously damp soil in lowlands (pl. 8, *A*).

Where potatoes are planted in crumbling lava combined with humus, as on eastern Maui and in Kona, Hawaii, the soil is softened and heaped carelessly in little pockets and patches utilizing favorable spots on slopes. The crumbling porous lava gives ample aeration without much mounding.

Kamakau (40) gives full directions for planting sweet potatoes in moist lowland soil:

> These moist lowlands were planted with sweet potatoes only during dry weather when foliage was yellowing. A large area was burnt over, and a week later the whole area was dug up, and stubble and shrubs thrown out. Then the field was left for a month before being planted. In this type of planting all the men worked together, in preparing the soil, in planting, and in harvesting.
>
> When planting time approached, the *lau* (vine cuttings) were gathered, bundled in packets of 80 or 100, bound with rope, wrapped in ti or other leaf, and left for a week or two before planting. When the time came for planting, all the men armed with long digging poles (*oo*) went out in a body, bedecked as for a festive occasion, and working in unison, planted out the whole field. "But one evening was required to plant a patch of five acres or more." The slips were planted in mounds as in the dry planting.
>
> The teamwork described by Kamakau is particularly interesting in that it resembles the ancient Maori manner of digging, in which the crops of planter-warriors moved pace by pace, thrust their *oo* into the earth and turned the soil, moving as a body in unison. In Hawaii "the planting of the sweet potato slips began with the first row, which was laid out very straight with fish line or rope. The mounds for the potatoes were set 3 or 4 fathoms apart. It was not well to have them too close, lest the growing vines become tangled together. When the measuring cord had been laid down, then the sticks were held on either side of the cord, and the digging began. The men stood at one end of the field with their backs turned toward the patch. All thrust down their digging sticks before them, their arms working in unison. They thrust once, twice, and at the third thrust the point of the implement entered deep into the soil. Then they bent it backward so as to turn up a clod of moist soil and pressed a foot on the clod to loosen the soil. Then the *oo* was removed. Some women carried the slips and threw two of them into each hole, then other women drew the slips together into the holes and trod the earth down with their feet. It was a magnificent sight to see as the digging sticks rose, fell, and were bent backward in perfect unison, the arms rising together as though beckoning."

That a patch of this sort required little cultivation is indicated by the fact that there were no prayers or tapus associated with it. The danger was not of drought and pests but of drowning. Heavy rains flooded the lowland patch, necessitating quick harvesting of all the potatoes under water before they should rot. The men went into the flooded ground and dug out the potatoes, using their feet as shovels. Sheds were erected nearby in which the crop was dried and stored. At such a time, only the plants growing on the slopes above the flooded locality could be left to mature normally.

The following good account of planting on Hawaii is from the Hawaiian newspaper Kuokoa for March 24, 1922 (60):

> Rocky lands in the olden days were walled up all around with the big and small stones of the patch until there was a wall [*kuaiwi*] about 2 feet high and in the enclosure were put weeds of every kind, *ama'u* tree ferns and so on, and then topped well with soil taken from the patch itself, to enrich it, or in other words to rot the rubbish and weeds and make soil.
>
> After several long months, the rotted weeds were truly converted into soil of the best grade. The farmer waited for the time when he knew that the rains would fall, then he made the patch ready for planting. If for sweet potatoes, he made mounds for them and for taro too, on some places on Hawaii.
>
> In planting his sweet potato slips or taro, his work ended when the rain fell. When the rains came the farmer's heart was gladdened because it gave the slips a start, the roots began to creep and his troubles were all over.
>
> Another way of doing this was to rot weeds where the soil was good and then carry them to fill the hollows made on the *pahoehoe* and then plant whatever plants he chose.[9] O my reader, the proofs of these are on Hawaii. There are the *pahoehoe* lava beds walled in by the ancestors, in which sweet potatoes and sugar cane were planted and they are still growing today. Not only one or two but several times forty (*mau kaau*) of them. The house sites are still there, not one or two but several times four hundred in the woods of Panaewa. Our indigenous bananas are growing wild, these were planted by the hands of our ancestors.
>
> The sweet potato tubers borne on the *pahoehoe* lava beds were both large and sweet. The farmer observed his mounds to see whether there were any potatoes or not. If the mounds decreased in size then there were no potatoes, but if they increased in size then there were potatoes for the tubers forced the earth outward.
>
> Another thing was to remove the tubers from the mounds. We [now] pull the whole plant up. The ancients took only the large potatoes and left the small ones for the next time. There was a great deal of wisdom, care and economy because our ancestors did not eat wastefully. The only part thrown out to the chickens and the pigs was that which was unfit for man, such as taro and sweet potato peeling. The sweat of the brow was considered because they knew how hard they labored and toiled in the rain and heat of the sun.

CULTIVATION DURING GROWTH

When cuttings sprout vigorously, the soil about their roots is stirred with a stick on several successive days. In dry planting this cultivation should be continued until a shower gives the soil a good soaking, after which the moist earth should be heaped up around the vines anew. In damp localities

[9] This was widely practiced in Kau, Hawaii.

the soil is kept heaped up around the plants. The work of softening the earth and pressing it down around the plants is termed *kaiue*. Weeding (*olohio*) is done at intervals; the weeds that are relatively harmless are stamped into the soil, and *honohono* (wandering-jew), that will root from scraps and spread rapidly, is thrown out of the patch.

When the vines show sturdy growth they are turned under (*wiliwili*), each vine is twisted (*wili*) around its own base and covered with firmly pressed earth thrown up from the sides of the mound. This prevents the potatoes from running wild like morning-glories and induces the plant to put its growing power into its tubers under ground.

After heavy rain and where frequent showers make it advisable, thick maturing or matured vines are turned back and over the tops of the mounds to dry the foliage and to allow sun and wind to dry the soil beneath the vines. This prevents wet rot and mildew.

When the tubers have commenced to grow well, following abundant leafing a month or so after the vines have been turned under, the smaller potatoes (*hahae*) should be dug out with the fingers and broken off, while the larger ones are left undisturbed to fill out and mature. As with taro, the potato plants should be left undisturbed during the period of maturing. The recognition of this fact was the basis of the old Hawaiian tapu laid on the patch after the first new potatoes had been dug and offered at a sacramental feast, with prayers for full maturity to the god of the sweet potato. Thereafter no one was permitted to enter the patch or disturb the plants.

HARVESTING

Digging out the potatoes was termed *kilo*. Formerly the potato plantation, like the taro field or *lo'i*, was fostered so as to derive the maximum of food from a single planting. The plants were never dug out completely as is often done now. Enough potatoes for current needs were dug with a stick and removed by hand, care being taken not to disturb the rest of the tubers and the plant. Between plantings the old roots and tubers remained in the ground and supplied cuttings for the next planting. One Kaupo planter advises excavating only one side of a row of potato hills at a time. Another important recommendation is that the earth be heaped anew over remaining vines and tubers. If this is not done, the roots and tubers will grow above the surface and rats will gnaw them, dry rot will destroy their value, and they will crack and harden where exposed.

Fornander (25, vol. 6, pp. 164-165) quotes the directions of a planter for taking successive crops of potatoes from one planting, evidently on *kula* land:

> After harvesting the first lot of potatoes [*kauaiki*] the patch is left for a while, then the old vines [*kalina*] which remain in the ground and will bear a second crop [*kaioio*]

termed *haaweawe* [aftergrowth] are cultivated. The patch is then left to run wild, and when later it is cleared (now termed *kahili pulu* [becoming worthless]) tubers are found on the old stock; these are called *pu'u kolea* [plover's dung hill]. When the stubble and old dry vines of the potato plants are set on fire [in preparation for replanting] these potatoes are thrown in the fire. [In other words, they are not good to eat, but should be cleared out of the soil before replanting.]

Hawaiian planters frequently grow a number of varieties in the same patch, some quick maturing (like *Mauna pohaku*) and others (like *Piko ha'o*) slow growing and with the ability to remain good when left in the ground many months after maturing. This is done in order to have a continuous supply maturing month after month. Also, I think, variety appeals to native planters, both for the interest of cultivation and pleasure of eating.

In Waipio Valley one Hawaiian planter cultivates two varieties, *Pa'u'u* which matures in 4 months, and *Mohihi* which matures in 6 months. After the first planting he eats *Pa'u'u* from the fourth to the sixth month, replanting in the fifth month so that a second crop will mature in the ninth month. In the sixth month the *Mohihi* matures and can be eaten through the eighth, until *Pa'u'u* again comes in. By thus rotating his two varieties he always has potatoes ready for eating. He alternates patches in replanting.

PESTS

Cutworms (*kakala* or *poko*) and weevils (*mu*) which attack the stems, roots and tubers, and caterpillars (*peelua*) which eat up the leaves of the sweet potato, were recognized as enemies of the planter, but were attributed in the old days to offended gods rather than to natural causes. Kamakau (40) writes that it used to be believed that if the ground was trod upon unnecessarily the potatoes would later be attacked by caterpillars and cutworms. He warns also against chickens being allowed on the ground.

The Hawaiian planter knew that the yellowing of leaves (*ponalo*) indicated dry rot and unhealthy tubers, generally caused by excessive rain and humidity combined with heat, also by neglect and poor cultivation.

The worst enemy of the potato in the old days appears to have been the rat. Kepelino (41, p. 86) says:

During the wet season nothing in the plains is safe from rats . . . During the last months of the wet season, in Welehu, Makalii, and Kaelo, the rat makes its nest in the potato hills and returns to the mountains in the month of Kaulua as it begins to grow warm. By the month of Nana a large number of rats have returned to the mountain, and by the month of Welo there are no rats left in the plain.

This seasonal migration of the rats into the lowlands probably applies particularly to the dry leeward exposures of coast and plain, such as Maui from Makawao to Kaupo and Hawaii from Kawaihae to Kau.

STORAGE

There was in Hawaii no systematic storage of potatoes in pits and bins comparable to that in New Zealand. Temporary storehouses were made when wet weather required the digging out of a whole lowland field or when food was amassed for a feast. Actually, the ground of his field was the Hawaiian's storehouse for his potatoes; his system of planting and harvesting to meet current needs and to take advantage of regular and occasional rains, combined with the ability of the tuber to remain good in the ground for several months after maturing (some varieties much longer), enabled him to dispense with storage.

As described by Mrs. Pukui, sweet potatoes were stored in Kau in the following way:

> When the potatoes were removed from the imu, the surplus was placed in open-work baskets or in nets and hung up where the wind would blow about and dry them. Potatoes were always wind-dried rather than sun-dried, although a little sunning was good. The potatoes were put in medium-sized, loosely woven baskets (*kiki*) made of any handy material (pandanus, coconut leaf, *ilima kula* or upland *Sida*). (Tightly woven baskets were not good, for the wind must reach the *uala* not only from above but also from below.) After all the moisture was gone, the baskets of *uala* were stored away in a *hale papa'a* or storehouse, which was a small platform or floor on four posts, walled and roofed. Every now and then the baskets were put out in the wind. Thus my people dried *uala* and took them to the seashore when the summer fishing season opened. When wire fencing and mosquito screening became common, my old folks used these for *uala* drying racks. Keliihue's daughter still dries *uala* in a rack as our old folks used to do when we were children.

USES

FOOD

Potatoes were formerly cooked in the imu or ground oven, and are now generally boiled in a kerosene tin or cooking pot. Although commonly steamed in the jacket and eaten that way, they were sometimes peeled and mashed with the stone pounder and mixed with water to make sweet potato poi (*poi uala*). This is regarded by Hawaiians as dietetically superior to taro poi, but it is less relished; and in a practical way it is much less satisfactory as a staple since it keeps only a few days without excessive fermentation, whereas taro poi remains edible for a week or more. *Piepiele uala* is sweet potato mashed, mixed with coconut milk, and steamed.

The young leaves growing near the ends of the vines make excellent greens (*palula*) and were so used by Hawaiians. They are recommended especially for invalids and pregnant mothers. The small-leaved varieties are the most delicate, but all are edible.

Uala awaawa (sour or fermented potato) is a beer made of the sweet potato which may have been introduced from New England where a similar

drink is said to have been brewed in colonial times, or it may be ancient as some Hawaiians insist. Considering the quick fermentation of sweet potato poi, and the general liking of Hawaiians for fermented poi, it would seem strange if *uala awaawa* were not known to the Hawaiians before European contact. Only the varieties with tubers containing much sugar are good for making this drink. The potatoes are cooked, peeled, mashed and mixed with a large quantity of water, then left in the barrel or jar for three days, being stirred each day. On the third and fourth days the fermentation is sufficient to give the beer enough head to be exhilarating. *Mohihi* was the most popular variety for making *uala awaawa*; because of its exhilarating effect when fermented, it was nicknamed *Kauaheahe* (staring fixedly). *Uala awaawa* had a great vogue during the period of clearing forests in Hamakua, Hawaii, in the early days of sugar planting. A native landowner would plant a large patch of *Mohihi,* harvest and cook all of it, put it down in barrels to ferment, and then invite his countrymen from far and near to come and help him clear his land, and in return enjoy a wild orgy of talk and festivity in emptying the barrels of prime *Mohihi awaawa.*

Hog feed

The sweet potato vines and foliage make excellent hog feed and have always been used for this purpose by the Hawaiians. Certain rapid-growing varieties are planted in upper Kaupo especially for this purpose, and the foliage is regularly cut about once a month. The potatoes themselves are also fed to the hogs for fattening.

Medicine

Sweet potatoes enter largely into the native pharmacopoeia, different varieties being conceived to possess qualities required for different purposes. Names of varieties employed medicinally and prescriptions for compounding with other ingredients are given by Kaaikamanu (34, pp. 35-37). The latex from the raw tuber of *Piko ha'o* or other coarse varieties is widely used for dislodging phlegm in throat and stomach, being used as a gargle and swallowed.

Fishing

The meat of the *Pu* is used by fishermen as *palu* (bait) in feeding and attracting *opelu* fish in their breeding places (*ko'a*) offshore.

Ceremonial

A broken potato vine exuding milky sap was believed to be conducive to a flow of milk in a nursing mother if worn as a lei around the neck or used

to slap the breasts gently. But the sweet potato did not enter into the ritual of the kahunas as did the taro. Despite the fact that there was more worship associated with the planting of the potato than with that of the taro, because of the pressing need for rain in the areas where it was planted, the sweet potato was not a sacred plant. This is shown by the fact that women as well as men cultivated the humble potato, but only men the noble taro.

Old leaves and vines of the *uala* were used as padding under mats in the houses of the country Hawaiians.

Planting Localities

NIHOA AND NECKER

Nihoa is extremely interesting agriculturally, for there sweet potatoes were cultivated intensively in stone-faced terraces covering the steep habitable land (pl. 8, *B*). Presumably this was the work of fishermen, who came from Kauai or Niihau and resided periodically on Nihoa, or possibly of refugees, for the island could scarcely support an established population. Emory (23, p. 17) says that "Most of the agricultural terraces are low, narrow, and long. The floors are rough and uneven, a characteristic most marked in the widest terraces. The retaining walls are faced with stones of all sizes carelessly laid up." This terrace type of culture was occasionally used on steep, dry slopes in the larger islands. As population increased, it would undoubtedly have become more and more common in these islands, had the evolution of native agriculture not been ended by intrusion of foreign settlers and their agriculture.

Historically, the significance of Emory's discovery on Nihoa lies in the fact that the shrines (heiaus) associated with and incorporated in the terraced plantations represent an archaic early Polynesian design. This probably indicates a very considerable antiquity for sweet potato cultivation in this particular locality.

Necker Island, where Emory found more striking examples of this early type of Polynesian temple, which is characteristic of the interior of Tahiti and of the Tuamotu atolls, apparently was not terraced in the same way. This does not preclude the possibility or likelihood of sweet potato planting on the more level ground. Terraces mentioned by Emory (23, p. 61) may have been for planting.

NIIHAU

Although yams were grown extensively and some breadfruit, sweet potatoes were the staple for Niihau and are mentioned by early voyagers together with yams as articles of trade offered by the people. Very few potatoes are

now grown; in a brief visit in 1931, only one small patch with young plants was found. (Leaf forms are shown in figures 13, *c, h, i*; 15, *d, k*; 16, *h.*) There were undoubtedly others, however; the time was not favorable for judging the degree of interest in this old culture, for my visit was made at the end of a long period of drought. After rains there would be more planting from cuttings sprouting from old stock left in the ground and surviving the drought.

Samwell (66, p. 237) who visited Niihau with Captain Cook, pictures this island as sparsely inhabited by Hawaiians whose main article of diet was the sweet potato. In early times, fishermen undoubtedly had patches around their houses in many places along the shores, and presumably there was planting on damper *kula* lands. It is probable that Samwell saw a limited area, and may have underestimated the degree of planting in sandy and low localities, along the sea and swamps, and in the small valleys through which the intermittent streams drain the highland on the east coast of Niihau. He writes:

> Neehau for the most part consists of low land entirely bare of trees. The soil is rich and capable of producing all kinds of fruit, was it properly cultivated, but as the island is thin of inhabitants, the small patches which are here and there planted with yams and sweet potatoes afford a sufficient supply for them, while large plains of fine land is suffered to waste. . . . saw a few plantations of sugar cane and plantain and two or three palm trees. . . We procured yams enough here to serve the ships for bread for six weeks. . . The natives cultivate more sweet potatoes than yams.

KAUAI

On Kauai sweet potatoes are still planted in many places near the seashore where sandy soil is mixed with humus. Such planting may be seen on the delta and near the dunes at Anahola. Similar planting is now occasional but used to be universal near the shore at Moloaa. The narrow coastal strip between the hillsides and the sea at Kalihi-kai and Anini is also ideal for this type of planting and there are now a number of flourishing patches. The coastal plain of Haena is similar in places where there are flourishing plantations.

Kapaa, Waipouli, Olohena, and Wailua are districts which have broad coastal plains bordering the sea, any part of which would be suitable for sweet potato plantings; presumably a great many used to be grown in this section. There are a few flourishing plantations in Wailua at the present time. At Kipukai, southeast of Nawiliwili, the sandy strip between the cliff and the sea is said to have been formerly a good place for planting sweet potatoes. On the other side of the ridge toward Koloa the people of Paa district subsisted almost entirely on sweet potatoes. One informant who spent her childhood in this district remembers the potato patches enclosed in stone walls. Koloa had many taro plantations but sweet potatoes must have had a large place in the subsistence economy of the people. At Nomilu near the coast in Koloa

there are terraces but no evidence of irrigation. These Bennett (4, site 67) took to be taro terraces, but they may have been terraced sweet potato patches. There are some terraces in isolated localities north of Mana that do not look irrigable and some in Kalalau, which were probably sweet potato terraces comparable to those of Nihoa and to some in dry localities on Oahu.

Sweet potatoes are now sometimes planted on old dry taro terraces. Some of the upper levels of taro patches below the falls of Opaekaa Stream in Wailua were planted with sweet potatoes, the lower terraces being planted with rice.

Upland *kula* lands that were famous for their sweet potatoes were Kukuiolono above Lawai (the present park covering the McBryde estate) and the elevated *kula* lands east of Wahiawa Stream. I was unable to obtain any information as to the uplands of Kalihi and Kilauea, but this and much of the *kula* land from here to Kealia is the same type of terrain and presumably was once used to some extent for growing sweet potatoes by taro planters in these districts. A *kamaaina* of Wahiawa says that inland of the cliff named Kawaikapuluna, the people used to have taro patches in the gulch, while their houses and potato patches were on the *kula* land above, bordering the gulch on either side. I was told that this arrangement was typical also of Nawiliwili, and presumably also of Hanamaulu, Hanapepe, Makaweli, and Waimea in the lower sections of their canyons.

In the great valleys just mentioned there were also house sites and potato patches; in fact most of the inhabitants lived in the valley and practically every house had its potato patch. Vancouver (71, vol. 1, p. 374) writes:

> I proceeded along the riverside and found the low country which stretches from the foot of the mountains toward the sea occupied principally with the taro plants. . . interspersed with a few sugar canes of luxuriant growth, and some sweet potatoes. The latter are planted on dry ground, the former on the borders and partitions of the taro ground. . .

Cook (12, vol. 2, pp. 225 ff.) describes the potato fields in Waimea as being,

> . . . on higher grounds and planted with the same regularity [as taro]; and always with some determinate figure; generally as a square or oblong; but neither these nor the others are enclosed with any kind of fence . . . The higher ground furnishes sweet potatoes, that often weigh ten and sometimes twelve or fourteen pounds; very few being under two or three.

Occasionally in dry localities old Hawaiian house sites are seen, around which presumably sweet potatoes were formerly planted. Bennett (4, site 202) reports a number of house sites of this sort in Kauhao on the west coast where nothing but sweet potatoes could have been grown for subsistence, as the rainfall is only 30 to 40 inches a year.

OAHU

Sweet potatoes were cultivated on Oahu on the coastal plain and in sandy soil near the shore from Wailupe to Waikiki. Menzies (49, p. 23) describes sweet potato, as well as taro, growing in the plantations of Waikiki. The fisher families living near the shore had potato patches around their houses, from Pearl Harbor to Honouliuli, from Nanakuli to Kaena, and along the whole of the northwest and windward coasts. In the dry section from Kaena to Laie the sweet potato was the staple. An old Hawaiian of Kawaihapai, beyond Mokuleia, remembers when the sandy coastal strip north of the elevated coral, which lies between the shore and the cliffs, was extensively planted with sweet potatoes. The careful cultivation in sandy soil by a fisher family at Kahana is shown in plate 8, *A*. This kind of planting was typical also of the sandy plains of Kailua and Waimanalo.

The *kula* lands below the cliffs of Waimanalo also supported sweet potato plantations. There is some evidence of dry terracing near the old village of Lanapou, and on the narrow strip between the cliffs and the sea there are many wall enclosures in which sweet potatoes were cultivated before this settlement was abandoned by Hawaiians. On the south side of the ridge at this end of the island, Maunalua and Hahaione districts were famous for their sweet potatoes. In this section there are various enclosures and walls which were thrown up around the old plantations before Hawaiians abandoned the land and it was utilized for ranching. The following observations were made by McAllister (44, site 29):

> From the Lighthouse road to the small old crater in Kaiama Valley are to be found traces of old Hawaiian sweet potato patches. Located on the crest of the old (red) lava flow are small piles of rocks, a foot or more high and a few feet apart, with comparatively clear spaces between them. It is said that sweet potatoes were planted between these rock piles in the rich red soil that covers this region. The distance from the road to the crater is about 800 feet, and the top of the flow, which was used for cultivation, is between 250 and 350 feet wide. Beyond the gullies on either side of the flow there are no rock piles or other evidences that the soil was cultivated. Throughout this 5.5 acre tract are a number of irregular walls from a few feet to 50 or 100 feet in length. There is nothing in the location of these walls to indicate a 'pattern' . . . For many years this site was used as a cattle range.

According to the last surviving *kamaaina* of Maunalua, sweet potatoes were grown in the small valleys, such as Kamilonui, as well as on the coastal plain. The plain below Kamiloiki and Kealakipapa was known as Ki-kula-o-Kamauwai. This was the famous potato-planting place from which came the potatoes traded to ships that anchored off Hahaione in whaling days. The village at this place, traces of which may still be seen, was called Wawamalu.

The districts and valleys westward from Maunalua, namely Keawaawa, Kuliouou, Niu, Wailupe, and Waialae, were dry; sweet potatoes, planted in the valleys, on the hillsides, and on the coastal strip, were the staple. There

were a few small patches in Keawaawa and Kuliouou in 1935. Sweet potatoes were grown by the taro planters on the lower *kula* lands, the lower sides of gulches, and the foothills above taro plantations south of the Koolau Range, all the way to Waikele.

The region around Makiki and Round Top, between Makiki and Manoa Valley, is perhaps the most favorable locality on Oahu for sweet potato cultivation; here Hawaiians still have many small plantations, mostly for domestic use, though occasionally they market their products. The volcanic cinder mixed with humus in this locality seems to be ideal for sweet potato cultivation and normally the amount of rainfall is about right. Round Top, the Hawaiian name for which is Ualakaa (literally, Rolling Potatoes), is famous in the annals of Hawaiian agriculture because here Kamehameha I established his own plantation on the steep slopes above Manoa.

Punchbowl Crater (Puowaina), on both the inner and outer slopes, was also famous in ancient times as a sweet potato locality. The planting was especially good on the inland side near the present Hawaiian homestead of Papakolea.

The eastward slopes of the southern end of the Waianae Mountains below Puu Puna were famous for sweet potato growing. Although there was a little taro grown in the valleys of Waianae-uka, sweet potatoes grown on the *kula* lands were the main food of the people here. On the other side of the Waianae Mountains sweet potatoes were planted on the dry slopes of Nanakuli, Lualualei, Waianae-kai, and the other small valleys as far as Makua. With the exception of Waianae-kai, the sweet potato was the staple for the inhabitants of this dry section. On the north side of the island sweet potatoes were planted on the *kula* lands of the districts all the way from Mokuleia to Kahuku, and although there was a little taro grown here and there, especially in Waimea, Kahuku, and Mokuleia, sweet potato was the primary food in most of the districts of this section, excluding Waialua. Southeastward from Laie, throughout the great taro-growing section of the windward coast, sweet potatoes were planted with taro on the lower *kula* land and near the shore. The *kula* beneath the cliffs of Kualoa and the coastal strip between Kaaawa and Kahana were utilized for sweet potatoes, paper mulberry, sugar cane, and bananas. The *kula* lands above the lower sections of the streams in Kaneohe and Kailua were planted extensively in sweet potatoes according to old *kamaaina*. Portlock refers to sweet potatoes seen in Kaneohe along with other agricultural products. (See page 98.)

Upland *kula* were planted with sweet potatoes in Kamananui, Paalaa, Halemano, and Wahiawa, where the sweet potato was the main staple, although some taro was grown. In gulches of this region and also in Waimea where there were taro patches in the valley, as at Wahiawa on Kauai, families

had their taro *lo'i* in the gulch or valley; their houses, surrounded by patches of sweet potato and other native plants, were on the *kula* land bordering the gulch.

MOLOKAI

While the windward pali coast and Halawa Valley on the eastern tip of Molokai were famous for taro, the southern coast and the western plateau of the island were planted in sweet potatoes along the shore and on the *kula.* At Kamalo, I observed a unique method of planting potatoes on top of mounds in marshy soil, round the base of which taro is planted (p. 101).

In 1931, I visited potato patches at various places near the road along the south coast, and I was told that many parts of the *kula* land used to be planted with both sweet potato and dry taro. It is safe to assume that potatoes were grown all along this coastal plain fringed with fishponds from Waialua to Punakou. On the slopes of Kakalahale and Luahine hills, between Kaunakakai and Kalamaula, there were potato plantations. Kualapuu, the name of a hill farther westward, probably refers to sweet potato planting. In 1931 there were many flourishing patches on the Hawaiian homesteads at Hoolehua. It is said that Hoolehua and Palaau were noted for sweet potatoes in olden days. Any part of the pineapple lands westward from this section may have been used for sweet potatoes. However, much of western Molokai was formerly covered with trees. On the eastern and southern slopes of Mauna Loa, near Kahualewa, there are many lines of stone (*kuaiwi*) on the hillsides marking the divisions of old potato plantations, where stones cleared from the ground were thrown up along the sides of the fields. Southwest of Mauna Loa in Punakou district is the site of Pakaa's house and of his potato plantation famous in legend. (See 25, vol. 5, p. 74.) Phelps, in his field notes, refers to Kaluakoi, "just south of Amikopala", as the traditional site of Pakaa's sweet potato patch.

On the hillside east of the stream at Kaumanamana Bay, there is a rough stone platform. Among the algaroba trees below are other house terraces, and on the stony beach what looks like a canoe slip. Running inland from the stream on the east side is an ancient paved footpath, which leads toward the potato patches and zigzags through the rough stone, with white "sandstone" chunks placed at intervals, probably as guides for night walkers. Here traces of the plantation may still be seen below the steep hillside looking seaward about 4 miles west-southwest from the summit of Mauna Loa. Phelps gives the following note:

> For Palaau (Apana 2), Kaluakoi, and Punakou, Hoolehua, and Naiwa, planting areas for yams and sweet potatoes cannot be delimited but it is known that these were grown in that general area and were, with fish, the staples of the inhabitants. In northwest

Kaluakoi, in an area roughly bound by the sea on the north from Ka Ilio to Moomomi, on the west by the sea from Ka Ilio to Kawakiuiki, on the south by a line running from Kawakiuiki to Puu Pili (perhaps even to Mauna Loa), thence to Moomomi on the east, I doubt if there were either plantings of any kind or inhabitants.

It is evident from the following quotation (56) that Kalaupapa was once famous as a sweet potato locality:

These are sweet potatoes from ancient times. Most of mine seen here in Kalaupapa are of these kinds. There are nineteen varieties. Nine are dark, ten are white and fragrant. Of the dark varieties previously mentioned, only three are good, the apo, the likolehua, and the halonaipu. These may be the names by which they are known on other islands or perhaps they had other names. I have heard that the halonaipu is called mohihi on Kauai. These three mentioned above are much sold at Kalaupapa with the addition of some white and dark sweet potatoes. The likolehua and halonaipu when ready to be sold are heaped at the seaport like bruised mountain apples on the beach, their purplish color lying against the pahoehoe lava. The eyes scan them up and down with desire for the tubers raised by the farmers.

The President of the Board of Education asked us to report all undesirable sweet potatoes, that is, those which were watery and speckled. All the white ones were watery and speckled and because the white men did not want them they all became spoiled. According to the orders, we are to destroy all bad potatoes. But, we must stop a bit there. This may be a better idea, to separate all unwanted sweet potatoes for the families and the animals, because we know what hearty eaters Hawaiians are. They put in and put in till the abdomens grow large with the quantities of Maiola's food. Separate the old fashioned dark sweet potatoes from those introduced from South America for trading with ships.

Kalaupapa is a good land because the crops planted are successful and the gain is large. They are not eaten by caterpillars and cut worms. The number of animals from Kalaupapa to Waikolu are over a hundred, cattle, horses, donkeys, and mules. They do not swallow these things because there is much grass. The Hawaiians are mistaken in the idea that the land is growing but it is just the same. The animals are multiplying more and more. Our patches are like the places where the ropes for the riggings are kept outside of the sides of the whaling ships which move on the sea. Not a thought is given if there is a hole somewhere.

Many sweet potatoes are being planted now, four or five patches to each man. Most of the crops are watermelons, and some small and big beans and onions. Be on the watch, you traders, for Kalaupapa is the best in all the islands for good prices and fast work. All the California ships come to Kalaupapa. This is my thought, with my regards too.

LANAI

According to Emory (24), except for the several localities in which taro was planted, sweet potatoes were planted in every part of the island where there were settlements: on the shore, in valleys, on the *kula*, and the upland. In other words, the sweet potato was the staple, although taro, yams, and breadfruit were important supplementary items of diet. There was an abundance of good land for planting and Lanai has ample rain for sweet potatoes; but settlements and gardening were very definitely limited by dearth of drinking water. Emory's study of the archaeology of the island (24) indicates sparse and widely separated settlements.

MAUI

The coastal area along which sweet potatoes were planted on Maui was proportionately less than on Oahu. On the northeast coast of western Maui it was only the shores and adjacent flatlands below the taro terraces of Waihee and Waiehu that were favorable for the combined enterprises of planting potatoes and fishing. The flat north coast, eastward from Wailuku, had fishing settlements here and there in ancient times and presumably sweet potato plantations. On the south side of western Maui the flat coastal plain all the way from Kihei and Maalaea to Honokahua, in old Hawaiian times, must have supported many fishing settlements and isolated fishermen's houses, where sweet potatoes were grown in the sandy soil or red *lepo* near the shore. For fishing, this coast is the most favorable on Maui, and, although a considerable amount of taro was grown, I think it is reasonable to suppose that the large fishing population which presumably inhabited this leeward coast ate more sweet potatoes than taro with their fish. Almost no sweet potatoes are planted in this section now, however, which is partly due to the displacement of Hawaiians by Orientals on the industrialized sugar and pineapple plantations.

Between Kihei and Makena there was probably very little settlement in former times. Today along this dry coast there are a few settlements and houses and a few gardens with sweet potatoes.

Makena is today a small community of native fishermen who from time to time cultivate small patches of potatoes when rain favors them. Formerly, before deforestation of the uplands, it is said that there was ample rain in favorable seasons for planting the sweet potato, which was the staple here. A large population must have lived at Makena in ancient times for it is an excellent fishing locality, flanked by an extensive area along shore and inland that was formerly very good for sweet potato planting and even now is fairly good, despite frequent droughts.

Between Makena and the lava-covered terrain of Keoneoio (another famous fishing locality) the coastal region includes the small *ahupua'a* of Onau, Moomuku, Mooloa, Mooiki, Maluaka, and Kaeo. According to an old *kamaaina,* these *ahupua'a* had in former times a continuous population of fisher folk who cultivated potatoes and exchanged their fish for taro, bananas, and sweet potatoes grown by the upland residents of the Ulupalakua section. A few Hawaiians still live here. One living near Puu Olai has a sizable sweet potato patch in the dusty soil near the shore; another raises fine potatoes in a low flatland of white sand near the abandoned schoolhouse of Makena.

Maui excelled in sweet potato planting on *kula* lands between the moun-

tains and the sea. I am told that in ancient times there were numerous settlements on western Maui, between Honokohau and Kahakuloa, and also several between Kahakuloa and Waihee. Settlements in these localities imply planting of sweet potatoes on the lower *kula*. From Waihee to Waikapu there is much good land below and bounding the ancient terrace area on the *kula* and in the lower valleys which would be ideal for sweet potato culture, but it is said that little was grown in this section because there was so much taro. Occasionally a small patch is seen today. Orientals often plant sweet potatoes along the borders of sugar cane plantations and irrigation ditches; this explains the apparently wild sweet potato vines sometimes observed. In Olowalu, where a small group of Hawaiians still cling to their irrigated taro, there are a few patches of sweet potatoes, but the natives take so little interest in them that they do not even know their names. From this point along the leeward coast, through Kaanapali, the *kula* lands now used for sugar cane and pineapple would have been ideal for sweet potato culture. Some accounts indicate, however, that potato planting was practiced only as an adjunct to the taro culture in and below the great valleys (p. 106). On eastern Maui the semi-dry slopes of Hamakua must have been planted with sweet potatoes by the people living along the coast from Maliko to Waipio. Samwell (66) says, probably referring to this region: "This island is mountainous, the sides of the hills are covered with trees, from thence to the water side are large open plains on which stood their houses and where they have their plantations of sweet potatoes, taro, etc."

For the most part even the lower *kula* of Koolau is too wet to be favorable for sweet potato planting except in a dry season. Nevertheless in 1934 there were some excellent patches of sweet potatoes above Keanae and at Wailua and Nahiku, and above the latter place I was told that there are wild sweet potatoes in the lower forest, indicating that they used to be planted there. In Hana, at Helani, there are a number of Hawaiian plantations in rich soil of decomposed lava and humus. Here dry taro and sweet potato appear to grow equally well. Before the era of sugar plantations there must have been many localities over this whole rich country where sweet potatoes were planted with other Hawaiian crops. There are today a few potato patches at Honokalani and in the neighborhood of Hana town. Here the little cinder mountain named Kauiki was, and still is, a famous place for planting sweet potatoes. Southward from Hana town on the high slopes along the coast, including those above Hamoa, Makaalae, Waiohonu, Puuiki, Pohue, Pukuilua, Haou, Hulihana, Muolea, and Koali, there are still many Hawaiian homesteaders who have small patches. Hana is a little too wet for sweet potatoes, but this coast seems to be ideal. The same is true of the Kipahulu section on the southeast side of the island where formerly a very large population lived,

subsisting partly on taro and breadfruit, but largely on sweet potatoes. There are a few small but flourishing patches in Kipahulu at the present time.

Kaupo has been famous for its sweet potatoes, both in ancient times and in recent years. Sweet potatoes can be cultivated from sea level up to about 2,000 feet in the rich pulverized lava of this district. This old culture is unfortunately vanishing here, due to a combination of economic and climatic circumstances. From here through Kahikinui, Honuaula, and Kula the sweet potato was the staple food for a considerable population, supplemented with dry taro grown in the low forest zones. This is the greatest continuous dry planting area in the Hawaiian islands. A few Hawaiians at Ulupalakua have sizable patches of sweet potatoes at the present time, and a few patches are still planted at Kaupo; but beyond this, the ancient subsistence culture has completely vanished from these vast *kula* slopes which are now given over wholly to ranching. The fishermen along the coasts of Kahikinui and Honuaula used to exchange their fish for sweet potatoes and taro grown by those living up on the *kula*; Hawaiian tradition gives ample evidence that the population of this now almost depopulated country was considerable.

Kula was always an arid region throughout its long low seashore, vast stony *kula* lands, and broad uplands. On the coast, where fishing was good, and on the lower westward slopes of Haleakala, a considerable population existed, fishing and raising occasional crops of potatoes along the coast, and cultivating large crops of potatoes inland, especially in the central and northeastern section including Keokea, Waiohuli, Koheo, Kaonooulu, and Waiakoa, where rainfall drawn round the northwest slopes of Haleakala increases toward Makawao. Few Hawaiians, except cowboys, live in Kula now, and, so far as I observed, no sweet potatoes are planted.

HAWAII

Kona, like eastern Maui, with its decomposing lava mixed with humus and with intermittent rainfall which soaks away quickly in the porous soil and rock, is ideal for sweet potato cultivation. Sweet potatoes were the staple in lowland localities where there was sandy soil, as at Kailua, Honaunau, Kealia, and Hookena. Ellis describes Kailua in 1823 as follows (20, p. 27):

> The houses, which are neat, are generally built on the sea-shore, shaded with cocoanut and *kou* trees, which greatly enliven the scene. The environs were cultivated to a considerable extent in every direction. Small gardens were seen among the barren rocks on which the houses are built, wherever soil could be found sufficient to nourish the sweet potato, the watermelon, or even a few plants of tobacco which in many places seemed to be growing literally in the fragments of lava, collected in small heaps around their roots.

About a mile inland from the shore the ground was more favorable for planting, and Ellis describes the appearance of the native gardens (20, p. 27):

After traveling over the lava for about a mile, the hollows in the rocks began to be filled with a light brown soil; and about half a mile further, the surface was entirely covered with a rich mould, formed by decayed vegetation and decomposed lava. Here they enjoyed the agreeable shade of breadfruit and *ohia* trees. . . The path now lay through a beautiful part of the country, quite a garden compared with that through which they had passed, on first leaving the town. It was generally divided into small fields, about fifteen rods square, fenced with low stone walls, made from fragments of lava which had been gathered from the surface of the enclosures. These fields were planted with bananas, sweet potatoes, mountain taro, tapa trees, melons and sugar-cane, flourishing luxuriantly in every direction. Having travelled about three or four miles through this delightful region, and passed several valuable pools of fresh water, they arrived at the thick woods, which extends several miles up the sides of the lofty mountain that rises immediately behind Kairua.

The lofty mountain referred to is evidently Hualalai, which indicates that the missionaries were ascending the slopes of Kona directly toward the uplands. If this is so the plantations must have extended for 4 or 5 miles inland in this section of Kona which is drier than that farther southward.

The description given by Captain Cook in 1779 (12, vol. 2, p. 27) indicates that sweet potatoes were seen in the plantations above Kaawaloa almost up to the forest. Here the forest zone is described as being about 4 miles from the sea. Breadfruit is mentioned within this zone, but not sweet potatoes:

Three of us . . . made a short excursion up country towards the snowy mountains. As we ascended the hills, we came among the plantations where we saw a few houses. Here is a rich soil tho' I believe it is nowhere very deep, being no more than a layer of earth over the lava of which I think the body of the island is composed. Their plantations are divided from each other by thick, low walls of lava. Here we found the breadfruit trees, plantains, taro root, sweet potatoes, ginger root and sugar canes.

Ellis, the surgeon with Captain Cook, gives a similar description of the plantations containing sweet potatoes, as well as taro, sugar cane, bananas, and breadfruit (19, vol. 2, pp. 91-96).

Menzies, surgeon with Captain Vancouver in 1793, gives an interesting description of the country above Kealakekua, indicating the planting of sweet potatoes between or in the midst of breadfruit trees in the median zone (49, p. 75):

. . . On leaving this station [the drier coastal zone], we soon lost sight of the vessels, and entered their bread-fruit plantations, the trees of which were a good distance apart . . . but here the size of the trees, the luxuriancy of their growth and foliage, sufficiently show that they thrive equally well in an elevated situation. The space between these trees did not lay idle. It was chiefly planted with sweet potatoes and rows of cloth plant.

Proceeding beyond this median zone, Menzies (49, pp. 75-76) describes the intensive cultivation of the little fields enclosed by walls of stone thrown out in clearing:

The produce of these plantations, besides the above mentioned, are the cloth plant. . . taro and sweet potatoes. The latter are here planted three or four feet apart and earthed up around their stems much in the same manner as the common potatoes are treated in England. When they dig up any, we remarked that, after stripping off the potatoes, they carefully put the old plant back again in the ground for the ensuing crop.

Today sweet potatoes are planted by many Hawaiians living along the coast of Kona, either in the sandy soil near the shore at places like Hookena, Kealia, and Honaunau, or in spots where there is sufficient soil in the midst of the dry lava. Two sizable plantations were visited on the dry slopes half a mile to a mile inland in the Kailua section. Sweet potatoes flourished at the government experiment station at Kainaliu, at an altitude of 1,500 feet in North Kona; and patches are seen at various points both above and below the "Belt Road", in North and South Kona at altitudes of 1,800 feet. On the plantations in which taro, sugar cane, and bananas are still grown in the higher plantation zone up to an altitude over 2,000 feet, no sweet potatoes were seen at this time.

Wherever a little soil could be heaped together along the dry lava coast of North Kona, a few sweet potatoes were planted by fishermen at such places as Honokohau, Mahaiula, Makalawena, Kaupulehu, Kiholo, Keawaiki, and Kapalaoa. Doubtless potatoes were planted on the upland of North Kona, on the lower slopes of Hualalai toward Puu Waawaa, up to a considerable altitude in rainy seasons. In recent times the flatlands of Puu Anahulu, having an elevation of about 2,300 feet, have supported a number of patches planted by Hawaiian cowboys.

The coastal section of Waimea, now called South Kohala, has a number of small bays with sandy shores where fishermen used to live, and where they probably cultivated potatoes in small patches. Anaehoomalu, Waialua Honokaope, Kalahuipuaa and Pauoa all have sandy strips along the sea; and there is an area of black cinder in this section where sweet potatoes might be grown in rainy seasons. Puako was a sizable fishing village at one time where there were undoubtedly many sweet potato patches. The same is true of Kawaihae, which was an important locality in ancient times as is indicated by the great temple of Puukohola. Between Kawaihae and the upland taro plantations in the vicinity of Waikoloa Stream (below the present town of Waimea) there were many plantations on the *kula* lands from the coast up to 2,500 feet, as is indicated by the stone walls and dry terraces on the hillsides. At Waiaka (elevation 2,413 feet) one Hawaiian planter still has sweet potato patches in which the tubers flourish, though they do not grow to great size.

That a very considerable population lived in this region is indicated by the following observation of Menzies in 1793 (49, p. 56):

A little higher up, however, than I had time to penetrate, I saw in the verge of the woods several fine plantations, and my guides took great pains to inform me that the

inland country was very fertile and numerously inhabited. Indeed, I could readily believe the truth of these assertions, for the number of people I met loaded with the produce of their plantations and bringing it down to the water side to market, for the consumption was now great, not only by the ship, but by the concourse of people which curiosity brought into the vicinity of the bay [Kawaihae].

Ellis (20, p. 196) writes that between Kapulena and Waimea town

. . . The soil was fertile, the vegetation, flourishing, and there was considerable cultivation. . . Here [in the valley of Waimea] a number of villages appeared on each side of the path, surrounded with plantations, in which plantains, sugar-cane, and taro, were seen growing unusually large.

It is probable that sweet potatoes were grown also in this upland valley, although it may have been too foggy and damp.

Describing the west coast of Kohala north of Kawaihae, Ellis (20, p. 217) writes:

The coast was barren; the rocks volcanic. The inhabitants were all fishermen. Mr. Thurston was informed, that the inhabitants of the plantations, about seven miles in the interior, were far more numerous than those of the seashore.

On the north coast of Kohala sweet potato was the staple of the inhabitants who lived on the dry *kula* land in the region about Hawi and fished along the shores eastward and southward from Upolu Point. According to a *kamaaina* of Kohala, fishing families also planted sweet potatoes at Mahukona, Haena, and Honoipu.

On the wet *kula* lands along the northern slopes of the Kohala Mountains, sweet potatoes were planted around the houses, which stood on the open ground bordering the gulches in which the householders cultivated their *lo'i* and on the sloping lands between the gulches, along with the taro and sugar cane, right down to the sea. Accounts of early voyages indicate that the slopes of Kohala were intensively cultivated.

In the deep valleys from Pololu to Waipio very little potato was planted, though presumably some portions of the sand dunes may have been utilized for this purpose. The uplands are too wet. That sweet potatoes were formerly planted in Waipio along with taro is indicated by Bingham's reference to them in 1855 (5, p. 379). Taro planters today in Waipio plant patches of sweet potatoes to vary their taro diet.

On the vast slopes of Hamakua sweet potatoes used to rival taro as a staple, being grown in patches all along the lower slopes that are now covered by sugar cane. Many Orientals and a few Hawaiians still have potato patches. In 1931 a number of varieties were collected at Honokaa with the help of Sheriff Rickard and his men.

The northern section of Hilo is much like Hamakua in topography though rainfall becomes more abundant to the southward. A good many small potato patches are seen today. Laupahoehoe, at the northern limit of Hilo, has evi-

dently always been a great sweet potato locality, as it is today, for with it is identified a particular variety of potato known as *Kihi poepoe*. It was at this place that an old planter presented me with a *Mauna pohaku* tuber weighing 16 pounds. Sweet potatoes have never been grown much in the wet lowlands of South Hilo, but today there are a number of Hawaiian gardens in upper and lower Waiakea and about Hilo town where sweet potatoes are raised successfully by very high mounding so that tubers and foliage do not mould from constant rains and damp soil. In the prosperous Hawaiian settlement of Keaukaha, I am told, a first crop of sweet potatoes may be successfully grown in the shallow soil on top of the lava, but that subsequent crops raised on the same ground are small and very hard. Ellis (20, p. 187) mentions sweet potatoes along with other native plants and remarks that " . . . in several of the less fertile parts of the district we saw small pieces of lava thrown up in heaps, and potato-vines growing very well in the midst of them, though we could scarcely perceive a particle of soil."

At Keaau, the northernmost settlement on the coast of Puna below Waiakea in Hilo, Ellis (20, p. 174) saw sweet potatoes cultivated in plantations together with taro and sugar cane. We may infer that similar cultivations were typical of the other sections along this northeast section of Puna. The sandy soil southeast of Honolulu must have been utilized for sweet potatoes. As to the interior of northern Puna in ancient times, I have no information. There are a few patches now in Koae and the vicinity of Kapoho; the slopes and higher ground inside Kapoho crater are ideal for sweet potatoes. A variety of wild potato with deeply cut leaf, which had obviously gone wild from cultivation, was found near the rich taro land of Malama homesteads. It is safe to assume that sweet potatoes were cultivated throughout southeast Puna both inland and along the coast wherever there were plantations. They are still grown in small patches at Kaimu, Kalapana, and Kapaahu. It is said that on the barren coast beyond Kapaahu, fishermen scraped together piles of broken lava and rubbish when rains came and successfully grew sweet potatoes in them. Despite the fact that sweet potatoes were planted almost universally and many patches are still maintained, the Puna natives seem to regard this vegetable with little interest, probably because Puna people prided themselves upon and relished their breadfruit, and also because potato was nowhere and at no time the staple for this rainswept district.

On the other hand, most of the population dwelling on the windswept and relatively dry coastal plains of Kau subsisted on the sweet potato; consequently it held a large place in the interest of Kau planters. Early descriptions indicate that where the taro was planted sweet potatoes were also seen (p. 129). But below the zone of upper *kula* land where taro was planted and along the whole coast of Kau there are broad, gently sloping lands upon

which sweet potatoes alone could be grown. This sweet potato belt included the steep slopes mountainward from the present government road, where there was insufficient rainfall for taro, and all the coastal plains to seaward of the road from Hilea to Waiohinu. Beyond Waiohinu, going toward Kona, the government road ascends into the taro zone so that old taro lands extend for a short distance seaward of the road; but most of the land, stretching for over 5 miles inland from the coast over the districts named Kamaoa and Pakini, was given over to sweet potato cultivation. A large section of this land mountainward from Kamaoa homesteads and around the homesteads was gone over in detail with a *kamaaina* born and raised here; the number of local names for planting areas indicates fairly continuous cultivation of the land in ancient times. This country is given over wholly to ranching now, except for a few Hawaiian homesteads. There are a few potato patches near Hawaiian houses in Waiohinu, and one elderly couple, whose advanced years do not interfere with their industrious love of the planting traditions and techniques of their race, have one of the best kept small plantations of taro and sweet potatoes seen in the islands, just above the government road about a mile west of Waiohinu.

YAMS

Yams were not systematically cultivated in gardens by Hawaiians, as they were in Tonga where they were the staple food and in many parts of Melanesia where the vines twine themselves on poles set up in garden plots. However, many yams were planted in Hawaii to be used as food in dry seasons and during droughts, and quantities of them were traded to ships. Generally yams were planted in wet gulches and forests where trunks and branches of trees served to carry the vines.

There are three plants, introduced by the ancient Polynesian settlers, to which early European visitors probably referred indiscriminately as "yams" —the *uhi, hoi,* and *pi'a*[10]. All three are vines having tubers and growing similarly in the forest. Hawaiians always speak of "yams" as *uhi.* The *pi'a* has a coarse edible root. The *hoi* has aerial tubers (*alaala*) which are poisonous but were somehow prepared for eating in times of extreme famine.

The *uhi* or *ulehihi* is *Dioscorea alata,* the yam. Its vine is slightly angular in cross section with longitudinal ribbonlike wings which are green or reddish according to variety. Its leaves are lighter in color than those of the *hoi,* having 7 to 11 nerves similarly joined at the apex, and it has large tubers. This is easily distinguished from the *hoi* by wings on the vines. (See figure 17 for appearance and terms for parts.)

The *pi'a* is *Dioscorea pentaphylla,* and has a vine angular in cross section but palmate leaves and small tubers. According to Hillebrand, it is less com-

[10] Pronounced *pi'a,* not to be confused with *pia,* pronounced *piya,* which is arrowroot (*Tacca pinnatifida*).

mon than the *uhi* and was probably never cultivated. I am told by Dr. Richard Thurnwald that the "yam" with 5-fingered leaf is extensively cultivated in New Guinea.

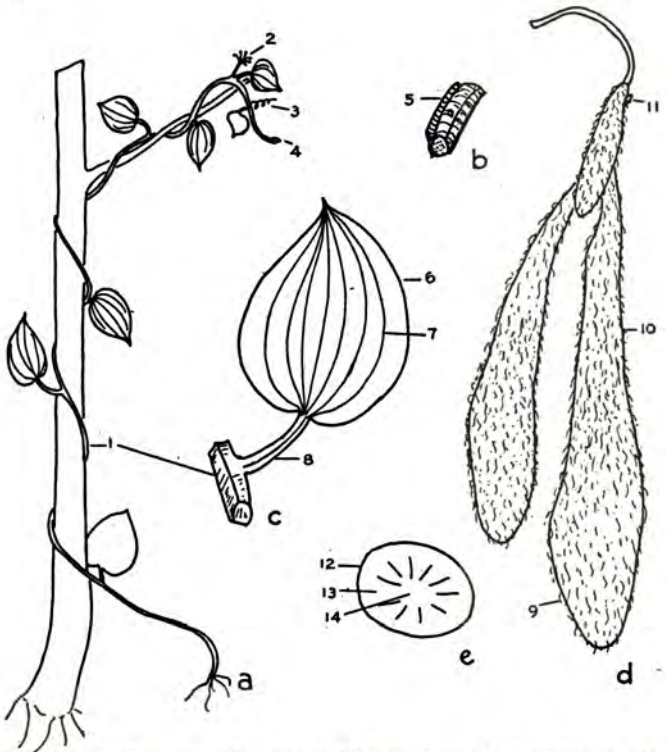

FIGURE 17.—The native yam showing habit and terms for parts: *a*, vine; *b*, cross section of vine; *c*, leaf; *d*, tubers; *e*, cross section of tuber.

1. ka: vine
2. pua: flower
3. umiumi: tendril
4. mu'o: leaf bud
5. molina: wing
6. lau: leaf
7. a'a lau: leaf veins
8. ha: petiole
9. a'a mole or huluhulu: rootlets
10. hua uhi, mole uhi, or uala: tuber
11. maka: bud tubers
12. ili: skin
13. i'o: flesh
14. iho: core

The *hoi* (called *pioi* on Kauai) is *Dioscorea bulbifera,* or bitter yam, and has a vine with a round stem. The leaf is dark, glossy green with 7 to 11 nerves converging at the apex, and a small tuber (no larger than a medium-sized white potato) develops from the aerial tuber that falls and plants itself. This is a prolific wild plant, but was never cultivated.

My immediate authority for the definitions of *hoi, pi'a* and *uhi* is Mrs. Pukui, but I have verified her statements in the field. Any informed country Hawaiian knows that *hoi* has aerial tubers that are poisonous, a round stem, and "round" leaf; that *pi'a* grows wild and has an edible tuber like the *uhi,*

but a "fingered" leaf; and that *uhi* was cultivated, has a large tuber, square stem, and "round" leaf.

Hillebrand (29) identified *hoi* as *Dioscorea sativa* (synonym of *D. bulbifera*). But "the *uhi* and *ulehihi (pioi* in Kauai)" he identified as a native vine, belonging to the lily family, *Smilax sandwicensis,* which does not have roots used for food, according to Mrs. Pukui, and which does not have aerial tubers. Hillebrand's confusion of this native *Smilax,* known to Hawaiians as *hoi kuahiwi,* with *Dioscorea alata* must have arisen from the closely similar round leaves of the two vines. He did not include in his list *D. alata* (*uhi*), the only yam cultivated, and misstates that *D. bulbifera* was the cultivated yam. He does say, however, "A third species has been seen by me in the neighborhood of Honolulu, but I regret not to find a specimen in my collection." The statement in the Andrews-Parker Dictionary that *hoi, D. sativa* (synonym, *D. bulbifera*), was cultivated for the supply of ships is again an error that must be due to confusion of native names and botanical identifications. Mrs. Pukui's definition conforms precisely to the use of the names *uhi* and *hoi* by Polynesians elsewhere: throughout tropical Polynesia the *uhi* is *Dioscorea alata,* the cultivated yam; the *hoi* is *D. bulbifera,* the wild, bitter yam.

Cultivated Varieties

With the exception of the Kauai *Uhi ke'oke'o,* and *Uhi ulaula,* specimens of which were collected from Kauai, eastern Maui and Kona, Hawaii, my notes on yam varieties are based entirely on description by informants. *Ke'oke'o* and *Ulaula* were universal throughout the islands, from Niihau to Hawaii, where informants described them to me in Kona, Kau, Puna, Hilo, and Hamakua. *Ulaula* was collected growing wild in Hana, Maui and in Kona, Hawaii. At Haena, Kauai, the following varieties of yams were cultivated and the first two were collected:

Ke'oke'o, having a tuber with white flesh and white skin, and green vine with green "wings", small red dot at base of petiole, green petiole and veins. (Used only for food, never medicinally.)

Ulaula, having a tuber with white flesh and red skin, green vine with green "wings", red dot at base of petiole, green petiole and green veins. (Used medicinally and as food.)

Kalakoa or *oni'oni'o,* having a tuber with flesh mottled reddish and white, and white skin; green vine with red "wings".

On Maui the *uhi* was sometimes called *Palau.* In Puna, Hawaii, two varieties are still found:

Poni, the tuber of which has white flesh and purple (*poni*) skin.

Alela, with white flesh and white skin.

In Kona the varieties of *uhi* described by informants were:

Laha, having a tuber with white flesh.

Niihau, having a tuber with pink flesh.

Lehua, having a tuber with light pinkish flesh and vine with red wings. (Presumably the same as *Ulaula.*)

In Hamakua and Hilo, Hawaii, the following are the varieties of *uhi,* which Judge Tucker said were once common:

Poni, having a tuber with flesh described as being red and white "in bands", with red skin; vine green with red "wings", petiole red and veins of leaf red.
Hoonohonoho, having tuber with white flesh and red skin; vine green with green "wings", petiole red and veins red and green.
Ke'oke'o, having a tuber with white flesh and white skin, and vine and foliage green throughout.
Uala, whose tuber was "like a sweet potato." (Detailed description lacking.)

Planting and Cultivation

In general, yams were planted in the inland gulches, on high semiforested *kula* slopes or in the lower zone of the rain forests. Their growth is therefore more definitely seasonal than that of either the taro or the sweet potato. Toward the end of the rainy season in February or March, buried tubers begin to sprout and in the late spring and summer, strengthened by hot sunlight, the vines festoon the branches and trunks of trees, stones, or whatever they can twine around. The foliage matures in October and withers in December.

When the foliage withers, the plant is mature, but the tuber continues to fill out. The tubers should therefore be left in the ground during the dormant period of the foliage and dug after rains again set in and the new shoot appears from the top of the tuber. Then the tubers have attained their maximum growth and are succulent, whereas if they are dug at the end of the dry season they are mealy (*punapuna*). If left in the ground until the new vine has grown, the old tuber will become watery (*loliloli*).

Small "seed tubers" or baby yams, or pieces of the top of the mature yam having "eyes" (*maka*) or sprouts, are used in propagating the *uhi,* being planted about a foot deep in a hole and covered with lightly packed earth, which should be heaped up and covered with refuse. Digging out yams requires excavating to a great depth, since the tubers grow deep and root themselves firmly.

The following old Hawaiian method of planting *uhi* in Hamakua and Olaa was described to me by Judge George Tucker of Olaa whose Hawaiian forbears taught him yam culture[11]. On the ground in the forest a great bin of tree-fern trunks (*hapuu*) was built 3 to 4 feet high on the sides, the fern trunks being laid horizontally. The bin was filled with decaying fern leaves and other rubbish. The seedling tubers (*hua uhi*) were then stuck in the rubbish a few inches below the surface. No earth was put in, but as the rubbish in the bin decayed and sank, more rubbish was heaped on top. Fully

[11] As planting "nights" for yams, *Mahealani* (16th night) and *Hua* (13th night) are best.

matured tubers grown by this method are said to have weighed up to 50 pounds.

Another interesting practice in planting yams on steep hillsides and the sides of gulches on the Hamakua coast and in North Hilo was to dig a vertical hole in the side of the slope, 2 to 3 feet deep, and place a large flat stone in it. The hole was then filled with earth and decaying leaves, and the seed yam planted near the top of the hole. The rock at the bottom of the hole prevented the tuber, which grew downward, from growing deep into the ground and forced it to spread out. When time for digging, the earth on the side of the hill or gulch was simply dug away and the tubers extracted.

Uses

As food the *uhi* was steamed in the earth oven like the sweet potato and the taro, and was eaten so. The flesh is too mealy to make a paste. The tuber is best for eating when its foliage is in the early stages of second growth.

Medicinally the *uhi* has many uses: it is an ingredient in prescriptions for cough, for vomiting blood, constipation and "appendicitis", apoplexy, and dysentery.

Planting Localities

NIIHAU

Niihau once produced quantities of yams, which were planted presumably in the large pockets in the elevated coral at the southeast of the island, the bottoms of which are said to be filled with vegetable mould.

When I visited the island in 1931, I was told that yams are no longer found on the island, which has been used for many years for sheep ranching. I had no time to search for wild yams.

The first foreigners who had intercourse with the island speak of yams on Niihau. Cook (12, vol. 3, p. 116) refers to it as "producing an abundance of yams." When Portlock provisioned his ship there in 1789, yams were the chief article of trade. He speaks also of receiving sweet potatoes, pigs, and sugar cane; but states (63, pp. 83-84) specifically that yams were the main produce. His judgment was based on food received on board, rather than observation ashore: "The island appears to be well cultivated; its principal produce is yams. There are besides, sweet potatoes, sugar-cane and the sweet root which is called *tee* by the natives." Samwell (66) says that more potatoes than yams were planted, which is probably correct; however, he may have seen only the plains where potatoes were planted.

KAUAI

Yams were preferred to sweet potatoes by the captains of European ships because they kept better at sea. Several who knew what quantities of yams were raised on Niihau expressed their disappointment when they found few available on Kauai. This does not necessarily indicate that yams were not planted as extensively here as elsewhere. The Niihau people undoubtedly dug up everything they had in the ground to offer for Portlock's trade articles. The people of Kauai, on the other hand, had far more taro, sweet potatoes, and pigs for trade, and probably did not go into the great valleys and the distant uplands for the yams which quite certainly grew there. Very likely it was not the season for digging yams. It must be remembered, too, that all the early voyagers traded at Waimea, which is in the dry section where fewest yams were grown.

Unquestionably, yams were planted in the valleys and uplands along the Napali coast. They were found under cultivation in Wainiha in 1931, and it may be presumed that quantities were grown inland throughout Halelea, Koolau, and Puna. *Kamaaina* of this section have told me that they were planted in the gulches and in lower forested areas in Paa and Wahiawa. Probably fewest yams were planted in the dry southeast of the island (Kona). The upper gulches and forests in and above Waimea Canyon should be favorable localities for yams.

OAHU

Bennett (3, vol. 1, p. 214) says that in Manoa Valley yams were grown "chiefly for the supply of shipping." Menzies (49, p. 23) describes the plantations behind Waikiki as "little fields planted with taro, yams, sweet potatoes, and the cloth plant." This suggests that yams were grown in garden plots, which is contrary to the data given me by informants. It is unlikely that at the time of Vancouver's visit (1792), Hawaiians had been induced by the prospects of trade with ships to plant yams in their lowland gardens, though this is not impossible as Cook's men showed preference for yams.

Old *kamaaina* of Oahu say yams were planted in the valleys, gulches, and forests, but none know where they are now to be found. *Hoi* and *pi'a* grow in the valleys, but I have never seen *uhi* growing wild here.

MOLOKAI AND LANAI

Evidently yams were planted extensively on Molokai, for Cook (12, vol. 3, p. 114) writes that "its produce, we are told, consists chiefly of yams." He also mentions yams as produce of Lanai (12, vol. 3, p. 115). Phelps

found wild yams on Molokai in 1937. Emory has indicated to me on the map of Lanai a number of localities on the upland where *uhi* are known to have been planted in old Hawaiian times.

MAUI

On Maui *uhi* have been found growing wild on the rain-watered *kula* of Hana, and I am told that they used to be planted throughout eastern Maui. Presumably the same was true in the interior of the valleys and in the lower forests of western Maui.

HAWAII

On the island of Hawaii, yams were planted extensively in Hamakua and North Hilo on the steep slopes of the wet gulches, and in the lower fern forests of Hilo and Puna, following the unique method of propagation described on pages 169-170. They were also planted in holes in the ground where their vines could twine on trees, throughout the lower forests in all districts. In Kau and Kona especially, as in North Hilo and Hamakua, they were valued as a dry season supplement to dry taro and sweet potatoes. In Kau, Menzies (49, p. 186) speaks of yams planted in fields with taro. I think it likely that Menzies sometimes failed to distinguish between sweet potatoes and yams.

Yams are generally not considered one of the staples of the Hawaiians. But in view of the universal custom of planting *uhi* as a dry season supplement to taro and sweet potato and the very considerable areas of interior valley and forest ideal for yam planting, I believe we habitually underestimate the importance of the yam as an element in Hawaiian economy, especially in hard times and for the poorer people. The *uhi* has not been accorded its due because, growing in the forest, it was not as noticeable to observers as taro and sweet potatoes. Natives had little esteem for it, since it could not be made into poi. For the same reason, white potato has never appealed to Hawaiians.

BANANA

The habit and parts of the Hawaiian banana are shown in figure 18. Color terms applied to the banana are the same as those used for the sweet potato. (See list, p. 131.) The following list gives terms used in describing various characteristics of the banana plant:

	e'a mai'a	a big grove of bananas
Stalk:	ha'aha'a	short
	kiekie	tall
	mu'oiki	tapering
	palohuki	very old stump

Leaf:	uauahi	"frosted" (petiole or leaf surface)
	palahalaha	wide
	maka	green
Fruit:	hakonakona	skin adhering to flesh
	ololi	narrow
	pala	yellowed
	loloa	long
	pokopoko	short
	kihikihi	angular
	poepoe	round
	pu'ipu'i	fat
	wiwi	thin
	palupalu	soft
	uaua	tough
	pa'akiki	hard
	awa-awa	sour
	momona	sweet-tasting
	ala	sweet-smelling
	lahilahi	thin (skin)
	pa'apu	thick or coarse
	maniania	smooth
	kalakala	rough
	maka	green (banana)
	o'o	approaching ripeness
	pala ha'ama	half ripe
	pala	just ripe
	palaku	ready to drop
	pala kapule	black spots on the skin
	palaho	rotten
Flower:	pilali mai'a	honey in the blossom

Cultivated Varieties

Pope (62, pp. 1-48) gives systematic botanical descriptions, based on observations of trees planted at the Federal Experiment Station, of the following varieties: *Polapola, Maoli, Haikea, Manaiula, Ka-ua-lau, Eleele, Koae, Mahoe, Puhi, Eka, Ihu-u, Iholena, Kapua, Lele, Popoulu, Kaio, Moa,* and *Oa.* My characterizations of these are based on Pope's descriptions, supplemented by field observations. Other descriptions are from observations in the field, supplemented by Mrs. Pukui.

Other lists of varieties which I have consulted are those of Thrum (70), and Mr. Thomas Wight (72) of Kona, Hawaii. The list below is not complete, as limitation of time made impossible any attempt to record all the names of varieties remembered in different islands and districts.

Eka has fruit curved and angular, with thick skin, reddish after flowering, becoming dark green, and yellow when ripe (like *Manaiula*) and is edible only when cooked. The petiole and midrib are pale red, the trunk light green tinged with red.

Eleele is a mountain banana of medium height growing on all the islands, so called because of the blackness (*eleele*) of the trunk, and the dark color of the fruit when young, also called *Hinu-pua'a* because the trunk looks as if it had been polished with pig's grease (or bacon grease). The skin of its dark green angular fruit yellows when it ripens and

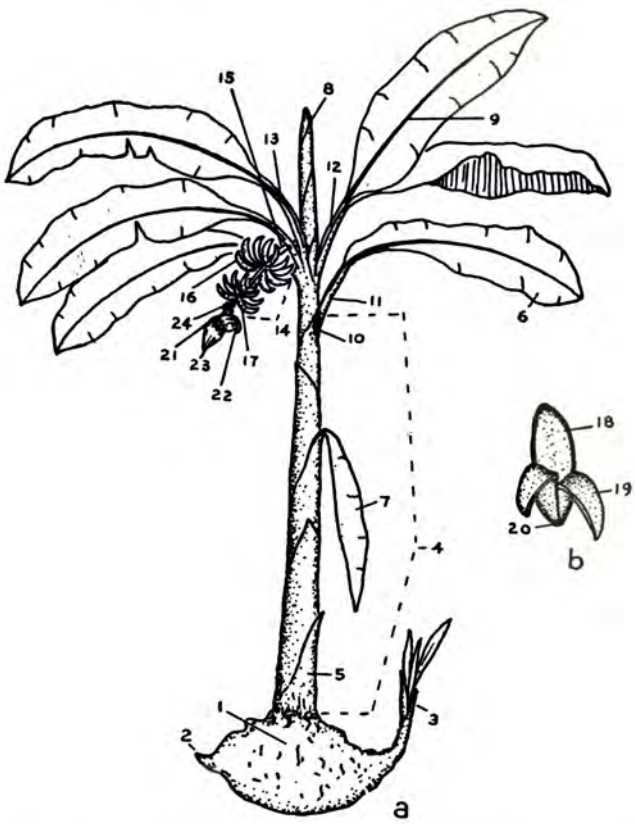

FIGURE 18.—The banana plant showing habit and terms for parts: *a*, tree; *b*, detail of fruit. (Original sketch by Mary Pukui.)

1. mole: root stalk
   2. opu'u: root bud
   3. pohuli: root sucker, young plant
4. pu maia: stock, stump, or trunk
   5. ha maia: stalk sheathing, layers forming trunk, or fibers of sheathing
6. lau: leaf
   7. lau hulu: old dried leaf
   8. mu'o maia: young leaf
   9. haha maia: petioles and midrib
      10. kumu ha: base of petiole
      11. ili ha: skin of petiole
      12. mawae: channel in petiole
      13. lihi mawae: edge of petiole channel
14. ahui: bunch of fruit
    15. kano or au maia: stem of bunch, rachis
    16. eka maia: hand of bananas
    17. hua maia: banana
    18. i'o: flesh of fruit
    19. ili: skin of fruit
    20. piko: tip of fruit
21. pua: blossom
    22. opuu maia: blossom case
    23. pola maia: sheath of blossom
    24. pu maia: small flowers, blooming stalk

the flesh is orange, growing in small bunches. Hawaiians value this banana not for its fruit which is edible when cooked, but for the black skin of the stalk (*ili ha*) which used to be employed in plaiting ornamental borders on mats and since missionary times has been used in the same way in plaiting hat braids. It is said that when this banana is planted near the sea it loses its blackness. In Puna, *Eleele* is planted on the lowlands. To preserve its blackness, Puna planters always plant *Eleele* on a dark moonless night. This variety is sometimes called *Poni* (purple).

Ha'a or *Ha'aha'a* is a low (*ha'a*) tree with a short, broad, hard leaf, the fruit of which grows on a short rachis in a compact stocky bunch and is edible raw or cooked when ripe. The skin is yellow when ripe. *Ha'a* is taller than the introduced "Chinese banana", which bears larger bunches.

The *Haikea* bears fruit that is angular and slightly curved, skin when ripe is thick and *"bright waxy yellow"*, flesh yellow, edible raw or cooked. The petiole is brownish at base, green with reddish wash above, margin of petiole purplish, curving upward. The trunk is tall, green, with reddish base. According to Pope (62, p. 37), the term *hai* is said to be a contraction of *mohai*, meaning an offering to the gods. This suggests that this plant may have been ritualistically equivalent to the *Lele*, which it resembles, for *Haikea* may be translated "light green (*kea*) offering", *kea* being used to describe varieties in which whitish green predominates.

Hapai is one of the most interesting of the native bananas in its growth. Its bunch matures within the trunk about two thirds of the distance up from the ground. Ripeness of the fruit is detected either by swarming of fruit flies around the swollen trunk or by crawling ants. Then the trunk is opened and the little fruits, only about as long as a finger, ten or fewer, are pulled out. The stem on which the fruits are arranged in small hands grows upright. The ripe skin and flesh are yellow and quite sweet when raw. The tree is of medium height. *Hapai* means "pregnant" and describes the appearance of the trunk. It is also called *Huawaena* (fruit in the center).

Iholena is a great favorite and grows anywhere. It is good to eat raw when very ripe or cooked. Its name "yellow core" describes the salmon-pink color of the ripe flesh. The bunches are small and the fruits are angular, plump in the middle, arranged loosely on the stem and stand out at right angles to the stem. The skin is thin, green when immature and yellow when ripe. The leaf blade is light green with an edge like a narrow dark brown ribbon which continues down the edge of the petiole channel. The young leaf is bronze colored on the under side. The trunk is green with streaks of purple and pink. It grows well on the high windy slopes of eastern Maui and also flourishes near native homes in the lowlands, as in Honolulu. Also called *Hilahila*, according to Pope (62, p. 42).

The *Ihu-u* (snub-nosed) is rarely cultivated but grows wild in forests on Kauai and Hawaii (62, p. 42). It has curved, angular fruit growing on a small stem, with a tough yellow skin when ripe and yellow flesh which is edible only when cooked. The name of the tree describes the shape of its fruit. The leaf is dark green with a light green midrib and petiole, and dark brown patches at the base of the petiole. The trunk is short, slender and tapering, and green throughout.

Kahiki, meaning "foreign" or perhaps "Tahiti", is rarely cultivated now but grows wild in abundance on Maui. I have seen it on Maui at Hana, Kipahulu, and Kahakuloa. Kamakau, who was an Oahuan, mentions its name, but Mrs. Pukui never heard of it on Hawaii. The fruit is long, skin ripens yellow, meat white and edible cooked but not raw. It grows tall. *Kahiki hae* was described on Maui as similar, but short. *Kahiki mauki* was observed on Maui: fruit looks like *Kahiki*, midrib of leaf green and rim red, petiole green with very slight pink edges, edge of channel red, trunk tall and grass green.

Ka-ua-lau has fruit that looks like *Maoli*, except that when immature the dark green skin is speckled with light green spots which resemble fine raindrops, hence the name meaning "many little raindrops." The leaf is solid green, shaped exactly like that of *Maoli*. The skin of the fruit is medium thick, rich yellow when ripe, and looks "waxy." The flesh is light yellow, good only for cooking in the oven but not for *piepiele*. The fruits are

straight, plump, and blunt. The leaf is broad, midrib pinkish, petiole green with pinkish margins, trunk of moderate height, tapering, green with brown patches. It is common in Puna, Hawaii, where it is said to be a heavy bearer and is a favorite for cooking: reported also in Kona, and on Oahu.

The most beautiful native banana is the *Koa'e, A'ea'e* or *Manini,* which I have seen only on Hawaii. It is commonest in Kona, rare in Hilo and Puna. *Koa'e* is the tropic bird, *a'ea'e* means "hair prematurely graying," and the *manini* fish has dark and light stripes. The banana plant is likened to all these because of the white or very light green lateral stripes, of varying widths, on the dark green leaves, and the white and green alternating on the midrib, petiole, and trunk, and on the skin of the fruit when immature. The fruit ripens yellow, is short and round, with yellow flesh, and is generally cooked but can be eaten raw.

Lele is one of the commonest wild bananas of the uplands on all the islands. It has a tall, slender, tapering trunk with narrow leaves. The fruit grows in compact small or long bunches on a long stem, is angular and tapering, and several fruits are generally warped or pressed flat; the skin is thin, green when immature, yellow when ripe; the flesh is light pink, edible raw or cooked, good for *piepiele.* The leaf is light green (young leaf reddish underneath), petiole light green. The trunk is light green with a yellowish tinge. This banana used to be planted by the altar (*lele*) in the temples. *Lele* means to fly. In "feeding" ancestral spirits (*aumakua*), this banana served as an offering (*mohai*). In love magic (*hana aloha*), one ate a *lele* banana to make love "fly away." In weaning, two *lele* bananas were laid in front of the child: if it ate one, the desire for the breast "flew away", if it did not take one, weaning was postponed. Juice extracted from the root of the sprout (*pohuli*) was given to children as medicine for thrush (*ea*). This banana was used in feeding patron sharks at Kamilo beach, Kau. Awa drinkers ate it to take away the bitter taste.

Mahoe (twins), also called *Pa-lua* (double), *Mana-lua* (two-bunched), or *Hua-lua* (bearing in twos) is a native banana the stem of which divides into two, forming two bunches. This variety is common in Kona, Hawaii. Pope (62, p. 41) reports one plant found in Hilo which "had its fruiting stem divided in an attempt to produce six separate bunches of fruit." The fruits are small, skin yellow when ripe, flesh light salmon, said to be delicious when well ripened. The leaf is green on the upper surface, light green beneath, the petiole margin red. The trunk is green tinged with pink and splotched with brown.

Malei, or *kahiki malei* (? foreign *Malei*), observed on eastern Maui under cultivation, has a fruit said to be like *Puhi,* leaf green with midrib black underneath, becoming green toward the tip, and red rim; petiole base black, black on the under side, with pink margins; trunk green and pink with vertical dark brown bands.

Maleiula, Malaiula, Maneiula, or *Manaiula* is so called because the tough fibers of the stalk are used to string flowers in making leis with a coconut needle (*manai*). The fruit has a thin skin which is maroon (*ula*) when immature, green when half-ripe, and yellow when ripe, with orange-colored flesh, good for cooking but not for eating raw. The long narrow leaf light green above, pinkish underneath, midrib pinkish on the under side, petiole flesh color with margin dark reddish, in-turned and splotched black at base; trunk light green to mahogany color. This banana was common, under cultivation and in the mountains, on all the islands. Tradition says that it was brought by the gods Kane and Kanaloa and planted in the uplands.

Maoli, which means "indigenous", grew everywhere in uplands and lowlands, a sweet banana when cooked, also eaten raw. The fruit grows in large compact bunches, is long with thick skin that is a rich waxy yellow when ripe, with yellow flesh. The leaf is very long and wide with petiole margins curved in so that they almost touch, edges tinged with pink extending into brown margin around the blade. The trunk is green with faint pink and brownish patches below base of petiole.

Moa or *Huamoa* is not very common but I have seen it on Kauai and Maui, and Thrum mentions it. The fruit is large and plump "like hens' eggs" (*hua moa*), with

yellow skin and yellow flesh; it grows in a small bunch (about four hands) and is eaten raw or cooked. The leaf midrib and petiole are pinkish and the petiole is frosted with pink edges; the margin of the leaf is brown; base of petiole marked with brown. The trunk is tall, slender, yellowish green.

No'u means "big mouthful" or "a person as broad as he is long" and refers to the short, thick, round fruit the skin of which is green when young and yellow when ripe; the flesh is cream colored and may be eaten raw or cooked. The leaf blade is broad, the midrib pink underneath, petiole green with yellowish-pinkish wash and frosted margins red and in-turned. The trunk is green with pink wash on margins of sheaths and brownish-blackish splotches. It is cultivated, rarely growing wild, on Hawaii.

Oa or *Maʻa oa* now grows above Iao Valley on Maui. Pope (62, p. 46) believes that the Hawaiians planted the seed "for some medicinal purpose", but informants know of no such use. Thrum (70, p. 80) reports that it was brought to Oahu from Kona, Hawaii. Trunk and foliage are dull green tinted with bronze and purple. *Oa* is unique in having flattened seeds that will reproduce the plant, borne in a tough placenta which is not edible. According to Pope (62, p. 46): "The variety is of value to the banana breeder, because a portion of its flowers are perfect and through self-pollination produce seeds becoming viable in the mature fruit. The staminate flowers produce an abundance of pollen, which also may be used in crossbreeding banana varieties. The Maia-oa is probably a distinct species."

Polapola is the Tahitian *Musa fehi* with a tall black trunk and upright stalk bearing large round fruit the skin of which is reddish orange when ripe; the flesh is yellow, deep yellow when cooked, and is not edible raw. This is believed to have been introduced from the Society Islands after Cook's discovery, but some Hawaiians claim it came in ancient times. It now grows in the uplands of all the principal islands of Hawaii. It is called *Akua* on Maui, *Kane* by some on Oahu, *Liko* by Thrum. When taro was scarce, Hawaiians used to eat it as *poi maʻa*, steaming it in the oven, mashing it with the stone pounder, and keeping it in a gourd like taro poi. The black bark is used in braiding, like that of *Eleele*, but it is not so shiny.

Popoulu is so called because the fruits, angular when young, mature as ball-like (*popo*) as breadfruit (*ulu*). The skin is fairly thin and yellow when ripe, flesh light salmon pink, edible raw but especially relished when baked (*pulehu*). The midrib is pinkish when young, and the petiole green. The trunk is low and green. The root of the young shoot (*pohuli*) may be substituted for the *Lele* in treating thrush. *Popoulu lahi* or *Ili lahi* (thin skin) is probably the same. *Popoulu* is one of the two varieties that women were permitted to eat; the other is not known.

Related to *Popoulu* but differing considerably is the *Popoulu kaia* or *Kaio*, with plump, tapering fruit and salmon pink flesh, edible raw or cooked. The under side of the leaf, midrib, and petiole, and the trunk are green with pinkish tints.

Popoulu puapua nui or *Kapua* resembles *Iholena*. It has a medium thick, tough skin which is yellow when ripe and the flesh is light salmon color, edible raw or cooked. The fruit is broad at the tip, hence the name *Puapua nui*, meaning "fan-tail on a fowl." The leaf is broad, green on the upper surface, dull below, bronze on the under side when young; the midrib is trough-like on top and flesh colored underneath, has brown margins with purple and pink below. The trunk is tall, green with pink and patched with brown.

Puhi or *Kahiki puhi* is an old Hawaiian banana taking its name from the twisted appearance of the fruit when young, like an eel (*puhi*). The fruit is long and fat, the skin medium thick and yellow when ripe, the flesh yellow, edible when cooked. The leaf rim is brown, the petiole green with faint pink, margin pink. The trunk is green with brown markings. This banana is essentially a mountain plant but I have seen it flourishing near the sea on eastern Maui.

Other ancient Hawaiian bananas about which we know little were the *Aulena, Ekelua, Lahi* (this is not *Popoulu*), *Loae, Loha* (said to have a trunk and leaf like the *Lele* but fruit like the *Iholena*), *Ohe* or *Hakea, Polua* and *Waimuhea* or *Kaupo*.

Nuholani, whose name means "New Holland," is said to have been cultivated for many generations by Hawaiians. Its fruit is yellow when ripe, edible raw or cooked. The leaf is green, the young leaf pink on the under side. The petiole is green with red margins and black base. The trunk is tall, slender, tapering, and green throughout.

Pope (62, p. 24) writes: "According to a manuscript, written in 1870, by G. P. Kalokuokamaile, of Napoopoo, Hawaii, fully 70 varieties of bananas were known to the old Hawaiians of the Kona district, and large areas of the Kona woods were covered with banana plants at one time. It is also known that half a century ago wild bananas covered large areas in East Hawaii, which are now utilized for grazing. Apparently many varieties that were formerly grown there have disappeared."

Names of Banana Varieties

Aulena
Eka
Eke-ula
Eleele or Poni or Hinu-pua'a
Ha'a or Ha'aha'a
Haikea
Hapai or Huawaena
Iholena or Hilahila
Ihu-u
Kahiki
Kahiki hae
Kahiki mauki
Kaio
Kapua
Ka-ua-lau
Koa'e or A'ea'e or Manini
Lahi
Lele
Loae
Loha
Mahoe or Pa-lua or Hua-lua
Malei
Manaiula or Malaiula or Maleiula
Maoli
Moa
No'u
Nuholani
Oa
Ohi
Polapola
Polua
Popoulu
Puapuanui
Puhi
Waimuhea

Planting and Cultivation

Apparently there was never any systematic cultivation of bananas in plantations as there was of taro, sweet potato, *wauke,* and *olona.* Perhaps this is because the banana and sugar cane were regarded mainly as condiments and as famine food rather than as staples. All but two varieties of bananas were tapu to women in normal times.

From prehistoric times until today Hawaiians have planted clumps of banana plants around their dwellings and on the well-watered banks of the flooded taro terraces. Now, however, since the banks have been narrowed in the commercial exploitation of the *lo'i,* this is rarely seen. Kamakau writes that bananas were sometimes planted in dried terraces, as may be seen today in many localities on Maui: at Honomalu, Wailuku, Waihee, and others.

Hawaiians say that native varieties are less capable of withstanding wind than the introduced Chinese or Cavendish variety; therefore the old planters never cultivated the banana in open areas like those now utilized at Kaneohe and between Manoa and Waikiki on Oahu. On the lower forest fringe the native varieties were planted in little protected gulches, as along the base of

the cliffs at Waimanalo, Oahu, and all along the Koolau, Hamakua, and Hana coasts of Maui, and in Hamakua, Hawaii. On all the islands, including Niihau, bananas were planted in the median forest belt, from an altitude of 1,500 to 3,000 feet, to serve as insurance against famine. Descriptions of such localities on Hawaii are given on pages 116-119. On Maui today there are clumps and groves of wild bananas, relics of bygone planting days, above Iao, Olowalu, and Kahakuloa valleys on western Maui, and along the north, east, and south slopes of Haleakala, sometimes in very extensive groves, as above Hana Bay. Wild bananas are also found in inland localities not denuded by cattle on other islands, such as Wainiha on Kauai and the uplands between Waipio and Kohala on Hawaii.

The story of Kahuoi (25, vol. 5, pp. 598-604) describes the origin of an upland plantation and the use of its bananas in famine time above Waiohonu, Maui, where a large grove is said to be still flourishing.

On the windward sides of the islands and in forested uplands where rainfall and mist may be relied on, bananas may be planted at any time of the year. This is true also of drained terraces and terrace banks. But where there is a regular dry season, as in Kaupo, Kahikinui and Ulupalakua on Maui, and Kona and Kau on Hawaii, banana plants should be put in in December, the beginning of the rainy months. In Kaupo, Maui, August is generally best, and in North Kona and Kau on Hawaii, February is recommended.

Moon phase and time of day are regarded by Hawaiians as particularly important in planting bananas. Old Hawaiian practice is to plant bananas during the following moon phases:

If planted in *Laau*, the fruit will be hard and so heavy that props or poles (*laau*) will have to be used to brace the tree.

When planted at *Muku*, the bunches will be as long as the measure from crooked elbow to opposite finger tip (*muku*). The fruit will be soft. *Mauli*, immediately preceding *Muku*, is considered good by some planters.

Hua is favored because there will be many bananas (*hua*) on each bunch, but they will be small.

Mahealani is good because the name implies that the fruits will crowd each other, the word *mahea* asking "whither."

Planted in *Kulu*, the bunches will be so heavy that they will drop (*kulu*) to the ground.

Akua (god) is good, because it is the moon phase of the gods (of fertility). Fruit planted then will be so prolific as to be supernatural (*ho'oakua*), but the bananas will be thick-skinned (*pa'apu*). Fish are believed to eat voraciously in this phase "in an effort to multiply."

The *Ole* are favored by a few but for what reason I have been unable to learn: *Ole* (nothing) is the proper time for weeding, not planting.

Time of day is of prime importance. If planted when the seedling casts a long shadow, the tree will grow tall and spindly. Hence the most favored time is high noon when the shadow rests "within" the plant: "Ua kau ka la i ka lolo, ua hoi ke aka i ke kino" (The sun is directly over the brain, the shadow

retires into the body). Planted at noon, the strength is said to go into the trunk and fruit, and the tree will come quickly to maturity, as the sun descends quickly in the afternoon. If planted in the morning, the tree will grow tall and bear slowly, as the sun rises and descends in the full day. Some say evening is a good time for planting, and one oldtimer has recommended planting at night with a moon full at zenith. Disregarding the ancient beliefs, a modern Hawaiian planter points out that in a dry season or district, it is best to dig the hole and plant in late afternoon.

In selecting root sprouts (*pohuli*) or "seed bananas" for planting, sturdy stock should of course be chosen. One planter tells me that suckers chosen for planting should be growing "in front" (*i ke alo*), that is, from the side of the tree on which the bunch is hanging, or "at the back", that is, from the side opposite the bunch. According to Mrs. Pukui, the shoots on the east side that get the morning sun are the strongest and best for transplanting. A hole about as deep as the length of the arm from elbow to finger tips (*hailima*) and 3 or more feet in diameter should be dug, and the plant set in the bottom and covered with earth. It is generally not necessary to use mulch in planting the banana because it is placed so deep. The size of the hole really depends on the nature of the soil and the amount of rain to be expected. Where soil is dry and hard, the hole should be dug deep enough and wide enough to contain the roots and should be filled with good earth, as was done sometimes in Kau; where soil is rich and damp, as in wet gulches and forests, the hole is dug deep simply to hold the plant against gusty winds. On windy slopes like those of eastern Maui it is well to plant deep.

Magical potency was believed to affect the plant through acts, postures, and words, for the banana plant was regarded as a person. Fornander (25, vol. 6, p. 164) quotes Hawaiian planting directions as follows:

> Dig until the hole is wide open, about one and a half feet deep. The reason for digging so deep is that the banana may not be blown down by the wind. Then bring the seed banana and place it on the edge of the hole. Eat to satiety and then plant the banana. Grasp the seed plant, lift it up and exclaim in boasting words (with great force):
>
> | | |
> |---|---|
> | Ka mai'a nui e! | The great banana! |
> | Ka mai'a nui e! | The great banana! |
> | He umi eka ke hua! | It will yield ten hands! |
> | Aole hiki ka ahui ke amo, | The bunch cannot be carried, |
> | Elua kanaka hiki ke amo | It will take two men to carry it |
> | Hiki inoino. | With difficulty. |

During the early stage of growth of the new plant, the ground should be mulched around its base where it is dry, care being taken not to injure the new suckers. I have never heard of using fertilizer for banana plants.

When the new plant has grown about 4 feet high, some planters cut off the top. Just before the fruit stalk appears, comes a short little leaf that looks as if it had been cut off at the top with a knife.

According to Kamakau (40), the mature bananas used to be wrapped in dried leaves to ripen and buried in pits or put in large gourd containers. Fruit so ripened was sweet and fragrant, better flavored than that allowed to ripen on the plant. Mrs. Pukui says that wild mountain bananas from the cold uplands were so ripened in Kau, in pits just deep enough to take one banana bunch and allow a few inches for covering with earth. The pit was lined with banana leaves, leaves were laid over the bunches, and earth was thrown on top. It was customary to ripen bunches on the plant on the lowlands. "Proud was the farmer of the bananas that ripened in the field, and proud as he displayed them as he walked along the way, to show that he was indeed a farmer of note" (40).

A single plant bears only once. Hence the plant is felled when the bunch is mature to make way for the group of sprouts springing up around it. In the second generation, these grow into a small clump, which will maintain itself in a favorable location. Some varieties spread out gradually to form a grove.

Uses

In ordinary times, bananas were a delicacy rather than a staple, sometimes restricted to the chiefs and priests and consumed at ceremonial feasts. But in hard times those planted within the forest zone, along with *pia, uhi, hoi, olona, ki* (ti), and other forest plants, and about homes and fields with the sugar cane, served to stave off the famine that followed upon extended drought in such places as the southern coast of eastern Maui and south and southwest Hawaii. Those varieties which had to be cooked to be edible were steamed in the oven (*maʻa kalua*) and eaten just so, or in times of scarcity mashed to make *poi maʻa. Maʻa pulehu* are bananas roasted in hot ashes or over embers. Certain sweet varieties were favored by awa drinkers as *pupu* to top off the drink and take the bitter taste from the mouth.

Banana leaves (presumably *Lele* variety) sometimes covered the small shrines called *unu*; a chant from an old manuscript says, "Dedicated to heaven, sacred is the banana leaf covering of the *unu*."

Common banana leaves served as covering for the imu (earth oven). Trunks of felled banana plants were formerly used as canoe rollers.

The black bark of the *Eleele* and *Liko* (or *Polapola*) is used to braid hats. The stringy fibers of *Manaiula* were formerly used to string leis, a shaved-down midrib of coconut serving as the needle. Layers of the sheath were wrapped around the earth ball of a plant to be transplanted when coconut-leaf sheaths were not available.

Some medicinal recipes call for bananas of a particular variety as the *pani* or food to be consumed after dosage is completed. The honey from the tip

of the flower was fed to babies "like orange juice", and juice expressed from roots of certain varieties was medicine for thrush (*ea*).

The fruits of certain varieties were used by Kau fishermen to feed their shark patrons.

The banana plant itself entered figuratively into the unwritten literature of the Hawaiians in such sayings as the following, given me by Mrs. Pukui:

He pu maʻa ia kanaka, he hina wale,
A man like a banana stalk, who falls easily.
He maʻa ke kanaka a ka la e hua ai.
Man is like the banana, bearing fruit in due time.
Aohe hua o ka maʻa i ka la hookahi.
A banana plant does not bear in a day.

SUGAR CANE

I did not attempt an exhaustive or systematic study of the native canes in the course of my field work. Nevertheless, I examined all canes that I saw and discussed with informants the relation of different varieties to ceremonial and medicinal uses. In 1935, at my request, Mrs. Pukui studied the canes growing near the home of Mrs. Kaoaoloa Kukahiko at Punaluu, Oahu.

In 1920, E. L. Caum and W. G. Moir collected for the Hawaiian Sugar Planters' Association and studied in detail all the native canes then growing in these islands. The record of this study will presumably be published in full in due time. Obviously, for me to have devoted much time to the canes would have been not only a duplication of effort but a waste of time, for many of the native canes available fifteen years ago are undoubtedly now extinct. A few of the canes collected at that time are still cultivated for experimental purposes in the Hawaiian Sugar Planters' Association Kailua (Oahu) station, but I understand that some of the names were confused when the stools were transferred from the earlier plantation in Manoa Valley.

The typical habit of Hawaiian cane and the names for parts are given in figure 19. *Pulapula* is the piece of stalk with sprouts at the nodes, which is planted in order to propagate; *wai ko* is the juice of the stalk; and *muʻo kole* is the cane after blooming, when growth is complete. The following terms refer to planting methods: *opu ko* (a clump of sugar cane), *mala ko* (a field of cane), *lalani ko* (a row of growing cane), *pae ko* or *ko a palena* (cane bordering a patch).

Cultivated Varieties

Moir (52) has published an abbreviated study of the canes collected in 1920. Instead of giving my incomplete and imperfect descriptions, I quote in Appendix 2 (p. 220) the identifications from Moir's paper. In the volume on ceremonial and other phases of Hawaiian horticulture, I shall discuss several

ceremonial and magical data. A few uses of this sort, taken from my notes, are included below by way of illustration.

Ko kea or "white cane", so called because the flesh is white, is now probably the commonest variety because it is planted near Hawaiian homes for medicinal use. Its juice was believed to have therapeutic value, but in the main, mixed with a dose, or drunk or sucked after taking one, it served to counteract bad taste and to lubricate. For description of characters, see pages 223-224.

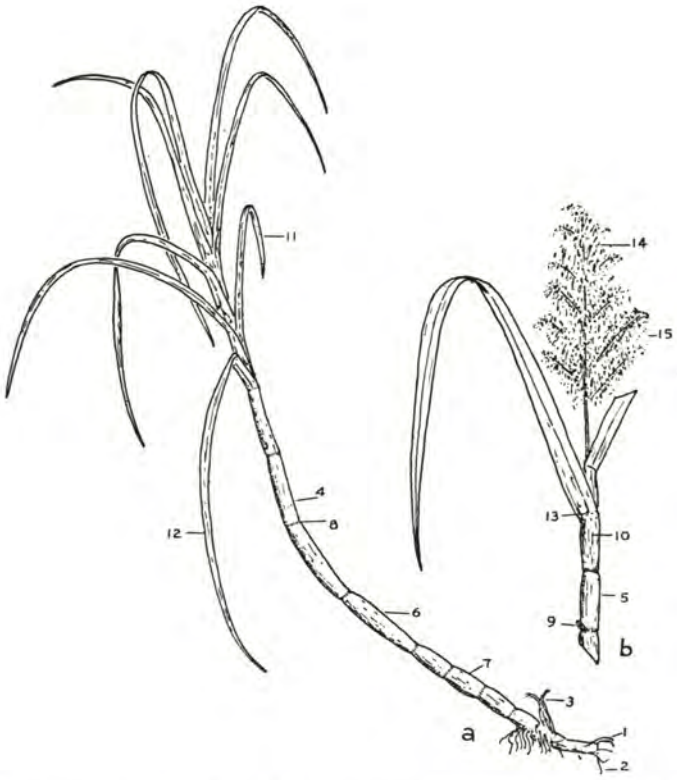

FIGURE 19.—The sugar cane plant showing habit and terms for parts: *a*, cane stalk; *b*, cane tassel.

1. a'a ko: root
2. huluhulu: rootlets
3. mu'o ko: leaf shoot
4. ko or kumu ko: cane stalk
5. puna ko: internode
6. loloa ka puna: long internode
7. pekepeke ka puna: short internode
8. pu'upu'u ko: node
9. maka ko: sprout on node
10. ha ko: leaf sheath, midrib
11. lau ko: green leaf
12. la-o: dried leaf or leaf cut off from plant
13. heu: bristly down on leaves and sheaths
14. pua ko: blossom
15. kilepalepa ko: tassel

The other great medicinal cane is the deep red *Honua ula* which, according to E. L. Caum (personal communication) comes by its name in the following way: "The wind blowing the leaves exposes the reddish under surface, reminding one of the dust clouds from Kihei or Lanai—hence Red Earth or Red Soil." This cane was used by fishermen in Kau as a substitute for the *Lele* banana in "feeding" patron sharks when awa was offered.

Manu lele or "Flying bird" is the cane famous (or infamous) for its work in love magic (*hana aloha*). "The Flying bird" wings the prayer (*pule*) laden with power (mana) to induce love (aloha) or yearning (*li'a*) in its victim.

Papa'a or "Hold fast" cane is also used in love magic. The name really means "burnt" and refers, I am told, to the burnt-sugar smell that is peculiar to the raw juice. It looks much like *Honua ula,* with which it is often confused.

Pili mai, the name of which means "come hither", had magical potency to cause attachment.

Lau Kona or *Lau Kona Kona* is a beautiful cane that is distinguished by green and white (sometimes yellow) stripes, white or striped midrib and green and white striped leaf blade. *Kona* refers to the southerly winter storms, and refers figuratively to gusty anger. Hence this cane was believed to be potent to counteract love magic, termed "unloosening love work" (*kala hana aloha*) or "warding off love work" (*pale hana aloha*). The prayer or spell recited, working through the cane when it is eaten by the victim of *hana aloha,* will blast away the unwanted infatuation with the fury of the Kona wind.

Eia mai au o ke Kona,	Here I come, the southerly storm,
Ka makani hele uluulu.	The wind that blows furiously.

Planting and Cultivation

Sugar cane was and still is planted in clumps where there is good soil and moisture around dwellings. But as an element in the systematic horticulture of the old natives it had a fixed place in relation to taro and sweet potatoes. In wet taro farming, cane was planted along the embankments separating the flooded terraces and flats. In dry taro and sweet potato fields on the sloping *kula* or in the lower forest zone, cane was planted as hedges along the lines of stone and rubbish thrown up between the fields. Thus it helped the planter to utilize to the maximum his soil and water, and acted as a windbreak against the gusty breezes which blow in most valley bottoms, along the coasts, and on the uplands where taro is grown. In Kohala, a hedge of cane marking the border of a field was termed *ko a palena* (boundary cane). The appearance of these cane breaks on taro embankments and along dry fields is described on pages 116-119.

According to Kamakau (40), cane used to grow wild along streams, on

the plain, in the forest, and in the mountains. One variety of white cane is said to have thrived in barren regions and on dry ridges.

In lowland planting in Kau and Kona on the island of Hawaii, November and December are considered the proper months to plant cane because it will grow quickly with the winter rains, will flourish during the hot summer, and will bloom about a year later. It is considered best for eating just before it blooms. The tops of the cane cut for eating in the late fall were replanted; thus a cycle of late fall harvesting and replanting was roughly maintained. However, cane was and is planted at almost any time except during a drought; the best time for planting of course varies with exposure, locality, and elevation. The cane planted in the uplands does not bloom. Kamakau (40) recommends July and August, but why or where is not clear, unless it be in the forest, for these months are dry almost everywhere. By those who adhere to the old traditions of planting, the moon phases named *Kaloa* are favored for planting, because cane planted then will have long (*loa*) internodes and stalks.

In planting, vigorous stock should be chosen. Hawaiians consider the upper portion the best part of the stalk for planting. The leaves are cut off and the cane is cut two or three sections below the lowest sheath (*ha ko*). Fornander (25, vol. 6, p. 166) recommends "the upper part nearest the middle." The stocky part at the base of the stalk, where the internodes are short and woody, is not favored for planting, but may be used, if the sprouts or "eyes" (*maka*) on each side of the nodes are good.

A trench 6 or 8 inches deep is dug and the soil in the bottom is softened. The *pulapula* are then stuck in (*umoki*) the softened earth at the bottom of the trench, being laid flat and covered with soil. Grass or leaves are put on top to keep in the moisture. Hawaiians cultivate cane in mounded clumps (*opu'u*), not in rows.

When the sprouts appear above the surface, the soil is mulched and the sprouts covered with earth, and at intervals during the growth of the cane the soil around its roots is softened and heaped up to make a mound (*pu'u*) around the base. As the stalks grow long, the old leaves are pulled off (*hole-hole*) as they droop.

In general, I am told the native canes mature in from 12 to 15 months in the lowlands, and from 18 to 24 months in the uplands. The upper limit of altitude is about 1,800 feet on the windward coasts (north and east) and 2,800 feet on the leeward or southerly (Kona) slopes of the main islands.

Uses

The chief use for cane was as a food. In normal times it was a condiment, in famine times a "life saver." Sugar cane is eaten between meals as a sweet,

being especially liked by children. Chewing its tough fibers and pulp strengthens the children's teeth and, according to Hawaiians, this use is one of the main reasons for planting sugar cane near most native homes where it is not too dry. It served to relieve the gnawings of hunger when on a long journey and, during drought and famine, was eaten by the poorer country people, as it always has been by the lower classes in India. In hard times "when one was hungry and dizzy" with famine, writes Kamakau (40), "sugar cane was a lifesaver." It was against these times that quantities of cane and bananas were planted in the forest zone and on the borders of taro patches and fields.

Juice extracted from cane toasted over an open fire is fed to nursing babies; in fact, Hawaiians say that in an emergency or when an infant is ill, its life may be maintained on juice of toasted cane.

Medicinal uses are many. The juice serves as sweetening in many compounds, and cane is chewed after taking an unpalatable medicine. Any cane may be used for this. It is the white *Ko kea* and the red *Honua ula* only that are regarded as having particular therapeutic properties. These enter into many compounds and tonics.

The Hawaiians extracted the juice by peeling off the skin from a section of the stalk and pounding or chewing it to soften and break the fibers, then squeezing out the juice with one or both hands.

In many old Hawaiian houses cane leaves served as inside wall covering; but, so far as I know, they were never used for thatching the roof outside, as in Samoa. Sometimes in the uplands where no *pili* grass was available, temporary shelters (*kamala*) were thatched with cane leaves.

The bloom-stalk and tassel served as darts in a children's game called *ke'a pua*. The skin of these stalks has been used in post-missionary times for plaiting hat braids. The white midrib of the leaf serves the same purpose.

In the old system of incantation several varieties of cane served particular purposes, especially in working love magic. These uses are discussed on page 184.

BREADFRUIT

According to Fornander (25, vol. 4, p. 392), Kaha'i, the son of Moikeha, is said to have made a voyage to Kahiki (general name for foreign lands, here possibly Tahiti) and to have brought the breadfruit back from Upolu (the old name of the valley in Tahiti now called Papenoo; likewise the old name of the island of Tahaa, northwest of Tahiti, and the present name of the chief island of the Samoan group). Kaha'i planted his breadfruit at Puuloa on the southern coast of Oahu, in Ewa district.

The Hawaiian myth explaining the origin of the breadfruit undoubtedly also came from Tahiti (64, p. 127). Ku, in time of famine, to save his chil-

dren from starvation buried himself alive in the earth near the house. From his head sprang the tree bearing as fruit the staff of life shaped like a man's head.

According to Mrs. Pukui (64, p. 127), there is a bushlike *ulu* differing from the tree.

> The low-lying breadfruit is called *kino-o-Haumea,* body-of-Haumea, and *na uluhua i ka hapapa,* low-lying like a bush. It is thought of as female. The ordinary upright tree is called male and named *ulu ku,* or "upright breadfruit."

An informant on Kauai told of an *ulu* growing on rocky places on Niihau, which she termed *ulu ne'e i ka papa* or *ulu kupua,* which she described as having leaves and fruit like the breadfruit, but as being non-edible. Mrs. Pukui says that Niihau meles mention *na ulu ne'e i ka hapapa,* the breadfruit that creeps on the rocks. This is the same as the *ulu hua* mentioned above, and it grows only on Niihau.

The terms listed below are applicable to all trees; special terms used only for the breadfruit are given in figure 20.

Parts of Trees

a'a: lateral roots, midribs or leaf veins
a-a'a: rootlets or fibers or minute leaf veins
kumu: trunk
iho: pith
la'au, iwi, or iwi la'au: wood
papa'a: thick bark, "that which adheres"
ili papa'a: epithelium
kohu: sap
mahae lau: indentations of leaf
alo lau: upper surface of leaf
kua lau: under surface of leaf
ka'e lau: edge of leaf
ku'au: petiole
mu'o: leaf bud
pua: flower
hua: fruit or seed
anoano: seed
i'o: flesh of fruit
ili: rind of fruit or epithelium of bark
kawowo: small sprout from root or seed
hehu: root sucker or seedling of woody bush or tree

Planting and Cultivation

Breadfruit is spoken of as *ai kameha'i,* meaning that it is a food (*ai*) that simply reproduces itself "by the will of the gods", that is, by sprouting. It is not planted by means of seeds or slips. In transplanting the root sucker, the parent root (*makua*) is cut 6 or 8 inches away from the sucker on either side. The cutting is transplanted with its ball of soil undisturbed, for it will die

if pulled out of the earth. The sprout (*hehu*) or sucker that is transplanted is called *keiki ulu* (breadfruit child). A hole is dug just large enough to take the ball of earth, and the cutting is placed at the same depth as it was originally. It grows in humus (*lepo*) or red earth (*lepo ula*), but not in sand or cinders (*one*) or crumbled lava (aa).

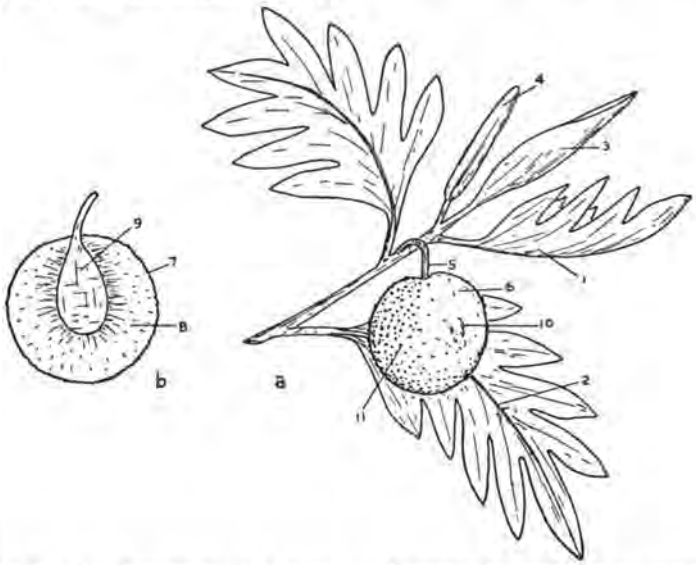

FIGURE 20.—The breadfruit: *a*, flowering and fruiting branch; *b*, cross section of fruit.

1. kua-lau: back of leaf
2. aa-lau: midrib
3. malo: leaf or flower sheath
4. ule ulu, poule, or poulo: male flower
5. kuau ulu: stem
6. ulu: fruit
7. ili: rind
8. i'o: flesh
9. pikoi, iho, or ikoi: core of fruit
10. kepau: gum on ripened rind
11. opakapaka: rough markings on skin

The breadfruit is ready to pick when the gum on the skin turns brown and the skin itself takes on a brownish color. "Nana i ka ulu i paki kepau" (Look for the breadfruit spotted with gum). When said to a girl, this means, figuratively, seek a husband who will support you. The ripe fruit must not fall on the ground; when it strikes, it becomes hard and brown (*hakonakona*) from skin to core. A child climbs the tree and with a *lou* (a long pole having a short stick lashed across it obliquely, which serves as a hook) knocks the fruits to someone below, who catches them.

USES

The chief use of breadfruit is as a food. The simplest way of cooking the ripe fruit is to bake it in its skin on an open fire (or in a modern oven). This is called *ulu pulehu*. But as a substitute for taro, it is commonly steamed in the imu, then peeled and cored by cutting around the stem with a sliver of

bamboo, after which it is mashed with a little water to make *poi ulu.* This poi keeps as long as that made from taro, but Hawaiians consider it inferior in taste and in nutritional value, and inferior because it produces much gas in the stomach. It is most relished in the form or *piepiele ulu.* The very ripe fruit is mashed as in making poi, but coconut milk is mixed with it instead of water, and this paste is wrapped in ti leaves and cooked in the oven. *Pepeiee ulu* is *piepiele* made with a great deal of coconut milk, cooked thoroughly in the oven wrapped in ti leaves, then cooled, sliced, and dried in the sun so that a hard oily film forms over the surface. If sunned occasionally to prevent mildewing, this will keep from the end of one bearing season to the beginning of the next.

Medicinally, the uses of breadfruit were few. The bark was used in treating an unknown disease. For thrush (*ea*), leaf buds pounded with *alaea* (ferrous oxide) were smeared in the mouth, after which the small greenish *aeaea* fish was eaten. The latex, or gum, was used for some skin troubles.

Children used to chew the hardened latex as chewing gum. This served also as glue in fastening together gourds for hula accompaniment with the *ipu,* and for caulking boats. The sticky latex served as "bird lime", being smeared on a stick placed in a tree to catch small birds.

The leaf or sheath of bud or bloom, when dry, served as a polisher for bowls and kukui nuts.

From the bast of the bark was made an inferior kind of tapa, termed *poulu,* which is brittle and hard.

The wood is durable and firm and was used to some extent in various kinds of woodwork, but far less than in Samoa. The wood was good for bow and stern pieces and gunwales of canoes and for poi boards.

Planting Localities

Except in Puna, Hawaii, breadfruit was wholly secondary to taro and sweet potato as a staple. I am told that in Puna in a good year, breadfruit may be eaten for 8 months of the year, beginning with May. Elsewhere 5 months is the usual period, from May into September. But the first fruiting is so sparse as to be negligible. The real bearing time for breadfruit in Hawaii includes June, July, and August only. It is obvious, therefore, that this fruit, so valuable in tropical Polynesia where different varieties bear almost the year round, could never have attained more than secondary importance in Hawaii.

On Kauai, early voyagers noted extensive planting of breadfruit along the southern and leeward coast, from Waimea to Wailua. According to Keahi Luahine, there were many breadfruit trees in Anahola.

On Oahu, breadfruit was planted mostly on the southerly side—Wailupe, Waikiki, Kalihi, Ewa, along the coast west of the Waianae Mountains, and to a lesser degree in sheltered places inland along the windward coast—Waialua, Waimea, Kahuku, Laie, Punaluu, Kahana, Kaneohe, Kailua, Waimanalo.

On Molokai, the tree was cultivated chiefly on the southern side toward the east end. Apparently much breadfruit was planted on Lanai.

The southern shores of western Maui were perhaps second only to Puna, Hawaii, as a favorable locality for breadfruit culture. Brigham (6, p. 123) wrote in 1911 that "at Lahaina on Maui, were as fine trees forty years ago as any I have seen in Samoa or Fiji." Lahaina is referred to in meles as *ka malu ulu o Lele,* "the breadfruit-shade of Lele." There was also much breadfruit in the lower inhabited areas of the great valleys from Olowalu, through Waikapu, Wailuku, Waihee, to Waiehu. On eastern Maui, breadfruit was grown in all the settlements and up into the valleys throughout Hamakua, Koolau, Hana, and Kipahulu. In many valleys of this region that once supported Hawaiian communities that are now abandoned, old breadfruit trees still flourish, especially near Honomanu and Wailuanui, in Nahiku, and in Hana, Wailua, and Kipahulu as far as Kukuiula.

Puna on Hawaii was the district most famous for its breadfruit. The tree was extensively planted in Hilo also and in the sheltered valleys of the Hamakua coast, where there are still a great many, and to a less extent in gulches in Kohala. Kau is too windy for breadfruit, Waimea, too high, and Kawaihae and south Kona too dry.

COCONUT

The coconut tree grows well in Hawaii only on protected leeward shores or in sheltered valleys at or near sea level. It is propagated here, as elsewhere, by planting the nut itself in a shallow hole in sand or earth. There are only two varieties native to these islands, both tall trees: *Niu hiwa,* with nut dark green when mature and shell black (*hiwa*), used ceremonially, medicinally, and for cooking; *Niu lelo,* with nut reddish and shell yellow (*lelo*), used for all secular purposes but not ceremonially or medicinally.

Niu-ola-hiki is the mythical name of the spirit who was man, god, eel, and coconut in different forms (*kinolau*). The story of the origin of the tree and its nut, whose appearance is suggestive of an eel's head with eyes and mouth, told in Hilo, Hawaii, is similar to that told in Tahiti about the origin of the tree from the buried head of a decapitated monster eel.

Special terms applied to the coconut

kumu niu: the coconut tree
ulu niu: a grove of coconut trees
lau niu: leaflet
ni'au: midrib
a-a'a niu: fibrous sheathing at base of petiole sheath of flower
holo wa'a: sheath of flower
ahui or huihui niu: cluster of nuts
niu: the whole nut
maka: the eyes of the nut
wai niu: water inside the nut or milk squeezed from grated meat
ili niu: surface of the husk
pulu niu: fibers of the husk, from which sennit is made
iwi niu: shell of the nut
i'o niu: flesh of the nut
pani niu: the bottom of the nut which opens like a lid (pani) when cracked by blows around the base; the nut is held bottom side up when so opened for drinking
aha: sennit plaited from fibers spun (milo) on the thigh
o-io: jellylike flesh of the unripe nut (niu oio)
haohao: the soft white flesh of the maturing nut, while the shell is still white (niu haohao)
ili kole: the flesh of the half-ripe nut (niu ili kole), not good for cooking; eaten raw with red salt and poi
niu o'o: nut after the flesh has matured but the husk is not dried
niu malo'o; nut after the husk has dried and there is still water in the nut; the best stage for making pepeiee and kulolo; this is the nut for planting
Niu aka'a or oka'a: old nut in which water is dried out and the meat separates by peeling (aka'a) or rolling (oka'a) off the shell. The flesh becomes gray and oily and is best for making oil (mono'i)
mono'i or mano'i: coconut oil
oka niu: what is left after grated coconut is squeezed to extract oil or milk; fed to chickens

Planting and Cultivation

In planting a coconut, the Hawaiians took a nut that was already sprouting, dug a hole a little deeper than necessary to cover the nut, placed an octopus (*he'e*) in the bottom of the hole, set the nut on top of the octopus, and covered it with earth. The octopus was believed to give the root a spread and grip like its own and to produce nuts bulbous like its head or body (*pu*).

Keahi Luahine of Kauai says her father made unfruitful trees bear by driving four small pegs of *lama* wood into the trunk as high as he could reach from the ground, one peg each on the north, east, south, and west sides. *Lama* wood was used in making ceremonial structures of several kinds, its name having relation to *ma-lama-lama,* which means light.

In Kona it was the custom to have a pregnant woman embrace the trunk of a coconut tree if it bore no fruit.

Uses

As elsewhere in Polynesia, the uses of the coconut tree and fruit were many. The swelling base of the trunk was cut into food containers (*umeke*)

and used in making the large hula drum (*pahu hula*). The *pu niu* was a polished shell used as a small container or as a small hula drum. *Apu* were cups made by cutting the shell lengthwise, used in awa drinking and in taking medicine.

The base of the leaf stalk (*kuʻau*) served for beating or pounding the banks (*kuʻau-na*) of taro beds. The fibrous sheath at the base of the leaf stalk was used as a wrapper for the bundles of food or bait (*palu*) let down in deep-water fishing. In transplanting cuttings or young plants the sheath was wrapped round the earth ball.

Leaflets were plaited into fans (*peahi*) and balls (*kini popo*) with which children played. Midribs of the leaflets tied with sennit were made into brooms (*pupu niʻau* or *niʻaukahili*). They served as rods to hold the kukui nuts burned for light and warmth. Snares for shrimps (*puluaha*) were made of midribs. In fishing in Kau, the end of the leaf, about 3 or 4 feet long, served as *pula* for poking under ledges to frighten out fish, and also as tapu markers along shore where hau did not grow.

The uses of the flesh as food are referred to under the terms for the nuts at different stages of maturity (p. 191). Medicinal uses were numerous: the water, flesh, and shell were all used.

For grating the coconut meat, the Hawaiians used a large *opihi* shell with the thumb pressed against the upper edge, scraping on the downward stroke. The grated flesh was mixed with the water of the nut and pressed and strained through shredded *ahuawa*.

In Puna, *manoʻi* or coconut oil was made as follows: The fresh gratings, with *maile* or other *kupukupu* (any odoriferous plant) to give fragrance, were placed in a container in the hot sun. When the oil separated from it, the mass was squeezed through *ahuawa* and the refuse (*oka*) thrown away. The oil was used for anointing the body and hair and washing the hair. In Kau, Hawaiians took a piece of oily mature coconut meat when they bathed in the sea, chewed it, and squeezed the saliva and oil on the head and rubbed it into the scalp, then plunged into the salt water and washed it out.

Among the most important products of the coconut was plaited sennit, made by pounding the fibers of the husk loose, stripping and cleaning them, spinning them on the thigh (*milo*) and then plaiting strands to form the strong cord (*aha*) used in lashing canoe parts together, house building, and to a limited extent as fishlines and in making nets.

Planting Localities

In old Hawaii cultivation of the coconut was limited, because these islands are a little too far north for this tropical tree to flourish. However, trees

were scattered about near sea level. Today remnants of old groves indicate the following as the general distribution of extensive planting.

On Kauai the favored places were Haena and Hanalei; Wailua, the site of the famous sacred grove belonging to the reigning alii; Nawiliwili, Koloa, Lawai, Waimea, Kekaha, and Mana. In Mana beyond Kuana and Howea, there is still a scattering of old coconut trees, the last survivors of a once famous grove (25, vol. 5, p. 198):

> Uweuwelekehau and Luukia were at this time declared the king and queen of Kauai. Among their first acts to commemorate their great fortune were the planting of the grove of coconut trees at Kaunalewa and the building of the temple at Lolomauna.

On Oahu, there was a famous grove named Pokai at Waianae, often mentioned in songs. Waikiki was noted for its coconut grove. There were groves also at Wailupe, Ewa, Waialua, Punaluu, and Kailua, and presumably at many other places where they did not survive and are not remembered.

On Molokai, Wailua is said to have had a great grove, and Phelps reports clumps of coconut trees at other points along the south shore of the island. This does not prove that there was ancient planting at these points, but it indicates that coconuts will grow all along this coast and implies former planting throughout the region.

Lahaina and the whole southern coastal plain of western Maui undoubtedly had scattered groves, as did Waihee and other sheltered valleys on the northern side of western Maui. Kihei has coconuts now and probably always has had. On eastern Maui, the Makena section beyond Kihei has undoubtedly always been a good place for coconuts. On the windward coast there are remnants of ancient groves at Keanae and Wailuanui, Honokalani and Wailua in the district of Hana.

On Hawaii in the district of Kau, Honuapo was famous for its coconuts, as is implied by the old saying "I ahona Honuapo i ka lau niu" (Honuapo is cooled by coconut leaves). In Kona, Honaunau and Kailua have always been famous for their coconuts, and trees have been planted from time immemorial in such places as Hookena and probably all along the lower slopes of the district. Puna has probably always had the greatest continuous planting area for coconuts in the Hawaiian islands; today old coconut groves are scattered everywhere along the wet lava-covered coastal plain. There were also many coconuts along the Hilo coast. On windward Hawaii, Laupahoehoe has always had a grove, and there are very old trees in Waipio, Waimanu, and Hawi. Kawaihae now has some trees and probably always has had.

PANDANUS

The pandanus tree (*puhala*) is planted from seed near houses. The Hawaiians recognized only one variety. Wild pandanus grows sporadically

almost everywhere along coasts and in lower valleys and in great numbers where there were once famous groves. Kauai meles speak of "Na hala o Naue" (Naue's pandanus grove), beyond Hanalei; Oahu meles mention "Na hala o Kekele" (The pandanus of Kekele) below the Nuuanu Pali, a grove noted for its fragrance, which was destroyed, except for a few trees, when pineapples were planted at Kaneohe. At Haena on Kauai is a tree named "Ka hala o Mapuana" (The pandanus of Mapuana), famous in meles, with a deep reddish orange "key." When seen by Mrs. Pukui in 1936 it appeared to be dying. The district of Puna, Hawaii, is called "Puna paia ala i ka hala" (Puna hedged with fragrant hala). Hana district on Maui had many pandanus groves.

Special terms applied to hala

puhala: whole tree
ahui hala: fruit cluster
hala: keys
ikoi hala: core
iwi hala: hard red of the key
pani hala: "key" that fits in like the key-stone of an arch at the bottom; when knocked out the rest of the keys come out easily
pua hala: fleshy end of the key
hinano: flower of the male tree
ehu hinano: pollen
hala hinano: male tree with hard wood
lau hala: leaf
kalala or kokala: thorns on the leaf
kuakua: thorny midrib
po'o lau: base of the leaf
e lau: apex or end of the leaf
ule hala: pendent roots

Pandanus was valuable chiefly for its leaves, which were used for plaiting mats. Mat making and the use of plaited pandanus leaf by the Hawaiians is described cursorily by Brigham (7), but the art has not yet been recorded in detail. The preparation of the leaf for plaiting is described by Mrs. Pukui as follows:

> The leaves should be prepared early in the morning when they are moist and fresh (leaves are soaked in salt water only when they are brittle). The ends are cut off where the leaf narrows, and the base is cut off 3 or 4 inches from the butt end of the leaf, the thorns along the sides are ripped off (*kihae*), and those back of the midrib scraped off. Then with the cut-off base of the leaf in the hand the leaf is smoothed (*u'u*) with considerable pressure along its whole length. Several leaves are laid one upon the other, their bottoms held in the left hand, flattened and rolled (*oka'a*) into a small roll and tied. Later these are sorted, rolled into big rolls, tied, and put away. The large rolls are called *kuka'a*.

The leaf of the pandanus was used to thatch houses in districts, such as Hilo and Puna on Hawaii, where *pili* and other suitable grasses were sparse

and the pandanus tree prolific. It was also widely used as walling inside the frame, underneath the thatching of *pili* grass.

The fibers of the root of the female hala served for stringing leis. Where *ahuawa* was lacking, these fibers in a sizable bundle were used for straining awa. The keys were used for leis. The tips of the pendent roots and the leaf buds were used as medicine. Children cracked the dry keys and ate the pith.

KUKUI

The kukui (candlenut tree), which grows in dense groves in all wet gulches and valleys and in ancient groves on Molokai, Kauai, and Hawaii, was introduced into these islands by the ancestors of the Hawaiians. In Molokai, the famous grove is Lanikaula. Kau-hakake is the kukui grove in Moloaa on Kauai where grand old trees are still standing, survivors of a once great forest. In Kona, Hawaii, two famous groves are still remembered, named Ko-au-kukui-ula and Kukui-ala-inamona. Hamakua, Hawaii, once had vast forests of kukui.

It is an old Hawaiian belief that a householder should not plant kukui near his house, but that if a stranger plants it for him, it is all right.

Special terms for parts of the candlenut tree are:

pilali: gum formed by the sap when the bark is bruised
hili kukui: bark (papa'a is the common name)
alualu kukui: rind of the nut
iwi kukui: shell
kohu kukui, pi'iku, or kulukulu a: juice from the rind that gathers when the stem breaks off

The gum (*pilali*) was chewed by children and was used as glue. The oily kernels were strung on the midrib of a coconut leaflet and burned for light and warmth. *Ina mona* or *aki mona* is a sauce made by cooking the nuts in hot ashes, taking the kernels out, and pounding them with salt.

The kukui has a prominent place in native medicine—the leaves, flowers, rind, nut, and bark being used. Juice of the rind or inner bark is prescribed for sore throat. The nut, eaten raw, is a strong cathartic, and mashed was used in enemas. The leaves were used as poultices for swellings.

The brown pigment used in dyeing fishnets and canoe bottoms was made by pounding kukui bark and mixing it with water.

KOU

Kou was planted from seed in hot southern and leeward localities, chiefly near settlements. The wood was highly prized for making bowls, and the flowers were favored for necklaces and were used as medicine for thrush (*ea*).

It is said that there were once many kou trees on the *kula* land above Makena, Maui. There is a place in Kau, Hawaii, called Papai Kou (Little Kou House) where formerly the alii had a great grove of kou trees and a little house. According to Mrs. Pukui, there was a kou grove named Kaulu Kou (The Kou Shade) near Koko Head, Oahu.

HAU

Hau, which grows wild everywhere, was planted from stem cuttings near the sea and near houses and plantations. There were two varieties of hau: that which grew straight up (*hau oheohe*), planted for its bast, and the creeping variety (hau), planted for wind breaks. The slimy sap was used as a mild laxative, and, drunk by a woman in labor, was believed to promote easy parturition. The base of the flower, with the petals broken off, was given to children as a laxative. For use as thongs, hau was planted in upland planting grounds (*kihapai*), and I am told that wherever there are clumps of hau in the forest zone one will find other evidence of ancient cultivation.

WAUKE (PAPER MULBERRY)

The story of Maikoha (25, vol. 5, pp. 270-271) describes the mythical origin of *wauke* as being at Kaupo, Maui. (The same legend is localized in Nuuanu, Oahu, by Kamakau.) Near Kaupo in the district of Hana is the cave in which the chiefess Luukia (Ruutia is a historic character in Tahiti) is said to have first put designs on tapa. According to Kamakau's account, the two daughters of Maikoha were respectively the founders of tapa making and tapa decoration. The Kaupo story and the cave of Luukia in Hana seem to me to imply original introduction of the *wauke* in that section. But these legends, like that of the origin of the breadfruit, may have come northward with the colonists who brought the *wauke*, being localized here in the course of time.

Mrs. Pukui tells me that her elders say there are two kinds of *wauke*, termed *wauke malolo* and *wauke*. *Wauke malolo* is good for medicine but not for tapa making; the *wauke* is good for both. How old Hawaiians distinguished the two she has not been able to learn. Lahilahi Webb has likewise heard of these two varieties of *wauke* but does not know how to distinguish them.

Planting and Cultivation

Wauke requires a great deal of moisture. In wet lowland localities it was planted about dwellings and in villages. But most *wauke* was planted in the lower fringes of the wet forests.

The proper time for planting *wauke* is at the beginning of a rainy period. *Wauke* is said to mature in 18 months from the time of planting. Thereafter it continues to grow, young shoots springing from the roots to replace old ones. By recultivating an old patch, a flourishing crop of stems may be had. But according to Thrum (1896, p. 77) sometimes the whole plant was pulled out in the upland plantations, the roots lopped off and cut into segments for replanting.

Kamakau (40) speaks of planting *wauke* along streams, in woods, hollows, on uneven ground, in dry taro patches, in moist land where water flows, and in wet lands. The locations chosen should be sheltered from wind. Formerly the patches were surrounded by enclosures made with dried banana leaves to shelter the plants until they were hardy. After the land was cleared, it was recommended that the surface of the ground be covered with leaves to rot and serve as fertilizer.

Shoots for planting should be taken preferably from plants that have already been cut and that have grown again, that is "second growth." The new shoots, termed *ohi* or *ae,* spring from the roots beside the old plants. The shoots for planting should be from 1 to 1.5 "fathoms" (*anana,* total arm span) long. In cutting the shoot, care must be taken not to break the tap root (*piko*) belonging to the original plant, for if the *piko* is broken, the plant will dry up. Slips (*lala*) and pieces of root (*a-a'a*) may be planted. All the leaves of the shoot or slip are removed, except the leaf bud (*mu'o*) at the tip. The shoots are then wrapped and tied in ti and banana leaves to keep them moist. They are kept in water overnight if water is available, or kept moist in a shady place and planted the next day. Before planting, a small hole is dug for each slip, and the soil in the hole is worked until it is fine and soft. When the young plants have rooted and are sprouting, the patch is weeded and moist leaf mould heaped up around the plants.

As the plants grew, Hawaiians used to pluck off the lateral branches (*lala*) as they budded in order to have a clean straight stalk (*kumu*) free from protruding pieces of bark (*pa'a na'a na'a*) up to 8 or 9 feet high. Above that the branches were left growing to give strength to the plant.

Uses

The raw bast (*ka'e*) of the *wauke* was given to children to chew, to strengthen their teeth. Its slimy sap was believed to have a mild laxative effect and enters into some compound remedies. On Maui, strips of coarse tapa made of *wauke* were worn around the neck by women to induce a flow of milk, as sweet potato vines were used elsewhere. Plain white *wauke* tapa was also burnt and the ashes used in treating thrush (*ea*). The raw bast was twisted into cord for fishing nets and nets to hold calabashes of gourd or

wood. However, the bast was used chiefly for making bark cloth (kapa). The processes of manufacture are described by Mrs. Pukui:

> The straight stems were cut at the upper and lower ends, and a longitudinal cut through the bark was made with a knife. Then from the top the bark all round the stem was rolled back and, with a series of jerks (*unu*), it was stripped down the whole length. The outer bark was scraped off (*uhole*). The bast was then soaked for some days in running water or in pools of sea water by the shore to soften it and leech out the slimy juice. About five soft strips were then laid one on top of the other and tied together with little strips of the bast at either end and in the middle, making a bundle called *mo'o mo'o*. This might be kept dried indefinitely.
>
> The next stage was to lay the *mo'o mo'o* on a wooden anvil (*kua*) and beat it with a round, smooth, heavy wooden cloth beater (*hohoa*), to form a solid thick strip. These strips were again soaked, laid edge to edge, and felted together by beating with wooden beaters of different sizes, square in cross section, having carved geometric designs on their four faces to give watermarking. Many successive beatings with lighter and lighter clubs were required to make the finest cloth.
>
> Decoration of Hawaiian tapa, in addition to the watermarking, consisted of dyeing, felting on strips of colored tapa by beating, and stamping with small bamboo printing blocks (*ohe kapala*).

Lahilahi Webb describes tapa making somewhat differently:

> Stripping the bark off the *wauke* tree is *kihae*. The outer bark was removed and the bast saved. The maker of tapas decided beforehand what she wanted to make, whether kapa, malo, or pa'u. The strips of bast were laid one over the other, rolled up and wrapped well with ti leaves. This bundle was put into a sea pool with an outlet, permitting fresh sea water to go in or out, and weighted with stones. There it was left for 10 days to two weeks to remove the *ka'e* or slimy substance and to permit the bast to decompose (*palahe*) to the right stage for beating. The strips were then beaten on a flat stone with a round mallet until a strip (*mo'omo'o*) of very coarse cloth was formed. This was stretched out in the sun to bleach. When thoroughly dry it could be stored away for future use. The strips were again wrapped in ti leaves and soaked in fresh running water for 10 days to two weeks. After this the beating was done on a wooden *kua* (anvil) with the *i'e hohoa*. Decorative stripes were felted into the tapa by pressing damp strips of colored tapa onto the wet background with the hand.

Mrs. Webb saw tapa made this way by a friend in Kipahulu in 1884. Mrs. Webb asked Kaahaaina Naihe, the aged nurse of the Cooke family, how she made tapas long ago, and she gave the same description as that above.

Hala-nut brushes were not used in painting, so far as these tapa makers knew.

Planting Localities

Kona, on Hawaii, and the eastern coast of eastern Maui were the most famous localities for planting *wauke* and making tapa. Here clumps of the trees still grow wild. It is said still to grow wild in old forest plantings (*wahi mahiai*) in Kau and Puna. I have seen it in abandoned inland homesteads (*kihapai*) on eastern Maui, Oahu, and Kauai.

On Kauai, the southern coast from Hanalei to Waimea was the *wauke* planting area. Keahi Luahine has described the planting in and above the

valley of Wahiawa. She says that when she was a little girl her grandmother used to take her to Moloaa to get *wauke* for making tapa. The name of the valley probably means "Matted roots" (*molo,* matted; *a'a,* roots) and refers to the density of the *wauke* on the slope of the valley.

On Oahu, early voyagers describe *wauke* planted on the coastal plain, on *kula* land, and in the lower reaches of valleys such as Manoa, Maunalua, Waikele, on the southern coast. Living informants have pointed out localities all along the windward coast from Kaneohe to Waialua, which it would be useless to list, for it may be said that *wauke* was planted wherever conditions of soil, moisture, and elevation were right.

On Molokai, Maui, and Hawaii also it would be useless to list places where *wauke* has been seen by early observers and by modern informants. *Wauke* was regularly cultivated on sloping sides of valleys and on well watered *kula* lands up to the wet forest zone. The nature of the plant and of the places utilized for its cultivation prevented the development of a systematic culture like that of taro. In Puna, Hawaii, there are localities in and near Malama where quantities of *wauke* still grow, and the same is said to be true of Waimanu Valley.

Mr. A. F. Judd told me that the other plants the bast of which was most used in making cloth, namely *mamaki* and *akolea,* are commonly found growing in old garden plots (*kihapai*) together with *wauke,* especially on the Hamakua and Kohala coasts of Hawaii. Mr. Judd observed there pockets (*poho*) on the upper reaches of the cliffs, probably artificially enlarged and leveled for planting.

OLONA

Olona was always planted in wet uplands, requiring much more moisture than *wauke.* Eastern Maui from Hana to Kaupo was famous for *olona* and so were eastern Molokai and the Hamakua and Kohala coasts of Hawaii. The region around Laa (now called Olaa from the designation "mauka o La'a, the upland of La'a") was the only part of Puna district in which it flourished. In Kau it is said to have grown wild in the forest.

Keahi Luahine says that on Kauai, in her native district of Wahiawa, *olona* was planted in the upper valley on the semi-boggy slopes opposite Puu Aukai. The topographic map (U.S.G.S., 1912) shows a boggy area about 1.5 miles beyond Puu Aukai. In Francis Gay's book of Kauai place names there are numerous boggy areas in the uplands marked *lile olona* which, according to Keahi, means an upland bog once cultivated. This use of the word on Hawaii is unknown to Mrs. Pukui.

The legend of the birth of Kamehameha the Great relates that the child was carried away and hidden by Naeole in order to escape death at the hands of Alapai, whose jealousy had been aroused by the prophecy of Kamehameha's

greatness. Hattie Reinhardt and Lahilahi Webb have both told me that Kamehameha was taken to a place in the uplands of Kohala, where he was suckled by a woman scraping *olona,* who had hidden her own child under a pile of fiber heaped on the floor.

Kamakau (40) says *olona* flourishes in rainy lands, marshy lands, and wet uplands with a windward exposure. By "marshy" lands I presume he means bogs in the uplands, for *olona* will certainly not thrive in lowland marshes.

Kamakau (40) describes the cutting down of fern, felling of trees, and weeding in the locality selected for planting. Shoots from the roots or cuttings from the stem were planted, exactly as for *wauke.* The patch had to be kept free from weeds until the young plants were half a yard high and growing so thick a man could not pass through. The morning-glory and other creepers had to be pulled out, for these would choke the *olona.* Patches of 2 or 3 acres were planted, and the *olona* grew close "like hair on the head." After a year or more, the leaves began to yellow, indicating maturity, but even while the leaves were still green the stems might be broken and harvested. When the time for harvesting came, long sheds for preparing the fiber were built near running water. To these sheds the stalks were carried in bundles.

Kamakau (40) describes the preparation of the fiber as follows:

> To prepare the fiber, the *olona* was first broken and laid in a pile. Then the branches were stripped of bark and thrown away. The branches and leaves must not be left in the field but thrown away elsewhere lest they kill the *olona* plants. The bark was laid in water: but it should not be left long before scraping, only one or two days, lest the fibers rot and become brittle and spoiled. For the process of scraping, a narrow board was used, perhaps 5 inches broad, one and a half arm spans (*anana*) long, and half an inch or perhaps less thick. One end of the board was thin so that it could be tied to a post to keep it steady, and a prop was laid under the other end. The scraper was made from one of the plates (*uhi*) from the shell on the back of a turtle, the inside of which had been filed down close to the outer shell that had come in contact with sea water, until it was very sharp, then polished with pumice stone and shaped to the board so as not to break the fibers. The board too was polished smooth. The [strip of] *olona* bark was then brought, the scraper grasped with the right hand, and the end of the bark doubled over the blade of the scraper, and held firmly at the back of the scraper. Then the scraper was placed down on the front end of the board and slipped forward while the left hand kept the bark flat below the scraper as the scraper slipped forward to the end of the strip. Then, while the left hand continued to hold down the base of the *olona,* the right hand pressed the edge of the scraper down on the board and, releasing the end, scraped back and forth between the ends until the *olona* was flattened against the board; then, returning to the beginning, brushed aside the pulp, or "dirt" of the *olona.* When that was done, the bark was turned over and the pulp removed in the same way. The bark was turned upward again and the process repeated until the fiber was clean and white. Forty of these strips made one *apana,* or piece also called a *mi-le,* and they were tied together, and so on. An expert man or woman could prepare 400 to 800 *apana* in one day, but *olona* scraping required skill and could not be done by one who was untrained.

Olona was much the best fiber for fishlines and fishnets. When used for cord (*aho olona*) the strands of the cleaned fiber were simply spun on the thigh and twisted (*nino* or *milo*). *Olona* cord has a tensile strength greater than that of hemp, but its great value for fishlines and nets lies in the facts that it does not kink and that it lasts longer than any other material. The cord was also used for making nets (*koko*) to carry containers and as a base for ti-leaf raincoats and feather capes. The fresh bark and leaf buds were thought to have medicinal value.

AWA

The special terms applied to the awa plant, in addition to the usual native botanical terms for leaf, bud, stem roots, etc., are:

aka: jointed stalk
opu awa: bush or clump
pu awa: stocky root
pu'upu'u awa: joints of the stalk

Kamakau (40) gives a mythical origin for awa: "The gods brought awa from Ho-aniani-ku." Native tradition reports that awa was first planted in the Hawaiian islands on Kauai by Oilikukaheana (Fornander, 25, vol. 5, pp. 606-608), who brought it from Tahiti (Kahiki):

It is said that this plant was brought from Kahiki by Oilikukaheana. He brought it for fishing plant [*la'au*, medicine]. When he came and landed at Kauai, he saw a beautiful woman, Kamaile; she became his wife, and the plants were cared for by her. Afterwards she threw them away and they grew at Waialeale. Some were pulled up by Moikeha and brought by him from Kauai; and without his knowing the kinds of plants they were, he planted them at Halawa, on Oahu. When Moikeha saw that the plants grew he went and told the owner of them, Oilikukaheana, who said the name was Paholei. Moikeha waited until the plants grew large, and because he had forgotten the name, he went to Ewa. This was the time when Ewa and Halawa were living separately [the districts were not united]; Halawa was not available to every one, hence the saying: "Halawa is not to be seen; 'tis a land at the end of Ewa," etc.

He went to Ewa, and she told him to go and get the plant. So he went for some, and found that the roots had grown large. So he pulled up the plants, roots and leaves, and brought them to Ewa. Ewa said: "Let me first eat of this plant, and should I die, do not plant it, for it would be valueless; but should I not die, then we will be rich." When Ewa ate it she became drunk and was intoxicated all day. When she awoke she called the plant "awa"; from thence forward this plant was called awa, the awa of Kaumakaeha, the chief. . .

It is said that the awa is propagated from the joints, that is, the branches; it is pressed down and weighted with a stone until the roots develop; then it is taken to where it is desired to be planted. Again, when the awa roots are being dug up, that is, when it is pulled, the branches are chopped up and thrown back into the holes from which the roots have been taken, then covered over with soil, and when the sprouts appear, called Nihopuaa, they are taken and planted. The method of planting that I have seen is the same as that followed in the planting of cane.

Varieties

Limitation of time made impracticable any effort at systematic collecting and identifying varieties of awa from different localities. Here I merely summarize what is in print and in my field notes, based on observation of a few specimens but mainly upon description by local residents. The descriptions make it evident that the characters of varieties are by no means fixed. The sources of information and localities are designated as follows by letters in parentheses: A, Akuna, a planter in Puna, Hawaii; E, Emerson (22), writing about Oahu; K, Kamakau (40), also writing about Oahu; Ka, Kaaikamanu (34), a *kamaaina,* writing about Maui; Kl, Keliihue, an old *kamaaina* of Kau, Hawaii; M, Mawai, an old *kamaaina* at Nahiku, Maui; P, Mrs. Pukui, born in Kau, Hawaii, very well acquainted with Puna and with the island of Kauai, and now a resident of Oahu.

Apu, distinguished by short joints and green stalk (E).

Hiwa has long joints and dark green stalk (E), "resembling the Honuaula sugar cane" (K) and forms a low bush. *Wai a ka manu* is a special form coming from *hiwa* as an offshoot, having joints green on one side and dark (*eleele*) on the other (M).

Ke'oke'o, described as "whitish in general appearance and more commonly found than the others" (K). Probably the same as *Papa kea.*

Kumakua, internodes of medium length, green, bush tall (A).

Kuaea, see *Awa nene.*

Makea has long internodes (K), lighter green than *Apu* (E) with one subvariety spotted (E) and with reddish color at the nodes (Ka). This is called *Mahakea* in Kau, Hawaii (Kl). I am told that both *Makea* and *Papa* sometimes put out a dark shoot which becomes one of the dark varieties (*Eleele, Hiwa, Mo-i*). Makea grows into a tall bush.

Mamaka was seen at Wainiha, Kauai. The internodes are short and the stalk light green.

Manienie, a white, smooth stalk (Kl).

Mo-i, the internodes are short and dark green and the nodes are somewhat whitish (E, P, Ka). Called *Papa mo-i* in Kau, Hawaii (Kl). A mutant from *Makea* (A).

Mokihana, the famous awa of Kauai, has "short and stubby" internodes (Ka), looks like *Papa* (E), and has "stalks like a clump of bamboo standing in a sunny place with branches thick together" (K). It is fragrant, hence is named for the *Mokihana* berry; and it makes very strong brew. Internodes short and yellowish green. It is peculiar in having hairlike rootlets (M).

Nene or *Kuaea* has long internodes and is "somewhat spotted with bumpy appearance of the bark and trunk. In general appearance, the spots resemble those of the turtle's back" (Ka).

Papa has short internodes and spotted stalk (E). The bush grows low (A).

Papa eleele has internodes shorter than *Mo-i* and is dark green. It is described by Kamakau (K) as a "creeping variety," while, according to Kaaikamanu (Ka), it grows wild, "its branches scattering here and there among the shrubs."

Papa kea is like *Papa eleele* as to internodes and habit, but has light green stalk.

Kau la'au is the famous awa of Puna, Hawaii, which grows in the crotches of trees where, according to the Hawaiians, it becomes planted by birds building pieces of the stem into their nests (M). A line from a mele reads: "Ka manu ahai kanu awa e" (The bird clipping the twig of awa and planting it elsewhere; see 21, p. 30). Kaaikamanu (Ka) identifies it as the same as *Mokihana,* but Mrs. Pukui, who is well acquainted with Puna (Kaaikamanu came from eastern Maui) tells me that any variety might be found

growing in this way. This Puna awa was famous for its strength, which was due, in Mrs. Pukui's opinion, to the fact that its roots grew in sunlight.

Planting and Cultivation

Awa grows well only where there is constant moisture and not too much sun. Formerly, when it was cultivated, the Hawaiians planted it in or just below the borders of the lower forest zone, in clearings within the lower ranges of the forest, along streams, and in pockets along the base of and upon wet escarpments. Growing wild, awa may be found today in such localities on all the islands. In Kau, Hawaii, it was customary to plant awa in the forest range above the upper taro plantations.

There are certain localities on each of the islands which used to be famous for their awa. Kamakau (40) names some of these: Koukou on Kauai, Hena on Oahu, Lanakila on Maui, and Puna on Hawaii. John Hana (25, vol. 5, p. 610) gives as localities famous for awa: Kamaile on Kauai; Halawa and Hakipuu, "at a place called Hena" where "is located a stone awa container and a stone awa cup", on Oahu; "the awa roots of Eleo" (locality unknown), on Maui; and Puna on Hawaii.

The following account of awa planting is based on Kamakau (40):

> Awa should be planted on large tracts of land in warm localities, beside streams, at the edge of woods, on slopes where *kukae puaa* grass flourishes or where the *ama'u* fern grows, or in rainy localities. Awa, *wauke,* and upland taro grow well in the same localities and under the same conditions.
>
> Awa is planted much like sugar cane, by means of sections of the stalk, from whose joints grow the sprouts or "eyes" (*maka*). The planter carries to the place selected the stalks of the variety desired, and there cuts them into short sections, being careful not to break off the "eyes." The sections later to be planted he lays in a trench filled with mud, leaving them to sprout there, while he clears his ground and leaves the grass and weeds on the soil to rot. When the segments in the trench have sprouted, he removes them and plants them in shallow trenches.
>
> A new plantation would require from two to three years before its *pu awa* were large enough to use; but once a plantation was growing, the roots would continue to grow and send up new stalks. In other words, the awa plantation never required replanting, but would "serve as an inheritance to one's descendants. . . "

The following excellent description is given by Emerson (22, pp. 131-132):

> . . . In planting it there is usually scant digging. Joints are set in the ground in somewhat the same manner as natives plant their hillocks of sugar-cane. After a time it is hilled, humus and leaves being used, and after this single hilling it is generally left to grow without further care. It will thus continue to grow on for an indefinite time, spreading its roots abroad, to be dug at the convenience of the consumer.
>
> It is said that age does not impair the vitality or vitiate the quality of the root, but rather enhances its value. Roots thus left in the ground for twenty years or more will reach an enormous size, one root is sometimes large enough to be divided into loads for two or three men.

Uses

The fact that awa was the cherished narcotic of the culture explains the nature of its ceremonial uses. Between men it served as a ceremonial gift; it was offered to the ancestral spirits on the domestic altar; it was "fed" (*hanai mano*) to the shark patron by fishermen; it was offered to the spirits by mediums (*haka*). The cup of awa was gazed into and drunk by seers to induce the desired passivity or trance.

Medicinally, the root was used by Hawaiians for many purposes—for congestion in the urinary tract and for rheumatism and asthma. Awa was, I believe, the first of the native crude drugs to be analyzed. At one time, large quantities were raised and shipped to Germany and elsewhere. (See 22, p. 132, 1903.) Hawaiians consider the leaf good as a poultice for headache or for placing under a patient to make him perspire to break a cold or fever. Many remedies specify a particular variety of awa.

Awa was used principally as a narcotic to induce relaxation and sleep. In historic times it has been so used by all classes of people, especially fishermen, farmers, hunters, and the like whose strenuous work left them stiff and taut with fatigue. Mrs. Pukui considers the statement that awa was tapu to the common people in the old days to be erroneous. The distinction between the awa drinking of alii and commoners was one of manner and purpose of using the drink. The alii class drank for pleasure largely, the kahuna class ceremonially, and the working people for relaxation after labor. There was an abundance of awa for everyone. Because the best of everything belonged to the chiefs, I think it may be inferred that the strong *Awa kau laʻau* of Puna, Hawaii, the fragrant *Mokihana* of Kauai, and possibly the dark *Mo-i awa,* the name meaning "best", were reserved for the alii. *Mo-i* is called for in many medicinal recipes and, as a dark awa, was used ceremonially. *Hiwa,* the darkest of all varieties, was the ritualistic awa used by the kahunas and may have been reserved for such use. All the other varieties were common awa which anyone might use.

In the old days, the root was chewed (*mama*) by young girls or boys with strong teeth. Before chewing, the mouth was rinsed out with wood ashes mixed with water. Then enough root to make a small ball (*mana awa*) in the mouth was chewed for a long time, taken out with the fingers and put in the bowl (*kanoa*). This was repeated until there was sufficient chewed fiber for the quantity desired. Water was added. A bundle of fiber of *ahuawa* was dropped in and turned (*hoka*) round and round clockwise, while pressing down, to catch up the fibers (*oka*). The *ahuawa* was then tucked down all around the inside of the bowl with the fingers of both hands, closed in, lifted up, and squeezed. Then the fibers were shaken out, and the *ahuawa,* formed into a funnel-shaped nest with a little depression in the center, was held over

the cup (*apu*) while the awa was poured (*kahe'e*) through it into the cup. The drinker took his cup outside, dipped his right index finger in three or five times, each time passing his hand back over his right shoulder and flipping (*pana*) the drops of awa up and backward. While doing this, a prayer was said to the family gods (*aumakua*), "Here is food for the gods", continuing with whatever requests (for health, long life, etc.) the drinker had in mind. He then came back into his house, sat down and drank his awa, topping it off (*pupu,* to finish any ceremony) with a sweet banana or stick of sugar cane to take the bitter taste away. He then ate sparingly of warm food (cold food is said to be nauseating) and soon slept peacefully. (From Paahana Wiggin and Mrs. Pukui.)

TI

By no means the least important of the plants grown by the Hawaiians is the ti (*ki*). This grows luxuriantly in damp regions from sea level to the marginal forest zone, where it runs wild, spreading by rhyzomes from earlier plantings. Special terms applied to the plant or parts of ti are given in figure 21.

Ti was and is planted about dwellings, where the plants were believed to have beneficent and protective psychic influence, and on the embankments of taro terraces. Planting requires simply the cutting of a stalk, piece of stalk, or root, and sticking it in the ground, where it grows without cultivation.

In old Hawaii the root (*ki*) steamed in the imu was a favorite sweet, chewed like sugar cane. Some of the voyagers coming to Hawaii soon after its discovery found that excellent beer for their crews could be brewed from liquor of boiled ti root. Portlock (63, p. 91) gives a detailed description of his method of making beer, which he found to be excellent for scurvy. This, distilled, makes the Hawaiian *okolehao* ("alcohol") of recent times.

The main use of ti leaves and the chief purpose for which ti was planted thickly about dwellings was for wrapping food, for cooking, for preservation, and for transportation. Variously shaped packages and bundles were made for different purposes, and bunches of leaves served to cover the imu. These ways of using ti leaves constitute an art which deserves discussion in a study of cooking rather than in this paper.

Ti leaves were believed to have potent properties as protective agents against psychic evil. Worn around the neck, the waist, or the ankles, or even slipped into the clothing or under a sheet or mat, they guarded against evil. Slapping the body with a bunch of ti leaves held in the hand exorcised from a patient the evil causing sickness. In certain rites of exorcism, a patient was laid upon ti leaves. Planted around a house, ti protected its inmates.

Ti root enters into a few Hawaiian medicines, but it was not regarded as

very important medicinally. Eaten in quantity, its effect was laxative: "Ai ke ki, ki, ki: a hi, hi, hi" (Eat ti, ti, ti: [the bowels] run, run, run). In famine times ti roots were gathered from the forest in large quantities and steamed in great ovens, then grated, mashed, mixed with water, and drunk. It is said that there was a famous oven of this sort east of Honolulu at Kaimuki (Ka-imu-ki, "The-ti-oven"). At Keanae, Maui, there was likewise a great *imu ki,* a pit in the lava (now filled) on the west side of the peninsula, near where the road passes the old boat landing.

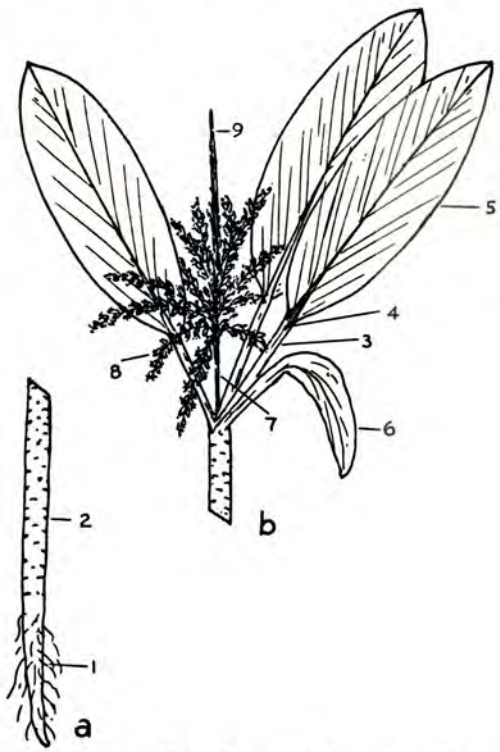

FIGURE 21.—The ti plant: *a,* stalk and roots; *b,* leaves and blossom.

1. mole: root
2. au: stalk
3. ku-au: petiole
4. mawae: channel in petiole
5. lau-ki, la-ki, or la-i: leaf
6. lau-pala: yellowed leaf
7. pu-au: stem of blossom
8. puaki: blossom
9. mu'o: leaf bud

The skirt of split ti leaves worn by hula dancers since Kalakaua's time was not known in ancient Hawaii; it was adapted from the grass skirts worn for dancing by Gilbert Islanders working on the sugar plantations. Rain capes, worn by the bird catchers (*lawai'a manu* or *kia manu*) in the forest, were made by tying dried ti leaves onto an *olona* net. These men thatched their upland shelters with dried ti leaves (or with tree bark). Sandals (*kama'a la-i*)

to protect the feet on lava or coral, were made by plaiting the dried leaves. (Bulrushes were also used.) The long drag nets called *huki lau,* used in driving fish in shallow water, were made from dried ti leaves.

GOURDS

Terms applied to gourd plants, other than those used for all plants, are:

ipu, hua ipu: gourd
ka: vine
umiumi: tendrils
iwi: shell
heu: pubescence
anoano: seed
piko: apex of the gourd

VARIETIES

Two varieties of *Lagenaria* (true gourds) were grown, the poisonous "bitter gourd" (*ipu awaawa*) and the "sweet gourd" (*ipu manalo*), which was not poisonous. I am told by Lakalo of Makena, Hawaii, one of my most reliable informants, that the vine, flower, and leaves of the "bitter" and "sweet" gourd plants "look the same." I have not compared the two, for I have never seen the *manalo* growing. Both are to be found today.

The so-called "giant gourd" (*ipu nui*) was not a gourd, as identified by Hillebrand (29), but an immense hard-shelled pumpkin or *Cucurbita,* limited in its distribution in Polynesia to the Hawaiian islands and here used for large containers (*umeke*) to hold food, clothing, and other possessions. This has been disproved. By studying sections of gourd containers used in ancient times and now stored in the Bishop Museum, Dr. A. J. Eames, plant anatomist at Cornell University, has lately shown that Hillebrand and other botanists have been in error when they listed *Cucurbita* as being present in Hawaii before the arrival of Captain Cook. Dr. Eames states in a letter to the Curator of Collections, Bishop Museum:

> There is a marked anatomical difference in the fruit walls of *Lagenaria* and *Cucurbita,* and your material, without exception, belongs to the former genus. In this material there is certainly no support for the opinion that some of the older vessels, especially the larger and heavier-walled types, belong to *Cucurbita.*

The *ipu nui* is now extinct. There were two types of *ipu nui* that were cultivated in Kona and Kau, Hawaii, the *hulilau* which was broad, and the *lono lau* which was deep.

Different forms of *Lagenaria vulgaris* (synonym, *L. siceraria*) bear fruits varying greatly in size and shape, and in thickness of walls. In Kau, Hawaii, Keliihue gives the following types of gourds that used to be grown:

> *Hulilau* and *Lono lau,* respectively broad and deep *ipu nui.*
>
> *Kukae iwa,* "skin-colored" or green with white splotches as though spattered with white excrement (*kukae*) of the frigate bird (*iwa*). These grow both large and small. According to Mrs. Pukui, they are still grown on Molokai and eastern Maui.
>
> *Palaai,* now long extinct, was shaped like a pumpkin, hence the pumpkin was so called when first introduced. (Now it is called *pu.*)
>
> *Olo* or *hokeo* bore the long gourd used for the hula drum and for holding the fisherman's tackle. These still grow wild in Kau, near Punaluu, and are cultivated at Hoolehua on Molokai.

Pu lʻuliʻu, still growing wild in Punaluu (Kau), bears a small gourd about as large as a coconut, which was used for cups (*apu*) and for rattles in the hula dance, and for individual poi bowls for babies.

Pakaka was a squatty, small gourd used for meat and fish (*ipu kai*). Mrs. Pukui says these are still grown at Waianae, Oahu.

Iole holo kula ("rat running on the Kula slopes"), now extinct, was a tiny gourd, no larger than a kukui nut, growing on a long vine. This was a "sweet gourd" (*ipu manalo*), and its fruit was used for medicine.

Huewai puali was the "bottle gourd" with a constriction around the middle.

Io was a round, light-colored "bitter gourd" about one foot in diameter. These still grow at Keauhou, Kona, Hawaii.

Mrs. Pukui gives in addition to the above, the following terms applied to different shapes:

Huewai, the "water bottle", with bulbous base and long, thin neck.

Hokeo, somewhat pear-shaped but with constriction above the middle, used by fishermen to hold their kits, and by voyagers as water containers.

Kamakau, from Oahu, uses the following terms:

Nounou, a tiny calabash.
Paka, a shallow dish (*pakaka* in Kau, Hawaii).
Laha, a calabash painted with patterns.
Holei, a colored calabash.
Kaku or *kilu,* a container for fish.
Huli lau, large container for clothing.
Hokeo, container for fishing gear, used for carrying tapa in a canoe.

A complete study of differences in terminology between islands has not been attempted, but Mrs. Pukui tells me that the round and narrow gourd termed *mua* on Hawaii was called *ipu wai* on Oahu and *omo* on Kauai. *Umeke* refers in general to large containers. *Umeke pohue* is a container made of calabash in distinction to the wooden containers termed *umeke laʻau* or *palapaʻa.* General descriptive terms for gourds, referring to their uses, are:

ipu iʻa or *ipu kai,* for serving fish
ipu lei, for holding flower necklaces
ipu holoholona, for the fisherman's kit
ipu ai, food containers
ipu nui, any large container
ipu hula, the gourd hula drum

Planting and Cultivation

In the Hawaiian newspaper Kuokoa for March 24, 1922, presumably from the pen of John Wise (74), who was then the editor, appeared the following description of gourd culture:

Among the plants grown by the Hawaiians, there was no other plant that was cared for like a baby like the *ipu awaawa.* [It was cared for] during the growing period, the blossoming and the fruiting.

When the fruit grew larger, the farmer watched carefully by spreading grass and setting the fruit upright. The idea back of this was to make the fruit round out well and stand by itself so that it could be used for a poi container, a hula drum, a container for his fishing paraphernalia, a place to keep his tapa garments or anything he wished to use it for. There were many uses.

The fruit was watched until it was ripe enough to pluck from the vine, then it was

put in a good place for a few days, after which the top was cut and the contents removed. It was done with patience and care. All the pulp clinging to the shell was removed, then it was filled with water. Care was taken not to let the water remain in it too long lest it rot. At this time, when the water was poured out, scrapers were put in to clean it. The purpose of the water was to soften the remaining pulp.

When all the pulp had been removed, then cleaners were put to work, and then we could see, O reader, the way that cleaning was done. Stones from the beach were the sandpaper of that time. The cleaning was done in the evening, after eating, when one sat down to talk. As the mouth talked, the hands rubbed. That was how it was done until it was very clean. Then it was rinsed with water.

As evident from this article, the gourd required careful handling in every stage of growth and preparation after picking. It was believed that a pot-bellied man should plant gourds, and that before he planted he should eat a large meal, so that his gourds would fill out like his stomach (*opu*). He should stoop as he carried his seed, holding his arms bowed out as though embracing a huge *ipu,* struggle along, and puff. Coming to the hole he had dug and dropping the seed suddenly with an outward motion of the hands, palms up (not twisting and turning down the palms, which would make the gourd crooked and shriveled), he should say:

He ipu nui!	A huge *ipu*!
O hiki ku mauna,	Growing like a mountain
O hiki kua,	To be carried on the back,
Nui maoli keia ipu!	Really huge is this gourd!

Encouraged by this little drama, the plant was certain to produce huge fruit. This rite was doubtless addressed only to the giant gourd seed (*ipu nui*).

Kepelino (41, p. 158) calls for wooden tools in planting *ipu* "so that the rind will be thick." But Mrs. Pukui says he has in mind the soft *ipu* of the white man, the watermelon and the pumpkin. Iron tools were favored for calabash planting in Kau because they are hard as the shell should be.

There was much theft and mischief connected with growing gourds; but if a gourd were given the name of an ancestor, it would not be stolen or marred by a malicious neighbor.

The proper night for planting gourds (and melons and pumpkins) in Kau, Hawaii, is *Hua,* because if planted then, there will be good fruit (*hua*). The beginning of the rainy season is the proper time to plant; maturing in six months, the gourds will have the hot dry summer to bring them to full size.

A gourd vine should not be planted where the shadows of people walking back and forth will strike the flower, because the gourd is the body (*kino lau*) of Lono, the rain god. For the same reason a gourd vine should never be touched by a menstruating woman. Hence in old Hawaii gourds were not planted near the house.

The soft young gourd is covered with a downy pubescence. When this is rubbed off, the skin shrivels (*mimino*), withers (*malili*), or becomes

splotched (*kikiko*). Black scale, insect stings, and aphids also blight (*eleao*) the skin. Vines are sometimes shriveled (*ponalo*) by a blight (presumably fungus) that "looks like black powder." When this came, the Kau people pulled up and burned the vines, except one family, related to Lono, who buried the vines instead of burning them. *Nakaka* refers to cracking of the skin, the cause of which was not known if it occurred before picking.

Captain Cook's account says that gourds were given different forms "by tying bandages round them during their growth" (12, vol. 3, p. 151). According to both Keahi Luahine and Paahana Wiggin, this is a misconception; all forms were the result of natural growth.

As the gourd grew big, a little prop or frame (*koo laau* or *haka*) was made with three sticks, set so that the gourd hung suspended between them: this made the fruit symmetrical. Stones and pebbles were removed from beneath the gourd, and a "platform" (*paepae*) of grass or leaves (in later times, a board) was laid out under the gourd.

When the stem of the fruit withered, the sign of full maturity, the gourd was ready for picking. If picked before this stage, the skin would crack when exposed to the sun.

The cleaning process for the "bitter gourd" consisted in cutting off the top, and filling the gourd with sea water. The water was changed each day for ten days. This eliminated the acidity and softened the tough flesh. The flesh was scraped out slowly with pumice (*ana*). The gourd after being cleaned and scraped was termed *pohue* or *umeke pohue*. The flesh of the "sweet gourd" could be cleaned right out, the calabash washed and used immediately.

Most of the Hawaiian gourds were undecorated. For many purposes they were suspended in nets (*koko*) of *olona* fiber. Large containers had lids, which were sometimes hinged with two cords through holes.

Occasionally, but rarely, says Mrs. Pukui, Oahu gourds were stained in patterns, but this was never done on Hawaii. Keahi Luahine says gourds on Kauai were dyed in patterns. The geometric patterns were made by scraping off areas of skin of the shell where the dye was to show, then soaking the gourd in dye of the color desired. When the color had soaked into the exposed shell, the gourd was removed and allowed to dry. Then the remainder of the skin was scraped off, leaving the design standing out clearly in the dyed pattern. The gourd was then wrapped in ti leaves and steamed in the ground oven to set the color. Finally it was polished with soft fine pumice. The dyes used were as follows:

black: charcoal and the juice of some herb (unknown)
purple: material unknown—perhaps berries of the *papa'a hekili* (according to Mrs. Pukui)

gray: juice of crushed leaves of the *palaa* fern mixed with water (in this the gourd had to be soaked for a week)
yellow: crushed bark of the *holei* tree mixed with water

The "spotted" or "tattooed" gourds for which Niihau was famous were decorated with geometric designs pricked into the skin, after which the gourd was buried in black mud. These were termed *pawehe*.

Captain Cook (12, vol. 2, p. 238) made the following interesting observation on gourd utensils observed at Waimea, Kauai:

> They stain their gourd-shells prettily with undulated lines, triangles, and other figures of a black colour; instances of which we saw practiced at New Zealand. And they seem to possess the art of varnishing; for some of these stained gourd-shells are covered with a kind of lacker . . .

Uses

The uses of gourds in general have been indicated in the descriptions of forms. A unique practice of deep-sea fishermen was described to Mrs. Pukui by Jennie Saffrey and Keahi Luahine. The deep-sea fisherman always carried a number of large bottle gourds in his canoe. When he sighted a tiger shark (*niuhi*) making for his canoe, he took a gourd and threw it high out over the water, not toward the shark but to one side. The gourd landed on the water with a sharp splash, and the *niuhi,* attracted by this, turned from the canoe and rushed at it. When his nose struck the gourd it bobbed away, and while the shark furiously attacked it, trying in vain to get it in his mouth, the fisherman dashed for shore.

Planting Localities

Gourds grew best on the hot shores and lowlands on leeward and southerly coasts where there was moderate rainfall and plenty of sun. Niihau was famous for its gourds. On Kauai the section from Waimea to Mana was the gourd country. Keahi Luahine remembered that relatives exchanged fish from Wahiawa for gourds from Mana. It is said that gourds once grew abundantly in Kekaha district (25, vol. 6, p. 168).

On Oahu, the southwestern section, especially coastal Waianae and presumably Ewa, was the best gourd country. Gourds are said still to grow wild and cultivated at Ewa. A few gourds have recently been grown at Waimanalo, Hauula, and Laie.

The southern coast of eastern Maui was formerly the best gourd country, although some were grown on the windward side in sheltered lowlands. At Hamoa, in Hana, one family was cultivating *ipu awaawa* in 1933.

Kau, Kona, Kawaihae, and Kohala were the gourd raising areas on Hawaii. In Kau some varieties still grow wild, and at Keauhou and Honaunau in Kona they are still planted by Hawaiians.

ARROWROOT

The arrowroot (*pia*) grew wild in the forest, but it was also cultivated as a part of the systematic horticulture. It was planted on the banks of wet taro terraces, in damp upland localities where dry taro grows, as in Kona, Hawaii, and eastern Maui, and about houses and gardens. It is said also to have been planted in small patches in open woodland and on moist, grass-covered slopes, especially on the island of Kauai. In Hanakapiai on Kauai and in some localities on Oahu wild arrowroot still flourishes on the hillsides. In Hilo and Puna *pia* still grows wild, but in Kau it has been trampled out by cattle. It is still cultivated in Kau and Kona.

Pia is planted by merely making a hole in the ground and sticking in a tuber. The proper time is toward the end of the rainy season when new growth is showing. The plants mature during the summer; in the dry season the leaves yellow and wither. Then the tuber is ready for eating. The seed matures, but whether it is fertile I do not know. Hawaiians always planted the tubers.

In Kau, according to Mrs. Pukui, the root (*hua pia*) was grated (*wa'u*) raw on a rough stone. The gratings, which are bitter when fresh, were left standing in a bowl of fresh water. When the starch (*pia*) settled in the bottom of the vessel, the water was poured off and fresh water added. This was repeated day after day, until the starch lost its bitterness (*mu'e*). The *oka* or rubbish was strained out with *ahuawa* fibers. The person preparing *pia* did not talk while working, for conversation was believed to lessen the quantity of starch.

Hau pia is *pia* with coconut milk, boiled nowadays. In the olden days it was steamed in the imu wrapped in ti leaves.

The starch was regarded as having important medicinal qualities; taken raw in water, it was prescribed for diarrhea, and it was mixed with *alaea* (red ocher) for dysentery.

TURMERIC

Turmeric (*olena*) grows wild in the forest and was also planted near dwellings, being propagated by transplanting wild sprouting rhizomes at the beginning of the rainy season. These sprouts come up in the spring and mature and die down in the fall. In Hawaii, turmeric was not eaten except perhaps in famine time.

The root (*olena*) was greatly valued ceremonially: a bit of the root was mixed with saltwater for sprinkling (*pikai*) to exorcise, literally, "shake out" (*kuehu*) evil influences, in purifying places, things, and persons for ceremonial purposes or at times of sickness. The root steamed in the imu, chewed and swallowed, was prescribed for consumption. Mashed raw with a stone

pounder, the juice was squeezed and allowed to drop into the ear to relieve earache.

For making dye the root, raw for light yellow, steamed for deep orange, was pounded and the pulp mixed with water which was strained after standing for some time.

BAMBOO

On Kauai, I am told that there are two native bamboos (*ohe*). *Ohe Hawaii* has long joints, green color, and large leaf. This variety is too soft for use in house building or for fishing rods, but makes the best *puili* or split bamboo rattles for the hula. When young, long joints at the base were cut, the green scraped off, the joints split in half and then peeled in three layers, making large, thin, flexible, pure white rectangular pieces. Divided into narrow strips, this very light white "straw" was braided into hats. This variety was known on Hawaii by the same name. *Ohe Kahiki* had short joints, green color, and large leaf. The *Ohe Kahiki,* being hard, was best for knives (made by splitting off a sliver), for fishing poles and for light house construction (as in sheds). This variety was introduced, according to Mrs. Pukui, presumably from Tahiti.

The bamboos grow wild in the lower forest zone. Originally the groves must have been planted, and propagated by transplanting sprouting roots.

So far as I know, the shoots of bamboo were never eaten by Hawaiians.

ILIMA

Ilima, poetically called *pua apiki,* used to be planted round the houses for making leis. There were three shades of *ilima,* a light yellow (*ha lenalena* or *kuakea*), the strong yellow (*melemele*), and bronze red (*ulaula*). Several varieties of *ilima* were distinguished:

Ilima kukahakai: grows by the beach and spreads flat.
Ilima ku kula: very tall and grows on *kula* land.
Ilima makana-a: smaller flowers, of medium height, and grows on the old lava in Kau.
Ilima apiki or *lei*: domesticated *ilima* cultivated for leis; a tall, spreading bush.
Ilima kolikukui: bloom bronze red, grows on Oahu, domesticated; named after the torch (*koli*), made of reddish brown kukui nuts strung like a lei on a coconut midrib.

When *ilima* is transplanted, one *opihi* shell, with the inside turned up, is imbedded under the young shoot (*hehu*) to give the bush "the firmness of the *opihi.*" The bushes were kept from growing too tall by breaking off the leaf buds when the bush reached a convenient height. This caused thick branching and blooming.

Medicinally the *ilima* was called *kanaka maikai* (good man). The flowers or the juice squeezed from them were given to infants. Pregnant women ate the flowers up to the time of parturition.

HIBISCUS

The native hibiscus, with white blossom (*pa makani*) and with red blossom (*kokio*), used to be planted near houses for the sake of the flowers which were used ornamentally and medicinally like hau and *ilima*.

PINEAPPLE

In Puna, Kau, and Kona on Hawaii and in Kaupo on Maui, some elderly natives consider the pineapple, termed *hala kahiki* (foreign pandanus) to be indigenous. The *hala kea,* which is plain green when unripe and ripens yellow, and the *hala ula,* in which the unripe fruit and the leaves have a reddish tinge, are distinguished from the introduced commercial varieties by having thorns (*kuku*) along the edges of the leaves, and by spreading like a vine. If planted from the long shoots (*lala*), they bear after the first year; but if the top (*pupu*) is planted, it takes two years. The fruit is not over 4 inches in diameter, and luscious. They are very sweet-smelling, and the segments of the skin (*maka*) were used in making leis. Phelps reports wild Hawaiian pineapple in the depopulated valleys of windward Molokai.

WILD FOODS

The forest supplied a variety of wild foods in famine time. The most important of these was the starch-filled core of the fern trees or *hapu'u pulu* having the golden wool (*pulu*) round the young leaf shoots (*pepe'e*); and the *hapu'u i'i* without *pulu*. One trunk may contain in its core from 50 to 70 pounds of almost pure starch. This was used as food for pigs as well as for humans. At Kilauea, on Hawaii, a whole trunk was thrust into a steam hole and covered with leaves; when cooked, it was split open and thrown to the pigs. Just how the starch was gotten free from the fibrous growth when used by men as famine food I have not been able to learn. Presumably the trunk was steamed and the starch pounded out as in New Zealand.

The root stock of the *pala* fern is also rich in starch. It was eaten, but whether cooked or not I do not know. When used medicinally the raw root was cut into little pieces and allowed to stand, and the water was drunk as a laxative.

The *pepe'e* or young leaf shoots of the *hoi'o* fern (called *pohole* on Maui) were eaten raw with mountain shrimps (*opae kolo*) from the streams.

Kikawaio, kikawaioa, or *pakikawaio* (Maui) fern, which resembles the "fishtail" or Boston fern except that it does not branch, was eaten raw—both the leaf shoots and the root, which was scraped.

Other roots or tubers that were cooked and eaten in famine times were the *kupala,* sometimes called *paha* or *uala koali* (morning-glory sweet potato), a wild sweet potato or a morning-glory with an enlarged tuber like a sweet

potato. This has been described to me both in Kau and in eastern Maui, but I have been unable to obtain a specimen. This should be eaten young, cooked like a sweet potato. When old it has a strong cathartic effect, like the wild morning-glory (*koali*). Cut up raw it was fed to pigs.

The *maka koali,* a wild sweet potato found in Puna, was also fed to pigs, cut up raw. Presumably it was cooked and eaten in hard times.

The *pi'a* had a large tuber like the *uhi* which was steamed and eaten warm —cold it is tasteless. Cooked, these tubers make excellent food for fattening pigs, but, except in famine times, were too coarse to be relished by human beings.

The aerial tubers of the *hoi,* which look like flattish white potatoes, are poisonous; but they are known to have been utilized as famine food in ancient times. As to how the poison was eliminated or how they were prepared and eaten, I have been unable to get any precise information. They were also used as medicine. The small tuber underground was not eaten, so far as I know.

A few native wild berries and nuts are edible raw: the *akala* or wild raspberry; the shiny, pulpy *ohelo; poha pa'ina* or Cape gooseberry; kukui *ne'ene'e;* and *popolo.*

Of the trees which bore fruit eaten in the old days, the chief was the *Ohi'a ai* or mountain apple. Eaten fresh in quantity this fruit causes stomach ache. Hawaiians used to split the fruit, string the halves, and allow them partly to dry in the sun (*hoomaemae*). Then the fruit could be eaten in quantity. The fruit of the *noni,* which has a repulsive smell when overripe, was eaten when there was nothing else. Berries of the *pi'oi* and *lama* trees, and *ulei* bush were eaten.

A number of plants were cooked green. First the *popolo* deserves mention because of its ceremonial and medicinal uses. The leaves (*polopolo*) of the young bush make excellent greens. Leaves of the *pakai, ahea* or *aheahea,* and *aku* or *aku'aku* were also cooked in the same way as taro tops or stems and sweet potato leaves.

Edible seaweeds are so numerous and variable as to locality, season, and regional nomenclature, that it is best not to attempt to list even the most common here. Some of the Hawaiian edible fresh-water plants and seaweeds have been studied by Miller (51).[12] To give botanical identification, habit, dietary and medicinal uses, and ceremonial uses and significance of these plants would require almost a life's work. For example, *limu kala* is the common, coarse, yellowish brown seaweed with small spiny leaves and round "berries", often seen floating at Waikiki and other beaches. It is edible, though coarse; it is named *kala* (spine) because of the little spines on the

[12] See also Reed, Minnie, The economic seaweeds of Hawaii and their food value: Haw. Agr. Exper. Sta., Ann. Rept. for 1906, pp. 61-88, 1907.

leaves (which look like miniature holly leaves); because of the spines and name, it is identified with the *pua kala* or beach poppy, the *uala kala* or sweet potato with pointed leaf, with the migratory bird called *kala,* having a tuft of feathers on its head like a spine, and with the surgeon fish named *kala* which has a spine on its head. Between all these there is magical and mythological relationship. Because *kala* also means "to loosen", this seaweed has many ceremonial uses. Thus, when a convalescent wants to be freed from all vestiges of his disease, he makes a lei of *kala* seaweed and swims seaward with it round his neck, allowing the waves to wash it off—with it will be "loosened" the guilt or other evil causing the illness.

This is the *kala* riddle given by Mrs. Pukui:

Ke kala o uka	The *kala* of the upland
Ke kala o waena	The *kala* in between
Ke kala o kai	The *kala* of the sea

Answer: A *kala* berry, the *pua kala* (beach poppy), and *limu kala* (*kala* seaweed).

The folklore and ceremonial aspects of Hawaiian horticultural and wild life, in their relationships to mythology, ritual, and the social and economic order, in their historical setting, will make up the content of "The Hawaiian Planter", Volume II.

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APPENDIX 1

Directions for Planting and Fishing According to Nights of the Moon

These directions for planting and fishing according to nights (*po*) of the moon were given by Paahana Wiggin. A "night" extends from noon to noon, relating to the phase of the moon in the intervening night.

1. Hilo (new moon, just a line of light, pua hilohilo)	Fishing fair.
2. Hoaka	Not very good for fishing, especially at night; ghosts cast shadows (hoaka) and keep fish away.
3. Kukahi 4. Kulua 5. Kukolu 6. Kupau	Good for planting sweet potatoes which are firm and long or upright (ku) in the ground.
7. Ole-ku-kahi 8. Ole-ku-lua 9. Ole-ku-kolu 10. Ole-ku-pau	Not good for planting or fishing; ole means "nothing" or non-productive. Tides are high during Ole.
11. Huna	Good for gourds. Leaves are large and gourds hide (huna) under leaves. Good for sweet potatoes which hide deep in the mounds.
12. Mohalu	Excellent for flowers, gourds, sweet potatoes, and taro. Not good for trees.
13. Hua	Hua means "fruitful." Good for gourds, taro, sweet potatoes, yams, and for fishing. Not good for trees.
14. Akua	Akua produces in a "hoakua" or abundant manner. Sweet potatoes, taro, gourds, and yams bear large hua and fishing is good.
15. Hoku	Hoku-kua means "lined up close together" or "bearing in abundance." Good for planting sweet potatoes and taro and for fishing.
16. Mahealani (full moon)	Good for sweet potatoes, taro, gourds, flowers, yams. Excellent for fishing. "Where under heaven (mahealani) can I find room?" say the fruits and fish.
17. Kulu	Good for bananas. Kulu means to drop; the sheath of the banana bloom "drops off", and another hand appears.
18. La'au-ku-kahi 19. La'au-ku-lua 20. La'au-pau	Good for bananas but not for sweet potatoes which become thin, stringy, and woody (la'au) running mostly to vines. Good for kahunas to prepare medicine (la'au) for the sick.

21. Ole-ku-kahi 22. Ole-ku-lua 23. Ole-pau	Not good for fishing or for planting.
24. Kaloa-ku-kahi 25. Kaloa-ku-lua 26. Kaloa-pau	Good for fishing. Makaloa and ole shell fish are plentiful. Good to plant bamboo for weaving material and sugar cane because the joints will be long. Not good for sweet potato which will run to vines (ka-loa, long vine).
27. Kane	The night of Kane, the god of life, hence kapu, spent in prayers. Old Hawaiians prayed for health and food, and for life in bodies of men, animals, and plants. Only Christian converts fished and planted.
28. Lono	Lono was the rain god, hence this night was kapu, spent in prayers for health and food.
29. Mauli	Good for fishing and for planting trees. Uli (dark), referring to foliage, means healthy green growth.
30. Muku (the moonless night)	Good for banana planting. Big bunches will grow a muku long (i.e. from fingertips of the right hand, extended parallel to shoulder, to the crooked elbow of the left arm). Not good for taro and sweet potato.

APPENDIX 2

Descriptions of Cane Varieties (Moir, 52)

Group I

A. *Akilolo family.*

Dark brown pith, position of buds on the stalk not opposite but at the points of the hands of a clock at 4 o'clock. Named after a fish whose colors are found in the stripes of two colors. Medium height canes under normal conditions.

1. *Akilolo*—striped green and deep purplish red when young. Yellow and deep red on older exposed stalks. Leaf sheath striped with purple.
2. *Nanahu*—or *Red Akilolo*—the red mutant of Akilolo. Solid purple leaf sheath and fairly heavy purple cast to leaves.
3. *Pilimai*—or *Yellow Akilolo*—the yellow green mutant of Akilolo. Very similar to Uala in appearance but eyes not opposite.
4. *Pakaweli*—or *Hou*—or *Pailolo*—names given to the same cane on various islands. Deep purple red and green striped cane identical with Akilolo except that the leaves are somewhat variegated. The purple stripes on the leaf sheath are underlaid with white, giving a pinkish red appearance in contrast to the deep purple of Akilolo. An occasional top will be very much variegated with even a pink flush throughout the white on the leaves. This cane will also produce mutants of solid yellow and red very similar to Pilimai and Nanahu. A close study has not been made to distinguish any differences.

B. *Akoki family.*

Very dark brown pith. Position of buds—opposite on stalk. Top very heavy and leaves somewhat longer than Akilolo. Stalks usually larger and plant more vigorous in appearance, especially so in wetter districts where Akilolo does not thrive.

5. *Akoki*—deep red and green when young, changing to purple and brown yellow on exposure; leaf sheath striped with purple.
6. *Uala*—yellow mutant of Akoki—very large stalks—often called Pilimai because of very close similarity but a stronger cane than Pilimai.
7. *Papaa*—deep red or purple mutant of Akoki; large sized stalks, leaf sheath purple striped in contrast to Nanahu's solid color; faint, purplish cast to leaves.

6a. *Makaa*—a faint, green striped mutant of Uala.

C. *Manulele family.*

Dark brown pith color. Position of buds—opposite on stalk; conical internodes; large stalks of medium height.

8. *Manulele*—yellow brown with red brown stripe underlaid with green in newly exposed portions, changing to buff brown and maroon in old exposed stalks, with a very fine stripe of canary yellow. The leaves are somewhat variegated, while the leaf sheaths are green with a purplish cast, and striped with white; the leaves have a decided purplish cast.
9. *Honuaula*—dark brown red mutant of Manulele. Leaf sheath and leaves decidedly purple in color. Newly striped stalks are of a dirty brown color.
10. *Mikokoi*—lighter brown red mutant of Manulele without purple cast to leaves and sheath.

D. *Ainakea family.*

Position of buds—opposite. Pith dark except where stated below. Erect and and of medium height. This family may be related to the Akohi family.

11. *Ainakea*—striped maroon red and apple green when young. Changing to purplish red and yellow when mature. One of the prettiest canes in the collection. Could be mistaken for Ohia when young but on taking a cross-section of the stalk the pith will be found segmented—white where the stalk is red outside, and brown where it is yellow. Leaves are somewhat variegated and leaf sheaths are distinctly striped with white.
12. *Yellow Ainakea*—the yellow mutant of Ainakea—pith dark brown. It is very difficult to separate from Uala—no clear cut differences seem apparent.

E. *Awela family.*

Very strongly of the Badila type of growth and appearance. Very dark pith color, very susceptible to borer damage, because of being easily knocked over by other canes and covered with trash. Position of buds—opposite. The leaf sheath has the tendency to split open above the bud with the sprouting eyes coming through the split.

13. *Awela* or *Puaole*—the flowerless cane; green and yellow striped cane that becomes flushed with rose when exposed to the sun, barrel-shaped internodes, leaf sheath striped with white and leaves somewhat variegated.
14. *Uluhui*—or *Uleohiu*—or *Yellow Awela*—Bronze-yellow mutant of Awela or vice versa. On exposure to the sun the stalks take on a deep reddish bronze cast over the yellow, looking like old gold.
15. *Alaihi*—probably a red mutant or very closely related to Awela. Deep red cane, decidedly barrel-shaped internodes, leaf sheath purple and leaves with purple cast.

F. *Palani or Molokai Akoki family.*

Markedly of Badila type of growth and appearance, very dark pith color, short in stature, position of buds similar to Akilolo, that is, not opposite, leaf sheath having strong tendency to split above the bud.

16. *Molokai Akaohi*—brownish purple and deep olive green striped cane; purple stripes on leaf sheath and leaves with flush of purple.
17. *Palani*—purple cane with deep olive green cast when young, changing to reddish yellow on exposure to the sun, green leaves and sheath. Very likely the parent of the cane Molokai Akoki and not its mutant.

G. *Miscellaneous group*

Not definitely placed in the above groups but of the same general appearance and closely related.

18. *Ohia*: deep red and green striped cane when young becoming bronze red and yellow brown on exposure. (The colors are the same as the leaves and flower of the Ohia-ai tree from which it got its name). Leaf sheath striped with white, which is nearly always flushed with pink; leaves somewhat variegated; position of buds as in the Akilolo family, to which it is probably related; with very dark brown, especially near the rind.
19. *Waiohia*—deep olive brown striped with dull red; no stripes on leaf sheath or purple cast to leaves; dark-colored pith; position of eyes like in Akilolo family. A fairly vigorous grower but with small stalks.
20. *Lauloa*—yellow green, striped with light yellow brown, when young; with exposure a deep olive, striped with dark brown red (not distinct as in Akilolo, Akoki, etc.); broad, long, green leaves; large sized stalks; pith—deep brown; position of buds—opposite. A more robust looking cane than the others of this type.
21. *Uhu*—a dirty-red cane very similar to Lauloa in general appearance and probably related to it, deep brown pith; position of buds—opposite; leaves, green.
22. *Ulaula*—a deep claret red cane of medium size when young changing to black purple on exposure; position of buds—opposite; leaf sheath; purple; leaves with strong purple cast; old midribs of leaves deep purple; pith, deep orange brown.
23. *Pilikoa*—yellow green, with pale brown red stripes when young, changing to deep bronze yellow with darker brown red stripes; position of buds as in Akilolo family; pith colored in segments as in Ainakea; leaf sheath and leaves, green.

Group II

Canes of the Lahaina type of growth in contrast to the Badila, usually free tasseling, heavy stooling, and rather semi-erect to recumbent growth in contrast to the erectness of the other type; large, long heavy tops.

H. *Laukona family.*

Vigorous growing, heavy-stooling canes of medium size with long conical internodes, pith of dark brown; buds opposite; very susceptible to mosaic, eye-spot and brown stripe diseases; large, long tops; tassels long, open and light.

24. *Laukona or Manini* (Laukona because of its use in the Kahuna profession; Manini because of its great resemblance to the striped fish of this name). Orange yellow with light green stripes, when young, changing to pea green stripes on orange yellow, with a rose flush over all; leaves and sheath very much variegated. Frequently mutates to a solid yellow cane (Lahi).
25. *Lahi or Ualalehu*—(the latter name later applied to Yellow Bamboo). The yellow mutation of Laumona, otherwise same as Laukona without variegations and stripes and very much more robust in growth.

26. *Pink-striped Lahi*—a pink or light red striped mutation of Lahi—otherwise same as Lahi.

I. *Maikoiko family.*

A very common cane, relished for chewing purposes. Medium-sized stalks; vigorous stooler and grower; buds, opposite; pith very dark brown; leaves of light yellowish green with a very slight tinge of red; sheaths deep red; very striking wax band, root band and growth ring when newly stripped of its old leaves; root eyes very prominent. This cane seldom tassels and when it does shows a purple, open tassel well above the cane.

27. *Maikoiko* or *Ko Eleele* (black cane) or *Kawila* or *Niger* [Nigger] *cane*—The blackest cane in the series when exposed to the sun. Distinct fringe of long hairs on leaf scar of node.

28. *Striped Maikoiko*—a buff-brown and maroon striped cane when young, becoming olive brown and very deep purple on exposure. Readily mutates to Maikoiko.

J. *Uahi-a-Pele family.*

Heavy stooling cane very similar in appearance to H109; internodes, barrel-shaped; pith very dark brown; position of buds—opposite; very susceptible to eye-spot disease; heavy tasseler.

29. *Uahi-a-Pele* (*Volcano Smoke*) or *Naaukaki*—a light red purple cane with a very heavy wax bloom. The term Naau-kaki meaning "sausage-like" is very descriptive of the shape of the internodes. A fringe of long brown hair (½ inch or over) remains at the leaf scar after the leaf is removed, the hairs being longest just below the buds.

30. *Pohina*—almost identical to Uahi-a-Pele except that it is less vigorous, dies back after tasseling, which it does freely, and has practically no wax bloom. This gives it a dirty red to brown color.

K. *Opukea-Halalii family.*

A very vigorous, large sized stalk cane of the Lahaina type; heavy stooler; somewhat constricted above nodes and enlarging as the next node is approached; distinct wax band; not a free tasseler; pith distinctly white; resistant to eye-spot. These canes are quite different to other Hawaiian canes, and probably the most superior of them all.

31. *Halalii or Wehehala or Ukuhala or Pakaiea*—The first three names are in relation to its top, being somewhat like a small hala tree (Pandanus odoratissimus). It was supposedly first noticed by the Hawaiians of Niihau growing in the sand dunes with the stalks buried by the drifting sand; leaving only the green top above the surface; therefore the name. The last name is a sea weed. This is a light orange yellow and green striped cane with a decided pink flush on exposure, giving a red, yellow, and green striped appearance to the whole stalk; flesh next to the rind colored like stripes outside; leaves somewhat variegated (slightly more than those of Badila type but less than Laukona), sheaths striped with white; buds—opposite. Often called by Hawaiians of today "Puaole", whose colors it resembles. It is very similar to the Nanemo or Bogela cane of Australia, introduced from New Guinea.

32. *Opukea*—The solid yellow cane that gives rise to Hawaii or is the mutant of Halalii. It takes on a rosy red flush on exposure. Where it is a mixed planting with Kea and Lahi, it is rather difficult to separate, except where eye-spot disease is prevalent; then Lahi is badly infected. (Kea, medium, and Opukea, clean.)

L. *Kea family.*

The only other family group besides Halalii that has white pith. Erect type of growth; medium to small sized stalks of greenish yellow; heavy stoolers; compact, deep green tops; buds—opposite; somewhat of the Creole cane type of growth.

33. *Kea*—the best known and most used cane of the collection. The erect compact stooling of this cane with its clinging trash, leaves the stool in such a shape that one cannot see through it. It never attains any very great height. Medium susceptibility to eye-spot and borer damage.
34. *Iliopua*—identical with Kea but never attaining the stature of Kea—that is, always dwarfed. Like Kea, readily damaged by borer due to very compact nature of the leaves and stalks preventing parasitism of the borer by the Tachnid fly.

M. *Miscellaneous group.*

These are a few canes—probably seedlings, mutations or direct importations—that do not fit into the above groupings.

35. *Hinahina*—this cane may be a member of the Laukona group, but no close study has been made to determine points of similarity. It is grayish-green cane with a rosy flush, and the whole covered with a very heavy wax bloom; very susceptible to mosaic and eye-spot; pith, dark brown; buds—opposite. General appearance like Lahi.
36. *Oliana*—A cane very similar in appearance to Lahaina, that is, in type of growth and color, but the pith is very dark brown and the leaf sheath is very fully covered with long red brown hairs; buds, opposite, cane very hard.
37. *Moano*—a red cane that becomes very dark purple on exposure; leaf sheath very hairy and somewhat purple in color; leaves of medium dark green, never with purple cast nor stiff and erect like the Badila type canes listed above; pith, dark brown; buds, opposite.
38. *Lehu, Hairy Bamboo* or *Fotiogoo*—This is more than likely a recently introduced cane extensively planted by the Hawaiians and given the name Lehu, meaning ashes. The stunted mature canes look like dead stalks except that they have green leaves attached. A gray to green-brown cane with a heavy vesture of hairs over the whole stalk, giving it a frosted appearance; pith, a green white; buds, opposite; scattered, long hairs on both upper and lower surfaces of leaf; leaf sheath covered with hairs; buds, large and glabrous.

At the present writing these are not all collected in one place; some have been lost and others mixed together. Attempts will be made to rearrange these in a museum plot in the near future.

Fish [and other] Names Applied to Hawaiian Canes:

Alaihi	Holocentrus
Akilolo	Gomphosus varius
Awela	Thalassoma purpureum (small)
	Thalassoma fuscum
Aweoweo	Priacanthus cruentatus
Hou	Thalassoma purpureum (large)
Maikoiko	Hepatus atramentatus
	Hepatus lencopareius
Makaa	Carangus politus
	Malacanthus parvipinnis
Malolo	Evolantia microptera (flying fish)
	Parexocoetus branchypteurs
	Exocoetus volitans
	Cypsilurus simus
Manini	Hepatus sandvicensis
Moano	Pseudupeneus chryserydros
	Pseudupeneus multifasciatus
Palani	Hepatus dussumieri
Pakaweli	same as Hou

Pilikoa ..... Paracirrhites arcatus
Uhu ..... Callyodon miniatus
Ulaula ..... Etelis marshi
Akoki ..... may be fish name or some term used in Kahuna-ism.
Ainakea ..... white variety of sugar cane; bagasse.
Eleele ..... black
Halalii ..... a small hala (Pandanus odoratissimus)
Hinahina ..... grayish
Honuaula ..... red earth
Iliopua ..... cloudy
Kanio ..... many colored pattern.
Kawila ..... a very dark wood
Kea ..... white
Lahi ..... thin
Laukona or Laukonakona ..... to despise: to treat contemptuously.
Lauloa ..... leafy
Lehu ..... ashes
Manulele ..... flying bird
Mikioi ..... neat, handy
Naaukake ..... sausage-like
Nanahu ..... biting charcoal
Ohia ..... mountain apple (Eugenia malaccensis)
Oliana ..... singing
Pailolo ..... name of channel between Molokai and Maui
Pakaiea ..... species of sea-weed
Papaa ..... tight
Pilimai ..... cuddle
Pohina ..... smoky
Puaole ..... flowerless
Puahala ..... flower of hala
Uahi-a-Pele ..... volcano smoke
Uala ..... sweet potato
Ualalehu ..... ashy sweet potato
Ukuhala ..... small hala
Uluhui ..... mixed growth
Uleohiu ..... (not known—may be used in Kahuna-ism)
Waiohia ..... juice of mountain apple
Wehehala ..... open hala

GLOSSARY

Names in brackets show correct use of the hamzah (') for the dropped letter *k*.

aa ['a'a]: porous or crumbling lava
ahea ['aheahea]: herb, Chenopodium album Linnaeus
ahuawa ['ahu'awa]: sedge, Cyperus javanicus Houttuyn
ahupua'a: sub-district
akala ['akala]: shrub, wild raspberry, Rubus macraei Gray
akolea ['akolea]: fern, Athyrium poiretianum (Gaudichaud) Presl
aku ['aku]: small tree, Cyanea tritomantha Gray
ali'i: chief:
auwai ['auwai]: irrigation ditch
awa ['awa]: shrub, Piper methysticum Forster
elepaio ['elepaio]: bird, Chasiempis sclateri Ridgway [on Kauai]; C. gayi Wilson [on Oahu]; C. sandwichensis (Gmelin) [on Hawaii]
hala kahiki: herb, "native pineapple", Ananas comosus (Linnaeus) Merrill
hala or puhala: tree, Pandanus odoratissimus Linnaeus f.
hapu'u: tree ferns, Cibotium chamissoi Kaulfuss; C. glaucum (Smith) Hooker and Arnott
hau: tree, Hibiscus tiliaceus Linnaeus
he'e: "squid", more correctly a common octopus, Polypus marmoratus (Hoyle)
hoi: yam, Dioscorea bulbifera
hoi'o [ho'i'o]: fern, Diplazium arnottii Brackenridge
honohono: grass, Oplismenus hirtellus (Linnaeus) Beauvois; herb (wandering-jew), Commelina diffusa Burmann f.
humuhumu: fish, "trigger fishes" (family Balistidae). Different species had different qualifying terms
ieie ['ie'ie]: woody climber, Freycinetia arborea Gaudichaud
ili ['ili]: small land section
ilima ['ilima]: shrubs, Sida spp.
ipu: climber, gourd, Lagenaria vulgaris Seringe; L. siceraria (Molina)
ipu awaawa [ipu 'awa'awa]: climber, the poisonous "bitter gourd", Lagenaria vulgaris Seringe; L. siceraria (Molina)
ipu manalo: the non-poisonous "sweet gourd", Lagenaria vulgaris Seringe
ipu nui: climber, giant gourd, Lagenaria vulgaris Seringe; L. siceraria (Molina)
kahuna: priest or wizard
kala: bird (tern), Sterna panaya, S. fuliginosa, S. lunata
kala: seaweed
kalo: taro, Colocasia esculenta (Linnaeus) Schott
kalo malo'o: "dry" (unirrigated) taro
kalo wai: irrigated taro
kamaaina [kama'aina]: as used in this bulletin, means a native born in a specific locality
ki: woody plant, ti, Cordyline terminalis Kunth
kikawaio: fern, Dryopteris cyatheoides (Kaulfuss) O. Kuntze
ko: sugar cane, Saccharum officinarum Linnaeus
koali: morning-glory, Ipomoea spp.
kokio [koki'o]: shrubs, native red mallows; Kokia drynarioides (Seemann) Lewton; K. rockii Lewton; Hibiscus kokio Hillebrand
konohiki: land supervisor, "konohiki lands" during the monarchy were those cultivated for the chief
kukaepua'a: grass, Digitaria pruriens (Trinius) Busse
kukui: tree, Aleurites moluccana (Linnaeus) Willdenow
kula: sloping lands between mountains and sea
kuleana: small private land holding
kumu: fish, Upeneus porphyreus (Jenkins)
lama: tree, Diospyros spp.
lepo: soil

limu kala: brown seaweed, Sargassum spp.
lo'i: flooded terrace for planting taro
mai'a: herbaceous tree, banana, Musa paradisiaca spp. sapientum (Linnaeus) O. Kuntze
maile: woody vine, Alyxia olivaeformis Gaudichaud
mamaki: shrubs and small trees, Pipturus spp.
mana: fern, Pteris irregularis Kaulfuss; Hypolepis punctata (Thunberg) Mettenius
manini: fish, Hepatus triostegus (Linnaeus)
ma'u or ama'u: tree-fern
moku: island, or district of large island
niu: coconut palm, Cocos nucifera Linnaeus
noni: small tree, Morinda citrifolia Linnaeus
ohe ['ohe]: tree cane, bamboo, Bambusa vulgaris Schrader and Wendland
ohelo ['ohelo]: small shrub, bearing berries, Vaccinium reticulatum Smith
ohia ['ohi'a ai]: tree, Eugenia malaccensis Linnaeus; ['ohi'a lehua], Metrosideros collina ssp. polymorpha Gaudichaud
olena ['olena]: herb, turmeric, Curcuma longa Linnaeus
olona: shrub, Touchardia latifolia Gaudichaud
one: sand
o'opu ['o'opu]: fish, gobies (Gobiidae) and their near relatives (Eleotridae)
opelu ['opelu]: fish, Decapterus sanctae-helenae (Cuvier) and Scomber japonicus Houttuyn
opihi ['opihi]: limpets, mollusks of the family Patellidae
pahoehoe: smooth lava
pakai: herb, Amaranthus viridis Linnaeus
pala: large fern, Marattia douglasi (Presl) Baker
pali: cliff
palai: fern, Microlepia setosa (Smith) Alston
pamakani: native white hibiscus, Hibiscus arnottianus (A. Gray) Hillebrand
pia: herb, arrowroot, Tacca pinnatifida Forster
pi'a: vine, yam, Dioscorea pentaphylla
piko: spot at heart of leaf surface where petiole joins leaf-blade of taro
pili: grass, Heteropogon contortus (Linnaeus) Beauvois
poha or pa'ina: herb, "cape gooseberry", Physalis peruviana Linnaeus
poi: paste made from crushed steamed taro corms
popolo: herb, Solanum nodiflorum Jacquin
pua kala [puakala]: herb, "beach poppy", Argemone alba var. glauca Prain
pualele: herb, sow thistle, Sonchus oleraceus Linnaeus
pueo: owl, Asio accipitrinus sandvicensis (Bloxam)
u'ala ['uala]: vine, sweet potato, Ipomoea batatas Lamarck
uhi: yam, Dioscorea alata Linnaeus
ulei ['ulei]: shrub, Osteomeles anthyliidifolia (Smith) Lindley
ulu ['ulu]: tree, breadfruit, Artocarpus incisa Linnaeus f.
waena: a clearing in the forest
wauke: small tree, paper mulberry, Broussonetia papyrifera Ventenat

WILLIAM KALANI, EXPERT *KANAKA MAHIAI* (FARMER), SHOWING TARO CUTTINGS PROPERLY CUT.

A

B

WET TARO PLANTING: *A*, CUTTINGS PLANTED IN LINES IN FLOODED TERRACES, HONOKOHAU, MAUI. *B*, TARO PLANTED IN MOUNDS (*PU'EPU'E*) IN SWAMPY LAND, HAKIPUU, OAHU.

A

B

WET TARO: *A*, BLOOMING TARO IN TERRACES, WAIHEE, MAUI. *B*, MATURE TARO IN TERRACES, HANAPEPE, KAUAI.

A

B

TARO IRRIGATION: *A*, TIERS OF VALLEY-BOTTOM TERRACES, HONOKOHAU, MAUI. *B*, TYPICAL IRREGULAR UPLAND TERRACING AT WAILUA, HANA, MAUI.

A

B

TERRACE AREAS: *A*, KEANAE, MAUI, WHERE LAVA PENINSULA WAS ANCIENTLY SURFACED WITH SOIL BY HAWAIIANS. *B*, INLAND PLANTATION, WAIKANE, OAHU.

A

B

TERRACE AREAS: *A*, TERRACING IN VALLEY BOTTOM, WAIPIO, HAWAII. *B*, TERRACING IN MOLOAA, KAUAI. (PHOTOS BY 18TH WING PHOTO LAB., U. S. ARMY.)

A

B

DRY TARO PLANTING: *A*, MATURE TARO AT KAINALIU EXPERIMENT STATION, KONA, HAWAII. *B*, MULCHED TARO IN FOREST CLEARING AT KAHOONOHO, PUNA, HAWAII.

A

B

SWEET POTATO PLANTING: *A*, HIGH MOUNDING (*PU'EPU'E*) TYPICAL OF CAREFUL DAMP LOWLAND PLANTING, KAHANA, OAHU. *B*, TERRACES FOR SWEET POTATO PLANTING ON THE ISLAND OF NIHOA.