Hawaiian Ethnobotanical Studies I. Native Food and Beverage Plants

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Cultivated food plant stocks were brought to Hawaii by the immigrating Polynesians and composed most of their basic diet. Extensive use, however, was made of the highly endemic (95% for flowering plants and 67% for ferns) flora. The Hawaiian was both a proficient agriculturist and naturalist. Nearly all of the vascular plant genera were given vernacular names, as well as many species and varieties.

Twenty-five genera and over 85 species of vascular plants were used as food sources. These included fern auricles, pith, young fronds, and rhizomes; flowering plant roots (both aerial and underground), tubers, stems, young plants, young shoots, leaves, male flower bracts, fruits, and seeds. Six genera and 55 species of vascular plants were prepared for beverage purposes. These plants are listed in a table, with the following information provided: family, scientific name, common names, species distribution (island, altitude, occurrence, and habit), and plant part utilized. Lists of vernacular names and plant part sources are also included.

Succeeding papers will cover other aspects (introduced food and beverage plants, and native and introduced plants used for ceremonies, cultural artifacts, decorations, dye, fiber, etc.).

Introduction

Portions of this paper were first presented in 1961 in abbreviated form as part of the course material for Botany 105, "Economic Plants of Hawaii," at the University of Hawaii. The information on Hawaiian economic plants has been expanded with each succeeding class (the course is now known as "Hawaiian and Pacific Ethnobotany") to include not only those plants used for food and beverage, but also those for ceremonies, cultural artifacts, decorations, dye, fiber, medicine, plaiting, and thatching. This paper covers only those native vascular plants used for food and beverage by the Hawaiians prior to European contact in 1778. Succeeding papers in this series will cover other aspects of the ancient Hawaiian culture relating to plants.

Discussion

When the voyaging Polynesians discovered Hawaii probably over 1,500 years ago, they found an extremely isolated island archipelago. The Hawaiian Islands are over 2,000 miles from the nearest high island group or continental mass, and 600 miles from the nearest atoll. Some of the plants which the discoverers of this land found native to Hawaii had related species in their homeland, since 40% of the flowering plants have Indo-Pacific affinities; 16.5% are Austral; and 12.5%, Pantropic and Cosmopolitan (13). Other species and genera were, however, new, distinct, and different.

The Hawaiian flora is unique, with many rare species and unusual types of plants. There are about 2,000 species and varieties of native flowering plants, derived from about 272 original immigrants. According to Fosberg (13), 94.4% are endemic, or found nowhere else in the world but the Hawaiian Islands. Wagner (37) states that as many as two-thirds of the more than 180 fern species are restricted in distribution to Hawaii. A preliminary compilation which I have made indicates that 62.5% of the 226 species and varieties of mosses are endemic to Hawaii. Dr. Maxwell S. Doty, Professor of Botany, University of Hawaii, has made a provisional compilation of the endemism of the

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Hawaiian algae. Approximately 13% of the 420 species of marine algae are endemic (21% of the 90 species of *Chlorophyta,* 35% of the 35 species of *Phaeophyta,* and 14% of the 237 species of *Rhodophyta*). None of the 58 species of marine and fresh water *Cyanophyta* are endemic. To date, there appears to be no evidence for endemic fungi in the Hawaiian Islands, as most species (500+) represent those of cosmopolitan distribution (1, 2, 36). Of the 678 species of lichens, 38% are endemic (21).

Some of these endemic species of vascular plants are confined to individual gulches, valleys, ridges, or mountains, while others are found on several islands or are widespread throughout the archipelago. Many native taxa have become very distinct or may possibly be relics and have no apparent relatives known elsewhere.

Several Hawaiian genera are monotypic, as *Dissochondrus* (family Gramineae), *Touchardia* (Urticaceae), *Heimerliodendron* and *Rockia* (Nyctaginaceae), *Hillebrandia* (Begoniaceae), and *Brighamia* (Lobeliaceae). A number of widespread genera are represented in Hawaii by only one species.

Speciation is pronounced in some genera, while in others, the differentiation is not sufficiently distinct. The genus *Cyrtandra* (family Gesneriaceae), for example, has 159 known species in the Hawaiian Islands, of which 118 are found only on the island of Oahu (32). Study of this genus on the other islands will undoubtedly increase this total. Speciation is also notable in most of the lobelioid genera and several of the composite genera. On the other hand, speciation in *Sophora chrysophylla* has not progressed appreciably, so there is only one recognized species with many subspecific taxa (5).

This unusual and different flora did not offer large amounts of wild foodstuffs. However, because of their versatility as agriculturists and naturalists, the Polynesians did find many uses for these plants. Many authors, such as Buck (4), have summarized the uses of native wild plants as follows: "Indigenous plants which supplied any form of food were utilized . . . anything edible, in the form of pith, root tuber, corm, fruit, or leaf became part of the scanty diet. However, except in times of scarcity, these were abandoned after the introduction of cultivated plants. . . . The pith in tree fern trunks is below the leaf bases . . . The thick, starchy leaf bases of the *pala* fern were eaten cooked or raw, and the young, uncoiled (sic) fronds of ferns were eaten, some raw, some cooked. Of the other wild foods, the various fruits were unimportant, the leaves were cooked to provide a green vegetable, and various kinds of seaweed were used as a relish with other foods." Handy (15) states that "the forest supplied a variety of wild foods in famine time."

Although the use of native edible plants was probably in many cases restricted to periods when cultivated foods were scarce, or during travels across the mountains, a large number of such plants were utilized for food. Twenty-five genera and more than 85 species were sources of food from the following plant parts (see Table III): fern auricles, 1 species; tree fern pith, 2 genera, 7 species; young fern fronds, 4 genera, 12 species; fern rhizomes, 2 genera, 3 species; roots and stems of flowering plants, 4 genera, 5 species; aerial roots, 1 species; leaves (young shoots and young plants), 4 genera, 9 species; bracts, 2 genera, 2 species; fruits or seeds, 13 genera, over 54 species. Six genera and 55 species were used for beverage purposes. Beverages were usually prepared as hot teas from dried leaves. Many of these preparations also had medicinal properties. The most commonly used plants for tea were *Bidens* spp. (ko'oko'olau) (8), and the second most important source was *Heliotropium anomalum* var. *argenteum* (hinahina).

Cultivated food plant stocks were brought to Hawaii by the first groups of immigrating Polynesians. As they later journeyed back to their homeland and returned, more economic plants, as well as weeds, were introduced. From many of these, single or multiple clones were developed into many different cultigens, for the Hawaiian was a proficient horticulturist. There were, for example, probably more taro (*Colocasia esculenta* var. *antiquorum*) varieties found in Hawaii in pre-European times than anywhere else in the world, yet introductions of clones from elsewhere must have been relatively few in number. It has been estimated that about

150-250 distinct taro varieties were known to the ancient Hawaiian (38). Many of these varieties are unfortunately lost forever: for today, fewer than 70 have survived.

The native plants which were similar in appearance to the plants the immigrating Polynesians knew in their homeland were given the same names. Many of the names chosen indicate significant botanical relationships. Sometimes the names were derived from superficial plant resemblances, with no genetic relationship. For example *'ape* is the Hawaiian name for the pre-European introduced monocot *Alocasia macrorrhiza* of the Araceae, while *'ape'ape* is the name of the native *Gunnera,* a member of the dicot family Haloragaceae. Both of these plants have large leaves. Other names were chosen because of their suggestion to non-plant objects or because of their economic use.

In some cases, a binominal system of nomenclature was used. *'Ōhi'a* is the word used in pre-European times to indicate members of the Myrtaceae. *'Ōhi'a-'ai* (literally, edible *'ōhi'a*) is *Eugenia malaccensis; 'ōhia-hā, E. sandwicensis;* and *'ōhi'a-lehua, Metrosideros collina* ssp. *polymorpha.* This system was also used to define groups of varieties of introduced economic plants as taro and banana. Most of these varieties had two names: the first word indicating the varietal group name; and the second word, that particular varietal name.

Eventually, most of the Hawaiian vascular plant genera were named, as well as many species. Nearly all of these names have been included in a comprehensive Hawaiian-English Dictionary (24). They are also listed in many of the earlier botanical works, such as Hillebrand (16), and Rock (29, 30).

The manner in which plants of post-European introduction were quickly adapted to various economic uses by the Hawaiians indicates their knowledge and resourcefulness with plants and plant products in general. These will not be included in this series, since they form a later, post-historical culture. In many cases, their role from the 1800's to the present time has been of such significance and so widespread that some Hawaiians will insist that the origin of these plants is prehistoric—even when the actual introduction date can be pinpointed.

Hawaiian Cooking Methods

Buck (4) lists three methods of cooking: broiling, boiling, and a combination of steaming and roasting in the earth oven.

Broiling was done on hot coals (*kō'ala*) or on hot ashes (*pūlehu*). This method was used away from the home or at home when the quantity of food was small. Some fruits were broiled in their skins, as bananas and breadfruit, while other foods were wrapped in *ki* leaves (*Cordyline terminalis*).

Boiling (*hākui, pūholo*) consisted of heat from the inside rather than the outside, since the Hawaiians had only gourd and wooden bowls, which were not fireproof. Wooden bowls were filled with food and water, and heated stones were added. This was the most commonly used method of cooking greens.

Roasting and steaming (*kālua*) was done in an earth oven (*imu*). Either a permanent kitchen, with a shallow hole in the ground under a shelter, or an oven in the open for special occasions was used. Rocks were heated in the bottom of the pit by kindling wood. Grass or leaves were placed on top of the stones, then the food to be cooked was placed in the oven. Layers of leaves, old mats, and tapas were used to cover the food and retain the heat. This method involved several hours and was used to cook both meat and vegetables.

Explanation of Table I.

The information about the food and beverage plants utilized by the Hawaiians prior to European contact (1778) is listed in Table I. These data have been assembled from many literature sources, none of which provides complete information about these plants. The data are arranged as follows:

(1) *Family.* They are listed in botanical sequence.

(2) *Scientific Name.* Synonyms are listed in parenthesis, since many different scientific names are found in the literature. The synonymy listed are only those which have been frequently used in reference sources, both botanical and anthropological.

(3) *Common Names.* Except for three vernacular names, all of those listed are found in Pukui and Elbert (24). The first

(*Text continued on page* 236)

TABLE I
LIST OF HAWAIIAN NATIVE FOOD AND BEVERAGE PLANTS

(1) *Family*	(2) *Scientific Name*	(3) *Common Name*	(4) *Distribution*	(5) *Plant Part Used*
	(*PSILOTUM*)			
Psilotaceae	1a. *Psilotum complanatum* Swartz f. *fosbergii* Degener & Degener	moa, moa-nahele, pipi, Psilotum, whisk ferns.	All islands (this form, according to Degener, 1966, is endemic; the species is found in Polynesia, Malaya, and Tropical America); lower and middle rain forests, usually epiphytic; occasional, not so common as *P. nudum*; herb.	Plant: beverage (m) (7, 12, 23).
	1b. **P. nudum* (L.) Beauv. (*P. triquetrum* Swartz)		All islands; sea level to 4,500 ft elev.; moist to dry habitats, terrestrial or epiphytic; locally common to occasional; also Pantropic; herb.	
	(*FERNS*)			
Marattiaceae	2. *Marattia douglasii* (Presl) Baker in Hook. & Baker	pala, Douglas' mulesfoot fern.	All islands; 1,000–4,500 ft elev.; usually in fog-belt or dense rain forests; (now no longer common) occasional to rare; herb.	Auricle: raw (m) (8), broiled (8, 9, 12, 16, 20, 23) or roasted and steamed (20); beverage (m), slices soaked in cold water (8, 9, 12, 16, 20, 22, 23).
Dicksoniaceae	3a. *Cibotium glaucum* (J. E. Sm.) H. & A. (*C. lauii* Degener & Greenwell, p.p.; *C. nealae* Degener, p.p.; *C. st. johnii* Krajina, p.p.)	hāpu'u, hāpu'u-pulu; Hawaiian tree fern.	All islands; (500) 1,500–4,800 (6,600) ft elev.; moderately wet forests to bogs; occasional to rare (certain varieties); tree.	Pith: (ff) broiled or roasted and steamed (4, 7, 12, 15, 22, 23, 26). Young frond (pepe'e): (ff) boiled or roasted and steamed (16, 18, 22).

TABLE I—(Continued)

(1) *Family*	(2) *Scientific Name*	(3) *Common Name*	(4) *Distribution*	(5) *Plant Part Used*
	3b. *C. splendens* (Gaud.) Krajina (*C. chamissoi* Kaulf., auct. non. Hbd., Rock, et al; *C. hawaiense* Nakai & Ogura, p.p.)	meu[a] (ssp. *hawaiense* (Nakai & Ogura) Krajina); Hawaiian tree fern.	All islands; (near sea level) 1,000–4,300 (6,700) ft elev.; dry and wet forests; abundant to rare (certain varieties); tree.	
	4. *C. chamissoi* Kaulf. (*C. menziesii* Hook.)	hāpu'u-'i'i, 'i'i; heii[b], Hawaiian tree fern.	All islands; 1,000–6,000 ft elev.; common in rain forests with best development and abundant on island of Hawaii; tree.	
Aspidiaceae	5. *Athyrium meyenianum* (Presl) Milde (*A. arnottii* (Brack.) Milde, *Diplazium arnottii* Brack., *D. meyenianum* Presl)	hō'i'o; pohole (Maui).	All islands; 800–4,300 ft elev.; damp habitats; common; herb.	Young frond (pepe'e): raw. (4, 12, 15, 23, 24).
	6. *A. microphyllum* (Sm.) Alston (*A. baldwinii* (Hbd.) C. Chr., *A. poiretianum* (Gaud.) Presl)	'ākōlea.	All islands; 1,500–6,500 ft elev.; damp habitats; common to occasional; herb.	Rhizome: cooked (18).
	7. "Dryopteris" *keraudreniana* (Gaud.) C. Chr.	waimaka-nui, ala'alai.	All islands; 600–4,000 ft elev.; moist habitats; occasional; herb.	Rhizome: cooked (18).
	8. **Thelypteris cyatheoides* (Kaulf.) Fosberg (*Cyclosorus cyatheoides* (Kaulf.) Farw., *Dryopteris cyatheoides* (Kaulf.) O. Ktze.)	kikawaiō, pakikawaiō; kupukupu-makali'i (var. *depauperatum*).	All islands; 750–4,600 ft elev.; rain forests; common; recorded also from New Guinea, Samoa, and Sumatra; herb.	Rhizome: raw (grated and salted) (4, 12, 15, 23, 24), or cooked (18). Young frond (pepe'e): raw (4, 12, 15, 23, 24) or cooked (16.).

[a] Ripperton, 1924:3; vernacular name not listed in Pukui & Elbert, 1965.
[b] Hillebrand, 1888:546; vernacular name not listed in Pukui & Elbert, 1965. This may be the indefinite article, *he* + 'i'i.

TABLE I—(Continued)

(1) *Family*	(2) *Scientific Name*	(3) *Common Name*	(4) *Distribution*	(5) *Plant Part Used*
	9. **T. stegnogrammoides* (Baker) Fosberg (*C. sandwicensis* (Brack.) Copel., *D. sandwicensis* Brack., *D. stegnogrammoides* (Baker) C. Chr.)	hō'i'o-kula.	All islands; (near sea level) 1,000–4,300 ft elev.; usually moist habitats; common; also Fiji, Pitcairn; herb.	Young frond (pepe'e): raw (23, 24).
Blechnaceae	10a. *Sadleria cyatheoides* Kaulf.	'ama'u; 'āma'uma'u and ma'uma'u (plural); tree fern, Sadleria.	All islands; (300) 1,200–4,000 (6,600) ft elev.; dry to very wet forests; abundant to common; tree.	Pith: (ff) broiled or roasted and steamed (7, 12, 23, 24). Young frond (pepe'e): boiled or roasted and steamed (7, 22).
	10b. *S. fauriei* Copel.		Oahu; 1,500–1,800 ft elev.; leeward lower forest; rare; tree.	
	10c. *S. rigida* Copel.		Kauai, Lanai; 2,500–4,800 ft elev.; wet forest to bog; rare; tree.	
	10d. *S. souleyetiana* (Gaud.) Moore	'ama'u-ke'oke'o[c] (*f. brevisora* H. Christ).	All islands; 1,300–4,000 ft elev.; moderately wet forest to bog; occasional to rare; tree.	
	11. *S. pallida* H. & A. (*S. hillebrandii* Rob.)	'ama'u-'i'i, 'i'i, tree fern, Sadleria.	All islands; 1,100–6,000 ft elev.; moderately wet to bog; occasional; tree.	
	12. *S. squarrosa* (Gaud.) Mann (*S. polystichoides* (Brack.) Heller, *S. unisora* (Baker) Rob., p.p)	'apu'u, 'ama'u, Sadleria.	All islands; 1,800–4,800 ft elev.; moderately wet to bog habitats; occasional; herbaceous to suffruticose.	Young frond (pepe'e): boiled or roasted and steamed (22).

[c] Hochreutiner, 1912: 204. Listed as "amahu keu-keu (keu-keu signifie blanc)." *Amahu* probably is Hochreutiner's way of spelling *'ama'u*, since a glottal stop is often designated in speech with a pause. Since he stated that *keu-keu* means white, the correct spelling would be *ke'oke'o*. Vernacular name not listed in Pukui & Elbert, 1965.

TABLE I—(Continued

(1) *Family*	(2) *Scientific Name*	(3) *Common Name*	(4) *Distribution*	(5) *Plant Part Used*
	(*DICOTS*)			
Chenopodiaceae	13a. *Chenopodium oahuense* (Mey.) Aellen (*C. sandwicheum* Moq.)	ʻāheahea, ʻāweoweo, ahea, ʻāhewahewa, alaweo, Hawaiian goosefoot.	All islands; 10–8,250 ft elev.; dry areas; common; also several islands of Leeward Hawaiian Chain (i.e., Nihoa, Necker, French Frigate Shoal, Laysan); (var. *discosperma* Fosberg, found on Maui at an elev. of 6,750 ft, is herbaceous), shrub (low elevations) to small tree (high elevations).	Leaf, young shoots, and young plants: boiled (4, 14, 15, 16, 24).
	13b. *C. pekeloi* Degener, Degener & Aellen		Molokai; arid rocky slopes; rare; herb.	
Rosaceae	14. *Fragaria chiloensis* (L.) Duchesne var. *sandwicensis* (Decaisne) Degener & Degener	ʻōhelo-papa, Hawaiian strawberry.	Hawaii, Maui (this variety is endemic according to Degener, 1961; the species is American); 2,700–7,800 ft elev.; dry areas; locally common; herb.	Fruit: raw (16, 23, 24).
	15. **Osteomeles anthyllidifolia* (Smith) Lindl.	ʻūlei; eluehe (Molokai).	All islands; sea level to 4,000 (8,000) ft elev.; common in dry areas; also Polynesia, Bonin, and Ryukyu Islands; creeping shrub (low elevations) to tree (high elevations).	Fruit: raw (4, 14, 15, 23) (Hillebrand, 1888: 119, considers the fruit "quite unpalatable").
	16a. *Rubus hawaiiensis* Gray	ʻākala, ʻākalakala, Hawaiian raspberry.	All islands except Oahu and Lanai; (2,000) 4,000–7,500 ft elev.; locally common; shrub to small tree.	Fruit: raw (4, 7, 15, 16, 23).

TABLE I—(Continued)

(1) *Family*	(2) *Scientific Name*	(3) *Common Name*	(4) *Distribution*	(5) *Plant Part Used*
	16b. *R. macraei* Gray		Hawaii, Maui; 4,000–6,000 ft elev.; not so common as *R. hawaiiensis*; trailing shrub.	
Sapindaceae	17a. *Alectryon macrococcus* Radlk. (*Mahoe* Hbd., gen. nov.?)	māhoe, 'ala'ala-hua.	Molokai, Maui; 1,600–2.600 ft elev.; leeward side of dry regions; rare; tree.	Fruit (aril) and seed: raw (8, 14, 30).
	17b. *A. mahoe* St. John & Frederick		Kauai (?), Oahu; 1,500–2,400 ft elev.; usually in dry areas; occasional to rare; tree.	
Sterculiaceae	18. **Waltheria americana* L.[d]	'uha-loa, 'ala'ala-pū-loa, hi'a-loa, kanaka-loa.	All islands; arid lowlands; locally common; also tropical America; creeper to shrub.	Root and leaf: beverage (m) (24.)
Myrtaceae	19. *Eugenia sandwicensis* Gray (*Syzygium sandwicensis* (Gray) Ndz., *S. oahuense* Degener & Ludwig, p.p.)	hā, 'ōhi'a-hā, kauokahiki; pā'ihi (Maui).	All islands except Hawaii; (350) 1,000–3,600 (4,200) ft elev.; occasional; tree.	Fruit: raw (23, 24, 30). (Hillebrand (1888: 129) states "the fruit is resinous-astringent, insipid).
Ericaeae	20a. *Vaccinium reticulatum* J. E. Smith	'ōhelo, 'ōhelo-'ai.	Maui, Hawaii; near sea level to 6,000 (10,000) ft elev.; abundant to common on open lava beds; shrub.	Leaf: beverage (24); Fruit: raw (4, 7, 15, 16, 23, 24).
	20b. *V. berberidifolium* (Gray) Skottsb.		Maui Hawaii (?); 6,000–10,000 ft elev.; common to occasional; shrub.	

[d] Considered by some botanists to be introduced by the Polynesians.

TABLE I—(Continued)

(1) *Family*	(2) *Scientific Name*	(3) *Common Name*	(4) *Distribution*	(5) *Plant Part Used*
	20c. *V. dentatum* J. E. Smith		All islands except Hawaii; 1,200–10,000 ft elev.; usually in rain forest; common to occasional; shrub.	
	20d. *V. pahalae* Skottsb.		Molokai, Hawaii; 3,000 ± ft elev.; open rain forest to bog; occasional; shrub.	
	20e. *V. peleanum* Skottsb.		Hawaii; 7,500–11,000 (12,250) ft elev.; subaiplne to alpine; locally common; shrub.	
	21. *V. calycinum* J. E. Smith	ʻōhelo-kau-lāʻau.	All islands; 2,000–4,000 ft elev.; abundant to common on Kauai, Maui, and Hawaii in rain forest; shrub to small tree.	
Ebenaceae	22a. *Diospyros ferrea* (Willd.) Bakh. ssp. *sandwicensis* (A. DC.) Fosberg (*Maba sandwicensis* A. DC.)	lama (PPN, rama; PMP, damaR) Hawaiian persimmon.	All islands (the subspecies, according to Fosberg, 1939, is endemic; The species is distributed from India to the Pacific); 450–3,000 ft elev.; dry to wet forests; common to rather rare (certain forms); tree.	Fruit (piʻoi) and seed: raw (4, 11, 14, 15, 16, 30).
	22b. *D. hillebrandii* (Seem.) Fosberg (*M. hillebrandii* Seem.)		Kauai, Oahu; 1,300–2,400 ft elev.; rain forest; locally common to occasional on Oahu; tree.	

TABLE I—(Continued)

(1) *Family*	(2) *Scientific Name*	(3) *Common Name*	(4) *Distribution*	(5) *Plant Part Used*
Convolvulaceae	23. **Ipomoea cairica* (L.) Sweet (*I. palmata* Forsk., *I. tuberculata* Roem. & Schult.).	koali-'ai, koali-lau manamana; koali, kowali, kūpala, paha, 'uala-koali, Cairo morning glory.	All islands; lowlands; dry rocky places; common; also tropical Africa and Asia; creeper.	Root and stem: (ff) cooked (4, 15, 16, 22, 23, 24).
	24. **I. pes-caprae* (L.) Sweet ssp. *brasiliense* (L.) van Ooststr.	pōhuehue, beach morning glory.	All islands; strand (coastal sand dunes); abundant; also Pantropic; creeper.	Root and stem: (ff) cooked (23, 24).
	25. *Jacquemontia sandwicensis* Gray	pā'ū-o-Hi'i-aka, kākua-o-Hi'i-aka.	All islands; strand and lowlands (above strand); on dry plains and rocky slopes of lowlands; common to occasional on leeward side; creeper.	Stem and leaf: beverage (m) (18); Root: (ff) cooked (8, 16).
Boraginaceae	26. *Heliotropium anomalum* H. & A. var. *argenteum* Gray	hinahina, hinahina-ku-kahakai, beach heliotrope.	All islands (the variety is endemic, while the species is distributed in the Pacific); strand and lowland (above strand); often in dry sandy soil; abundant to common; herb (sometimes suffruticose).	Plant: beverage (m) (23, 24), second choice when *Bidens* spp. not available.
	27. **H. curassavicum* L.	kīpūkai, nena, seaside heliotrope.	All islands; strand and lowlands; often in clay soil of drying salt marshes; occasional, but widespread; also American; herb (sometimes suffruticose).	Leaf: boiled (14, 22); beverage (m) (7, 24).
Solanaceae	28a. *Nothocestrum breviflorum* Gray	'aiea, hālena.	Hawaii (also one specimen each collected on Oahu and Maui; rare?); 2,400–4,000 ft elev.; dry forests; occasional; tree.	Fruit: (ff) raw (23, 30).

TABLE 1—(Continued)

(1) *Family*	(2) *Scientific Name*	(3) *Common Name*	(4) *Distribution*	(5) *Plant Part Used*
	28b. *N. latifolium* Gray		All islands; 1,200–4,500 ft elev., dry (to wet) forests; locally common; tree.	
	28c. *N. longifolium* Gray		All islands; 1,800–4,000 ft elev.; rain forests, but also drier sections; occasional; tree.	
	28d. *N. peltatum* Skottsb.		Kauai; 3,000–4,000 ft elev.; moderately wet forests; occasional; tree.	
	28e. *N. subcordatum* Mann		Oahu, Molokai, and Lanai; 1,200–4,000 ft elev.; dry to wet forests; rare; tree.	
Rubiaceae	29a. *Morinda sandwicensis* Degener	noni-kuahiwi.	Oahu; 1,500–2,600 ft elev.; dry forests; rare; shrub to tree.	Fruit: (ff) raw. Presumed to have been eaten since the introduced *M. citrifolia* was used for famine food.
	29b. *M. trimera* Hbd.		Kauai, Maui, Lanai; 1,700–4,200 ft elev.; moderately wet to wet forests; rare; tree.	
Lobeliaceae	30. *Clermontia* spp. (25 species) (*C. gaudichaudii* Hbd., *C. hawaiiensis* (Hbd.) Rock, *C. macrocarpa* Gaud., and other species)	ʻōhā, ʻōhāhā, hāhā, ʻōhā-wai; ʻōhā-kēpau and ʻōhāhā-wai-nui (*C. hawaiiensis*); ʻōhā-wai-nui (*C. arborescens* (Mann) Hbd.); hāhā-ʻai-a-ka-manu (*C. gaudichaudii*).	(Genus) All islands; (500) 1,200–5,000 (7,000) ft elev.; rain forest; common to occasional to rare; shrub to tree.	Fruit: raw (7, 16, 18, 23, 31); Leaf: boiled (7, 18, 23, 31).
	31a. *Cyanea angustifolia* (Cham.) Hbd.	hāhā, ʻōhā (vernacular names for *Clermontia* and *Cyanea*).	Oahu, Molokai, Maui, Lanai; lower (to middle) wet forests; common; shrub.	Leaf: boiled (4, 15, 16, 24, 31).
	31b. *C. rollandioides* Rock	ʻakūʻakū.	Hawaii; lower wet forest; occasional; shrub.	

TABLE I—(Continued)

(1) *Family*	(2) *Scientific Name*	(3) *Common Name*	(4) *Distribution*	(5) *Plant Part Used*
	31c. *C. tritomantha* Gray	'akū.	Hawaii; 1,500–3,000 ft elev.; wet forests; occasional; shrub.	
Compositae	32. *Bidens* spp. (*Campylotheca* spp.) (43 species)	ko'oko'olau; po'olā-nui (*B. cosmoides* (Gray) Sherff); Hawaiian Bidens.	(Genus) All islands; sea level to 6,000 ft elev.; various habitats, but usually dry regions; locally common to rare (certain taxa); herb to shrub.	Leaf: beverage (m) (7, 8, 23, 24), most common source of tea.
	(*MONOCOTS*)			
Pandanaceae	33. *Freycinetia arborea* Gaud.	'ie'ie, climbing hala, Freycinetia.	All islands; (near sea level) 1,000–2,000 (4,500) ft elev.; dry and wet forests; abundant; woody climber, and trailer.	Male flower bract: raw (23). Fruit: raw (23).
	34. *Pandanus tectorius* Sol. var. *sandwicensis* Warb. (**P. odoratissimus* L.f., **P. tectorius* Sol.)	hala (PPN, fara; PMP, panDan), pū hala; Pandanus, screw pine.	All islands; sea level to 2,000 ft elev.; abundant on windward side; tree.	Male flower bract: raw (23). Fruit: raw (7, 15, 23). Aerial root (uleule hala, ule hala): cooked (m) (22).
Palmae	35. *Pritchardia* spp. (possibly 30 species)	loulu; noulu; loulu-hiwa (*P. gaudichaudii* (Mart.) H. Wendl.); loulu-lelo (*P. hillebrandii* Becc.); Pritchardia.	(Genus; species as presently defined restricted to one island only) All islands; (near sea level) 1,000–3,000 (6,500) ft elev.; (dry to) wet forests; occasional small stands to isolated trees; tree.	Seed (hawane, wahane): raw (14, 16, 22, 23, 30).
Liliaceae	36. *Smilax sandwicensis* Kunth.	hoi-kuahiwi, aka'awa, Smilax.	All islands; (near sea level) 1,000–2,000 (4,000) ft elev.; moderately wet forests to bogs; common to occasional; woody vine, climber.	Tuber: cooked (16).

TABLE II
LIST OF VERNACULAR PLANT NAMES AND SCIENTIFIC NAMES

ahea, 'āheahea, 'ahewahewa	13.	*Chenopodium oahuense, C. pekeloi.*
'aiea	28.	*Nothocestrum breviflorum, N. latifolium, N. longifolium, N. peltatum, N. subcordatum.*
aka' awa	36.	*Smilax sandwicensis.*
'ākala, 'ākalakala	16.	*Rubus hawaiiensis, R. macraei.*
'ākōlea	6.	*Athyrium microphyllum.*
'akū	31c.	*Cyanea tritomantha.*
'akū' akū	31b.	*Cyanea rollandioides.*
'ala'ala-hua	17.	*Alectryon macrococcus, A. mahoe.*
ala'alai	8.	*"Dryopteris" keraudreniana.*
'ala'ala-pū-loa	18.	*Waltheria americana.*
alaweo	13.	*Chenopodium oahuense, C. pekeloi.*
'ama'u, 'āma'uma'u	10.	*Sadleria cyatheoides, S. fauriei, S. rigida, S. souleytiana.*
'ama'u, 'apu'u	12.	*Sadleria squarrosa.*
'ama'u-'i'i	11.	*Sadleria pallida.*
[a]'ama'u-ke'oke'o	10d.	*Sadleria souleytiana* f. *brevisora.*
'āweoweo	13.	*Chenopodium oahuense, C. pekeloi.*
eluehe	15.	*Osteomeles anthyllidifolia.*
hā	19.	*Eugenia sandwicensis.*
hāhā	30.	*Clermontia* spp.
	31.	*Cyanea* spp.
hāhā-'ai-a-ka-manu	30.	*Clermontia gaudichaudii.*
hala	34.	*Pandanus tectorius* var. *sandwicensis.*
hālena	28.	*Northocestum breviflorum, N. latifolium, N. longifolium, N. peltatum, N. subcordatum.*
hāpu'u, hāpu'u-pulu	3.	*Cibotium glaucum, C. splendens.*
hāpu'u-'i'i, [a]heii	4.	*Cibotium chamissoi.*
hi'a-loa	18.	*Waltheria americana.*
hinahina, hinahina-ku-kahakai	26.	*Heliotropium anomalum* var. *argenteum.*
hoi-kuahiwi	36.	*Smilax sandwicensis.*
hō'i'o	5.	*Athyrium meyenianum.*
hō'i'o-kula	9.	*Thelypteris stegnogrammoides.*
'ie'ie	33.	*Freycinetia arborea.*
'i'i	4.	*Cibotium chamissoi.*
	11.	*Sadleria pallida.*
kākua-o-Hi'i-aka	25.	*Jacquemontia sandwicensis.*
kanaka-loa	18.	*Waltheria americana.*
kauokahiki	19.	*Eugenia sandwicensis.*
kikawaiō	8.	*Thelypteris cyatheoides.*
kīpūkai	27.	*Heliotropium curassavicum.*
koali, koali-'ai, koali-lau manamana	23.	*Ipomoea cairica.*
ko'oko'olau	32.	*Bidens* spp.
kowali, kūpala	23.	*Ipomoea cairica.*
kupukupu-makali'i	8.	*Thelypteris cyatheoides* var. *depauperatum.*
lama	22.	*Diospyros ferrea* ssp. *sandwicensis, D. hillebrandii.*
loulu	35.	*Pritchardia* spp.
loulu-hiwa	35.	*Pritchardia gaudichaudii.*
loulu-lelo	35.	*Pritchardia hillebrandii.*
mahoe	17.	*Alectryon macrococcus, A. mahoe.*
ma'uma'u	10.	*Sadleria cyatheoides, S. fauriei, S. rigida, S. souleytiana.*
[a]meu	3.	*Cibotium splendens* ssp. *hawaiense.*
moa, moa-nahele	1.	*Psilotum complanatum* f. *fosbergii, P. nudum.*
nena	27.	*Heliotropium curassavicum.*

[a] Vernacular name not listed in Pukui & Elbert, 1965. All other names are listed in this dictionary.

TABLE II—(Continued)

noni-huahiwi	29. *Morinda sandwicensis, M. trimera.*
noulu	35. *Pritchardia* spp.
ʻōhā	30. *Clermontia* spp.
	31. *Cyanea* spp.
ʻōhāhā, ʻōhā-wai	30. *Clermontia* spp.
ʻōhāhā-wai-nui, ʻōhā-kepau	30. *Clermontia hawaiiensis.*
ʻōhā-wai-nui	30. *Clermontia arborescens.*
ʻōhelo, ʻōhelo-ʻai	20. *Vaccinium reticulatum, V. berberidifolium, V. dentatum, V. pahalae, V. peleanum.*
ʻōhelo-kau-lāʻau	21. *Vaccinium calycinum.*
ʻōhelo-papa	14. *Fragaria chiloensis* var. *sandwicensis.*
ʻōhiʻa-hā	19. *Eugenia sandwicensis.*
paha	23. *Ipomoea cairica.*
pāʻihi	19. *Eugenia sandwicensis.*
pakikawaiō	8. *Thelypteris cyatheoides.*
pala	2. *Marattia douglasii.*
pāʻū-o-Hiʻi-aka	25. *Jacquemontia sandwicensis.*
pipi	1. *Psilotum complanatum* f. *fosbergii, P. nudum.*
pōhuehue	24. *Ipomoea pes-caprae* var. *brasiliense.*
poʻolā-nui	32. *Bidens* spp.
pū hala	34. *Pandanus tectorius* var. *sandwicensis.*
ʻuala-koali	23. *Ipomoea cairica.*
ʻuha-loa	18. *Waltheria americana.*
ʻūlei	15. *Osteomeles anthyllidifolia.*
waimaka-nui	7. *"Dryopteris" keraudreniana.*

TABLE III

PLANT PARTS UTILIZED FOR FOOD AND BEVERAGE

A. Beverage Plants (6 genera, 55 species).
- 32. *Bidens* spp. (leaves) (43 species)
- 26. *Heliotropium anomalum* var. *argenteum* (plants)
- 27. *H. curassavicum* (leaves)
- 25. *Jacquemontia sandwicensis* (stems and leaves)
- 1. *Psilotum complanatum* f. *fosbergii, P. nudum* (plants)
- 21. *Vaccinium calycinum* (leaves)
- 20. *V. reticulatum, V. berberidifolium, V. dentatum, V. pahalae, V. peleanum* (leaves)
- 18. *Waltheria americana* (roots and leaves)

B. Fern Auricles (1 genus and species).
- 2. *Marattia douglasii*

C. Fern Pith (2 genera, 7 species).
- 4. *Cibotium chamissoi*
- 3. *C. glaucum, C. splendens*
- 10. *Sadleria cyatheoides, S. fauriei, S. rigida, S. souleytiana*
- 11. *S. pallida*

TABLE III—(Continued)

D. Young Fern Fronds (4 genera, 12 species)
5. *Athyrium meyenianum*
4. *Cibotium chamissoi*
3. *C. glaucum, C. splendens*
10. *Sadleria cyatheoides, S. fauriei, S. rigida, S. souleytiana*
11. *S. pallida*
12. *S. squarrosa*
8. *Thelypteris cyatheoides*
9. *T. stegnogrammoides*

E. Fern Rhizomes (2 genera, 3 species)
6. *Athyrium microphyllum*
7. *"Dryopteris" keraudreniana*
8. *Thelypteris cyatheoides*

F. Roots (1 genus and species)
25. *Jacquemontia sandwicensis*

G. Aerial roots (1 genus and species)
34. *Pandanus tectorius* var. *sandwicensis*

H. Tubers (1 genus and species)
36. *Smilax sandwicensis*

I. Roots and Stems (1 genus, 2 species)
23. *Ipomoea cairica*
24. *I. pes-caprae* var. *brasiliense*

J. Young Plants, Leaves, and Young Shoots (1 genus, 2 species)
13. *Chenopodium oahuense, C. pekeloi*

K. Leaves (3 genera, over 7 species)
30. *Clermontia* spp.
31. *Cyanea angustifolia, C. rollandioides, C. tritomantha*
27. *Heliotropium curassavicum*

L. Male Flower Bracts (2 genera and species)
33. *Freycinetia arborea*
34. *Pandanus tectorius* var. *sandwicensis*

M. Fruits (10 genera, over 22 species)
30. *Clermontia* spp.
19. *Eugenia sandwicensis*
14. *Fragaria chiloensis* var. *sandwicensis*
33. *Freycinetia arborea*
29. *Morinda sandwicensis, M. trimera*
28. *Nothocestrum breviflorum, N. latifolium, N. longifolium, N. peltatum, N. subcordatum*
15. *Osteomeles anthyllidifolia*
34. *Pandanus tectorius* var. *sandwicensis*
16. *Rubus hawaiiensis, R. macraei*
21. *Vaccinium calycinum*
20. *V. reticulatum, V. berberidifolium, V. dentatum, V. pahalae, V. peleanum*

N. Fruits and Seeds (2 genera, 4 species)
17. *Alectryon macrococcus, A. mahoe*
22. *Diospyros ferrea* ssp. *sandwicensis, D. hillebrandii*

O. Seeds (1 genus, possibly 30 species)
35. *Pritchardia* spp.

(*Text continued from page* 223)

vernacular name given for each species is the one most commonly used. Other vernacular names may be reduplicated forms in less common use than the root or roots less commonly used; variant forms or spellings; or names which are restricted to a single island. In the case of the latter, the island name is indicated in parenthesis.

Where applicable, the glottal stop (') and macron (-) are shown. Glottal stops are necessary to distinguish such pairs of words as *pia* (*Tacca leontopetaloides*) and *pi'a* (*Dioscorea pentaphylla*). They are considered as consonants, and "vowels following glottal stops are especially short . . . a glottal stop (is) similar to the sound between the *oh's* in English *oh-oh*" (24).

The macron is a symbol of vowel length and stress. The stress or accent is made on all vowels "marked with macrons: ā, ē, ī, ō, ū. Normally the accent is on the next-to-the last syllable and preceding alternate syllables. Words with five syllables without macrons have the stress on the first and fourth syllable" (24).

Proto-Polynesian (PPN) and Proto-Malayo-Polynesian (PMP) reconstructions are given when available. Proto-Polynesian (PPN) reconstructions are the "hypothetical reconstructed form in the Proto-Polynesian language spoken by the ancestors of the Hawaiians before the separation of the Polynesian peoples; this reconstruction is based largely on the form in use today in Tongan, Uvean, or Futuan, which languages have preserved more archaic features than any other Polynesian languages thus recognized. Similarly . . . (is) the hypothetical reconstructed form in the Proto-Malayo-Polynesian (PMP) language, the ancestor of Proto-Polynesian, spoken much earlier, before the separation of the Polynesian and other peoples from the Indonesians; this form can be reconstructed only when cognates are unmistakably present among Indonesian languages . . ." (24).

(4) *Species Distribution.* Data in this part include the following:

(a) Island(s) where the plant is found. The term "all islands" includes Kauai, Oahu, Molokai, Maui, Lanai, and Hawaii. Kahoolawe and Niihau are excluded from this group, since the number of native plant species remaining on Niihau is small, while Kahoolawe has only a small amount of vegetation. The elevation of these islands is low (Niihau, 1,281 feet; Kahoolawe, 1,427 feet), when compared to the other major Hawaiian Islands. Plants which are native to the Hawaiian Islands but are found also elsewhere (indigenous) have an asterisk (*) preceding the scientific name.

(b) Altitudinal range of the species in the Hawaiian Islands are given when available. Figures in parenthesis indicate the extreme limits of the species when they do not fall within the "normal" distribution pattern. These data were verified in most cases with herbarium specimens in the Bernice P. Bishop Museum. In some cases, the species distribution is defined, for the sake of simplicity, by the ecological zones proposed by Rock (30): (i) Strand: beach area; (ii) Lowland: area beyond the beach to 1,000 ft elevation; (iii) Lower forest: 1,000-2,500 ft elevation; (iv) Middle forest: 2,500-5,500 ft elevation; (v) Bog region: 4,000-5,500 ft elevation, where a bog condition exists; and (vi) Upper forest: 5,500-11,000 ft elevation. With some exceptions, most of the plants today are found only at elevations above 1,000 ft. What their distribution prior to 1778 was is subject to conjecture.

(c) Occurrence: abundant, common, locally common, occasional, rather rare, rare.

(d) Habit: tree, shrub, herb, climber, creeper.

(5) *Plant Part* used for food, and whether raw or cooked. The abbreviation (*ff*) indicates that the plant part was considered to be a "famine food". When the abbreviation (*m*) follows the use of a plant part, this indicates that it was considered to have had medicinal properties; in the case of many beverage plants, it was as a "tonic". Numbers in parenthesis refer to literature sources (see "Literature Cited").

Acknowledgments

I appreciate the assistance given to me by Dr. Samuel H. Elbert, Department of Pacific Languages and Department of Linguistics, University of Hawaii, who provided the Proto-Polynesian and Proto-Malayo-

Polynesian reconstructions and reviewed the vernacular names included in this paper.

Dr. F. Raymond Fosberg, Museum of Natural History, Smithsonian Institution, and Dr. Charles H. Lamoureux and Dr. Melvin L. Bristol, Department of Botany, University of Hawaii, kindly consented to review the manuscript. Miss Janet Bell, Curator, Hawaiian and Pacific Collections, University of Hawaii, assisted in procuring certain references. Dr. Warren H. Wagner, Jr., Director, Botanical Gardens, University of Michigan, provided information on the nomenclature of some of the ferns.

Literature Cited

1. Anastasiou, C. J. 1964. Some aquatic *Fungi Imperfecti* from Hawaii. Pacific Sci. **18:** 202-206.
2. Baker, G. E. 1966. The occurrence of fungi in selected aquatic habitats. In press.
3. Beccari, Odoardo, and Joseph F. Rock. 1921. A monographic study of the genus *Pritchardia*. B. P. Bishop Mus. Mem. VIII (1). 77 p.
4. Buck, Sir Peter Henry (Te Rangi Hiroa). 1957. Arts and crafts of Hawaii. B. P. Bishop Mus. Spec. Pub. 45. xv + 606 p.
5. Chock, Alvin K. 1956. A taxonomic revision of the Hawaiian species of the genus *Sophora* Linnaeus (Family Leguminosae). Pacific Sci. **X:** 136-158.
6. Copeland, Edwin Bingham. 1947. Genera Filicum, the genera of ferns. Chronica Botanica, Waltham, Mass. xvi + 247 p.
7. Degener, Otto. 1930. Plants of Hawaii National Park, illustrative of plants and customs of the South Seas. Honolulu Star Bulletin, Ltd., Honolulu (1945 offset ed., Edwards Bros., Ann Arbor). xv + 312 p.
8. ———. 1932. Kokoolau, the Hawaiian tea. J. Pan-Pacific Res. Inst. **VII**(2): 3-16.
9. ———. 1933-1963. Flora Hawaiiensis or new illustrated flora of the Hawaiian Islands, 6 vols. (vol. 7, 1963). Privately published, Honolulu. n.p.
10. Ellis, William. 1963. Journal of William Ellis, narrative of a tour of Hawaii, or Owhyhee; with remarks on the history, traditions, manners, customs and language of the inhabitants of the Sandwich Islands. (Reprint of the London 1827 ed. and the Hawaii 1917 ed.) Advertiser Pub. Co. xii + 342 p.
11. Fosberg, F. R. 1939. *Diospyros ferrea* (*Ebenaceae*) in Hawaii. B. P. Bishop Mus. Occ. Pap. **15:** 119-131.
12. ———. 1942. Uses of Hawaiian ferns. Amer. Fern. J. **32:** 15-23.
13. ———. 1948. Derivation of the flora of the Hawaiian Islands. *In* Zimmerman, Elwood C. Insects of Hawaii **1:** 107-119. Univ. Hawaii Press, Honolulu.
14. Handy, E.S. Craighill, Kenneth P. Emory, Edwin H. Bryan, Peter H. Buck, et al. (Helen Pratt, editor). 1965. Ancient Hawaiian civilization, a series of lectures delivered at The Kamehameha Schools. rev. ed. Chas. E. Tuttle Co., Tokyo. 333 p.
15. Handy, E. S. Craighill. 1940. The Hawaiian planter, volume I, his plants, methods and areas of cultivation. B. P. Bishop Mus. Bull. 161. 227 p.
16. Hillebrand, William. 1888. Flora of the Hawaiian Islands, a description of the phanerogams and vascular cryptogams. Carl Winter, Heidelberg (1965 reprint edition, Hafner Co., New York). xcvi + 673 p.
17. Hochreutiner, B. P. G. 1912, 1925, and 1934. Plantae Hochreutineranae: Etude systématique et biologique des collections faites par l'auteur au cours de son voyage aux Indes Néerlandaises et autour du monde pendant les années 1903 a 1905. Fasc. I: Ann. Conserv. Jard. Bot., Genève **XV/XVI:** 145-247 (1912); Fasc. II: Candollea **II:** 317-513 (1925); Fasc. III: Candollea **V:** 175-341 (1934).
18. Kaaiakamanu, D. M., and J. K. Akina. 1922. Hawaiian herbs of medicinal value, found among the mountains and elsewhere in the Hawaiian Islands, and known to the Hawaiians to possess curative and palliative properties most effective in removing physical ailments. Terr. Hawaii, Bd. Health, Honolulu. 77 p.
19. MacCaughey, Vaughan. 1917. The food plants of the ancient Hawaiians. Sci. Mo. **4:** 75-80.
20. ———. 1919. The pala or mule's-foot fern, *Marattia Douglasii* (Presl) Baker, in the Hawaiian archipelago. Torreya **19:** 1-8.
21. Magnusson, A. H. 1955. A catalogue of the Hawaiian lichens. Ark. Bot., ser. 2, band **3**(10): 223-402.
22. Malo, David. 1951. Hawaiian antiquities (Moolelo Hawaii), 2nd ed. B. P. Bishop Mus. Spec. Pub. 2. xxii + 278 p.
23. Neal, Marie C. 1965. In gardens of Hawaii. Rev. ed., B. P. Bishop Mus. Spec. Pub. 50. xix + 924 p.

24. Pukui, Mary Kawena, and Samuel H. Elbert. 1965. Hawaiian-English Dictionary. 3rd ed., Univ. Hawaii Press, Honolulu. xxxii + 370 p.
25. ———. 1964. English-Hawaiian Dictionary. Univ. Hawaii Press, Honolulu. xii + 188 p.
26. Ripperton, J. C. 1924. The Hawaiian tree fern as a commercial source of starch. Hawaii Agr. Exp. Sta. Bull. 53. U. S. Government Printing Office, Washington, D. C. 16 p.
27. ———, and E. Y. Hosaka. 1942. Vegetation zones of Hawaii. Hawaii Agr. Exp. Sta. Bull. 89. 60 p.
28. Robinson, W. J. 1912-14. A taxonomic study of the *Pteridophyta* of the Hawaiian Islands. Bull. Torr. Bot. Club. **39:** 227-248 (1912); **40:** 193-228 (1913); **41:** 51-59 (1914).
29. Rock, Joseph F. 1913a. List of Hawaiian names of plants. Terr. Hawaii, Bd. Agr. & Forest., Bot. Bull. 2. 20 p.
30. ———. 1913b. The indigenous trees of the Hawaiian Islands. Privately printed, Honolulu. iv + 518 p.
31. ———. **1919.** A monographic study of the Hawaiian species of the tribe *Lobelioideae*, family *Campanulaceae*. B. P. Bishop Mus. Mem. VII. xvi + 394 p.
32. St. John, Harold. 1966. Monograph of *Cyrtandra* (*Gesneriaceae*) on Oahu, Hawaiian Islands. B. P. Bishop Mus. Bull. 229. 465 p.
33. Selling, Olof H. 1946. Studies in Hawaiian pollen statistics. Part I. The spores of the Hawaiian Pteridophytes. B. P. Bishop Mus. Spec. Pub. 37. 87 p.
34. ———. 1947. Studies in Hawaiian pollen statistics. Part II. The pollens of the Hawaiian phanerogams. B. P. Bishop Mus. Spec. Pub. 38. 430 p.
35. Skottesberg, C. 1927. *Artemisia, Scaevola, Santalum*, and *Vaccinium* of Hawaii. B. P. Bishop Mus. Bull. 43. 89 p.
36. Sparrow, F. K. 1965. The occurrence of *Physoderma* in Hawaii, with notes on other Hawaiian Phycomycetes. Mycopath. Mycol. Appl. **25:** 119-143.
37. Wagner, Warren H., Jr. 1963. Pteridology in Hawaii. Hawaiian Bot. Soc. Newsletter **II:** 117-123.
38. Whitney, Leo D., F. A. I. Bowers, and M. Takahashi. 1939. Taro varieties in Hawaii. Hawaii Agr. Exp. Sta. Bull. 84. 86 p.