

A Taxonomic Study of the Genus *Eugenia* (Myrtaceae) in Hawaii¹

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THE PANTROPIC GENUS *Eugenia* (Myrtaceae) is represented in the forests of Hawaii by several species. A recent taxonomic treatment of the genus by Merrill and Perry (1939) divided the greater number of species of *Eugenia* into the genera *Syzygium* and *Eugenia* sensu strictu. A later study by Henderson (1947), based on the Malayan species, rejected this classification.

According to the Merrill and Perry classification, both *Syzygium* and *Eugenia* sensu strictu are present in the Hawaiian flora. Therefore, it seemed that an evaluation of the recent generic treatments based on these representatives would be of value. My study of the generic status of *Eugenia* and *Syzygium* led to the question of the specific status of the indigenous Hawaiian members. As a result of my investigations I have rejected the transfer of species of *Eugenia* to *Syzygium*, described a new species from the island of Molokai, and reduced two species and one variety to synonymy.

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HISTORY OF THE GENUS

Since Linnaeus' treatment of *Eugenia* in *Species Plantarum* (1753: 470), more than 800 species have been described or transferred to this genus. Many botanists have been dissatisfied with the wide range of difference in form shown by the members of the genus.

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One of the most comprehensive reclassifications of *Eugenia* was proposed by Niedenzu (1893). He established several segregate genera which were based mainly on the characters of the flower. His system was adopted by many workers, but, because of the lack of distinct generic limits, many other botanists continued to consider *Eugenia* in a broader sense. Later studies of the members of the group led more and more botanists to reject Niedenzu's classification and to return the segregated genera to *Eugenia*.

Because of the great number of species described in *Eugenia* the group has become rather unwieldy, and Merrill and Perry (1938a, 1938b, 1939) proposed a new systematic treatment of the group. They redefined some of the earlier proposed segregates of the genus. The new systematic treatment which they proposed is based on the structure of the seed. According to them, species of *Eugenia* are diagnosed as having a pericarp which is easily crushed and "the seed is free, the testa is smooth, chartaceous to cartilaginous and mostly lustrous, and the cotyledons are mechanically inseparable, i.e., they have grown together in such a way that often the line of their opposing faces is scarcely distinguishable." *Syzygium*, one of the segregate genera, is described as having "fruits that when dried are not too easily broken, and, when opened, the embryo (not the entire seed) falls out leaving the roughish seed coat more or less loosely adhering to the pericarp; the embryo has two distinct cotyledons usually attached near the middle of the opposing faces which conceal the hypocotyl within."

In a monograph of the species of *Eugenia* in Malaya, R. M. Henderson (1949) critically analyzed Merrill and Perry's classification. Henderson, in his study, decided that neither the degree of adherence of the seed coat to the cotyledon, nor the nature of the cotyledons themselves is consistent enough to be regarded as a good generic character. In fact, he gives detailed descriptions of the seeds of several different species which illustrate an

intergrading series from those with two distinct and separate cotyledons to those with the cotyledons completely fused. On the basis of these observations he rejects the transfer of species from *Eugenia* to *Syzygium*.

In 1953 Ingle and Dadswell published the results of their studies of the wood anatomy of several Pacific Myrtaceae.³ They concluded that the anatomy of the wood of *Eugenia* provides ample characters for splitting the genus. They added that the "suggested split on anatomical grounds involved only the two groups *Eugenia A* [corresponding to *Eugenia sensu stricto*] and *Eugenia B* [including the genera *Acmena*, *Cleistocalyx* and *Syzygium*]."⁴

The most recent treatments of the genus have been inconsistent. By far the majority of workers (Airy Shaw, 1949; Backer, 1945; Degener and Ludwig, 1952) have accepted Merrill and Perry's classification without any apparent critical study. A few botanists (White, 1945; Amshoff, 1942), seemingly in doubt as to the validity of this system, have hesitated to adopt it.

EVALUATION OF THE RECENT GENERIC TREATMENTS

The Hawaiian flora, although predominantly Asiatic in its affinities, includes representatives of the tropical regions of both the Old World and the New World. Because of the uniqueness of the Island flora in this respect, the Hawaiian Islands may be considered an ideal region for evaluating the recent treatment of *Eugenia*.

The two most important features used by Merrill and Perry in segregating the genera are: (1) the nature of the embryo, and (2) the degree of adherence of the testa to the cotyledons. On the basis of these characters

³ See also Dadswell and Ingle, 1947.

⁴ Since this paper went to press Kathleen M. Pike published the results of her studies in the pollen morphology of the Myrtaceae. (*Austral. Jour. Bot.* 4(1): 13-53, 1 pl., 1956.) She found that the pollen grains of "*Eugenia A*" are distinct from those of "*Eugenia B*" and thereby adds support to the groupings of Ingle and Dadswell based on the wood anatomy.

Merrill and Perry (1938*a*, 1938*b*, 1939), in studies of Indo-Chinese, Chinese, and Bornean species of *Eugenia*, redefined the group, placing most of the species of those regions in the genus *Syzygium*. Geographically, their new concept limits *Eugenia* mainly to tropical America, and *Syzygium* primarily to the tropics of the Old World.

The genus *Eugenia* in the Hawaiian Islands is represented by eight species as I interpret them. In my opinion, according to the Merrill and Perry system, four of the Hawaiian representatives of *Eugenia* would be classified in the segregate genus *Syzygium*, while four would fall in *Eugenia* *sensu stricto*.

Eugenia malaccensis and *E. Jambos* have fruits which contain a rather large seed loosely attached within the pericarp. In both species the embryo has two distinct, fleshy cotyledons. The surface of the cotyledons is very rugose and the thick seed coat adheres firmly to it. Young seedlings of *E. malaccensis* were found growing which had the two cotyledons still attached. The pericarp had rotted away and no evidence of it could be seen, but on the surfaces of the cotyledons remains of the seed coat were still present.

In fruits of *Eugenia Cumini* the fleshy pericarp peels off, leaving the seed coat firmly adhering to the cotyledons. The cotyledons are fleshy and distinct. In dried, raw fruits the seed coat readily peels off with the pericarp. However, when boiled, the pericarp may be easily removed without disturbing the seed coat.

Upon removal of the pericarp the testa of *Eugenia sandwicensis* also remains attached to the cotyledons. The two fleshy cotyledons are not consolidated. In boiled dried material, depending on the amount of care given it, the pericarp may or may not peel away from the seed coat.

The seeds of *Eugenia rariflora* and *E. koolauensis* have their cotyledons plainly separated, partly fused, or entirely consolidated. When the cotyledons are consolidated the line of their opposing faces is not evident. In both

dried and fresh fruits the thin seed coat peels off with the pericarp.

On the basis of the studies I have made, it seems evident that neither the character of the seed coat nor that of the embryo offers a satisfactory basis for the reclassification of the group. Neither one of the characters is constant. The degree of fusion of the cotyledons varies even within a single species.

The conclusions I have drawn on the basis of investigations of the Hawaiian representatives of *Eugenia* strongly support Henderson's rejection of the segregation of species of *Eugenia* into the genera *Syzygium* and *Eugenia* *sensu stricto*.

No attempt was made to study the wood anatomy of the Hawaiian species of *Eugenia*. In view of Ingle and Dadswell's findings (1953) I suggest that additional more extensive investigations may reveal other morphological characters to support their conclusions. The characters of the seed, since they are so variable, do not justify the split.

VARIATION AND DISTRIBUTION OF THE SPECIES IN HAWAII

The genus is represented in Hawaii by only four indigenous species, three of which are endemic. Of these four, *Eugenia rariflora* and *E. sandwicensis* show the greatest degree of variation within the entire group. Both show variations in leaf size ranging from very small to rather large.

The greatest degree of variation is seen in *Eugenia sandwicensis*. The forms of *E. sandwicensis* with the larger leaves are found most often on Kauai; the forms with elliptical and elliptical-lanceolate leaves are more prevalent on Maui, and most of the Oahu representatives have the smaller obovate leaves. On Lanai the majority of the representatives of this species have small obovate leaves similar to those of the most common forms on Oahu. Most of the members on Molokai have leaves which resemble the forms on Maui, although in general they are not as long. It is possible

for a person who is familiar with the species to determine, in the majority of cases, from which one of the islands a specimen was collected. However, this broad generalization of geographical distribution is not constant, and almost all forms are present on each of the islands where the species occurs.

Of the naturalized species *Eugenia Cumini* is by far the most widely distributed. *E. malaccensis* is confined mostly to shaded, moist valleys where it is likely they were planted originally by the Hawaiians. Both *Eugenia Jambos* and *E. uniflora* are only sparsely distributed in the native forests.

These introduced species are remarkably constant in their characters and show no significant degree of variation.

EXPLANATIONS

Unless otherwise indicated, the specimens studied are in the Bernice P. Bishop Museum. The standard abbreviations of Lanjouw and Stafleu (1954) are used to indicate the locations of the other specimens:

- BISH—Bernice P. Bishop Museum,
Honolulu
GH—Gray Herbarium, Cambridge
K—Royal Botanical Gardens, Kew
M—Botanische Staatssammlung,
München
MICH—University of Michigan, Ann Arbor
NY—New York Botanical Gardens,
New York
US—United States National Herbarium,
Washington

I have examined the following numbers of fruits and seeds of the species included in this problem. When possible both fresh and dried material was studied.

	<i>Fresh</i>	<i>Dried</i>
<i>Eugenia malaccensis</i>	15	3
<i>E. Jambos</i>	—	5
<i>E. sandwicensis</i>	100	60
<i>E. Cumini</i>	50	20
<i>E. uniflora</i>	10	5
<i>E. rariflora</i>	—	15
<i>E. koolauensis</i>	20	10

TAXONOMY

Eugenia L., Sp. Pl. 470, 1753.

Syzygium Gaertn., Fruct. 1: 166, t. 33, 1788.
Jambosa DC., Prodr. 3: 286, 1828.

Trees or shrubs. Shoots glabrous or pubescent. Leaves simple, opposite, glandular-punctate, pinnately veined with a continuous intramarginal vein. Leaf scar with a single vascular bundle. Flowers single or in pairs, axillary, or in terminal, or axillary cymes or racemes, or inflorescence on leafless branches. Calyx tube⁵ globose to elongate-turbinate, extending beyond the ovary or not so, usually minutely glandular-punctate; calyx lobes 4, large persistent and spreading, or small and early deciduous; petals 4, free and spreading persistent or caducous, or cohering and falling off as a calyptra; stamens numerous, free on a staminal disk lining the calyx tube or inserted on the margin of the calyx tube; anthers versatile, cells splitting longitudinally, connective gland present; style filiform, stigma small; ovary inferior, 2-celled. Fruit a berry with only 1 seed (rarely 2) developing from the many ovules, crowned by the persistent calyx lobes or by the truncate scars of the calyx lobes; umbilicus sometimes present; seeds large with a thin membranaceous or a thick cartilaginous or fibrous seed coat; cotyledons thick, fleshy, completely free or partly or entirely fused.

Type species: *Eugenia uniflora* L.

KEY TO THE SPECIES IN HAWAII

- A. Flowers in cymes or racemes; calyx tube extending beyond the ovary.
B. Calyx tube 10–30 mm. long.
C. Inflorescence axillary from older leafless nodes or rarely from leafy

⁵ "Calyx tube" is used here, as is customary in treatments of the genus, to refer to the inferior ovary and especially to the tissues adhering to it. There is no intention to imply the exact morphological nature of the inferior ovary of *Eugenia* by the use of this term. The origin of the inferior ovary in this genus has not as yet been satisfactorily determined.

nodes; petals not reflexing at anthesis; stamens 1–2 cm. long; leaves 5–9 cm. wide, elliptical to obovate-oblong. 1. **E. malaccensis**

C. Inflorescence terminal; petals reflexing at anthesis; stamens 2–5 cm. long; leaves 2.5–5 cm. wide, linear-lanceolate. 2. **E. Jambos**

B. Calyx tube 3–8 mm. long.

D. Stamens 20–30, included in the calyx tube, inflexed, 0.5–1.5 mm. long; fruit pink to deep red. 3. **E. sandwicensis**

D. Stamens more than 50, exserted, spreading, 3–7 mm. long; fruit dark purple or black. 4. **E. Cumini**

A. Flowers single or in pairs, axillary; calyx tube not extending beyond the ovary.

E. Fruits longitudinally 8-ribbed; calyx lobes membranaceous. 5. **E. uniflora**

E. Fruits not ribbed; calyx lobes fleshy.

F. Leaves flat or slightly concave, glabrous beneath or only sparingly puberulent near midrib. 6. **E. rariflora**

F. Leaves strongly concave and with the entire lower surface puberulent.

G. Fruit orange-yellow; flowers with punctiform pistil. 7. **E. koolauensis**

G. Fruit red; flowers with peltate pistil. 8. **E. molokaiana**

verse; leafy branches brown, glabrous, 3–5 mm. in diameter, angled or terete; internodes 1.5–6 cm. long; leaves 14–25 cm. long, 5–9 cm. wide, elliptical to obovate-oblong, apex abruptly acute or obtuse, base cuneate to abruptly cuneate; margin entire or slightly undulate; blade coriaceous, above glabrous, shiny, dark green, sparsely black punctate, below pale, glabrous, minutely black punctate; midrib light green, shallowly impressed above, elevated below; primary lateral veins alternate or opposite, 8–14 on a side 1–2.5 cm. apart, irregularly ascending at 140–150°, meeting in a conspicuously sinuate, continuous intramarginal vein 0.5–1.5 cm. from leaf margin, smaller, continuous intramarginal vein 1–2 mm. from leaf margin, irregularly lobed, raised or impressed above, elevated below; the veinlets less distinct, raised-reticulate; petioles 1–1.5 cm. long, 3–4 mm. wide, reddish-green, glabrous; cymes axillary or on stems below leaves 2–5 cm. long; peduncle 5–10 mm. long, angled or terete, glabrous, reddish-green, pedicels when present, 2–8 mm. long, glabrous, reddish-green, articulate, but some flowers sessile; calyx tube green to reddish-green, 1–3 cm. long, 1–1.5 cm. wide, obconic, elevated above ovary, narrowing into a short pseudostalk 0.5–1.0 cm. long, subtended by 2 deltoid bracts 1–1.5 mm. long; calyx lobes 4, persistent, broad, rounded, 2–3 cm. long, 6–8 cm. wide, green; petals 4, spreading, obovate-orbicular, pink to red, glabrous, deciduous, glandular-punctate, 6–9 mm. long, 7–10 mm. wide, apex rounded or acuminate, base truncate; stamens numerous (about 100), exserted, 1.0–2.0 cm. long; filament slender, red, glabrous, terete above, flattened below; anthers white 9–12 mm. long, oblong; style red, subulate, 1.5–2 cm. long, glabrous; ovary 2-celled multi-ovulate; fruit obovoid 5–7.5 cm. long, 4–6 cm. in diameter, pinkish to dark red, umbilicate on top, crowned with truncate scars of the calyx lobes or calyx lobes persisting;

1. *Eugenia malaccensis* L., Sp. Pl. 470, 1753.

Jambosa malaccensis (L.) DC., Prodr. 3: 286, 1828.

Syzygium malaccense (L.) Merr. and Perr., Arnold Arboretum, Jour. 19: 215, 1938.

Tree 8–20 m. tall; branches greyish-brown, smooth, glabrous; leaf scars 3–6 mm. wide, lunate-elliptic, pale; bundle scar large, trans-

pericarp crisp, watery, 1.0–2.0 cm. thick; seed loosely attached within, subglobose, 1.5–2.0 cm. in diameter; seed coat fibrous, brown, 1 mm. thick, adhering closely to the rugose surface of the cotyledons; cotyledons 2, white or greenish, equal or unequal, not fused.

Common name: "Ohia ai," Mountain Apple.

DISTRIBUTION: Common in the moist gulches on the larger islands. Native to the Indo-Malayan region, it may now be found in cultivation, widely distributed in the tropics of the world.

Specimens examined:

HAWAIIAN ISLANDS: *Hillebrand and Lydgate*; *Mann and Brigham* 119; *U. S. Explor. Exped.* (NY).

KAUAI: Waioli Valley, along stream, alt. 100 m., Feb. 27, 1927, *MacDaniels* 909.

OAHU: Punaluu, stream bank, elev. 800 ft., Sept. 28, 1930, *St. John* 10,581 (NY); Punaluu Valley, in dark forest in wet ground at bottom of Pig God trail, Sept. 2, 1932, *Degener* 7,349; Waikane-Schofield trail, side of trail, 1000 ft. alt., Dec. 2, 1951, *Wilson* 46; Koolauloa, Kaluanui, Sacred Falls Valley 700 ft. alt., May 18, 1952, *Wilson and Doty* 137, 138, 139, and 141; Kipapa Gulch, frequent at bottom of gulch, in "koa zone," *Egler* 37–421; Kalihi Valley, Jan. 1, 1920, *Garber* 97; Moanalua Valley, March 7, 1910, *Forbes* 1465.0; Kaumokunui Gulch, rich dark wet gulch at 1500 ft., April 13, 1936, *Degener* 11,887 (NY, MICH); Waianae Mts.: Makaleha Valley, Jan. 14, 1929, *Neal*; Puu Kaupakuhale, 2nd gulch of N.E. slope of Puu Kaala, in wood, May 14, 1933, *St. John* 13,173.

MOLOKAI: Mapulehu, April 1910, *Rock*.

MAUI: Kailua, Haleakala, April 1911, *Rock*.

HAWAII: Hilo, May 1909, *Faurie*.

Eugenia malaccensis was most likely introduced into the Hawaiian Islands by the Polynesians. It may be found growing in large groves in moist, shaded valleys where it was probably originally planted and has subsequently become established.

2. *Eugenia Jambos* L., Sp. Pl. 470, 1753.

Jambosa Jambos (L.) Millsp., Field Mus. Nat. Hist., Bot. Ser. 2(1): 80, 1900.

Syzygium Jambos (L.) Alston, in Trimen, Fl. Ceyl. 6 (Suppl.): 115, 1931.

Tree 6–10 m. tall; branches brown to yellowish-brown, glabrate, longitudinally ridged; leaf scars rounded shield-shaped, 2.5–4 mm. wide, pale; stems of leafy branches 3–4 mm. in diameter, 4-angled or compressed, becoming terete in age, glabrous; internodes 1.5–3 cm. long; leaves 10–20 cm. long, 2.5–5 cm. wide, lanceolate or oblong-lanceolate, tapering to an acuminate apex, base cuneate; margin entire; blade coriaceous, above olive-green to reddish-green, glabrous, shiny, minutely pustulate, below paler, glabrous, minutely glandular-punctate; midrib shallowly impressed above, elevated below, light yellowish-green to reddish-green; primary lateral veins alternate or opposite, 10–15 on a side, 5–15 mm. apart, slightly elevated above, very prominent below, straight or slightly curved ascending at 140–150°, meeting in an irregularly lobed continuous intramarginal vein 3–5 mm. from leaf margin; the veinlets obscure above, distinctly raised-reticulate below; petiole 5–10 mm. long, 2–3 mm. wide, glabrous, dark reddish-green; racemes terminal, 6–10 mm. long, rachis 6–15 mm. long, 3–4 mm. wide, 4-angled brownish-green to reddish-green, glabrous; pedicels 7–15 mm. long, flower single on the pedicels, 3–6 cm. long, 6–8 cm. in diameter; calyx tube obconic, 1–1.5 cm. long, 7–10 mm. wide, elevated above ovary, narrowed into a short pseudostalk, glabrous or sparsely puberulous, minutely glandular-punctate, green or yellow-green, subtended by 2 caducous, glabrate, subulate bracts 0.8–1.0 mm. long; calyx lobes 4, persistent, fleshy, unequal, 1 pair 6–8 mm. long and 8–9 mm. wide, the smaller pair 4–6 mm. long, 8–9 mm. wide, below minutely glandular-punctate, glabrous or sparsely puberulous; petals 4, white to greenish-white, orbicular to ovate-orbicular, concave, spread-

ing, glandular-punctate, 1–1.7 mm. in diameter, glabrous; stamens numerous (about 200), creamy-white, 1–5 cm. long; filament slender, terete, creamy-white, glabrous; anthers white, oblong, 1–2 mm. long; style terete, subulate, 3–4 cm. long, glabrous, creamy-white to greenish-white, exerted or included; fruit subglobose, 2–4 cm. tall, 4–6 cm. wide, yellow or pinkish-yellow, minutely glandular-punctate, umbilicate on top, crowned by persistent calyx lobes, style often persistent; pericarp fleshy, 1–1.5 cm. thick; seed loosely attached within, subglobose, 2–2.5 cm. in diameter; seed coat 1 mm. thick, brown, coriaceous, closely adhering to the surface of the cotyledons; cotyledons white or greenish-white, equal or unequal, not fused.

Common name: "Ohia loke," Rose Apple.

DISTRIBUTION: Sparingly naturalized on probably all of the larger islands of Hawaii. Widely distributed in the tropics of the world.

Specimens examined:

KAUAI: Kokee Camp, becoming naturalized, July 5, 1926, *Degener 7,341* (NY); Waioli Valley, along stream, alt. 50 m., Feb. 27, 1927, *MacDaniels 908*.

OAHU: Waikane-Schofield trail, Waikane, 750 ft. alt., side of road, Dec. 2, 1951, *Wilson 45*; Waiahole, Jan. 23, 1909, *Rock 1,285 and 1,287*; Manoa, near Woodlawn, spreading locally, Apr. 1937, *Egler 37-423*.

MAUI: Iao Valley, Wailuku, roadside, elev. 800 ft., Feb. 9, 1930, *St. John 10,277* (BISH, NY).

HAWAII: Naturalized, *Degener 7,344*; South Kona, Honomalina, Ranch House, near Kona highway, 1800 ft. alt., Sept. 7, 1952, *Chock 768*; near Glenwood, naturalized in pasture, June 23, 1929, *Degener 7,343* (NY).

Degener (1932–34) records that *Eugenia Jambos* was probably first introduced into Hilo from Rio de Janeiro by Mr. Bridge in 1853. It may now be found growing along road and trail sides and in other moist areas. Although Degener also records it as "def-

initely known from Kauai, Molokai, Oahu, Maui and Hawaii," no specimens of it were seen from Molokai.

3. *Eugenia sandwicensis* Gray, U. S. Explor. Exped. Bot. (official ed.) 519, 1854.

Syzygium sandwicense (Gray) Ndz., in Engl. and Prantl Pflzfam. 3(7): 85, 1893.

Eugenia sandwicensis var. *parvifolia* Hdb., Fl. Hawaii. Is. 129, 1888.

Syzygium oahuense Deg. and Ludw., Bot. Staatsaml. München, Mitt. 4: 113, 1952.

Tree or shrub, 3–25 m. tall; branches greyish-brown to reddish-brown, glabrous; leaf scars 1–4 mm. wide, rounded, shield-shaped, reddish-brown to yellowish-brown; young leafy branches green to reddish-green, glabrous, 1–4 mm. in diameter, distinctly 4-angled, angles winged; wings 0.2–2.0 mm. wide, branchlets becoming terete with age, dark red to reddish-brown bark scaling off in longitudinal strips exposing yellow-grey to reddish-yellow bark beneath; internodes 1–5 cm. long; leaves 2–14 cm. long, 1.5–5.0 cm. wide, obovate, ovate, elliptic or ovate-lanceolate, apex acute, obtuse, retuse, or apiculate, base truncate to cuneate, blade coriaceous, flattened or concave, margin entire, slightly revolute (rarely strongly so), above dark green or yellowish-green, shiny, glabrous, minutely glandular-punctate, below paler, dull, glabrous, minutely glandular-punctate, midrib pink to dark red, shallowly impressed above, elevated below; primary lateral veins alternate or opposite, 15–30 on a side, 2–8 mm. apart, irregularly ascending at 100–115°, meeting in an irregularly lobed intramarginal vein 0.5–1.5 mm. from leaf margin, raised on both surfaces but more distinct below; the veinlets raised-reticulate; petioles 2–10 mm. long, 1–2 mm. wide, reddish-brown, glabrous, cymes simple or compound, in axils of upper leaves, 5–8 cm. long; peduncle 2.5–3.5 cm. long, 1.5–3 mm. wide, 4-angled, winged, yellow-green to reddish-green, pedicels 2–4 mm. long, articulate; calyx tube turbinate, 3–4

mm. long, 3.5–5 mm. wide, glabrous, reddish-green to yellow-green, minutely glandular-punctate, subtended by two deciduous, glabrous, deltoid bracts 1–2 mm. long; the 4 calyx lobes 0.5 mm. long, imbricate, obtuse, reddish-green to dark red, early deciduous; petals 4, white to greenish-white, spreading, soon deciduous, usually discrete but sometimes united and falling off as a calyptra, ovate or obovate, often emarginate, glabrous, glandular-punctate, apex subacute or obtuse, base truncate, 2–3 mm. long, 2–3 mm. wide; stamens (about 30) inserted on the margin of the calyx tube, 0.5–1.5 mm. long, introrse, included; filaments white to pinkish, subulate, glabrous; anthers white 0.4–0.8 mm. long, orbicular-ovate; pistil white to reddish, glabrous, slender, 0.8–1.5 mm. long, included; ovules 4–10 in a cell; fruit light pink to dark red, 4–10 mm. high, 5–10 mm. wide, glabrous, shiny, minutely glandular-punctate, globose or elliptic, flattened on top, crowned by truncate scars of the calyx lobes; pericarp fleshy, 1–1.5 mm. thick; seed globose, elliptic or oblong-elliptic; seed coat reddish-brown, 0.5 mm. thick, loosely adhering to the pericarp, closely adhering to the smooth surface of the cotyledons; cotyledons equal, greenish or white, conspicuously glandular-punctate, not fused.

Type: U. S. Explor. Exped. "Oahu, Sandwich Islands; on the mountains behind Honolulu" (US).

Common name: "Ohia ha," known on Maui as "Paihi."

DISTRIBUTION: Endemic to the Hawaiian Islands. Found in the moist forests on Kauai, Oahu, Molokai, Lanai, and Maui; not known from the island of Hawaii.

Specimens examined:

KAUAI: Waimea, Alakai Swamp trail, 3800 ft. alt., rain forest, Dec. 25, 1952, *Wilson* 206; on Kaholuamanu above Waimea, Sept. 2–9, 1895, *Heller* 2,241; Kaholuamanu to Waimea, Oct. 27, 1916, *Hitchcock* 15,558 (US); near Kaholuamanu, Kauluwehi Swamp, Oct. 25, 1916, *Hitchcock* 15,520 (US); Wahiawa Mts.,

Lydgate; Wahiawa Mts., August 1909, *Forbes* 181.K; Wahiawa, Kahili Swamp, 2100 ft. alt., Lihue-Koloa Forest Reserve, Dec. 29, 1930, *St. John et al.* 10,850; Koloa, Laaukahi ridge, $\frac{3}{4}$ mile north of N.W. facing slope, 850 ft. alt., moist wooded gulch, Dec. 24, 1947, *St. John, Webster and Wilbur* 23,007; Laaukahi, Haiku, 1300 ft. alt., dense woods on precipitous slope, Dec. 22, 1933, *St. John and Fosberg* 13,486; Ka Loko Reservoir (Kilauea), Oct. 8, 1916, *Forbes* 544.K; E. fork of Kilauea River, rain forest, alt. 400 m., Feb. 11, 1927, *MacDaniels* 654; Wainiha, Wainiha Valley, moist lower forest, 800 ft. alt., Jan. 1, 1934, *St. John and Fosberg* 13,929; Wainiha, Wainiha Valley, 1000 ft. alt., on bank, side of road, in native forest, Dec. 31, 1952, *Wilson* 235; Hanakapiai, Napali Coast, forest on cliff, Jan. 2, 1931, *St. John et al.* 10,992; Hanakoa, Waiahuakua Stream, 350 ft. alt., Dec. 31, 1952, *Wilson and St. John* 238; Hii Mts., Oct. 22, 1916, *Forbes* 652.K.

OAHU: No locality: *Mann and Brigham* 204; *Hillebrand* (received July 1865) 311 (GH) (locality illegible, probably Oahu); *U. S. Explor. Exped.* (US). Koolau Mts.: Kahuku Army trail, July 1930, *Russ*; Hauula, Kaipapau Forest Reserve, Maakua-Papali ridge, wooded ridge, 1200 ft. alt., *St. John* 13,372; Kahana Valley, head of, Hauula Forest Reserve, 1000 ft. alt., lower woods, Dec. 10, 1933, *St. John* 13,410; Kahana Valley (south side of), ridge mauka of church, dense forest at 1500 ft., Nov. 5, 1950, *Degener and Silva* 21,069 (US); Kahana Valley, head of, 1500 ft. alt., Aug. 31, 1924, *Harris*; Kaipapau on S. slope of ridge, 2500 ft. alt., Oct. 15, 1933, *Suehiro*; Punaluu, Dec. 3–4, 1908, *Rock* 632 and 687 (GH), and 526; Punaluu, Dec. 24–29, 1908, *Rock* 377 (GH); Punaluu, Dec. 3, 1908, *Rock* 149 (GH); Punaluu, wet mountain side, Nov. 30, 1929, *Tanaka*; Punaluu to Kaipapau, May 8–13, 1909, *Forbes*; Punaluu to Kaipapau, May 3–8, 1909, *Forbes and Cooke*, and *Forbes and Thompson*; Punaluu to Kaipapau, Nov. 14–21, 1908, *Forbes*; Kahana, Kaluanui, open woods, 2000 ft. alt., Nov. 30, 1929, *St. John*

10,099 (US); Waikane-Schofield trail, Waikane, 750–1250 ft. alt., Oct. 16, 1932, *Krauss*; Waikane-Schofield trail, near summit, 2000–3000 ft. alt., Sept. 16, 1932, *Yuncker* 3,186 (US); Waikane-Schofield trail, 2200 ft. alt., Dec. 2, 1951, *Wilson* 44; north ridge of Kaaawa Valley, April 12, 1931, *St. John* 11,085; Heeia, Haiku Valley, Waiahole Forest Reserve, 500 ft. alt., in *Dicranopteris* thicket on ridge, Dec. 11, 1932, *St. John* 12,260; Kona-huanui, Jan. 16, 1909, *Forbes* 1,040; Kona-huanui—*Forbes* 1,003, and 1,309, *Bryan* 208, *MacDaniels* 124, and *Heller* 2,241 (US, MICH); Pupukea Military trail, Jan. 29, 1927, *MacDaniels* 549; Waimea-Malaekahana, 1900 ft. alt., March 22, 1953, *Ozaki* 391, 392, 390, and 389; Paalaa, South Opaulea Gulch, Nov. 9, 1930, *St. John* 10,630; Waipio, Kipapa Gulch, wet high mountain ridge, Nov. 10, 1929, *Tanaka*; Waipio, Kipapa Gulch, E. of Puu Kamana, wooded ridge, 1700 ft. alt., May 15, 1932, *St. John* 11,683; Waipio, Kipapa Gulch, south ridge, wooded slope, 1300 ft. alt., Nov. 10, 1929, *St. John* 10,037; Waipio, Kipapa Gulch, south ridge, 1400 ft. alt., woods, Oct. 29, 1929, *St. John* 9,965; Kawailoa, Kawaiiki Ditch trail, alt. 1340–1000 ft., Nov. 2, 1947, *Wilbur* 257 (US); Kawailoa, Kawaiiki Ditch trail, moist *Metrosideros* forest, 1050 ft. alt., Jan. 17, 1953, *St. John* 24,973; Kawailoa, Kawaiiki Ditch trail, Aug. 15, 1922, *Skottsberg* 230; Kawailoa trail, rain forest, Oct. 31, 1937, *Hartt*; Kalauao ridge, Ewa Forest Reserve, moist woods, March 29, 1933, *St. John* 13,028; Halawa ridge trail, in moist forest, April 25, 1948, *Cowan* 973; *mauka* of Red Hill, in forest, Oct. 9, 1932, *Degener* 7,328 (US, MICH); Kalihi-Nuuanu ridge, alt. 550 m., Jan. 23, 1927, *MacDaniels* 156; Kalihi-Nuuanu, Puu Lanihuli, main ridge running S.W. from Kalihi-Nuuanu, wooded ridge, 1600 ft. alt., Nov. 29, 1931, *St. John* 11,176; Kalihi-Nuuanu, Lanihuli trail, Sept. 17, 1908, *Forbes*; Lanihuli trail, Nov. 14, 1908, *Forbes*; Lanihuli trail, Dec. 10, 1908, *Forbes*; Nuuanu-Kalihi ridge, Aug. 13, 1922, *Skottsberg* 156; slope *mauka* from Tantalus, alt. 600 m., Nov.

1, 1926, *MacDaniels* 98; Pauoa, Konahuanui trail, Feb. 15, 1921, *Garber* 229; Pauoa flats, 1926, *Skottsberg* 1,783; Manoa, slopes back of Woodlawn, on crest of ridge, alt. 1000 ft., Dec. 31, 1942, *Kuykendall* 49; Olympus trail, alt. 700 m., Dec. 21, 1926, *MacDaniels* 125; Palolo-Manoa ridge, alt. 350 m., Dec. 21, 1926, *MacDaniels* 122; Palolo Valley, near first falls of Palolo, Nov. 16, 1919, *Garber* 70; Palolo Valley, Oct. 22, 1914, *Forbes* 1929.0; ridge between Palolo and Waialae-iki, Jan. 30, 1917, *Forbes* 2411.0; Palolo-Waialae ridge, Jan. 27, 1927, *MacDaniels* 484 and 487; Wiliwilinui ridge, 1600 ft. alt., March 16, 1952, *Wilson* 106, 108, 111, 113, 115, 116, 117, 118, 119, and 120; Niu Valley, summit ridge, Aug. 22, 1909, *Rock* 4,840. Waianae Mts.: Dupont trail, northern slope of Kaala, Feb. 29, 1949, *Degener et al.* 19,428; Dupont trail, north slope of Mt. Kaala, 2800 ft. alt., rain forest, Sept. 10, 1950, *Hatheway et al.* 344; eastern part of Kaala summit, Sept. 25, 1938, *Degener et al.* 12,247 (NY); Kaala, Oct. 13, 1929, *Yoshinaga*; Mokuleia, 1200 ft. alt., July 18, 1924, *Wilder* 1,287; Makaha Valley, Feb. 12–19, 1909, *Forbes*; Honouliuli, ridge above Kupehau, dry brushy slope, alt. 650 m., June 30, 1935, *Fosberg* 10,986; Palehua, Aug. 23, 1922, *Skottsberg* 207; slope south of Palawai Gulch, ca. 2700 ft., March 27, 1948, *Wilbur* 602.

MOLOKAI: Olokui, 3000 ft. alt., ridge between upper forks of Waialele stream, rain forest, Feb. 6, 1948, *St. John and Wilbur* 23,343; Halawa, ridge south of valley, Aug. 1912, *Forbes* 477.Mo. (US); Kaluaaha, April 1910, *Rock* 7,060 (GH); Kaluaaha, rain forest, June 28, 1928, *Degener* 7,323 (GH); Pukoo, June 1910, *Faurie* 434.

LANAI: Aug. 1913, *Munro* 15; Sept. 1917, *Forbes* 361.L (US); Waiakeahua Gulch, in decadent, deer devastated forest at 2500 ft., Aug. 4, 1949, *Degener and Murashige* 20,322 (US); Waiakiola Valley, July 28, 1910, *Rock* 8,056 (GH); Kaiholena, *Munro* 6; Lanaihale, July 28, 1940, *Degener* 12,976 (US); Puu Aalii, Kealia Aupu-Kaunolu divide, lower forest,

April 14, 1938, *St. John* 18,851; mountains near Koele, June 1913, *Forbes* 78.L; mountains near E. end, June 1913, *Forbes* 275.L.

MAUI: Makawao, Oct. 1910, *Rock* 8,617 (US); April 1911, *Curran* 62 (US); upper ditch trail Haleakala, Oct. 13, 1922, *Skottsberg* 808; Kailua, north slope of Haleakala, June 13, 1920, *Forbes* 2499.M (US); Kailua, Dec. 25, 1908, *Rock*; Kipahulu, 2500 ft. alt., Kaukaia Gulch, west ridge, summit of, *Acacia Koa* woods, Dec. 28, 1936, *St. John and Catto* 17,806; Nahiku, July 1910, *Forbes*; along ditch near Oopuola stream, lower rain forest, July 7, 1927, *Degener* 7,324 (US); Puu Kukui, upper forest, 3-5000 ft., Sept. 25, 1916, *Hitchcock* 14,804 (US); near where trail leaves tunneled stream for Mt. Eke climb, rain forest, Aug. 27, 1927, *Degener and Wiebke* 2,307 (US, MICH).

This species exhibits extreme variation, especially in the leaves. The leaves are of various shapes, with a great number of intermediate forms, and they range in size from 14 × 5 cm. to 2 × 1.5 cm. The obovate leaf with an obtuse apex is most frequently encountered, but even on a single branch with leaves predominantly of this shape, others with ovate leaves and acute apices may be found. Of all the characters the flowers are the most constant.

No combination of characters was found on which a separation of the various forms could be based. Any attempt at reclassifying the group always disclosed intergrading forms which rendered the system impractical.

The absence of this widely distributed species on the island of Hawaii is peculiar. *Rock* (1913a) lists this species as occurring "on all islands of the group," but no single collection of it was found from Hawaii.

4. *Eugenia Cumini* (L.) Druce, Bot. Exch. Club Brit. Is., Rpt. 3: 418, 1914.

Myrtus Cumini L., Sp. Pl. 471, 1753.

Eugenia Jambolana Lam., Encycl. 3: 198, 1789.

Syzygium Cumini (L.) Skeels, U. S. Dept. Agr., Bul. 248: 25, 1912.

Tree 6 to 20 m. tall; branches pale yellowish-grey, glabrous, in age the bark greyish-white; leaf scars 2-4 mm. wide, rounded shield-shaped, yellowish-grey; leafy branchlets 1-3 mm. in diameter, terete or slightly angled, glabrous, pale brown to greyish-white; internodes 1.5-4.5 cm. long; leaves opposite, 7-18 cm. long, 3-8 cm. broad, oblong-ovate to elliptic-oblong, apex shortly or abruptly acuminate, rarely obtuse, base broadly cuneate narrowing toward petiole, margin entire or slightly undulate, blade coriaceous, above olive-green, minutely glandular-punctate, glabrous and shiny, below dark yellowish-green, dull, minutely pitted or pustulate, glabrous; midrib shallowly impressed above, elevated below; primary lateral veins numerous, alternate or opposite, 25-40 on a side, 2-5 mm. apart, irregularly ascending at 140-150°, meeting in an irregularly lobed intramarginal vein 1-3 mm. from leaf margin, raised on both surfaces; the veinlets raised-reticulate; petioles 1-2.5 mm. long, 1 mm. wide, glabrous; inflorescence cymose, on previous years' branches or occasionally in axils of the leaves, rarely terminal, 4-12 cm. long; peduncle 1-3 cm. long, terete or slightly angled, glabrous, subtended by two deciduous, subulate bracts 0.5-1.5 mm. long, glabrous; pedicels decussate, articulate, slender terete or slightly angled, subtended by one deciduous subulate bract; flower sessile, calyx tube campanulate, 3-5 mm. long, 2-3 mm. across, brownish-pink, glabrous, finely glandular-punctate, narrowing into a stout pseudostipe, subtended by 2 deciduous bracts; bracts reddish-brown, deltoid, 1-1.5 mm. long; calyx lobes 4, quickly deciduous; petals 4, white, minutely glandular-punctate, orbicular, concave, 2-3 mm. in diameter, falling off as a calyptra; stamens numerous (about 100), exerted and spreading, inserted on the margin of the calyx tube; filaments pinkish, 2-6 mm. long, slender, subulate, glabrous, finely glandular-punctate, anthers white, 3-7 mm. long, orbicular-ovate; style terete, subulate, included, 5-6.5 mm. long, glabrous, finely

glandular-punctate; berry oblong to oblong-elliptic, asymmetric 1.5–2.0 cm. long, 1.0–1.5 cm. wide, glabrous, dark purple or black, shiny, minutely glandular-punctate, umbilicate, crowned by the truncate scars of the calyx lobes, umbilicus 1–2 mm. tall, 1.5–3 mm. in diameter; pericarp pulpy, 1.5–3 mm. thick, seed ellipsoid or oblong-ellipsoid, 1.0–1.5 cm. long, 0.5–1.0 cm. wide, seed coat, crustaceous, 0.5–1.0 mm. thick, closely adhering to the subrugose surface of the cotyledons; cotyledons unequal, not fused, conspicuously glandular-punctate.

Common name: Java Plum.

DISTRIBUTION: Widely distributed on all the Hawaiian islands, found in large stands in dry and moist valleys; cultivated, spreading from cultivation, and established. Widely distributed in the Indo-Malayan region and in the tropics of the world.

Specimens examined:

KAUAI: Hanapepe, Koula Valley, 750 ft. alt., on side of road, Dec. 27, 1952, *Wilson* 210.

OAHU: Koolau Mts.: Honolulu, Nuuanu Valley, Dowsett Highlands, by road, Sept. 19, 1943, *Neal*. Waianae Range: Kamananui, Dupont trail on ridge south of Pamoia Gulch, by forest reserve fence, 1500 ft. alt., Sept. 14, 1952, *Wilson* 145; N. of Kaala, naturalized in pasture, April 26, 1937, *Degener* 11,902 and 11,903 (NY); Mokuleia, Makaleha Valley, 900 ft. alt., in lowland scrub, Sept. 15, 1950, *Hatheway et al.* 357; Honouliuli, Puu Manawahua, lower woods, 1800 ft. alt., Sept. 29, 1929, *St. John* 9,893.

MOLOKAI: Halawa Valley, 150 ft. alt., spreading along trail, by abandoned, overgrown taro patches, Dec. 27, 1932, *St. John et al.* 12,676; eastern side of Wailau Valley near ocean, naturalized, Aug. 14, 1928, *Degener* 9,664 (NY); near Kanalo, naturalized, Aug. 8, 1928, *Degener* 7,345 (NY).

MAUI: Wailuku, culta, Aug. 1909, *Faurie* 55; Muolea, E. Maui, 3 miles from Hana, along roadside, Dec. 27, 1951, *Wilson* 101; Ukumehame, Ukumehame Gulch, 800 ft. alt.,

along bank of stream, Dec. 29, 1951, *Wilson* 104.

HAWAII: Puna, Pahau Nui, alt. about 1700 ft. associated with guava, Aug. 2, 1945, *Fagerlund and Mitchell* 1,104; above Hilo, along Malili stream, homestead, alt. 650 m., *MacDaniels* 249.

Eugenia Cumini is of recent introduction into the Hawaiian Islands. It has rapidly become established and widely distributed, most likely by birds which relish the fruit. It may now be found in abundant stands in the dryer regions of the islands, forming the dominant vegetation of valleys with periodically dry streams.

No record has been found that indicates when this species was introduced into the islands. The earliest collection of it in the Hawaiian Islands was by Faurie on Maui in August 1909. He records it as "Wailuku Culta."

5. *Eugenia uniflora* L., Sp. Pl. 470, 1753.

Shrub 2–3 m. tall, branches greyish-brown, smooth, glabrous; leaf scars 1–1.5 mm. wide, rounded shield-shaped, yellow-brown to reddish-brown; leafy branches green to greyish-brown, glabrous, 1–4 mm. in diameter, angled when young, becoming terete in age; internodes 2–4 cm. long; leaves 4–7 cm. long, 2–4 cm. wide, ovate to ovate-lanceolate, tapering to acuminate apex, base rounded to sub-cuneate; margin entire, slightly revolute; blade thin coriaceous, above glabrous, shiny yellow-green to dark olive-green, minutely glandular-punctate, below pale yellow-green, glabrous or very sparsely puberulous, minutely glandular-punctate; midrib reddish-green, shallowly impressed above, elevated below; primary lateral veins alternate or opposite, elevated on both surfaces but more conspicuous below, 9–12 on a side, 4–7 mm. apart, irregularly ascending at 140–150°, meeting in an irregularly lobed continuous marginal vein 2–5 mm. from leaf margin; less conspicuous continuous or sometimes interrupted marginal vein 0.5–1 mm. from leaf

margin; the veinlets less distinct, raised-reticulate; petioles 2–5 mm. long, 0.5–1 mm. wide, dark reddish-green, glabrous; flowers single or in pairs, axillary; peduncles 2–4 cm. long, 4-angled or terete, glabrous; calyx tube 2–3 mm. long, 3–4 mm. wide, green, glabrous or sparsely puberulent; calyx lobes 4, persistent, 3–4 mm. long, 3–4 mm. wide, membranaceous, green, ovate with acute apex, ciliate, minutely glandular-punctate, attached to annular disk within the tube; petals 4, white, spreading, persistent, obovate with an obtuse apex, ciliate, 7–8 mm. long, 5–6 mm. wide, sparsely glandular-punctate; annular disk raised 0.5 mm. above point of petal insertion, strigose; stamens numerous (about 50), spreading, inserted on annular disk; filaments 3–7 mm. long, white glabrous, subulate; anthers white, 0.5–1 mm. long, orbicular-ovate; style, terete, subulate, slightly exerted or included, 4–6 mm. long, glabrous; fruit subspherical, red, 1–2 cm. high, 1–2 cm. wide, glabrous, minutely glandular-punctate, crowned by the persistent calyx lobes, conspicuously longitudinally 8-ribbed; pericarp fleshy, 2–3 mm. thick; seed subglobose, 8–15 mm. in diameter, seed coat thin membranous, loosely adhering to the pericarp or to the surface of the cotyledons; cotyledons fused, finely glandular-punctate.

Common name: Surinam Cherry, Pitanga.

DISTRIBUTION: Very sparingly naturalized on the larger islands. Native to Brazil.

Specimens examined:

KAUAI: Lihue, planted, June 10, 1926, *Degener* 2,080.

OAHU: U. S. Expt. Station, Oct. 25, 1926, *MacDaniels* 349.

MOLOKAI: Halawa Valley, 50 ft. alt., shrubs by roadside, Dec. 27, 1932, *St. John et al.* 12,665.

HAWAII: Planted and persisting, April 10, 1930, *Degener* 7,331 (NY).

The number of collections of this species is very meager, and future collections should be made to establish the occurrence of it in the Hawaiian Islands.

6. *Eugenia rariflora* Benth., in Hooker's London Jour. Bot. 2: 221, 1843.

Eugenia waiianensis Deg., Fl. Hawaii., Fam. 273, 7/15/32.

Eugenia koolauensis Deg. var. *glabra* Deg., Fl. Hawaii., Fam. 273, 8/10/32.

Eugenia rariflora Benth. var. *parvifolia* Hdb., Fl. Hawaii. Is. 129, 1888.

Tree or shrub 3–7 m. tall; branches grey to greyish-white, glabrous, in age the bark greyish-white to greyish-brown, longitudinally and transversely irregularly furrowed; leafy branchlets 1.5–2 mm. in diameter, quadrangular to terete, brown, brown puberulent when young; leaf scars rounded shield-shaped, 1–1.5 mm. wide; bundle scar 1; internodes 0.5–3 cm. long; leaves opposite, 3–7 cm. long, 1.5–5 cm. wide, blade elliptical, ovate or obovate, apex obtuse, acute, retuse or apiculate, base cuneate or rounded, coriaceous, above olive-green, shiny, minutely glandular-punctate, glabrous or sparsely puberulent near midrib, below dull, yellowish-green, minutely pustulate, glabrous or somewhat puberulent at base near midrib; midrib shallowly impressed above, elevated below; primary lateral veins alternate or opposite, 5–3 on a side, 4–8 mm. apart, irregularly or straight ascending at 140–150°, meeting in an irregularly lobed intramarginal vein, 1–2 mm. from leaf margin, raised on both surfaces, but more distinct below; the veinlets raised-reticulate; petioles 2–4 mm. long, 1 mm. wide, brown, glabrous or slightly puberulent; flowers single or in pairs, axillary; peduncles 5–15 mm. long, glabrous or puberulent; calyx tube 2–3 mm. long, 3–4 mm. across, obconic, brown, puberulent, minutely glandular-punctate, subtended by two persistent, subulate sparsely puberulent bracts 1–1.5 mm. long; calyx lobes 4, unequal in length, 1 opposite pair 3–4 mm. long, 3–4 mm. wide, the other pair shorter, 2–3 mm. long, 3–4 mm. wide, ovate, green, fleshy, persistent, below minutely glandular-punctate, glabrous, above glabrous, within the tube attached to annular

disk; petals 4, white, spreading, persistent, 6–8 mm. long, 4–5 mm. wide, inserted on the margin of the disk, ovate, obovate or elliptic, minutely glandular-punctate, membranaceous, ciliate and sparsely puberulous, apex obtuse or acuminate, base truncate; annular disk raised 0.5 mm. above point of petal insertion, glabrous; stamens numerous (about 150), inserted on disk; filaments white, 1.5–5 mm. long, slender, subulate, glabrous; anthers white, 0.5–0.8 mm. long, orbicular-ovate; style terete, subulate, slightly exerted or included, 2–4 mm. long, glabrous; fruit ovoid to subspherical, crowned by persistent calyx lobes, 1–2 cm. high, 1–1.6 cm. wide, glabrous or somewhat appressed-pilulous, red, orange or yellow, minutely glandular-punctate; pericarp fleshy, 1–2 mm. thick, seed globose, 8–10 mm. in diameter; seed coat thin membranous, closely adhering to the pericarp; cotyledons 2, white or yellowish, minutely glandular-punctate, usually fused, but sometimes only partly fused or entirely free.

Lectotype: "Feejee Islands" (Fiji) *Hinds* 1841 (K).

Common name: "Nioi" (Rock, 1913*b*).

DISTRIBUTION: High islands of Polynesia. In the Hawaiian Islands it is found on all the large islands except the island of Hawaii.

Specimens examined:

KAUAI: Hanakoa, 750 ft., Aug. 28, 1926, *Judd* 44; Haupu, Kipu, 800 ft. alt., wooded slope, Dec. 25, 1933, *St. John and Fosberg* 13,616; northeast of Kipu, June 17, 1926, *Degener* 7,304 (NY).

OAHU: Koolau Mts.: Waimano, 6–1919, *Russ*; Waimano, E. branch, E. slope above pass, May 29, 1933, *Russ*; Waimano, Oct. 1935, *Meebold (Degener 20,768)* (M); ridge between Niu and Wailupe, April 11, 1917, *Forbes* 2458.0. Waianae Mts.: Near Kawaihapai, shaded dry slope, Jan. 27, 1929, *Degener and Bush* 7,305 (GH, NY); Mokuleia, Kaaawa (= Kaawa?) Gulch, north of Kaala, dryish forest slope, Aug. 2, 1938, *Degener and Odonez* 12,192 (US, NY); Mokuleia, west side of east branch of E. Makaleha stream, 1300

ft. alt., steep talus slope, in dryland forest, Aug. 31, 1950, *Hatheway* 376; Mokuleia, east side of east branch of Makaleha Valley, densely forested slope at 1600 ft., July 2, 1950, *Degener, Hatheway and Greenwell* 20,824 (US); Mokuleia, west branch of E. Makaleha Valley, 1800 ft. alt., dry forest on steep valley side, June 11, 1952, *St. John* 24,827; Mokuleia, west branch, E. Makaleha Valley, in small side gulch, 1750 ft. alt., Sept. 30, 1950, *Hatheway* 384; Makaleha Valley, May 2, 1918, *Rock* 17,005 (GH); Makaleha Valley, Oct. 23, 1936, *Meebold (Degener 21,980)* (M); Mokuleia, gulch southwest of Dillingham Ranch, in shade at 1700 ft., April 23, 1950, *Degener, Hatheway and Carrol* 20,615; Mokuleia, 4th gulch east of Puu Kaupakuhale, Kamananui, Puu Kaala, Oct. 23, 1932, *Yuncker and Hosaka* 3,216 (US); half mile southwest of Pohakea Pass, single, dying tree on dry grass and lantana covered slope, July 30, 1932, *Degener and Bush* 4,194 (GH); Honouliuli, ridge above Kupehau, dry lantana covered slope, June 30, 1935, *Fosberg* 10,995; Honouliuli, Kanehoa Gulch, dry slope, elev. 700 m., Oct. 12, 1927, *Judd* 65; Honouliuli, between Palehua and Palikea, near summit ridge, Dec. 16, 1935, *Degener et al.* 11,300; third small valley northeast of Palikea (contains pipe line arising from tunnel), dry woods, Sept. 19, 1932, *Degener, Park and Bush* 7,303 (GH, MICH, NY); north of Puu Pane, sunny gulch at 200 ft. elev., south of ruin of cathedral, March 26, 1950, *Degener and Carroll* 20,581 (US); on firebreak trail 1 m. north of Puu Kaua, 1700 ft. alt., on dry slope, Sept. 5, 1952, *Wilson, St. John and St. John* 143; on firebreak trail, 1 m. N. of Puu Kaua, alt. 1700 ft. on dry slope, Feb. 29, 1948, *Cowan* 843; Kahanahaiki, 234 m. alt., dry river bottom, Oct. 16, 1925, *Judd* 23; southern slope of Kahanahaiki Valley, dry forest, Nov. 1, 1931, *Degener et al.* 7,296 (GH, MICH, NY); Makua Valley, May 1930, *Russ*; small gulch on south side of upper Makua Valley, dry forest, May 10, 1931, *Degener, Park and Bush* 7,295 (GH, NY); Waianae, Feb. 1930, *Meebold* 8,629

(M); U. S. Explor., Exped., highland near Waianae; large branch of Lualualei Valley, southwest of Pohakea Pass, Aug. 4, 1932, *Degener and Bush* 7,299 (NY).

No locality: Collect. Dr. Hillebrand, Oahu, Maui (GH).

MOLOKAI: Central Molokai, wet forest, Oct. 13, 1916, *Hitchcock* 15,193 (US).

MAUI: Olowalu Valley, May 19, 1920, *Forbes* 2417.M (US); Wailuku, W. Maui, *Hillebrand and Lydgate*.

Eugenia rariflora was first recorded for the Hawaiian Islands by Hillebrand in 1888. It occurs occasionally in the drier regions of the larger islands except Hawaii. This species shows considerable variation in its leaves although not to as great a degree as *E. sandwicensis*.

Both *E. waianensis* and *E. koolauensis* var. *glabra* are here reduced to *Eugenia rariflora* because of intermediate forms which make it impossible to set definite limits upon the two.

The concave leaves would be the only character which would separate *E. koolauensis* var. *glabra* from *E. rariflora*. But a collection from Palikeya, Oahu (*Degener* 7,303) has leaves which are only slightly concave; another specimen (*Degener* 20,581) shows leaves that are more strongly concave. This character is certainly not a reliable one, and is of no taxonomic value in this case. This conclusion is supported by the fact that the characters of *E. koolauensis* var. *glabra* are identical in all other respects with those of *E. rariflora*.

The size of the leaves of *E. rariflora* might seem to offer a remarkably valuable taxonomic character, particularly when the extremes in form are considered. *E. waianensis* is described as differing from *E. rariflora* in having smaller leaves. This character seems to be of value when specimens with extremely small leaves are studied (*Degener* 7,296). However, some specimens, such as those collected by Forbes (2417.M) and Rock (17,005), have leaves which show a series of intermediate sizes between *E. waianensis* and *E. rariflora*. In such cases this character proves to be of little value.

7. *Eugenia koolauensis* Deg., Fl. Hawaii. Fam. 273, 8/10/32.

Tree 4–7 m. tall; branches grey, glabrate, in age the bark reddish-brown, black spotted; leaf scars 1–2 mm. wide, rounded shield-shaped, reddish-brown; leafy branchlets 1–3 mm. in diameter, 4-angled to terete, densely brown subappressed-pilosulous; internodes 9–19 mm. long; leaves 2.5–5 cm. long, 1–3.3 cm. wide, obovate to elliptic, apex obtuse or apiculate, base subcuneate, blade coriaceous, concave, margin entire, more or less strongly revolute, above olive-green, minutely glandular-punctate, glabrous and shiny or subappressed-pilosulous near veins with intervals glabrous, below pale yellowish-green, minutely pitted or pustulate, subappressed-puberulent; midrib shallowly impressed above, elevated below; primary lateral veins, alternate or opposite, 5–7 on a side, 5–10 mm. apart, irregularly ascending at 140–150°, meeting in an irregularly lobed intramarginal vein 1–2 mm. from leaf margin, raised on both surfaces but more distinct below, rarely slightly shallowly impressed above; the veinlets raised-reticulate; petioles 2–4 mm. long, 1 mm. wide, brown subappressed-pilosulous; flowers single or in pairs, axillary; peduncles 1–8 mm. long, subappressed-pilosulous, bracteate; bract subulate, yellow-brown subappressed-pilosulous, 1 mm. long, 1 mm. wide; calyx tube obconic, 2–3 mm. long, 3–4 mm. across, subappressed-pilosulous, subtended by two persistent subulate brown subappressed-pilosulous bracts 1–1.5 mm. long; calyx lobes 4, of unequal length, 1 opposite pair 3–4 mm. long, 3–4 mm. wide, the other pair 2–3 mm. long, 3–4 mm. wide, ovate, green, fleshy, persistent, below finely yellow glandular-punctate, appressed-puberulous, above glabrous, within the tube attached to annular disk; petals 4, white, spreading, persistent, inserted on margin of disk, concave, ovate or obovate or elliptic, apex subacute or obtuse, base truncate, 6–8 mm. long, 4–5 mm. broad, membranaceous, minutely glandular-punctate, ciliate and sparsely puberul-

ous; annular disk raised 0.5 mm. above point of petal insertion, puberulent; stamens numerous (about 150), inserted on disk occupying 0.5 mm. of the marginal region; filaments white, 1.5–5 mm. long, slender, subulate; anthers white, 0.5–1.0 mm. long, orbicular-ovate; style terete, subulate, slightly exserted or included, 2–4 mm. long, sparsely pilose; ovules 8 in a cell, berry ovoid and asymmetric, 1.2–2.0 cm. high, 1.2–1.6 cm. wide, sparingly appressed-pilosulous, light orange-yellow, shiny, minutely yellow glandular-punctate, crowned by the persistent calyx lobes; pericarp fleshy, 1–2 mm. thick; seed globulose, 8–9 mm. in diameter; seed coat thin, membranous, closely adhering to the pericarp and free from the surface of the cotyledons; cotyledons either completely fused or only partly so, or entirely free.

Type: Oahu, "Northern slope of Kaipapau Valley," *Degener and Park* 4,169 (BISH).

DISTRIBUTION: Endemic to the island of Oahu.

Specimens examined:

OAHU: Koolau Mts.: Pupukea, dry gulch side, Sept. 28, 1925, *Judd* 20; Pupukea, elev. 300 m., Nov. 2, 1925, *Brown* 1, 274; Kahuku, entrance of Pupukea-Kahuku trail, lower edge of decadent dry forest among lantana, Nov. 22, 1931, *Degener, Park, and Kwon* 7,297 (BISH, NY); Laie, Kahawainui Gulch, elev. 100 m., March 2, 1928, *Judd* 71; Hauula, Papali Gulch on trail, March 1933, *Judd*; Hauula, on top of small cliff, elev. 160 m., Sept. 8, 1926, *Judd* 54; Kaipapau, northern slope of Kaipapau Valley, moderately dry woods near top of ridge, Oct. 11, 1931, *Degener and Park* 4,169; Waimea, N. fork of Kamananui stream, very steep, north facing valley wall, alt. 750 ft., April 16, 1949, *St. John* 23,683, and Sept. 5, 1952, *Wilson, St. John and St. John* 142, and Nov. 18, 1952, *Wilson and Lambertson* 163; gully having prominent dyke, north-north-east of Puu Kamaohanui, Dec. 11, 1932, *Degener* 7,302 (NY).

Closely related to *Eugenia rariflora*, *E. koolauensis* may be clearly differentiated by its

distinctly concave leaves which have sub-appressed puberulence on the lower laminar surface. It is a rare species and occurs in the rain forest of the Koolau Range on Oahu.

8. *Eugenia molokaiana* K. Wilson and J. F. Rock, sp. nov.

Figs. 1 and 2

Arbor 2.5–3 m. alta, ramulis foliosis 0.5–1.5 mm. diametro manifeste tetragonis usque teretibus, crebrissime brunneis subadpressi-pilosulis, internodis 7–24 mm. longis, foliis oppositis 2.0–3.0 cm. longis, 1.4–2.0 cm. latis, suborbicularibus, ellipticis vel obovatis, apice obtuso vel apiculato rare retuso, basi subcuneato, laminis coriaceis concavis, margine integris valde revolutis, supra olivaceis minute pustulatis novellis dense subadpressi-pilosulis, in aetate nitidi-glabrescentibus, subtus pallide flavidi-viridibus minute glandulosi-punctatis dense subadpressi-puberulentibus, petiolis 1–3 mm. longis 1 mm. latis dense brunneis subadpressi-pilosulis, floribus solitariis in bracteorum axillis, bracteis subulatis dense brunneis subadpressi-pilosulis 1–1.5 mm. longis 1 mm. latis, pedunculis 5–7 mm. longis 0.5 mm. latis subadpressi-pilosulis, calycis tuba 2–3 mm. longa 3–4 mm. diametro subadpressi-pilosula, a 2 bracteis persistentibus subulatis brunneis subadpressi-pilosulis subtensa, bracteis 1.5–2.0 mm. longis, calycis lobis 4 ovatis viridibus carnosius persistentibus longitudine inaequalibus, quorum uno jugo opposito 2 mm. longo 2 mm. lato, altero 3 mm. longo 2 mm. lato, petalis 4 albis in disci annularis margine insertis ovatis vel obovatis 4 mm. longis 3 mm. latis membranaceis ciliatis, apice obtuso, basi truncato vix puberulo minute glandulosi-punctato, pistillo tereti subulato 2–5 mm. longo basi dense puberulenti supra glabroso, stigmati peltato, fructibus ovoideis symmetricibus in sicco 8 mm. diametro dense adpressi-pilosulis rubris insigniter flavidi-glandulari-punctatis calycis lobis persistentibus coronatis.

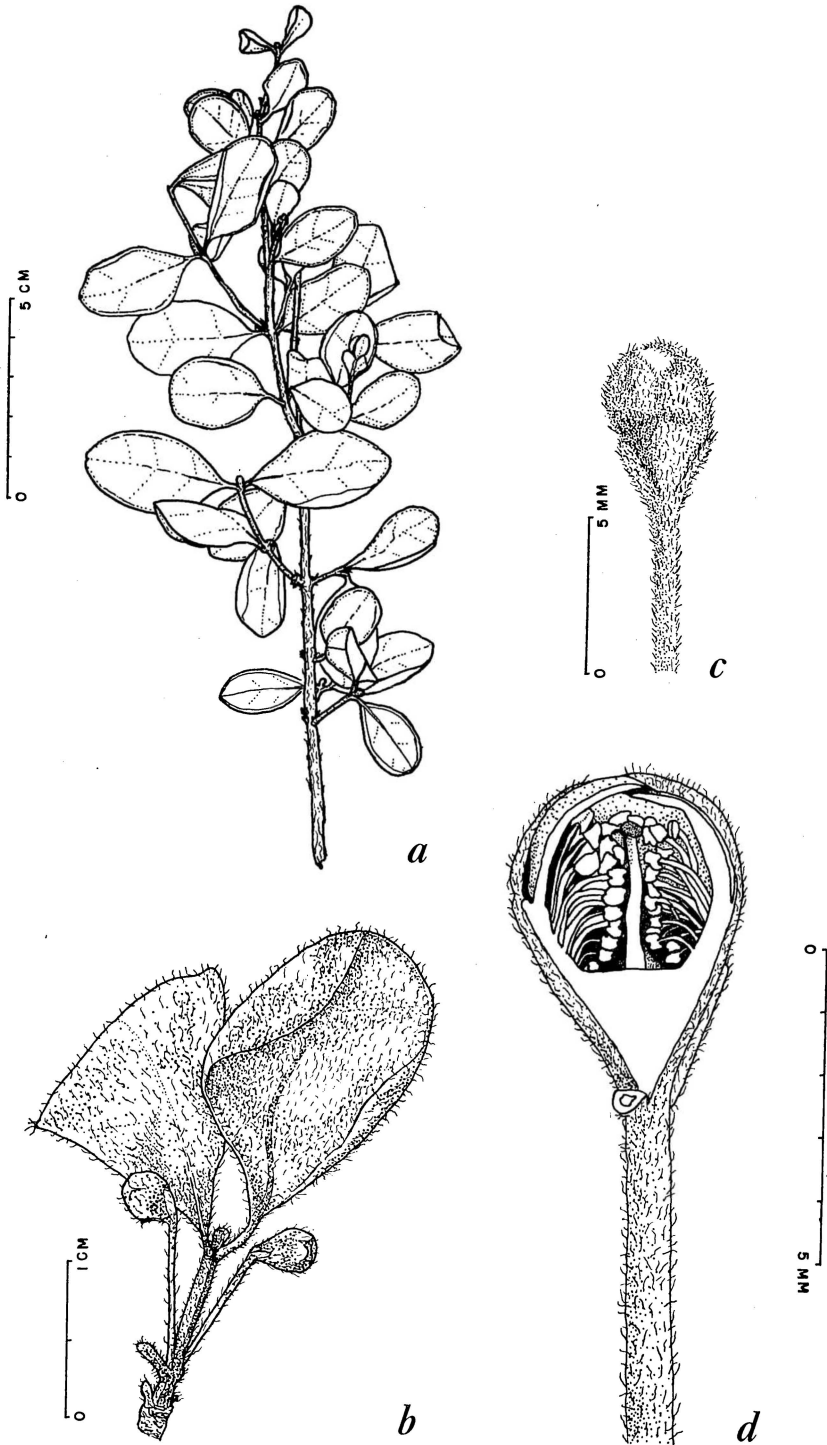


FIG. 1. *Eugenia molokaiana*. *a*, Habit $\times .50$; *b*, flower bearing branchlet $\times 2$; *c*, bud $\times 4$; *d*, dissected flower bud $\times 8$. From Rock 17,144B.

Tree 2.5–3 m. high; branches greyish-brown, glabrate, in age the bark smooth yellowish-red; leaf scars 1–1.5 mm. wide, rounded shield-shaped, reddish-brown; leafy branchlets 0.5–1.5 mm. in diameter distinctly 4-angled to terete, densely brown subappressed-pilosulous; internodes 7–24 mm. long; leaves 2.0–3.0 cm. long, 1.4–2.0 cm. wide, suborbicular, elliptic or obovate; apex obtuse or apiculate, rarely retuse, base subcuneate; blade coriaceous, concave, margin entire, strongly revolute, above olive-green, minutely pustulate, densely subappressed-pilosulous when young, becoming glabrous and shiny in age, below pale yellowish-green, minutely glandular-punctate, densely subappressed-puberulent; midrib shallowly impressed above, elevated below, primary lateral veins alternate or opposite, 5–7 on a side, 4–9 mm. apart, irregularly ascending at 140–150°, meeting in an irregularly lobed intramarginal vein 1.0–1.5 mm. from leaf margin, raised on both surfaces but more distinct below, the veinlets less conspicuous, raised-reticulate; petioles 1–3 mm. long, 1 mm. wide, densely brown subappressed-pilosulous; flowers single, in the axils of bracts; the bracts subulate, densely brown subappressed-pilosulous, 1–1.5 mm. long, 1 mm. wide, peduncles 5–7 mm. long, 0.5 mm. wide, subappressed-pilosulous; calyx tube 2–3 mm. long, 3–4 mm. across, subappressed-pilosulous, subtended by two persistent subulate, brown, subappressed-pilosulous bracts; the bracts 1.5–2.0 mm. long; calyx lobes 4, ovate, green, fleshy, persistent, of unequal length, 1 opposite pair 2 mm. long, 2 mm. wide, the other pair 3 mm. long, 2 mm. wide; petals 4, white, inserted on margin of annular disk, ovate or obovate, 4 mm. long, 3 mm. wide, membranaceous, ciliate, apex obtuse, base truncate, sparsely puberulous, minutely glandular-punctate; stamens numerous (about 150); filaments white, 0.5–2.0 mm. long, slender, subulate, glabrous; anthers white, orbicular-ovate, 0.2–0.5 mm. long; style terete, subulate, 2.5 mm. long, densely puberulent at base, glabrous

above; stigma peltate; fruit ovoid, symmetrical, 8 mm. in diameter (when dry), densely appressed-pilosulous, red, conspicuously yellow glandular-punctate, crowned by the persistent lobes of the calyx.

Type: Hawaiian Islands, Molokai: Maunaloa; June 1918, *J. F. Rock 17,144*, in the Bernice P. Bishop Museum Herbarium.

Common name: "Nioi."

DISTRIBUTION: Known only from the type locality, Maunaloa, Molokai, and now probably extinct.

Specimens examined:

MOLOKAI: Maunaloa: April 1918, *Rock 17,144*; June 1918, *Rock 17,144*; Feb. 1920, *Rock 17,144B* (BISH, GH).

Eugenia molokaiana is known only from the collections made by Rock at Maunaloa, Molokai. When the locality was first visited in 1918, Rock photographed the tree which was then already dying (Fig. 2). Since 1920 there has not been a single subsequent collection of this species. In 1953 Rock was fortunate in being able to revisit Maunaloa, Molokai, in search of this tree. Unfortunately there is no longer any trace of its existence. *E. molokaiana* has disappeared, like many other trees from that locality.

If ever it should be found, *E. molokaiana* may be easily recognized by its small red fruits, its peltate stigma, and its small, concave, pubescent leaves.

The description of the flower is based on a bud just before anthesis. Unfortunately no open flowers have been seen. The nature of the embryo and seed are not known since it did not seem advisable to dissect the single fruit which was available.

Miss Marie C. Neal informs us that the *nioi* growing on Maunaloa, Molokai, was one of three trees of that region which played an important role in Hawaiian traditions. According to the notes in the Bishop Museum on the native Hawaiian names of plants, the *nioi* from Maunaloa, Molokai, was identified as "the tree form of a god, Kane-ikaulana ula." The tree was used for making images

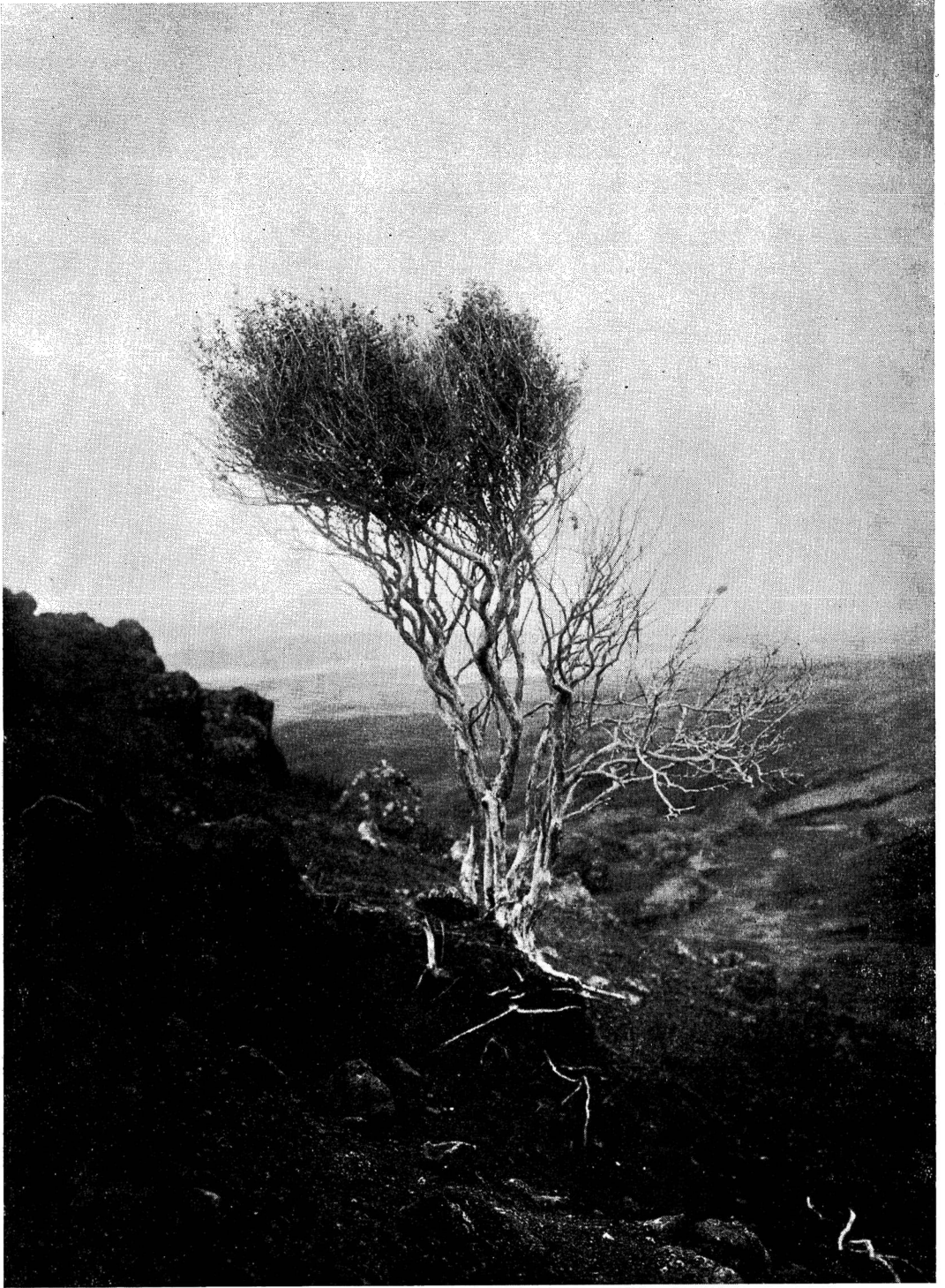


FIG. 2. *Eugenia molokaiana* growing on Maunaloa, Molokai. (Photo by J. F. Rock.)

by the command of the chiefs, or parts of it were used in "vicious sorcery." The *nioi* growing on Maunaloa was also claimed to be poisonous (Neal, letter). If our identification of this *nioi* as *Eugenia molokaiana* is correct, then we can attribute the belief of its toxicity only to superstition.

TAXA REQUIRING FURTHER STUDY:

Episzygium oahuense Suesseng. and Ludw., Bot. Staatsaml. München, Mitt. 1: 10, 1950.

The genus *Episzygium* is based on a single specimen which was collected by A. Meebold in the Waianae mountains in 1930, [A. Meebold 8,445 (M)]. I believe that the peculiar 4-loculed ovary is most likely an abnormality of *Eugenia sandwicensis*. Until such a time that additional corroborative material is collected, I feel that the genus *Episzygium* and the species *Episzygium oahuense* should be considered as being based on an aberrant individual.

Hillebrand (1888), Rock (1913), and Degener (1932-34) all reported a rare white form of *Eugenia malaccensis* (*Jambosa malaccensis* f. *cericarpa* Deg.). I have not been able to locate any specimens of this form.

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