

A Taxonomic Study of the Indigenous Hawaiian Species of the Genus *Hibiscus* (Malvaceae)

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THE GENUS *Hibiscus* is a member of the Malvaceae, a family of 80 or more genera distributed throughout the world except in frigid regions. Many abound in the tropics and subtropics, where they are important as ornamental and commercial plants.

Since *Hibiscus* hybridization was first successfully accomplished in Hawaii in 1872 by Governor Archibald Cleghorn of Oahu, a growing interest in the genus has prevailed not only in Hawaii, where the legislature has designated one of the species as the official flower, but also throughout global tropical and subtropical regions. Horticulturists striving to secure desirable varieties have introduced to Hawaii many new species, subspecies, and forms (Nakasone, 1953). The popularity of the genus has stimulated numerous amateur hybridizers to produce thousands of complex hybrids whose parentage is now impossible to trace. The attractiveness of these exquisite cultivars has encouraged and nourished the organization of several societies to foster such hybridization.

Little attention, however, has been given to the indigenous members of the genus, several of which have been useful in the production of these hybrids. Heretofore, no single comprehensive work has been done on the native members of the genus. Individual descriptions have appeared in print as far back in 1819. Hillebrand (1888) and Rock (1913) both included

several *Hibiscus* species in their Floras. It is the purpose of this work to record as complete as possible an investigation of the native species, varieties, and forms, resolving the groups of the indigenous *Hibiscus* populations into taxonomically recognizable groups.

This study could neither have been undertaken nor accomplished without the help of friends who gave time, knowledge, and encouragement. I am primarily indebted to Dr. Harold St. John, former Professor of Botany at the University of Hawaii, for introducing me to the problem. I am indebted to Mr. Irwin Lane for supervising the taxonomic and nomenclatural conclusions. Dr. Joseph F. Rock also contributed many hours in discussing the problem and collecting specimens. I am indebted to Miss Marie Neal, Dr. Otto Degener, Mr. and Mrs. Colin Potter, and Messers. Paul Weissich, Donald Anderson, Albert Duvel, and Henry Wiebke for their contributions to this work. Dr. Reed C. Rollins and Dr. Robert C. Foster of the Gray Herbarium checked and reported on material there. Dr. Richard S. Cowan investigated the *Hibiscus* specimens at the Smithsonian Institution (U. S. National Museum) and sent lengthy descriptions and explanations. On the island of Kauai, Mr. George Cliff acted as guide during my stay at Waimea Canyon. Mrs. Hector Moir of Poipu, Mr. John Santos of Eleele, Mr. Stephen Au of Lihue, Mr. Ronald Harker of Hale Manu, Mr. Adam Jacinto of Kalaheo, and Mr. Solomon Malina of Kipu were instrumental in helping me with collections on Kauai.

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tina Francis of Maryknoll High School.

All herbarium specimens mentioned in this paper are deposited at the Bernice P. Bishop Museum in Honolulu, unless otherwise stated.

HISTORY OF THE GENUS *Hibiscus* IN HAWAII

The history of the indigenous Hawaiian *Hibiscus* dates back to Gaudichaud's *Hibiscus Youngianus*, which was collected on the Freycinet Expedition, 1819. He mentioned it (1826) but failed to add any details; hence it was a *nomen nudum* as published, until Hooker and Arnott furnished the description (1832). Gray (1854) described both *H. Brackenridgei* and *H. Arnottianus*. In 1888 Hillebrand added *H. Kokio* to the three published species. This was followed closely by Heller's description (1897) of the Kauai white *H. waimeae*. Hochreutiner (1900) included all members in the genus known in all parts of the world. The Hawaiian populations received treatment by him. Forbes (1912) found and named an endemic Kauai species, *H. kabilii*, which is still considered rare. From 1912 to 1930 little was done in the way of publication until Caum presented Rock's *H. Brackenridgei* var. *molokaiana*; a variety of his own, *H. Brackenridgei* var. *kauaiana*; and a variety to *H. Kokio* var. *pukoonis*. Skottsberg, on his Hawaiian Bog Survey assignment, found and described a variety and a form of *H. Arnottianus*. From that time, 1944 to 1957, no new groups were established. Degener (1957) recently raised Skottsberg's var. *punaluuensis* of *H. Arnottianus* to the level of a species, *H. punaluuensis*.

At present we recognize 15 populations of *Hibiscus* as indigenous to the Hawaiian Islands—9 species, 5 varieties, and 1 form.

DESCRIPTION OF GENERIC CHARACTERS

The genus *Hibiscus* is a large taxon whose species, hundreds in number, are restricted to the warmer regions of the world. It is polymorphic, including species that are herbaceous, shrubby, or arborescent, some of the latter attaining heights of 30 ft. or more.

Linnaeus (1754) listed *Hibiscus* under genus

no. 756 and gave the fundamental description of this taxon. His original characters included double perianth; bracts 8 or more in number; calyx cup-shaped; 5 heart-shaped petals united at base; numerous filaments joined to column; anthers reniform; 5-celled ovary; divided stigma; reniform seeds.

Since this original description of Linnaeus, we have broadened our knowledge of the genus. It can be summarized in the following manner. Involucre consists of several free bracts. Calyx 5-lobed or toothed, persists with fruit. Flowers borne singly in axils, composed of 5 petals which are frequently wider toward their apices, narrowing towards base, where they usually unite with column. Flowers commonly large, showy, and of conspicuous colors. Staminal column composed of filaments which are united into hollow sheath for some distance from base; 5-toothed at apex. Filaments extend out from column at various positions, usually close to stigma. Style runs through column and terminates in 5 branches, each of which has a terminal discoid stigma. Five carpels, each containing several ovules, united into a 5-celled ovary. Capsule opens loculicidally. Seeds vary in shape from reniform to globose, with surfaces from glabrous to tomentose. Leaves variously lobed or entire, alternate, stipulate, and scarcely to distinctly palmately veined.

The genus *Hibiscus* seems closely related to the genera *Paritium* and *Abutilon*. *Paritium* is allied to *Hibiscus* inasmuch as both genera have involucre calyces which are 5-lobed; also 5-style branches with capitate stigmas. The involucre bracts of *Paritium*, however, are united, whereas those of *Hibiscus* are free.

Abutilon and *Hibiscus* both have carpels with 2 or more ovules. *Abutilon* species do not have involucre bracts but have staminal columns ending in filaments.

In distinguishing the various taxa under consideration, the following characters were most valuable: bract number (5–10), calyx length (1.0–3.0 cm.), and venation of calyx and leaves. Staminal column lengths (2.0–19.0 cm.), vesture, petal shapes, position of filament extension from column, and seeds are also important differentiating characters.

KEY TO KNOWN HAWAIIAN MEMBERS OF THE GENUS *Hibiscus*

- A. Corolla yellow.....B
- B. Calyx 10-veined; petals 3.0–4.0 cm. long.....C
- C. Leaves deeply lobed; bracts 8–10, glabrous, terete, nonglandular; calyx glandular; petals 3.0–3.5 cm. long, ca. 2.5 cm. wide; staminal column 4.0–4.5 cm. long.....2. *H. Brackenridgei*
- C. Leaves moderately lobed; bracts 7–8, hirsute, terete, nonglandular; calyx nonglandular; petals 3.0–4.0 cm. long, ca. 5.0 cm. wide; staminal column 7.0–8.0 cm. long.....
-5. *H. Brackenridgei* var. *mokuleiana*
- B. Calyx 5-veined; petals more than 4.0 cm. long.....D
- D. Leaves deeply lobed; bracts 8–9, hirsute, terete, glandular; calyx nonglandular; petals ca. 5.0 cm. long, 4.3–4.5 cm. wide; staminal column 4.0–5.0 cm. long.....
-3. *H. Brackenridgei* var. *molokaiana*
- D. Leaves entire to shallow lobed; bracts 5, hirsute, nonterete, nonglandular; calyx glandular; petals 5.7–6.0 cm. long, 4.8–5.0 cm. wide; staminal column 2.3–2.5 cm. long.....
-4. *H. Brackenridgei* var. *kauaiana*
- A. Corolla not yellow.....E
- E. Corolla pink; plant densely hirsute; bracts 10–12, bifid, 1.0–1.3 cm. long, ca. 1.0 mm. wide; calyx glandular, lobes 2.3–2.5 cm. long, cleft 1.0 cm. from apex.....1. *H. Youngianus*
- E. Corolla not pink; entire plant not densely hirsute; calyx nonglandular.....F
- F. Corolla red.....G
- G. Calyx glabrous; petioles 2.0–4.0 cm. long; staminal column 5.5–5.7 cm. long; petals 5.5 cm. long, 3.5 cm. wide.....H
- H. Calyx 2.8–3.0 cm. long; 1.2 cm. wide; lateral calyx nerves fused immediately below cleft.....6. *H. Kokio*
- H. Calyx 2.4–2.5 cm. long; 1.0 cm. wide; lateral calyx nerves fused 5–10 mm. below cleft.....7. *H. Kokio* var. *pukoonis*
- G. Calyx nonglabrous; petioles less than 2.0 cm. long; petals more than 5.5 cm. long, less than 3.5 cm. wide.....I
- I. Staminal column more than 5 cm. long; peduncles more than 1.0 cm. long.....J
- J. Calyx cleft 1.2–1.3 cm., pilose; petioles 0.5–1.8 cm. long; petals 6.5–6.7 cm. long, 2.5–3.0 cm. wide; staminal column ca. 6.0 cm. long.....8. *H. Saintjohnianus*
- J. Calyx cleft 2.0–3.0 cm., pubescent; petioles 0.3–0.8 cm. long; petals 6.0–6.5 cm. long, 1.0–1.2 cm. wide.....9. *H. kabilii*
- I. Staminal column less than 5 cm. long; peduncles less than 1.0 cm. long.....
-10. *H. Newhousei*
- F. Corolla white.....K
- K. Staminal column white, leaf margin denticulate, apex rounded.....11. *H. immaculatus*
- K. Staminal column red, leaf margin entire or serrate, apex almost acute.....L
- L. Leaves velvety to the touch; calyx cleft 1.0–1.5 cm.; bracts 1.5–2.5 cm. long.....
-12. *H. waimeae*
- L. Leaves lack velvety touch; calyx cleft only 0.5 cm.; bracts 0.5–1.0 cm. long.....M
- M. Leaves 4–10 cm. long, 4–7 cm. wide, ovate to elliptical-parabolical, glabrous; petioles 0.5–2.0 cm. long, glabrous.....N
- N. Leaves 8–10 cm. long, 5–7 cm. wide; calyx 2–3 cm. long.....13. *H. Arnottianus*
- N. Leaves 4–6 cm. long, 4–5 cm. wide; calyx 1–2 cm. long.....
-14. *H. Arnottianus* f. *parviflora*
- M. Leaves 10–25 cm. long, 8–20 cm. wide, ovate-subcordate, pubescent; petioles 3–12 cm. long, densely puberulent.....15. *H. Arnottianus* var. *punaluuensis*

1. *Hibiscus Youngianus* Gaud. ex H. & A.

Figs. 1-3

Hibiscus Youngianus Gaud. ex H. & A. Bot. Beechey Voy., p. 79. 1832.*H. furcellatus* Lam. var. *Youngianus* (Gaud.) Hochr., Ann. Conserv. Jard. Geneve, p. 132. 1900.

DESCRIPTION. Stiffly erect with a paucity of pithy branches, to 3 m. high (average ca. 2.5 m.), diameter at base ca. 8 cm., hirsute and pilose throughout, lateral branches very strongly ascending, nearly parallel to the main stem. Leaves more abundant above, "Scheele green" in color (cf. Ridgway); stipules 5-6 mm. long, 0.5 mm. wide, pubescent; petioles 9-13 cm. long, scabrous; blade 10-12 cm. long, 11-12 cm. wide, wide ovate, varying from nearly entire to moderately lobed, base cordate, upper portions acutish, margins serrate-dentate, both surfaces scabrous-hispid, this more abundant on the veins; veins 5-9, palmately arranged throughout the blade. Peduncle axillary, 1.5 cm. long, 3 mm. in diameter, puberulent. Involucral bracts 10-12, 1-1.3 cm. long, ca. 1 mm. diam., terete, bifid at apex. Calyx "Scheele green" (cf. Ridgway), 2.2-2.5 cm. long, 1.5-1.8 cm. diameter at throat, hirsute, cleft 1 cm., lobes lanceolate, veins 10, prominent, gland on midvein of each lobe at the throat level. Petals "mallow purple" (cf. Ridgway), 5.8-6.5 cm. long, 4-4.5 cm. wide, tubular at base, prominently nerved, microscopic hairs on both surfaces. Staminal column dark maroon-purple, 2.0-3.0 cm. long; free filament tips extend 1-2 mm. from column, arranged in rings approximately 5 mm. apart; anthers deep purple; style inconspicuously exerted; style branches 1-2 mm. long, each terminating in a 1 mm. discoid stigma. Ovary ca. 1.0 cm. long, 8 mm. in diameter; seeds numerous, 2.8 mm. long, 2.0 mm. wide, dark brown, glabrous.

This species was first brought to our attention by Gaudichaud (1826): "...un hibiscus nouveau de la section 5 (furcaria) de M. Decandolle (h. youngiana)..." (*nomen nudum*). The first description was made in 1832 by

Hooker and Arnott, who credited the species to Gaudichaud, ex Hooker and Arnott. Hillebrand (1888) included this species, as did Heller (1897). Both authors regarded it as a true indigenous species. However, in 1900, Hochreutiner monographed the genus and reduced *H. Youngianus* to a variety of *H. furcellatus* Lam., and cited specimens of the latter from Central and South America as well as from Hawaii.

I have grown the species in question for several years and I know its morphology and growth habits well. I have also obtained and observed *H. furcellatus* Lam. and find the two populations very similar. It is easy to see how Hochreutiner arrived at his conclusion. However, after examining them minutely I feel that their differences warrant the classification of them as distinct species.

Table 1 shows several important distinguishing characteristics.

Skottsberg (1926) reviewed Hochreutiner's revision and concluded that the latter's proposed close proximity of *H. Youngianus* and *H. furcellatus* was an improbable one.

A contradiction regarding locality might also be thought to exist when comparing a statement of Hillebrand's found in small print following his description of *H. Youngianus* ("In marshes and abandoned taro patches here and there on all the islands...") with a statement of Mrs. Sinclair's (1885) that the species

...was once a common flower in nearly all valleys and sheltered places; seeming to flourish equally well on both the leeward and windward sides of the islands. Now cattle and cultivation have almost exterminated the plant on the dry lee-side, but it is still frequently met with on the windward side; where, owing to the more luxuriant vegetation, many plants, which have disappeared from the leeward side, are still found. The Hauhele [*sic*] was once so plentiful in many parts that the 'aho' (thatching sticks) of the houses were made of the stems, and anyone who knows what a great quantity of 'aho' a single, old-fashioned house required, will readily see how abundant the plant must have been.

FIG. 1. *Hibiscus Youngianus* Gaud. ex H. & A. Kawainui Swamp, Kailua, Oahu. Roe no. 205. Half scale. a, Cross section of ovary, $\times 1$; b, staminal column, $\times 1$.



TABLE 1

PART	<i>H. Youngianus</i>	<i>H. furcellatus</i>
<i>Stipules</i>	length 5–6 mm. vesture hirsute	length 8–10 mm. vesture short, stellate
<i>Leaf color</i>	"Scheele green" (yellowish green)	"grass green" (bluish green)
<i>Leaf shape</i>	apex acute blade roundly lobed	acuminate blade acutely cleft
<i>Stem</i>	puberulent, hirsute	pilose
<i>Bracts</i>	length 1–1.3 cm. vesture densely hispid	length 1.5–2.1 cm. vesture short, stellate
<i>Calyx of fresh flower</i>	hairs 1–1.5 mm. in length sepal length 2.2–2.5 cm. calyx diameter at throat 1.5–1.8 cm. densely hispid cleft 1 cm. from sepal apex veins raised	hairs microscopic sepal length 1.7–1.8 calyx diameter at throat 1.1–1.3 cm. sparsely hispid cleft 1.8 cm. from sepal apex veins extremely raised
<i>Petals</i>	length 5.8–6.5 cm. width 4–4.5 cm. color, "mallow purple" (deep pink)	length 4–5 cm. width 2.5–3 cm. color, light "phlox purple" (pale pink)

Hillebrand is correct in stating that *H. Youngianus* is a marshland plant, for I have collected it growing in several inches of water in the central area of Kawainui Swamp, Oahu, and similarly in water at the foot of Wailua Falls, Kauai. But likewise, Mrs. Sinclair could be correct in her statement of locality, for I have recently observed it in upper Manoa on a rather dry slope, but in a rainy belt. The species, however, grows more luxuriantly and flowers continually in a wet environment. I have grown it in areas

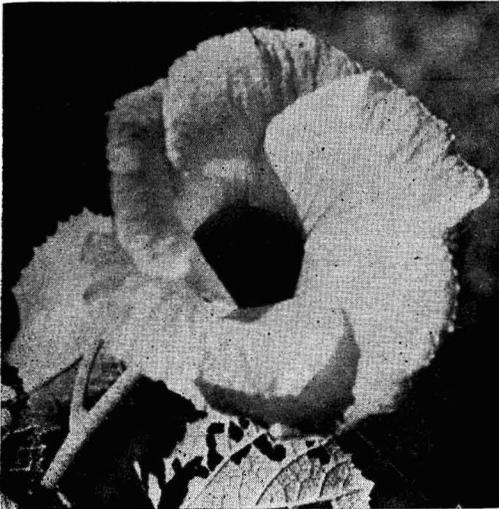


FIG. 2. *Hibiscus Youngianus* Gaud. ex H. & A.

of little rainfall. It continues to grow, but much less vigorously than in swamp areas.

Heller (1897) is incorrect in stating, "It is found only on Oahu." It has been collected on all of the major islands except Molokai, Lanai, and Niihau. (See Fig. 3.)

SPECIMENS EXAMINED: *Hawaii*: Rainbow Falls, May 16, 1915, C. N. Forbes 525.H. Lava flow near Hilo, May 17, 1915, C. N. Forbes 545.H.

Kauai: Hanalei, August 4, 1909, C. N. Forbes 128.K. Wailua Falls, October 5, 1916, C. N. Forbes 498.K. Wailua Falls, July 26, 1957, on the bank of the pool at the bottom of the falls, Roe 251. Weoweopilau Stream, on banks of stream near cane fields, altitude 500 feet, July 28, 1957, Roe 256.

Mauai: Haleakala, October 10, 1922, Skottsberg 793.

Oahu: Woodlawn, Manoa, October 2, 1933, Neal. Waihole Valley, November 4, 1938, Neal. Waihole Ditch, May 1957, Pearsall. Kawainui Swamp, Kailua, May 4, 1930, St. John. Manoa about 500 yards off Woodlawn Drive, about ¼ mile west of Old Ti Slide, altitude 550 ft., October 31, 1956, Roe 203. Kawainui Swamp, Kailua; plant growing in water, December 31, 1956, Roe 205.

Hawaiian Islands: H. Mann & W. T. Brigham 598. Onekahakale Beach, August 15, 1936. V. O. Fosberg 64.

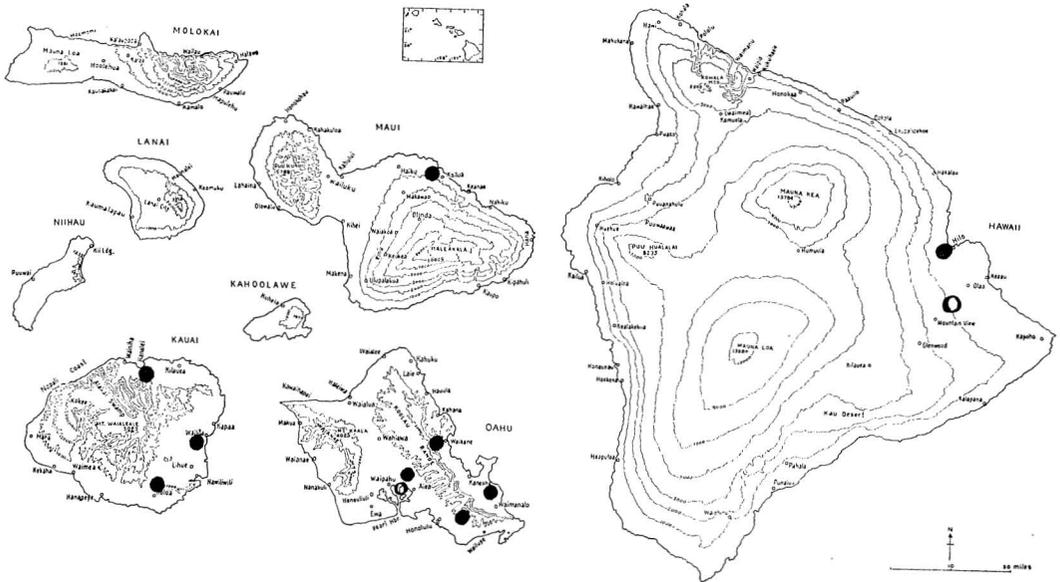


FIG. 3. Distribution of *Hibiscus Youngianus*. Solid circles indicate localities for which exact data are available; open circles represent localities where species have been reported but plants are unavailable.

2. *Hibiscus Brackenridgei* Asa Gray

Figs. 4, 5

Hibiscus Brackenridgei Asa Gray. Bot. U. S. Expl. Exped., p. 175. 1838.

DESCRIPTION: Shrubby plant, glabrous, leafy. Leaves rounded in outline and subcordate, diameter 5–10 cm., 5–7 lobes separated by acute and narrow sinuses, coarsely toothed, terminal lobe prolonged. Stipules setaceous, caducous. Flowers axillary; peduncle 5 mm. long, puberulent and sparingly hispid; bracts 8, rigid, setaceous-subulate, glabrous, nonglanduliferous. Calyx hispid, cleft to below the middle, lanceolate lobes each bearing dorsal gland on midrib near the base. Corolla yellow, green when dry. Petals 4–5 cm. long, externally stellate, pubescent. Staminal column antheriferous throughout, apex 5-toothed. Style branches hirsute; stigmas depressed-capitate. Ovary densely villous-hispid. Capsule 2 cm. long, ovoid, closely invested by calyx, silky-hispid. Seeds angled, minutely tomentose.

HOLOTYPE: From West Division of Maui, in Gray Herbarium. (In the Bishop Museum Herbarium are preserved a leaf and fruit of material used by Gray.)

SPECIMENS EXAMINED: *Lanai*: Maunalei, March 1918, *G. C. Munro* 638. Awalua, January 1919, *Munro*. Kanepuu, June 15, 1927, *Munro*. Kaena, April 1921, *Munro*. Puhiehelu, May, 1921, *Munro*.

Maui: Pohakea Gulch, West Maui, on a very arid slope, June 11, 1927, *Degener and Wiebke* 3634, 3635. Brown Hill, Kula, *Hillebrand and Lydgate*.

H. Brackenridgei, in at least one of its forms, has been reported and collected on the islands of Oahu, Maui, Lanai, Molokai, Kauai, and Kahoolawe. After gathering together specimens, descriptions, and illustrations of the group, and after studying the original type specimen, description, and locality, the following conclusions have been reached. There are at least four distinct groups in the population. As the original plant described by Gray (1854) was located "on a mountain in the west division of Maui," this Maui plant, a portion of which type specimen is in the Bishop Museum Herbarium, is rightly the true *H. Brackenridgei* Gray.

In 1930 Caum published two varieties: *H. Brackenridgei* Gray var. *molokaiana* Rock and var. *kauaiana* Caum. The holotypes for these two



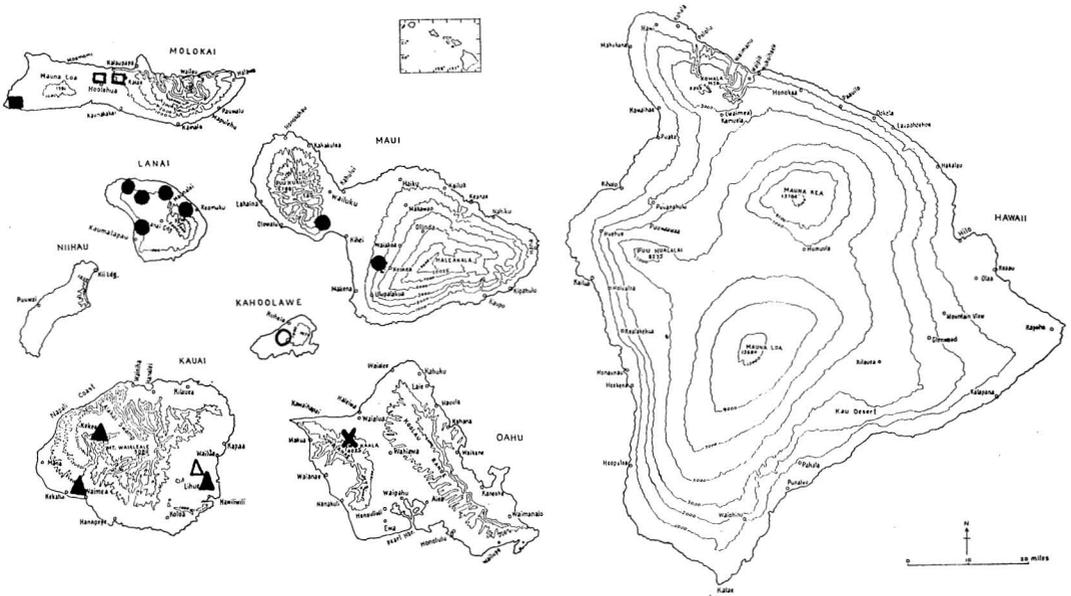


FIG. 5. Distribution of *Hibiscus Brackenridgei* populations:
 Solid circles, *H. Brackenridgei* (exact data)
 Open circles, *H. Brackenridgei* (plants unavailable)
 Solid squares, var. *molokaiiana* (exact data)
 Open squares, var. *molokaiiana* (plants unavailable)
 Solid triangles, var. *kawaiiana* (exact data)
 Open triangles, var. *kawaiiana* (plants unavailable)
 X, var. *mokuleiana* (exact data)

varieties are at the Bishop Museum.
 I have studied various specimens of the Lanai plants and cannot find sufficient difference from the Maui population to maintain it as an endemic variety.
 We have records that Jules Remy made collections of this species on the island of Kahoolawe between 1851–1855 (Remy no. 559). Remy’s specimens are not available and the plants can no longer be found on Kahoolawe, so a statement cannot be made regarding their taxonomy.

3. *Hibiscus Brackenridgei* var. *molokaiiana* Rock
 Figs. 5, 6

Hibiscus Brackenridgei Gray var. *molokaiiana*
 Rock. New Hawaiian Plants, Bishop Mus.
 Occ. Pap. 9(5): 4, pls. 2, 3. 1930.

DESCRIPTION: Straggling shrub; leaves 6–8 cm. long, deeply lobed; involucre bracts 8–9, linear, subulate, terete, glanduliferous on inner side, 2.5 cm. long, 2.5 mm. wide, hirsute with long yellowish hairs, adnate to base of calyx. Calyx “carmine red,” 1.5–2.0 cm. long, lobes prominently midribbed and nonglandular. Corolla “canary yellow,” tube “deep purple.” Petals 5 cm. long, 4.5 cm. wide, 10–12 veined, stellate puberulence on outside. Ovary densely villous-pubescent with whitish hairs. Staminal column 4 cm. long, irregularly antheriferous, naked at the base for 1 cm., puberulent. Free filament tips 2.5 mm. long. Style branches 2 mm. long, hirsute. Stigmas depressed, capitate.
 HOLOTYPE: Rock, west end of Molokai, February 1920.
 This variety was first found by Rock on west-

FIG. 4. *Hibiscus Brackenridgei* Gray. From West Maui. (This illustration, presented by Otto Degener, was made from his specimens collected on Maui.)

ern Molokai, back of Kalaeokalaau in 1910, and collected there by him again in 1920. Cuttings were made and several plants were cultivated at the "Rockery" on the University of Hawaii campus. I have since tried to find traces of this variety again on Molokai but with little success. Henry Wiebke, principal of Holomua School, Hoolehua, told me that he collected it in the late 1920's but cannot find it now. Mrs. Cooke, Molokai resident, is anxious to preserve the variety also but has been unable to locate it. (She did have several plants growing along her driveway until a few years ago.)

4. *Hibiscus Brackenridgei* var. *kauaiana* Caum
Figs. 5, 7

Hibiscus Brackenridgei Gray var. *kauaiana*
Caum. New Hawaiian Plants, Bishop Mus.
Occ. Pap. 9(5): 5-6, pl. 4. 1930.

DESCRIPTION: Erect to spreading shrub to 1 m. Leaves dentate, cordate, 8 cm. long, 8 cm. wide, shallowly 3-lobed, densely pubescent on both surfaces. Petioles 4-5 cm. long, pubescent. Stipules setaceous. Peduncles 1.5 cm. long; 5 bracts, 3 cm. long, 8 mm. wide, halberd-shaped, not terete, not glanduliferous, hirsute with short hair. Calyx 2.5 cm. long, triangular lobes each with an oblong gland at the base of a thick mid-

rib, hirsute with colorless hairs, glabrous on inner surface. Corolla 12 cm. in diameter, "lemon yellow" to "canary yellow," dark "reddish-purple" throat 3 cm. deep. Petals spreading, slightly reflexed at tips, 6 cm. long, 5 cm. wide, 14-16 nerved. Ovary pubescent with colorless hairs. Staminal column 3 cm. long, irregularly antheriferous for entire length, glabrous; lower filaments 5 mm. long, upper ones shorter. Style branches 2 mm. long, hirsute. Stigmas capitate, depressed, deep "reddish-purple." Capsule ovoid, acute at tip, 2.5 cm. high, 17 mm. maximum diameter. Seeds broad-reniform, 3 mm. long, hirsute with short gray hair.

HOLOTYPE: E. L. Caum. From plants in cultivation at 1420 Piikoi Street, Honolulu.

SPECIMENS EXAMINED: *Kauai*: Waiawa, April 1919, *Rock* 16038; also *Rock* 17141. "V. Knudsen's home," 1919, *Rock*. Waimea, near Hale Manu, altitude 3300 feet, July 28, 1957, *Roe* 253, 254, 257.

Oahu: 1420 Piikoi Street, cuttings from original type plant, *Caum*. 1508 Alexander Street, cuttings from Hale Manu plant, *Roe* 307.

H. Brackenridgei var. *kauaiana* is quite uncommon. I located it at Hale Manu near Kokee, but there were only three plants of it at this location. In tracing its origin to the Waimea area I found cuttings had been brought up there from a wild plant at a lower elevation. The original plant has not been found.

Several collectors, including Rock, have mentioned two distinct varieties of *H. Brackenridgei* on Kauai, one more arborescent than var. *kauaiana* Caum. In 1957 I made cuttings of a plant not in flower on Kauai that I felt had different growth habits. This plant is in cultivation now, with one also thought to be of this arborescent Kauai variety, given to me in July, 1958, by Rock. They have not flowered, so at present taxonomic judgment cannot be passed on their distinctness.

5. *Hibiscus Brackenridgei* var. *mokuleiana*
nov. var.

Figs. 5, 8

DESCRIPTION: Arbor 10-12 m. alta basi 20-25 cm. diametro. Stipulis 1-2 cm. longis pilosis. Petiolo 6-9 cm. longo piloso, lamina 9-11 cm.



FIG. 6. *Hibiscus Brackenridgei* var. *molokaiana* Rock. (Picture taken by Joseph F. Rock.)

longa 8–10 cm. lata, 5-lobatis sinibus angustis, basi cordate, margine serrata, nervis palmatis. Pedunculo 1.5 cm. longo, piloso echinatoque. Bracteis 7–8, 2–3 cm. longis subulatis teretibus, nonglanduliferibus, hispidis. Calyce campanulata 3–4 cm. longa, 1.5–1.8 cm. lata lobis eglanduliferis inter lobos 1.5 cm. partitis extus hispida deci-nervata. Corolla citrea, tubo atro purpureo. Petalis 8–10 cm. longis 5–8 cm. latis extus pubescentis, 12–16 nervatis. Ovario 0.8–1.0 cm. longo, 5 cm. lato, dense albo-villoso. Columna staminea 7–8 cm. longa puberula extremitates filamentorum liberae verticillatae per totam columnam longitudinem exsertae, ramuli styli 2 mm. longi tomentosi, stigmis capitatis compressis. Capsula 2.0–2.5 cm. longa lignea pilosa. Seminibus angulosis hirsutis.

Tree 10–12 m. tall, 20–25 cm. in diameter at base. Stipules 1–2 cm. long, pilose. Petiole 6–9 cm. long, pilose. Leaf 9–11 cm. long, 8–10 cm. wide, 5-lobed with narrow sinuses, base cordate, apex acute, margin serrate, palmately veined. Peduncle 1.5 cm. long, pilose and bristly; bracts 7–8, 2–3 cm. long, subulate, terete, nonglanduliferous, hirsute hairs 2–3 mm. long; calyx campanulate, 3–4 cm. long, 1.5–1.8 cm. wide, lobes nonglanduliferous, cleft 1.5 cm. from apex, hirsute with colorless hair on outer surface, inner surface glabrous, 10-veined. Corolla "lemon yellow," tube "deep purple." Petals 8–10 cm. long, 5–8 cm. wide, pubescent on outer surface, 12–16-veined. Ovary 0.8–1.0 cm. long, .5 cm. in diameter, densely pubescent with white villous hairs. Staminal column 7–8 cm. long, puberulent, free filament tips extend in rings the entire length of column. Style branches 2 mm. long, tomentose. Stigmas capitate, depressed. Capsule 2.0–2.5 cm. long, woody, pilose. Seeds angulate, hirsute.

HOLOTYPE: *Roe 210*. Second gulch east of Mt. Kaala, Oahu. Altitude 600 feet; about 40 ft. up a stream bank.

SPECIMENS EXAMINED: *Oahu:* Gulch north of middle ridge between Puu Kamaokanui and Puu Pane, Jan. 10, 1932, *O. Degener 8961*, also 8962, 8963. First small gulch northwest of Puu Pane Peak, April 2, 1950, *O. Degener 20943*. Kapalama Heights, Kamehameha Girls



FIG. 7. *Hibiscus Brackenridgei* var. *kauaiana* Caum.

School (in cultivation) March 21, 1932, *A. F. Judd*. Waianae Mountains, near Mokuleia Forest Reserve, near valley on slope of Puu Iki, altitude 500 ft., May 13, 1941, *Karl Korte*. Waianae Mountains, Mokaleha Cliffs, May 1917, *Rock 12986*. Waianae Mountains, Mokuleia area, February 16, 1957, *Roe 219*. In cultivation on Alexander Street, Honolulu, April 9, 1958, *Roe 269*. Waianae Mountains, Mokuleia, second gulch east of Puu Kaupakuhale, northeast of Puu Kaala, May 14, 1933, *St. John 13184*.

There exists on Oahu in the Mokuleia section a population of the species that shows distinct differences from the original Maui plants. This Mokuleia variety has been collected by Rock, A. F. Judd, Potter, St. John, Degener, K. H. Korte, and others. Degener made a notation on his plants nos. 8961, 8962, 8963 from this area, stating that this was a variety of *H. Brackenridgei* Gray. Rock recently gave me a photo of a tree of this taxon and on the back of the picture he had written "*Hibiscus Brackenridgei* var., 1917. J. F. Rock, Makaleha Cliffs, No. 12, 986."

This variety takes the form of an erect tree (reaching 30 ft.). It differs from the species in its leaf shape, size, and pubescence, and in bract number and surface lengths of petiole, stipules, calyx, petals, and column.

SUMMARY OF DISTINGUISHING CHARACTERS
OF *H. Brackenridgei* POPULATIONS

Upon observation of the *H. Brackenridgei* populations, it is evident that four groups are distinct. Var. *molokaiana* stands apart for its long petioles and small, deeply lobed leaves; var. *kauaiana* has larger leaves, entire to shallow lobed; and var. *mokuleiana* is definitely arborescent, bearing larger flowers. Table 2 compares the differentiating characters.

6. *Hibiscus Kokio* Hbd.

Figs. 9-11

Hibiscus Kokio Hillebrand. Flora of the Hawaiian Islands, p. 173. 1873.

H. Boryanus Hook & Arn. Bot. Beechey Voy., p. 79. 1841.

H. Arnottianus A. Gray in Bot. U. S. Expl. Exped. 1: 176 (pro parte). 1854.

H. Arnottianus var. *Kokio* Hochr. Ann. Conserv. Jard. Bot. Geneve 4: 133. 1900.

H. Arnottianus forma Sinclair. Indig. Fl. Haw. Isl., p. 9. 1885.

DESCRIPTION: Tall shrub with straggly branches from the base, growing to 20 ft.; few

lateral branches. Stipules 8 mm. long, glabrous. Petioles, 2-4 cm. long. Leaves 9-12 cm. long, 4-6 cm. wide, elliptical-ovate, long-acuminate apex, margin sinuately crenate, smooth surface, scarcely palmately veined. Peduncle 3.0 cm., articulate 5 mm. from involucre base. Involucre 6-7 lanceolate bracts, 1.3 cm. long, 1.5 mm. wide, slightly puberulent. Calyx 2.5-2.8 cm. long, 1.3 cm. wide, 10-veined, cleft 1 cm. from tips, 5 lobes, lanceolate, no glands, "lettuce green" in color, glabrate. Flowers axillary. Staminal column 5.5 cm. long, "scarlet red." Free filament tips extend 4 mm. from column, occupy apical 1.5 cm. of column. Style extension 4 mm.; style branches (horizontal) 8 mm. long. Petals 5.5 cm. long, 3.5 cm. wide, "scarlet red." Ovary truncate-conical, 6 mm. long, 4 mm. wide, pubescent (short, colorless hairs). Capsule glabrous, 2.5 cm. long. Seed reniform, 4 mm. long, brown, coarsely pubescent.

The nomenclature of this taxon is closely correlated with that of *H. Arnottianus* Gray. A discussion of their confusion can be found in the section of this paper dealing with the latter species. Gray's original description of *H. Arnottianus* included a fragment of a red-flowered hibiscus as well as the white.

TABLE 2
DISTINGUISHING CHARACTERS OF *H. Brackenridgei* POPULATION

CHARACTERS	<i>H. Brackenridgei</i>	VAR. <i>molokaiana</i>	VAR. <i>kauaiana</i>	VAR. <i>mokuleiana</i>
Growth habits.....	shrub	rambling shrub	rambling shrub	tree to 30 ft.
Leaf lobing.....	deeply cleft (5-7)	deeply cleft (5)	shallow-lobed (3)	moderately lobed
Leaf length.....	5 cm.	3-5 cm.	7-9 cm.	9-11 cm.
width.....	5 cm.	5-6 cm.	7-9 cm.	8-10 cm.
Stipules.....	0.5-1 cm. long	1 cm. long	1 cm. long	1-2 cm. long
Petiole.....	nearly glabrous	puberulent	densely pubescent	puberulent
Bract number.....	8-10	8-9	5	7-8
Bract shape.....	setaceous, terete	subulate, terete	hastate, not terete	subulate, terete
Bract glands.....	none	glands on inner side	none	none
Bract surface.....	almost glabrous	hirsute	hirsute	hirsute
Bract length.....	1 cm.	2.5 cm.	3.0 cm.	2-3 cm.
Calyx venation.....	10-veined	5-veined	5-veined	10-veined
Calyx length.....	1.5 cm.	1.5 cm.	2.5 cm.	3-4 cm.
width.....	1.5 cm.	1.0 cm.	1-1.5 cm.	1.5 cm.
Calyx glands.....	present	none	present	none
Petal length.....	3.5 cm.	5.0 cm.	6.0 cm.	8-10 cm.
width.....	2.5-3 cm.	4.5 cm.	5.0 cm.	5-8 cm.
Column length.....	4.0 cm.	4-5 cm.	2.5 cm.	7-8 cm.
	naked at base for 1 cm.	naked at base for 1 cm.	completely antheriferous	completely antheriferous



FIG. 8. *Hibiscus Brackenridgei* var. *mokuleiana* Roe. (Picture was presented by Joseph F. Rock.)

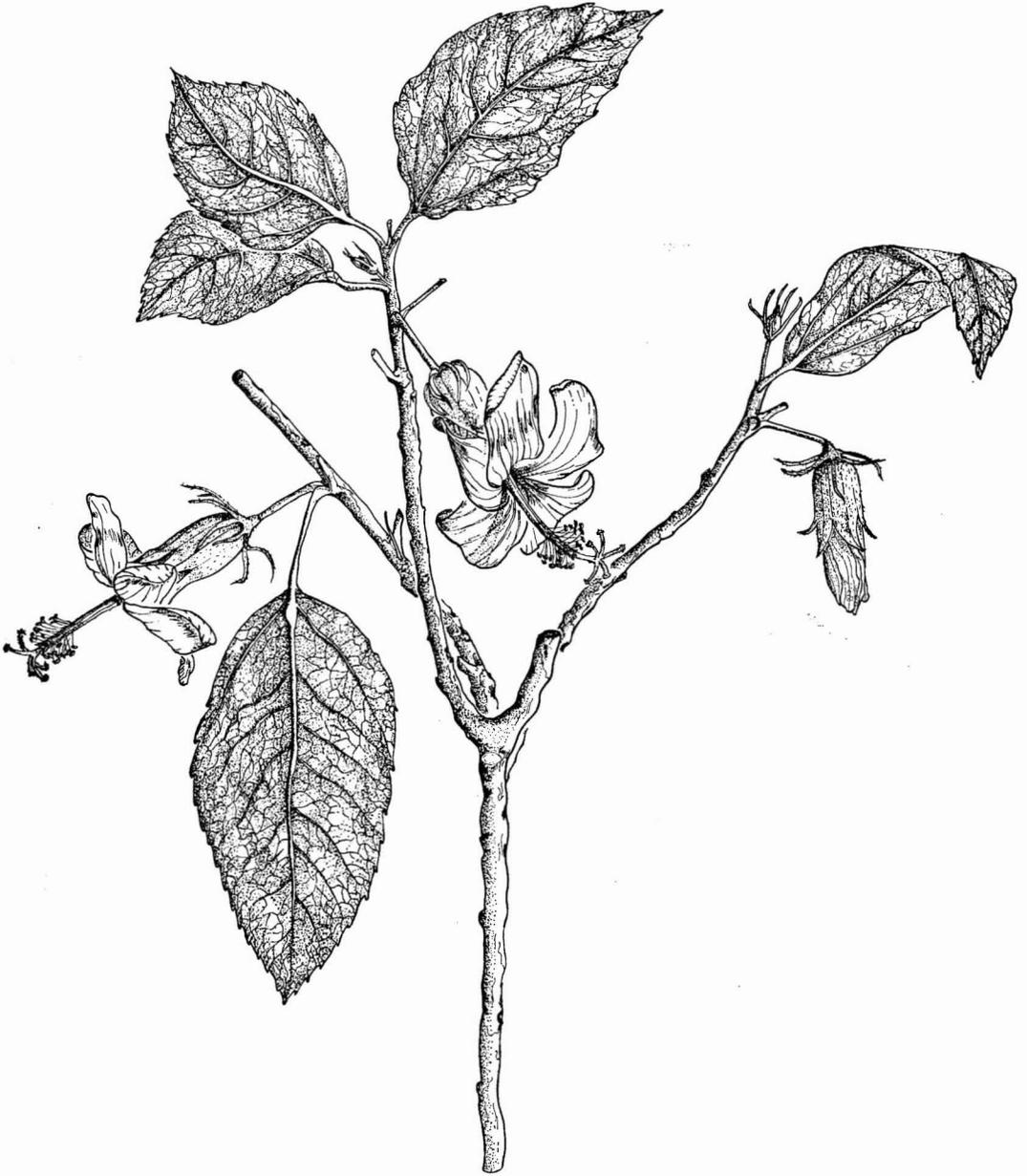


FIG. 9. *Hibiscus Kokio* Hbd. Plant collected on Nov. 23, 1956 at Kawaiiki Ditch Dam. Roe no. 204. (Thin straggly branch reaching 30 ft. in length.) Altitude 1,080 ft.

This red flower, as insignificant as it is in comparison with other luxuriant Hawaiian members of the genus, was designated in 1923 as the official flower of the Hawaiian Islands. This specimen has been collected by many botanists at the end of the Kawaiiki Ditch Trail overhanging the dam (Kawaiiloa, Koolau Range, elevation 1,080 ft.). From this location, many cuttings have been made and brought to cultivation.

As *H. Kokio* is known to hybridize freely, taxonomists hesitate to classify new groups. However, there seems to be a native red-flowered plant on eastern Kauai still undescribed. Sufficient material is not available to permit satisfactory classification; however, it appears that this group is a new species, closely allied to *H. Kokio* Gray and *H. kabilii* Forbes. The remaining Kauai native reds fall into either of the latter two taxa or that of the newly established species, *H. Saintjohnianus*.

At Puu Ka Pele in Waimea the Kokee rangers recently reported a red-flowered hibiscus. This has been collected by several botanists who have labelled it *Hibiscus* sp. After bringing it to cultivation and watching it for a year, the author has concluded that it is an introduced species bearing a large, reddish-purple flower.

HOLOTYPE: Fragment of the original type now in the Bishop Museum Herbarium reads "Ex Museo botanico Berolinensi." (From cultivated species in Hillebrand's garden.)

SPECIMENS EXAMINED: *Kauai:* In cultivation, 1913, Dewitt Alexander. Nonau Mountains, Oct. 16, 1916, *C. N. Forbes* 599.K. West side of Nualolu Pali, Waimea Drainage Basin, July 3, 1917, *C. N. Forbes* 963.K.

Oahu: Kanaikupai, Waianae Range, February 14, 1913, *C. N. Forbes* 1814.O. Kalihi Valley, October 1928, *A. F. Judd* 37. In cultivation at Queen Liliuokalani's Residence, Honolulu, Spring, 1916, *Rock*. Kawaiiki Ditch Trail, Kawaiiloa, Koolau Range, altitude 1080 feet, November 23, 1956, *Roe* 204. In cultivation at Foster Gardens, Honolulu, July 7, 1957, *Roe* 226. In cultivation at the Hibiscus Gardens at Waikiki, July 11, 1958, *Roe*. Ditch Trail (near intake), Koolau Range, 1922, *Skottsberg* 203. In cultivation, Honolulu, 1913, *Gerrit P. Wilder*.



FIG. 10. *Hibiscus Kokio* Hbd.

Hawaiian Islands: *H. Mann* and *W. T. Brigham*, 218.

7. *Hibiscus Kokio* var. *pukoonis* Caum
Fig. 11

Hibiscus Kokio var. *pukoonis* Caum. New Hawaiian Plants, Bishop Mus. Occ. Pap. 9(5): 7. 1930.

DESCRIPTION: A shrub 2–3 meters tall. Stipules 0.5–0.8 cm. long, setaceous. Petioles 2–4 cm. long. Leaves 8–12 cm. long, 4–7 cm. wide, ovate to elliptico-oblong, acuminate, sinuately crenate, scarcely palmately veined; soft-chartaceous. Peduncles 2.5–4.5 cm. long, solitary in axils near end of branches. Bracts 6–8, linear-lanceolate, 10–15 mm. long, 1.0–1.5 mm. wide, not adnate to calyx, glabrate. Calyx 2.5 cm. long, 1.0–1.3 cm. wide, cleft for 1.0 cm.; lobes acute, glabrate, tripli-nerved, the lateral nerves fuse 0.5–1.0 cm. below cleft, the calyx being 10-nerved at the base, nonglanduliferous. Petals 3–3.5 cm. wide, 6-nerved, slightly ciliate at margin, obovate, "scarlet red." Staminal column 5.0–6.0 cm. long, slender, light red, glabrous, acutely 5-lobed; free filament tips extend 0.3–0.4 cm.

from column, crowded on distal fifth of column. Style extension 2 mm. above column, branches 0.7 cm. long, red, ciliate, spreading slightly upward from the horizontal. Stigmas capitate, 0.1 cm. in diameter, red. Ovary truncate-conical, 0.5 cm. long, 0.3 cm. wide, scarcely puberulent with short appressed colorless hairs. Capsule glabrous, 1.5–2.0 cm. long. Seeds reniform, 0.4–0.5 cm. long, brown, coarsely pubescent.

In 1930, Caum published a variety of *H. Kokia* which he had collected just inside the native forest at the bottom of Pukoo Valley on Molokai (E. L. Caum, no. 155, Feb., 1921). He named this group of plants var. *pukoonis*. These plants do not flower freely and very rarely set fruit. They differ from the species in the texture and other characters of the leaf, petal shape and color, venation of the calyx, and other characters.

HOLOTYPE: E. L. Caum no. 155. Planted at Caum's Honolulu residence (1420 Piikoi St.), taken from bottom of Pukoo Valley, Molokai, just inside the native forest, February, 1921. (Specimen in the Herbarium of Bishop Museum.)

SPECIMENS EXAMINED: *Molokai:* Wailau Trail, 1912, C. N. Forbes 327.Mo. Halawa (the ridge south of the valley), August 1912, C. N. Forbes 472.Mo. Moist woods of Wailau Valley, elevation 500 feet, July 3, 1933, St. John 13230.

Oahu: In cultivation 1420 Piikoi St., Honolulu, October 8, 1930, E. L. Caum 155 (duplicate). In cultivation in the University of Hawaii Arboretum, October 25, 1956, Roe 202; also April 14, 1957, Roe 222. In cultivation on Alexander Street, Honolulu, May 30, 1958, Roe 270. In cultivation, 2365 Oahu Avenue (brought from Molokai by W. T. Pope), 1931, St. John 11170.

8. *Hibiscus Saintjohnianus* sp. nov.

Figs. 12–14

DESCRIPTION: Arbor 6 m. alta basi 5–8 cm. in diametro. Stipulis 7–12 mm. longis. Petiolo 0.5–2.0 cm. longo piloso; lamina 6–12 cm. longa 3–5 cm. lata elliptica vel oblonga, margine basi versus integro, nervo medio conspicuo, nervis haud palmatis, viride spinacii colorata (cf. Ridgway). Pedunculo 1–1.5 cm. longo 3

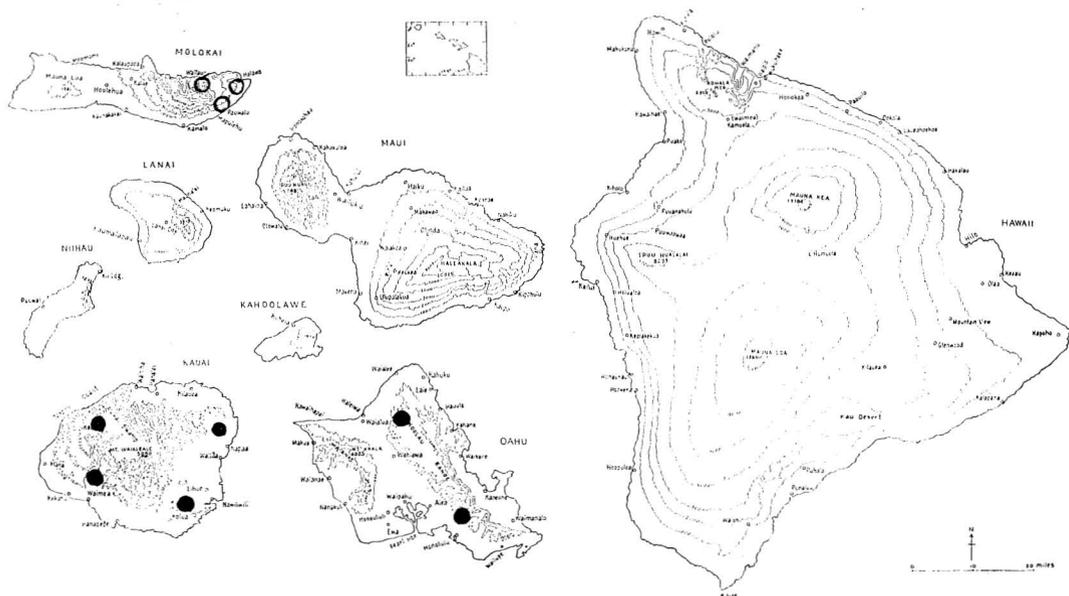


FIG. 11. Distribution of *Hibiscus Kokia* populations:
Solid circles, *Hibiscus Kokia*
Open circles, *Hibiscus Kokia* var. *pukoonis*



FIG. 12. *Hibiscus Saintjohnianus* Roe. Headland west of Hanakaiaia, Napali Coast, Kauai. Altitude 700 ft. St. John 25989. Dec. 22, 1956.

mm. infra involucreum articulato; bracteis 7–8 lanceolatis 5–8 mm. longis. Calyce 3 cm. longo 1.5–1.8 cm. lato tubulato partito 1–1.3 cm. piloso 10-nervato lobis acutis viride lactucae coloratis (cf. Ridgway); petalis 6.5 cm. longis 2.5–3.0 latis rubro-coralaceis coloratis extus pubescentis; columna staminarum 6 cm. longa gracilis glabra in apice 5-lobata acuti, apicibus filamentium liberis 4–5 mm. longis in quarta superiore columnae collacatis. Ramuli styli 5, 1.0 cm. longi modice puberulenti in 1.5 mm. stigma globosa terminanti. Ovario 5-loculare 1.0 cm. longis 6–8 mm. latis. Capsula 2.0 cm. longa 2.5 cm. lata superne. Seminibus 4 mm. longis 3 mm. latis globoso-reniformibus, fusco-sericeis.

Tree 6 m. tall, diameter at base 5–8 cm. Stipules 7–12 mm. long. Petiole 0.5–2 cm., slightly pilose. Leaves 6–12 cm. long, 3–5 cm. wide, elliptic-oblong, upper three-fourths of margin serrate, lower fourth entire, midrib prominent, veins scarcely palmate, "spinach green." Peduncle 1–1.5 cm. long, articulate 3 mm. below the involucre. Lanceolate bracts 7–8, 5–8 mm. long. Calyx tubular, 3 cm. long, 1.5–1.8 cm. wide, cleft for 1–1.3 cm., lobes acute, pilose, 10-nerved, "lettuce green." Petals laterally subfalcate, 6.5 cm. long, 2.5–3.0 cm. wide, "coral red," puberulent on outer surface. Staminal column 6 cm. long, slender, glabrous, apex acutely 5-lobed. Free filament tips extend 4–5 mm. from column, located on the upper fourth of column. The 5-style branches slightly puberulent, 1 cm. long, each terminating in a 1.5 mm. discoid stigma. Ovary 5-parted, 1 cm. long, 6–8 mm. wide. Capsule 2.0 cm. long, 2.5 cm. wide at upper section. Seeds 4 mm. long, 3 mm. wide, globose-reniform, covered with a sericeous pubescence, dark brown.

HOLOTYPE: Headland west of Hanakapiai, Napali Coast, Kauai. Altitude—700 feet; on partly precipitous slope. December 22, 1956. *H. St. John* 25,989.

SPECIMENS EXAMINED: *Kauai:* Hanakoa, altitude of 500 ft., Jan. 12, 1956, *H. F. Clay*. Kalalau Trail, Hanakapiai, September 1913, *C. N. Forbes* 462. *K.* Hanakapiai, between Hanakapiai Stream and Hoolulu Stream, 450 m. alt., December 24, 1956, *I. E. Lane* 56-561. In cultivation at



FIG. 13. *Hibiscus Saintjohnianus* Roe. (Picture taken by Irwin Lane on the Napali Coast, Kauai.)

Eleele, brought there from Awaawa Puhi Trail, Na Pali Kona Reserve, Waimea, July 29, 1957, *Roe* 258. In cultivation at Alexander Street, Honolulu; brought from Na Pali Cliff Trail, June 1, 1958, *Roe* 271.

This species was brought to my attention by H. St. John, who has made several collections of it from Hanakapiai, Napali coast, Kauai. It has been confused with *H. Kokio* Hbd. and *H. kabilii* Forbes. To one who is familiar with these two native species, this plant is differentiated by the distinct leaf shape and by the vermilion-orange corolla. It has closest affinity to *H. Kokio*, from which it differs by its longer stipules, shorter bracts, larger calyx, longer yet narrower petals, longer staminal column, larger ovary, longer style branches, and shorter peduncle.

There are records at the Bishop Museum stating that J. M. Lydgate brought it to cultiva-

tion at his home on Kauai. I investigated the grounds of his estate in 1957, desiring to locate this and other native *Hibiscus* that have been recorded as planted there by him, but none of them remain.

This species is in cultivation on Kauai, as I recognized it on several occasions, collecting it in Eleele. The Eleele plants were recorded as having been brought from Awaawa Pui Trail, Na Pali Kona Reserve (Waimea).

Irwin Lane, University of Hawaii, located the species in 1957 at Hanakapiai.

I have the plant in cultivation on Alexander Street, Honolulu. It is also growing at Foster Botanical Gardens in Honolulu. Both plants are from cuttings made by St. John on the Napali coast, Kauai.

9. *Hibiscus kabilii* C. N. Forbes

Fig. 14

Hibiscus kabilii C. N. Forbes. New Hawaiian Plants, Bishop Mus. Occ. Pap. 5(1): 4. 1912.

DESCRIPTION: Tree growing to 8 m. Petiole 3–8 mm. long, scabrous on both sides of blade and petiole. Leaves 5–7 cm. long, 3–5 cm. wide, ovate-elliptic, margin serrate on the upper half, lower portion entire. Peduncles 1.5 cm. long, flowers axillary. Calyx 2.5–3.0 cm. long, 1–1.5 cm. width at throat, cleft 2–3 mm. from top, pubescent. Petals 6.0–6.5 cm. long, 1.0 cm. wide, bright red, pubescent on outer side only, oblong-spatulate. Staminal column 5 cm. long. Styles 8–10 mm. long. Capsule unknown.

HOLOTYPE: Near Wahiawa Swamp, foot of Mt. Kahili, Wahiawa Mountains, Aug., 1909. *C. N. Forbes* 259.K.

SPECIMENS EXAMINED: *Kauai:* Wahiawa Mountains, *Lydgate*, May 1909, *Rock* 40 (2701). Northwest facing slope, ridge $\frac{3}{4}$ mile north of Laakahi, Koloa, 900 ft. altitude, moist gulch, December 24, 1947, *St. John* 23023.

Oahu: In cultivation on Palolo Street, brought there from Kauai, Oct. 25, 1956, *Roe* 201.

This species was described by Charles N. Forbes in 1911. It is closely related to *H. Kokio* Hillebrand, from which it differs by its pubescent calyx, smaller leaf, shorter petioles, shorter

peduncle, longer yet narrower petals, shallower cleft, and longer style extension.

This species is poorly known. Forbes claimed it was first collected by Lydgate several years before he made his type collection in August, 1909. *Rock* (1913*a*) cited Forbes' species but did not give it lengthy treatment. *Rock* recently tried to find *H. kabilii* again on Kauai but was unsuccessful. In a letter dated August 15, 1958, from Albert Duvel, Kauai forester, we find *H. kabilii* still difficult to obtain. Duvel wrote, "I am not able to locate a place or specimen of *H. kabilii*." The last record of it in its native environment was in 1947, when St. John (no. 23,023) collected the species on a ridge .75 mi. north of Laaukahi, Koloa, Kauai. It was in a moist gulch at 900 ft. altitude. This species has been found in cultivation in Honolulu.

In the herbarium at the Bishop Museum there are several specimens of a plant closely allied to *Hibiscus kabilii*. These were collected by Forbes (643.K) on October 22, 1916, in the Hii Mountains, Kauai. This population is undoubtedly a variety of *H. kabilii*, as it resembles it in most characters. The stem surface of these specimens is distinct, and the leaves are larger and by far more pubescent. I am unable to completely describe this variety at present, as sufficient material is not at hand. It has not been reported since 1916.

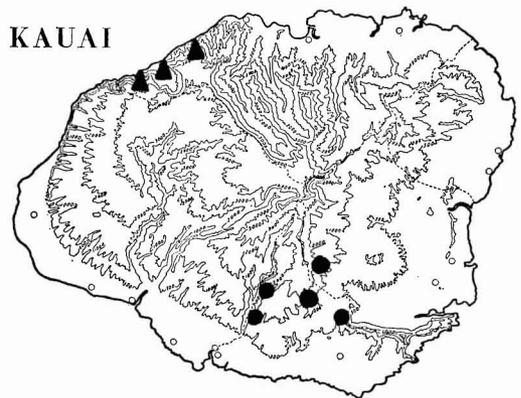


FIG. 14. Distribution of *H. kabilii* and *H. Saintjohnianus*:

Solid circles, *H. kabilii*

Solid triangles, *H. Saintjohnianus*

10. *Hibiscus Newhousei* sp. nov.

Fig. 15

DESCRIPTION: Arbor 6 meters alta. Stipulis 4–6 mm. longis. Petiolo 0.3–1.8 cm. longo piloso. Lamina 4.5–9.0 cm. longa 2.5–4.0 cm. lata. Pedunculo 0.7–0.9 cm. longo articulato 2 mm. infra involucrem; bracteis lanceolatis 7–8 mm. longis. Calyce 1.8–2.0 cm. longo 1.0–1.4 cm. lato, furcato 0.3–0.7 cm. cum lobis acutis, 10-nervoso piloso. Petalis 5.0–5.2 cm. longis 1.3–1.6 cm. latis, rubro colorato. Columna staminarum 3.0–3.8 cm. apicibus filamentum liberis ca. 4 mm.

Tree 6 m. tall. Stipules 4.0–6.0 mm. long. Petiole 0.3–1.8 cm. long, pilose. Leaves 4.5–9.0 cm. long, 2.5–4.0 cm. wide; margin irregular, apex distinctly acuminate. Peduncle 0.7–0.9 cm. long, articulate 2 mm. below the involucre. Lanceolate bracts 6–8, 7–8 mm. long. Calyx tubular 1.8–2.0 cm. long, 1.0–1.4 cm. wide, cleft for 3–7 cm., lobes acute, pilose, 10-nerved. Petals 5.0–5.2 cm. long, 1.3–1.6 cm. wide, dark red, puberulent on outer surface. Staminal column 3.0–3.8 cm. long, slender, glabrous, apex 5-lobed. Free filament tips extend ca. 4 mm. from column, located on the upper half of the column.

HOLOTYPE: Moloaa Forest Reserve, Kauai; ca. 500 feet altitude. November 10, 1958. I. E. Lane 44.

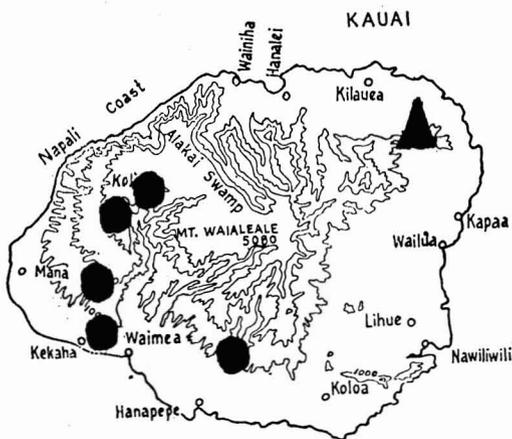


FIG. 15. Solid circles, *Hibiscus waimeae*; solid triangles, *Hibiscus Newhousei*.

This group is the most recent of the indigenous hibiscus to be discovered. It had been reported several years ago and rediscovered in 1957. Mr. and Mrs. Jan Newhouse found it growing along the Moloaa Stream in the Moloaa Forest Reserve, northeastern section of Kauai. They brought it to cultivation at that time. A year later Irwin Lane made a second collection in its original habitat. Lane sent cuttings to the Foster Gardens in Honolulu, where this species can now be found.

One of its notable characters is its distinctly acuminate leaves. *H. Newhousei* shows closest proximity to the native *H. Kokio*, from which it differs by leaf shape and size, shorter peduncles, shorter bracts, smaller calyx, shallower clefts, shorter column, and other characters. Flowers are dark red and leaves are deep green on both surfaces.

11. *Hibiscus immaculatus* sp. nov.

Figs. 16–18

DESCRIPTION: Arbor 3 meters alta basi 6 cm. in diametro. Petiolo 1.0–1.5. Lamina 5–7 cm. longa 4–6.5 cm. lata ovati-obovata margine dentate, nervis haud palmatis viride lactucae nervo medio subter pubescente stellato. Pedunculo 2–3 cm. longo 2–3 mm. lato articulato 1 cm. infra involucrem; bracteis lanceolatis 5–8 mm. longis. Calyce 2.5–3.0 cm. longo, 0.8–1.0 cm. lato, furcato 4 mm., cum lobis acutis, 10-nervoso piloso flavi-virente. Petalis 8–11 cm. longis 2.5–3.5 cm. latis glabris albis. Columna staminarum 10–14 cm. paulo papillosa apicibus filamentum liberis 10–20 mm. longis. Ramuli stylosum 1.5–2.0 mm. longi erecti papillosum. Ovario 1.0 cm. longo 7–8 mm. lato.

Tree 3 m. tall, diameter at base 6 cm. Petiole 1.0–1.5 cm. Leaves 5–7 cm. long, 4–6.5 cm. wide, ovate-obovate, margin denticulate, veins scarcely palmate, "lettuce green," midrib bears slight stellate puberulence on underside. Peduncle 2–3 cm. long, 2–3 mm. wide, articulate 1 cm. below involucre. Lanceolate bracts 6, 5–8 mm. long. Calyx 2.5–3.0 cm. long, 0.8–1.0 cm. wide, cleft for 4 mm., lobes acute, 10-nerved, pilose, "dull green yellow." Petals 8–11 cm. long, 2.5–3.5 cm. wide, glabrous, white. Staminal column 10–14 cm. slightly papillate. Free filament

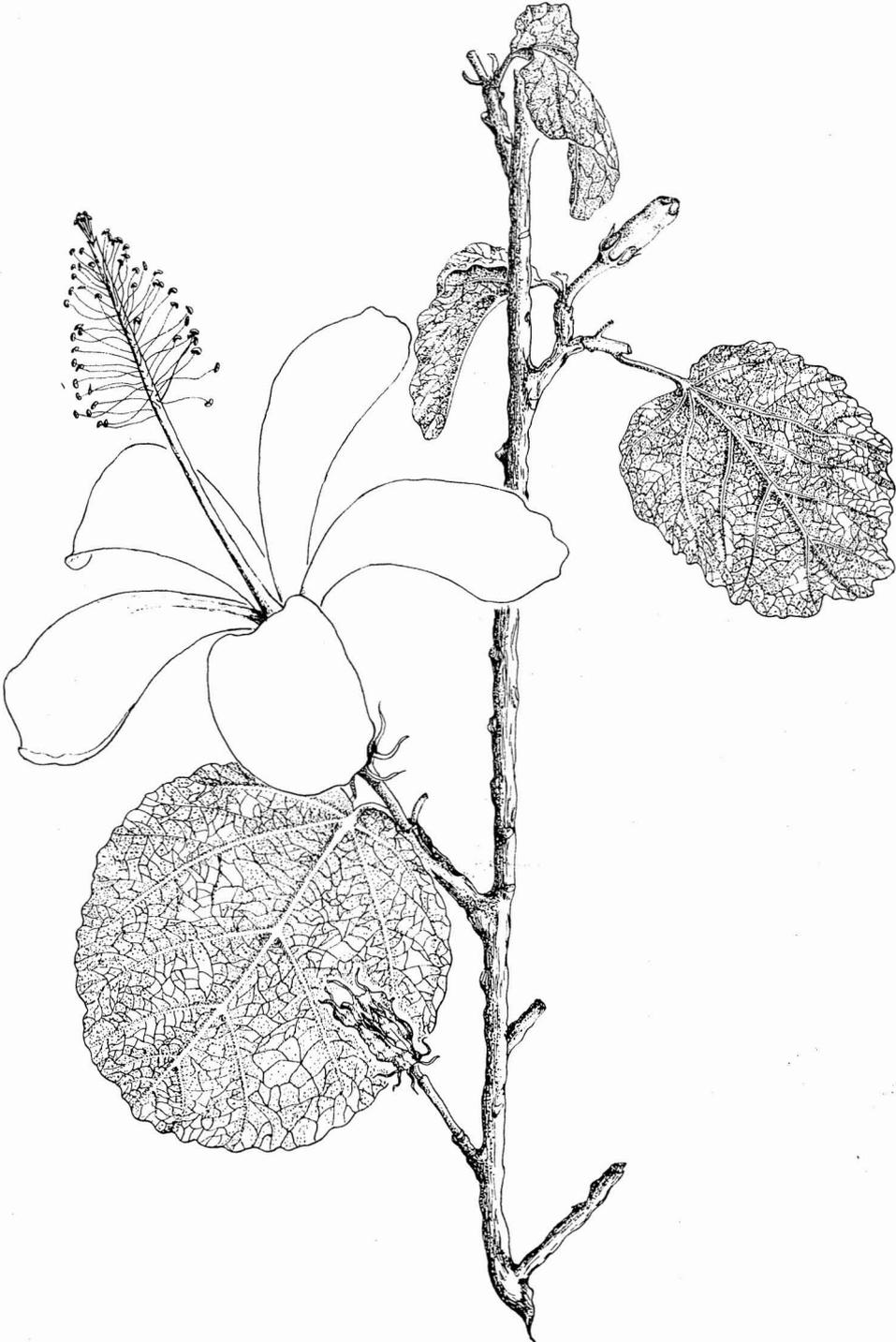


FIG. 16. *Hibiscus immaculatus* Roe. Pali of Olokui above Waiehu, Wailau Valley, Molokai. Sept. 1912. C. N. Forbes 551.Mo.



FIG. 17. *Hibiscus immaculatus* Roe.

tips 10–20 mm., located on the upper third of column. Style branches 1.5–2.0 mm., erect, papillate. Ovary 1.0 cm. long, 7–8 mm. wide.

HOLOTYPE: Pali of Olokui above Waiehu, Wailau Valley, Molokai, September 1912. *C. N. Forbes 551.Mo.*

SPECIMENS EXAMINED: Wailau Valley, Molokai, *C. N. Forbes 550.Mo.* Hibiscus Gardens in Honolulu, introduced from Molokai, July 10, 1958. *Roe 301.*

In September, 1912, Forbes made several collections of a distinct white hibiscus from the Pali of Olokui above Waiehu, Wailau Valley, Molokai. He noted that the staminal column was entirely white, which is not the case in our other Hawaiian white-corolled species. Forbes at first considered this a form of *H. Arnottianus*; in fact an early label read: "*H. Arnottianus* Gray Form nov." Forbes, following subsequent study of his specimens of the plant, concluded it was a distinct species and noted this on his herbarium sheets. However, he did not leave any description of the new species. In 1913 Rock related that this "pure white flowered one occurs on the beach of Wailau Valley on Molokai." A letter written on July 16, 1958, by Henry Wiebke, Hoolehua, Molokai, confirmed the fact that the species continues to exist in the original locality. Mr. Wiebke wrote: "There is

a native white hibiscus still growing in Wailau Valley in and around Kalae. Records show that these have been reported a number of times. This one is completely white."

The plant has also been found in cultivation in Honolulu, and in each case its origin has been traced to Molokai. It is attractive, but smaller and less showy than *H. Arnottianus*. Its rounded leaf of "lettuce green" is quite distinctive and this, together with the pure white corolla and column of the flower, makes it a desirable plant for cultivation.

12. *Hibiscus waimeae* Heller

Figs. 15, 19, 20

Hibiscus waimeae Heller. Observation of the Ferns and Flowering Plants of the Hawaiian Islands, Minn. Pub. of Botany (1897) 851, pl. 53.

H. Arnottianus Gray forma. Mrs. Sinclair, Indigenous Flowers of Hawaiian Islands (1885), pl. 8.

H. waimeae var. *Helleri*. Hochreutiner, Ann. Conserv. Jard. Bot. Geneve 4: 132, 1900.

DESCRIPTION: Tree 7–8 m. in height; DBH, 16 cm. Stipules 5–6 cm. long, lanceolate. Petioles 3–4 cm. long, 2–3 mm. wide, puberulent. Blade 6–9 cm. long, 5–7 cm. wide, obovate-orbicular, surfaces entirely velvety pubescent, margin serrate, "forest green." Peduncles 2–3 cm. long, articulate 6 mm. below involucre. Bracts 7, lanceolate, 1.5–2.5 cm. long, pubescent. Calyx 3.5–4.0 cm. long, 1.0–1.5 cm. wide, widest at base of teeth, cleft 1–1.5 cm. from apex, teeth ovate-lanceolate, velutinous. Corolla white, pubescent on outer surface. Petals ca. 14 cm. long, 4–5 cm. wide (at greatest width), prominently veined. Staminal column stout, long exerted,

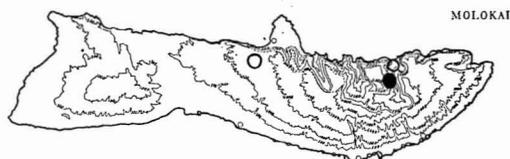


FIG. 18. Distribution of *Hibiscus immaculatus*: Solid circles, represent localities of collections. Open circles, represent areas where plants have been reported.

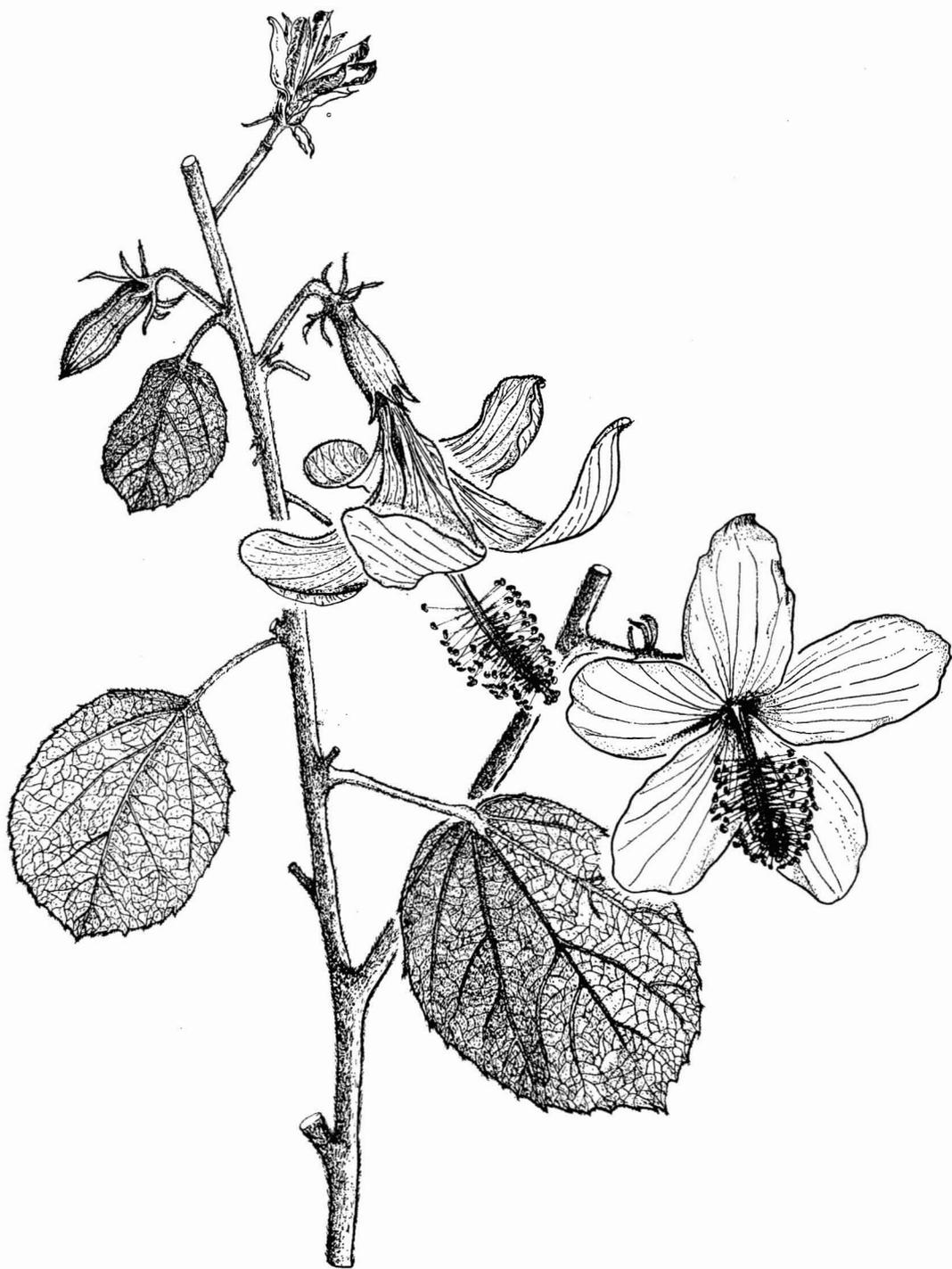


FIG. 19. *Hibiscus Waimeae* Heller. Kokee region of the Na Pali Kona Reserve, altitude 3,200 ft., on bank of canyon. Jul. 29, 1957. Roe 261.

red. Filament tips extend approximately 2 cm. from column.

HOLOTYPE: Kaholuamanoa above Waimea, 900 m. September 2-9, 1895. *A. A. Heller 2785*. (Isotype examined.)

SPECIMENS EXAMINED: *Kauai:* Waimea Canyon, January 12, 1956, *H. F. Clay*. Mountains back of Waimea, September 1909, *C. N. Forbes 422.K.* Waimea Drainage Basin, West side (humid forest), July 3-August 18, 1917, *C. N. Forbes 993.K.* Halemanu February 20, 1909, *Rock 39 (1559)*. Below Kaholuamano in gulches at 1800 feet, September 1909, *Rock 5629*. October 1916, *Rock 17093*. Kokee region of Na Pali Kona Reserve, altitude of 3200 feet on bank of canyon, July 29, 1957, *Roe 261*. In cultivation at Kalaheo, altitude of 750 feet, July 27, 1957, *Roe 252*. In cultivation at the Hibiscus Gardens of Honolulu, July 2, 1958, *Roe 290*.

This species, although closely related to *H. Arnottianus* and unfortunately confused with it, is very different in numerous distinct characters, such as petals, column, stamens, calyx, leaves, tree shape, pubescence, and texture. Hillebrand considered all Hawaiian white-flowered hibiscus to be *H. Arnottianus*. Heller studied the situation and felt that the white-flowered plant from Kauai was distinct and unnamed. He published its description in 1897. In 1900, Hochreutiner reopened the case of *H. Arnottianus*. (A thorough discussion of this situation will be found in my treatment of *H. Arnottianus*.) To the large Oahu white, Hochreutiner attached the name of *H. waimeae* (Heller) var. *Hookeri* Hochr., and to the real *H. waimeae* of Heller he gave the name *H. waimeae* var. *Helleri* Hochr. Hochreutiner gave the name *H. Arnottianus* to what is known today as *H. Kokio* Hbd., thus establishing two varieties. T. A. Sprague in 1914 also added to the confusion. He suggested the name *H. Arnottianus* be dropped completely and replaced by *H. waimeae*. Skottsberg in 1926 concluded that the treatment given by Hochreutiner and Sprague is "...inadmissible and has resulted in a more and more hopeless confusion..." He continued, "...to replace 'Arnottianus' with 'Waimeae' Heller, to distinguish two varieties of this and to call Heller's type var. *Helleri* is wrong for the simple reason

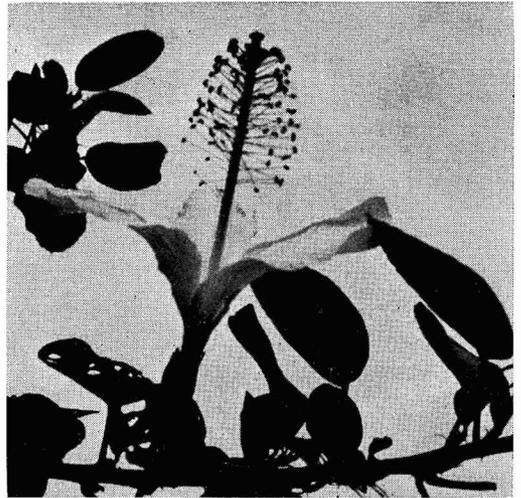


FIG. 20. *Hibiscus waimeae* Heller.

that 'Arnottianus' Hillebrand and 'waimeae' are different species."

The major differences between *H. Arnottianus* and *H. waimeae* are these: *H. Arnottianus* is nearly glabrous throughout, while *H. waimeae* has a velvety pubescence. The petioles of the Kauai species are almost twice as long as those of the Oahu plant; their calyces are also longer and wider. The calyx cleft of *H. Arnottianus* is only 5 mm. deep and that of *H. waimeae* is 1-1.5 cm. deep. The staminal column of *H. waimeae* is stouter than that of the Oahu species.

13. *Hibiscus Arnottianus* Gray

Figs. 21-23

Hibiscus Arnottianus Gray. Bot. U. S. Expl. Exped. 1: 176. 1854.

H. Boryanus H. & A. Bot. Beechey Voy., p. 79, partim, non DC. 1832.

H. Waimeae var. *Hookeri* Hochreutiner. Ann. Conserv. Jard. Bot. Geneve, 4: 132. 1900.

H. Fauriei Leveil. Fedde Repert. 10: 120. 1911.

DESCRIPTION: Tree growing to 35 ft., well branched, nearly glabrous. Stipules subulate, caducous. Petioles 0.5-2.0 cm. long, glabrous. Blades 8-10 cm. long, 5-7 cm. wide, ovate to elliptical-parabical, apex acute-acuminate, chartaceous, margin sinuately crenate to entire,



FIG. 21. *Hibiscus Arnottianus* Gray. North end at junction of Manoa Cliff and Pauoa trails; 1,300 ft., Tantalus, Manoa. (Tree 8 m. \times 2 dm.), Apr. 17, 1957. St. John 26053.

scarcely palmately veined with 3 strong nerves and 2 less prominent nerves branching from base of blade. Flowers solitary in axils of leaves. Involucre with 5-7 linear-lanceolate bracts 0.7-1.0 cm. long. Calyx tubular, 2-3 cm. long, 0.8-1.0 cm. wide, 5 acute lobes, cleft 5 mm. from apex, glabrous to slightly pilose. Corolla white often with a slight pink tinge. Petals 7-12 cm. long, 2-3 cm. wide. Staminal column long exerted, 10-15 cm. long, red, free filament tips 1.0-1.8 cm. long, from upper half of column. Style branches erect, 5-8 mm. long. Capsule chartaceous, 2-3 cm. long. Seeds reniform, 4-5 mm. tomentose, dark brown.

SPECIMENS EXAMINED: *Oahu*: North slope of Mt. Tantalus (tree 6 m. tall; 45 cm. DBH), June 15, 1930, *Christopherson 1373*. Beside stream in open forest, Wailupe, Kului, June 23, 1937, *F. E. Egler No. 37-68*. Konahuanui, Jan. 6, 1909, *C. N. Forbes 1000.O*. East side of Nuuanu Valley, Oct. 1910, *C. N. Forbes 1601.O*. Waialae Valley, October 15, 1914, *C. N. Forbes 1948.O*; also May 4, 1914, *Forbes 2496.O*; and January 1919, *Forbes 2522.O*. Manoa Cliff Trail, April 11, 1920, *Gerber D. Wesley 372*. "Hauhele" *Hillebrand*. Niu, *Hillebrand and Lydgate*. Tantalus Ridge, September 5, 1909, *H. L. Lyon*. "Oahu" *H. Mann and W. T. Brigham 530* (2 sheets). Mt. Tantalus, July 8, 1922, *C. Skottsberg 84*. North end at junction of Manoa Cliff and Pauoa Trails, 1300 feet, Tantalus, Manoa (tree 8 m. x 2 dm.), April 17, 1957, *St. John 26053*.

There has been so much confusion and controversy regarding Gray's *H. Arnottianus* that a presentation of its history is necessary. His original description (1838) of *H. Arnottianus* reads:

H. fruticosus, glaberrimus; foliis ovatis sen ovalibus subcoriaceis integerrimis (nunc subdentates) basi tri-nervatis; floribus solitariis pedunculatis; involuicelli phyllis 5-7 parvis deciduis; petalis (rubis) oblongis basi attenuatis atque in tubum gracilem calyce cylindrico longiorem coalitis; columna staminea proelonga spitamoëa; capsula polysperma.

Hibiscus Arnottianus, Gray in herb. Hook anno 1837

H. Boryanus, Hook & Arn Bot. Beech. Voy. non DC

Hab. Sandwich Islands; on the Kaala Mountains behind Honolulu, Oahu; where it was gathered by Macrae, Lay & Collie, Diell, Barclay, etc. (Byron's Bay, Hawaii; Macrae, Diell.)

This description includes a red-flowered hibiscus having the long staminal column characteristic of the white-flowered Oahu plant. There are at least two distinct species included in Gray's description of *H. Arnottianus*.

Hillebrand described as new the small red-flowered hibiscus, calling it *H. Kokio* Hbd. He stated his belief that the red-flowered hibiscus from Byron's Bay, referred to by Hooker and Arnott under *H. Boryanus* and considered by Gray as the *H. Arnottianus* from "Byron's Bay, Hawaii, Macrae," belonged to the taxon *H. Kokio*.

Hillebrand applied the name *H. Arnottianus* to the plant collected during Beechey's voyage and distinguished it from his newly described *H. Kokio*. It is presumed that Hillebrand studied the types.

Heller in 1897 studied both plants in question and concluded that Gray's type for *H. Arnottianus* was probably collected by Diell at Byron's Bay and that it had red flowers. Heller at that time was in a position to designate the type but did not do so. Gray mentioned first "the Kaala mountains behind Honolulu" and secondly, in brackets, "Byron's Bay, Hawaii, Macrae, Diell." Heller felt that the white-

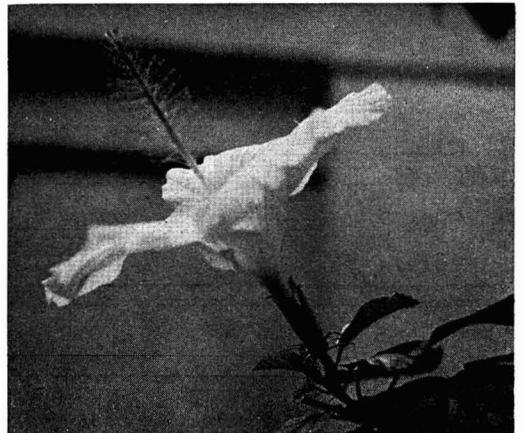


FIG. 22. *Hibiscus Arnottianus* Gray.

flowered Kauai hibiscus was distinct from both *H. Arnottianus* and *H. Kokio*, and he described it as *H. waimeae*.

In 1900 Hochreutiner published his revision of the genus *Hibiscus*, including the Hawaiian species. He presented a new interpretation of *H. Arnottianus*. While Hillebrand and Heller had applied Gray's description to the plant collected during Beechey's voyage, Hochreutiner felt that the name *H. Arnottianus* belonged to the plant collected by Diell, called by Hillebrand *H. Kokio*.

Hochreutiner classified the plants in question as follows:

<i>H. Waimeae</i> Heller	(white-flowered species)
var. <i>Hookeri</i> Hochr.	(Beechey plant)
var. <i>Helleri</i> Hochr.	(Kauai white)
<i>H. Arnottianus</i> Gray	(red-flowered species)
var. <i>Kokio</i> Hochr.	(Hillebrand's <i>H. Kokio</i>)
var. <i>genuinus</i> Hochr.	(Byron's Bay-red-Macrae, Diell)

Rock (1913*a*) makes no mention of Hochreutiner's revision, which leads one to believe that he was not familiar with it. He was aware, however, of the original problem regarding *H. Arnottianus* and, to verify his classification, he sent a specimen of the white-flowered *H. Arnottianus* to the Gray Herbarium, where B. L. Robinson made comparisons and replied, "There can be no question that the white-flowered species (No. 8831) from Oahu is precisely the real *H. Arnottianus* Gray." As far as Rock was concerned the case of *H. Arnottianus* was settled. However, in 1914, T. A. Sprague began again to dispute its nomenclature. He wrote in the Kew Bulletin, "So much confusion has arisen in the past in connection with the name *H. Arnottianus* that it is perhaps desirable to abandon the use of it altogether." Sprague claimed that Gray had a red-flowered species in mind when describing *H. Arnottianus*, for he sent a specimen of this species collected by Diell to Sir William Hooker under the name *H. Ar-*

nottii Gray (later altered to *Arnottianus*). However, Sprague disregarded the name *H. Arnottianus* entirely and retained *H. Kokio* Hbd. for the red-flowered species.

Skottsberg (1926), in reviewing the nomenclatural history of *H. Arnottianus*, exclaimed, "The confusion is very complete." His conclusion, however, is very sound and offers the only logical solution to the problem. He rebuked Hochreutiner and Sprague for their "inadmissible" treatment given to the species in question, and joined Rock in his view of the situation.

It is concluded that Gray had two species on hand when he described *H. Arnottianus*—the white-flowered Oahu hibiscus bearing the long staminal column, and the small red-flowered plant. The red plant was the material sent to Sir William Hooker and the white-flowered species was retained in the Gray and the U. S. National Museum herbaria. This white species compares to our Oahu white according to the judgment of Dr. Robinson. In a recent letter, Reed C. Rollins, director of the Gray Herbarium, also testified that *H. Arnottianus* from the Wilkes Expedition is "white-flowered, with a very long, apparently red, staminal column."

Likewise, Richard S. Cowan of the U. S. National Museum, in a letter dated June 28, 1958, confirmed this belief regarding the material deposited there. Cowan wrote:

We have one sheet bearing one flowering branch collected by the U. S. Exploring Expedition; the label is the standard label for this Expedition but the locality is in long-hand and reads: "Oahu, S. Islands." The only other notation is the name "*Hibiscus Arnottianus* Gray." I have compared both the quoted items with a scrawl of Gray's in our holograph collection and I feel certain that they were made by the same person. There is no question in my mind that the specimen is of the white-flowered element, for red-flowered *H. Kokio* clearly shows red flowers even in the dried condition. The length of the staminal column in one of the two flowers on our specimen is 10.5 cm. In most respects, this specimen appears very similar to the following collections in our herbarium assigned to *H. Arnottianus*: Mann & Brigham 530 and Christopherson 1373.

elevation 1500 feet, edge of woods; tree 8 m. \times 25 cm., November 8, 1936, *St. John* 17,655. Mokuleia Trail, Waianae Range, elevation 2200 feet, tree 6 m., January 11, 1948, *Webster L. Grady* 1180.

This population was brought to our attention in 1944 when Skottsberg published it as a form of *H. Arnottianus* Gray. Skottsberg felt that the variation was slight and showed principally in the smaller flower. Besides the flower difference, the leaves, calyx, and bracts of this form appear smaller than those of the species.

15. *Hibiscus Arnottianus* Gray var. *punaluensis* Skottsberg
Fig. 23

Hibiscus Arnottianus Gray var. *punaluensis* Skottsberg. Vascular Plants from the Hawaiian Islands, IV. Acta Hort. Gotoburg. 15: 396. 1944.

H. punaluensis (Skottsberg.) Deg. & Deg. Flora Hawaiiensis 5: Family 221. 1957.

DESCRIPTION: Tree to 35 ft. Stipules subulate, caducous. Petioles densely puberulent, 3–12 cm. long, scarcely palmately veined (5 radiating ribs), veins strongly pubescent. Blade 10–25 cm. long, 8–20 cm. wide with puberulent-pilose surface, ovate, base subcordate, apex acuminate. Bracts 5–7, linear-lanceolate, 1.0–2.0 cm. long, pilose. Calyx scabrous, 1.8–2.5 cm. long, 1.0–1.5 cm. wide, cleft 5 mm. Petals white, 8–12 cm. long, 2.5–4 cm. wide, stellate pubescent on outer surface. Staminal column red, 12–19 cm. long, free filament tips 1.5–2.5 cm. long, red. Style branches 1.0 cm. long.

HOLOTYPE: Punaluu, Koolau Mountains, Oahu (Hawaiian Bog Survey) Sept. 27, 1938. *O. Selling* 3638. (Isotype examined; type not seen.)

SPECIMENS EXAMINED: *Oahu*: Edge of Kaluanui Stream, Castle Trail, December 22, 1940, *E. H. Bryan, Jr.* 1501. Between Punaluu and Kaipapau, Koolau Mountains, November 14–21, 1908, *C. N. Forbes*. Near Head Gate, Wahiawa, August 17–20, 1915, *C. N. Forbes* 2198.0. Punaluu, elevation 2000 feet, September 28, 1930, *E. Y. Hosaka* 304. Kaluanui River Bank, Koolau Mountains, elevation 2800 feet, September 28, 1930, *Inafuku*. Upper Kaluanui Valley, Castle

Trail, October 21, 1945, *R. Kuykendall* 117. Waiahole Ditch Trail, June 1932, *A. Meebold*. Near Mt. Stream, Koolau Mts., Nov. 14–21, 1908, *Rock* 37 (309) (duplicate). In cultivation in Wilder's Garden, *J. F. Rock*. Along Puunahia streams near Castle Camp, tree 30 feet, August 1911, *Rock* 8831. Kaluani, Castle Trail, Koolau Range, November 14, 1955, *Roe* 18. Kaluanui, by stream 1950 feet altitude, rain forest, tree 7 m. \times 15 cm., November 25, 1956, *St. John* 25977.

Skottsberg in 1944 established this new variety, *punaluensis*, and called it after the locality where the type was collected. It differs from the species by a characteristic venation: between the base with the five radiating ribs and the next strong pair (which forms an angle of 45 degrees with the midrib) is a wide stretch with only faint veins issuing at an angle of about 90 degrees. The leaves are longer and wider than those of the species, the petiole being approximately 5 cm. longer. The veins are strongly pubescent. The free filament tips and style branches are longer in the variety. The calyx is conspicuously hairy.

In 1957 Otto Degener raised this population to the status of a species. These plants differ from *H. Arnottianus* but show such similarity that I hesitate to agree with Degener. The differences are not so great as they are between the other taxa which have been accorded specific rank. Skottsberg's treatment seems more satisfactory.

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