ARTEMISIA, SCAEVOLA, SANTALUM, AND VACCINIUM OF HAWAII

BY

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PREFACE

This study of some critical Hawaiian genera of flowering plants is based on my observations in the field and on a considerable number of herbarium specimens, including whenever possible the types of each species or variety. Material was loaned by the following herbariums, in this paper indicated by the corresponding letters in parentheses: Botanisches Museum, Berlin-Dahlem (B); Herbarium of the Royal Gardens, Kew (K); Muséum d' histoire naturelle, Paris (P); Riksmuseum, Stockholm (S); Naturhistorisches Museum, Vienna (V); United States National Herbarium, Washington (W). My own collections are still in the herbarium of the Botanic Garden, Gothenburg (G). In 1926, I visited the Gray Herbarium of Harvard University, Cambridge (C); and the Bernice P. Bishop Museum, Honolulu (H). I am extremely obliged to A. E. Gepp, B.A., and Dr. A. B. Rendle of the British Museum and to Dr. B. D. Jackson of the Linnean Society of London for information regarding the Vaccinium specimens preserved in the herbariums under their charge. I owe to Mr. E. Hultén the inspection of *Artemisia* in the Herbarium of the Botanical Garden, Leningrad (L). To the directors and other members of the staff of these institutions I beg to tender my most sincere thanks for kind assistance. I am especially indebted to Professor Herbert E. Gregory and to the Trustees of the Bishop Museum who generously supported my work in Hawaii and made it possible for me to spend three months in 1922 and one month in 1926.

THE GENUS ARTEMISIA

History of Species

During a visit to the Hawaiian islands in 1922, I collected two species of *Artemisia.* To judge from Hillebrand's Flora (18),[1] nothing should be easier than to classify Hawaiian *Artemisiae;* still, I had to go back to the older literature and finally to bring together material ample for comparison. With the types of all described forms at hand, I found it necessary to rearrange the species.

The first Hawaiian *Artemisiae* seem to have been collected in 1816, on Oahu, by Chamisso and by Eschscholtz, both members of the Kotzebue Expedition. Chamisso's plant was described by Lessing (23, p. 522) as *Artemisia australis* Lessing; that of Eschscholtz, by Besser (1, p. 24) as *A. eschscholtziana* Besser.

The date of publication for the first is 1831. For the second, 1832 is generally quoted, but the volume containing the description appeared in 1834. In a supplement to his paper in the same volume (Additamenta et Corrigenda, p. 87), Besser suppressed his species and identified it with *A. australis,* a course followed by all subsequent writers, including de Candolle (3, p. 106). I have seen the types of both species and have found them identical.

The specimens gathered during the United States Exploring Expedition were listed by Asa Gray (13, p. 137). He records two forms of *A. australis* var. *α eschscholtziana* from Oahu and Kauai, and var. *β mauiensis* from the crater of Haleakala, Maui. I have seen material of both these varieties (W). The *α eschscholtziana* from Oahu belongs to *A. australis; β mauiensis* is a good species mentioned by me (34, p. 282) as *A. mauiensis* and here described.

The next date of collecting, so far as I am aware, is 1850—an interesting specimen (K). On the herbarium sheet is written "Seemann" (the collector), probably in W. J. Hooker's handwriting. Glued to the sheet are two small labels, one containing the words "2267, Oahu, 1850," the other "A. oahuensis Cham." This name remains a mystery. Chamisso, who died in 1838, had nothing to do with Seemann's specimen. So far as I have been able to discover, no *A. oahuensis* has ever been described. It is a different species from *A. australis* Lessing, but mistaken for this by Hillebrand. I call it *A. hillebrandii.*

[1] The numbers in parentheses refer to the Bibliography (p. 88).

Mann (25, p. 176) records *A. australis* Lessing with the following varieties: *eschscholtziana,* Kauai, Mann and Brigham No. 539; *mauiensis;* and *microcephala* (C). The variety *microcephala,* from Hawaii, had been communicated to Gray by Hillebrand. An inspection of material (K, W) showed that *A. eschscholtziana* from Kauai is not the same as Gray's specimen from Oahu (United States Exploring Expedition). The heads are very undeveloped in this, and Gray perhaps got the conception of his α from Kauai plants (op. cit.). Unfortunately, I have not seen these, but it may be safely concluded that Gray's var. α comprised both species, as understood by him; while Mann's is *A. hillebrandii.* Wawra's specimen from Kauai (1869-70), published as *A. australis* var. *eschscholtziana* Gray (38, vol. 56, p. 80) also belongs to *A. hillebrandii.*

Hillebrand (18, p. 230), distinguished two species, *A. australis* Lessing and *A. microcephala* Hillebrand. The examination of his entire material in Berlin and several specimens distributed from there to other herbariums showed that he was right in distinguishing two species; but his *australis,* at least the material from Oahu and Kauai, is not the same as Lessing's; while his *microcephala* is identical with the type of *A. australis* (*A. eschscholtziana* Besser). The var. *mauiensis* is not mentioned by Hillebrand, whose *A. australis* from Maui is Lessing's species.

Good material of *A. hillebrandii* from Oahu has been distributed by Heller as *A. australis* (17, p. 916). Heller says that he found the same plant above Waimea on Kauai, but he did not collect it.

Key to Species

Leaves greenish above, their segments linear, 2 to 3 mm. or more wide, panicle more or less ample, heads numerous.

Involucral scales linear, 3 to 5.3 mm. long, longer than the florets ..... **A. hillebrandii**

Involucral scales ovate, scarious, 2 to 3 mm. long, as long as or shorter than the florets ..... **A. australis**

Leaves white tomentose all over, their segments filiform, about 0.5 mm. wide, panicle short, simple, with few heads..... **A. mauiensis**

Description of Species

Artemisia australis Lessing (figs. 1 and 2).

Artemisia australis Lessing: Linnaea, vol. 6, p. 522, 1831.

Artemisia eschscholtziana Besser: Nouv. Mém. Soc. Imp. Moscou, vol. 3, p. 24, 1834.

Artemisia australis, Hillebrand: (pro parte) Flora of the Hawaiian islands, p. 230, 1888.

Artemisia australis var. *microcephala* A. Gray: Am. Acad., Proc., vol. 7, p. 176, 1868.

Artemisia microcephala, Hillebrand: Flora of the Hawaiian islands, p. 230, 1888.

Seen from the following localities:

Kauai. Halemanu, Rock No. 1700 (H).

Niihau. Kaala, Stokes (H).

Oahu. Chamisso (B, type; K, V); Eschscholtz (K, L); Waianae, Kaala, United States Exploring Expedition (W); Manoa, Rock No. 10307 (H); Waiolani ridge, Forbes No. 1873 (H).

Molokai. Mauna Loa, Forbes No. 12, No. 384 (H).

Lanai. Mahana, Forbes No. 133, No. 227 (H).

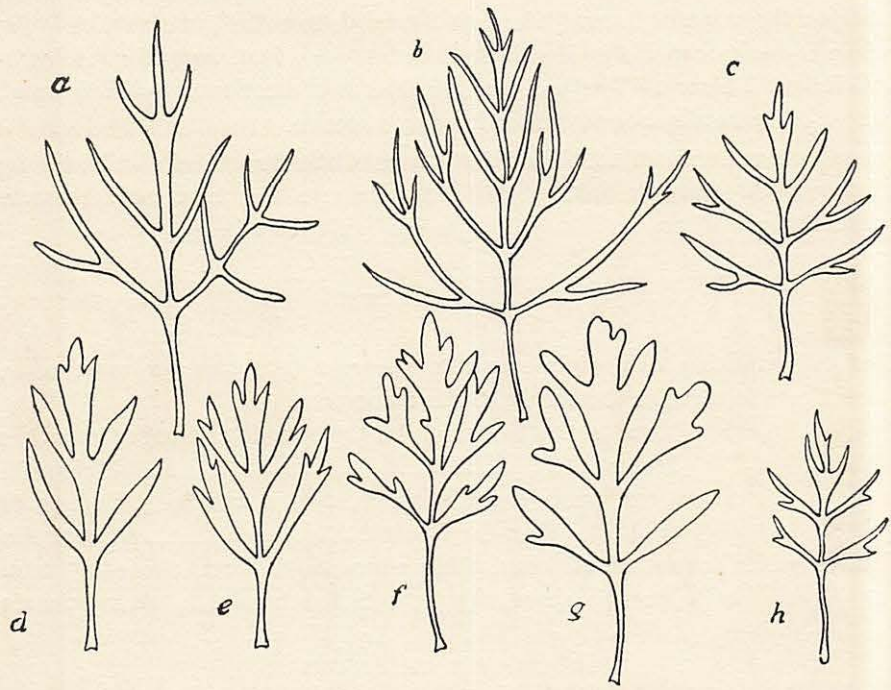


FIGURE 1.—Leaves of *Artemisia australis* Lessing: *a*, Oahu, Chamisso; *b*, Oahu, Eschscholtz; *c*, Hawaii, Hillebrand; *d*, *e*, East Maui, Skottsberg No. 795; *f*, *g*, Oahu (Manoa?) (*A. hillebrandii*) or East Maui (?) (*A. australis*); *h*, Hawaii, Hillebrand (*A. microcephala* Hillebrand).
All three-fourths natural size.

Maui. East Maui, Hillebrand (B); Makaiwa gulch, Rock No. 10307 (H); Haleakala, Lower Ditch Trail, common, Skottsberg No. 795 (G); beyond Auahi, Rock No. 8667 (H).

Hawaii. Without locality or indication of collector (V). Central plateau, 5,000 to 6,000 feet, Hillebrand (B, K, V, W); east coast, along the railroad, Skottsberg (seen, not collected).

Remarks on Some Examined Specimens

1. "O Wahu Ad v Ch 1816 *Artemisia australis* Less. Chamisso ded. 1831, Herb. Kunth." Part of the material used by Lessing for his description. Lower leaves, see fig. 1, *a*. Leaves of flowering shoots entire, or the largest with one or two lateral lobes. Panicle ample, total length, including lower naked part of rhachis, as much as 27 cm., lateral branches long, 10 to 15 cm. Heads very numerous, long pedicellate, scales about 10, 1.5 to 2 mm. long or the largest as much as 2.6 mm, about 1 mm. wide (fig. 2 *a* to *c*). Florets 19 in the head examined, of them 12 female, hardly more than 2 mm. long (fig. 2, *j-m*). I have seen other pieces of Chamisso's plant (K, V).

2. Two different sheets (L). One, labelled "Artemisia Eschscholtziana mihi E Wahu montibus," apparently written by Besser, belongs to the type material of Besser's species. There are no basal leaves, only the small

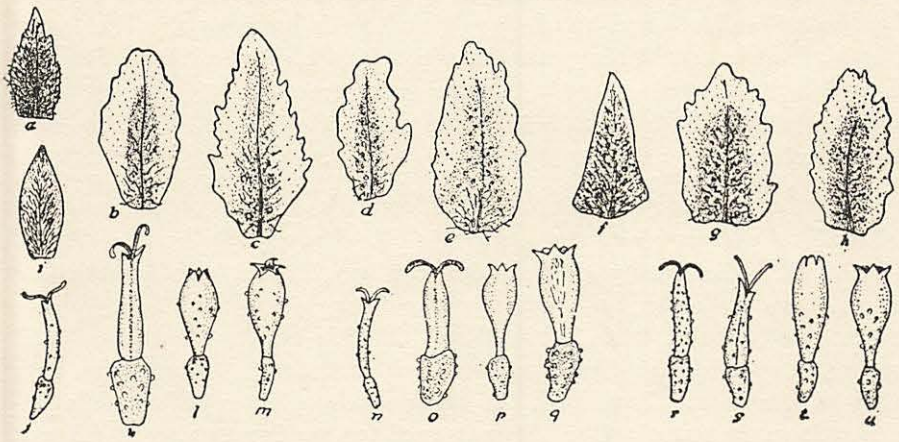


Figure 2.—Involucral scales and flowers of *Artemisia australis* Lessing: *a*, outer; *b*, *c*, inner scales, Oahu, Chamisso; *d*, *e*, inner scales, Oahu, Eschscholtz; *f*, outer scale; *g*, *h*, inner scale, Hawaii, Hillebrand (*A. microcephala* Hillebrand); *i*, outer scale, Oahu, Eschscholtz; *j*, *k*, ♀ and *l*, *m*, ☿ flowers (same specimen as *a*, *b*, *c*); *n*, *o*, ♀ florets, and *p*, *q*, ☿ florets, same specimen as *d*, *e*, *i*; *r*, *s*, ♀ and *t*, *u*, ☿ florets, same specimen as *f-h*.

All × 10.

entire ones of the floral region. The scales of the involucre (fig. 2, *d, i*) measure 1.5 to 1.8 mm. only. Florets (fig. 2, *n, p*) 1.5 to 2 mm., as in Chamisso's plant. The second specimen is labelled "Artemisia australis Less.," written by Ledebour, and "Wahu Eschscholtz D. 20." Lower leaves as described by Besser, width of lobes 1 to 2 mm. (fig. 1, *b*). Scales 9 or 10, some larger than in the first specimen, 2.5 mm. (fig. 2, *e*). Florets as before: two with nearly mature achenes are figured (fig. 2, *o, q*). There is (K) a small piece of Eschscholtz' plant, labelled "Artemisia Eschscholtziana mihi E Wahu montibus Herb. W. Besser."

3. "Artemisia australis Less. Kaala Mts. Wai-nai Oahu U. S. Expl. Exp.," written by Asa Gray (W). Lower leaves pinnate with few secondary lobes, upper entire. The inflorescences are very little developed, but the heads would have become numerous and the minute scales have a broad hyaline edge, so that it seems safe to bring this to *A. australis* in the sense of Lessing. I suppose Gray brought it to his variety *eschscholtziana.*

4. "Artemisia microcephala Hbd Ostmaui" (B). One branch about 15 cm. long, with entire leaves and numerous small, long pedicellate (to 1 cm.) heads. Florets as in typical *A. australis;* one head contained 23 ♀ and 7 ☿. Unfortunately, there are no lower leaves. It is possible that by some mistake they have been associated with *A. hillebrandii.* (See special remarks under No. 1, p. 7, also fig. 1, *f, g.*)

5. *Artemisia australis* Less., East Maui, Skottsberg No. 795 (G). Leafy sterile shoots and attached to them old inflorescences. The leaves (fig. 1, *d, e*) have wider segments than usual, with shorter lobes. Some of the old heads showed distinctly that the scales are about 1.5 mm. long and almost hyaline. Both ♀ and ☿ florets were observed, all about as long as the scales.

6. Part of the type material of Hillebrand's *A. microcephala* was distributed to various places, two sheets (B). Leaves small, little divided (fig. 1, *h*). The locality is "Centralplateau von Hawaii," the name in one case, *A. australis* var. *micrantha;* in the other, *A. microcephala.* Upper leaves mostly entire, some triscuspidate. Panicle ample, branches of first order 5 to 10 cm. long. One head contained 16 ♀ and 7 ☿ florets, the ♀ to 1.8 mm., the ☿ to 2 mm. long. A better specimen from Hillebrand's collection from the same locality (K) was used for my figures 1, *c;* 2, *f-h, r-u.* Another sheet is in the United States National Herbarium (W). The single specimen (V) is labelled: "n. 2329 A. australis Less. var. microcephala A. Gray Hawaiische Insel Kauai l. Hillebrand comm. Dr Wawra." The label was written by Wawra, who quotes the specimen (38, vol. 56, p. 80) thus: "Kauai, aus Hillebrands Herbar 2329." There is no authentic label and

the number has been added by Wawra. The locality is clearly false, for Hillebrand collected no *A. microcephala* on Kauai. The specimen belongs to the set from Hawaii.

7. Printed: "Hawaii leg."; written: "Artemisia australis Less. ex. herb. Reichenbach fil" (V). Typical *A. australis.* Leaves of sterile branches rather small, sub-bipinnatifid, on fertile branches entire or tripartite. Heads small with about 12 scales, 1.5 to 1.8 mm. long. Florets very glandular; ♀ 1.3 to 1.5 mm.; ☿ 1.5 to 1.8 mm. In one head, 22 ♀ and 14 ☿ florets were counted; in another, 14 ♀ and 9 ☿.

8. A somewhat exceptional form is Rock No. 8667 from East Maui. The leaves are bipinnate with very narrow to almost filiform segments, narrower than in any other form that I have seen. There are single additional segments to the pinnules in some leaves. The heads are those of *A. australis;* florets ♀, 10 to 16; ☿, 11 to 16. Rock No. 10307 has exactly the same kind of leaves as Skottsberg No. 795.

9. Rock No. 1700 from Kauai seems to be the first record of the true *A. australis* from that island. The leaves and heads are very like those of the type specimen. The numbers of flowers: ♀, 7 to 14; ☿, 13 to 19.

In habit, *A. australis* and *A. hillebrandii* are very alike. I have found no good characters by which sterile specimens might be distinguished with certainty. The leaves have about the same range of variation in both, but as a rule they are more tomentose and less divided in *A. australis.* Larger leaves vary between 4.5 and 8 cm. in length, with a petiole of 2 to 3 cm., and between 2.5 and 5 cm. in width. Few segments are over 2 mm. wide. The leaves of the floriferous branches are as a rule entire and narrow linear-spatulate; a few of the lower ones show one or two lateral lobes. My Maui specimens have wider segments (fig. 1, *d, e*). Very similar leaves are found on a sterile piece mounted with the type of *A. hillebrandii* (B), while Hillebrand's specimen from Maui lacks the leafy shoots. If these leaves belong to the Maui specimen, which is not improbable, it would signify the possible occurrence of a special variety on Maui, besides the species. Many of the panicles are quite large, almost 30 cm. long with branches of 10 cm. or even more. I have seen no *A. hillebrandii* with such large inflorescences. The heads, forming branches of third or fourth order and borne on long, filiform pedicels, are very numerous and measure about 2 to 2.5 mm. across. The scales number 9 to 14, some outer narrow, triangular, more hairy and glandular, 1.5 to 2 mm. long, the inner more numerous, thinner, broadly scariose, 1.8 to 2.5 mm. long. In some heads, one or two of the innermost bracts are smaller and quite hyaline. The receptacle is flatter than in *A. hillebrandii,* which was pointed

out by Hillebrand. The number of florets varies in the heads examined between 19 and 36, 7 to 23 being ♀. They agree with those of *A. hillebrandii,* though slightly shorter: ♀, 1.3 to 1.8 mm., or rarely 2 mm.; ☿, 1.5-2 mm. The ripe achene, which shows no trace of a crown, measures about 1 mm. The whole floret is more or less covered with glandular papillae.

Hillebrand (l.c.) records *A. australis* from Molokai. There are no specimens in his herbarium (B), but the specimens collected by Forbes (H) show that the true *A. australis* grows on the island.

Artemisia hillebrandii new species (fig. 3, *a* - *c*; 4, *a* - *n*).

Artemisia australis (pro parte, non Lessing) Hillebrand: Flora of the Hawaiian islands, p. 230, 1888.

Frutex parvus canescens a basi ramosus. Rami patentes, ± incani, inferiores ad 4 vel 5 mm. crassi, cortice glabrescente; steriles innovantes inferne cicatricosi, versus apicem dense foliosi. Folia pubescentia, supra cano-viridia, demum glabrescentia, subtus incana, ambitu late ovata, majora lamina 5 ad 7 cm. longa, petiolo 2 ad 2.5 cm. longo suffulta, profunde et anguste pinnatipartita, pinnis oppositis vel suboppositis, 1.5 ad 3 mm. latis, apice rotundato-obtusis vel subacutis vel acutis et apiculatis, supremis rarius etiam ceteris integris, inferioribus incisis vel partitis lobis linearibus: folia hoc modo subbipinnatipartita. Rami florigeri inferne subnudi vel nudi, ± 2 mm. crassi, in paniculam haud amplam exeuntes, ramulis primariis ad 4 usque 5 cm. longis, iterato ramosis, sat dense foliosis, foliis parce divisis supremis (bracteis) subintegris vel omnino integris. Capitula numerosa, 3 ad 4 mm. lata, pedicello brevi vel brevissimo pubescente bracteolato suffulta. Involucri squamae 15 ad 20, paucae exteriores triansgulares vel anguste lineares, firmae, longiores, 4 ad 5 mm. longae, virides, dorso dense canescentes glandulis immixtis, apice anguste scarioso-marginatae; interiores 3 ad 4 mm. longae, anguste triangulato-lineares, glabriusculae, inferne ± glandulosae, margine scariosae. Receptaculum conicum nudum. Flosculi 25 ad 40 (sec. Hillebrand), in capitulo typico (vide infra) 22 ♀ et 10 ☿ visi, tubo et ovario glandulosis; ♀ anguste tubuliformes, orificio bidentato, 2 ad 2.5 mm. longi (corolla 1.2 ad 1.7 mm.); styli exserti curvati; ☿ e cylindrico urceolati, 5-dentati, 1.5 ad 2 mm. longi (corolla 1 ad 1.5), staminibus stylisque inclusis. Achaenia matura non visa; immatura glandulosa, compressa, indistincte coronulata.

Seen from the following localities:

Oahu: Manoa, Hillebrand (B, type; K); Oahu 1850, Seemann No. 2267 (K); Oahu pali (Nuuanu pali) Heller No. 2364 (K, W, H). Skottsberg No. 1867 (G).

Remarks on Some of the Examined Specimens

1. "Artemisia australis Less. Manoa auf Oahu Hillebrand in Herb. Berlin." Original label wanting. Parts of flowering branches. Infloresence a short, densely leafy panicle; lowest leaves 3 to 5 partite with one or two pair of lateral lobes, upper entire and linear. Involucral scales (fig. 4, *a, h-j*) more or less acute, as many as 21 to one head of which 5 to 6 outer, shorter or long, some very long (largest measured 5.3×0.6 mm.), all with

more or less distinct hyaline tip and densely white woolly on outside. Inner scales shorter and more glabrous, some not over 2.5 mm. long. Florets damaged by some insect, mostly destroyed; ♀ 2 to 2.5 mm. long (fig. 4 *b, c*). On the same sheet is a sterile branch. The leaves (fig. 1, *f, g*)

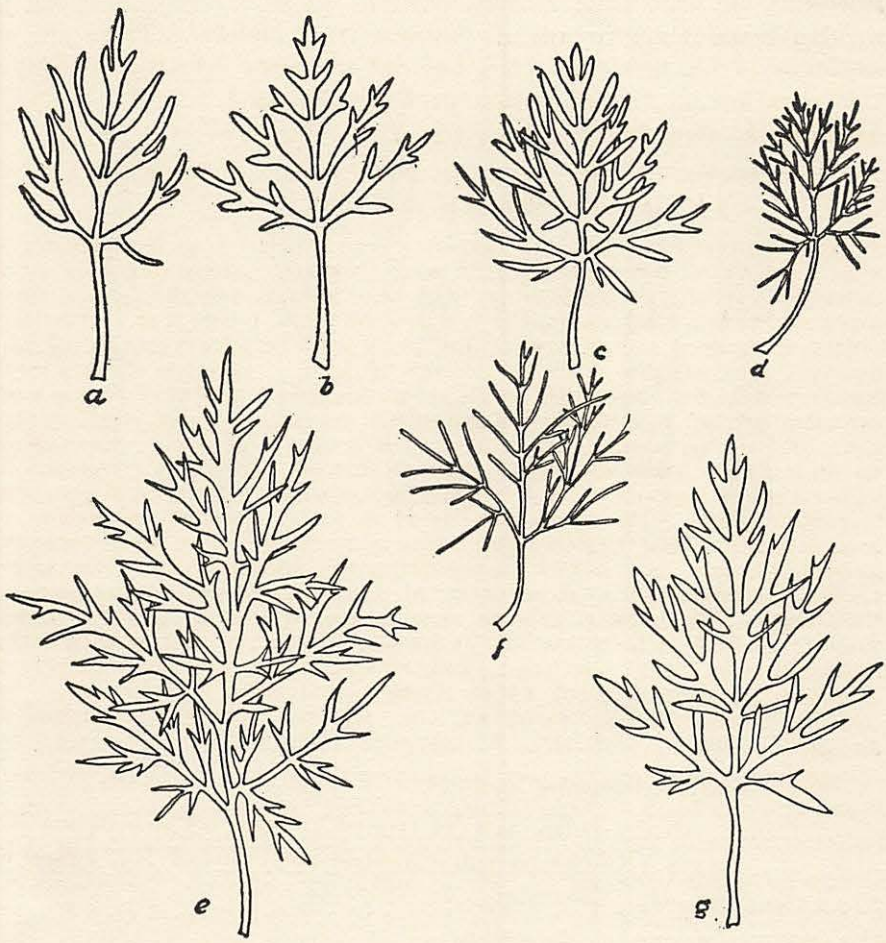


FIGURE 3.—*a-c*, Leaves of *Artemisia hillebrandii* Skottsberg: *a, b*, Seeman No. 2267 (= "A. oahuensis Cham."), *c*, Heller No. 2364; *d, f, A. mauiensis* Gray Skottsberg No. 816; *e, g, A. hillebrandii* var. *kauaiensis* Skottsberg; *e*, Knudson; *g*, Wawra No. 2102.

are unlike others of this species and agree better with leaves from Maui specimens of *A. australis*. They also fit Hillebrand's specimen of this species from East Maui. However, there is nothing in Hillebrand's description of the leaves of his Oahu plant to support an assumption that a mistake has been made.

2. "24 Artemisia australis common at elevation of 1000 2500 feet" (K) from Hillebrand's collection. Sterile, leaves sub-bipinnatifid and very like Seemann's and Heller's specimens, for that reason I refer all to *A. hillebrandii.* The locality is probably Oahu, but it is also possible that it represents the plant from Molokai which is quoted by Hillebrand but is wanting in the Berlin herbarium.

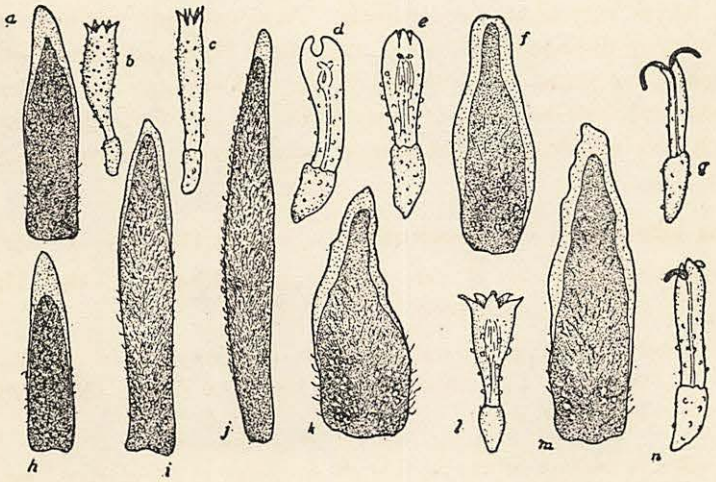


FIGURE 4.—Involucral scales and florets of *Artemisia hillebrandii* Skottsberg: *a, i,* inner scales; Hillebrand; *b. c.* ☿ florets, same specimen; *d, g, n,* ♀ and *e, l,* ☿ florets, Seemann, No. 2267; *h, j,* outer scales, Hillebrand; *f,* inner scale and *k, m,* outer scales. Heller No. 2364.

All × 10.

3. "Seemann Oahu 1850 A. oahuensis Cham." (K). The name *A. oahuensis* was discussed on page 4. Leaves (fig. 3, *a, b*) almost glabrous above, gray beneath. Upper leaves few-lobed, passing into entire ones. Inflorescence as in the following. Involucral scales shorter than in the type, rarely over 3 mm. long. In one head 32 florets were counted, of which 22 ♀, 2 to 2.5 mm. long (fig. 4, *d, g, n*); ☿, 1.5 to 2 mm. (fig. 4, *e, l*). A trace of a coronula appears on the achene.

4. "Artemisia australis Less. Oahu Pali Heller n. 2364" (K, W, H). Sterile shoots with semi-bipinnatisect leaves, as in figure 3, *c.* Of the leaves on floral branches, only the uppermost are undivided. Flower-bearing region of the panicle 7 cm. long with a dozen side branches, the lower 4 to 5 cm. long, the upper much shorter. Pedicels of heads short or almost wanting, simple or with one or two lateral heads. Involucral scales (fig. 4, *f, k, m*) not over 4 mm. long, about 12 in number. Florets more or less destroyed by insects in one specimen (K). One specimen (H) has very small, not

yet developed heads and is rather like *A. australis*. In 1926, I collected the same *Artemisia* in the same place, No. 1867. Only traces of old heads were present, with largest involucral scales 5 mm. long and exactly matching those in the type.

General Remarks

The leaves vary in size and cutting. As a rule they are less pubescent above but more dissected than in *A. australis*. Flowering plants are easily distinguished, as stated by Hillebrand; the inflorescence is shorter in *A. hillebrandii* and does not project beyond the leaves. The heads are larger and much less numerous. The largest heads were observed in the type specimen.

Artemisia hillebrandii var. **kauaiensis,** new variety (fig. 3, *e*, *g*; fig. 5, *a-g*).

Artemisia australis, β var., Hillebrand: Flora of the Hawaiian islands, p. 230, 1888.

Artemisia australis α *eschscholtziana* A. Gray: Am. Acad., Proc., vol. 5, p. 137, 1862; Mann, H.: Am. Acad., Proc., vol. 7, p. 176, 1868.

Folia quam in praecedenti majora, 9 ad 10 cm. longa et 5.5 ad 7 cm. lata, petiolo 2 ad 2.5 cm. longo suffulta, profunde bipinnatim vel subtripinnatim dissecta, laciniis longis acutis vel acutissimis, lamina minus pubescens, superne glabrata; folia floralia summis exceptis pinnatisecta. Capitula ut in praecedenti (non semper minora ut exposuit Hillebrand l. c.). Flosculi ad 32 visi quorum 10 solum, ♀, caeteri ☿. Pappus coronulam hyalinam 4 ad 5 dentatam distinctam formans.

Kauai: Knudsen (β′, type); Wawra, No. 2102 (V); Waimea, 2000-3000 feet. Mann and Brigham No. 539 (K).

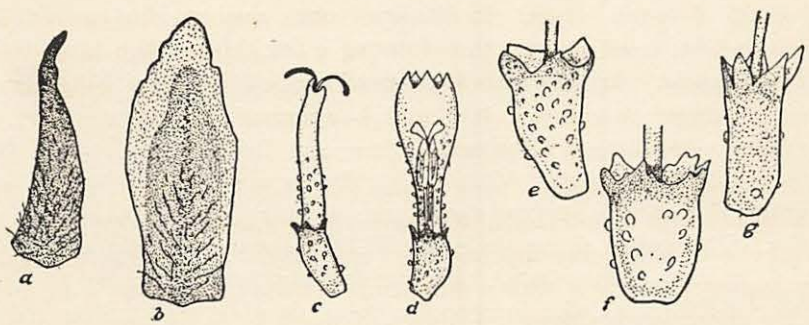


Figure 5.—Involucral scales and florets of *Artemisia hillebrandii* var. *kauaiensis* Skottsberg, Mann and Brigham No. 539; *a*, outer scale; *b*, inner scale; *c*, ♀ and *d*, ☿ floret; *e*, *g*, young achenes of ♀; *f*, of ☿ florets, all from the same specimen. *a-d* × 10; *e-g* × 20.

Remarks on the Specimens

1. "Artemisia australis Less. var. β Kauai, Knudsen." Leaves of sterile shoots larger and more divided than in any other form seen (fig. 3, *e*), nearly glabrous above and with vanishing indument beneath. Flowering branch not well developed, otherwise as in *A. hillebrandii.* Heads a little smaller than in this, with about 12 scales, not more than 3 mm. long.

2. "Artemisia australis Less. var. ded. A Gray Waimea, Kauai 2000-3000 ft. Mann and Brigham n. 539" (K). According to Hillebrand (18, p. xci), Mann and Brigham collected in 1864-65, so that their material can not have been used by Gray for his treatment of *Artemisia* in 1862. Mann (25, p. 176) quotes No. 539 under var. *eschscholtziana.* There are two pieces on the sheet, one with young and the other with open flower heads. There are no sterile branches, but to judge from the nature of the leaves in the floral region which are pinnatifid or even sub-bipinnatifid, only a few of the uppermost being entire, the leaves of sterile branches must have been quite as much divided as in Knudsen's specimen. The mature heads measure 4 to 5 mm. across, which is as much as in the typical species. The involucre is of the same type; scales (fig. 5, *a, b*), 10 to 17 in number, 3 to 4.5 mm. long, 3 to 5 being outer and narrower. The florets (fig. 5, *c, d*) numbered 32 and 29 respectively, in the two heads I have examined, only 10 ♀ in each. Their length varies between 2 and 3 mm. A pappus crown was quite well developed (fig. 5, *e, f, g*).

3. "n. 2102 Artemisia australis Less. var. Eschscholtziana Gray Hawaiische Inseln Kauai. Dr. Wawra." A sterile branch only. Leaves as in Knudsen's plant or a little less divided (fig. 3, *g*) almost glabrous above, sparingly pubescent beneath.

General Remarks on Variety

Knudsen's plant, No. 1 above, looks very distinct on account of the very much dissected leaves. In Wawra's plant they are bipinnatifid, only the lowest lobes again incised, thus forming a transition to the more divided Oahu specimens. According to Hillebrand (op. cit.), variety β has smaller heads, but these are not well developed in Knudsen's specimen, the mature ones being more or less destroyed. Mann and Brigham No. 539 is interesting in several respects. Thus the ♀ florets are few. In all the other Hawaiian *Artemisiae* examined (with one exception) they exceeded the ☿ in number. The genus *Artemisia* is devoid of a pappus, and the crown (fig. 5, *e, f, g*) is of course quite different from what is generally termed a pappus; still, I think, the four or five lobes must be regarded as reduced sepals. They were found in ♀ as well as in ☿ florets and are quite conspicuous. It remains to be seen if all plants from Kauai possess such a crown on their achenes.

Artemisia mauiensis new species (figs. 3, *d, f*; 6, *a-j*).

Artemisia mauiensis Skottsberg: Acta Horti Gothoburgensis, vol. 2, p. 282, 1926 (nomen solum).

Artemisia australis β mauiensis Gray: Am. Acad., Proc., vol. 5, p. 187, 1862.—Mann: op. cit., vol. 7, p. 176, 1868.

Frutex ad 0.5 m. vel. paulum ultra altus, a basi parce ramosus, niveo-canescens. Truncus usque 5 mm. crassus, primum argenteo-pubescens mox glabrescens, denique glaber cortice nigresceute striato. Rami erecti, longi usque 20 ad 30 cm., inferne nudi vel foliis et ramulis emortuis nec non cicatricibus arcte prominentibus instructi, dein foliis siccis et ramulis dense vestiti, versus apicem folia viva et ramulos vegetativo-florales gerentes. Folia densissime conferta, omnino adpresse albosericea, ± 4 ad 6 cm. longa, ambitu late ovata — orbicularia, petiolo angusto basi dilatato 1.5 ad 2 cm. longo suffulta, usque rhachidem angustissimam pinnatipartita, pinnis plurijugis, superioribus simplicibus vel pinnatis, intermediis pectinato-pinnatis, infimis interdum subbipinnatis, pinnis laciniisque omnibus lineari-filiformibus, ± 0.5 mm. latis, apice obtusiusculis. Ramuli dense foliosi, aut steriles innovantes, aut fertiles 6 ad 7 cm. longi et in paniculam apicalem exeuntes. Folia fulcrantia sensim minora, pinnata usque subsimplicia. Panicula subsimplex racemiformis, plerumque 3 ad 4 cm. solum metiens, capitulis paucis, 10 ad 20. Capitula pedicello albohirsuto bracteolato 2 ad 4 mm longo suffulta, hemisphaerica, 4 mm. lata. Involucrum biseriale 18 ad 21 phyllum, extus glandulosum. Squamae extremae perpaucae 2.5 ad 3 mm. longae et 1 ad 1.5 mm. latae, triangulares dense villosae, ceterae anguste ovatae, obtusae margine irregulariter dentato latissime scarioso, viridi-fuscae, minus hirsutae usque subglabrae, intimae paucae sublineares subhyalinae. Receptaculum hemisphaericum nudum. Flosculi ad 63 visi quorum 33 ♀, glandulosi; ♀ anguste tubulosi, orificio profunde 4-lobato, 2.2 ad 2.5 mm. longi, stylis valde exsertis; ☿ e cylindrico anguste campanulati, 5-lobati; 2.5 ad 2.6 mm. longi, stylis staminibusque inclusis. Achaenia matura non vidi.

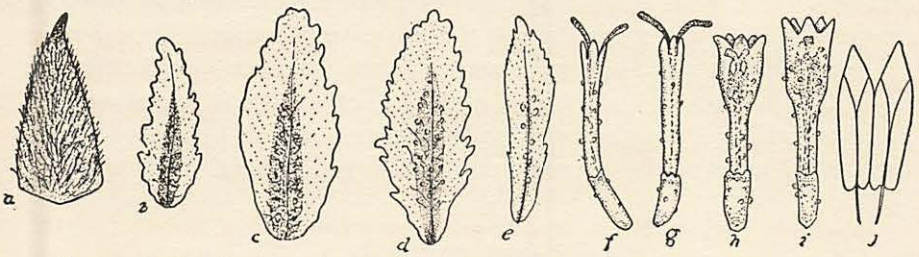


FIGURE 6.—Involucral scales and florets of *Artemisia mauiensis* (Gray) Skottsberg, Skottsberg No. 816; *a*, outer scale; *b-d*, inner scales; *e*, one of the innermost scales; *f-h* ♀ florets; *h-i*, ☿ florets; *j*, stamens.

a-i × 10; *f* × 35.

Maui: Crater, East Maui, United States Exploring Expedition (type, W, C); inside crater of Haleakala, rock wall below the rim ± 2300 m., abundant, Skottsberg No. 816 (G); Haleakala, Rock Nos. 8606, 8606 *a* (H); Forbes No. 292 (H); Puu Nianiau, Forbes No. 710 (H); Auahi, Forbes No. 2093 (H).

This is indeed the most distinct of all Hawaiian *Artemisae* and without question an independent species. It is only known from Haleakala, where so many local endemics have been found. Gray's specimens and my specimens agree in all respects.

THE GENUS SCAEVOLA

Introduction

In the Hawaiian islands, species of the genus *Scaevola* are a salient feature in the vegetation from the sandy and rocky seashore to the rain forests on the mountain ridges. The latest monographic study (22) records seven species. Several more have been described but have become synonyms. Naturally, I tried to base the classification of the specimens I collected in 1922 on the monograph. Finding, however, that many facts could not be brought to agree with the statements, I referred to the older literature and started to search for the taxonomic types assisted by a number of institutions mentioned in the Preface. However, I was unable to form an opinion of the value of some species until I began to investigate a character quite neglected before, the shape and size of the endocarp. It is not to be supposed that the endocarp is subject to as much variation caused by the influence of external factors as are such features as the size and serrature of the leaves, the length of the petiole, and the pubescence, but even after this new character has been applied some doubts remain regarding the delimitation of some of the species. This became quite evident after I had an opportunity to revisit the islands in September, 1926, and to go through the extensive collections in the Bernice P. Bishop Museum. Most of the material there has been brought together by Mr. J. F. Rock and the late Mr. C. N. Forbes, but it has never been diligently studied although Forbes made notes on some of the sheets showing that he had a description of new or critical forms in mind.

History of Species

In 1829 (for dates of issue see Merrill, 26) Gaudichaud described the first Hawaiian *Scaevolae, S. montana* and *S. chamissoniana* (12, p. 460-461, pl. 82). Both probably came from the island of Hawaii. In 1832, Hooker and Arnott (20, p. 8) changed the name *montana* Gaudichaud to *gaudichaudii* on account of an older *S. montana* Labillardière (1824-25) from New Caledonia. I am not sure that this change was necessary as there is an older name for Labillardière's species, *S. saligna* Forster fil. (1786). The reason why this has not been taken up by Krause (22) is unknown to me. Hooker and Arnott (l. c.) also described two new species, *S. mollis* and *S. glabra,* both from Oahu. In 1833, Chamisso (6), who was unable to identify his specimens with Gaudichaud's descriptions, established *S.*

gaudichaudiana (not to be confused with *S. guadichaudii*) and *S. menziesiana*. Later authors have reduced *gaudichaudiana* to *chamissoniana* and *menziesiana* in part to *chamissoniana*, in part to *gaudichaudii*. The type material of *S. gaudichaudiana* served G. Don (8, p. 728) for his description of *S. ciliata*, to which *S. gaudichaudiana* was referred, and Don further acknowledged *S. menziesiana* and *S. gaudichaudii*. Nuttall added four new species in 1843 (23): *coriacea, plumerioides, pubescens,* and *ligustrifolia*. The first is a good species, the second is generally identified with the common widespread *S. frutescens* (Miller) Krause, the third and fourth were referred to *chamissoniana* by Asa Gray (16) and all subsequent writers. The earliest detailed treatment of all species found in the islands is that of Hillebrand (18), who added two new ones, *S. cylindrocarpa* from Lanai and *S. procera* from Molokai, West Maui, and Kauai. In 1909 Rock (29) described *S. swezeyana* from Oahu. Finally, Léveillé (24) enriched the flora with one new species, *S. fauriei* from Kauai, referred to *S. frutescens* by Rock (30). Krause (22) has copied Hillebrand with the difference that he reduced *S. cylindrocarpa* to a variety of *chamissoniana*.

All the species are endemic except *S. frutescens*, a widespread tropical shore-plant.

The Scaevola Chamissonia Assemblage

Scaevola chamissoniana Gaudichaud (figs. 7; 13, *a, b;* Pl. I, *D, E, F*).

Scaevola chamissoniana Gaudichaud: Voyage autour du monde, Botanique, pl. 82, p. 460, 1826-30.—Skottsberg: Acta Horti Gothoburgensis, vol. 2, p. 272, 1926 (auct. cet. pro parte solum).

Temminckia chamissoniana de Vriese: Nederland. Kruidk. Archief. vol. 2, p. 143, 1851 (pro parte); Nat. Verh. Holland Maatsch. der Wetensch, 2nd ser., vol. 10, p. 8, pl. 1, figs. 1-8, 11, 1854.

The original description by Gaudichand (12, pl. 82, p. 461, 1829) is short and insufficient, but his plate makes clear what he had before him, for there is in the islands a plant that corresponds to his plate, although it is not what now passes as *S. chamissoniana*. No locality except "in insulis Sandwicensibus" was quoted by Gaudichaud but in his sketch of the vegetation which, according to his statement (op. cit., p. 88), was prepared from the notes made on the island of "Owhyhee" (Hawaii), both *S. chamissoniana* and *S. montana* are enumerated (op. cit., p. 98).

In all herbariums the common *Scaevola* from the mountains back of Honolulu lies under the name *S. chamissoniana*, and this is the form that is

claimed by Hillebrand (18, p. 208, *pro parte*), Heller, Rock (31, p. 495, *pro parte*), Krause (22, p. 123-124, *pro parte*), and others to be the typical state of Gaudichaud's species. Like other people who have collected on the slopes of Tantalus, I obtained ample material of this "chamissoniana," but I found that it did not at all agree with Gaudichaud's description or figure,

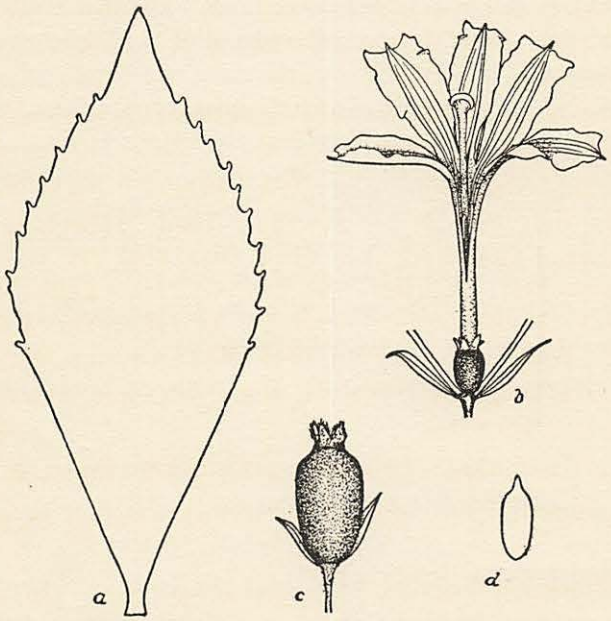


FIGURE 7.—*Scaevola chamissoniana* Gaudichaud: *a*, leaf; *b*, flower; *c*, a ripe drupe; *d*, outline of stone. West Maui, Skottsberg No. 765. Natural size.

and I recognized in this a different plant, apparently also included in Hillebrand's *chamissoniana* and collected by me on the island of Maui. There were thus two species confounded under the same name. I tried to obtain Gaudichaud's type from Paris and I received one sheet labelled *S. chamissoniana,* but to my great disappointment it was not the species Gaudichaud had described and figured under that name. He has sent the same "pseudo-chamissoniana" to Berlin, where there are four sheets of it—all are the ordinary Oahu species and not the one from Hawaii or Maui. I wish to draw attention to the fact that Gaudichaud had not written the name on the sheets; they had been added afterwards. To judge from de Candolle's remark (4, p. 506) that the flowers were smaller than in Gaudichaud's plate, he did not see the real *chamissoniana.* At the same time, de

Candolle listed the common Oahu form as *S. ciliata* G. Don, with *S. gaudichaudiana* Chamisso as a synonym, a name he rejected, I suppose, on account of its resemblance to *S. gaudichaudii* Hooker et Arnott. It was Chamisso who first discovered that there was a *S. chamissoniana* in Oahu different from the one Gaudichaud had described and figured; he pointed out the differences with great accuracy and named the Oahu species *S. gaudichaudiana.* But nobody seems to have followed him. His new species, and Don's *ciliata,* which is the same, were simply reduced to *S. chamissoniana* and have remained synonyms.

As limited here, *S. chamissoniana* Gaudichaud—*sensu stricto*—is known to me from the following localities:

Sandwich Islands: Hillebrand (W). Molokai: Rock, No. 6157 (H, C); Pelekunu trail, Forbes, No. 245 (H). Maui: Hillebrand (B). West Maui: Hillebrand (B); Rock, Nos. 8019, 8651, 8657 (H, C); Puu Kukui, Forbes, No. 604 (H); Skottsberg, No. 765 (G); Mauna Eka, Rock, Forbes, No. 373 (H); Maunahuoma, Forbes, N. 38 (H); Yao Valley, Faurie, No. 657 (H); Wailuku, Wawra No. 1853 (V); East Maui, Haleakala south, Hillebrand (K); slope of Haleakala, Rock, No. 8551 (H, C); Ukulele, Forbes, No. 706, 920 (H).

Hawaii: Gaudichaud? Hillebrand (H), locality uncertain.

Type specimen: The original to Gaudichaud's plate, l. c., probably (P) if not lost.

The following description, accompanied by figures (Pl. I, *D, E, F,* fig. 7), was prepared from the plants quoted above, all agreeing well with the original figure.

Leaves pubescent or glabrate, firm, almost coriaceous, dark green, ovate-lanceolate to ovate-rhomboidal, acute, cuneate at base and narrowed into a generally short petiole, in some subsessile, axils heavily tufted. Margin of blade sharply dentate-serrate in the upper half or two-thirds, teeth 8 to 12 on each side. Size of lamina including the petioloid portion 6.5 to 10.5 cm. by 2.5 to 4.7 cm. Cymes several flowered, in average as long as the leaves, glabrate. Bracts long and narrow. Buds pubescent. Flowers more or less glabrate, very large, 40 to 50 mm. long; ovary 5 to 8 mm. crowned by a conspicuous calyx of acutish, puberulous teeth; corolla tube 24 to 28 mm. or even as much as 30 mm., lobes 12 to 15 mm., broadly winged, milky white, and the central portion with 3 to 5 dark violet streaks. Stamens considerably shorter than the tube, anthers 2 to 3 mm. long. Style hispid in the lower two-thirds, indusium 2 to 3 mm. across, short ciliate on the rim. Drupe 12 to 14 mm. high, 6 to 7 mm. across, ellipsoid; stone 8 to 10 mm. high, distinctly flattened, 3.5 to 4 mm. wide across its widest part.

Even as limited here, *S. chamissoniana* remains polymorphous in various respects. It is the common form on Maui, with large flowers, distinctly striped with violet, and large fruits. The largest stone was observed in one

of Hillebrand's specimens and measured 11.2 by 4.5 mm. (Pl. I, E), approaching smaller fruits of var. *cylindrocarpa*. Some bracts are so well developed as to approach those of var. *bracteosa,* so in Rock Nos. 8651 and 8657 and Forbes No. 245. Rock No. 6157 from Molokai also comes close to var. *cylindrocarpa,* with stones 10 to 11 mm. long. The pubescence varies considerably; while No. 8019 and 6157 are glabrous or nearly so, most specimens are more or less hairy.

On the high mountains of West Maui *S. chamissoniana* becomes dwarfy, apparently rising very little from the ground.

Scaevola chamissoniana var. **bracteosa** Hillebrand (Pl. I, *G, I*; fig. 8, *a, b*).

Scaevola chamissoniana var. *bracteosa* Hillebrand: Flora Hawaiian islands, p. 268, 1888.—Krause: Das Pflanzenreich, herausg. von A. Engler, vol. 4, pt. 277, p. 124, 1912.

Scaevola dielliana Gaudichaud: according to Hillebrand, l. c.

The following description was prepared from the type material:

Arbor parva ramis novellis dense pubescentibus. Folia subsessilia vel pseudopetiolata, lanceolato-ovata, ovata vel subobovata, acuminato-acuta, basi longe cuneata, margine ad 2/3 long. super. crebre serratodentata, 5 ad 11 cm. longa et 2 ad 4.5 cm. lata, superne parcius subtus densiuscule breviter pubescentia, axillis longe denseque sericeo-barbatis. Inflorescentiae multiflorae foliorum longitudine, pedunculis pedicellisque pubescentibus, bracteis majusculis foliaceis inferioribus usque 15 ad 20 mm. longi et 4 ad 5 mm. latis, ovato-lanceolatis. Alabastra dense puberula. Flores quam in *S. chamissoniana vera* breviores, ovario 4 ad 5 mm. longo, calyce distincto coronato, tubo 16 usque ad 24 mm. longo, lobis 13 ad 14 mm. longis et 5 ad 6 mm. latis. Stylus et stamina ut in praecedente sed paulum breviora. Drupa 8 ad 10 mm. alta, endocarpio reticulatim sculpurato 6.5 ad 7.5 mm. alto et 3 mm. lato, apiculato, a latere leviter compresso.

According to Hillebrand, this variety is known by the large flowers and fruits, and especially by the large foliaceous bracts. His *bracteosa,* however, comprised also what I have called typical *chamissoniana,* and he mentions that the large flowered form, quite like var. *bracteosa* but with narrow bracts is common in Hawaii and Maui. Foliaceous bracts occur combined with smaller or larger flowers and fruits. The essential characters in Hillebrand's own specimens of *bracteosa* are the denser pubescence, the smaller, purely white flowers and the smaller endocarp. Bringing together the forms which agree in these characters, even though they differ in the size of the bracts, I have found var. *bracteosa* represented from the following localities:

Molokai. Heights back of Kamalo, Hillebrand (B).

Lanai: See var. *cylindrocarpa* (p. 22).

Maui. West Maui, Forbes No. 117 (H); Kipahulae Valley, Forbes No. 1633 (H); Haleakala, F. L. Clark (C).

Hawaii. U. S. Exploring Expedition (C, W); Finsch No. 7 (B, W); Hillebrand (W); Kohala Mountains, Hillebrand (B type; K); Forbes No. 497 (H); Rock No. 8357 (H, C); Hamakua District, Rock Nos. 4605, 4688 (H); Kilauea, Rock No. 8780 (H, C); below Kilauea Skottsberg No. 1907 (G); Uloa, Forbes No. 662 (H); Kau, Kapapala, Forbes No. 410 (H); Byron's Bay, Diell (C).

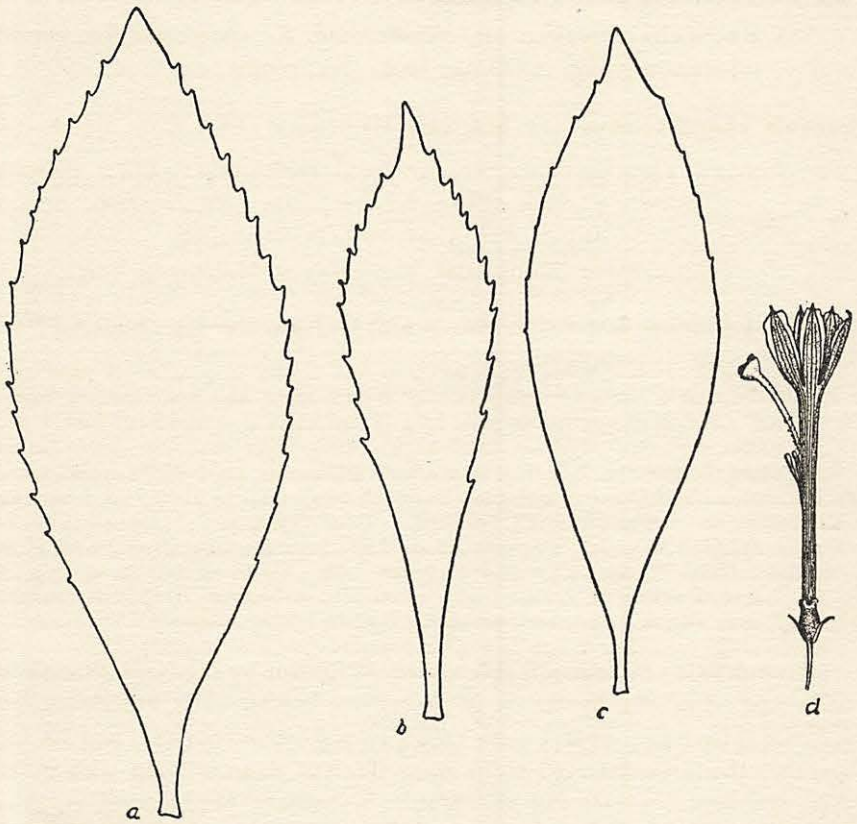


FIGURE 8.—*a, b,* Leaves of *Scaevola chamissoniana* var. *bracteosa* Hillebrand: *a,* Hawaii, Kohala, type of Hillebrand; *b,* United States Exploring Expedition; *c, d,* leaf and flower of var. *hitchcockii* Skottsberg, type, Hitchcock No. 14799.
Natural size.

When describing this form Hillebrand paid more attention to the size of the bracts than to other characters. There are, however, all gradations between large and small bracts, and possibly there is no sharp limit between var. *bracteosa* and var. *chamissoniana* proper. It is even possible that Gaudichaud's type is intermediate. The amount of pubescence varies a great deal, even in the same locality, while the size and creamy white color of the

flowers, which lack the violet stripes, and the size of the endocarp in those specimens in which this could be examined remain the same. This form is undoubtedly the leading *Scaevola* in the middle forest zone of the island of Hawaii and in this region appears quite distinct from the typical *chamissoniana,* as limited by me.

Scaevola chamissoniana var. **cylindrocarpa** (Hillebrand) Krause (Pl. I, *B*).

Scaevola chamissoniana var. *cylindrocarpa* Krause: Das Pflanzenreich, herausg. von A. Engler, vol. 4, pt. 277, p. 124, 1912.

Scaevola cylindrocarpa Hillebrand: Flora Hawaiian islands, p. 268, 1888.

While var. *bracteosa* represents a race with smaller flower and fruit, var. *cylindrocarpa* is distinguished by the very large flower and drupe, and also by the short, few-flowered cyme.

The type (B) consists of a single sheet with two branches. They are unlike. In addition are some flowers and numerous fruits in an envelope. It is of interest to compare these two branches with one another and with the original diagnosis. I call the specimen on the left "L" and the one on the right "R." My comments appear in brackets.

A glabrous shrub, shortly tufted in the axils [L strongly tufted]. Leaves glabrous [puberulous in R] obovate or obovate oblong, shortly petiolate [in L, as much as 10 mm in R], acuminate [only L], denticulate, 3-6′×1½-2′ [L: largest 15 by 4.5 cm. second 8.5 by 2.3 cm.; R: largest 7.5 by 2.5, others 5 to 6 cm. by 2 to 2.5 cm.]. Cyme shorter than its leaf [L: only one cyme with one flower left, as long as the leaf; R: cymes longer or at least as long as their leaves], generally 3-, but sometimes 1- or 5-flowered [flowers more numerous in R], the peduncle 1 — 1½′ [as much as 5 cm. in both], the linear bracts 7-4″ [L: bracts as in *S. bracteosa;* R: narrow, to 8 mm. long]. Calyx elongate with teeth of 1-1½″ [rather less in both]. Corolla . . . tube 12″, lobes 5″ and broadly winged [only one flower attached to L, besides 3 buds and 2 flowers in envelope probably belonging to L; those of R unknown]. Style pubescent near the base only [at least to two-thirds], the rim of the indusium apparently not ciliate [distinctly ciliate]. Drupe cylindrical, 7 — 8″ long slightly 8-10-ribbed [largest fruit 15 by 4 mm.; unknown in L, young dried fruits are more or less ribbed as a result of desiccation]. Stamens as long as the tube [L, in bud only, much shorter than tube of mature flower].

Hillebrand based his species on both specimens, but only "R" is in fruit, showing the long narrow drupe with stones 13 by 4 mm. It is a *chamissoniana* with a larger fruit. The other specimen may be the same, but it has almost as large bracts as var. *bracteosa.*

I have seen the following specimens:

Lanai: On the high ridge, Hillebrand (type, B). Forbes No. 313 (H); mountains, east end, Forbes Nos. 228, 279 (H); mountain top, Forbes No. 11 (H); Kaele, Forbes No. 92 (H); Pulekunu trail, Forbes No. 245 (H).

The pubescence varies as in the other forms, some plants are glabrous, others densely hirsute as Forbes No. 92, marked "f. pilosa Forbes." Nos. 245 and 279 have foliaceous bracts. But in spite of divergences of this kind, I am convinced that all the Lanai specimens examined belong together.

A sheet (C) labelled "Scaevola gaudichaudii Hook. et Arn., Rock No. 8029, Lanai." Of the same number there is an ample set of specimens (H), called "Sc. Chamissoniana var. γ Hillebrand" and here the locality given is West Maui. To judge from Hillebrand's description of variety γ (18, p. 267), it can not be this. Unfortunately, Hillebrand's specimen cannot be found. Rock No. 8029 is without doubt a *cylindrocarpa*. The only difference from other specimens lies in the shape of the leaves which are more regularly ovate and almost entire, while the flowers and enormous drupes exactly match the type, the drupes even a little larger than in other specimens, fully 20 mm. long in one specimen, with a stone 14.5 mm., the largest I have seen.

Scaevola chamissoniana var. **hitchcockii,** new variety (Pl. I, *A, C, H*; fig. 8, *c, d*; 13, *c*).

Glabra. Folia ut in praecedentibus. Cymae optime evolutae, foliis aquilongae vel longiores, bracteis parvis 3 ad 5 mm. longis. Flores perlongi tubo 25 ad 27 mm. longo, lobis lanceolatis, alatis, crassiusculis, trinerviis, 9 ad 10 mm. longis. Stamina 20 ad 21 mm. longa, antheris ± 3 mm. Stylus 33 ad 34 mm., ad 2/3 long. hispidus, indusio 2 mm. lato parce ciliolato. Drupa 8 ad 9 mm. alta et 5 mm. crassa. Endocarpium ovoideum, a latere paulum compressulum, basi et apice truncatulum, leviter sulcatum et irregulariter sculpturatum, manifeste mucronatum, 5.5 ad 7 mm. altum et 3 ad 3.5 mm. crassum.

Maui: West Maui, Rock No. 8142 (H); Puu Kukui, upper forest 3000 to 5000 feet, Hitchcock No. 14799 (type, W); Honokahau drainage basin, Forbes No. 498 (H).

This represents the form of *chamissoniana* with smallest fruit, and if I had only seen Hitchcock's plant I would not have hesitated to regard it as a good species, the leaves being more regular ovate and less toothed and the cymes better developed than in all other *chamissoniana* varieties, but Rock No. 8142 combines the ordinary type of leaf with the small drupe and endocarp, of *hitchcockii* the smallest I have seen (Pl. I, *H*).

The Oahu "Chamissoniana"

Scaevola gaudichaudiana Chamisso (Pl. II, *A-E, G, H, J, O*; figs. 9, *a, d, e;* 13 *d*).

Scaevola gaudichaudiana Chamisso: Linnaea, vol. 8, p. 226, 1833.—Skottsberg: Acta Horti Gothoburgensis, vol. 2, p. 272, 1926.

Scaevola ciliata G. Don: A general history of dichlamydeous plants, vol. 3, p. 728, London, 1834.—de Candolle: Prodromus syst. nat. regni vegetabilis, vol. 7, p. 506, 1838.

Scaevola chamissoniana Hooker et Arnott: Botany of Capt. Beechey's voyage, p. 89, 1841 (pro parte).—Gray: Am. Acad., Proc., vol. 5, p. 152, 1862 (excl. synon. *menziesiana et dielliana*).—Mann: Am. Acad., Proc., vol. 7, p. 187, 1868.—Wawra: Flora, vol. 56, p. 60, 1873.—Hillebrand: Flora of Hawaiian islands, p. 267, 1888.—Krause: Das Pflanzenreich, hersaug. von A. Engler, vol. 4, pt. 277, p. 123, 1912 (excl. var. *pubescens* et *bracteosa*).—Rock: The indigenous trees of the Hawaiian islands, p. 495, pl. 210, 1913.

Scaevola ligustrifolia Nuttall: Philadelphia Soc., Trans., new ser., vol. 8, p. 253, 1843.

Scaevola pubescens Nuttall: Philadelphia Soc., Trans., new ser., vol. 8, p. 253, 1843.

Temminckia ciliata de Vriese: Nederland Kruidk. Archief, vol. 2, p. 144, 1851; Nat. Verh. Holland, Maatsch der Wetensch., 2nd ser., vol. 10, p. 9, 1854.

Temminckia chamissoniana de Vriese: Nederland Kruidk. Archief, vol. 2, p. 143, 1851; Nat. Verh. Holland. Maatsch der Wetensch., 2nd ser., vol. 10, p. 8, 1854 (pro parte).

This is the common *Scaevola* from the Koolau Mountains in Oahu, generally known as *S. chamissoniana,* with which, as limited here, it has nothing to do. Chamisso's type and description (B) leave no doubt as to his understanding of his species. He had tried to identify it with *chamissoniana* of Gaudichaud, and although he had not seen the type, from a diligent comparison with the description and plate, Chamisso arrived at the conclusion that there were two different, closely allied species—"corollis extus glabris minoribus, foliis obsoletius antice tantum serratis et subintegerrimis, cymis magis evolutis . . . differre videtur. Rami pedunculique nostrae graciliores, subpetiolaris foliorum pars longius angustata, germen minus, tubus corollinus gracilior quam in illius icone adumbrata. Folia adulta nostrae 3½ pollicaria, pollicem lata. Corollae pollicares vel pollice lato paulo longiores, nec ut in praelaudata sesquipollicares," is Chamisso's very accurate description of the common Oahu *Scaevola.* It is difficult to understand why no one has paid attention to it and that even the monographer for the "Pflanzenreich" felt justified to let Chamisso's serious study fall into oblivion. Chamisso adds (op. cit., p. 227): "Specimen innominatum

Gaudichaudianum ipsius nostrae speciei in herbario Kunthiano asservatur . . . "an vulgarior Sc. Chamissonianae varietas?"—a quite interesting remark.

I have seen the true *S. gaudichaudiana* Chamisso, of which a leaf (fig. 9, *a*), a flower (fig. 9, *d, e*), and endocarps (Pl. II, *A, B*), from the type are figured, from the following localities:

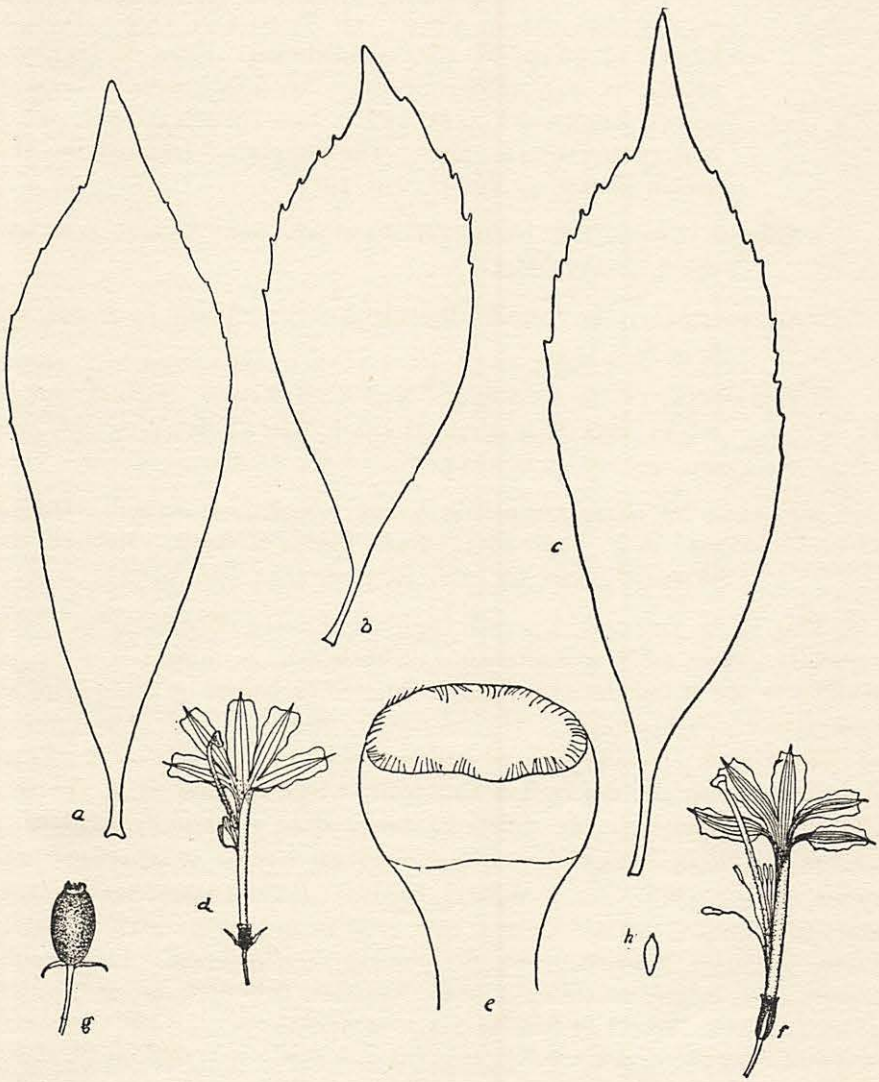


FIGURE 9.—*a, d, e,* leaf, flower, and indusium of *Scaevola gaudichaudiana* Chamisso, type; *c,* leaf of f. *kauaiensis* Skottsberg, Heller No. 2569; *b, f, g, h,* leaf, flower, ripe drupe, and outline of stone of var. *stenolithos* Skottsberg No. 273.
e × ± 20, others natural size.

Hawaiian islands, Gaudichaud 1819 (P, B); Meyen (K).

Oahu, Macrae (K, B, V); Beechey (K); Remy No. 310 (C); Meyen (V); Barclay, Diell No. 93, Seemann No. 1720, Hinds, Nuttall (K); Didrichsen, Bennett (B); Mann and Brigham No. 9, United States Exploring Expedition 1840 (W); Hillebrand comm. Wawra No. 2349 (V); west end of Oahu, Hillebrand No. 1072 (K); Koolau Mountains, Rock No. 110 (H); near Schofield, Hitchcock No. 14047 (W); Waimea, Forbes No. 2050, and Wahiawa, Forbes No. 2211 (H); Niu, Hillebrand (B); Kalihi, Heller No. 2340 (C); Hitchcock No. 14098 (W); Nuuanu, Hillebrand (B, K); along Tantalus, Heller No. 2052 (W); Pacific Heights, W. A. Bryan (H); Honolulu, Chamisso (type, B); N. J. Andersson (S); Lillie Riggs (W); Pauoa, Skottsberg Nos. 59 and 1771 (G); Konahuanui, Rock (H); Palolo, Forbes, Hillebrand (B); Rock (H); Olympus, Rock No. 10066 (C); Waiolani, Wawra No. 1657 (V): Forbes (H).

[?Maui: East Maui, Hillebrand (B).]

A small tree with light brown bark. Leaves softer coriaceous than in *S. chamissoniana,* light green, glabrous, ovate to slightly obovate, more or less cuspidate, long cuneate and narrowed into a distinct petiole of 5 to 15 mm., the blade 5 to 10 cm. by 2 to 3 cm., more or less serrate in the upper third or half, rarely with more than 5 or 6 toothlets on each side. Axillary hair tufts small and caducous. Cymes as long as the leaves or longer, slender, many-flowered, glabrous; bracts small in most specimens, but in some the lowermost as much as 10 mm. long, all narrow linear or filiform, glabrous as is the whole inflorescence. Flowers much smaller than in *S. chamissoniana,* pure creamy white without lilac stripes, glabrous. Ovary 3 mm. high, ovoid, crowned by five subobtuse, slightly puberulous calyx lobes, which are very small and not always distinct. Corolla tube 15 to 19 mm. long, lobes 8 to 12 mm., broadly winged. Stamens about two-thirds the length of the tube, anthers 2 mm. Style as in *S. chamissoniana,* but more slender and with a smaller indusium. Mature drupe ovoid, 6 to 8 mm. by 3 to 4 mm. Endocarp light brown, indistinctly sulcate, obovoid, a little compressed from the sides, abruptly apiculate, with dorsal and ventral portions sculptured, 3 to 4 mm. high, 2 to 2.5 mm. across.

Easily known by the fruit and stone: Plate II, *A-E, G, H, J, O* shows the range of variation in the material I have had an opportunity to examine.

All specimens from the Koolau range belong to *S. gaudichaudiana typica.* The labels on many specimens do not tell from what part of Oahu the plant came. I did not collect it in the Waianae range, but there is (K) a specimen found by Hillebrand at the western end of Oahu. This has the largest leaves of any I have seen, maximum sixe 132 by 42 mm., with petiole of 13 mm., but flower and fruit as in the others.

The only specimen of *S. gaudichaudiana* labelled Maui is dubious as to its extraction. It has two labels, both written by Hillebrand. One reads "Scaevola Chamissonis Gaud. back of Pumelei July 58." I have not been able to find out where Pumelei is situated. The other is inscribed "Scaevola

Chamissoniana Gaud. E. Maui." The two branches on the sheet are fairly typical, glabrous *gaudichaudiana,* but unfortunately mature flowers and fruits are missing. In a small envelope are a number of buds and flowers that, however, do not belong to the branches. They are typical *chamissoniana* flowers (in my sense). With them is a small label, "Scaevola Hamakua," not written by Hillebrand. There is one Hamakua on Maui and another on Hawaii, and *S. chamissoniana* occurs, as has been noted, on both these islands.

S. ligustrifolia of Nuttall is represented in Kew by a small piece, probably communicated to W. J. Hooker by Nuttall. Nuttall (28, p. 253) writes "allied to S. Chamisgoniana [sic], but the leaves are never toothed." Leaves of some *S. gaudichaudiana* are not more toothed than those in Nuttall's specimen, which agrees very well with *S. gaudichaudiana.* I have not seen the fruit. Regarding *S. pubescens* Nuttall, nothing is definitely known. I have not yet located the type.

Scaevola gaudichaudiana f. **leucocarpa** new form.

A typo differt fructibus albis.

Oahu: Koolau, Pupukea Forest Reserve, E. L. Caum, Skottsberg No. 1819 (G).

Scaevola gaudichaudiana f. **kauaiensis,** new form (Pl. II, *K, M;* fig. 9, *c*).

A typo differt endocarpio majore ad 5 mm. alto et 1.5 ad 2 mm. crasso.

Kauai: Lydgate (H); between Hanapepe and Wahiawa rivers, Heuer No. 2569 (W, K); Hii Mountains, Forbes No. 614, 643 (H); Lihue, Forbes No. 29 (H).

Lydgate's specimen has no fruit. In the others, the endocarp is in all cases examined slightly larger than in typical *gaudichaudiana,* so I have thought it proper to call special attention to the Kauai form.

Scaevola gaudichaudiana var. **stenolithos,** new variety (Pl. II, *N, P*; figs. 9, *b, f-h,* 13, *e*).

S. gaudichaudianae typicae simillima. Folia subglabra, utrinque pilis parcissime inspersa, ovato-rhomboidea, apice cuspidata, basi longe cuneata, petiolo manifesto 8 ad 10 mm. longo suffulta, lamina textura firma, discolor, 4 ad 6 cm. longa et 2 ad 2.5 cm. lata, tertia parte superiore vel usque ad medium glanduloso-serrulata, dentibus utrinque 3 ad 6. Cymae foliis plerumque longiores, ad 9 cm. longae visae, glabrae, pedunculo 3 ad 4 cm., pluriflorae, bracteis sublineares-subulatae, ad 6 mm. longae. Alabastra pilis mox caducis inspersa, ovarium cylindraceum 4 mm. altum, corolla lactea flavescens, haud violaceo-notata, gracilis, tubo quam in typo conspicue longiore, 22 ad 24 mm., lobis 10 ad 12 x 4 ad 5, bene alatis, stamina 20 mm. longa antheris ± 2 mm.; stylus

ut in praecedente, ad 30 mm. longus. Drupa matura 8 ad 10 mm. alta, ellipsoidea. Endocarpium laeve, obscurum, anguste obovoideo-conicum, basi et apice mucronato perangustum, 5 ad 6 mm. altum 1.5 ad 2 mm. crassum, haud compressum.

Oahu: Waianae, Palehua, Skottsberg No. 273 (G).

Already in floral stage this form is recognized by the long and narrow ovary and the longer tube. The fruit is so different that at first I felt inclined to regard var. *stenolithos* as a separate species; *f. kauaiensis,* however, seems to form a transition between the extremes, and the range of variation as to the size of the endocarp is even greater in *S. chamissoniana.*

Finally, I want to draw attention to the following doubtful plant:

"*Scaevola chamissoniana* var. *foliis parvulis* Oahu." United States Exploring Expedition, scripsit Asa Gray (C, W).

A very puzzling plant, habitually not unlike *S. gaudichaudiana,* but with obovate, spathulate leaves as in *S. menziesiana;* blade 3.5 to 5 cm. long and 12 to 15 mm. wide, distinctly petioled, the margin with 1 to 3 serratures on each side near the rounded, mucronulate tip. Cymes shorter than their leaves, glabrous, 3- to 7-flowered, peduncle 12 to 25 mm. bracts filiform, 6 to 8 mm. long. Flowers glabrous, tube 13 to 14 mm., lobes 10 to 11, caudate, narrowly winged. There are a few ripe fruits in one of the specimens. The endocarp agrees well with that in *S. menziesiana,* but is more rugose and distinctly obovoid, thus of an intermediate type. The possibility of a natural cross should be considered. I have not seen other material of this form.

Scaevola Menziesiana and Allied Forms

Scaevola menziesiana Chamisso (fig. 10; Pl. II, *F, I*).

Scaevola menziesiana Chamisso: Linnaea, vol. 8, p. 227, 1833 (non auct. cet. vel tantum pro parte).

Scaevola gaudichaudii Hooker et Arnott; Botany of Capt. Beechey's voyage, p. 89, 1832-40.—Gray: Am. Acad., Proc., vol. 5, p. 151, 1862.—Hillebrand: Flora of Hawaiian islands, p. 266, 1888.—Krause: Das Pflanzenreich, herausg. von A. Engler, vol. 4, pt. 277, p. 122, 1912 (omnes quoad formam glabram).

Scaevola montana Gaudichaud: Voyage autour du monde, Botanique p. 460, 1826-40.

Scaevola swezeyana Rock: Torrey. Bot. Club, Bull. vol. 36, 1909.

Temminckia menziesiana et *gaudichaudii* de Vriese: Nederland Kruidk. Archief, vol. 2, p. 144; Nat. Verh. Holland. Maatsch. der Wetensch, 2nd ser., vol. 10, pp. 10, 11, 1854.

The accurate description of Chamisso published in 1833 leaves no doubt as to what he understood by his species. His var. *glabra* is the same as *S. gaudichaudii* Hooker et Arnott, but the more or less hairy forms seem not to be separable from the glabrous one.

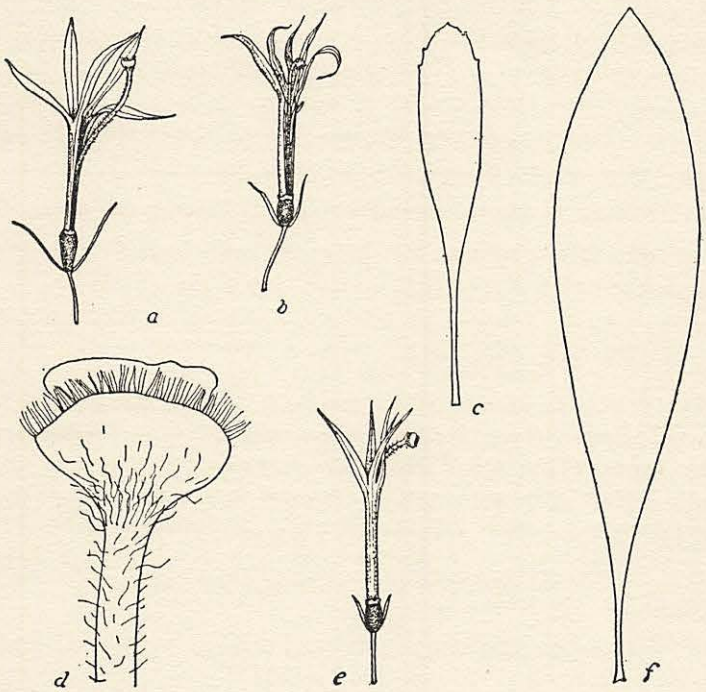


FIGURE 10.—*Scaevola menziesiana* Chamisso: *a*, type; *b*, *c*, *d*, coll. Hillebrand; *e*, *f*, Hitchcock No. 14135 (*Scaevola swezeyana*, Rock).
d, × ± 20, others natural size.

The nomenclature of this plant is a little difficult. In the sense used here it was first described by Chamisso, who distinguished between a pubescent and a glabrous form. I can not find that they can be kept separate. The type (B) (fig. 10, *a*), labelled "Scaevola Menziesiana n. O-Wahu Sandwicensium Adelbert v. Chamisso" is slightly pubescent. A more recent label bears the name *S. chamissoniana* var. *pubescens* Krause. The specimen was renamed *S. gaudichaudii* by Rock. This, strictly spoken, is a glabrous form with entire leaves: an older name for it is *S. montana* Gaudichaud (12, p. 460, 1829). The name *gaudichaudii* is quoted by Krause as published in 1838. Merrill (26) gives the date of publication of Captain Beechey's voyage, where *S. gaudichaudii* appears, as 1833-40, but at the same time remarks that the first fascicle was issued in 1830 and the second in 1832, together comprising pages 1 to 96; consequently, the description of

Scaevola on page 89 should date from 1832. Nowhere in the book is there any information on this matter; the title page reads 1841. To quote 1838 is, in any case, impossible, for *S. gaudichaudii* of Hooker and Arnott is quoted by G. Don (8, p. 728) already in 1834. Probably the name *gaudichaudii* is one year older than *menziesiana,* which ought perhaps to be rejected according to the priority rule; still, *gaudichaudii* is only part of the species. Even if *gaudichaudii* is taken up again, the name *gaudichaudiana* may still be retained although it is likely to cause confusion. The second oldest name for *gaudichaudiana* is *S. ciliata* G. Don (1834), a most inappropriate name. It is decidedly better to use the names as proposed here until it has been decided whether *S. montana* cannot be restored to good usage.

I have seen *S. menziesiana* (including *S. gaudichaudii*) from the following localities:

Hawaiian islands, Hillebrand (W, K); ex herb. Reichenbach fil. (V) United States Exploring Expedition (W).

Kauai: Mana, Rock No. 16039 (H).

Oahu: Chamisso (type, B; V); Macrae (K, C); Niu, Hillebrand (B); Forbes No. 1903 (H); Rock Nos. 4804, 4850, 4851 (H, C); Kaimuki ridge, Forbes No. 1857 (H); Palolo, Forbes No. 2398 (H); Rock No. 14135 (H); Hitchcock No. 14135 (W); Kaaawa, C. S. Judd.

Molokai: Pukoo ridge, Forbes No. 349 (H); Halawa, Hillebrand (B); Kalae, Hillebrand (B, K).

Lanai: Munro No. 7 (W); Mahana, Forbes No. 375 (H) and Rock No. 8129 (C); Kaiholena, Munro No. 47 (H).

Maui: Remy No. 304 (C); W. Maui, Hillebrand (B, C); E. Bishop No. 21 (H); Mann and Brigham No. 385 (K); Lahainaluna, Forbes (H); E. Maui, Kealii forest, Forbes No. 2121 (H).

Hawaii: Hilo and Puna, according to Hillebrand (18, p. 267).

Of Rock No. 8129 there are numerous specimens in the Bishop Museum herbarium; one is labelled "West Maui," the others, on the cover, "West Oahu," while the specimen (C) is said to have come from Lanai. Only one of the localities is correct, but which?

Leaves of typical *menziesiana* (fig. 10, *c*), chartaceous to slightly carnose, spathulate, with blade 25 to 50 by 7 to 15 mm., obtuse, apiculate, with few more or less distinct serratures, gradually narrowed into a petiole of 6 to 13 mm. Flowers solitary or in cymes of 2 or 3, with peduncle 7 to 15 mm. long, bracts long and narrow, about 10 mm. in Chamisso's plant. Corolla tube 13 to 15 mm., lobes 10 to 11 mm., narrow lanceolate, not winged, very acute and forming a conspicuous beak in the bud. Stamens a little shorter than the tube. Style 19 mm. long, hairy throughout. Indusium hairy round the base, margin longer ciliolate than in *S. chamissoniana* or *gaudichaudiana.* Drupe 6 to 8 mm. high, ellipsoid. Endocarp smooth, light brown, ovoid, acute, almost orbicular in cross section, 6 to 6.5 mm. high, 2.5 to 3.2 mm. across.

S. swezeyana Rock was mentioned by Krause as probably synonymous with *S. gaudichaudii*. Apparently this view has been adopted by Rock, for on Hitchcock No. 14135 he has written "Scaevola Gaudichaudii H. et A. (S. Sweyzeana [sic] Rock)." The specimen is typical *gaudichaudii*, quite glabrous, with leaves more lanceolate than spathulate, 50 to 80 mm. long and 13 to 21 mm. wide on petioles of 7 to 11 mm. (fig. 10, *e*). The flowers (fig. 10, *f*) are typical in every respect, but there is no fruit.

The only earlier reference to Kauai is in Hillebrand (op. cit.) where γ var., collected by Knudsen, is described. It was named var. *dentata* by Krause. Unfortunately, the specimen cannot be found. The corolla is said to be yellow. Fresh material of this interesting form is very desirable.

Some specimens from Lanai are sterile and remain somewhat doubtful. The leaves are more broadly spathulate than in other specimens from other islands and recall *S. coriacea* in outline, but are quite thin, at least in a dry state.

A very interesting form was collected on Hawaii by Rock in July, 1918, on the 1823 lava flow near Kilauea. The leaves are of typical *menziesiana*-shape, but very thick coriaceous; the peduncle is prolonged and several flowered. The only flower present is as in *menziesiana*. There is no fruit.

Scaevola coriacea, Nuttall (Pl. III, *A, C, D*).

Scaevola coriacea Nuttall: Philadelphia Soc., Trans., new ser., vol. 8, p. 253, 1843.—Gray: Am. Acad., Proc., vol. 5, p. 151, 1862.—Hillebrand: Flora Hawaiian islands, p. 266, 1888.—Krause: Pflanzenreich, herausg. von Engler A., vol. 4, pt. 277, p. 122, 1912.

Type locality: "Ins. Atooi" [quid?], Nuttall. Not seen.

Specimens examined:

Hawaiian islands: United States Exploring Expedition 1840 (W, C); Hillebrand comm. Wawra No. 2350 (V).

Niihau: Remy No. 3151 (var. β A. Gray, 16, p. 151) (C). Not found again, according to Forbes (9, p. 25).

Kauai: Hillebrand (18, p. 266), no specimens.

Oahu: Cape Kaena, Hillebrand (B); Barbers Point, Rock No. 17037 (H).

Lanai: Paomai, Munro No. 692 (H).

Molokai: Remy No. 313 var. γ A. Gray (16, p. 151) (C).

Maui: United States Exploring Expedition 1840 (W); sandy isthmus, Mann and Brigham No. 388 (W); Kalepolepo, Lydgate No. 88 (B).

Hawaii: United States Exploring Expedition (C).

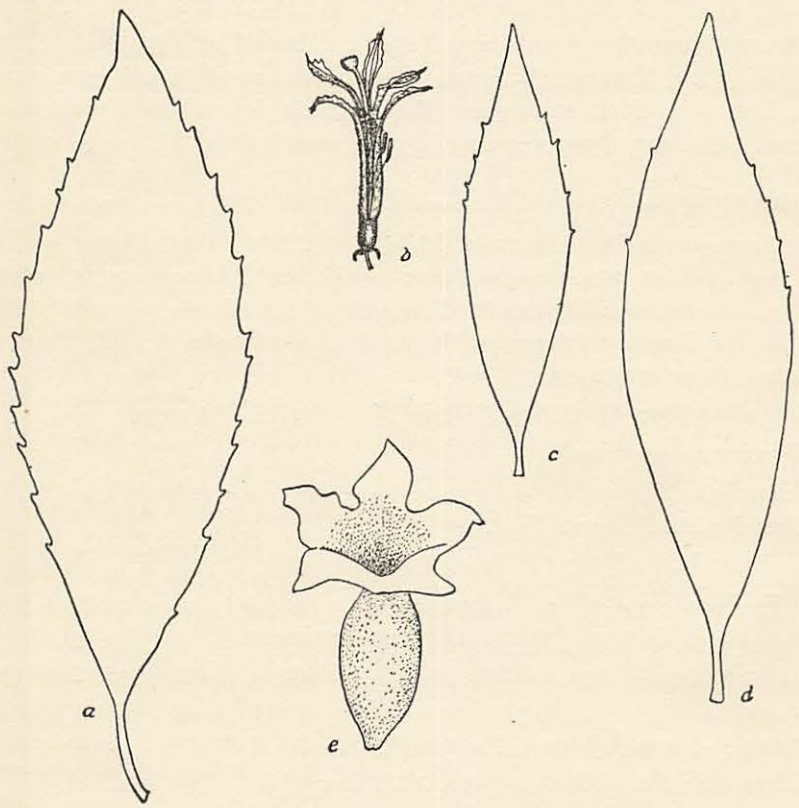
Near *S. menziesiana,* but certainly distinct, although some forms apparently are intermediate and require further study. Cymes as in *menziesiana,* but peduncle not more than 15 or 20 mm. long and bracts very small. Corolla shorter than in any other Hawaiian species, barely 15 mm. long or even less, with tube and lobes woolly-hispid inside. Stamens 5 mm. Style hispid throughout and indusium densely hispid at base. Drupe 5 to 7 mm. high, endocarp dark brown, rugose, subglobular, very obtuse and minutely mucronate, 3.2 to 4 mm. high and 3 mm. across, not flattened.

Scaevola procera Hillebrand (figs. 11, *a-d;* 13, *f, g, h;* Pl. III, *E, G*).

Seaevola procera Hillebrand: Flora Hawaiian islands, p. 268, 1888. — Rock: Indigenous trees Hawaiian islands, p. 497, 1913.—Krause: von A. Engler, vol. 4, pt. 7, p. 123, 1912.

Seen from:

Kauai: Knudsen (B); Koloa, United States Exploring Expedition (W); Hanepepe ridge, Heller No. 2617 (W); Kaholuamano, Heller No.



FAGURE 11.—*Scaevola procera* Hillebrand: *a, b,* Molokai, type; *c,* Kauai, Hitchcock No. 15352; *d,* Kauai, Heller No. 2617; *e,* var. *pseudomollis* Skottsberg, f. *macrocalyx* Skottsberg, Kauai, Forbes No. 291.
e, × 2½, others natural size.

2857 (W); Forbes No. 379 (H); Rock No. 17097, 17102 (H); Hitchcock No. 15352 (H); Waimea, Forbes Nos. 780, 1021 (H); Waiolani, Forbes No. 114 (H); Wainiha, Faurie No. 669 (H); Halemanu, Rock Nos. 1513, 1667, 1669 (H); Lihue, Forbes No. 30 (H).

Oahu: Wahiawa, head gate trail, Forbes No. 2215 (H).

Molokai: Remy No. 311 (C); Hillebrand (K); Kalae, Hillebrand (type, B); Pelekunu, Hillebrand (type, B); Kamoku, Munro No. 564 (H); Rock No. 6159 (H, W); Waialua, Forbes No. 405 (H); Kalauaula, Munro No. 571 (H); central Molokai, Hitchcock No. 15166 (W).

All the specimens of *Scaevola procera* that I have examined differ from *S. chamissoniana* and *S. gaudichaudiana* in the cymes, which are short and crowded, and in the shape and size of the endocarp, from *S. chamissoniana* also in the smaller flowers, that are a little shorter even than in *S. gaudichaudiana.* A number of measurements gave the length of the peduncle as from 4 to 7 mm., the pedicels being of the same length or shorter. For Hillebrand's plants from Kalae the flowers range in length from 19.5 to 22 mm., in the one from Pelekunu from 21 to 24.5 mm. The ripe drupe is 9 to 10 by 5 mm., the endocarp is of the same type as in *S. menziesiana,* ovoid, pointed, not (or slightly)flattened, only faintly rugose; its size in the Kalae plant is 5 to 7 mm. by 3 to 4 mm.; in the Pelekunu plant, 5.8 to 6.3 mm. by 3.2 to 4.5 mm.

From the high land of Molokai, Hillebrand brought a *Scaevola* which he called *S. gaudichaudii* var. β, named var. *pilosa* by Krause (22, p. 122). A specimen of this form (W) collected by Hillebrand, is a hairy plant with small leaves, intermediate in shape between those of *menziesiana* and *procera,* some approaching *menziesiana,* some exactly as in *procera,* but smaller. The cymes are crowded on the bare stem as in *procera.* The single endocarp available for examination measured 4.5 by 2.5 mm. and looks like endocarps of either *menziesiana* and *procera,* as these species differ little. More material is needed before a definite position can be assigned to this remarkable form. According to Hillebrand (op. cit., p. 267) *S. coriacea* var. δ Gray is the same, but I believe that the Gray position is better.

Another doubtful plant is *Scaevola chamissoniana* Gaudichaud β var., Hillebrand (18, p. 267) called var. *pubescens* by Krause (12, p. 124). I have examined all the material in the Hillebrand collection, two sheets (B) and one (W). Hillebrand, and after him Krause, refers *S. menziesiana* Chamisso and *S. pubescens* Nuttall as synonyms to their variety β and *pubescens,* respectively. The variety has, however, nothing whatever to do with *menziesiana,* nor can it be brought to *chamissoniana, gaudichaudiana,* or any of the other species. I have not seen the type of Nuttall's *S. pubescens,* but judging from the description it is different. Hillebrand has written "Kaala Mts. and Kauai" on one specimen, only Kaala on another. The island of Kauai is not quoted in the flora. In my opinion, var. *pubescens* is more closely related to *S. procera* than to any other species. Habitually,

it is not unlike *S.cerasifolia* as to the development of the cyme, but the fruit is quite different. All I have seen is one mature endocarp (Pl. II, *L*) which is very like the endocarp in *procera* from Molokai. The drupe was 10 by 4 mm., the stone 6.6 by 3.1 by 3 mm., thus not perceptibly flattened. The same unusual development of the cyme in otherwise typical *procera* is

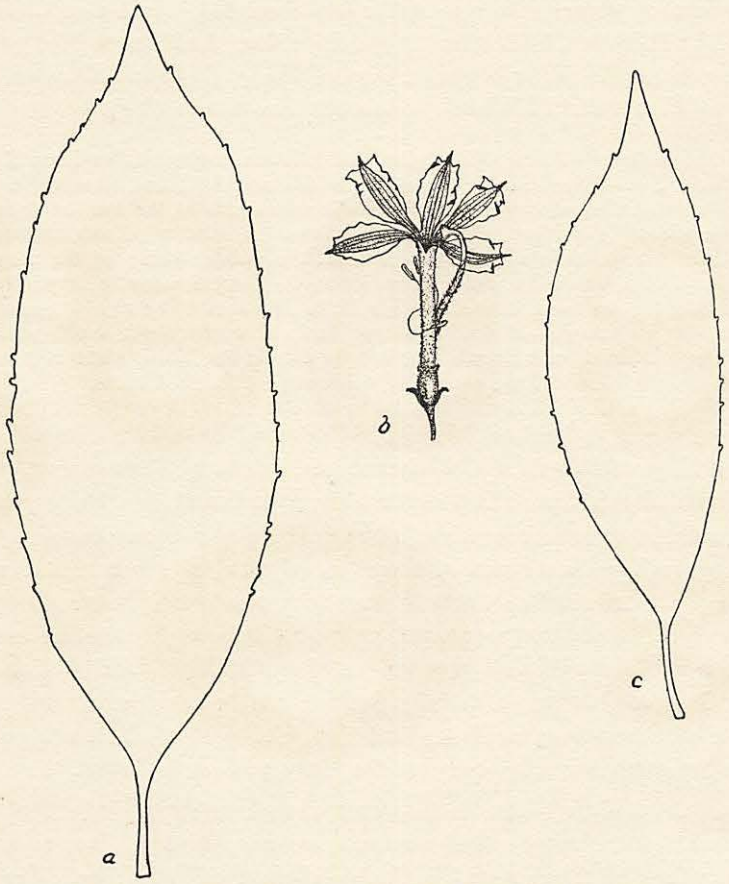


FIGURE 12. *Scaevola cerasifolia* Skottsberg No. 61, type. Natural size.

illustrated by Forbes No. 2211 from Wahiawa, Oahu, where Forbes also collected a plant with reduced cyme (No. 2213). In No. 2211, the common peduncle is as much as 20 mm. long.

A third doubtful type is Forbes Nos. 706 and 920 from East Maui, Ukulele. It is densely pubescent, as *S. procera* generally is, and has 5-flowered cymes about as long as the leaves. Habitually, it stands between *procera* and *chamissoniana*. No typical *procera* is recorded from Maui.

Scaevola procera var. **pseudomollis,** new variety (Pl. III, *F*; fig. 14, *a*).

Arborescens? ramis saltem novellis dense velutinis. Folia ovato-lanceolata, utrinque acuta, lamina 5.5 ad 14 x 1.5 ad 4 cm., discolor, supra glabrata, subtus dense cinerea tomento sericeo-velutino, margine ad 2/3 vel. 3/4 manifeste denticulata (specim. e Molokai) vel. subintegra (e Kauai), petiolo usque 1.7 cm. longo suffulta. Cymae brevissimae pauciflorae tomentosae, pedunculo ad 10 mm. longo, pedicellis brevioribus, bracteis minutis angustis. Ovarium albotomentosum. Calyx parum conspicuus vel in specim. Kauaiens. melius evolutus. Corolla ± 25 mm. longa, ut videtur violacea extus dense lanata, tubo ± 15 mm. longo lobis late alatis. Stamina 12 ad 15 mm. longa, stylus 18 ad 20 mm., ad 3/4 hirsutus. Indusium conspicue ciliatum. Drupa tomentosa-subglabra, 9 ad 10 x 5 ad 6 mm. Endocarpium ovoideum, non compressum, sublaeve vel rugosulum, 6 ad 6.5 x 3.5 mm.

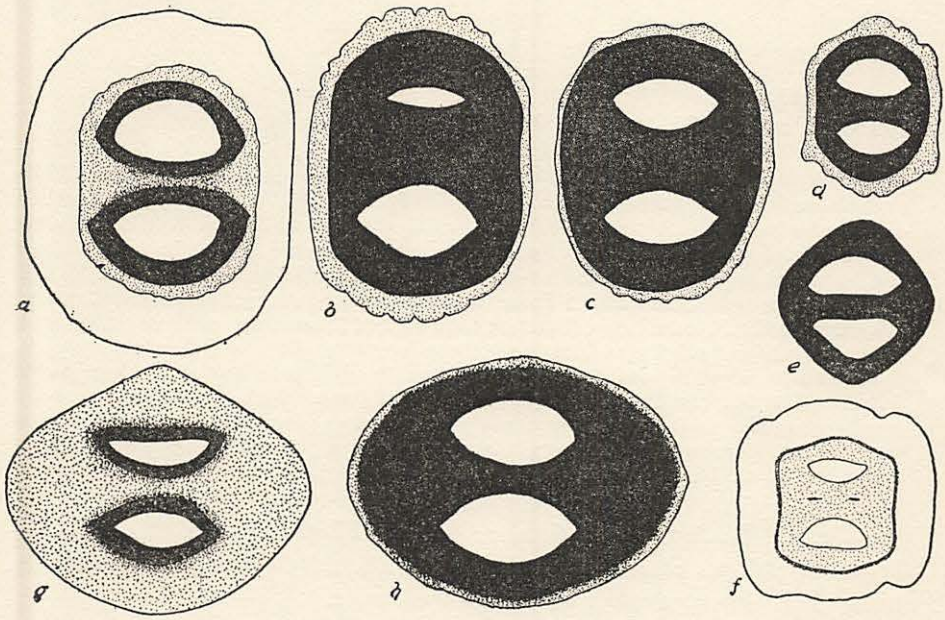


FIGURE 13.—Cross sections of drupes, flesh in most specimens removed [white: flesh; dotted: "mesocarp"; black; hard lignified endocarp, surrounding locules (seeds not drawn)]: *a, b, Scaevola chamissoniana, a,* not ripe; *b,* ripe; *c,* var. *hitchcockii; d, Scaevola gaudichaudiana; e,* var. *stenolithos; f, g, h, Scaevola procera,* three stages. All × 10.

Intermediate in appearance between *mollis* and *procera,* referred to *mollis* or *procera* by Rock, to *mollis* as a variety by Forbes. In hairiness it certainly approaches *mollis* very closely, but the fruit and endocarp show that it can not be referred to this, which in this respect can not be confounded with any other species and is not found on Kauai or Molokai.

Kauai: Remy No. 312 (C); Wahiawa Mountains, Lydgate (H); Lihue, Rock No. 2472 (H).

Molokai: Wailau Valley, Rock Nos. 7031, 7036 (H, C); Pelekunu trail, Forbes No. 246 (H).

Scaevola procera var. **pseudomollis** f. **macrocaly,** new form (Pl. III, *H*; figs. 11, *e*; 14, *b*).

Differt calyce majusculo, in statu fructifero accrescente, expanso vel reflexo, ad 12 mm. lato, lobis late triangularibus in tubum distinctum concretis, extus albotomentoso, intus subglabro.

Seen from:

Kauai: Wahiawa Mountains, Forbes No. 291 (H).

A very peculiar looking plant, but except for the enormously increased calyx there is nothing to distinguish it from var. *pseudomollis,* and fruit and endocarp are the same in both.

Scaevola cerasifolia, new species (Pl. III, *I, F, L*; figs. 12; 14, *c, e*).

Arbuscula metralis et ultra, cortice ramorum primo puberulo dein glabrato. Folia ovato-lanceolata, acuminata vel leviter cuspidata, discoloria, praecipue subtus pubescentia, superne mox glabrata, lamina 7.5-10 cm. longa et 2 ad 3.5 cm. lata, margine sat crebre glanduloso-denticulata, dentibus minutis, utroque latere 10 usque 16 (vulgo 12 vel 13), tertia parte inferiore solum integra, permanifeste petiolata petiolo 10 ad 15 mm. longo. Cymae pubescentes 5 ad 9 florae, foliis multo breviores, pedunculo suffultae 8 ad 17 mm. vulgo 12 ad 14 mm. longo. Bracteae angustae 3 ad 10 mm. longae. Flores pubescentes dilute albo-violacei pulchre violaceo-notati, ovario sparse piloso, calyce minuto hispido. Corollae tubus 15 ad 18 mm. longus lobis additis 10 ad 12 mm. longis manifeste alatis. Stamina 13 ad 14.5 mm. longa, antheris parvis 1.5 ad 2 mm. Stylus 20 ad 24 mm. ad 2/3 longit pubescens. Indusium glabrum, margine ciliatum. Drupa ovoidea glabra, 8 x 4 mm.: endocorpium ovoideum, fuscum, a latere compressum, conspicue rugosum et mucronatum, 6 x 3.5 ad 3 mm., biloculare, dispermum.

Oahu: Koolau, Pauoa flats, ± 600 m., Skottsberg No. 61, No. 1779 (type, G); slopes of Konahuanui, Forbes No. 2183 (H); Punaluu Mountains (H) without number or name of collector.

A very interesting form. It resembles *S. procera* in some respects. It was listed under that name by Skottsberg (34, p. 272). The pubescence is about the same, the shape of the leaves is similar, but the serrature is different, and the cymes are short though more developed than in typical *procera.* The endocarp is, however, absolutely different from that in *procera.* Its structure is shown in Plate III, *I, J, L.* Many more have been examined, all apparently alike. *S. cerasifolia* was found growing with *S. gaudichaudiana* and *mollis.* My first thought was that it might be a natural hybrid between them. But pollen and fruiting are good, and the plants raised from the seeds (only few in number) all look alike. The same idea apparently occurred to Forbes, for on one of his specimens he has written: "Hybrid mollis × Chamissoniana"—it should be borne in mind that Forbes used the name *chamissoniana* in the wide sense of Hillebrand. However,

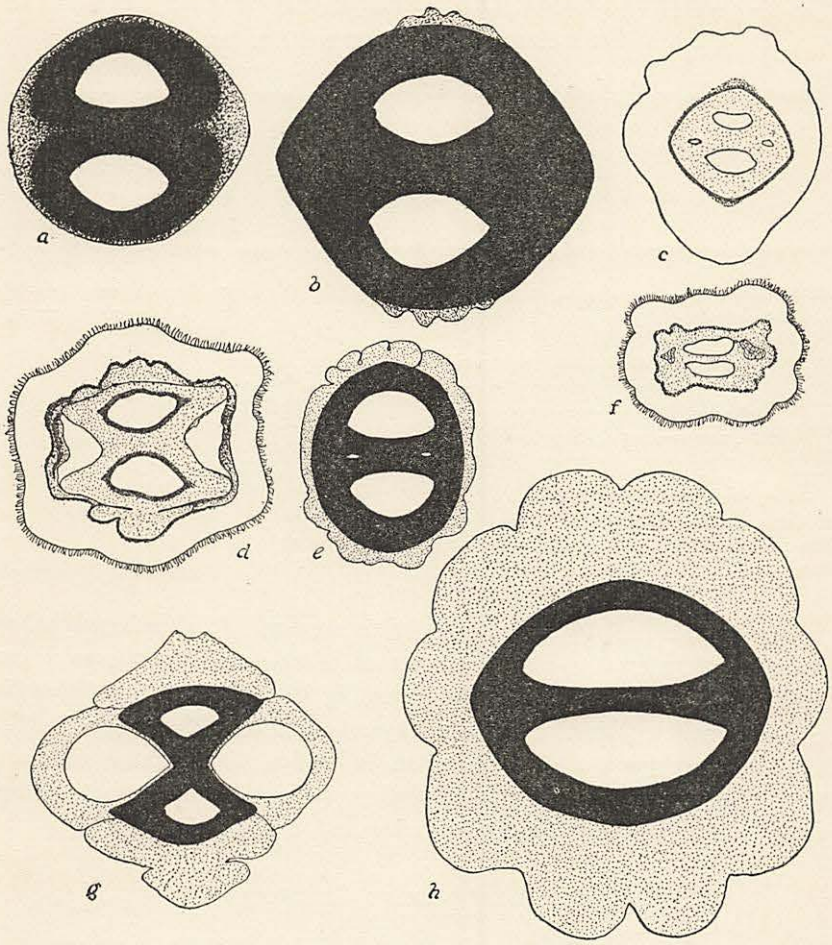


FIGURE 14.—*a, Scaevola procera* var. *pseudomollis,* not quite lignified; *b,* f. *macrocalyx,* not quite lignified; *c, e, Scaevola cerasifolia,* two stages; *f, d, g, Scaevola mollis,* three stages, very young to ripe; *h, Scaevola frutescens.*
All × 10.

if it is a cross, it is a fertile cross, and as the supposed parents are very unlike, a distinct splitting-up in the second generation may be expected. All shrubs I saw on my second visit to Pauoa in September, 1926, looked alike. My observations will be continued on cultivated specimens, this time raised in greater number.

TABLE 1. DISTRIBUTION OF THE ENDEMIC SCAVOLAE IN HAWAII, WITH EXCLUSION OF DOUBTFUL RECORDS.

	Niihau	Kauai	Oahu	Molokai	Lanai	W. Maui	E. Maui	Hawaii
Chamissoniana				+		+	+	+
var. bracteosa				+		+	+	+
var. cylindrocarpa					+			
var. hitchcockii						+		
Gaudichaudiana (incl. f. kauaiensis		+	+					
var. stenolithos			+					
Menziesiana		+	+	+	+	+	+	+
Coriacea	+	+	+	+	+	+	+	+
procera		+	+	+				
var. pseudomollis		+		+				
cerasifolia			+					
mollis			+					
glabra		+	+			+		

Kauai and especially Oahu are rich in species. *S. chamissoniana,* with its varieties, inhabits the central cluster of islands and extends to Hawaii, which is poorer in species than the other big islands. The *gaudichaudiana* type is confined to Kauai and Oahu, *procera* and its allies to the northern half of the archipelago. There is an indication that related forms are grouped together in the islands, but further study on a more ample material may, of course, modify present kowledge and conclusions.

THE ENDOCARP IN SCAEVOLA

In all Hawaiian *Scaevolae* a hard endocarp is developed. When the drupe approaches maturity, it becomes differentiated into an interior, stone-hard, dark brown, or ebony black internal coat, two-celled and including one seed in each chamber, and an external, light brown to whitish, less hard, almost spongy "mesocarp," surrounded by the flesh. The limit between the endocarp and the mesocarp is more or less well defined. Together with the size and outline of the stone, the amount of mesocarp and its configuration give special features to the stone in each species and offer characters of a certain taxonomic value. Figures 13 and 14 illustrate these differences sufficiently well and need no further description or explanation.

S. mollis Hooker et Arnott has, perhaps, a more striking endocarp than the other species (Pl. III, *B, K*). Hillebrand described the drupe as two-celled or four-celled, ellipsoidal, with suberose mesocarp. As the carpels in

Scaevola are two in number and the ovary in all Hawaiian species is two-celled and two-seeded, it is peculiar that Hillebrand's statement did not rouse the attention of later authors. Krause, the monographer of the family, even omitted it altogether. But it did not lack foundation. In the young drupe (fig. 14, *f*) there is a soft stone with two seed chambers, and as yet no differentiation between a mesocarp and an endocarp proper. On each side some sort of a lacuna, filled with loose, large celled tissue, is distinctly visible. Figure 14, *d* shows the next stage, the future stone-hard endocarp is well outlined and is beginning to become ossified, and the two lateral lacunae are extending. Figure 14 *g* is a section of a ripe stone, showing the great amount of suberose mesocarp, surpassed in quantity only by *S. frutescens,* the peculiar shape of the hard layer and the large empty lacunae. Considering these as cells, the drupe in *S. mollis* is always four-celled, but of course the lateral lacunae do not correspond to sterile seed locules. Possibly the stone, if dropped by a bird after it has consumed the flesh, is able to float for some time; be this as it may, *S. mollis* has preferred to remain confined to the island of Oahu.

In *S. mollis,* the limits between the smooth sutures and the rugose outer surface of the carpels is perhaps more distinct than in the other species. It is, however, always visible.

The last of the endemic Hawaiian species, *S. glabra* Hooker et Arnott, is remarkable in many ways, although there is hardly sufficient reason to dig up again the genus *Camphusia* of de Vriese. The fruit flesh appears to be thinner than in most species, while a thick suberose mesocarp is developed, passing gradually into the stone-hard putamen.

Finally, I shall add a few notes on the presumably very widespread *Scaevola,* formerly known as *S. lobelia* Linnaeus, *sericca* Forster, or *koenigii* Vahl and lately renamed *S. frutescens* (Miller) Krause (22, p. 125). It is reported from nearly all tropical shores of the old world. Whether it really is the same species everywhere is another question. For instance, the Hawaiian plant rarely has flowers as long as 18 mm., which is the minimum figure for the species in Krause's description. The drupe (fig. 14, *h*) in the Hawaiian plant is large, about 15 mm. high and 9 mm. across, slightly compressed laterally, white, with a very thin flesh and a voluminous, suberose 10-costate mesocarp that enables the drupe to keep afloat for a long time, I suppose.

A perfectly glabrous specimen from Kambara Island, Fiji (W) has small globular drupes barely 6.5 mm. high, with calyx lobes 4 mm. long, with much thinner mesocarp and seed chambers of different shape. It seems unlikely that this is exactly the same taxonomic form as the Hawaiian, and *S. frutescens* is recommended for further study.

and hitherto apparently unobserved difference between the two groups is that in the first, the ovary is partly superior, the tube of the perigone being slightly perigynous, while in the other the ovary is wholly inferior and the tube epigynous. This difference shows beautifully in the fruiting stage, for in the *freycinetianum* group the drupe has a wide ring indicating the site of the perigone, with a low, but distinctly prominent cone within, while in the *ellipticum* group, there is a narrow ring on the very top of the drupe, including the base of the style but no ovarial cone. This difference is easily understood by comparing figs. 16, *e*; 17, *e*; 18, *d* with 21, *g*; 22, *c*; 23, *l*.

I. Perigonal tube campanulate-cylindric; ovary semisuperior.

A. Cymes forming elongated, ebracteate, axillary or terminal panicles.

1. Leaves narrow ovate to lanceolate, acuminate, not glaucous.

a. Flowers 7 to 10 mm. long, disc lobes oval; drupe 11 to 12 mm. high, with smooth surface.... **freycinetianum**

b. Flowers 12 to 14 (to 17) mm. long. disc lobes narrow lingulate; drupe 15 to 17 mm. high, with wrinkled surface ..... **pyrularium**

2. Leaves broad elliptic to suborbicular, glaucous beneath..... ..... **lanaiense**

B. Cymes in an abbreviated, dense and bracteate panicle; leaves ovate or obovate-oblong. ..... **haleakalae**

II. Perigonal tube obconical-funnel shaped; ovary inferior.

A. Flowers small, 4 to 6 or rarely 7 mm. high, larger leaves rarely over 6 cm. long.

1. Leaves equal on both sides, bluish green, drupe subglobose.

a. Flowers 4 to 5 mm. high, with shallow tube, style 2.5 to 3 mm. long..... **ellipticum**

b. Flowers 5 to 7 mm. high, with deeper and narrower tube, style 3 to 4.5 mm. long..... **cuneatum**

2. Leaves green on upper, powdery-glacous on lower surface, drupe ovoid ..... **paniculatum**

B. Flowers larger, 7 to 8 mm. high, larger leaves 7 to 10 cm. long; leaves green on both sides..... **pilgeri**

Santalum freycinetianum Gaudichaud (figs. 15, 16).

Santalum freycinetianum Gaudichaud: Voyage autour du monde, Botanique, p. 442, pl. 45, 1826-30.—de Candolle: Prodromus syst. nat. regni. vegetabilis, vol. 7, p. 682, 1838.—Hillebrand: Flora Hawaiian islands, p. 389, 1888.—Rock: Indigenous trees of Hawaiian islands, p. 131, 1913 (pro parte min.); Haw. Board of Agri. For., Bot. Bull, 3, p. 19, pl. II, 1916.—Skottsberg: Acta Horti Gothoburgensis, vol. 2, p. 222, 1926.

FIGURE 15.—*Santalum freycinetianum*, Gaudichaud, type. It bears the label "Santalum Freycinetianum pl. 45 Uranie 1817-1820 Iles Sandwich."
Drawing supplied by Dr. H. Lecomte. Three-fourths natural size.

Santalum freycinetianum var. *ellipticum* Mann; Am. Acad., Proc., vol. 7, p. 198, 1868.—Hillebrand: Flora Hawaiian islands, p. 390, 1888.

Santalum ellipticum Rock: Indigenous trees of Hawaiian islands, p. 131, pl. 44, 1913 (non Gaudichaud); Hawaiian Board of Agri. For., Bot. Bull. 3, p. 25, 1916 (pro parte).

Santalum pyrularium Wawra: Flora, vol. 58, p. 172, 1875 (pro parte, non Gray).

Santalum longifolium Meurisse: Linnean Soc. Paris, Bull. Mens., p. 1026, 1892.

Seen from the following localities:

Hawaiian islands, Bennett (K); Wawra No. 2342 (V).

Oahu: Gaudichaud: Voyage "Uranie," 1817-20 (type, P; B); Beechey (K); United States Exploring Expedition, 1840 (B, W); Wouhala, Bennett 1830 (B); western end of main range at Kahuku, Hillebrand (K); Ewa, Waiawa, March 1858, Hillebrand (K); Waianae, Kaala, 1869, Hillebrand (B) and McEldowney and Skottsberg No. 377 (G); Palehua, Skottsberg No. 319 (G); Makaha and Makaleha, Forbes s. n. (H); Makaleha, Rock No. 17050 (H); Koolau, Pupukea forest reserve, abundant 250-300 m., Skottsberg No. 1809 (G); Kawailua, Forbes No. 2093 (H); Waimea, Forbes No. 2054 (H); Palolo, Rock No. 10063 (H); Hitchcock No. 14128 (W); Skottsberg No. 887 (G); between Niu and Wailupe, Forbes No. 1445, Wailupe, Rock No. 17119 (H).

Original description of *S. freycinetianum:*

S. foliis lanceolatis obtusiusculis, venosis, complicato-subfalcatis, petiolo quinquies longioribus; racemis terminalibus simplicibus; floribus oppositis, roseis; caule arboreo.
In insulis *Sandwicensibus* (Wahou). Alt. 350-400 hex.; cum sequente.
Cette espece, offerte à M. Louis de Freycinet, fournit le bois de santal, scule production commerciale des îles Sandwich. Elle est surtout remarquable par la grandeur des ses fleurs rose foncé.

Although very brief, this description enables recognition of the species, especially as it is accompanied by a fairly good figure. It is hard to understand that Gray and Hillebrand included so many different forms in *freycinetianum.* The only species that can be mistaken for it is *S. pyrularium.*

S. freycinetianum is a glabrous tree with narrow elliptic or broad lanceolate leaves of varying shape, more or less acute at base and apex, some distinctly acuminate, from 5 to 10 cm. long and 2 to 4 cm. wide, with a petiole of 1 to 2 cm. The blade is chartaceous, glossy, dark green above,

paler, in dried specimens almost greenish white below with reticulate, more or less reddish veins. In some specimens the lamina is folded along the midrib, "complicate-subfalcate" as Gaudichaud expresses himself (12, p.

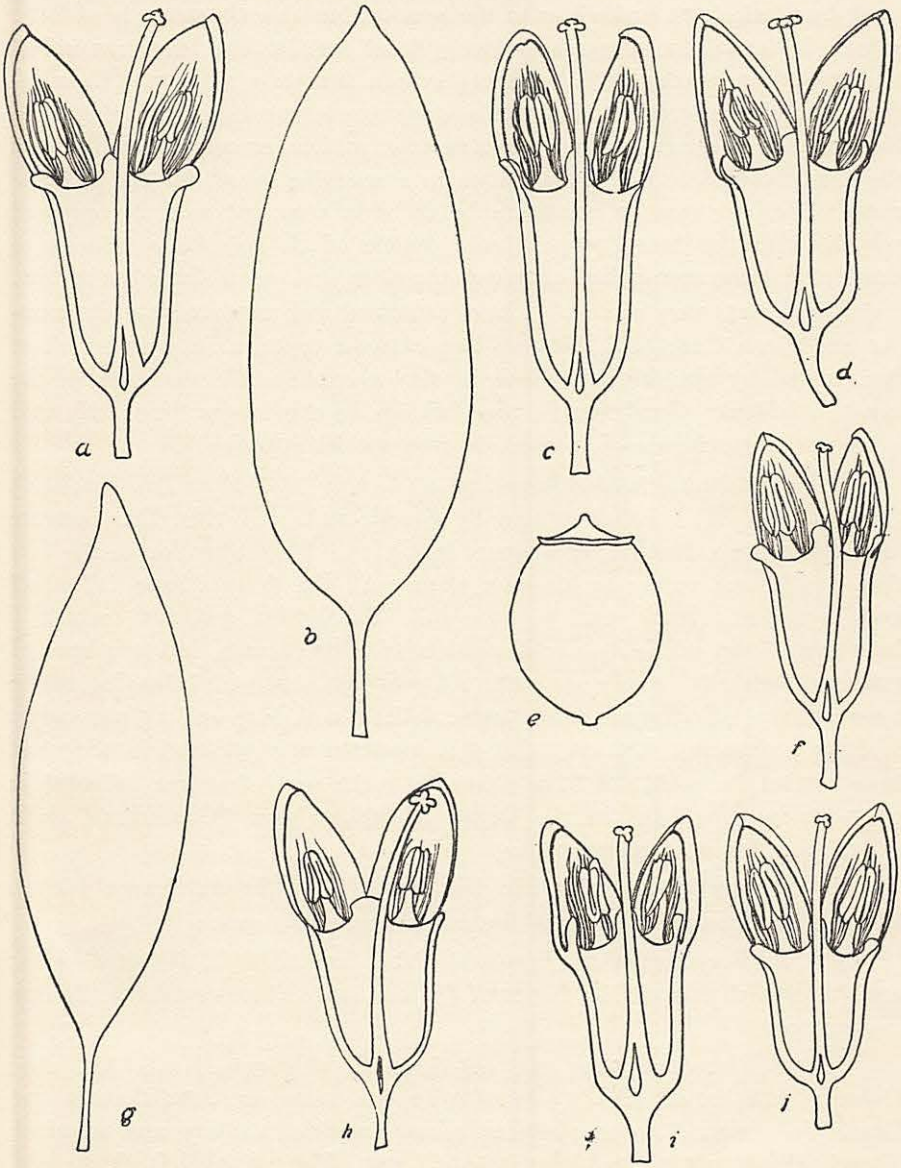


FIGURE 16.—Leaves, floral parts, and drupe of *Santalum freycinetianum: a,* Kaala, Hillebrand (× 5); *b,* Skottsberg No. 319 (natural size); *c,* Skottsberg No. 319 (× 5); *d,* Remy No. 510 (× 5); *e,* Skottsberg No. 377 (× 2½); *f,* Skottsberg No. 887 (× 5); *g,* Skottsberg No. 887 (natural size); *h,* Oahu, Hillebrand (× 5); *i, j,* Skottsberg No. 377.

442, pl. 45). The flowers are borne on naked or leafy terminal and axillary shoots. A remark on the inflorescence in *Santalum* may be inserted here. The position, if terminal or axillary, was used as an important distinguishing mark by Rock (32) in his key to the species, but this character is of little value. If lateral branches are entirely floral and leafless, they are called axillary inflorescences, if such shoots bear a few pair of leaves, their inflorescence becomes terminal. Both kinds appear in one and the same species. Rock speaks of the inflorescence as a raceme, panicle, or corymb. Of course the term raceme can not be used here in a scientific sense, for the inflorescence is strictly cymose, made up by dichasia arranged in a decomposed panicle; also the dense corymbiform panicle of *S. haleakalae* belongs to exactly the same morphological type as the elongated one in the other species.

The flowers vary in size. I have examined and measured a great number and I can distinguish between two extreme types, a long and a short one, united by transitions. There is also a considerable variation in the same individual. Gaudichaud's type belongs to the longer kind; this and a few more specimens of interest deserve special attention.

1. "Santalum Freycinetianum p. 45 Uranie 1817-1820 Iles Sandwich Gaudichaud" (P). Label written by Gaudichaud. Of this, Dr. Lecomte kindly sent me a drawing, reproduced in fig. 15. I call attention to the fact that Gaudichaud refers to his own plate. All the flowers have fallen off and been lost. Rock (32, p. 19), calls the Berlin specimen, which I have seen, "part of the type"; it consists of a few scraps, leaves, pieces of panicles, and buds. Only one mature flower was observed, belonging to the longer kind; pedicel 2 mm. tube 5 mm., lobes 5 mm. long and 2.5 mm. wide. If Rock's statement (op. cit.) that this specimen was gathered in 1827 had been correct, he could not have claimed it to be part of a type collected in 1817-20; but the label in the Berlin herbarium says "Gaudichaud dedit 1827," and this is a different thing.

2. *S. freycinetianum* "Oahu Beechey" (K). Several leaves falcate. Floral tube attaining a length of 6 mm., lobes 4 to 4.5 mm.

3. "S. Freycinetianum Wouhala Oahu dec. 1830 G. Bennett" (B); and, "Sandwich Islands Mr. Bennett" (K). Leaves plane or falcate; flowers undeveloped.

4. "S. Freycinetianum var. ellipticum S. ellipticum Kaala Mt. 1869 Oahu": Hillebrand (B). Undoubtedly the same as Gaudichaud's and Beechey's plants. Leaves plane or plicate, panicles axillary and terminal. Floral tube 5 to 5.5 mm., lobes 4 to 4.4 mm. (fig. 16, *a*). Rock op. cit., p. 25) quotes this under *ellipticum*.

5. Waianae, Palehua, Skottsberg No. 319. Surely the same as the former. Leaves (fig. 16, *b*) 5 to 8 cm. by 2.3 to 2.8 cm., on petioles of 12

to 15 mm. Inflorescences terminal or axillary, 3 to 4 cm. long. Pedicels 2 to 2.5 mm., tube reddish brown with a green or glaucous hue, 4.5 to 5.5 mm. high, lobes 4 mm. long, disc lobes 0.8 mm., stamens 2.5 mm., style 9 to 9.5 mm. (See fig. 16, *c*.)

6. "Santalum Iles Sandwich Oahu Voyage de M. J. Remy 1851-1855 No. 510" (P). A well developed specimen with plane leaves of 8.5 to 9.5 cm. by 2.8 to 4 cm. on petioles of 2 to 2.3 cm.; flowers on pedicels of 2 to 2.5 mm., 9 mm. long with tube and lobes of equal length (fig. 16, *d*). According to a communication from M. Lecomte, this is the type of *S. longifolium* Meurisse.

7. "Santalum Freycinetianum var. ellipticum Iliahi 287 Ewa Hillebrand"—one sheet (B) and another (K); illustrates what Hillebrand regarded as *S. ellipticum*. The height of the flower is from 8 to 9 mm. Another sheet (K), labelled "Iliahi 288 western end of main range at Kahuku" shows a considerable variation on the same branch, the largest flower having a tube of 5.5 mm. and lobes of 4.5 mm., the smallest 3.5 and 4 mm., respectively. Most flowers belong to the larger type.

8. "Iliahi 288 Hillebrand" (B, K). The real brevi-florous kind, tube 3.5 to 4.5 mm., lobes 3.5 mm. long (fig. 16, *h*).

9. All material from Palolo Valley; belongs to the smaller type. In Skottsberg No. 887 the lower surface of the leaf is less pale than usual, the blade measures 5 to 7 cm. by 1.5 to 2.3 cm. and is of the same shape as before (fig. 16, *g*). Panicles axillary and terminal. Pedicels 1.5 to 2 mm., tube from 4 to 5 mm., lobes 3 to 3.5 mm., stamens as before, but style only 7 mm. long (fig. 16, *f*). Rock No. 10063 and Hitchcock No. 14128, from the same valley, are identical.

10. Kaala, Skottsberg No. 377. Contrary to what I had expected, this is much more like the Palolo material than Hillebrand's plant from Kaala. The flowers (figs. 16 *i, j*) belong to the smaller kind; pedicel 1 mm., tube 3.5 mm. or rarely as much as 4 mm., lobes 4 mm. or a little less, stamens 2.2 mm., style 6.5 to 7 mm. Total length of flower 7 to 8 mm. Drupe black, smooth, 11 to 12 by 8 mm. (fig. 16, *e*).

As seen, the variation in the size of flower is quite considerable, but I have not been able to distinguish any forms deserving to be called good varieties. The smallest flower measures 6.5 mm., the largest 10.2 mm.; tube 3.5 to 6 mm., lobes 3 to 5 mm., stamens 2 to 2.5 mm., style 6.5 to 9.5 mm. In one specimen of the longiflorous type, there was a variation in one and the same branch of from 8.5 to 10.2 mm.; in another, from 8 to 9 mm.; in a third, even from 7.5 to 10 mm. In the breviflorous type, the variation in the same branch goes from 6.5 to 8 mm.; there is, thus, no break between the two series.

Most flowers have three stigmas, just as in other species, but flowers with four or five stigmas are common.

Santalum pyrularium A. Gray (fig. 17).

Santalum pyrularium A. Gray: Am. Acad., Proc., vol. 4, p. 327, 1860. Hillebrand: Flora Hawaiian islands, p. 390, 1888.—Rock: Hawaiian Board of Agri. For., Bot. Bull. 3, p. 21, pl. 6, 1916.—Skottsberg: Acta Horti Gothoburgensis, vol. 2, p. 222, 1926.

Santalum freycinetianum var. *ellipticum* Hillebrand. Flora Hawaiian islands, p. 390, 1888 (quod plantam ex ins. Kauai).

Santalum ellipticum Sinclair: Indigenous flowers of the Hawaiian islands, pl. 34, 1885.—Heller: Minnesota Bot. Studies, vol. 1, p. 818, 1897.—Rock: Hawaiian Board of Agri. For. Bot. Bull. 3, p. 25 pro parte et pl. 5, 1916; non Gaudichaud.

Seen from the following localities:

Hawaiian islands: Mrs. Sinclair (K).

Kauai: United States Exploring Expedition 1840 (W; C, type); Hillebrand (B); Wawra No. 2137 (V); above Lihue, Mann and Brigham No. 625 (C, B), and Forbes No. 18 (H); Manoa Mountains, Forbes No. 592 (H); Waimea Basin, Kalalau trail, Forbes Nos. 789, 1087 (H); Kokee, Skottsberg No. 1000 (G); between Hanapepe and Wahiawa, Hillebrand No. 2759 (C, K, W); Wahiawa Mountains, Lydgate (H); Halemanu, Rock No. 1833, 1834 (H, C); Kaholuamanu, Forbes No. 315, Rock No. 1822 (H); Hitchcock No. 15341 (W).

Oahu: Remy No. 505 (P).

A medium sized tree of the same habit as *S. freycinetianum*. Leaves thin and soft coriaceous, dark green, lamina 5 to 10 cm. long and 1.5 to 4 cm. wide, with a more obtuse base and perhaps a longer apex than in the former. Petiole 10 to 15 mm. Flowers the largest in the genus: pedicel 1 to 2 mm., flower 12 to 14 mm. (largest measured, 17 mm.), with the tube (including the ovary) of 6.5 to 9 (10) and lobes of 5 to 6 (7) mm. Disc lobes long and narrow lingulate, 2 mm. long; stamens 3 to 3.2 mm, style 9.5 to 12 mm. Drupe with a more or less wrinkled surface, 15.5 to 17 mm. high and 9 to 10 mm. across.

Easily known by the large flowers, the long and narrow disc lobes and the large fruit. Mrs. Sinclair's *S. ellipticum* is typical *pyrularium* as shown by the flower (fig. 17, *a*). Most likely her plant came from Kauai, where *S. pyrularium* is fairly common. A typical leaf, a flower and a ripe fruit from Skottsberg No. 1000 are shown in figure 17, *c, b, e*. According to the label attached to Remy No. 505, *S. pyrularium* is also a native of Oahu, where, however, nobody else has collected it. Printed on the label is "Iles Sandwich Voyage de M. J. Remy 1851-1855"; written "Santalum ellipticum

Gaud. Oahu No. 505." Typical *pyrularium* with flowers 13 to 14 mm. long (fig. 17, *d*), correctly quoted by Mann (25, p. 198), but not mentioned by Rock. Possibly the specimen has been wrongly labelled and comes from

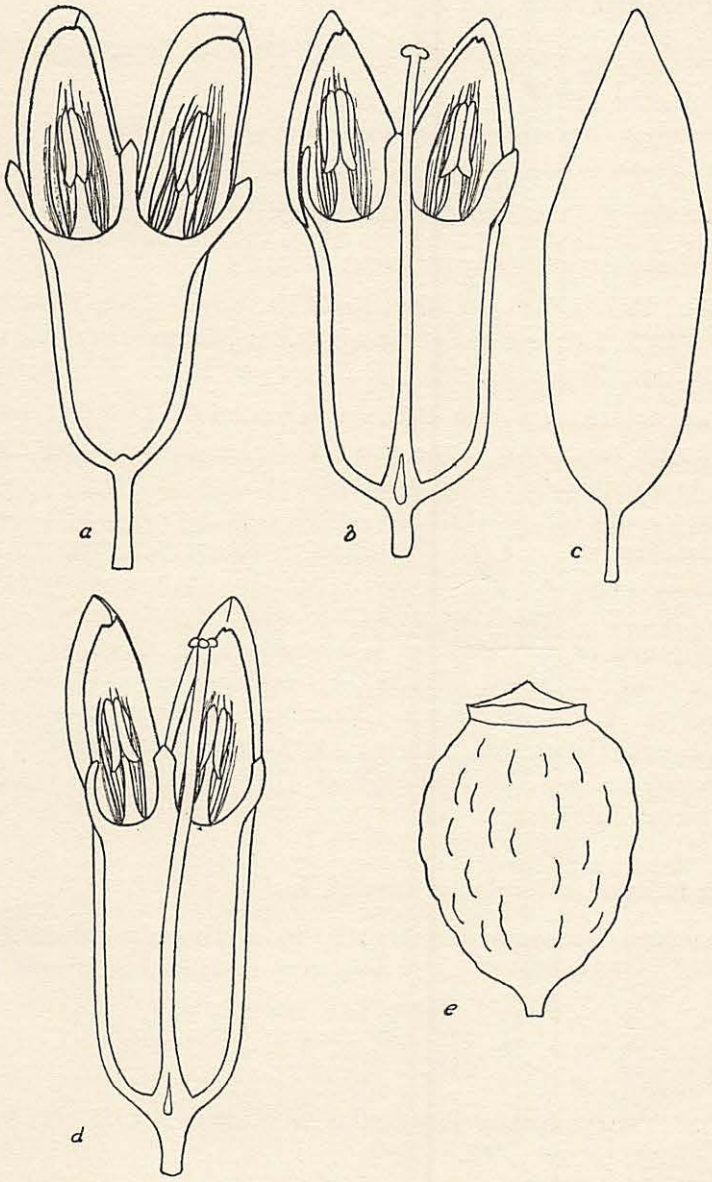


FIGURE 17.—Leaf, floral parts, and drupe of *Santalum pyrularium* Gray: *a*, Mrs. Sinclair (× 5); *b*, Skottsberg No. 1000 (× 5); *c*, Skottsberg No. 1000 (natural size); *d*, Remy No. 505 (× 5); *e*, Skottsberg No. 1000 (× 2½).

Kauai. Rock No. 1833 has the largest flowers of all specimens seen, 17 mm. long with a tube of 10 mm. and lobes of 7 mm.

Santalum lanaiense Rock (fig. 18, *a, c*).

Santalum lanaiense Rock: Hawaiian Board of Agri. For., Bot. Bull. 3, p. 21, pl. 3, 1916.

Santalum freycinetianum var. *lanaiense* Rock: Indigenous trees Hawaiian islands, p. 129, 1913.

Santalum freycinetianum var. *obovatum* Hillebrand: [in herb.].

Seen from the following localities:

Lanai: Main ridge, 3000 feet, Rock No. 10061 (type, H; C); Lydgate No. 156 (B, K); east end of Lanai, Forbes Nos. 229, 327 (H); Kaala, Forbes No. 200, Munro No. 678 (H); Konepau, Munro No. 679 (H).

Known before only from Rock's type material. Lydgate's specimens differ from the description in the more elliptic leaves, measuring 4.2 to 6.3 cm. by 3 to 2.5 cm., while Rock calls them orbicular in his plant and "7-10 cm. each way" (32, p. 21). He quotes Lydgate No. 156 under *L. paniculatum* (op. cit., p. 33). There can be no question, however, that it belongs to *L. lanaiense*. The leaves are typical in texture and coloring and the buds (fig. 18, *c*) and flowers (fig. 18, *a*) agree perfectly with those of *L. lanaiense,* and are very different in *L. paniculatum,* which belongs to the other section of the genus. Further, an examination of Rock's material of *L. lanaiense* shows the following dimensions of leaves: 5 to 8.5 cm. by 3.6 to 7.8 cm. Forbes No. 114 has ovate leaves but otherwise all the characters ascribed to *L. lanaiense* by Rock. This excellent species cannot be confounded with any other.

Santalum haleakalae Hillebrand (fig. 18, *b, d*).

Santalum haleakalae Hillebrand: Flora Hawaiian islands, p. 290, 1888.—Rock: Indigenous trees of Hawaiian islands, p. 133, 1913.—Rock: Hawaiian Board of Agri. For., Bot. Bull. 3, p. 23, pl. 4, 1916.—Skottsberg: Acta Horti Gothoburgensis vol. 2, p. 222, 1926.

Santalum pyrularium Gray var. *β* ?.—Mann: Am. Acad., Proc., vol. 7, p. 198, 1868.

Santalum freycinetianum var. *latifolium* Wawra: Flora, vol. 58, p. 172, 1875 (non A. Gray).

Seen from the following localities:

East Maui: United States Exploring Expedition 1840 (C); Haleakala, July 1858, Hillebrand (type, B); 7000-9000 feet, Hillebrand (K); Lydgate, Knudsen (B); Mann (B); Mann and Brigham No. 396 (K, W); Wawra No. 1892 (V); Forbes Nos. 301, 984, 1090, 1130 (H); lava fields of Auahi, Rock No. 8659 (H, C); Puunianiau crater, Rock No. 8588 (K, H, B); Curran No. 89 (W); near summit, Hitchcock No. 14972 (W); Halemau trail, in crater, Skottsberg No. 833 (G).

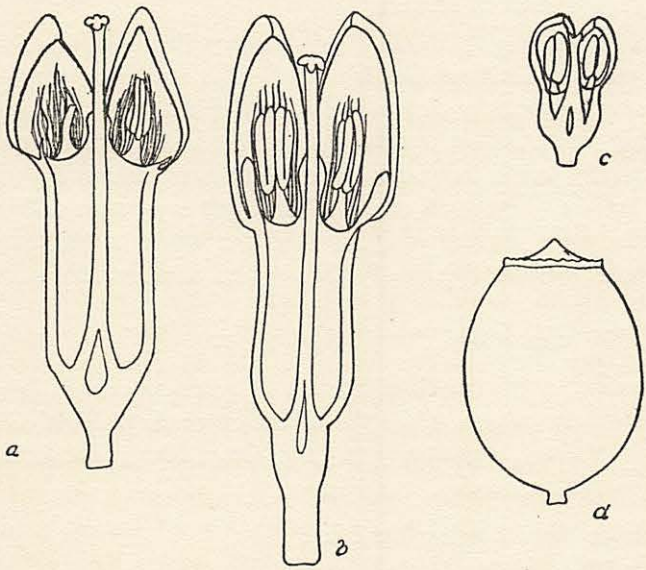


FIGURE 18.—*a, c, Santalum lanaiense* Rock, Lydgate No. 156 (× 5); *b, Santalum halaekalae* Hillebrand, Skottsberg No. 833 (× 5); *d, Santalum haleakalae,* Hillebrand (× 2½).

A very distinct species, easily known by the broad, thick leaves, the condensed inflorescence and the blood red flowers. Morphologically, the inflorescence is of the same type as in all the other species, dichasia in a panicle, but the main axis is shortened and the branches repeatedly di-trichotomous, forming a dense and striking mass of buds and flowers, 6 or 7 cm. across. The persistent bracts mentioned by Hillebrand (18, p. 290) are another feature not found in the other species. The flower (fig. 18, *b*) is of the *pryularium* type, but thick carnose, with a very stout pedicel and the tube slightly constricted below the rim; it measures 6 to 6.5 mm., the lobes 5.5 to 6 mm. Stamens 3 to 3.5 mm., style 10 mm.; disc lobes thick carnose, yellow and linguiform as in pyrularium, 1.5 mm. long.

Regarding the supposed occurrence of *Santalum haleakalae* in Kauai, Rock (32, p. 23) mentions a sheet (B) labelled *S. paniculatum,* Kauai,

Knudsen No. 171, and adds: "hardly referable to this species," without telling what it is. He does not quote it under *paniculatum.* This sheet contains three specimens, all called *S. paniculatum*: (a) Haleakala, Lydgate; (b) Kauai Knudsen 46; (c) Kauai Knudsen 171. Though they bear no flowers, there is good reason to bring them all to *S. haleakalae,* whence follows that a mistake has been made as to the locality. The specimens are not quoted by Hillebrand, either under *haleakalae* or *paniculatum.*

A ripe fruit is shown in fig. 18, *d.* It measures about 13 mm. in length and has a smooth surface.

Rock advances that *S. haleakalae* is intermediate between *S. pyrularium* and *S. ellipticum* (Rock non Gaud.), but he also says (32, p. 27) that *ellipticum* may be only a variety of *pyrularium,* and further (op. cit., p. 25) that it is undoubtedly intermediate between *pyrularium* and *freycinetianum;* the conclusion naturally would be that *S. haleakalae* is an extremely weak species. In reality, it is a very good one. What Rock says about *ellipticum* Rock is, of course, quite correct; only, it does not apply to the true *ellipticum* which, as will be shown presently, belongs to another section.

Santalum ellipticum Gaudichaud (figs. 19, 20).

> *Santalum ellipticum* Gaudichaud: Voyage autour du monde, Botanique, p. 442, 1826-30.—Skottsberg: Acta Horti Gothoburgensis, vol. 2, p. 222, 1926 (non Gray, Mann, Hillebrand, Sinclair, Heller, Rock).

Seen from the following localities:

Hawaiian islands: Hinde 1841 (K).

Oahu: Gaudichaud, voyage *Uranie,* 1817-20 (type, P); United States Exploring Expedition 1840 (W); Barclay (K); Waianae, Kaala, McEldowney and Skottsberg No. 378 (G); Waikalao gulch, Forbes No. 1445 (H); Makaleha, Rock No. 17028 (H); between Makoa Valley and Kaena Point, Forbes No. 1653 (H); Koolau, Kaaawa, C. S. Judd (H).

Gaudichaud's description (12, p. 442, 1830) runs: "S. foliis ovato-oblongis, obtusis, basi subcuneato-obliquis, petiolo ter quaterve longioribus, coriaceis, subtus aveniis; racemis axillaribus; floribus virescenti-flavescentibus; caule fruticoso."

Even from this short description it is evident that Gaudichaud had before him one of the shrubby forms with small, greenish flowers and not, as believed Hillebrand, and Rock, a species related to *freycinetianum* or *pyrularium.* It is only a logical conclusion of their incorrect interpretation of Gaudichaud's *ellipticum* that they regarded this as a new variety or species, *S. litorale* (Hillebrand) Rock, which differs so little from typical

ellipticum—apparently this is an inland form, while the other is a seaside variety—that it can hardly be kept separate. Hinde's and Barclay's specimens are perhaps quite as much *litorale* as *ellipticum typicum.*

Rock (32, p. 25) says that Gaudichaud's type, which he has not seen, "probably came from Oahu." He has overlooked that, under *S. freycinetianum,* Gaudichaud remarks: "Wahou cum sequente," that is growing with

FIGURE 19.—*Santalum ellipticum* Gaudichaud, type. It bears the label "Santalum ellipticum Uranie 1817-1820 Iles Sandwich." Three-fourths natural size. (Drawing supplied by Dr. H. Lecomte).

S. ellipticum. A. de Candolle, who examined the type, gave a better description (5, p. 682) possibly including the form later described as *S. cuneatum,* what we might well forgive him, as they are very close.

It should be mentioned here that Forbes No. 1653 is labelled *S. ellipticum,* which shows that he had the same idea of Gaudichaud's plant as I have. However, I want to emphasize that I have not seen the flowers of

Gaudichaud's type. There remains the possibility that Gaudichaud included the species now called *cuneatum* in his *ellipticum;* however, he says that he collected *ellipticum* with *freycinetianum.* As far as I am aware, *cuneatum* has not been found growing with this.

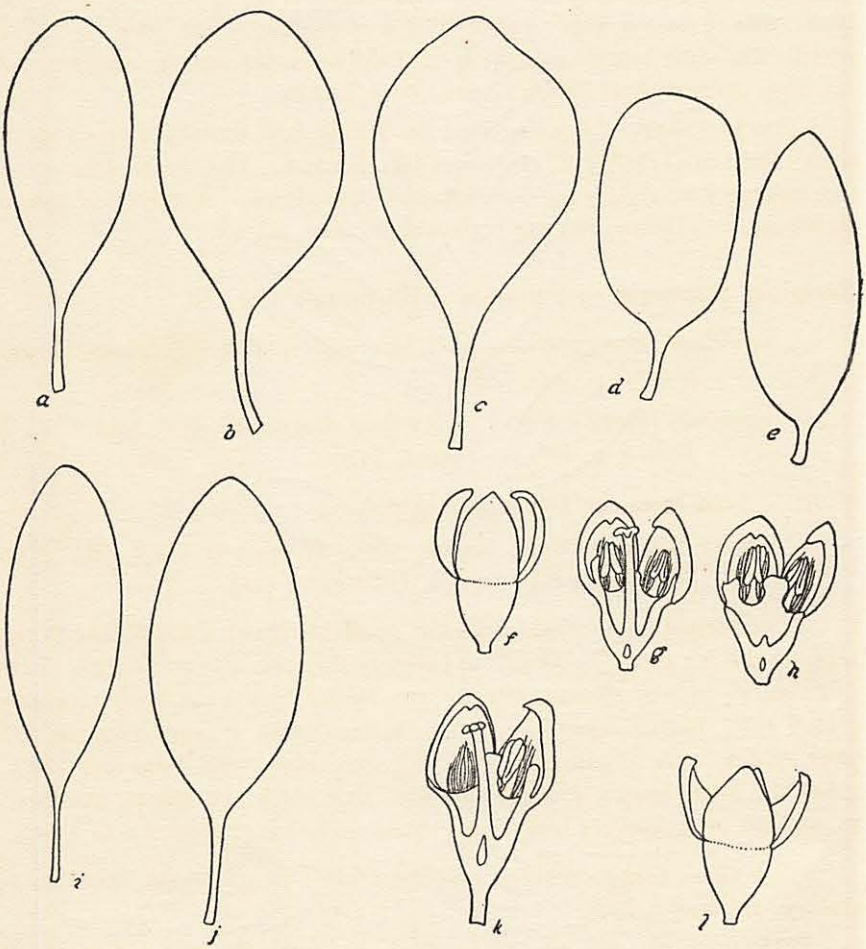


FIGURE 20.—Leaves and floral parts of *Santalum ellipticum: a-h,* Skottsberg No. 378 (*a-d,* natural size; *f-h,* × 5); *i-k,* Hinds (*i, j,* natural size; *k,* × 5); *e, l,* var. *litorale,* Hillebrand (*e,* natural size; *l,* × 5).

M. H. Lecomte, Paris, was kind enough to send me a drawing of the type (fig. 19) with a copy of the label written by Gaudichaud, as the specimen could not be sent on loan. The description below is based mainly on my own material, No. 378.

Leaves (fig. 20, *a-d*) glabrous, bright green with a bluish tinge, coriaceous, ovate to broadly ovate or obovate, round and obtuse at apex, cuneate and more or less oblique at base, blade 2.5 to 4.5 cm. by 1.6 to 2.5 cm., on a petiole of 10 to 15 mm., secondary veins indistinct. Panicles short, axillary, 2 to 3 cm. long. Flowers (fig. 20, *f, g, h*) small, only 4 to 5 mm. high; tube 2 to 2.5 mm., green with a glaucous bloom, limb of approximately the same length, yellowish or reddish brown inside; stamens 1.2 to 1.5 mm., with anthers about 1 mm.; style 3 mm.

The two sheets (K) collected by Hinds and Barclay come very near this. Both are labelled *S. ellipticum* Gaudichaud. The leaves (fig. 20, *i, j*) correspond very closely to Gaudichaud's description. A flower is shown in figure 20, *k*. Drupe 10 mm. high and 6.5 mm. across.

Santalum ellipticum var. **litorale** (Hillebrand) (fig. 20, *e, l*).

Santalum freycinetianum var. *littorale* Hillebrand: Flora Hawaiian islands, p. 390, 1888.

Santalum littorale Rock: Hawaiian Board of Agri. and For., Bot. Bull. 3, p. 41 (pro parte), 1916.

Seen from the following localities:

Oahu: Waianae, Cape Kaena, 1869, Hillebrand (type, B); Forbes No. 2276 (H); Kailua, Hillebrand (B).

1. Original label: "Santalum low prostrate shrub Cape Keena Waianae 1869 on the sea shore." This is apparently the type of var. *litorale*. Leaves (fig. 20, *e*) narrow elliptic, 3 to 4.5 cm. by 1.2 to 1.9 cm. with a petiole of 4 to 8 mm., panicles short, ± 3 cm., rather dense, flowers (fig. 20, *l*) almost sessile, very small, only 4 to 4.5 mm. high with tube and lobes of about the same length, glaucous outside, dull brick red inside, stamens 1.4 to 1.5 mm. with anthers little more than 1 mm. long; style 2.5 to 3 mm.

2. Kailua, Oahu: without original label. Drupe broad ovoid to subglobose, 7.5 by 6.5 mm.

Both specimens are quoted by Rock under *S. litorale:* besides, he lists others collected near Diamond Head and Koko Head, the Diamond Head specimen is figured by Rock (32, pl. 13). I have examined both. It seems that these two specimens and not the type were used for the preparation of Rock's diagnosis, otherwise it is difficult to account for his statement; leaves 2.5 to 3.5 cm. by 1.5 to 2 cm., petioles slender, 5 to 10 mm., flowers 6 mm. long, tube 4, lobes 2 mm. These specimens belong to *S. cuneatum* in my sense. Rock has tried to separate these two species by the form of the leaf, a difficult thing to do, while the length of the flower

seems to offer a fairly safe character. *S. ellipticum* and var. *litorale* seem to be confined to Oahu. Rock quotes *litorale* from Hawaii, as observed by him but not collected. More likely it belonged to *S. cuneatum,* which is known to exist on Hawaii.

Santalum cuneatum (Hillebrand) (figs. 21, 22).

Santalum freycinetianum var. *cuneatum* Hillebrand: Flora Hawaiian islands, p. 389, 1888.

Santalum freycinetianum var. *latifolium,* Mann: Am. Acad., Proc., vol. 7, p. 198 (pro parte), 1868. — Hillebrand: Flora Hawaiian islands, p. 389 (pro parte), 1888.

Santalum ellipticum, Forbes: B. P. Bishop Mus., Occ. Papers, vol. 5, p. 4, 1913 (non Gaudichaud).

Santalum paniculatum, Rock: Hawaiian Board of Agri. For., Bot. Bull. 3, p. 33, 1916 (pro parte min., non Hooker et Arnott).

Seen from the following localities:

Oahu: United States Exploring Expedition 1840 (W); Seemann 1849 (K); Remy No. 506 (C); Ewa coral plain, Forbes No. 1755, 2343 (H); Skottsberg No. 118 (f. *gracilius,* G); Wailupe, Forbes No. 2442 (f. *gracilius,*

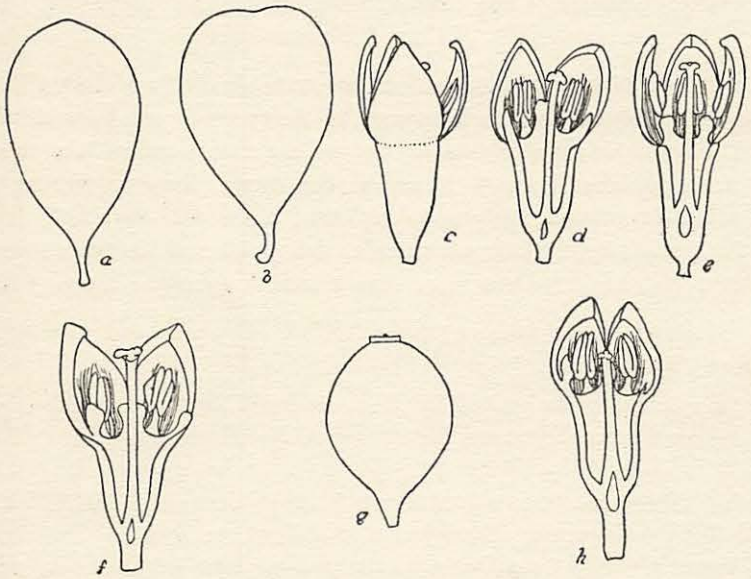


FIGURE 21.—Leaves, floral parts, and drupe of *Santalum cuneatum* (Hillebrand) Rock: *a-d,* type (*a, b,* natural size, *c, d,* × 5); *e,* Rock No. 12514, (× 5); *f,* Molokai, Hillebrand (× 5); *g,* Remy No. 507 (× 2½); *h,* Nuttall (× 5).

H); Koko Head, Shaw ex Rock No. 12514; A. F. Judd, Diamond Head, Forbes No. 1078, Rock No. 12513 (H).

Molokai: Halawa, Hillebrand (B); Puu Hulehule, Forbes No. 178; Pukoo, Forbes No. 353 (H).

Lanai: Hillebrand (type, B); Mann and Brigham No. 353 (C. W.); west end, Forbes No. 163; Rock No. 8004 (H. C); Mahana Valley, Munro No. 119, Rock No. 8048 (H. C.); Kaohai, Munro No. 23, 98; Paomai, Munro No. 82, Kaela, Forbes No. 293 (H); east end, Rock No. 8013 (H, C, B).

Maui: Remy No. 503 (C); West Maui, Lydgate No. 157, (f. *gracilius*, B); Wainee gulch, Forbes No. 84 (H); East Maui, Auahi, Rock No. 8683 (H, C).

Kahoolawe: Remy No. 507 (P, C).

Hawaii: Nuttall (K).

S. cuneatum has a greater range in the islands than any other species. The type came from Lanai. The following remarks on this and on other specimens may be added.

1. "Santalum Freycinetianum var. (latifolium Gray) obovatum Lanai July 1870." Named var. *cuneatum* Hillebrand by R. Pilger; it is the type of Rock's *S. cuneatum* (32, p. 37). Leaves (fig. 21, *a, b*) 2.5 to 3 cm. by 1.7 to 2.5 cm., obovate, broad rounded or slightly emarginate, with cuneate base, thick, glaucous; secondary nerves visible on upper surface only, parallel and issuing at an angle of 45°; petiole short and stout, more or less margined, 5 to 6 mm. long or less. Panicles ± 2 cm. long, axillary. Flowers (fig. 21, *c, d*) almost sessile, 6 mm. long with a deep and narrow tube of 3 to 3.5 mm., brownish green, glaucous, lobes reddish within. Stamens 1.5 mm., anthers 1 mm., style 4 mm. long.

Of other material from Lanai that I have seen, Mann and Brigham No. 353 is remarkable for the very small stamens, which appear to be anomalous. Rock No. 8013 is rather unlike Hillebrand's type, the leaves are larger and broad elliptic (to 5 by 2.7 cm.), with petioles as much as 11 or 12 mm., but there are transitions and, on Hillebrand's sheet, the two pieces in the upper right corner approach Rock No. 8013 in general appearance.

2. Rock (Shaw) No. 12514 (fig. 21, *e*) shows that the flowers are of the *cuneatum* type.

3. "Santalum Freycinetianum var. latifolium Halawa Molokai": Hillebrand (B). Quoted under *S. paniculatum* by Rock (32, p. 33). Lacks the characteristic pubescence of this, and the flowers are exactly as in *cuneatum* (fig. 21, *f*).

4. "Santalum Freycinetianum Gaud. var. Iles Sandwich Kahoolaue Voyage de M. J. Remy, 1851-1855. No. 507" (P). Hillebrand quotes Remy for Kahoolawe under var. *latifolium* (= *paniculatum*), without number, Rock mentions No. 507 under *paniculatum* as a specimen not seen by him. I believe he got this idea from Mann (25). The specimen is a comparatively small-leaved *S. cuneatum*; there are no developed flowers, only buds and ripe drupes which measure 8.5 to 9 mm. by 6.8 to 7 mm. (fig. 21, *g*). This must be the species called *S. ellipticum* by Forbes (10, p. 4); it is reported to be extinct in Kahoolawe.

5. "Santalum ellipticum Owhyhee Nuttal" (K). Pasted on a sheet with *S. paniculatum* leg. Hillebrand. A flower is shown in figure 21, *h*.

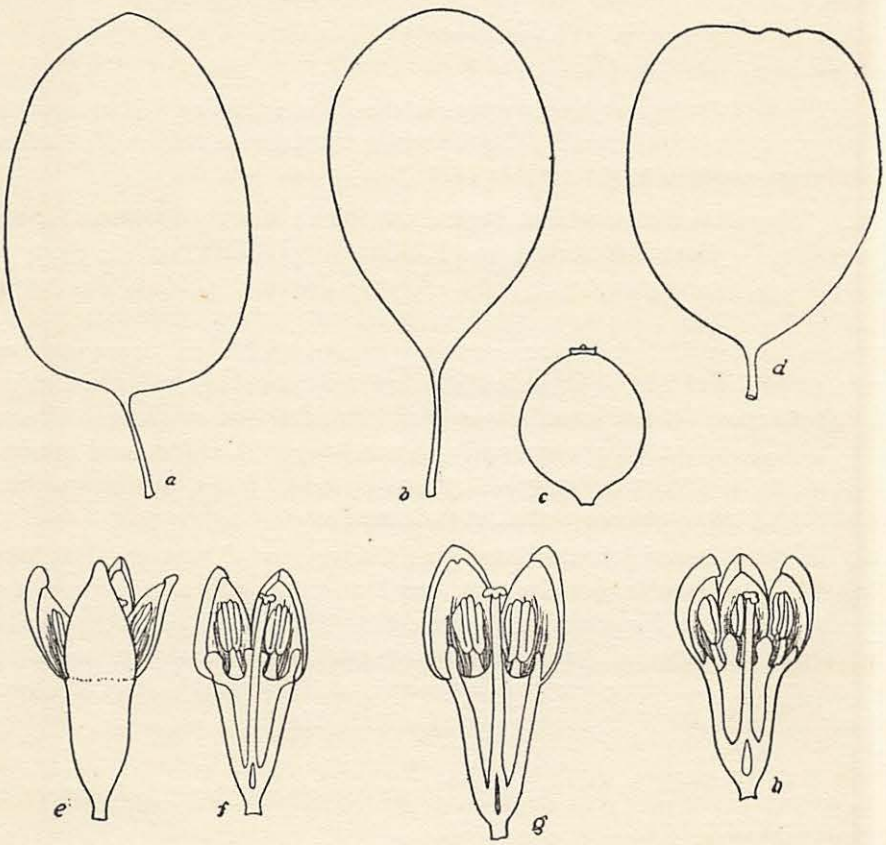


FIGURE 22.—*a-f*, Leaves, floral parts, and drupe of *Santalum cuneatum* f. *gracilius*, Skottsberg No. 118 (*a*, *b*, *d* from the same branch, natural size; *c*, × 2½; *e*, *f* × 5); *g*, same form, Lydgate No. 157 (× 5); *h*, *Santalum cuneatum* var. *laysanicum* Rock (× 5).

Santalum cuneatum var. **gracilius** new form (fig. 22, *a*, *g*).

Santalum f. *gracilius* Skottsberg: Acta Horti Gothoburgensis, vol. 2, p. 222, 1926 (nomen).

A typo differt habitu graciliori, foliis tenuioribus longius (usque 2 cm.) petiolatis, floribus paulum longioribus (6-7 mm.) distinctius.

A small tree with a broad head and slender, more or less pendulous branches. Leaves glabrous, variable in shape and size, oval, elliptic, obovate to almost orbicular (figs. 22, *a*, *b*, *d*), soft leathery, thinner than in typical *cuneatum*, glacous with indistinct lateral nerves: blade 2.7 to 7 cm. by 2.1 to 5.8 cm., petiole slender, 1 to 2 cm. long. Panicles 3 to 4 cm. long, axillary and terminal. Flowers (fig. 22, *e*, *f*) pedicellate, 6 to 6.5 or even 7 mm. long, with tube and lobes of approximately the same length; color as before. Stamens 2 mm., anther 1.5 mm., style 4 mm. Drupe ovoid to subglobose, 8 by 6 mm. (fig. 22, *c*).

This description is based on Skottsberg No. 118. Forbes No. 2442 from Oahu and Lydgate No. 157 from West Maui (quoted under *paniculatum* by Rock [32, p. 33] come very close to this. The leaves are more or less glaucous on both faces, the flowers are 7 mm. long, of *cuneatum* type (fig. 22, *g*).

Santalum cuneatum var. **laysanicum** Rock (fig. 22, *h*).

Santalum cuneatum var. *laysanicum* Rock: Hawaiian Board of Agri. For., Bot. Bull. 3, p. 39, pl. 7, 1916.

Santalum freycinetianum Bitter: Abh. nat. Ver. Bremen, vol. 16, p. 433, 1900 (non Gaudichaud).

Seen from the following localities:

Laysan: Schauinsland (B); W. Bryan, Fullaway (H).

Known by the thick and fleshy subsessile leaves. The flowers are also very fleshy, 6 to 6.5 mm. long with stamens 1.5 to 1.6 mm. and style 4 mm. long. The disc lobes are 0.8 mm. long, longer than in the type. According to Rock (op. cit.), the mature drupe is obovoid and 12 mm. high, which is more than in ordinary *cuneatum*.

Santalum paniculatum Hooker et Arnott (fig. 23).

Santalum paniculatum Hooker et Arnott: Botany of Capt. Beechey's voyage, p. 94, 1832-40.—A. de Candolle: Prodromus syst. nat. regni vegetabilis, vol. 14, p. 686, 1857. — Rock: Hawaiian Board of Agri. For., Bot. Bull. 3, p. 33, 1916 (quod specim. ex ins. Hawaii.—Skottsberg: Acta Horti Gothoburgensis, vol. 2, p. 222, 1926.

Santalum freycinetianum Gaudichaud var. *latifolium* Gray: Am. Acad., Proc., vol. 5, p. 327, 1860. — Mann: op. cit., vol. 7, p. 198, 1868 (pro

parte). — Hillebrand: Flora Hawaiian islands, p. 389, 1888 (pro parte). — Rock: Indigenous trees Hawaiian islands, p. 127, 1913.

Santalum pilgeri var. *luteum* Rock: Hawaiian Board of Agri. For., Bot. Bull. 3, p. 31, pl. 9, 1916.

Santalum latifolium Meurisse: Linnean Soc. Paris, Bull. Mens., p. 1026, 1892 (nomen).

Seen from the following localities:

Hawaiian islands: Gaudichaud, voyage *Bonite,* 1836 (P).

(? Oahu, see below).

Hawaii: United States Exploring Expedition, 1840 (W, C); slope of Manua Kea, Forbes No. 460 (B); Kilauea, 1825, Macrae (type K); Rock, Nos. 8000, 8770, 8790 (H, C), Skottsberg No. 554 (G); Hilo, Skottsberg No. 429 (G); Puuaulu, Rock No. 17149 (H); Kau Desert, Forbes No. 389 (H); Skottsberg No. 606 (G); below Kapapala, Skottsberg No. 1830 (G); Kau-Kona Road, common, Skottsberg No. 607 (G); Kona, Hanahana, Forbes No. 175, Kaalapunewale, Forbes No. 228, Kanehaha, Forbes No. 236 (H); Hualalai and central plateau, Hillebrand (B, K); Rock No. 10048 (H); between Huehue and Puuwaawaa, Rock Nos. 3611, 3613 (H); Skottsberg No. 1949 (G); Puuwaawaa, Forbes No. 15, Rock No. 3728 (type of *S. pilgeri* var. *luteum,* H); Hitchcock No. 14486 (W); Skottsberg No. 686 (G).

This good and easily recognized species appears to be confined to the island of Hawaii. Specimens quoted from Maui, Molokai, and Lanai belong to *cuneatum* or *lanaiense.* It has never been quoted from Oahu, but one of the specimens collected by Macrae (K) has a printed label "Woahoo Ins. Sandwich Macrae Maio, 1825." This is the type of label used for Macrae's Oahu collection. Another dubious record is found on another sheet labelled "Volcano Owhyhee Macrae," where one of the pieces is said to have come from Oahu, leg. Diell. It should be borne in mind that Hooker and Arnott only mention the island of Hawaii (20, p. 94).

Remarks on some of the examined specimens:

1. Printed label: "Herb. Soc. Hort. Lond. Ins. Owhyhee, ad montem ignivomum. Macrae. Junio, 1825"; written on the sheet: "Santalum paniculatum Hook. et Arn. Bot. Beech. 94 end of Oahu head." Whoever added the false locality "Oahu" I can not tell, but Hooker and Arnott quote only "volcano of Owhyhee," which, to judge from Macrae's label, means Kilauea, where *S. paniculatum* is fairly common.

Leaves coriaceous, dark and glabrous above, yellowish gray, densely and minutely pulverulent-papillose below, blade broad elliptic to obovate, 3 to 5.5 cm. by 2 to 3.8 cm., rounded at apex, narrowed into a broad petiole of 4 to 5 mm. Panicles terminal and

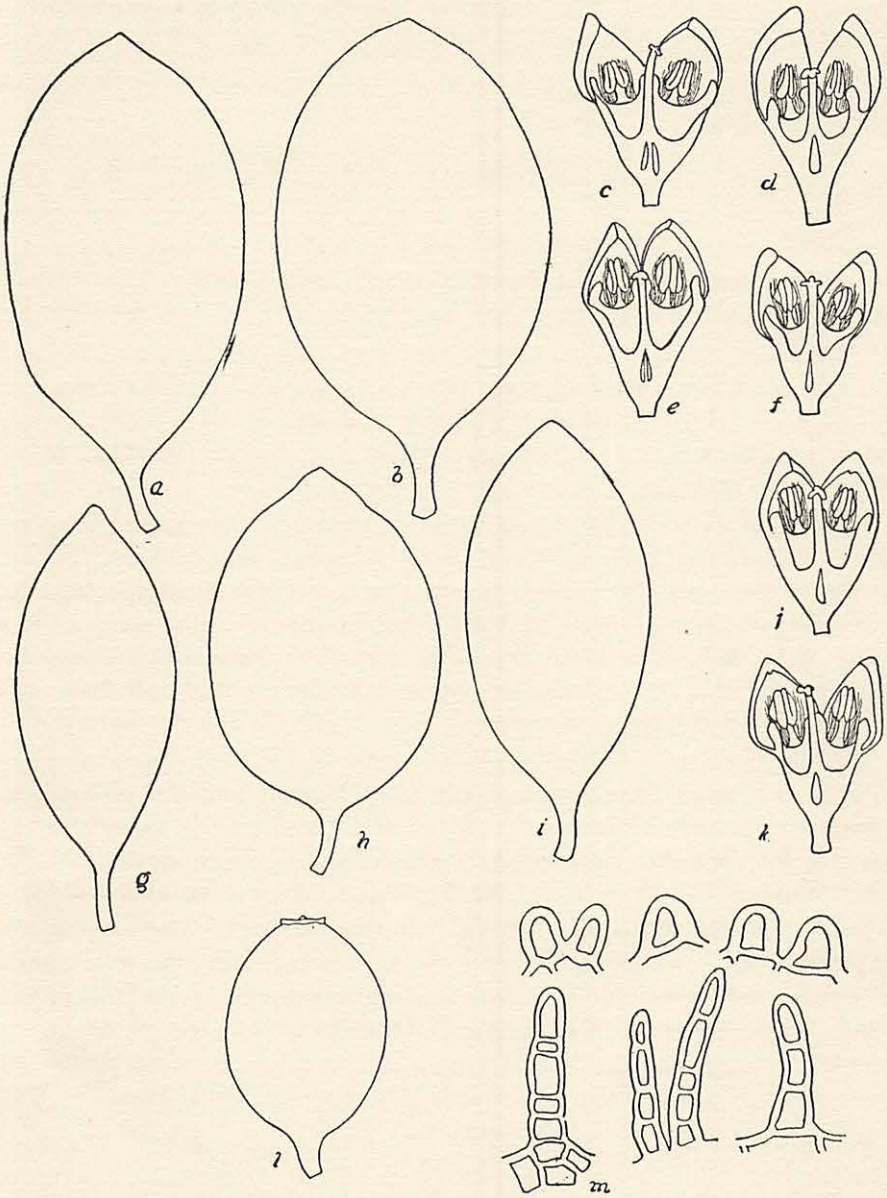


FIGURE 23.—Leaves, floral parts, drupe, and trichomes of *Santalum paniculatum* Hooker et Arnott: *a, b,* Skottsberg No. 554 (natural size); *e,* Hillebrand (× 5); *d,* Skottsberg No. 554 (× 5); *e,* Skottsberg No. 429 (× 5); *f,* Skottsberg No. 607, (× 5); *g, h, i,* Skottsberg No. 606 (natural size); *j,* Rock No. 3728 (× 5), type of *Santalum pilgeri* var. *luteum; k,* Skottsberg No. 686 (× 5); *l.* Skottsberg No. 686 (× 2½); *m,* trichomes from lower side of leaf (above) and floral region (below), (× 90).

axillary, 3 to 4 cm. long, covered by a powdery yellowish pubescence. Flowers not well developed. The most striking character is offered by the pubescence, the lower leaf surface being covered by small, thick-walled papillae, lengthening into pluricellular structures in the floral region (fig. 23, *m*). The cells are filled with a yellow brown substance.

2. The various specimens collected by Hillebrand and distributed as Nos. 290, 400, 422 agree perfectly with the type. The largest leaves seen measure 6.5 by 4 cm. The flowers (fig. 23, *c*) are small as in *S. ellipticum,* subsessile, only 4.5 mm. high, very open with a short and wide tube of 2.2 to 2.3 mm. and spreading lobes of about the same length. The stamens are small, only 1.2 to 1.3 mm. long, the anthers 0.7 mm. and the style 2.3 to 2.5 mm.

3. "Santalum Freycinetianum Gaud. Voyage de M. Gaudichaud sur la Bonite 1836-37. Iles Sandwich Septembre et Octobre 1836" (P). Typical *S. paniculatum,* and probably the type of *S. latifolium* Meurisse, which never was described.

4. Skottsberg No. 554, Kilauea (34, p. 222). Typical in every respect. Leaves (fig. 23, *a, b*) 5 to 6 cm. by 3.5 to 3.8 cm. Flowers glaucous and pubescent, castaneous inside, sessile, 4.2 to 4.5 mm. high (fig. 23, *d*), tube quite shallow, only 2 mm. high. Stamens about 1 mm. with anthers of 0.6 mm., hair tufts small, disc lobes very fleshy, style 2 mm. long or a little less. The Hilo specimens, No. 429 (fig. 23, *e*), have a little narrower leaves and flowers as much as 5 mm. high with stamens and style in proportion.

5. Specimens from Kau and other dry leeward localities differ from typical *paniculatum,* but I have sought in vain for characters by which they might be distinguished as a variety. The leaves are on an average smaller and narrower (fig. 23, *g, h, i*), but the flowers quite typical (fig. 23, *f*).

6. *Santalum pilgeri* var. *luteum* Rock, No. 3728, Puu Waawaa. Quite different from *S. pilgeri* which must be kept clean from such "varieties." Not to be distiguished from *S. paniculatum;* the leaves are narrower, less obtuse, more cuneate at base and with a longer petiole, but there are intermediate forms and the flowers (fig. 23, *k*) are quite typical. Drupe 13 by 9 mm. Hitchcock No. 14486 and Skottsberg No. 686 from the same locality are exactly like Rock's specimens. Leaves 4 to 6 cm. by 2.2 to 2.8 cm. petiole to 10 mm. Drupe 11 to 11.5 by 8 mm. ellipsoid. A typical var. *luteum,* Rock No. 10048, is listed by Rock (32, p. 33) as *S. paniculatum.*

Santalum pilgeri Rock (fig. 24).

Santalum pilgeri Rock: Hawaiian Board of Agri. For., Bot. Bull. 3, p. 39, pl. 8, 1916.

Santalum freycinetianum var. *gaudichaudii,* Hillebrand in herb.;

Santalum freycinetianum var. *latifolium:* Hillebrand, Flora Hawaiian islands, p. 389, 1888.

Santalum affine Pilger: in herbarium (B).

Seen from the following localities:

Hawaiian islands: Menzies (K).

Hawaii: Mauna Kea 1825, Macrae (K); Remy, 1851-1855, No. 509 (C); Mauna Loa 2000 to 3000 feet, Kona, Hillebrand (K); Kona 1862, Hillebrand No. 289 (B, V); S. Kona, Pulehua above Kealakekua, Rock No. 10033 (type, H; C).

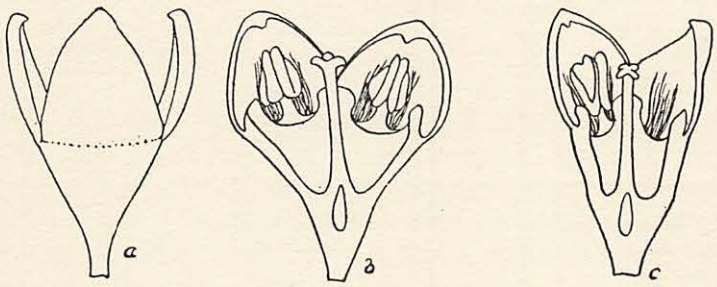


FIGURE 24.—Floral parts of *Santalum pilgeri* Rock: *a, b,* type, (× 5); *c,* Menzies (× 5).

Pilger had recognized the new species and labelled it *S. affine,* but Rock, who quotes this name (32, p. 39), preferred not to use it nor to make Hillebrand's specimen the type of *S. pilgeri.* His description is based on the plant from Pulehua (leaves as much as 10 cm. long, flowers, fig. 24, *a, b,* in axillary "racemes"). Some notes on other specimens may be of interest.

1. Kona, Hawaii 1862, Hillebrand (B). Well developed axillary and terminal panicles, just as in *S. paniculatum.* Leaves glabrous on both faces and dark brown when dry, hardly paler below and not glaucescent-papillose, ovate, round, obtuse or slightly pointed, with short cuneate base, 5 to 7 cm. by 3 to 4 cm., petiole stout, 2 to 4 mm. long only. Panicles stout, smooth and glabrous. Flowers subsessile, 7 mm. long, open funnel-shaped with tube and lobes of about equal length. Stamens 1.8 mm. with anthers 1.2 to 1.3 mm., style 3 to 3.3 mm. long. The specimen (K) from the south slope of Mauna Loa (both Hillebrand's and Rock's material came from South Kona) has leaves as much as 8 by 4.7 cm. and slightly glaucous below; the flowers attain a size of 8 mm. with stamens and style in proportion.

2. "Santalum Freycinetianum Sandwich Isles A. M." (= A. Menzies) (K). A fragmentary specimen, undoubtedly from Hawaii. Flowers 6.5 to 7 mm. high, narrow but otherwise typical (fig. 24, *c*).

3. "Ins. Owhyhee ad montem Kaah, Macrae Junio 1825" (K); and a second sheet without locality (K). Leaves faintly glaucescent below; flowers 6.5 to 7.2 mm.

S. pilgeri comes near *paniculatum,* but differs from this in the lack of pubescence and in the larger flowers. According to Rock it is a large forest tree.

TABLE 2. DISTRIBUTION OF SANTALUM

	Laysan	Kauai	Oahu	Molokai	Lanai	Kahoolawe	Maui	Hawaii	
freycinetianum			+						
pyrularium		+	+?						
lanaiense					+				
haleakalae							+		
ellipticum			+						
cuneatum	+		+	+	+	+	+	+	
paniculatum								++	
pilgeri								+	

As shown by Table 2, all species are remarkably local, each, except *S. cuneatum* (possibly also *S. pyrularium*), being confined to one island. It is interesting to note that *S. cuneatum,* a sea-side species, has the widest range.

All the species are endemic in the islands. Hillebrand and Rock quote *S. freycinetianum* from Tahiti, because they identify *S. insulare* Bertero with Gaudichaud's species. Apparently both overlooked de Candolle's monograph (5) where *S. insulare* is brought to a different group characterized by the very short style ("stigmata infra antheras sita"). Meurisse (27, p. 1026) brought *S. insulare* to *freycinetianum* as a variety. I have seen two specimens of *S. insulare,* both from Tahiti (P) where I suppose it is endemic. It has nothing to do with the Hawaiian *S. freycinetianum.*

THE GENUS VACCINIUM

History of Species

Species of *Vaccinium* were among the very first Hawaiian plants to be recognized and properly described, by J. E. Smith in 1819 (35). They had been collected in 1803, by Archibald Menzies, and were named *V. calycinum, V. reticulatum,* and *V. dentatum.* In 1826, Chamisso (7) identified a plant he collected in Oahu with *V. cereum* of Forster (11) known before from Tahiti. Chamisso's description, which is very accurate, shows that his plant is the same as *V. dentatum.* This species was described anew in 1829 by Gaudichaud (12) as *V. penduliflorum,* accompanied by a fairly acceptable plate, and Gaudichaud's name has been used by all subsequent writers until I restored the correct name *V. dentatum* (34). G. Don copied (8) Smith's descriptions, and listed *V. penduliflorum* as an independant species.

The present confusion in the genus as to its Hawaiian members dates back to 1837, when W. J. Hooker went over the material in his herbarium and published a description and figure of the Hawaiian "V. cereum" (19, pl. 87). It is peculiar that though he possessed good specimens of Menzies' material he could find sufficient ground to lump together all the species under the name of the somewhat similar though different Tahitian *V. cereum.* He says, in full:

Vaccinium Cereum

α. Foliis lato-ellipticis glabris. *V. cereum, Forst. Florul. Ins. Austr. Prodr.*, p. 28. *Cham. in Linnaea,* v. 1, p. 527. Sm. in Rees, Cycl.—(tab. nostr. LXXXVII.)
β. Foliis lato-ellipticis pubescentibus. *Dougl. Pl. of Sandw. Isl.* (*n.* 17).
γ. Foliis obovatis. *V. reticulatum. Sm. in Rees, Cycl.*
δ. Foliis oblongo-ovatis remotioribus, ramis strictioribus. *V. dentatum. Sm. in Rees, Cycl.*
HAB. Society Islands. Tahiti. *Forster. M. Morenhout* (*ex Herb. Webb*). Toobouia. *Cuming* (*n.* 1429). Sandwich Islands. Owhyhee. *Menzies* (at the volcano). *Chamisso. Douglas* (*n.* 16 and *n.* 17). Wooahoo. *Macrae.* Mowee. *Menzies.*

Further, Hooker adds that Menzies' specimens allowed him to unite, "without hesitation," *V. dentatum* and *reticulatum* with Forster's *cereum.* Plate 87 is a very good representation of the species now called *V. reticulatum* Smith: although Hooker quotes his plate under α, he does not tell where the figured piece came from. In order to learn this and to get a definite idea of what Hooker understood with his varieties, of course quite important, I sent for all the respective sheets of "Herbarium Hookerianum," incorporated in the Kew Herbarium in 1867. The collection contains three sheets obviously used by Hooker as he wrote his description. They bear

names and localities, also other references, all in Hooker's hand. My photographs of these sheets are reproduced here as Plates IV, *A, V,* VI.

Sheet No. 1 (Pl. IV, *A*) was inscribed: "Mounts, Sandwich Isles. 'Vaccinium.' A.M."—A.M. is A. Menzies. Probably also written by Hooker, but with a pencil, is: "V. calycinum Sm. in Rees Cycl." Hooker may not have wanted to include this in his all-embracing *V. cereum,* and it is not referred to in the Icones. But there are other notes on the sheet, apparently written by other persons: "Vaccinium penduliflorum Gaud. an var. of V. cereum foliis major. magis membranaceis dentibus calyc. etiam membranaceis"; finally, down in the lower righthand corner, appears: "V. reticulatum var. calycinum A. Gr." This means Asa Gray's variety, and consequently is a note of a much later date.

Sheet No. 2 (Pl. V) contains seven specimens. The branch in the lower right corner is accompanied by a label on which is printed: "Sandwich Islands. D. Douglas" and written by Hooker: "No. 16, Vacc. cereum Forst. Hook. Icon. Plant. t. 87." This is the branch that was used for Hooker's figure of *V. cereum* α, though it is in reversed position. A smaller twig in the upper right corner belongs to the same gathering. Of the remaining five pieces, four, without flower or fruit, belong together and form one lot; between two of them is written, by Hooker, "Volcano Owhyhee Macrae," while the fifth, a small-leaved form with flowers, has been designated as "*V. reticulatum* Sm." in Rees and, below, "Vaccinium.—Menzies. V. cereum v. Linnaea. Hook. Ic. Plant." This is the specimen Hooker quotes as having been collected by Menzies. No mention is made of a plant collected by Macrae in "Owhyhee." It is not necessary, however, to discuss an eventual mixup of localities and collectors. Both Macrae's and Menzies' specimens belong to *V. reticulatum* Smith and came from Hawaii.

Sheet No. 3 (Plate VI) contains six specimens. Below is a plant from Tahiti, labelled "Obu obu"—a native Polynesian vernacular name—"Arbutus mucronata Vacc. cereum Tahiti." I have not otherwise met with the name *Arbutus mucronata* for this plant: *A. mucronata* Linnaeus fil. is a south Chilean species, now called *Pernettya mucronata* Gaudichaud. The oldest name for the Tahitian plant is *Andromeda cerea* Linnaeus fil. (1781). G. Don (8, p. 857) after describing *Vaccinium cereum* Forster adds: "Perhaps a species of Pernettya." This suspicion lacks foundation. From Hooker's treatment it may be concluded that the specimen from Tahiti, Cuming's plant and Douglas No. 16 made up *V. cereum* α. Two specimens labelled "No. 17 Vacc. cereum Forst. β pubescens Hook. Sandwich Islands. D. Douglas," form the type of var. β. Close to each of the three remaining pieces Hooker has written with a pencil the number (2) showing that he regarded them as pertaining to one and the same form. Between the two to the left is written "Wooahoo Sandw. Isles. Macrae," near the third

"Vaccinium. Mowee A. M.," and below, "V. cereum Cham. in Linnaea V. dentatum Sm. in Rees." Hooker (l. c.) called this δ dentatum, and it is a typical specimen of *V. dentatum* Smith. However, starting under the righthand Macrae specimen Hooker has written "V. cereum γ." It has been observed that in Icones he used this letter for *V. reticulatum* Smith. Marcrae's plants belong without any doubt to *V. dentatum,* and from sheet 2 it is evident that Hooker has named a different species, collected by Menzies, *V. reticulatum. V. cereum* γ Hooker was described "foliis obovatis," a character found in both *dentatum and reticulatum.* The question whether Hooker really brought Macrae's plant from Oahu to the same variety as Menzies's from Hawaii is of little account. It is more important to know whether the specimens in his herbarium of *V. calycinum, dentatum,* and *reticulatum,* collected by Menzies and named with Smith's specific names can be considered as types or cotypes. When Smith published his diagnoses, the conception "type" in modern taxonomic sense hardly existed. Menzies's specimens were in the herbarium of Sir Joseph Banks, and Smith worked in Banks's herbarium, later incorporated in the collections of the British Museum (Natural History). However, as Mr. A. E. Gepp informs me, only *V. calycinum* and *reticulatum* are now represented there. But Smith retained, for his private herbarium, pieces of all three species, and his collection is in the Linnaean Society of London. Through the kind assistance of Dr. A. B. Rendle I got from the general secretary of the Society, Dr. B. D. Jackson, full information and tracings of Smith's specimens. There can be no doubt that the material in Herbarium Hookerianum once formed part of the same collection and is part of the type material. As regards the true *V. cereum,* see p. 65.

From this lengthy discussion and from the examination of the specimens, the following explanation of Hooker's *V. cereum* (19, pl. 87) presents itself.

α, Tahiti, Forster and Tubuai, Cuming = *cereum* Forster.
α, Douglas No. 16 = *V. recticulatum* Smith, a glabrescent form.
β, Douglas No. 17 = *V. reticulatum* Smith, a more hirsute form.
γ, V. reticulatum Smith = *V. reticulatum* Smith, a small-leaved form, and possibly also a part of *V. dentatum* Smith.
δ, V. dentatum Smith = *V. dentatum* Smith.
Owhyhee, Menzies = *V. reticulatum* Smith, part of type material.
Chamisso = *V. dentatum* Smith.
Wooahoo, Macrae = *V. dentatum* Smith, part of type material.
Mowee, Menzies = *V. dentatum* Smith, part of type material.

de Candolle (4) followed Hooker rather closely. Besides *V. cereum* Forster with Hooker's varieties he recognizes *V. calycinum* Smith and *V. penduliflorum* Gaudichaud, but that he was in doubt regarding the latter is shown by his remark: "an V. cerei var. δ ? An V. cereum Cham. huc re-

vocandum?" I can answer both questions in the affirmative. The next contribution was made by Nuttall (28, p. 264) who established the genus *Metagonia* to receive the Hawaiian and some other species, a genus rejected by later taxonomists. Nuttall seems to have entertained a rather vague idea of what the Hawaiian *Vaccinia* were like. *Metagonia calycina* Nuttall, "V. calycinum Sm. Cycl. no. 7," quoted from "the Pari, Oahu" (= Nuuanu pali) and described as an humble shrub with scarlet flowers, is *V. dentatum* Smith, still found along the Nuuanu pali and the only *Vaccinium* in that locality. *Metagonia penduliflora* Nuttall is supposed by Nuttall to be a variety of *M. cerea* Nuttall.

In 1851 Klotzsch (21, p. 59) added two new species, *V. macraeanum* and *V. meyenianum*. The type of *V. macraeanum* (B) is labelled "Mowee, Ins. Sandwich, Macrae Maio 1825 Lindley misit 1832." Another specimen of the same lot (K) is figured in Plate IV, *B*. It is a small-leaved form of *V. reticulatum* Smith. The type of *V. meyenianum* is also in Berlin, labelled Oahu, Meyen. It belongs to *V. calycinum* Smith.

The next important contribution, the collection of the United States Exploring Expedition, was studied by A. Gray (14, p. 323). Gray recognized only two species in Hawaii, *V. reticulatum* and *V. penduliflorum*, both with varieties. He was under the impression that the principal difference between the two species was the presence or absence of a basal cusp to the anthers. Such a cusp is seen on Gaudichaud's plate of *V. penduliflorum* (12 pl. 68, fig. 4), and all forms where Gray did not discover the cusp were consequently brought to *V. reticulatum*, to which *V. macraeanum* was referred as a synonym; these varieties were: *dentatum, calycinum,* and the new *lanceolatum,* the position of which remained doubtful, as no flowers were known. Of *V. penduliflorum,* Gray described var. *berberifolium* from Haleakala, but further on he mentions one f. *berberifolia* from Mauna Kea on Hawaii, said to be a form of *V. reticulatum* var. *dentatum* because the anthers had no basal cusp. I have examined numerous anthers from all the various species and varieties in the islands. Basal cusps are anomalous and rarely observed. They occur in *V. reticulatum* (fig. 29, *k, l*) quite as often as in *V. dentatum* (*penduliflorum*). I have also examined all the material used by Gray for his classification. His idea of *V. reticulatum, dentatum* and *calycinum* were correct although he did not recognize the two last mentioned as separate species. His var. *lanceolatum* is a notable form of *dentatum,* and var. *berberifolium* (incl. f. *berberifolia*) has been raised to specific rank by me.

Mann (25, p. 187) and Wawra (38, vol. 56, p. 69-70) accepted Gray's subdivision. I have seen all the specimens gathered by Wawra and named by him. His *V. penduliflorum* Gaudichaud is typical *dentatum,* and his var. *berberifolium* is exactly the same as Gray's. He lumped together all the other forms under *V. reticulatum: a* f. *grandifolia* Wawra from Maui,

(Plate VII); β f. *calycina* Smith from Kauai and γ f. *montana* Wawra from Kauai (Plate VIII) are slightly different forms of *V. calycinum;* δ f. *cerea* Chamisso from Maui is *V. reticulatum,* a form with nearly entire leaves, ε f. *lanceolata* Gray is the same as Gray's variety with this name and ζ f. *parvifolia* Wawra is typical *V. reticulatum.*

The present authority on *Vaccinium* in Hawaii is Hillebrand (18, p. 270-272). Unfortunately, his classification, compared with Gray's, meant a step back, for he misunderstood both *V. dentatum* and *V. calycinum* of Smith. Wawra's β *calycina,* identical with the true *V. calycinum* Smith, is simply referred to *V. penduliflorum* as a synonym, while Hillebrand brings *V. calycinum* Smith "and probably also *V.dentatum* Sm." under his own γ var. *calycinum*—but his specimens of this are nothing but common *V. dentatum.* Of course Hillebrand knew the plant called *calycinum* by Smith, but he named it *V. penduliflorum* var. β *gemmaceum* Hillebrand and referred *V. meyenianum* and *V. reticulatum* ∝ *grandifolia* Wawra to it as synonyms. Hillebrand's δ var. from Hilo and Hamakua is a form of *calycinum,* common on the island of Hawaii.

Finally, Léveillé (24, p. 152) described two new species, *V. fauriei* and *V. hamatidens.* Rock (30, p. 356) identified *V. fauriei* with "reticulatum f:a?" and *hamatidens* with *penduliflorum.* As far as I can judge from the scanty material both belong to *V. calycinum.*

In 1926 (34, p. 253-254) I restored the long forgotten or misinterpreted names of Smith and mentioned some new species or varieties. They are described in this paper.

Key to the Species and Varieties

I. Mature leaves 3 to 10 cm. long, tertiary veins not conspicuously reticulate, calyx lobes 1/3 to ½ as long as the corolla, stamens 5 to 7 mm.

- A. Leaves chartaceous, broad ovate-obovate, duplicidentate; blade 5 to 8 cm. long or more, rarely less; calyx and corolla green ..... **calycinum**
- B. Leaves coriaceous, 3 to 4 cm. long, rarely more, simplicidentate, calyx and corolla scarlet.
  1. Marginal teeth small, incurved, blade mostly slightly obovate.
     a. Blade 1.5 to 2 cm. wide..... **dentatum**
     b. Blade 0.5 to 1 cm. wide... **dentatum** var. **lanceolatum**
  2. Marginal teeth long, protruding, with single additional secondary ones, blade 3 to 5 cm. long and 1.5 to 2 cm. wide, ovate..... **dentatum** var. **argutidens**

II. Mature leaves coriaceous, less than 3 cm. long (generally 1.5 to 2 cm.), tertiary veins strongly reticulate, at least above.

A. Leaf margin pectinate with long, more or less double teeth, calyx lobes 3 to 5 mm. or more, corolla red, stamens 4.5 to 6 mm.

1. Hirsute; leaves elliptic, with strongly revolute margin and incurved teeth.....**pahalae**
2. Glabrous; leaves broad ovate to suborbicular, thick and flat, with strong erect spinelike teeth..**berberidifolium**

B. Marginal teeth small or wanting; calyx lobes 1 to 3 mm., stamens 3.5 to 4.5 mm.

1. Leaves with cunate-truncate base, green; calyx 1-2, corolla 6-8 mm., crimson.....**reticulatum**
2. Leaves with truncate-cordate base, glaucous; calyx 1-3, corolla 9-10 mm., dark purple.....**peleanum**

Description of Species

Vaccinium calycinum Smith (Pls. IV, *A*, VII, VIII; figs. 25, *a-d*; 28, *a*, *b*).

Vaccinium calycinum Smith: Rees. Cyclo. vol. 39, no. 7, 1819.—Skottsberg, Acta. Horti. Gothoburgensis, vol. 2, p. 254, 1926.

Vaccinium meyenianum Klotzsch: Linnaea, vol. 24, p. 59, 1851.

Vaccinium reticulatum Smith var. *calycinum* Gray: Am. Acad., Proc., vol. 5, p. 323, 1862.

Vaccinium reticulatum Smith α *grandifolia* Wawra; β *calycina* Wawra; γ *montana* Wawra.

Vaccinium penduliflorum Gaudichaud: β *gemmaceum* Hillebrand: Flora Hawaiian islands, p. 271, 1888.

Vaccinium hamatidens and *Vaccinium fauriei* Léveillé: Repert spec. nov. vol. 19, p. 152, 1912.

Seen from the following localities:

Hawaiian islands: in the mountains, Menzies (part of type, K); United States Exploring Expedition 1840 (W); Hillebrand (W).

Kauai: Waialeale, Wawra No. 2180 (V); Waimea, Halemanu, Wawra No. 2111 (B, V), Faurie No. 699 (type of *V. hamatidens* Léveillé, H), Faurie No. 701 (H), Rock No. 1555 (H); near Kokee, Skottsberg Nos. 968, 1132, 1138 (G); Kaholuamanu, Rock No. 2366 (C), 2367 (H); Wahiawa Mountains, Forbes (H); Hii Mountains, Forbes No. 672 (H).

Oahu: Meyen (type of *V. meyenianum* Klotzsch) (B, V), Mann and Brigham No. 102 p.p. (W), Hillebrand (K); Waianae, Makaha, Forbes (H); Kaala, Hitchcock No. 13994 (W, H).

Molokai: Pelekunu, Rock No. 7017 (H, C); north of Kamalo, 4000 feet, Hitchcock No. 15097 (W).

Lanai: Munro No. 276 (H).

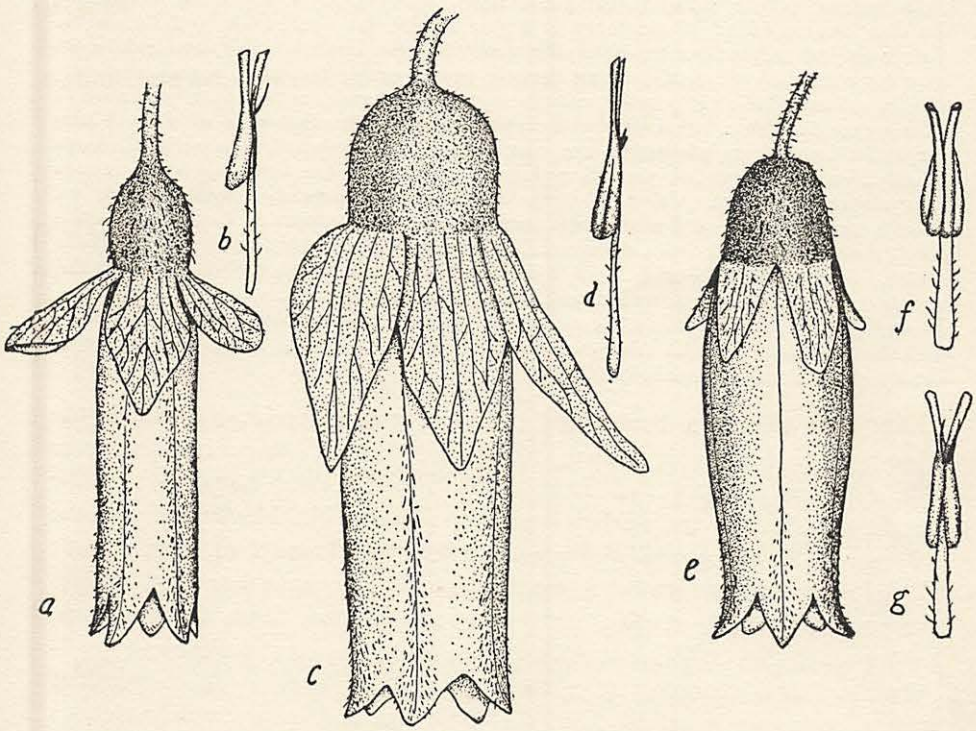


FIGURE 25.—*Vaccinium calycinum* Smith, and *Vaccinium dentatum*: *a, b,* flower and stamen from type material of *Vaccinium calycinum* Smith, leg. A. Menzies; *c, d,* flower and stamen of same species, Skottsberg No. 869; *e-g,* flower and stamen (front and back view) of *Vaccinium dentatum* Smith, Skottsberg No. 288.
All × 5.

Maui: West Maui, Honokahua basin, Forbes No. 425 (H), Puukukui, Hitchcock No. 14736 (W); East Maui, Haleakala, Wawra No. 2121 (B, V), Forbes Nos. 1027, 1204 (H); Olinda-Waiakamoi trail, Skottsberg No. 869 (G); Ukulele, Forbes Nos. 150, 224, 820, 913 (H), Walker No. 729 (H).

Hawaii: Forbes No. 900 (H); Kohala Mountains, Hillebrand (K), Hitchcock Nos. 14383, 14407 (W), Skottsberg No. 706 (G); Mauna Kea, United States Exploring Expedition 1840 (C), 3000 feet, Faurie No. 700

(type of *V. fauriei* Léveillé, H); Hilo side, United States Exploring Expedition 1840 (C); Kilauea, Forbes (H), Rock Nos. 8617, 8767 (H), Skottsberg No. 1870 (G); Hualalai, Rock Nos. 3673, 3851 (H), 3697 (C); Kona, Papaloa, Forbes No. 319 (H); Olaa, Forbes No. 643 (H); Halealohu, Forbes No. 751 (H); Halelouolu, Forbes No. 695 (H).

Arborescens, ad 2 m. altum. Rami obtuse angulati, puberuli sed glabrescentes. Folia magna, petiolo crasso brevi plerumque 2 ad 4 mm. solum longo pubescente suffulta; lamina 4.5 ad 10 cm. longa et 2.5 ad 5.5 cm. lata, vulgo 6-8 × 2.5-4 cm., in forma alpigena minor; lamina ovata-subobovata, basi late cuneata, apice acuminata, margine dense duplicidenticulata, dentibus hamatis, matura crasse chartacea, supra sat obscure viridis, subtus pallidior et punctis resinosis inspersis scaberula, nervis supra praecipue ± pilosis exceptis glabra, nervis subtus incrassatis obscurioribus interdum rubellis. Flores ex axillis squamorum alabastrae nec non e foliis ramuli inferioribus solitarii, longe (2 ad 2.5 cm.) pedunculati, penduli, pedunculo cum ovario hemisphaerico viridi minute puberulo vel subglabro. Calyx foliaceus viridis, venosus subglaber, laciniis acutis vel obtusis, nunc maximis ad 8 mm. longis, nunc brevioribus rotundatis. Corolla cylindrica viridissima, 9 ad 12 mm. longa diametro 2.5 ad 4 mm., glabra, extus lineis quinque pilosis notata. Stamina 6 ad 7.5 mm. longa, filamentis ad 3.7 mm. longis glabris vel puberulis, aristis dorsalibus plerumque minutis sed interdum sat longis. Stylus 8 ad 11 mm. longus. Bacca ubi visa obscure rubra, versus 1 cm. crassa, calycis lobis induratis purpurascentibus coronata. Semina trigono-ellipsoidea, miniata, ± 1 mm. longa, ut in speciebus ceteris pulchre reticulato-schulpturata.

V. calycinum is a distinct and easily recognized species, common in the damp, shady forests of Kauai, Maui, and Hawaii (very frequent near Kilauea), but also reported from Oahu, Molokai, and Lanai. It is the largest and the only truly arborescent *Vaccinium* in the islands and also the only species of that genus with green flowers. In Kauai I collected a plant (No. 1138) in which the corolla is slightly urceolate and shows five narrow reddish streaks, suggesting an influence from *V. dentatum,* among which No. 1138 grew. The leaves were, however, typical and duplicidentate. This character (fig. 28, *a, b*), mostly overlooked by previous writers, seems to be reliable, but the large size and comparatively thinner texture of the leaves are other good specific marks. Another leaf character was pointed out by G. Don (8, p. 852). He brought *V. calycinum* to his § 1, Leaves deciduous, while the other Hawaiian species belong to § 2, with evergreen leaves. There is some truth in this distinction, though I doubt that *V. calycinum* ever stands quite leafless. As far as my experience goes, in Kauai and Maui plants the old leaves are shed when the new shoots break or shortly after. In Hawaii I studied this species in the Kilauea region and in Kohala and found the leaves more persistent so that two generations are represented simultaneously. Flowers and new leaves developed in profusion on the high land of Kauai at the end of October, 1922; there were no fruits left nor old leaves except a few ones in No. 1138, and the same was true of the plants seen on Maui in the middle of October. In Hawaii, the new leaves and flowers were well advanced in

September, 1922 and 1926, but at the same time the previous generation of leaves and plenty of ripe fruit were still to be found.

The type material of Menzies (Pl. IV, *A;* fig. 25, *a, b*), probably collected on Maui, belongs to a kind with medium-sized leaves, not over 4.5 by 2.5 cm., and smaller flowers. The calyx lobes are rarely over 3 mm. long, nor does the corolla exceed 9 mm. The reason why Smith chose the specific name "calycinum" becomes intelligible only after inspection of his two other species, for the lobes are more foliaceous than in *dentatum* and much larger than in *reticulatum*. Smith did not know that on Kauai and also on Maui *V. calycinum* develops very large calyx lobes, of a size not attained by any other species and giving due credit to the specific name. This luxuriant form, with leaves as much as 10.5 cm. long and 5.5 cm. wide, was called α *grandifolia* by Wawra, No. 2121 from Maui (Pl. VII). Exactly the same has been collected on Maui by Forbes (Nos. 425, 913), Hitchcock (No. 14736) and Skottsberg (No. 869, figs. 25, *c, d*). The calyx lobes are 6 to 8 mm. long and 3 to 4 mm. wide and the corolla 10 to 12 mm. in length. Just the same form though with shorter calyx occurs on Kauai (Rock No. 2367, Skottsberg No. 968), in Waimea on Hawaii (Hitchcock Nos. 14383, 14407) and also on Oahu (Mann and Brigham No. 102, Forbes). Anyone who prefers to do so may call the large-leaved specimens f. *grandifolia,* but there is a continuous series with all gradations from small to large. I do not hesitate to bring Wawra's γ *montana* from Waialeale on Kauai to the same species. It is a reduced form with leaves only 2.5 to 3.5 cm. long and 1.5 to 1.8 cm. wide, but otherwise typical (Pl. VIII).

My first impression of the common form found in the island of Hawaii was that it was a separate variety. The leaves are, as already told, longer persistent, the calyx lobes are shorter and more obtuse, only 2.5 to 3 mm. long or increased to 4 mm. in the fruiting stage. Hillebrand's plants from Kohala are the same as mine, and so are all the specimens from Kilauea. *V. fauriei* Léveillé is, as far as may be judged from the miserable specimens, also the same, while *V. hamatidens* Léveillé is more typical *calycinum*. In *V. meyenianum* from Oahu the calyx is 5 mm. long, while the leaf characters are as in the form from Hawaii. So far I have not succeeded in segregating distinct varieties of *V. calycinum*.

Vaccinium dentatum Smith (Pls. V, VI; figs. 25, *e-g*, 26, *a*, 28, *c, d*).

Vaccinium dentatum Smith: Ree's cyclopedia, vol. 39, No. 31, 1919.
Skottsberg: Acta Horti Gothoburgensis, vol. 2, p. 253, 1926.

Vaccinium cereum Chamisso: Linnaea, vol. 1, p. 527, 1826.

Vaccinium penduliflorum Gaudichaud: Voyage autour du monde, Botanique, pl. 68, p. 454, 1826-30.

Vaccinium cereum Forster δ var. *dentatum* W. J. Hooker: Icones plantarum, vol. 1, pl. 87, 1837.

Vaccinium reticulatum Smith var. *dentatum* A. Gray: Am. Acad., Proc., vol. 5, p. 323, 1862.

Metagonia penduliflora et *calycina* Nuttall: Philadelphia Soc., Trans., new ser., vol. 8, p. 264, 1843.

Vaccinium penduliflorum cum var. *calycinum* Hillebrand: Flora Hawaiian islands, p. 271, 1888.

Seen from the following localities:

Hawaiian islands: Gaudichaud (part of type material of *V. penduliflorum,* B); United States Exploring Expedition 1840 (W); Hillebrand (W); unknown collector (V).

Kauai: Waimea, Forbes No. 961 (H), near Kokee, Skottsberg No. 967 (G); Kalalau trail, Forbes No. 1025 (H); Halemanu, Rock Nos. 1551, 1689, 1690 (H); 1684, 1691 (C); Kaholuamanu, Rock No. 5567 (C), Hitchcock No. 15357 (W).

Oahu: Macrae (K, V); Gaudichaud (part of type material of *V. penduliflorum,* K); United States Exploring Expedition 1840 (W, C); Mann and Brigham No. 102 p.p. (K); Didrichsen No. 3423 (H); Hillebrand (K); Wawra No. 1641 (V); Waianae, Palehuaiki, Skottsberg No. 288 (G); Koolau, Kalihi, Faurie No. 709 (H); Kalihi-Nuuanu ridge, 500 m., Skottsberg No. 160 (G); Nuuanu, Hillebrand (B); Nuuanu pali, ?Nuttall (W); Nuuanu-Pauoa ridge, Skottsberg No. 1766 (G); above Honolulu, Andersson (S); Pacific Heights, Bryan No. 439 (H); lower slopes of Waiolani, Heller No. 2393 (K, W), Forbes No. 469 (H); Waimano, Forbes No. 1989 (H).

Molokai: Waialua, Forbes No. 592, and Kalae, Forbes No. 54 (H).

Lanai: Hitchcock No. 14663 (W); Koele, Forbes No. 28 (H); Kaiholena, Forbes No. 130 (H).

Maui: Menzies (part of type, K); Gaudichaud (part of type material of *V. penduliflorum,* B); above Lahaina, Hillebrand (B); Maunahooma, Forbes No. 16 (H); Lahainaluna, Forbes No. 323 (H).

(?Hawaii: Macrae, K.)

Frutex parvus usque metralis ramis glabris angulatis. Folia subglabra usque glaberrima petiolo ad 4 mm. longo vel, rarius ultra suffulta, lamina 2.5 ad 4 cm. longa et 1 ad 2 cm. lata, ovata vel melius obovata, basi cuneata vel truncata, apice late rotundata, obtusa et apiculata vel acuta, margine crebre et simpliciter denticulata dentibus brevibus incurvis, matura dura coriacea, ± lucida, supra obscure viridis subtus pallidior, punctis resinosis inspersa scaberula, nervis supra pilosis subtus glabrioribus.

Flores longe (ad 2 cm. vel ultra) pedunculati, penduli, pedunculo versus apicem rubescente, cum ovario rubro minute puberulo. Lobi calycini rubescentes angustissime triangulati, acuti, 2.5 ad 5x1.4 ad 1.5 mm., pilis nonnullis inspersi. Corolla cylindrico-urceolata, pulcherrime coccinea, lobis apice viridibus, glabra vel versus apicem pilosula, 10 ad 11 mm. longa et 3.5 ad 4 mm. diametro, sub apice constricta. Stamina 5 ad 6 mm. longa filamentis rubescentibus parce pilosis. Stylus 8 ad 9 mm. longus, versus apicem rubescens. Bacca late ovoidea rubroviolacea, 10 mm. alta et 8 mm. crassa. Semina fere ut in *V. calycino*.

There is a certain individual variation also in this species, especially in the shape of the leaves, but in most specimens they are distinctly though slightly obovate (fig. 26, *a*). The serrature (fig. 28, *c, d*) is less dense than in *V. calycinum* and practically simple, the blade hard and coriaceous, glossy and nearly or quite glabrous; further, the leaves are more persistent, as many as three generations generally present at the same time. A peculiar form, of which I have seen only few specimens, was collected on Haleakala, 6000 to 10,000 feet by Hitchcock (No. 14979, W). The leaves are densely and finely serrate, narrow ovate and opaque. The type of *V. dentatum* came from Maui, whether west or east is not known, but all the other specimens that I have examined came from west Maui. Hitchcock's plant came from a region where *V. reticulatum* and *berberidifolium* are common.

Vaccinium dentatum var. **lanceolatum** (Gray) Skottsberg (figs. 26 *b*, 28 *e*).

Vaccinium dentatum var. *lanceolatum* Skottsberg: Acta Horti Gothoburgensis, vol. 2, p. 253, 1926.

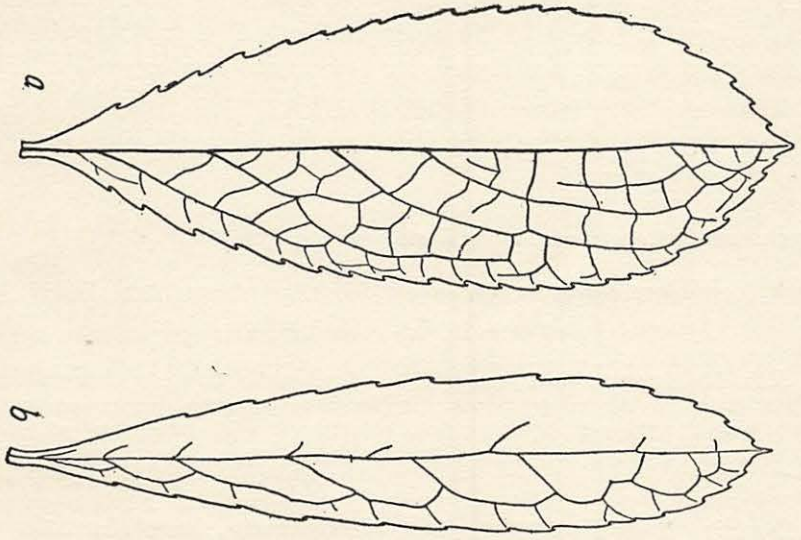


FIGURE 26.—*a*, Leaf of *Vaccinium dentatum* Smith, Skottsberg No. 160; *b*, leaf of *Vaccinium dentatum* var. *lanceolatum* (A. Gray) Skottsberg, Skottsberg No. 1012. All × 2½.

Vaccinium reticulatum Smith var.? *lanceolatum* Gray: Am. Acad., Proc., vol. 5, p. 323, 1862.

Vaccinium reticulatum Smith ε *lanceolata* Wawra: Flora, vol. 56, p. 70, 1875.

Vaccinium reticulatum Smith var. β *lanceolatum* Hillebrand: Flora Hawaiian islands, p. 272, 1888.

Seen from the following localities:

Kauai: tabular summit, United States Exploring Expedition 1840 (type, W); Wawra No. 2128 (V); Waimea, Forbes No. 1050 (H); near Kokee, Skottsberg No. 1012 (G); Alakai swamp, Forbes No. 918 (H).

Oahu: Koolau, Wahiawa, Forbes No. 2203 (H); Koolauloa, Forbes (H); Punaluu, Rock Nos. 10, 297 (H).

Folia lineari-oblanceolata, 2.5 ad 4 cm. longa et 0.5 ad 0.8 (usque 1.0 cm.) lata, in petiolum 2 ad 3 mm. longum angustata, margine sparse et minute denticulata, versus basin subintegra, coriacea, nervis supra exceptis glabra. Flores fere ut in specie typica sed corolla aliquot brevior, 8 ad 9 mm. longa; stamina 4.5 ad 5 mm., stylus 7 ad 8 mm. Bacca conico-ovoidea obscure rubra, seminibus fulvis paulum minoribus.

A striking form, habitually so unlike ordinary *V. dentatum* on account of the narrow leaves that at first I was inclined to regard it as a separate species. The same idea occurred to Forbes who has written on his specimens *V. lanceolatum* (Gray) Forbes. All plants from Oahu have slightly wider leaves, 0.8 to 1 cm., and I have seen specimens of *V. dentatum* with leaves approaching those of the variety (Faurie No. 709), so that unless the less close serrature and the shorter flowers and smaller seeds offer good enough characters, a varietal rank seems more suitable. Be that as it may, the name *V. lanceolatum* Forbes cannot be taken up, for there is an older *V. lanceolatum* DC.

Vaccinium dentatum var. **argutidens** new var. (fig. 28, *f, g*).

Vaccinium dentatum var. *argutidens* Skottsberg: Acta Horti Gothoburgensis, vol. 2, p. 253, 1926 (nomen solum).

Folia oblongo-ovata, brevissime petiolata vel subsessilia, basi ovato-truncata vel subcordata, apice apiculata vel acuminata, margine dense et argute dentata dentibus usque 2 mm. longis, rigidis et subpungentibus, porrectis-arcuatis, simplicibus vel in latere externo denticulo auctis, 2.7 ad 5 cm. longa et 1.5 ad 2 cm. lata. Flores ut in specie typica.

Kauai: Rock Nos. 5567, 5665, Kaholuamanu, Rock No. 2368 (H); ridge of Lehuamakanoe, Rock (H); Waimea near Kokee, Skottsberg No. 1137 (type, G).

Molokai: Kamoku, Rock No. 6122 (H, C).

The specimens from Molokai differ from the Kauai plants. The leaves are larger, some as much as 5 cm. long, and they have more numerous secondary teeth, while in the type they do not exceed 3 cm. and additional teeth are rare. The leaves of Rock No. 6122 are intermediate in shape between those of *dentatum* and *calycinum*. As yet nothing is known about hybrids between Hawaiian *Vaccinia*, but there is no reason why they should not occur. More extensive field studies are, however, required before either var. *argutidens* or any other intermediate form can be claimed to be of hybrid origin.

Vaccinium pahalae new species (figs. 27, *a*, 28, *h*).

Vaccinium pahalae, Skottsberg: Acta Horti Gothoburgensis, vol. 2, p. 254, 1926 (nomen solum).

Frutex parvus quam ceteris minus rigidus ramis subflexuosis subcylindricis dense cinereo-velutinis. Folia parva subsessilia, 1.5 ad 2.5 cm. longa et 1 ad 1.6 cm. lata, elliptica, basi et apice cuneato-rotundata, margine valde revoluta et eximie pectinato-dentata, dentibus acicularibus ± 1 mm. longis denticulis gracillimis uno vel altero munitis, coriacea, utrinque puberula secus nervos incrassatos et reticulatos densius pilosa. Flores (perpauci solum visi) sat longe (2.5 cm.) pedunculati, pedunculo pubescente, structura ut in *V. dentato*. Bacca ut in *V. dentato*.

Molokai: Munro No. 582 (H).

Hawaii: Mauna Loa, Pahala, Forbes Nos. 319, 428 (H), Skottsberg No. 585 (type, G); Halealoha, Forbes No. 809 (H).

I published the name of this species in April, 1926, at a time when I had seen only my own specimens; in September the same year I examined the material in the Bishop Museum and found several specimens of the same form, collected by C. N. Forbes in Hawaii and partly named on the labels *V. penduliflorum* f. *pahalae* Forbes. Of these, No. 428 exactly matches the type.

The leaves are not much larger than in *V. reticulatum* and even more reticulate, but the revolute margin and peculiar serrature seem to forbid identification with that species, especially as flowers and fruit of *V. pahalae* are as in *V. dentatum*. It differs from this in the greater amount of pubescence and in the shape, size, venation, and serrature of the leaves. Thus I can see no way of making *V. pahalae* a variety of either. Once more the question of a hybrid origin presents itself. Fruits and seeds are, however, well developed.

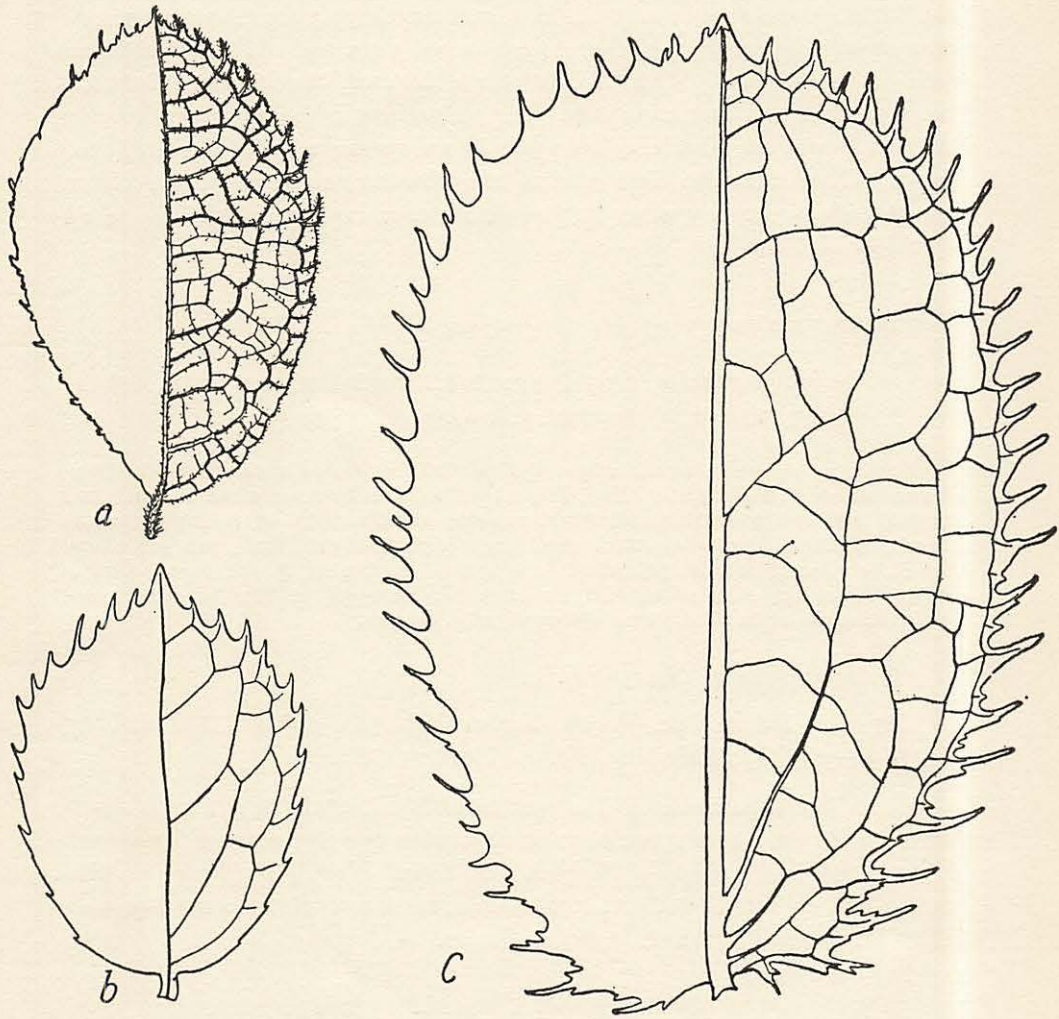


FIGURE 27.—Leaves of *Vaccinium pahalae* Skottsberg and of *Vaccinium berberidifolium* (A. Gray) Skottsberg: *a*, *Vaccinium pahalae* Skottsberg, Skottsberg No. 585, seen from above, most marginal teeth hidden under reflexed margin; *b*, normal leaf from *Vaccinium berberidifolium* (A. Gray) Skottsberg No. 832; *c*, very large leaf from a sterile shoot, same species, type specimen of Gray.
All × 2½.

Vaccinium berberidifolium new species (figs. 27, *b, c*; 28, *i*).

Vaccinium berberidifolium, Skottsberg: Acta Horti Gothoborgensis, vol. 2, p. 254, 1926 (nomen solum).

V. penduliflorum Gaudichaud var. *berberifolium* Gray: Am. Acad., Proc., vol. 5, p. 323, 1862.

V. penduliflorum, Hillebrand: Flora Hawaiian islands, p. 272, 1888 (pro parte).

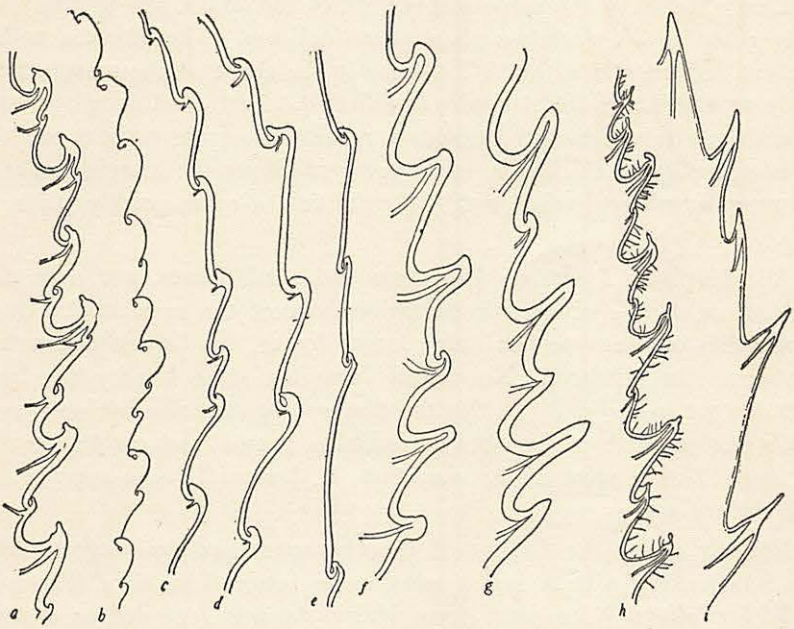


FIGURE 28.—Marginal serrature of leaves in *Vaccinium*: *a, V. calycinum* Smith, Skottsberg No. 869; *b,* same species, young leaf, Skottsberg No. 968; *c, V. dentatum* Smith, Skottsberg No. 967; *d,* same species, Skottsberg No. 160; *e,* var. *lanceolatum,* Skottsberg No. 1012; *f,* var. *argutidens,* Skottsberg No. 1137; *g,* same species, Rock No. 6122; *h, V, pahalae* Skottsberg, Skottsberg No. 585; *i, V. berberidifolium* (A. Gray), Skottsberg, Skottsberg No. 832.
All ± X 10.

Frutex nanus ramis glabris interdum glaucescentibus acutiuscule angulatis. Folia brevissime petiolata vel subsessilia, parva, 1.2 ad 2 cm. longa et 0.8 ad 1.4 cm. lata, rarius in ramulis novellis sterilibus majora usque 4 cm. longa et 2.6 cm. lata visa, late elliptica-subobovata, basi truncata, apice late truncata et apiculata, crebre et regulariter spinoso-dentata dentibus rectis 1 ad 2 mm. longis pungentibus et basi plerumque subserratis, plana, glaberrima, obscure viridia fuscescentia, crasse coriacea, nervis utrinque incrassatis et reticulatis. Flores pedunculo pilis nonnullis insperso ad 1 cm. longo praediti, purpurascentes, ovario conico, lobi calycini glabri, magnitudine sat variabili, 2.5 ad 7 mm. longi, obtusi vel acuti, corolla glabra 6 ad 11 mm. longa, cylindrico-urceolata lobis interdum serratis; stamina ad 8 mm. longa glabra, stylo paulum longiore Bacca purpurea conico-ovoidea 8 mm. longa; semina trigono-ovoidea, rufa, 0.8 ad 1 mm. longa.

Maui: Haleakala, United States Exploring Expedition 1840 (type, W), Mann and Brigham No. 430 (K, W), Wawra No. 1911 (V), Forbes Nos. 219, 1012, 1167, 1205, 1919 (H), Hitchcock, 6000-10,000 feet, No. 14968 (W), Halemauu trail, Skottsberg No. 832 (G): Ukulele, Forbes Nos. 708, 716, 812, 819 (H).

Hawaii: Mauna Kea; United States Exploring Expedition 1840 (W, C).

Easily known by the shape and texture of the leaves, and probably more closely allied to *V. dentatum* than to *reticulatum*. The likeness with *V. dentatum* var. *argutidens* and *V. pahalae* in the shape of the marginal teeth is only superficial, as the structure is different. In the latter two the teeth obtain their firmness mainly through a revolution of the margin, while the vein is only slightly thickened, in *V. berberidifolium* the margin is flat and incrassate, forming together with the rigid vein a solid, prickly point (fig. 28, *i*).

All the plants I saw on Haleakala had small leaves, not over 2 cm. long, and most all specimens in herbariums are of the same kind. One of the branches of the type has much larger leaves, the largest measuring 4 by 2.6 cm. In Hitchcock No. 14968 from the same locality the largest leaves are 3.2 by 1.9 cm. In this the flowers are of a size not seen in any other specimen, with calyx lobes as much as 7 mm. and corolla 10 to 11 mm. long. But in spite of this variation, *V. berberidifolium* appears to be a well defined species.

Nothing shows the futility of the character used by Gray to distinguish between *reticulatum* and *penduliflorum* better than his discussion on var. *berberifolium*. The plant from Haleakala was regarded as a variety of *penduliflorum*, with basal cusp to the anthers. The specimens from Mauna Kea, with roundish calyx lobes and without basal cusp are labelled *V. reticulatum* var. *dentatum* f. *berberifolia*. I have shown that the presence or absence of the cusp is of no account, and both lots belong to the same species.

Gray quotes East Maui and "apparently on the mountains of Oahu," also Mauna Kea on Hawaii. *V. berberidifolium* has never been reported from Oahu by any collector, nor have I seen specimens therefrom. It should also be remembered that no one seems to have observed it on Hawaii since 1840.

Vaccinium reticulatum Smith (Pls. IV, *B*, V, VI; fig. 29).

Vaccinium reticulatum Smith: Rees's cyclopedia, vol. 39, No. 30, 1819; Skottsberg: Acta Horti Gothoburgensis, vol. 2, p. 254, 1926. (auct. cet. pro parte), 1926.

Vaccinium cereum Forster β pro parte; γ (pro parte?), W. J. Hooker; Incones plantarum, vol. 1, pl. 87, 1837.

Vaccinium macraeanum Klotzsch: Linnaea, vol. 24, p. 59, 1851.

Vaccinium reticulatum Smith: α, Gray: Am. Acad., Proc., vol. 5, p. 323, 1862 (pro parte).

Vaccinium reticulatum Smith δ *cerea* Wawra et ζ *parvifolia* Wawra: Flora, vol. 56, p. 70, 1873.

Seen from the following localities:

Maui: Haleakala, Macrae (K, B—type of *V. macraeanum*); Wawra No. 1898 (V, B); Lydgate (B); Hillebrand (B); Rock No. 8622 (C); Hitchcock No. 14971 (W).

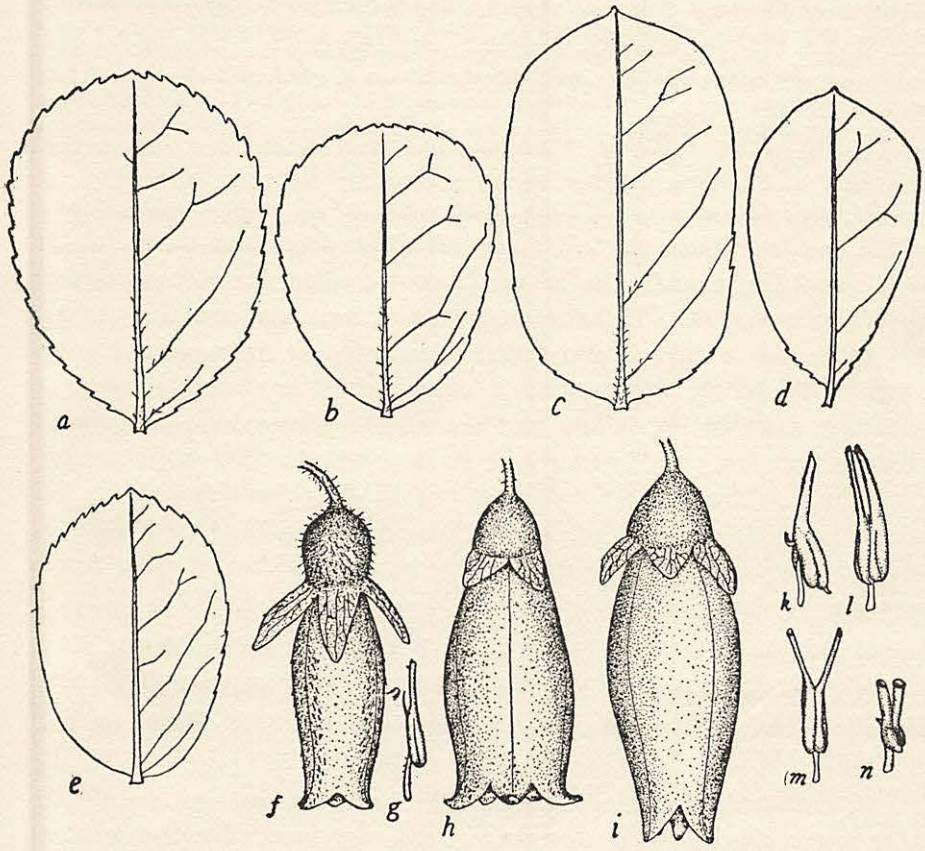


FIGURE 29.—*Vaccinium reticulatum* Smith: *a-d*, leaves, Skottsberg No. 423; *e*, leaf, Skottsberg No. 495; *f*, flower and *g*, stamen from type material, leg. A. Menzies; *h*, *i*, flowers and *k-m*, stamens, Skottsberg No. 423; *n*, staminode from female flower, Skottsberg No. 495.

a-e × 2½; *f-n*, × 5.

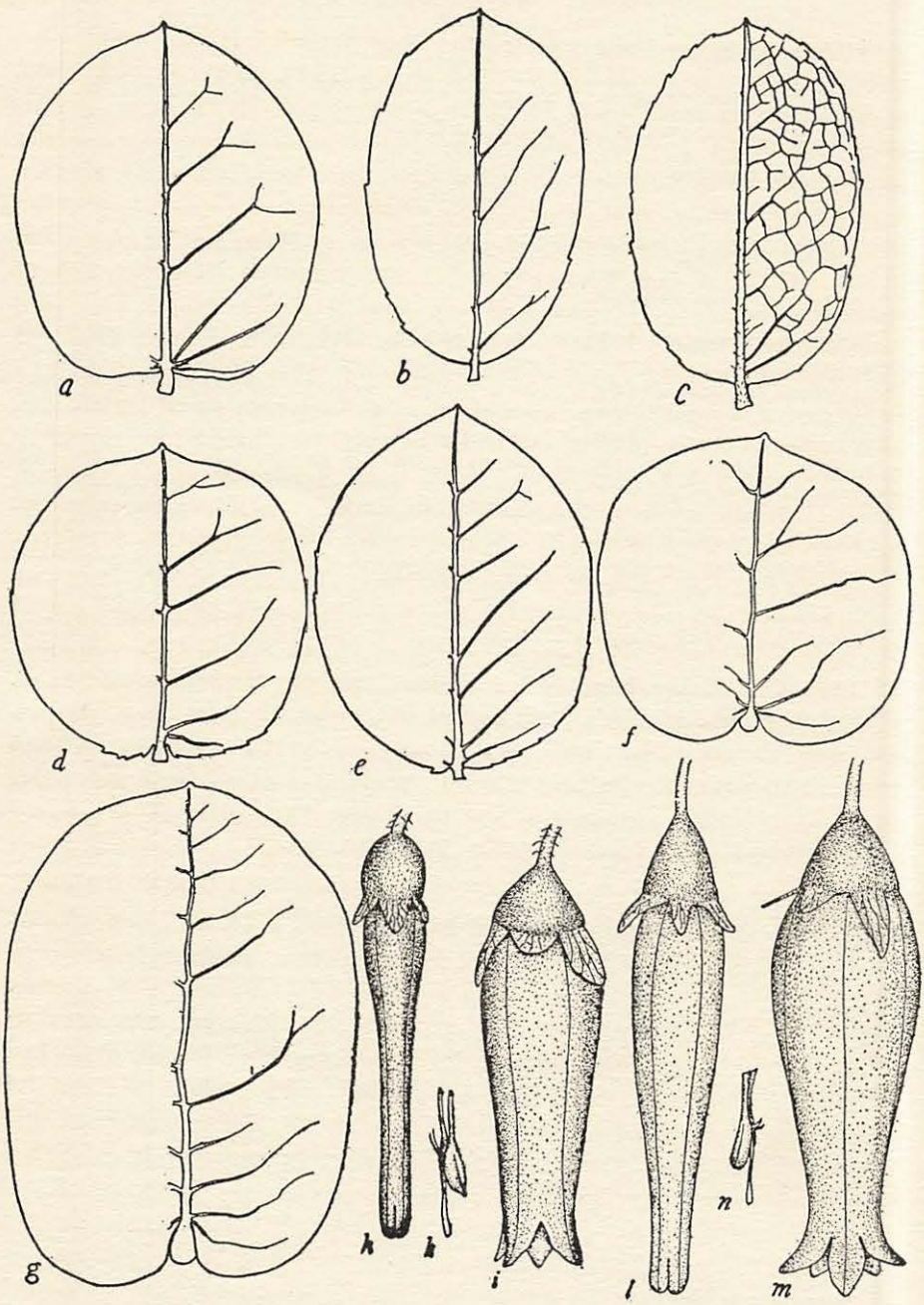


FIGURE 30.—*Vaccinium peleanum* Skottsberg: *a* - *g*, leaves; *h*, *i*, *l*, *m*, flowers; *k*, *n*, stamens. *a* - *c*, *h* - *k*, Skottsberg No. 521 (type); *d*, *e*, *l* - *n*, Rock No. 8302, *f*, *g*, Skottsberg No. 1793.

a-g × 2½; *k-n* × 5.

mountains are occasionally referred to; however, what is said about *Vaccinium* would refer to Haleakala were it not that a high mountain form, which has never been found on Maui, is mentioned. Rock says: "*Vaccinium reticulatum* (*Ohelo*), with its delicious berries, covers the mountain slopes, with another species which has lately been described as *V. Fauriei,* a very distinct plant, with large glaucous berries and small leaves; it grows much taller than *V. reticulatum,* and its berries are better tasting than those of the latter." *V. faurici* (24, p. 152) was described from two lots of specimens, one from Molokai and one from Hawaii, Mauna Kea, both collected by Faurie. I have only seen the Mauna Kea plant (H). It has absolutely nothing to do with *V. peleanum,* what is evident also from Léveillé's short description: " . . . foliis . . . obtusatis dupliciter dentatis . . . lobis calycinis ovatis, obtusis, eminenter nervosis . . . fructu . . . villosulo." It is identical with *V. calycinum.* What Rock understood by *V. fauriei* is visible from one of Hitchcock's plants from Mauna Kea, No. 14288, examined by Rock and named by him "*V. fauriei* Lévl." It is typical *V. peleanum.* Nobody has collected this species on Haleakala.

Though I admit that *V. peleanum* is close to *reticulatum,* I feel justified to regard it as specifically distinct. It is well known that in high mountains all over the world alpine forms replace lowland forms without being called species; the size of a plant and of the leaves, the pubescence, the size and color of the flower, etc., may be affected by the atmospherical and other conditions in the elevated stations, though it is equally true that many alpine modifications are constant and hereditary. The differences between *V. reticulatum* and *peleanum* enable quick distinction. *V. peleanum* is not a dwarf high alpine form, for it attains even a greater size than the other, nor are the leaves smaller. My figures 29 and 30 show that single leaves in *peleanum* look much the same as the ordinary leaves in *reticulatum,* but as a rule most leaves in *peleanum* are distinguished by their cordate base and glaucous bloom. And the difference in the shape and color of the flowers is quite conspicuous. The buds of *V. peleanum* are prolonged into a narrow beak (fig. 30, *h*). There is a zone where both species meet, and here transitional types, probably of hybrid origin, occur. Such specimens are Rock No. 3173 from Hualalai and Hitchcock No. 14420 from Mauna Kea.

TABLE 3. DISTRIBUTION OF VACCINIUM IN HAWAII

	Kauai	Oahu	Molokai	Lanai	W. Maui	E. Maui	Hawaii
calycinum	+	+	+	+	+	+	+
dentatum	+	+	+	+	+		
var. lanceolatum	+	+					
var. argutidens	+		+				
pahalae			+				+
berberidifolium						+	+
reticulatum						+	+
peleanum							+

Table 3 shows that several species have a restricted area, in spite of the juicy fruit much liked by birds. Hillebrand remarks (18, p. 272): "The shining fleshy berry . . . . is the principal food of the wild mountain goose." Plants with fruits of this kind are supposed to travel across oceans and it is sometimes argued that if they are local this is due less to obstacles affecting their travel capacities than to the difficulty of finding suitable soils in places they are otherwise able to reach. However, the most widely distributed species, *V. calycinum,* inhabits the forest, where new arrivals may find it hard to gain a foothold, while there are plenty of stations in all the islands with ample space for such as *V. reticulatum,* which thrives in open, barren, and rocky soil. But *V. reticulatum* is only found in two of the islands. *V. berberidifolium,* very attractive to every collector, is common on Hualalai and very rare on Mauna Kea; it has not reached either Mauna Loa or Hualalai, where there are plenty of suitable stations.

NOTES ON VACCINIUM CEREUM (L. FIL.) FORSTER

As was already told, the Hawaiian *V. reticulatum* and *V. dentatum* were considered by Chamisso and W. J. Hooker to be only forms of the Tahitian *V. cereum* (Pl. VI). It is Gray's merit to have shown that no *V. cereum* in the sense of Forster occurs in the Hawaiian islands. He pointed out (14, p. 323) that in *V. cereum* the corolla is more urceolate, the peduncles shorter and bibracteolate. The bracteoles are mentioned by Smith and after him by G. Don (8, p. 857). I have seen many specimens of *V. cereum* from Tahiti, including part of the type material (B, V, K). The leaves are similar to those in *V. reticulatum,* but slightly glaucous and comparatively wider. The peduncles are shorter than the supporting leaves and some not over 5 mm. long. Small bracteoles, lacking in all Hawaiian species, are present. Cuming No. 1429 from Tubuai (K), quoted by

Hooker (19, pl. 87) is like the plant from Tahiti, but sterile. *V. cereum* has also been reported from the Marquesas Islands (*Vaccinium adenandrum* Decaisne).

Systematic position of Pacific Vaccinia

All the Hawaiian species are more closely related to one another than to non-Hawaiian plants and form one natural group, the section *Macropelma* of Klotzsch (21, p. 59). Drude, in Natürl. Pflanzenfamilien, made this a section of his subgenus *Euvaccinium* and described it as possessing solitary flowers in the axils of budscales, a character also mentioned by Hillebrand (18, p. 270). Each vegetative-floral shoot starts with a number of scales, followed by ordinary leaves of which the first are more or less reduced in size; but the flowers are not confined to the axils of the scales. Many leaves, even normally developed, support flowers. Nevertheless, *Macropelma* is a natural group. Of the other sections, one is circumpolar in the Boreal zone, one represented in several tracts of the north hemisphere and in the Andes, one found only in East Africa and in Madagascar and one only in the Andes. *Macropelma* is probably closer to the first of these sections (*Myrtillus*) than to the others, but differs, among other things, in the persistent leaves and the strictly solitary flowers. I cannot indicate any species or group of species to which *Macropelma* is very closely related. It offers one of the many instances where a widespread, mainly Boreal genus is represented in the Pacific by a peculiar, presumably ancient section.

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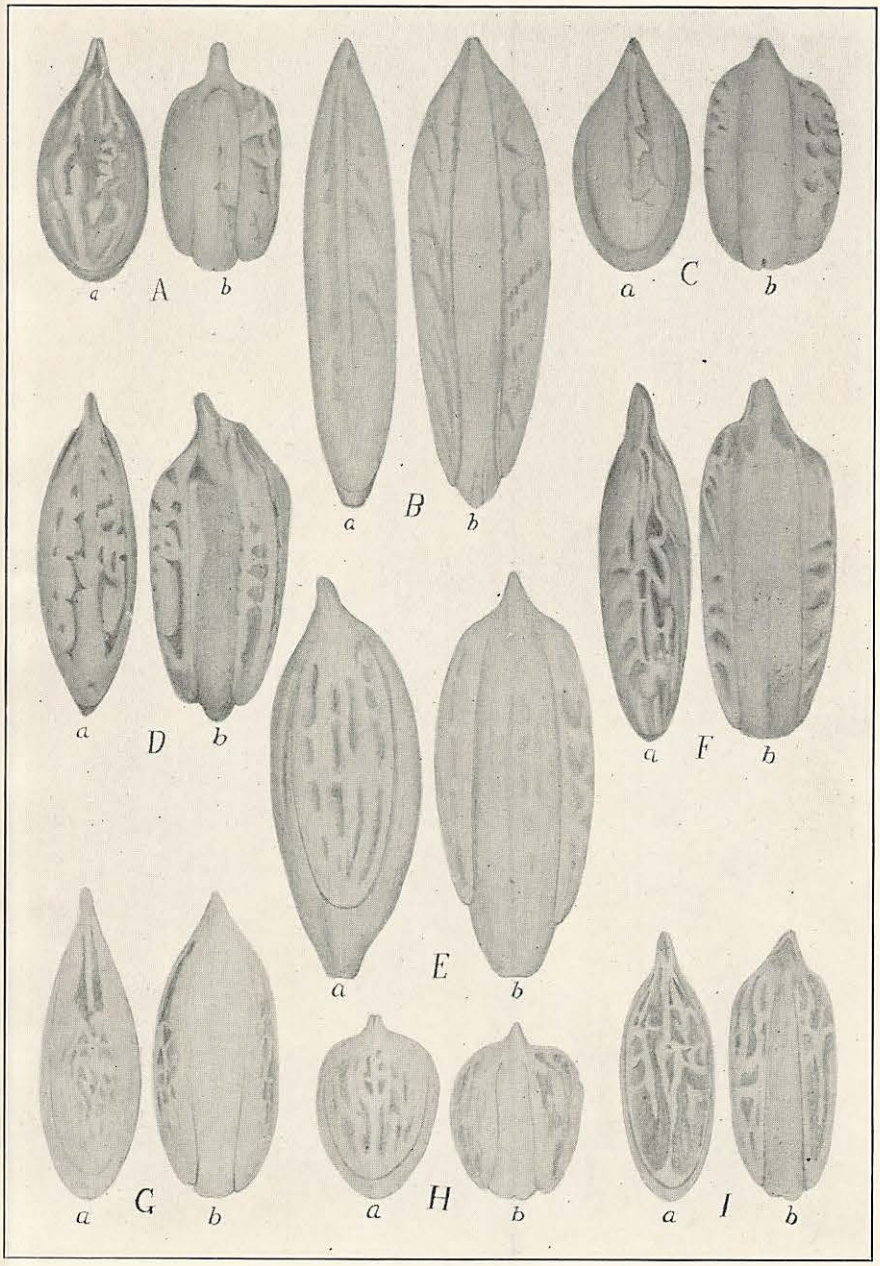
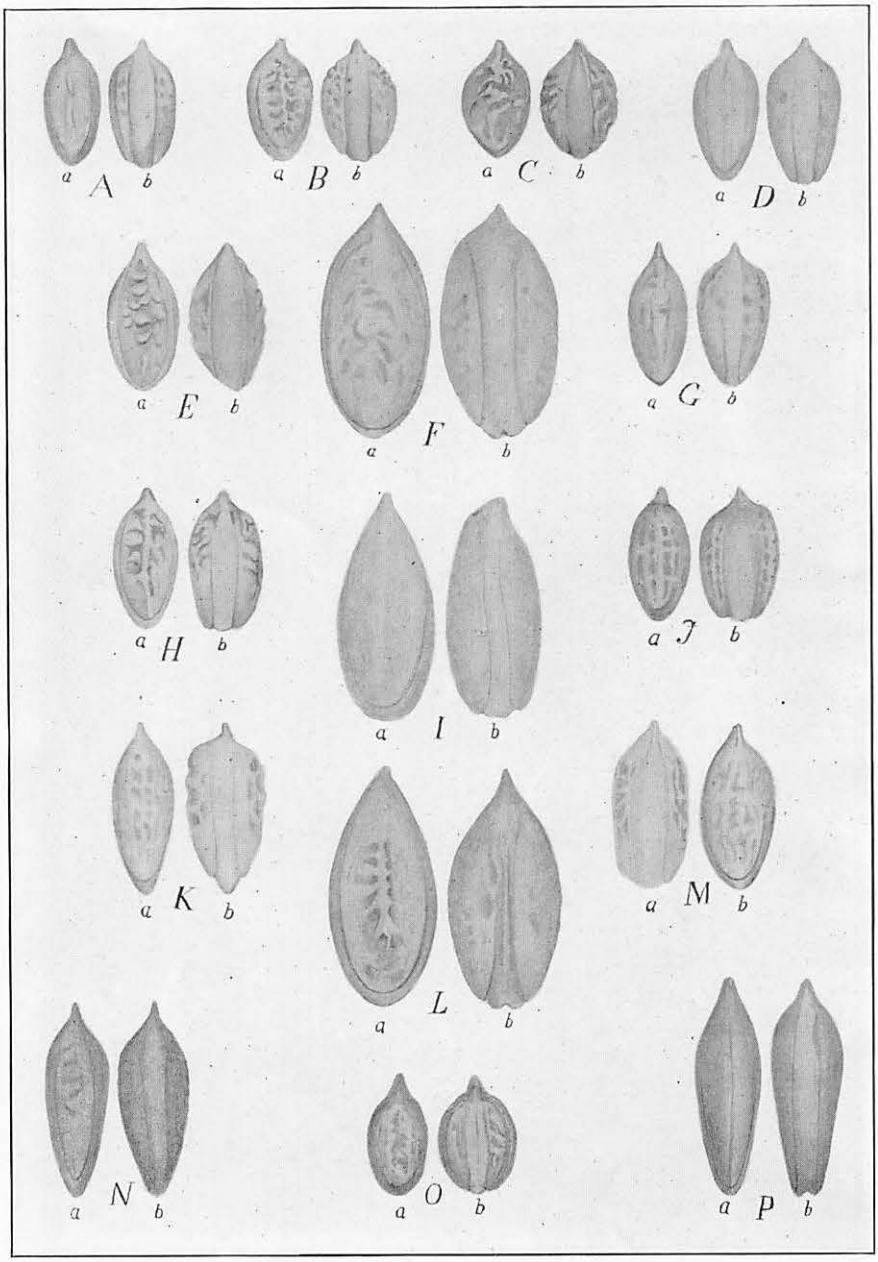


ENDOCARPS OF SCAEVOLA, DORSAL (*a*) AND LATERAL (*b*) VIEWS: *A, C, H,* S. CHAMISSONIANA VAR. HITCHCOCKII SKOTTSBERG, WEST MAUI: *A, C,* HITCHCOCK NO. 14799; *H,* ROCK NO. 8142. *B,* S. CHAMISSONIANA VAR. CYLINDROCARPA (HILLEBRAND) KRAUSE, LANAI, HILLEBRAND, TYPE. *D, E, F,* S. CHAMISSONIANA GAUDICHAUD S.S: *D,* HAWAII?, HILLEBRAND; *E,* HALEAKALA, HILLEBRAND; *F,* WEST MAUI, SKOTTSBERG NO. 765. *G, I,* S. CHAMISSONIANA VAR. BRACTEOSA HILLEBRAND: *G,* KILAUEA, SKOTTSBERG; *I,* HAWAII, KOHALA, HILLEBRAND, TYPE.

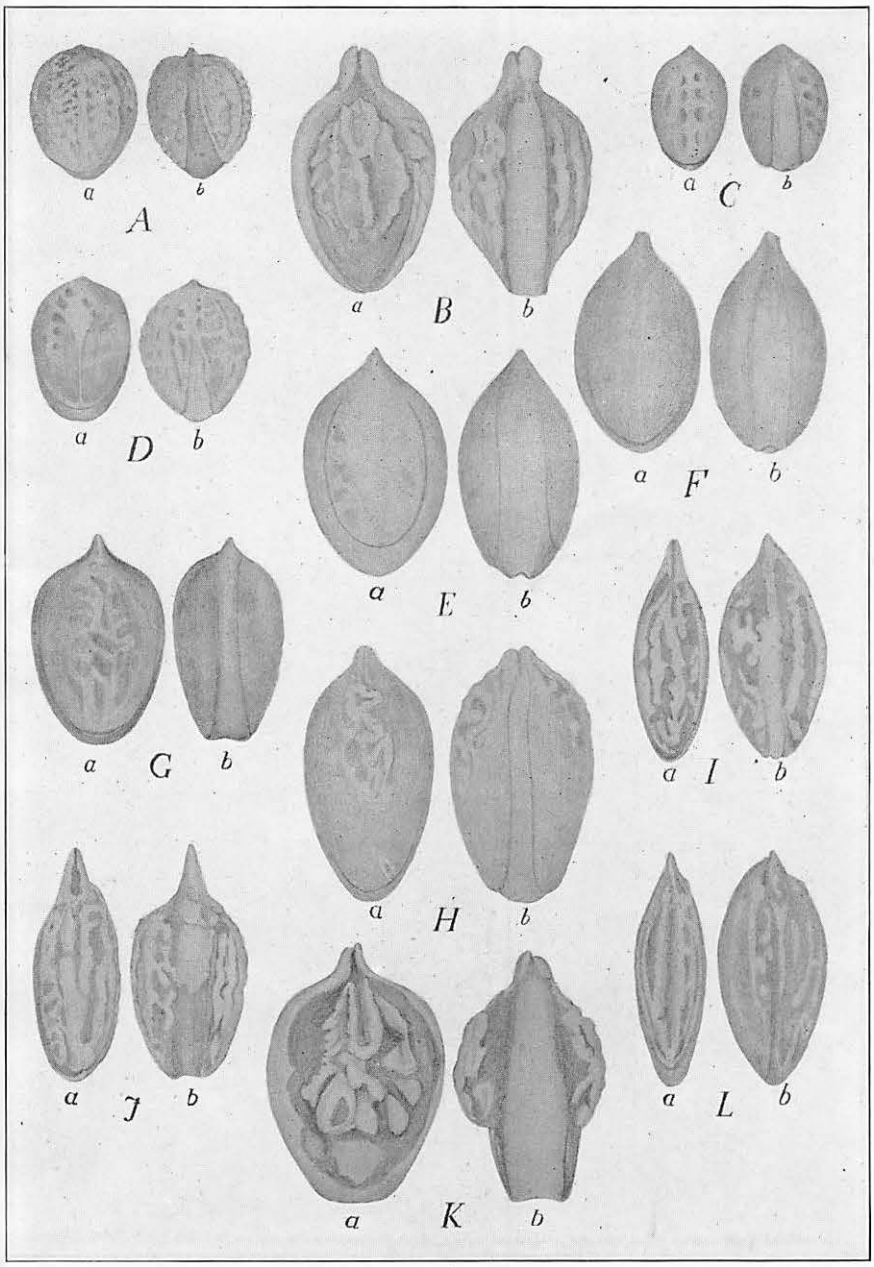
(ALL × 5.)



ENDOCARPS OF SCAEVOLA, DORSAL (*a*) AND LATERAL (*b*) VIEW:

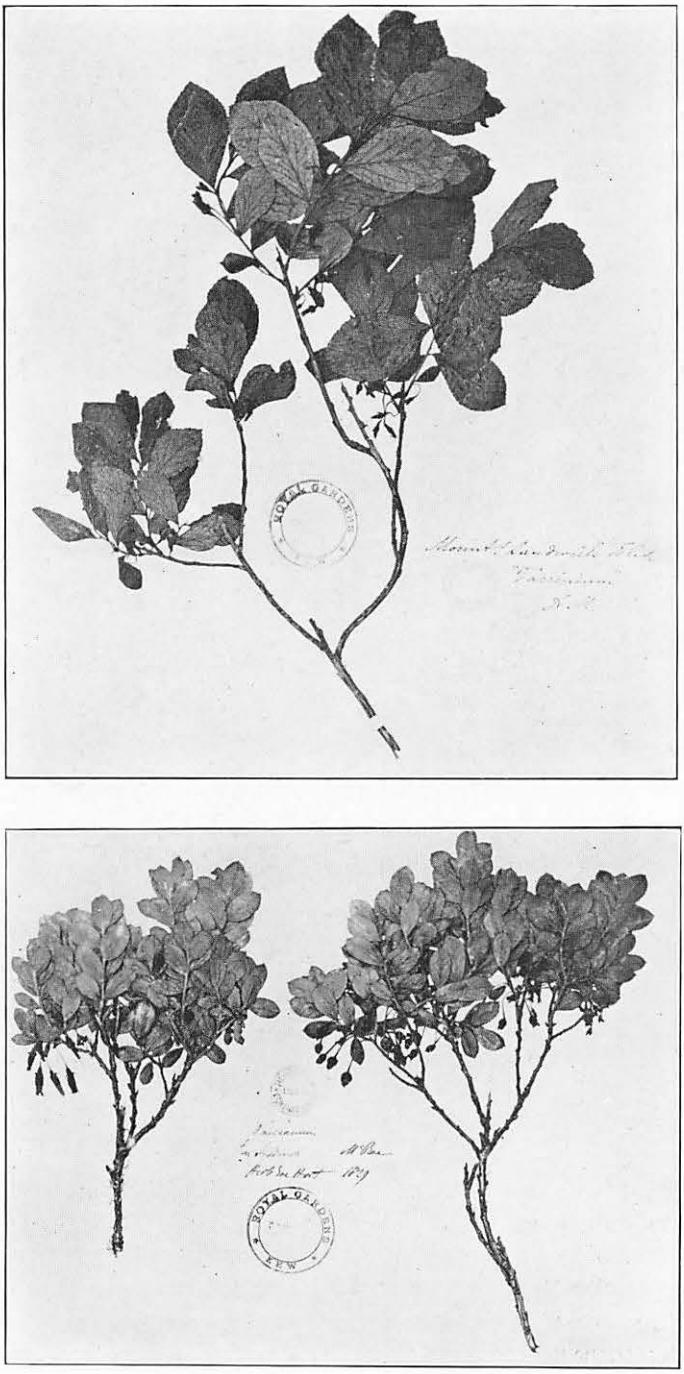
A-E, G, H, J, K, M-P, S. GAUDICHAUDIANA CHAMISSO: *A-E, G, H, J, O* FROM OAHU; *A, B*, TYPES, CHAMISSO; *C*, UNITED STATES EXPLORING EXPEDITION; *D*, N. J. ANDERSSON; *E*, HINDS; *G*, HELLER NO. 2340; *H*, HITCHCOCK NO. 14047; *F, O*, SKOTTSBERG NO. 59; *K, M*, F. KAUAIENSIS SKOTTSBERG, KAUAI, FORBES; *N, P*, VAR. STENOLITHOS SKOTTSBERG, OAHU, SKOTTSBERG NO. 273. *F, I*, S. MENZIESIANA CHAMISSO: *F*, OAHU, CHAMISSO, TYPE; *I*, MOLOKAI, FORBES NO. 349. *L*, S. CHAMISSONIANA VAR. β PUBESCENS HILLEBRAND (PROBABLY FORM OF S. PROCERA), OAHU, HILLEBRAND, TYPE.

(ALL × 5.)



ENDOCARPS OF SCAEVOLA, DORSAL (*a*), AND LATERAL (*b*) VIEWS:

A, C, D, S. CORIACEA NUTTALL: *A, C*, MAUI, UNITED STATES EXPLORING EXPEDITION; *D*, OAHU, HILLEBRAND. *B, K*, S. MOLLIS HOOKER ET ARNOTT, OAHU, SKOTTSBERG NO. 60. *E, G*, S. PROCERA HILLEBRAND, TYPE, FROM MOLOKAI: *E*, KALAE; *G*, PELEKUNU. *F*, S. PROCERA VAR. PSEUDOMOLLIS SKOTTSBERG, MOLOKAI, ROCK NO. 7036; *H*, F. MACROCALYX SKOTTSBERG, KAUAI, FORBES NO. 291. *I, J, L*, S. CERASIFOLIA SKOTTSBERG, OAHU, SKOTTSBERG NO. 61.

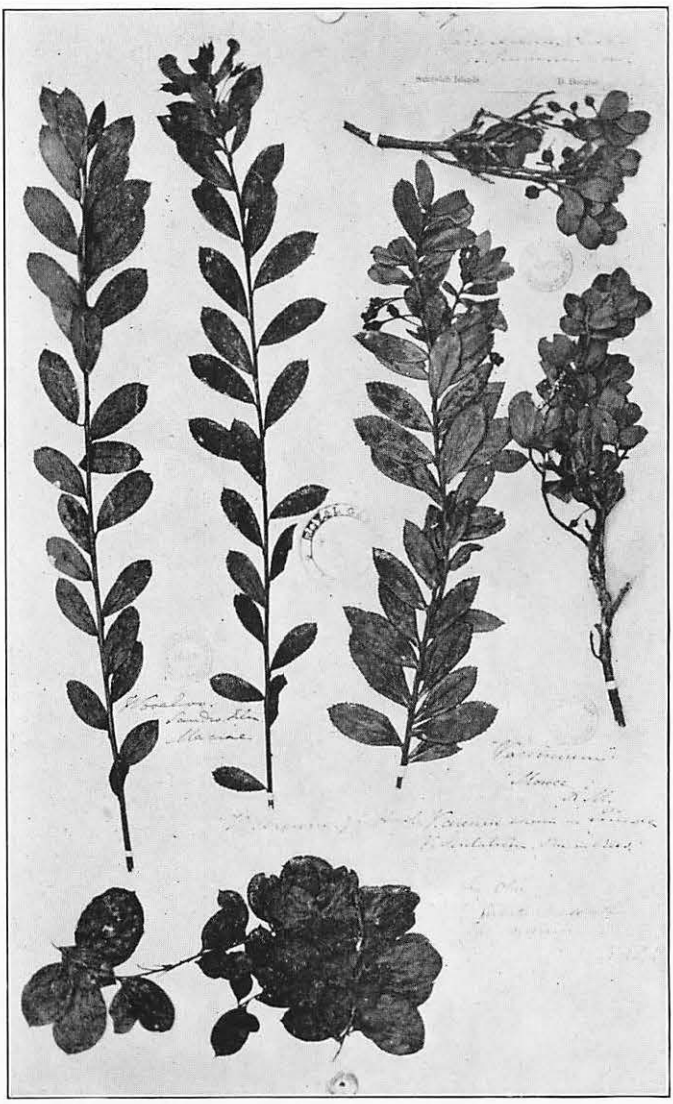


A, VACCINIUM CALYCINUM SMITH, PART OF TYPE MATERIAL, LEG. A. MENZIES; *B*, VACCINIUM RETICULATUM SMITH. (MACRAE'S SPECIMENS THAT SERVED AS TYPE OF V. MACRAEANUM KLOTSCH.)

(ONE-THIRD NATURAL SIZE)

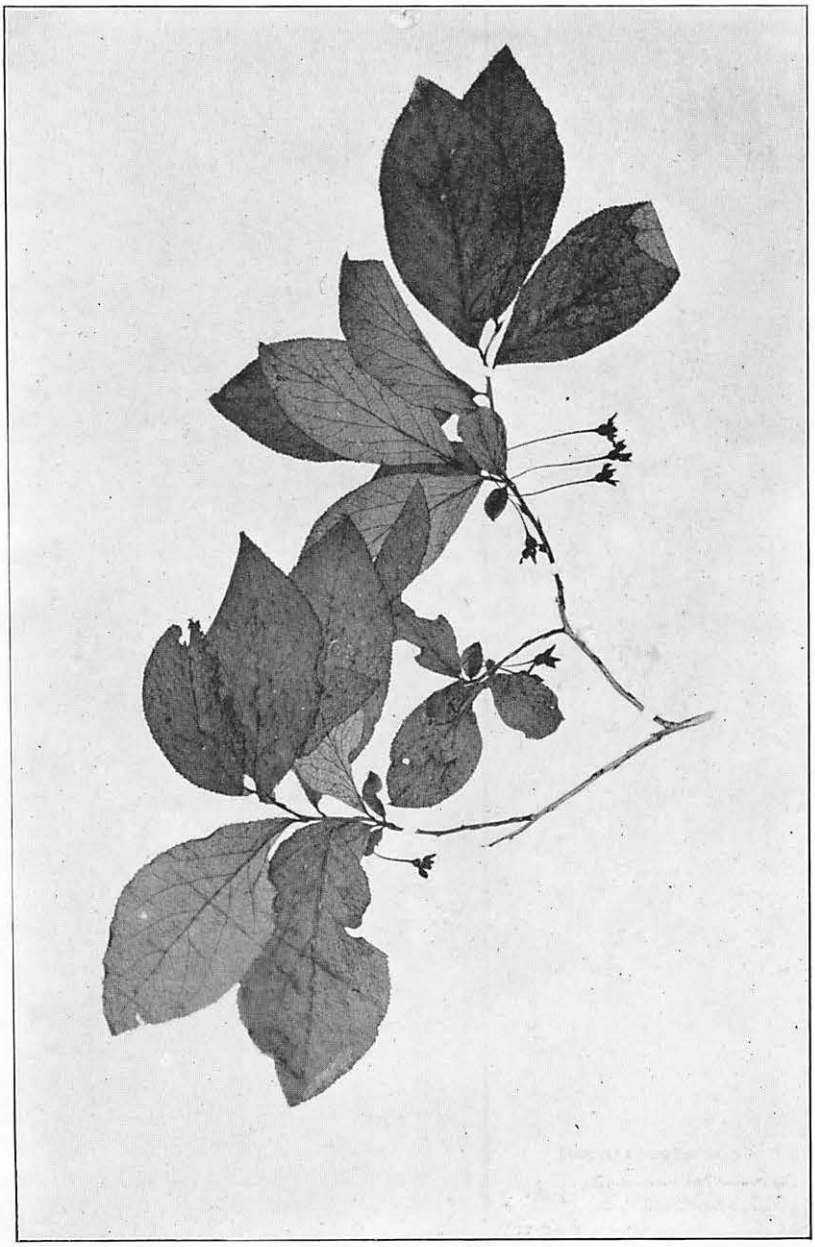
A SHEET OF VACCINIUM FROM HAWAII (V. RETICULATUM SMITH) IN W. J. HOOKER'S HERBARIUM.

(ONE-THIRD NATURAL SIZE)



A SHEET OF VACCINIUM FROM HAWAII (V. DENTATUM SMITH AND RETICULATUM SMITH) AND TAHITI (V. CEREUM FORSTER) IN W. J. HOOKER'S HERBARIUM.

(ONE-THIRD NATURAL SIZE)



LARGE-LEAVED FORM OF VACCINIUM CALYCINUM SMITH (TYPE OF V. RETICULATUM F. GRANDIFOLIA WAWRA).

(ONE-THIRD NATURAL SIZE)

SMALL-LEAVED FORM OF VACCINIUM CALYCINUM SMITH (TYPE OF V. RETICULATUM F. MONTANA WAWRA).

(ONE-THIRD NATURAL SIZE)