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Ericaceae and Santalaceae of Southeastern Polynesia[1]

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INTRODUCTION

Of the Ericaceae, the Mangarevan Expedition in 1934 collected a single species, *Vaccinium rapae* Skottsberg, endemic to Rapa and now collected for the third time, having been known previously from the type material, Collenette 782 (8, p. 97)[2], and specimens collected by Mrs. A. M. Stokes (2, p. 217).

Of the sandalwoods, three different forms of the *Santalum insulare* assemblage have been known previously from Mrs. Stokes' collection. They were described at length by Brown (2). His description leaves no doubt that we deal here with exactly the same forms, but the new material is more ample and permits us to get a better idea of the validity of certain characters used to distinguish *S. marchionense* from *S. insulare* (7).

Of *Exocarpus,* a new species was discovered in Rapa. The genus is new to southeastern Polynesia.

Genus VACCINIUM Linnaeus

Vaccinium rapae Skottsberg, Meddel. Göteborgs Bot. Trägård **8**:96, 1933.

Rapa: 1 km. northwest of Narioa Point, alt. 3 m., grassy slope, low shrub 0.4 m. high, July 8, 1934, *St. John and Maireau 15445*

[1] Mangarevan Expedition Publication 21.

[2] Numbers in parentheses refer to Literature Cited, p. 43.

(in fruit); Tuko, open, damp, boglike slope, alt. 40 m., low bush 0.5 m. high, flower greenish white, fruit dark red to purple, quite edible, good flavor, July 9, 1934, *Fosberg 11478*; Tubuai Bay, grassy hillsides, alt. 75 m., bush 0.3 m. high, flower white, fruit glaucous, blue, July 19, 1934, *St. John and Maireau 15457*; Mount Taga above watering place, boggy, turfy slope, alt. 75-200 m., shrub almost prostrate, flower light green, corolla 7 mm. wide at widest point, 4 mm. at narrowest point, 10 mm. long, fruit spherical, maroon, mostly immature, July 4, 1934, *Fosberg 11392*; Kaimaru, south ridge of Mount Perahu, alt. 500 m., thicket on steep ridge, decumbent shrub, height 0.2 m., July 13, 1934, *St. John and Maireau 15514* (sterile); hillside, July 1, 1934, *D. Anderson* (with fruit).

A low, compact, often decumbent shrub, the young branches minutely pubescent, otherwise glabrous, densely foliose. Leaves short petiolate (1-2 mm.), coriaceous, ovate-elliptic-obovate to suborbicular and broadly truncate, 20-40 mm. long, 14-34 mm. wide, with incrassate and more or less distinctly serrate edge, glabrous except along midrib, with a net of incrassate veins on both faces, discolorous, grayish green above, brownish green below when dry. Flowers solitary and axillary on a naked peduncle of 5-10 mm., subglabrous; calyx glaucescent, lobes narrow triangular, obtusate, (3-)4-6 mm. long and (1.5-)2-2.5 mm. wide; corolla urceolate, greenish white, 8-10 mm. long, 4-5 mm. wide, tips 2-3 mm. long and 1.5-2 mm. wide, their inside densely pubescent; stamens 4-5 mm. long with filament 2.5-3 mm. and anther 2.5-3.5 mm., bristles 1.2 mm.; style 6 mm. long. Berry globose, about 7 mm. in diameter; seeds ferrugineous, with reticulate testa, 1-1.2 mm. long.

The leaves vary as to shape and serrature; in no. 11478 some leaves are almost entire; in no. 15514 all are sharply serrate. In no. 11392, many hexamerous flowers are observed.

V. rapae shows the same mode of development of the vegetative-floral shoots as the Hawaiian Macropelmas; the innovation begins with a few reduced leaves, more or less like bud-scales, followed by normal, but comparatively small leaves. Both scales and leaves may support flowers.

Genus SANTALUM Linnaeus

Santalum insulare Bertero.

Typical *S. insulare* is known from Tahiti and Raiatea (9). The Marquesan sandalwood, formerly referred to the same species, was distinguished by me as *S. marchionense* (7, p. 142). I found that the leaves were almost alike in both, perhaps on an average more ovate to ovate-lanceolate in the latter, and more truly oval or elliptic to

elliptic-lanceolate in the former [Brown's key (2, p. 61) simplifies matters a little too much according to my view], and that the receptacle was deeper in *S. insulare* with a longer free beak of the ovary and a longer style. The discovery of closely related forms in Raivavae and Rapa, which according to Brown (2) are intermediate between the two, made me reexamine *S. marchionense*. In a fully expanded flower, the style (including free portion of ovary) attains a length of 1.8-2 mm. (1.25-1.8 according to Brown), and the stamens, which as a rule are larger in *S. insulare* (1.5 mm., anther 1.2 mm.), may occasionally reach the same length in *S. marchionense*, and, though as a rule the anthers are smaller in *S. marchionense* (not over 1 mm.), a size of 1.1 mm. has been measured. It therefore seems impossible to retain *S. marchionense* as a species, and henceforth I shall call it *S. insulare* var. *marchionense*.

Santalum insulare var. **raivavense** F. B. H. Brown, B. P. Bishop Mus., Bull. **130**: 62, 1935; (fig. 1, *a-f*).

Austral Islands: Raivavae, Vaiannaua Peninsula, west side, alt. 60 m., brush at top of forest, small tree 4 m. high, diam. 10 cm., Aug. 6, 1934, *Fosberg 11683* (small buds only); same locality and date, tree 5 m. high, flower greenish turning reddish, strong sweet odor, *Fosberg 11687*; east side, steep brushy slope, top of forest, alt. 30 m., erect shrub 2 m. high, flower white, turning red, very sweet odor, leaves pale green, Aug. 6, 1934, *Fosberg 11686* (buds and mature flowers); north slope of Mount Hiro, thicket on ridge, alt. 50 m., small tree 5 m. high, Aug. 10, 1934, *St. John 16077* (buds); Motu Tehau, coral gravel, alt. 1 m., tree 4 m. high, Aug. 11, 1934, *St. John and Wight 16139* (young buds only); Hotuatua Islet, dry, rocky hillside, alt. 2 m., shrub 2 m. high, leaves pale green beneath, Aug. 11, 1934, *St. John and Wight 16114* (sterile).

The type is Stokes 100 from Raivavae, Taniora, at 900 meters altitude (2). It is said to differ from *S. insulare* of Tahiti "in the more numerous veins of the leaves, shorter pedicels, shorter stamens, and shorter style." A description based on the very ample material now at hand follows:

Leaves coriaceous; petiole 6-17 mm. long, generally 8-13 mm.; blade ovate to ovate-elliptic to ovate-lanceolate or broad elliptic to oval, 5.5-10 cm. long, 3-6 cm. wide, pointed (not very sharply as a rule) to obtuse with about 6-10 (rarely more) lateral veins on either side. Inflorescence small, 4-6 cm. long, few-flowered. Flowers 5 mm. long, including the very short (less than 1 mm.) pedicel; tube 2 mm. or slightly longer; perianth lobes 2.4-2.5 mm. long and

1.9-2 mm. wide; disc lobes 0.7-1 × 0 8-1.1 mm., orbicular-quadrate; stamens 1.3-1.4 mm. with anther of 0.9-1.1 × 0.9-1.1 mm.; style including free portion of ovary 1.7-2 mm., solid style with stigma 0.8-1 mm.; stigmas nearly always 3, rarely 4.

The Raivavae sandalwood is closer to var. *marchionense* than to typical *S. insulare*. The leaf shape covers the whole range found in the forms of Tahiti and the Marquesas; the number of veins is no greater than in these: commonly 7-8 in nos. 11683, 11686, 11687, and 16139; perhaps oftener 8 or 9 in no. 16077 where the leaves are somewhat larger; and as many as 10 or 12 in no. 16114 in which the leaves are largest (sterile shoots) (fig. 1, *a-d*). There are quite as many lateral veins in *S. insulare* from Raiatea. The stamens agree closely with those in var. *marchionense*, and the style is almost the same length. The only characters which distinguish var. *raivavense* from var. *marchionense* are the subsessile flowers and the commonly trimerous gynoecium.

Santalum insulare var. **Margaretae,** new combination (F. B. H. Brown, B. P. Bishop Mus., Bull. **130**: 62, fig. 12, *a-k*, 1935); (fig. 1, *g-k*).

Rapa: about six trees on open slopes in saddle west of Mount Tanga, alt. 250 m. Tree 5 m. high, diam. 10 cm.; flower: sepals without green, within at first greenish white, later deep rose-magenta, disc lobes fleshy, yellowish, stamens brown, fimbriate scales white, flowers with strong, sweet perfume, July 23, 1934, *St. John and Anderson 15692*.

This was described (2, p. 62) as *S. Margaretae* and said to be very close to *S. marchionense* and *S. insulare*, the length of the style and depth of the receptacle being intermediate between the two, whereas the leaves agree with those of *S. insulare* in shape but are smaller and relatively narrow. The type is Stokes 392 (2, p. 63, fig. 12). The following description is based on the numerous specimens now at hand:

Leaves soft coriaceous; petiole short (5-)7(-9) mm.; blade elliptic to oblong, obtuse, 6-8 cm. long, 2.5-3.5 cm. wide, with about 7 lateral veins on either side of midrib. Panicle 3-6 cm. long, few-flowered. Flowers 5 or occasionally as much as 6 mm. long, nearly sessile; tube 2-2.5 mm., tepals 2.5 (-3) mm. long and 1.8-2 mm. wide; disc lobes rotundate-quadrangular, 0.8-0.9 × 1 mm.; stamens 1.3-1.5 mm. long, anther 1-1.1 × 1 mm.; style including free portion of ovary 1.8-2 mm., solid style with stigma about 1.2 mm.; stigmas as a rule 3, rarely 4. Drupe 12 × 10 mm. according to Brown (2).

Brown indicates 2.3-2.4 mm. as length of style, as in *S. insulare typicum,* but of the several flowers I have examined none had a style longer than 2 mm., some only 1.8-1.9 mm. So that 2.4 would seem exceptional. In flower structure, *S. Margaretae* agrees closely with var. *marchionense,* but differs from it as well as from *S. insulare typicum* in its subsessile flowers, short petioles, and narrower blades; but it must not be forgotten that all the material belongs to a single collection and the type very likely came from the same group of trees.

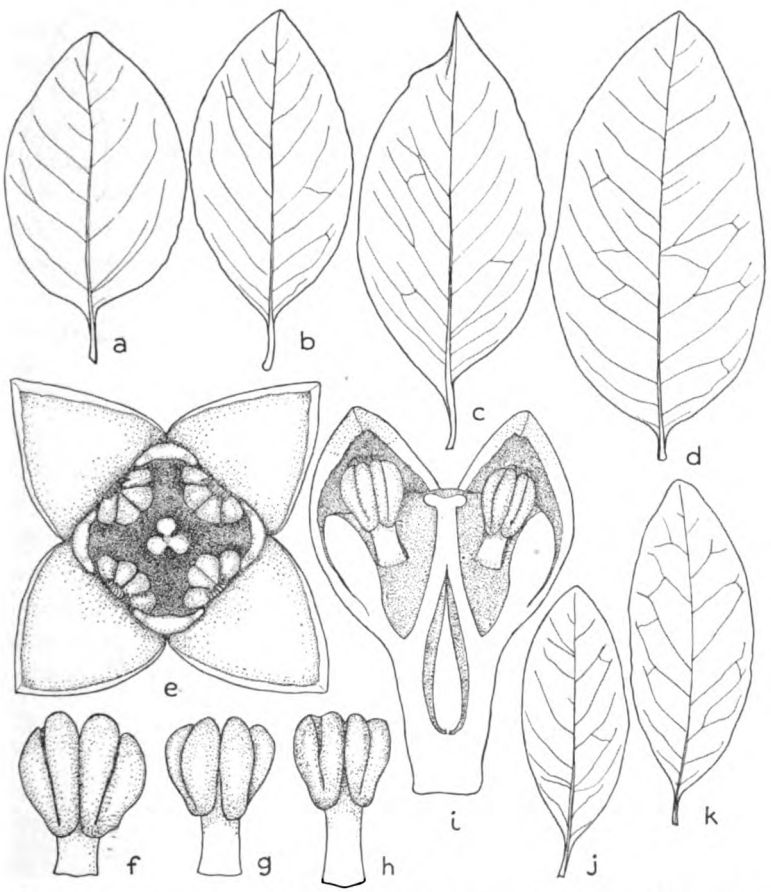

FIGURE 1.—*Santalum insulare* (*a-f*, var. *raivavense*, *g-k*, var. *Margaretae*): *a-d*, leaves, ½ nat. size: *a*, no. 11683; *b*, no. 11686; *c*, no. 16139; *d*, no. 16114; *e*, flower, no. 11686, × 10; *f-h*, stamens, × 15: *f*, no. 16077; *i*, flower in section, × 10; *j-k*, leaves, ½ nat. size (*g-k*, no. 15692).

As leaf width rarely surpasses 3 cm., *S. Margaretae* is a well marked form, but as I am unable to discover any characters of specific value in the flower structure, I find it necessary to reduce it to a variety of *S. insulare* in the wider sense used here.

Santalum hendersonense F. B. H. Brown, B. P. Bishop Mus., Bull. **130**: 66, fig. 12, *l-s*, 1935; (figs. 2-3).

Henderson Island, north end, thicket top of coral cliff, alt. 25 m., erect, 1 m. high, flowers green, stamens brown, odor heavy, sweet,

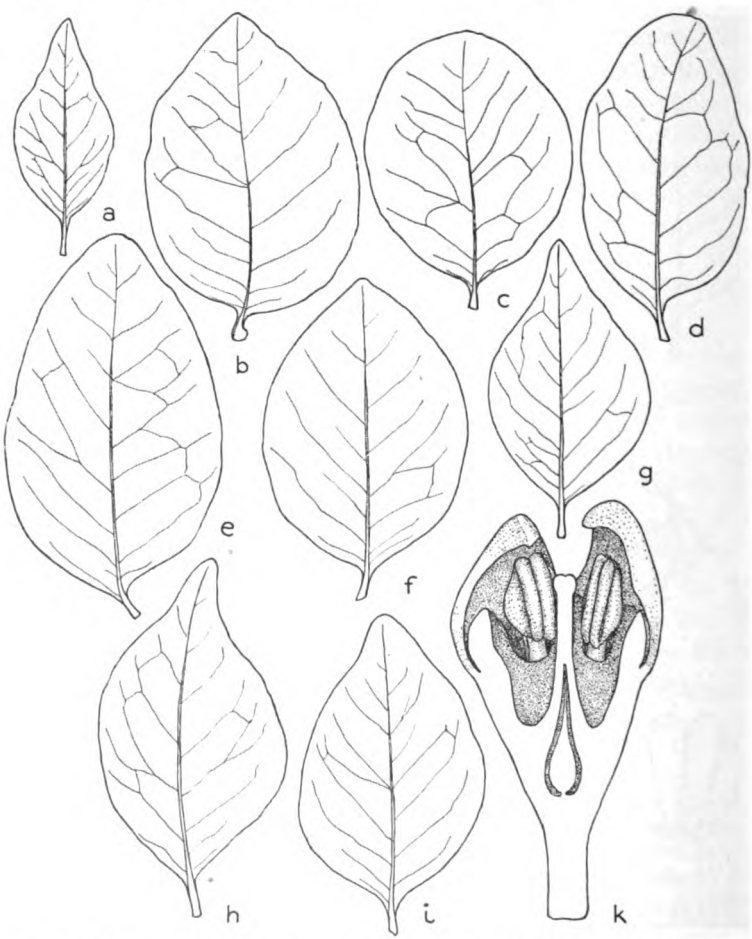

FIGURE 2.—*Santalum hendersonense* (*a-e*, no. 15110; *f-k*, no. 15144): *a-e*, leaves, ½ nat. size; *f-i*, leaves, ½ nat. size; *k*, flower in section, × 10.

June 17, 1934, *St. John and Fosberg 15078*; jungle on elevated dissected coral, alt. 30 m., tree 4 m. high, diam. 15 cm., flower petals orange-brown, stamens dark brown, heavy, too sweet odor, bark brown, sapwood white, heartwood brown, June 17, 1934, *St. John and Fosberg 15110*; same locality and date, alt. 33 m., tree 3 m. high, diam. 7 cm., flower light green, heavy sweet fragrance—unpleasant, *St. John and Fosberg 15079*; same locality and date, tree 8 m. high, diam. 20 cm., flowers sweet, too heavy perfume, tube greenish, tepals orange-brown, scales white, anthers dark brown, leaves chartaceous, impressed rugose above, glaucous beneath, fruit green, *St. John and Fosberg 15144*.

According to Brown (2), this belongs to section Hawaiiensia[3] Skottsberg (6) whereas all the other sandalwoods of southeastern Polynesia belong to section Polynesica[4] Skottsberg (6); Brown figures a longitudinal section of a flower with an inferior ovary (2, fig. 12, *l*). As his description shows that, in all other respects, the new species comes very near broad-leaved forms of *S. insulare* (in a broad sense), the structure of the ovary was unexpected. The type is not indicated, but presumably it is a specimen collected by Mrs. Stokes.

The present material is quite ample and should cover the whole range of variation which is considerable as regards leaf shape, whereas the flowers are very much alike in all specimens. I was able to examine a good number representing all the lots, but I have been unable to discover a single flower with an inferior ovary; every one has a semi-superior ovary of precisely the same kind as that in *S. insulare* and others (figs. 2, *k*; 3, *d, e*). Consequently it would seem logical to reduce *S. hendersonense* also to a variety of *S. insulare*. My description below explains why this is not done.

A tree to 8 m. high; leaves with a petiole of (4-)5-7(-8) mm., blade suborbicular in no. 15110, oval or elliptic in no. 15078, and ovate or ovate-elliptic and often distinctly acuminate in no. 15114, in all more or less pronouncedly obtuse, 5-9 cm. long, 3.2-5.7 cm. wide. Figures 2, *a-i*, and 3, *a-c*, illustrate the various forms; it must be remembered that the shape differs greatly in leaves from the same branch. Panicles 4-6 cm. long, usually 3 together at the end of the branches (1 terminal, 2 axillary), in some plants additional ones from lower axils. Flowers distinctly pedicellate, 6-7.2 mm. long including pedicel; ovary semi-superior; tepals 2.5-3 × 1.9-2.2 mm.; disc lobes rounded-quad-

[3] Not "Hawaiiensis", as written by Brown.

[4] Not "Polynesia", as written by Brown.

rangular, about 1 mm. each way; stamens 1.4-1.5 mm., attaining 1.8 mm. in no. 15079; anthers 1-1.25 × 0.9-1 mm.; style including free tip of ovary 1.7-2.5 mm. (commonly 2), solid style with stigma 1.2-1.5 mm. Stigmas 3, very rarely 4. Drupe (only one seen) large, 23 mm. long and 17 mm. wide in a dry state, on a thickened pedicel of 7 mm.

I think it best to recognize *S. hendersonense* as a species by itself. The leaves show a tendency to become acuminate; they are as wide in relation to their length as those in *S. insulare* var. *marchionense*

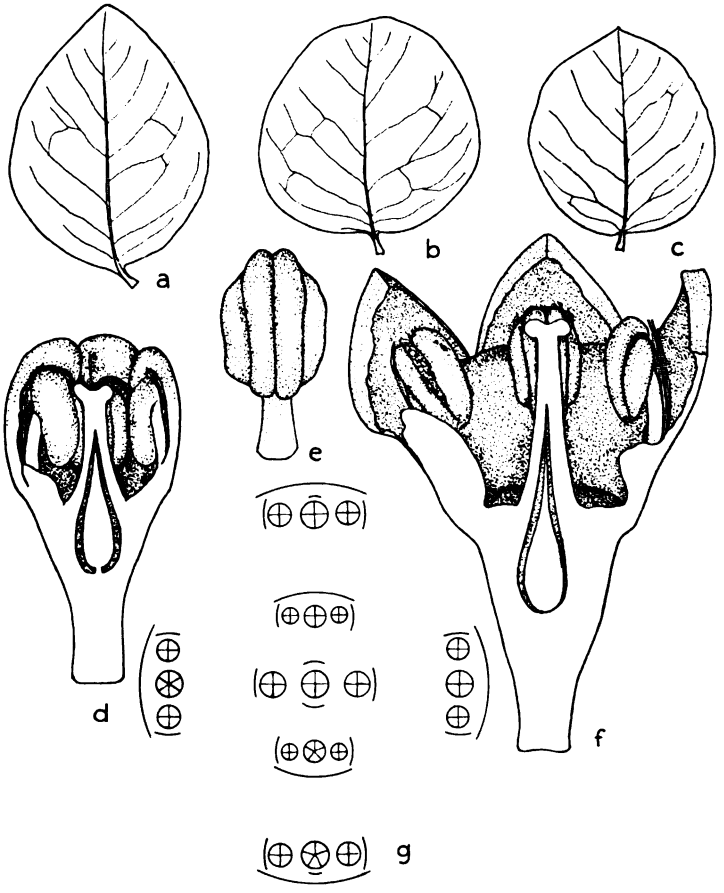

FIGURE 3.—*Santalum hendersonense* (*a-f*, no. 15079; *g*, no. 15110): *a-c*, leaves, ½ nat. size; *d*, bud, and *f*, open flower in section, × 10; *e*, stamen, × 15; *g*, diagram of top of panicle, showing, besides the tetramerous flowers, 2 pentamerous and 1 hexamerous.

and var. *raivavense,* but shorter petiolate. The flowers are more numerous, the number of branches to the panicle being greater. Pentamerous flowers are often observed. In no. 15079, they are quite common; of 12 flowers dropped from the branches, 5 were tetramerous in tepals and stamens, 2 of these also in the gynoeceum, the other 3 having 3 stigmas, 6 were pentamerous (1 had only 4 stamens, all had 3 stigmas) and 1 hexamerous (5 stamens, 3 stigmas). Pentamerous flowers occur in all the other specimens, but are more scarce (3 of 16 examined in no. 15110, 2 of 4 in no. 15018, and 1 of 10 in no. 15114). This tendency is interesting. Further, the great size of the drupe is remarkable. Unfortunately we know little about the fruit in this group, but *S. hendersonense* must, for the present, be regarded as a separate species, even though it is more similar to the rest than was assumed by Brown.

No. 15110 offered a good opportunity to study the morphology of the panicle. A diagram of a regular panicle top is shown in figure 3, *g*. The position of the perianth in relation to the bracts is the same in all specimens and equal in terminal and lateral flowers.

Genus **EXOCARPUS** Labillardière

Exocarpus psilotiformis Skottsberg, new species (figs. 4, 5).

Autexocarpus, Euexocarpus. Frutex (vel arbor?) erectus rigidus scoparius, subaphyllus, glaber, ad 3 m. altus. Rami erecti scopas densas formantes, vetustiores fusci, subteretes-trigoni, lineis elevatis pallidis notati, 3-4-5 mm. crassi, aphylli, juniores virides, complanato-trigoni, 1.5-2 mm. lati, conspicue vittati et sulcati, ultimi 0.5-1 mm. lati, primum foliosi; internodia plerumque 0.5-2 cm. longa, versus basin sensim angustata. Folia alterna, ad angulos innovationum sessilia, carnosula, lineari-filiformia, obtusiuscula, 2.5-3.5 mm. longa et 0.5 mm. lata, caducissima, basi conica minuta dentiformi persistente. Flores in spicas axillares brevissimas, 2-3 mm. longas subsessiles pauciflоras dispositi, rhachide paulum immersi, monoici, pentameri. Bracteae cucullato-triangulares, minutae, acutae. Flos ♂ expansus circ. 2 mm. diam. Tepala triangularia, 0.8 mm. longa et 0.6 mm. lata, receptaculo patelliformi subplano; stamina erecta, 0.5-0.6 mm. longa, anthera latior quam longa, 0.25-0.3 × 0.4-0.45 mm., filamento latiusculo; discus obtuse pentagono-lobatus, 0.7-0.8 mm. diam.; pistillodium minutum conicum. Flos ♀ expansus usque 3 mm. diam., receptaculo depresse conico, dein elongato; tepala ut in ♂ sed paulo majora, 1 × 0.7 mm.; staminodia 0.4 mm. longa, anthera 0.2 × 0.25 mm., in discum 0.8-1 mm. latum incumbentia; pistillum conicum 0.7 mm. altum stigmate truncato subintegro sessili. In statu fructifero receptaculum valde incrassatum, carnosum, rubrum, tepalis coronatum, 8-8.5 mm. (vel ultra?) longum, apice sec. cl. Fosberg 8-9 mm., inferne 6 mm. crassum; drupa sicca, ovoidea, acutiuscula, 8 mm. longa et 4 mm. lata, quarta (tertia?) parte receptaculo immersa. — Affinis *E. stricto*;

differt ramis paulo latioribus, receptaculo multum magis incrassato nec non drupa majore, magis elongata.

Hab. in ins. Rapa ubi legit *F. R. Fosberg n. 11561*. Typus in herb. Honol.

A broomlike, rigid, glabrous shrub, "strictly erect, height 3 m.," extremely like *Psilotum nudum* if we do not consider the difference in size. *Psilotum* is occasionally found in herbaria under *Exocarpus*. Lower parts of oldest branches

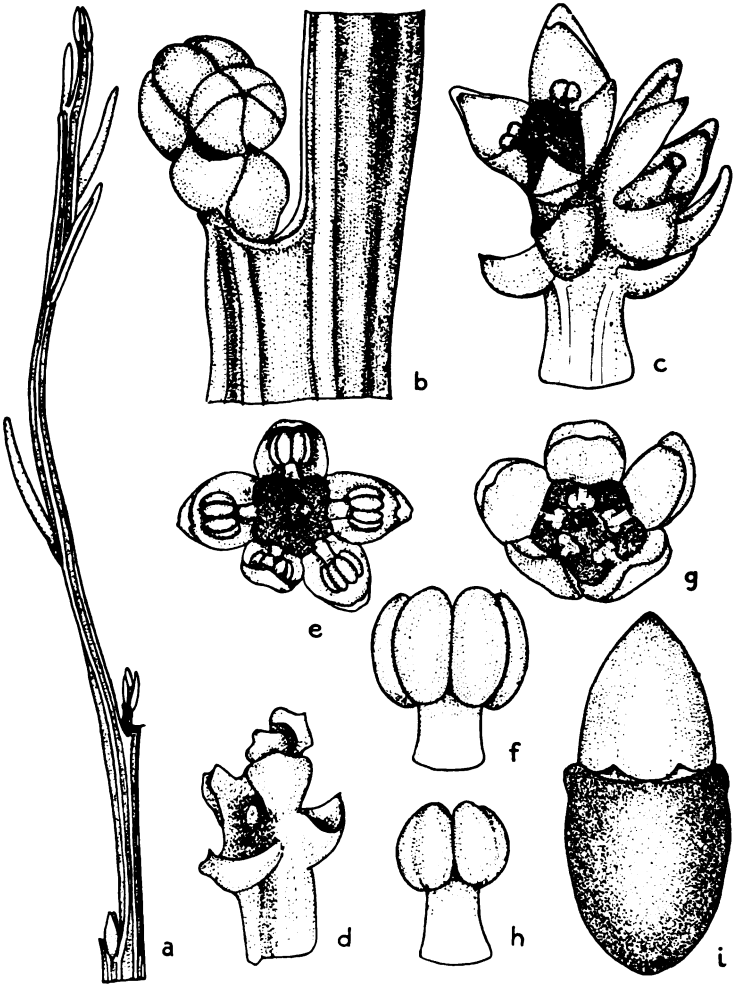

FIGURE 4.—*Exocarpus psilotiformis: a*, top of branch showing leaves, × 5; *b*, node with spike (male flowers in bud), × 15; *c*, spike with 2 female flowers, × 15; *d*, rhachis of same, showing cup with scar left of flower, × 15; *e*, male flower, × 15, and *f*, stamen, × 50; *g*, female flower, × 15, and *h*, staminode, × 50; *i*, drupe with receptacle, × 3.

seen subterete, brown with elevated lines of a lighter color; largest diameter observed, 5 mm.; the following branches presumably brownish green, cylindric-trigonous, the angles marked by a narrow ridge, the sides conspicuously vittate-sulcate; younger branches green, complanate-trigonous, marked with the same prominent lines with furrows between; internodes as a rule from 5 to 20 mm. long, 1.5-2 mm. wide at top, less than 1 mm. at base; youngest, still leaf-bearing branches 0.5-1 mm. wide. The branching is sympodial; when a branch stops growing it is overtaken by a side branch below the tip. Branches issue at a very acute angle, so that the whole system forms a dense, narrow broom. Leaves alternate, linear-filiform, ± obtuse, slightly fleshy, 2.5-3.5 mm. long, and 0.5 mm. wide; they are found only in the top region, being exceedingly caducous, but the hardened base persists as a small, conical knob. Flowers in subsessile, 2-3 mm. long, few (3-4)-flowered spikes, monoecious, pentamerous, supported by a minute, cucullate, toothlike bract but without bracteoles. Male flower about 2 mm. across when expanded, with flat, little developed receptacle; tepals triangular, 0.8 mm. long and 0.6 mm. broad at base, stamens erect, 0.5-0.6 mm. long with short and broad filament, the four-celled anther 0.25 + mm. long and 0.4 + mm. wide; pollen grains ellipsoid, smooth, 18-21 × 12-15 μ; disc flat, slightly 5-lobate; pistillode minute, conical. Female flower slightly larger, almost 3 mm. across, with a more developed receptacle; tepals 1 mm. long and 0.7 mm. wide; staminodes conspicuous, bent over the disc, 0.4 mm. long with a sterile anther of 0.2 × 0.25 mm.; ovary sunk with its base in the receptacle, its free part with the sessile, truncate stigma 0.7 mm. long. As in several other species the receptacle becomes much enlarged, swollen and quite showy in fruit ("fruit fleshy, receptacle red, fruit green, receptacle 8 to 9 mm. wide at top, 6 mm. wide at base, fruit sunken 1/3 of length"); it attains a length of at least 8 mm. (the original size is not quite regained even after prolonged immersion in boiling water). Drupe surrounded at base by the receptacle and by the persistent tepals, ovoid, pointed, about 8 mm. long and 4 mm. across, with a thin, leathery exocarp.

Rapa, Kaukauamoo, very steep side of top of ridge, alt. 350 m., fl.-fr., July 18, 1934, *Fosberg 11561.*

There are very few spikes left, so that little material was available for a detailed study. Of the two spikes examined, one had 2 flowers left, both ♀ ; 2 had been lost. At the top were 3 sterile bracts. The other spike bore 2 flowers, both ♂, a third had fallen off. It is possible, but not at all certain, that the spikes are unisexual. To judge from the material at hand, only one fruit is developed in a spike. The same is apparently true in *E. strictus.*

The new species belongs to subgenus *Autexocarpus* Pilger (4, p. 121; 5, p. 69), sect. *Euexocarpus* A. DC., and to a group with sessile, few-flowered spikes comprising a number of Australian and Tasmanian species; *E. Bidwillii* Hook. f. from New Zealand also belongs here. The Hawaiian species belong to the same section, but form their own little group, characterized by its heterophylly. *E. psilotiformis* is nearly related to *E. strictus* R. Br. of Australia and Tas-

FIGURE 5.—*Exocarpus psilotiformis*, type specimen, × 1/3.

mania, but differs from this in its coarser and more rigid habit, its slightly wider joints, the much more incrassate receptacle and the larger, more pointed drupe. In the specimens of *E. strictus* examined by me (from Tasmania), the flattened joints rarely exceed 1 mm. in width, the receptacle is cylindric-obconical, 3.5 ± mm. long, only 2 ± mm. wide at top, the drupe nearly globular, 3.5 ± mm. long and 3 ± mm. wide.

According to Pilger (5, p. 75), *Omphacomeria psilotoides* A. DC. (3, p. 681) is identical with *Exocarpus strictus*. It seems appropriate to commemorate the psilotoid habit of certain of the Exocarpi; hence the name *psilotiformis*, given to the new species, which of all species is most like the fern genus *Psilotum*. They offer an interesting example of morphological convergence.

From a geographical point of view, the discovery of *E. psilotiformis* is of considerable interest as it fills out the gap between Tasmania and the Hawaiian islands.

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