

East Polynesian Species of *Freycinetia* Gaudichaud (Pandanaceae)¹

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Abstract—Three species of *Freycinetia* (*F. arborea*, *F. impavida*, and *F. baueriana*) are found in Eastern Polynesia, defined as the Hawaiian, Marquesan, Society, Cook, Austral, and Tubuai Archipelagoes, and New Zealand. These have been known under various names, which are cited in synonymy. The species *F. baueriana* exists as two subspecies, one in Norfolk Island, one in New Zealand. Key to species, full literature citations, typification, and nomenclature are presented.

Introduction

Plants of the genus *Freycinetia* Gaudichaud, woody lianas of the family Pandanaceae, are frequent in the high islands of Polynesia. They are known to occur in the Society Islands, the Marquesas, the Hawaiian Islands, the Cook Islands, and in New Zealand. For the purposes of this account, Eastern Polynesia is rather arbitrarily defined to include the above-mentioned localities, while the Samoan Islands, the Tonga Group, and the islands in the Phoenix, Tokelau, Tuvalu, Horn, Kermadec, and Kiribati groups are excluded. *Freycinetia* typically occurs on the high, basaltic islands, and not on low coral atolls; but it may occur on old uplifted and weathered limestone. The region considered here is determined by the distribution and biogeographic relationships of the species of *Freycinetia* to be considered, which alone or together may be found in the localities herein referred to as "Eastern Polynesia."

Materials studied in this work are cited, and have come from, the herbaria whose codes, as stipulated in the Index Herbariorum, are mentioned below. In particular, I wish to thank the curators of the following herbaria: Bishop Museum (Honolulu); Martelli Herbarium, Firenze (Florence); Kew; British Museum; Rijksherbarium (Leiden); Missouri Botanical Garden; New York Botanical Gardens; U.S. National Museum (Smithsonian Inst., Washington, D.C.); University of California (Berkeley); Botanic Gardens, Singapore; Museum d'Histoire Naturelle (Paris); Berlin-Dahlem; Komarov Botanical Institute, Leningrad; ORSTOM-Noumeá (New Caledonia); Lae (Papua New Guinea); Brisbane; Royal Botanic Gardens (Sydney); and Geneva. In addition, thanks are owed to the D.S.I.R. New Zealand, to Miss E. Dickson, to O. Degener, to P. S. Green, to H. St. John, to A. C. Smith, to M. J. Raynal, H. S. McKee,

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A. Lourteig of the Paris Herbarium, to R. Ornduff, and to M. Jacobs.

***Freycinetia* in East Polynesia**

It has been known for a long time that the genus occurs in Polynesia. The type species of the genus is *F. arborea*, described by Gaudichaud from his own collections made in Hawaii on the voyage of the French Exploring Expedition vessels L'URANIE and LA PHYSICIENNE in the early nineteenth century. Curiously, Gaudichaud renamed and redescribed the same species on the basis of collections he made during a second visit to Hawaii in the vessel LA BONITE. The genus was named by Gaudichaud in honour of the Captain of the first-mentioned expedition, Louis de Freycinet.

Gaudichaud also is responsible for the name and first description of another species herein considered, *F. impavida*. He proposed this epithet in conjunction with a new generic name, *Victoriperrea*, evidently supposing it distinct from *Freycinetia*; but no later botanist has employed this name and it certainly refers to a plant which easily accords with the diagnosis of the genus *Freycinetia*. The species *F. impavida* however was even earlier referred to in manuscripts of Banks and Solander, though only published, and then very briefly, much later by Robert Brown and J. Bennett in Bennett and Brown (1838) as *Freycinetia demissa*, but in a manner not constituting valid publication.

Over the years it has become clear that in Hawaii there is but a single species of *Freycinetia*. Hillebrand (1888) took up the name *F. Arnotti* Gaudichaud, but this has been shown to be identical with *F. arborea* Gaudichaud (Stone, 1967). This species occurs on all the major islands.

In New Zealand it is also clear that only a single species occurs. Long known as *F. banksii* A. Cunn., it is now considered to be a subspecies of *F. baueriana* Endl., described from Norfolk Island.

In the two other main East Polynesian archipelagoes, the Society Islands and the Marquesas, two species occur. It is now evident that these are *F. arborea* and *F. impavida*, but as scrutiny of the synonymy which follows will show, several other names have been applied to both.

In Rapa and Rarotonga, apparently only one species occurs, and this corresponds to *F. arborea*.

The presence of *F. arborea* in Tahiti has long been suspected, but as late as 1968 there was no available unambiguous proof; when *F. impavida* was discussed (Stone, 1968) the presence of a second species in Tahiti was only conjectural. Since then, however, there have been made new collections and more intensive study of some older ones which show without any doubt that *F. arborea* is indigenous in Tahiti.

Extra-Polynesian distribution of *F. arborea*

After prolonged study, it may now be accepted that there are only two extra-

Polynesian localities of *F. arborea*: New Caledonia and the nearby New Hebrides. The New Caledonian population is fairly well known under the name *F. longispica* Martelli and recently I reported this from the New Hebridean island of Espiritu Santo (Stone, 1967). Though it is possible that *F. longispica* may on closer study form a subspecies, it is impossible on present evidence to exclude it from *F. arborea*.

Extra-Polynesian distribution of *F. impavida*

F. impavida occurs along an east-west axis and thus extends westward into Melanesia. It is known from the New Hebrides, from Fiji (where it has been called *F. parksii* Martelli) and from Bougainville in the westernmost Solomon Islands. It is closely related to *F. storckii* Seem. of Fiji, which under the synonymous name *F. samoensis*, has also been reported from Samoa and Tonga.

KEY TO SPECIES

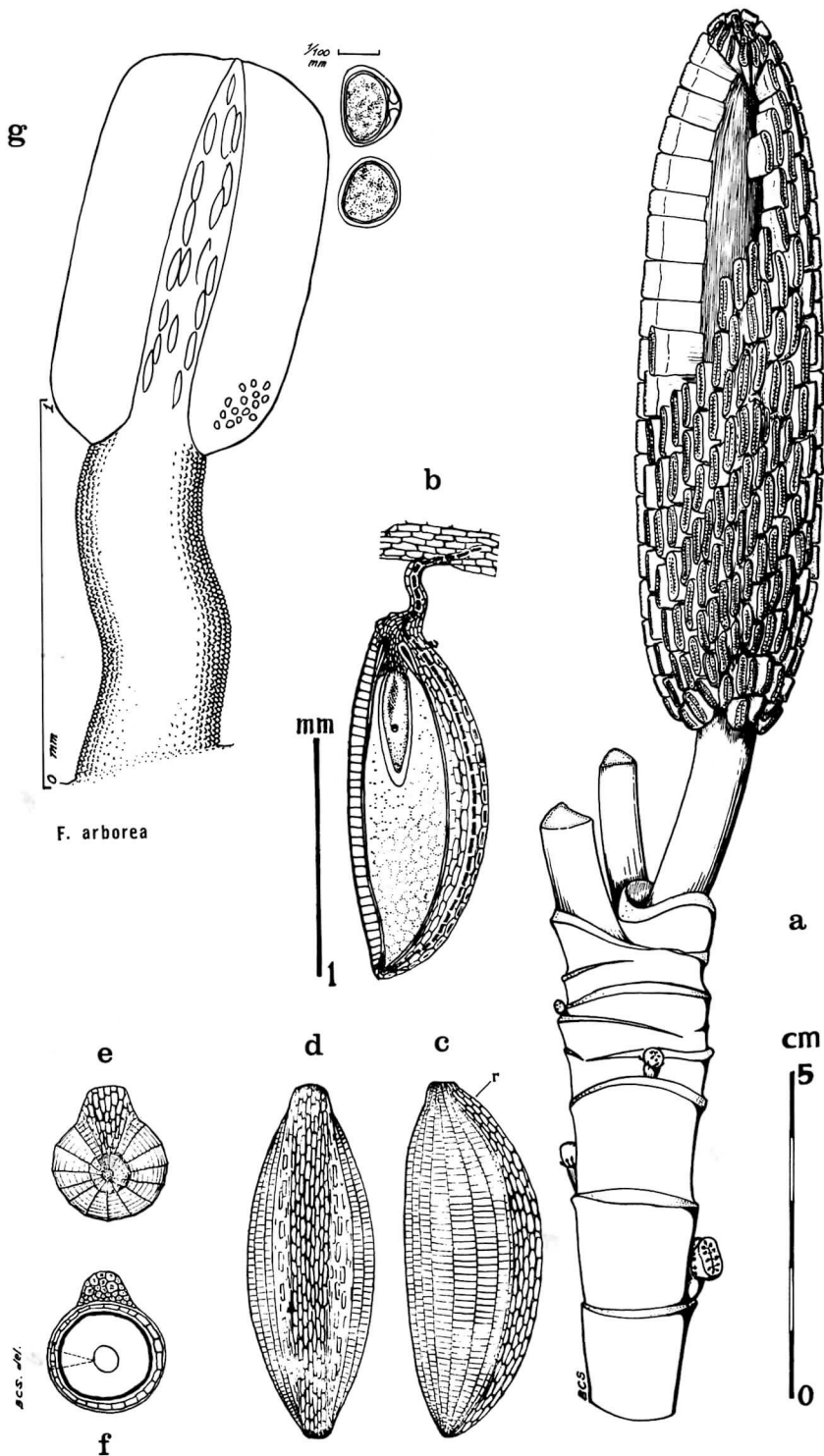
1. Berry elliptic to subterete in cross-section, stigmas in a ring or ellipse, usually 4-7; berry apex noticeably contracted; pistillate cephalia oblong-cylindric, but sometimes oblong-ellipsoid, up to 8 cm long or more and 3.5 to 4 cm wide; peduncles rather densely serrulate-hispidulous along the distal part, especially on the angles; leaf apex attenuate-acuminate, usually noticeably acuminate.
 *F. impavida* (3)
- 1'. Berry strongly bilaterally compressed, the stigmas appearing as if in 2 rows, usually 6-10 or more; berry apex with subparallel sides; pistillate cephalia oblong-cylindric, up to 15 cm long and 4.5 cm thick; their peduncles smooth or at most minutely scabridulous only on the distal angles; leaf apex gradually attenuate. 2
 2. Berries with about 6-12, usually 6-8, stigmas; flowering spathes salmon-orange or pinkish *F. arborea* (1)
 - 2'. Berries with 6-24, usually about 12, stigmas; often with staminodia at the base; flowering spathes white to purplish, or pinkish-salmon. 3
3. Spathes pinkish-salmon. *F. baueriana* ssp. *baueriana* (2a)
- 3'. Spathes white or purplish. *F. baueriana* ssp. *banksii* (2b)

Section *Freycinetia*

sensu Stone, 1967: 132; 1968b: 368

(1) *Freycinetia arborea* Gaudichaud

Freycinetia arborea Gaudichaud, 1824: 510; 1826: t. 41. Solms, 1878: 100. Mann, 1866: 469. Warburg, 1900: 41. Degener, 1930: 49. Stone, 1967: 130. TYPE: GAUDICHAUD (P! holo) from Hawaii.



F. arborea

F. baueriana subsp. *banksii*

Fig. 1.

F. Arnotti Gaudichaud, 1843: tt. 36, 37. Solms, 1878: 95. Hillebrand, 1888: 453. TYPE: GAUDICHAUD (P! holo) from Hawaii.

F. scandens sensu Hooker and Arnott, 1841: 37, *non* Gaudichaud.

F. rapensis F. B. H. Brown, 1931: 29. TYPE: QUAYLE *s. n.* (BISH! holo), from Rapa.

F. hivaoensis Martelli, 1932: 225. TYPE: DELMAS *s. n.* (FI! holo), from Hivaoa, Marquesas Islands.

F. wilderi Martelli, 1933: 171. TYPE: WILDER 11 (UC! holo) from Rarotonga.

F. monticola F. B. H. Brown, 1931: 29 (*non* Rendle). TYPE: BROWN 870 (BISH! holo) from Hivaoa, Marquesas Islands.

F. kiekie Stone, 1967: 131 (new name for *F. monticola* Brown *non* Rendle; based on same type).

F. longispica Martelli, 1910: 181, *syn. nov.* TYPE: VIEILLARD *s. n.* (P! formerly Caen), from New Caledonia.

Woody climber, with stems to about 2.5 cm diam. **Leaves** coriaceous, linear-lanceolate gradually attenuate, mostly 40–80 cm long, 1–3 cm broad, margins just above auricles minutely serrulate with teeth 0.2–0.6 mm long, or unarmed; middle part of leaf margin unarmed; distal part and apex again minutely serrulate but the teeth obsolete, nublike, often lacking; costa dorsally unarmed at base, near apex with minute prickles 0.25–0.4 mm long, 1–4 mm apart. **Auricles** narrow, tapered, entire, pale green, up to 11 cm long but mostly shorter. **Inflorescences** terminal; outer bracts with green leaflike apex, but at base salmon-orange colored, somewhat broadened; intermediate bracts deep salmon-pink tinged orange, fleshy, ovate-navicular, at apex the margins and dorsal costa minutely spinulose; inner bracts pink. **Pistillate cephalia** 3 rarely 4, on smooth stout peduncles about 3–4 cm long, 8 mm thick; heads cylindrical-oblong, up to 7.5–9.5 (–15) cm long, 1–2.6 (–3.2) cm wide, composed of very many crowded berries, ripening red. Berry compressed, oblong-truncate, up to 10 mm long, the subglossy slightly rigid pileus 2–4 mm long, faintly angular. Stigmas (4–) 5–10 (–12+), usually apparently in 2 rows because of compression of the berry, black, dotlike or minutely round-reniform, sometimes confluent. **Seeds** semilunar, narrow, to 1.5 mm long, 0.5 mm wide, the whitish conspicuous raphe about as wide as seed proper and dotted with scattered shining silvery raphidophorous cells. **Staminate spikes** yellowish-white, 3 or 4 together, on more slender smooth peduncles, up to

Fig. 1. Characteristics of *Freycinetia* Sect. *Freycinetia*, based on selected features of *F. arborea* and *F. baueriana*. a. Portion of fruiting spadix of *F. baueriana* ssp. *banksii* to show the diagnostic flattened polystigmatic berries. Note also the occurrence (a rarity) of the axillary reproductive structures, being highly reduced spikes of one or two berries. The bracts are not shown, but the scars show their former position. b–f. Seed structure (from *F. baueriana* ssp. *banksii*). b. Seed in longitudinal section. c. Seed in profile; 'r' indicates raphidophorous cells. d. Seed in frontal view. e. Seed in top view. f. Seed in transverse section. g. Magnified distal portion of a normal stamen; note the shining raphidophorous cells of the connective and the pustuliform epidermal cells of the filament. Pollen grains shown within the anther to scale, and much enlarged (inset). From *F. arborea*.

10 cm long (the peduncles half as long or less); consisting of numerous closely crowded stamens, the filaments pale orange, up to 15 mm long, threadlike, anthers oblong blunt, 0.7–0.8 mm long. A few (2–4) staminodia often present around base of berry in pistillate spike; pistillodia in staminate spike microscopic.

HAWAII: See specimens cited in Stone 1967: 130–131.

MARQUESAS ISLANDS: Hivaoa; Feani, Dec. 1921, F. BROWN 870 (BISH! type of *F. monticola* Brown and *F. kiekie* Stone). Hivaoa, Jan. 1932, S. DELMAS in 1932 (FI! type of *F. hivaoensis*). Hivaoa, Jan. 1932, MATHIAS YANN (FI!). Hanamenu trail from Atuona, 1140 m., SCHAEFER & OLIVER 5202 (US!). Atuona to Puamau below Mt. Ootua, 10/74–1/75, SACHET & DECKER 1917, 1917-BIS; SACHET, OLIVER & SCHAEFER 2128 (US!).

SOCIETY ISLANDS: Tahiti; Mt. Marau, 1450 m, July 1973, RAYNAL 18121 (P!). Mt. Orohena, between Pito-iti and Pihaiateta, 1850 m, July 1973, RAYNAL 18088 (P!).—Bora Bora; Tevaitapu, Tarapaia, 2015 ft. alt., Jan. 1931, GRANT 4987 (BISH! FI!).

COOK ISLANDS: Rarotonga; WILDER 11 (BISH; UC! type of *F. wilderi*).

TUBUAI ARCHIPELAGO: Rapa Island, QUAYLE *s.n.* (BISH! type of *F. rapensis*). STOKES 44 (BISH!). CHAPIN 894, 895 (BISH! NY!). ST. JOHN & FOSBERG 15296 (BISH!).

Extra-Polynesian specimens:

NEW CALEDONIA: VIEILLARD, ex Herb. Caen (P! lectotype of *F. longispica*); Mii, 1909, PERRET (FI!). Mt. Humboldt, 1400 m, VEILLON 2892 (NOU!). Boulinda Massif, 1150 m, JAFFRÉ 1092 (KLU! NOU!). Canala, BALANSA 2248 (P!) Conception, 550 m, 1870, BALANSA 2908 (P!). Col D'Amieu, 1961, MCKEE 8068 (P!). S.E. of Mt. Ignambi, 750 m, 1951, HÜRLIMANN 1862 (P!). Slope S. of Pic Buse, 500 m, 1941, VIROT 525 (P!).—Many others, in P!.

NEW HEBRIDES: Espiritu Santo Island; Mt. Tabwemasana, 1600–1800 m, 1971, MCKEE in RSNH 24169 (K! KLU!); VEILLON 2318 (KLU!), staminate.

(2) *Freycinetia baueriana* Endlicher

Freycinetia baueriana Endlicher, 1833: 25, t. 190, 193, 199. Solms, 1878: 94. Warburg, 1900: 40. Stone, 1973: 241. TYPE: F. BAUER *s.n.* (W. holo), from Norfolk Island.

(a) subsp. *baueriana*—Endemic to Norfolk Island.

(b) subsp. *banksii* (A. Cunn.) Stone, 1973: 242.

F. banksii A. Cunningham, 1836: 327. Moore and Edgar, 1970: 98.

TYPE: *A. Cunningham* (not located), from New Zealand.

F. inclinans R. Brown, ex Bennett and Brown, 1838: 32 (*nom. illegit.*)

This subspecies is restricted to New Zealand, where it occurs on both North and South Islands. For a full description, see Moore and Edgar (1970), where it is called *Freycinetia banksii*.

The two subspecies differ chiefly in the color of the bracts, white to lilac in subsp. *banksii*, pink or salmon in subsp. *baueriana*.

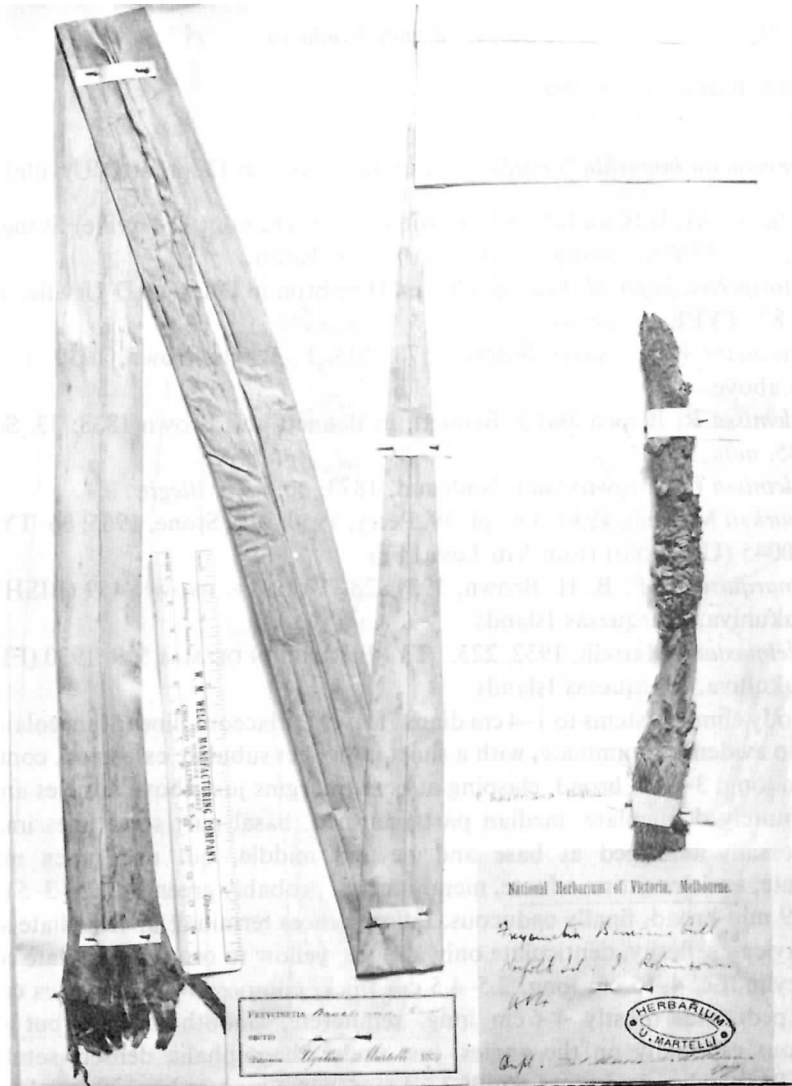


Fig. 2. A specimen of *Freycinetia baueriana* to show leaf shape in Sect. *Freycinetia*. Photo courtesy of Martelli Herbarium, University of Florence, Italy. (Norfolk Island: Coll. J. Robinson).

F. baueriana differs from *F. arborea* in its somewhat larger berries with, in most cases, a larger number of stigmas. It reaches the most southerly point of occurrence of any member of the family Pandanaceae, reaching nearly 46°S. (at Pigeon Island, Dusky Sound) in the South Island of New Zealand.

Section *Gaudichaudiella*

Stone, Blumea 1968: 369.

(3) *Freycinetia impavida* (Gaudichaud ex Hombron in Dumont D'Urville) Stone

Freycinetia impavida (Gaudichaud ex Hombron in Dumont D'Urville) Stone, 1968: 175. TYPE: HOMBRON (P! holo) from Tahiti.

Victoriperrea impavida Gaudichaud ex Hombron in Dumont D'Urville, 1852: t. 1, 1853: 83. TYPE: As above.

Freycinetia Victoriperrea Solms, 1878: 103. F. B. H. Brown, 1930: 1. TYPE: Same as above.

F. demissa R. Brown and J. Bennett, in Bennett and Brown 1838: 33. Setchell, 1926: 145. *nom. illegit.*

F. demissa (R. Brown) (*sic*), Nadeaud, 1873: 40. *nom. illegit.*

F. parksii Martelli, 1930: 330, pl. 39. Perry, 1950: 210. Stone, 1965: 86. TYPE: H. PARKS 20045 (UC! holo) from Viti Levu, Fiji.

F. marquisensis F. B. H. Brown, 1931: 28. TYPE: F. BROWN 459 (BISH! holo) from Nukuhiva, Marquesas Islands.

F. delmasiana Martelli, 1932: 223. TYPE: KIPIRI IN DELMAS 5. 9. 1930 (FI! holo) from Nukuhiva, Marquesas Islands.

Woody climber, stems to 1–4 cm diam.; leaves coriaceous, linear-lanceolate, apex slightly to evidently acuminate, with a short indistinct subulate extension, commonly 50–90 cm long, 3–5 cm broad, clasping at base, margins just above auricles and near apex minutely denticulate, median part unarmed, basal part sometimes unarmed; costa dorsally unarmed at base and beyond middle, but near apex minutely denticulate; **auricles** entire, adnate, membranous, probably greenish, (2–) 3–5 (–8) cm long, 3–9 mm broad, finally caducous. **Inflorescences** terminal; intermediate spathes ovate-navicular, fleshy, denticulate only at apex, yellow to orange. **Pistillate cephalia** usu. 3, cylindric, 4–15 cm long, 2.5–4.5 cm thick, composed of numerous crowded berries, peduncles mostly 4–6 cm long, semiterete, smooth at base but distally hispidulous especially on the angles, just under the cephalia densely setulose all around. Berry when immature about 3 × 1 mm, when mature lageniform, 18–28 × c. 3–4 mm, the pileus rigid 4–5 mm long, rostrate, tip narrowly pyramidal-truncate, the stigmatic areola roundish or often elliptic, stigmas mostly 4–10, arranged in a compressed ring, minute, black. **Seeds** about 0.8 mm long (or slightly more), ellipsoid, sublinear to slightly curving, raphe narrow, rather inconspicuous, strophiole none. **Staminate spikes** unknown.

The berries are easily distinguished from those of *F. arborea* or *F. baueriana* by their lageniform shape, the apex narrowed and produced like the neck of a bottle (exaggerated when dried), and the pileus often rounded and with a ring or ellipse of stigmas. The illustration by Brown of “*F. marquisensis*” (Brown, 1931, Fig. 5a, p. 28) is certainly wrong.

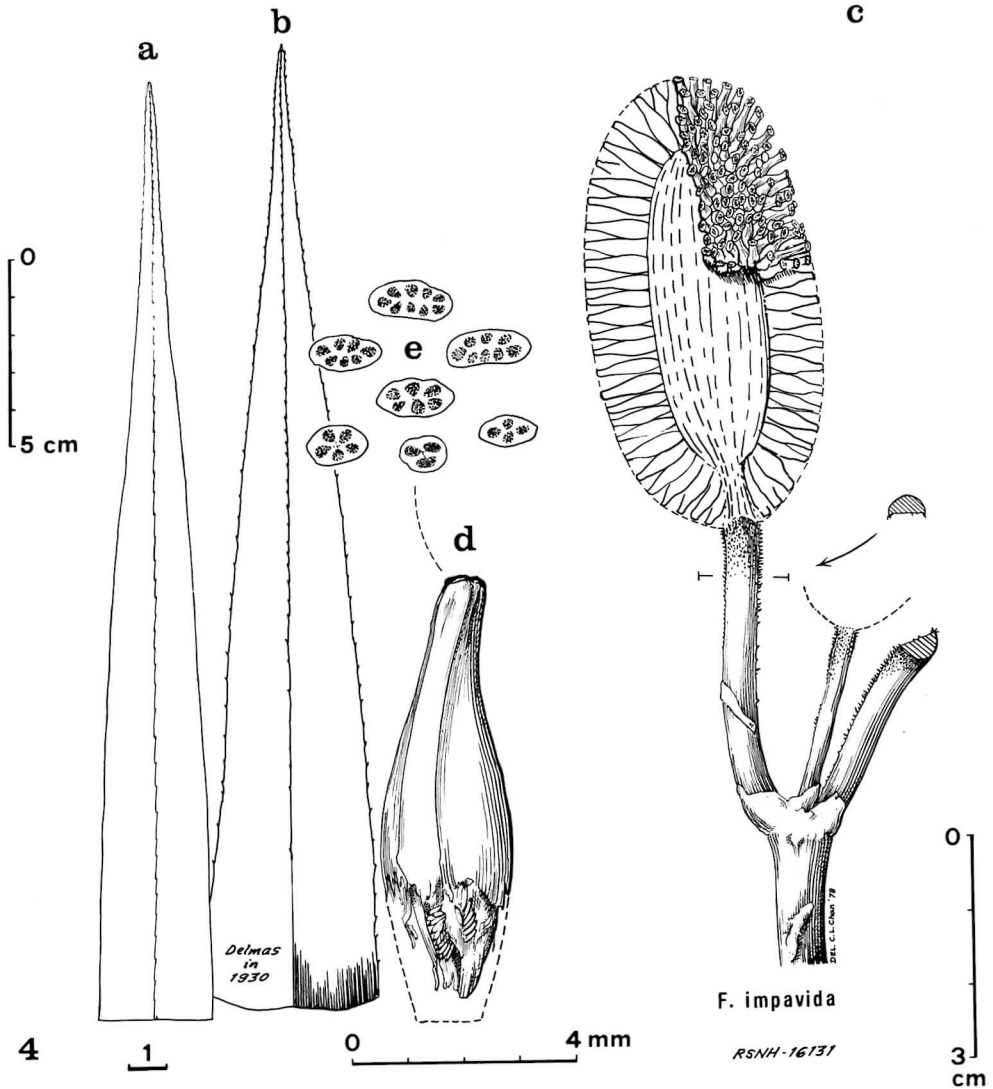


Fig. 3. Characteristics of *Freycinetia* Sect. *Gaudichaudiella*, based on selected features of *F. impavida*. a, b. Representative leaf tips. c. Portion of a fruiting spadix with one cephalium shown partly in plan, partly in longitudinal section; notice the scabridulous peduncles. d. A single berry in profile, much enlarged. e. Some berry apices in top view, to display variation in stigmatic number.

Fruit color according to MacDaniels is "lemon-yellow," but according to Raynal (no. 16551) is yellow-orange ("jaune orange").

MARQUESAS ISLANDS: Hivaoa; Below Mt. Ootua, Atuona-Puamao, 600 m., Nov. 1974, SACHET & DECKER 1918; Feani, 700–900 m., F.B.H. & E.D. W. BROWN

966 (BISH!). Ootua, 700–800 m., Dec. 1921, BROWN & BROWN 1062 (BISH!)—Nukuhiva; Tovii, 800 m., July 1921, BROWN 151a (BISH!) 459 (BISH!) type of *F. marquisensis*. Nukuhiva, Sept. 1922, QUAYLE 1273 (BISH!) Taiohae, 8 km du rivage, au pied de la mont. Ivinui, vers Hatiheu, 5. 9. 1930, s. DELMAS *s.n.* (FI! type of *F. delmasiana*). Uapou; Mt. Tekahiopu, Sept. 1922, QUAYLE 1135 (BISH!); same loc. & date, w. B. JONES in QUAYLE 1180 (BISH! FRUIT).

SOCIETY ISLANDS: Tahiti; Voyage of the ASTROLABE HOMBRON, D'URVILLE (P! holotype; FI! isotype).—Anno 1769, BANKS & SOLANDER (FI!).—no loc., MOERENHOUT (or BERTERO?)—Novara Expedition ex Hb. Vindobon., 147 (FI!).—NADÉAUD (F! photo). United States Exploring Expedition (US!).—DROLLET 3 in 1907 (FI! 3 sheets).—MACFARLANE in 1904 (FI!).—TILDEN 1134 (BISH! UC!).—TRYON & TILDEN 430 in 1912, Papara (BISH! UC!).—SETCHELL & PARKS 180 in 1922, beyond Maraia Caves (EDINB! UC!). Vaheria, 700 m., MAC DANIELS 1597 (BISH!),—Punaauia distr., Diadem, 1610 ft., 14. 5. 1930, M. L. GRANT 3616 (FI!)—Papara valley, 1650 ft., 29. 5. 1930, GRANT 3676 (FI!).—Papenoo, Ana Pua, 1220 ft., 6. 9. 1930, GRANT 4078 (FI!).—Mataiea, Vaihiria, 1800 ft., 7. 9. 1930, GRANT 4111 (FI!)—Papara? May 1930, GRANT 5450 (FI!).—Pueu, 300 m. MACDANIELS 1583 (BISH!).—same loc., 1927, MACDANIELS 1583-a (BISH! ster. juv.).—Mt. Torea, Paea distr., 1932, WILDER *s.n.* (NY!).—Tautira valley, 150 m, 1973. RAYNAL 18164 (P!).—Aiorai trail between Fare Hamuta and Belvedere, 900 m., 1971, RAYNAL & TAUREAU 16551 (P!).—Moorea; Afareiatu, Oaarau ridge between Niuroa and Hotutea valleys 380 m. 1973, RAYNAL 17932 (P!).—Huahine; Maeva distr., Matoereere, 1740 ft., GRANT 5324 (FI!).—Tahaa; Ruutia distr., Mt. Ohiri, 1480 ft., GRANT 5171 (FI!).— same loc., GRANT 5178 (FI!)—Raiatea; Arera, Temehani, 1960 ft., GRANT 5232 (FI!).—S. of Faoroa Bay, steep hillside, 1926, J. W. MOORE 280 (BISH! LAE!)—S. side of Toahiva valley, 1934, ST. JOHN 17303 (BISH!)—S. side of Paaioio valley, 200 m. 1934, ST. JOHN 17312 ♀, 17313 ♂ (BISH!)—Temehani plateau 500 m., ST. JOHN 17254 (BISH!)—Borabora; on high mount, Oct. 1960, coll. ignot. *s.n.* (BISH!).

Extra-Polynesian specimens:

NEW HEBRIDES: S.W. of Annobon, Seibiur, 14. 5. 1971, 200–400 m., SCHMID? no. 3791 (NOU!).—Erromango; 11 km W of Ipota, 29. 5. 1968, BERNARDI 13214 (G. NOU!).—Aneityum; Woptiabo, 630 m., 1971, CHEW in RSNH 98 (L! KLU!).—S. slope of Mt. Inrero, 380 m. 1971. GREEN in RSNH 1148 (K! KLU!).—S. of Nezwon Neounemala, 500 m. 1971, RAYNAL & SCHMID in RSNH 16131 (K! KLU!).

FIJI: See the citations in Perry, 1950: 210, under *F. Parksii*. Also: Viti Levu; Voma Mt., 900 m. 1927, GILLESPIE 2798 (UC!).—Mt. Nanggaranambuluta, 1100 m. 1947. SMITH 4876 (BRI!).—Vanua Levu; Korotini Range, 1933, SMITH 523 (NY!).—Mt. Mariko, 1933, SMITH 425 (NY!).—Kandavu; Mt. Mouke Levu, 1933, SMITH 244 (NY!).

BOUGAINVILLE (W. Solomons Grp.): N. of Buin, lower S. slope Lake Loloru crater, 2250 ft., 19. 8. 1964, CRAVEN & SCHODDE 306 (K! LAE!).

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