

On Some Species of *Pandanus* and *Freycinetia* (Pandanaeae) in Micronesia

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Abstract

Two new species of *Pandanus* from the Caroline Islands are described: *P. amissus* (Kosrae Island) and *P. lorencei* (Palau Island). New data on *P. kanehirae* and *Freycinetia villalobosii*, both from Palau, are also reported. The staminate flower of *P. whitmeeanus* is described for the first time. The taxonomic relationships of *P. whitmeeanus* within the genus *Pandanus* are reassessed.

Introduction

The taxonomy of the family Pandanaeae in Micronesia was widely investigated by Martelli (1934) and Kanehira (1935a-f, 1936a-b, 1937), who described several new species in *Pandanus* Parkinson and some in *Freycinetia* Gaudich. Recently, several specimens of *Pandanus* and *Freycinetia* were collected in Micronesia by botanists of the National Tropical Botanical Garden, Lawai (PTBG). In the course of their study, two unknown species of *Pandanus* were discovered, and new data on some previously described species of *Pandanus* and *Freycinetia* were obtained. The new species and the new data are described below.

New Species

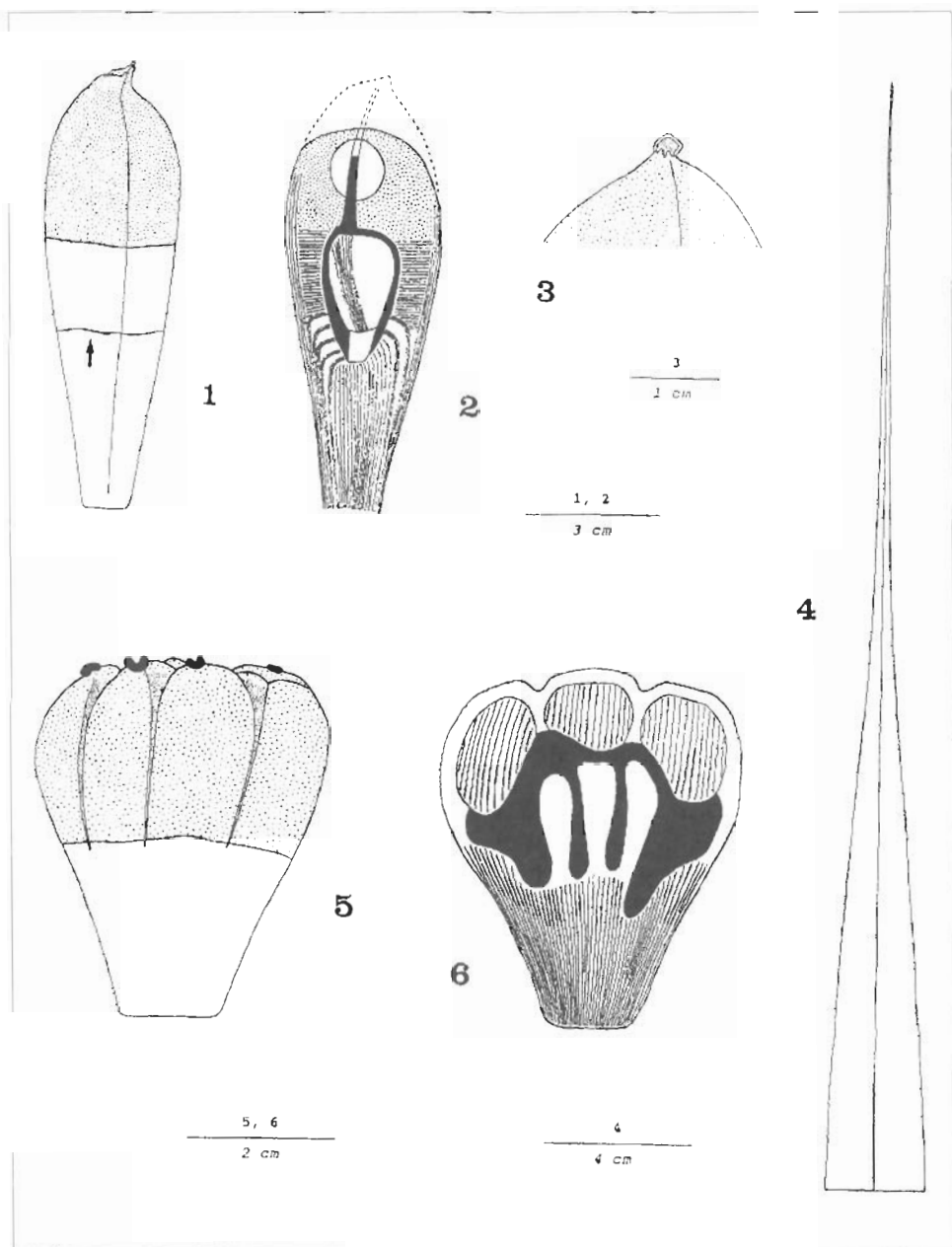
1. *Pandanus amissus* Huynh, sp. nov. (sect. *Lophostigma*)

Arbor 7–8 m alta, radicibus gralliformibus longissimis suffulta. Folia 2.5–3 m longa, 17 cm lata in medio 15 cm prope basim, ensiformia, apicem versus abrupte attenuata, in basi amplexicaulia; lamina in sicco brunnea, subcoriacea; plicis vix visibilibus; venis longitudinalibus plerumque utrinque distinctis sed transversalibus omnibus invisibilibus; denticulis marginalibus e 14–15 cm supra basim ad apicem praesentibus, omnibus antrorsis, plerumque parallelis, generaliter 1.5–2 mm longis sed inferne paulo brevioribus, prope basim 2–4 mm sursum versus 5–15 mm inter se separatis; denticulis costalibus in circiter 2/3 superis praesentibus, antrorsis, parallelis, ± tam longis latis quam marginalibus proximis sed multo magis inter se separatis (2–7 cm); vagina c. 14 cm longa 17 cm lata, utrinque fere tote non nervata. Infructescentia monosyncarpica; syncarpio globoso, 22–23 cm diametenti; pedunculo c. 45 cm longo. Drupae c. 10 cm longae 3.7 cm latae 3 cm crassae, maturitate in

6/10 superis liberae; stigmatibus unicus, c. 3 x 2 mm, reniformibus, verticalibus, c. 3 mm stipitatis; stylo fere horizontali, atrobrunneo, corneo, subnitido, in vertice atrobrunneo fere plano pileo excentrico, extrinsecus stigma ferenti; pileo c. 4 cm alto, convexiuscule pyramidali, laevi, corneo sed non nitido, 5 vel 6 angulato, angulis vix visibilibus, non prominentibus nec acutis; endocarpio c. 5 cm alto in axe (processu endocarpico supra loculum seminalem incluso), apice ad c. 1.5 cm infra basim stigmatis basi c. 3.5 cm supra basim drupae; loculo seminali ovoideo, c. 2.2 x 1.5 cm, apice plano, centro prope medium, parietibus endocarpicis tenuis, superne processu endocarpico excentrico c. 1.5 cm longo productis; tubo germinationis c. 7 mm longo infra loculum seminalem; mesocarpio supero percipiose medullosa, abundanter et tenuiter fibroso, in medio caverna subsphaerica praedito; mesocarpio infero copiose et grosse fibroso, ut videtur non medullosa. — Figs. 1–3.

Typus: *Flynn & Lorence 6320* (holo PTBG, iso PTBG); Caroline Islands, Kosrae Island, Tafunsak district, alt. c. 3 m, 13 September 1997; disturbed lowland forest; large tree of 25 ft, with prop/stilt roots, leaves glossy dark green, channeled; spines brown tipped, infructescence on pendulous peduncle c. 18 inches long, head globose, with 100–200 drupes, these glaucous blue-green, ripening with brownish-yellow base.

Tree 7–8 m tall, with very long stilt roots. Leaves 2.5–3 m long, 17 cm wide at the middle and 15 cm wide near the base, ensiform, abruptly attenuate towards the apex, amplexicaul at the base, brown when dry, subcoriaceous; pleats just visible; longitudinal veins mostly distinct on both surfaces, but all transverse veins invisible; marginal prickles present from 14–15 cm above the base up to the apex, all antrorse, mostly parallel, in general 1.5–2 mm long but a little shorter below, 2–4 mm apart near the base, 5–15 mm above; costal prickles present in about the upper 2/3, antrorse, parallel, more or less as long and wide as the closest marginal prickles but much more remote (2–7 cm); sheath c. 14 cm long, 17 cm wide, almost entirely not nerved on both surfaces. Infructescence monosyncarpic; syncarp globose, 22–23 cm in diameter; peduncle c. 45 cm long. Drupes c. 10 cm long, 3.7 cm wide and 3 cm thick, free in the upper 6/10 when mature; stigmas single, c. 3 x 2 mm, reniform, vertical, stipitate by c. 3 mm; style almost horizontal, dark brown, corneous, subnitid, eccentric on the dark brown, almost flat vertex of the pileus, bearing the stigma at the outside; pileus c. 4 cm high, pyramidal but a little convex, smooth, corneous but not nitid, 5–6-angled, the angles just visible, not prominent, not acute; endocarp c. 5 cm high on the drupe axis (incl. the endocarpic process above the seed locule), the apex at c. 1.5 cm below the stigma base, the base at c. 3.5 cm above the drupe base; seed locule ovoid, c. 2.2 x 1.5 cm, the apex flat, the centre near the middle, the endocarpic walls thin, prolonged above in the eccentric, c. 1.5 cm long, endocarpic-process; germination tube c. 7 mm long below the seed locule; upper mesocarp very abundantly medullous, abundantly and finely fibrous, with a subspheric cavern in the middle;



Figures 1-6: *Pandanus amissus* (1-3) (Flynn & Lorence 6320, holotype) and *P. lorencei* (4-6) (Lorence et al. 8310, holotype):

1: Drupe in lateral view (the stigma, vertical and in profile, is at top right; dotted: pileus; arrow: lower limit of free part). **2:** Drupe in axial section (black: endocarp; fibres partially shown in upper mesocarp). **3:** Upper part of drupe, showing stigma (densely dotted) in front view. **4:** Upper part of leaf flattened horizontally, viewed by adaxial face. **5:** Drupe in lateral view (dotted: pileus and free part). **6:** Same drupe in axial section (black: endocarp).

lower mesocarp abundantly and coarsely fibrous, apparently not medullous.
— Figs. 1–3.

Kosrae Island is at about 5°18'00"N 163°01'45"E.

Notes: *Pandanus amissus* is named in reference to its distribution remote from New Caledonia. New Caledonia is the centre of diversity of sect. *Lophostigma* (Brongn.) Warb., with 10 out of the 12 species in this section (St. John, 1989d), and including the type of the section, *P. viscidus* (Brongn.) Solms. Outside New Caledonia, *P. syozoi* Kaneh. is endemic to Palau and *P. amissus* is known only from Kosrae Island. *P. syozoi* is the only species of the section that has polysyncarpic infructescences (Kanehira, 1936b).

Pandanus amissus has very long prop roots, almost twice a man's height, as seen in a photograph of the type plant. In addition, it has the largest drupes in sect. *Lophostigma*, up to 10 cm long and 3.7 cm wide, compared with the New Caledonian species where the drupes do not exceed 6.7 cm in length and 1.6 cm in width (St. John, 1989d). Mature drupes of *P. syozoi* have not yet been collected (Kanehira, 1936b).

2. *Pandanus lorencei* Huynh, sp. nov. (sect. *Pandanus*)

Arbor c. 2.5 m alta. Folia c. 90 cm longa, medio basim versus 3 cm lata, e circiter medio ad apicem sensim attenuata, 6–8 cm flagellata; lamina in sicco coriacea, prope basim et infra apicem revoluta; plicis inermibus, fere e basi ad infra apicem perspicue canaliculatis; venis longitudinalibus utrinque visibilibus sed transversalibus invisibilibus; denticulis marginalibus e c. 3 cm supra basim ad apicem praesentibus, omnibus antrorsis, densis (c. 2–5 mm inter se separatis), in 1/3 infera divergentibus usque ad 1.5 mm longis, ceterum brevioribus minutis parallelis vel applicatis; denticulis costalibus e c. 6 cm supra basim ad apicem praesentibus, aliquot infimis retrorsis et multo brevioribus quam marginalibus proximis, ceterum antrorsis et plerumque tam longis, inferne multo magis separatis superne multo creberrimis medio ± tam separatis; vagina c. 3 cm longa, 4 cm lata in dimidio infero 3.5 cm in apice, fere tote longitudinaliter nervata in pagina abaxiali, fere tote laevi in adaxiali. Infructescentia monosyncarpica; syncarpio globoso, 12–13 cm diametenti; pedunculo ignoto. Drupae 4.3–5 cm longae 2.8–4 cm latae 2.4–3.3 cm crassae, truncatae in apice cuneatae basi, maturitate in 1/2–3/5 superis liberae, 6 vel 7 locales, carpellis exterioribus latioribus quam interioribus; stigmatibus verticalibus vel obliquis, reniformibus vel ± triangularibus, usque ad 2.5 mm latis, plerumque centripetis, sulcum 4–5 mm longum in vertice carpelli locatum aspicientibus; endocarpio c. 2.5 cm alto in axe, 0.5–1 cm peripheria; loculis seminalibus c. 1.5 cm longis, basi prope medium; mesocarpio supero in 1/3 supera, copiose meduloso, abundanter fibroso; mesocarpio infero in dimidio infero, meduloso, copiose fibroso. — Figs. 4–6.

Typus: *Lorence et al.* 8310 (holo PTBG, iso PTBG); Caroline Islands, Palau (Republic of Belau), Oreor (Koror) State, unnamed limestone rock island in vicinity of Omekang, W. of Bablomekang Island, 7°08'32"N 134°19'02"E, alt. 5–10 m, 17 February 1998; coastal palm forest; common,

on coastal cliffs; tree, trunk 2.5 m tall with a whorl of branches, leaves glaucous green, channeled, spines brown, heads 12–13 cm in diameter, globose, drupes ripening orange then brown.

Tree c. 2.5 m tall. Leaves c. 90 cm long, 3 cm wide from the middle down to the base, gradually attenuate from about the middle up to the apex, in 6–8 cm flagellate, coriaceous when dry, revolute near the base and below the apex; pleats unarmed, distinctly channelled almost from the base up to below the apex; longitudinal veins visible on both surfaces, but transverse veins invisible; marginal prickles present from c. 3 cm above the base up to the apex, all antrorse, close (c. 2–5 mm apart), in the lower third divergent from the margins and up to 1.5 mm long, above shorter, minute, parallel or applied to the margins; costal prickles present from c. 6 cm above the base up to the apex, some below retrorse and much shorter than the closest marginal prickles, the others antrorse and mostly as long as these, below much more remote than the closest marginal prickles, above much closer, in the middle more or less as remote as these; sheath c. 3 cm long, 4 cm wide in the lower half, 3.5 cm wide at the apex, almost entirely nerved longitudinally on the abaxial surface, almost entirely smooth on the adaxial surface. Infructescence monosyncarpic; syncarp globose, 12–13 cm in diameter; peduncle not known. Drupes 4.3–5 cm long, 2.8–4 cm wide, 2.4–3.3 cm thick, truncate at the apex, cuneate at the base, free in the upper 1/2–3/5 when mature, 6–7-celled, the outer carpels broader than the inner carpels; stigmas vertical or oblique, reniform or more or less triangular, up to 2.5 mm broad, centripetal for most of them, each facing a furrow 4–5 mm long on the carpel vertex; endocarp c. 2.5 cm high on the drupe axis, 0.5–1 cm high at the periphery; seed locules c. 1.5 cm long, the base near the middle; upper mesocarp in the upper third, abundantly medullous, abundantly fibrous; lower mesocarp in the lower half, medullous, abundantly fibrous. — Figs. 4–6.

Notes: *Pandanus lorencei* is named after David H. Lorence, the principal collector of this specimen.

In its smaller syncarp with fewer celled drupes and smaller leaves, *P. lorencei* is distinct from the other pandans in Palau, especially from the following species, which may be considered close relatives (Table 1).

Table 1. Comparison of *P. lorencei* with close relatives in Palau

<i>Pandanus</i>	Syncarp diameter (cm)	No. cells in drupe	Length of drupes (cm)	Length and width of leaves (cm)
<i>lorencei</i>	12–13	6–7	4.3–5	90 x 3
<i>divergens</i>	21	13–20	8	150 x 8
<i>duriocarpus</i>	16	16–18	4.5	(unknown)
<i>erythrophloeus</i>	19	7–13	5–6	150 x 8
<i>okamotoi</i>	18	12–16	7–8	200 x 6–7

Further notes on *Pandanus kanehirae*

Pandanus kanehirae Martelli is peculiar in that the carpels composing its drupes are deeply separate (Fig. 7), a feature emphasized by Martelli (1934: 120, Fig. 3). It was by reason of this character in particular that sect. *Palauenses* Huynh & B. C. Stone was defined to accommodate *P. kanehirae* (Huynh, 1980: 404).

Recently, new data on *P. kanehirae* were obtained from *Lorence 8202* (PTBG), collected on 10 February 1998 in Babeldaob (Palau), the type locality of this species. As revealed by a field note, *P. kanehirae* is a low tree 3–5 m tall. The infructescence comprises 4–6 syncarps (6 on the infructescence that was collected, 3 of which had been removed); the peduncle below the syncarps is at least 50 cm long. The structure of the infructescence is most unusual, and provides further support to the distinctness of sect. *Palauenses*. The rhachis of this infructescence is divided into six branches each bearing or having borne a syncarp (Fig. 9). The two lowermost syncarps (the 6th and 5th) have their pedicels at the same level, at c. 15 cm from the base of the uppermost syncarp; one pedicel has no node and is 6–7 cm long; the other pedicel was partly preserved and the remnant is c. 3 cm long and shows a node at c. 1.5 cm above the base. The two subsequent upper syncarps (the 4th and 3rd) also have their pedicels at the same level, at c. 12 cm from the base of the uppermost syncarp. These pedicels are separated from the two lowermost pedicels by three internodes and have no nodes: one is c. 6 cm long, the other c. 4.5 cm long. The subsequent upper syncarp (the 2nd) has its pedicel at c. 9 cm from the base of the uppermost syncarp; the pedicel was partly preserved and is separated from those of the 4th and 3rd syncarps by one internode, and from the uppermost syncarp by six internodes. Apparently these nodes have each borne a bract. No bracts were preserved, but bract scars are

observed. What is unusual in this infructescence is that: firstly, two syncarps may have their pedicels at one and the same level (instead of two); secondly, a syncarp may be separated from the subsequent syncarp(s) by several internodes (instead of one; in some polysyncarpic infructescences, two internodes were observed between the uppermost syncarp and the subsequent syncarp).

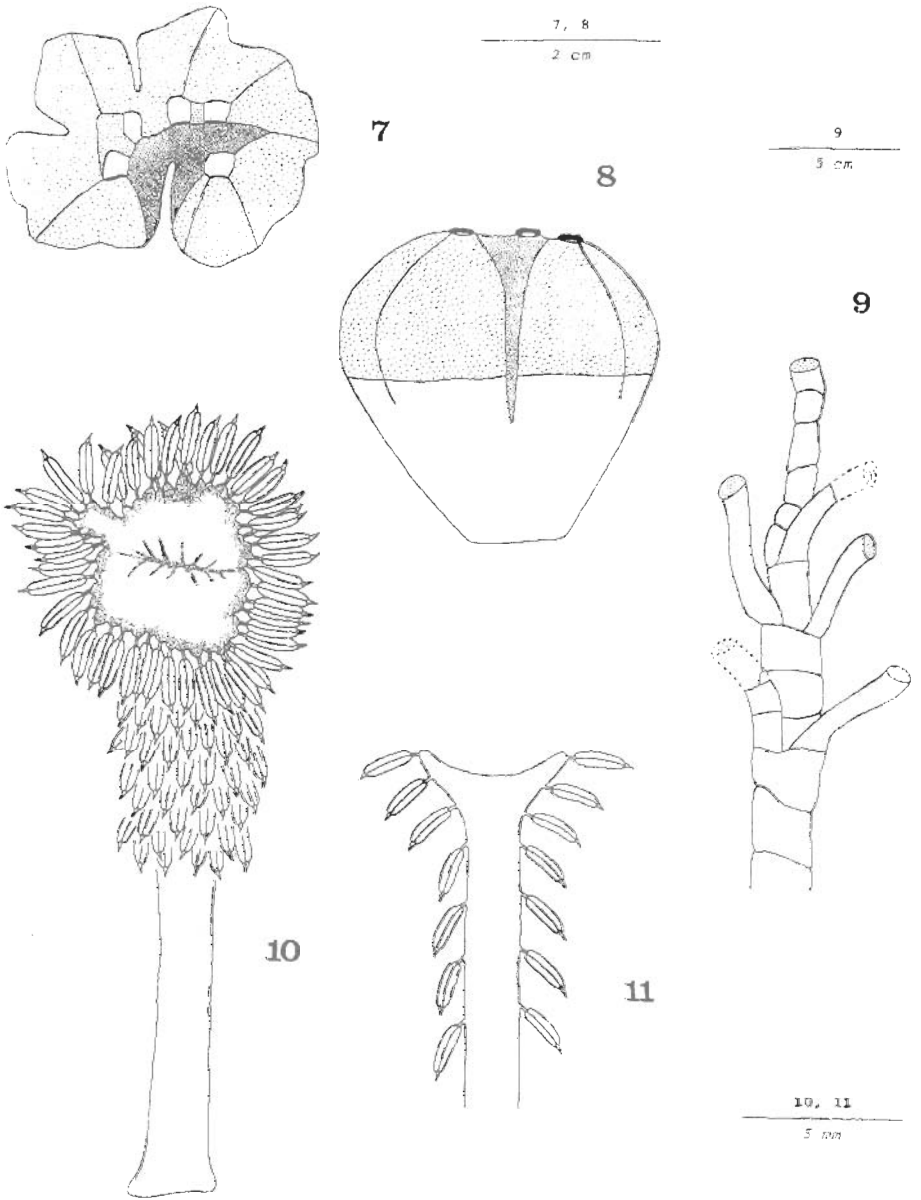
The specimen *Lorence 8202* also provides more detailed knowledge of the drupes of *P. kanehirae*. These are c. 3.5 cm long, (2.5–) 3–4 cm or more wide, and 2.5–3 cm thick. Sometimes, two adjacent drupes intimately fuse along their connate part (they are inseparable from each other), and viewed from above appear to form a single drupe. There are (1–)3–7 stigmas, which are vertical, eccentric, and very small. If two stigmas are close, they are located together on a nitid, slightly sunken area. On those drupes where it was possible to observe undamaged stigmas, these were found to be more or less facing the same lateral face: this corroborates a feature previously described of sect. *Palauenses* (Huynh, 1980: 404).

The specimen *Lorence 8202* also makes possible a re-examination of leaf characters of *P. kanehirae*. Leaves are c. 150–160 cm long, 7.5 cm wide at the middle and 10.5 cm wide near the base, attenuate acuminate in the apical part, and rigidly coriaceous in the lower half but subcoriaceous in the upper half. The margins are armed from c. 8 cm above the base up to the apex; the prickles are close, below up to c. 1 mm long along 20 cm, and just visible above that level. The midrib is unarmed in the lower third but armed above with minute prickles. The longitudinal veins are visible on both surfaces, but not the transverse veins.

Further notes on *Pandanus whitmeeanus*

Pandanus whitmeeanus Martelli is the type species of sect. *Coronata* Martelli, which is the only section of subg. *Coronata* Martelli (Stone, 1974: 521). It is unique in the genus *Pandanus* in that its stigmas are all «centripetally» arranged as described and illustrated by Stone (1974: 488, Fig. 13C) and St. John (1989a: Fig. 644; 1989b: Fig. 677; 1989c: Fig. 718).

In his taxonomic treatment, Stone (1974) divided the genus *Pandanus* into eight subgenera: *Pandanus* B. C. Stone, *Rykia* (De Vries) B. C. Stone, *Lophostigma* (Brongn.) St. John, *Kurzia* B. C. Stone, *Vinsonia* (Warb.) B. C. Stone, *Martellidendron* (Pic. Serm.) B. C. Stone, *Coronata*, and *Acrostigma* (Kurz) B. C. Stone. These were distributed in four groups, and Stone (1974: 468, 527) attributed subg. *Coronata* and subg. *Pandanus* to Group 3. No arguments, however, were given to explain these groupings. With regard to subg. *Coronata* in particular, the staminate flower of



Figures 7-11: *Pandanus kanehirae* (7-9) (Lorence 8202) and *P. whitmeeanus* (10, 11) (Whistler 6734):

7: Drupe with 5 stigmas in apical view; **8:** Same drupe in lateral view (dotted: piteus and free part). **9:** Rhachis of a 6-syncarpic infructescence (dotted: location of the bases of the syncarps). **10:** Staminate flower in lateral view (the peltate apex is dotted in margins). **11:** Upper part of staminate flower in axial section.

P. whitmeeanus described below seems to indicate that it does not fall within any of these groups and that it forms a group of its own.

According to Smith (1979: 478), *P. whitmeeanus* probably originated in Vanuatu (the New Hebrides) and was an aboriginal introduction into Fiji and other archipelagoes. These are Samoa, Tonga, the Cook Islands, and the Horne Islands (St. John, 1989c: 6). In these islands, it is cultivated as an economic plant. It is not known if it is cultivated also in the other archipelagoes in Micronesia. The leaves are used for making mats and plaiting handicraft articles (St. John, 1989b-c), while the fruits are used for decoration as garlands (St. John, 1989a). Nevertheless, until recently only the pistillate plant had been collected (Smith, 1979: 478).

However, a staminate plant of *P. whitmeeanus* has now been collected from Tonga: *Whistler 6734* (PTBG); Tongatapu Island, village of Ha'asini, 30 May 1989; tree 4 m high; local names *paongo* (the tree) and *hingano* (the inflorescence).

The flowers of this staminate plant consist of a column whose upper part comprises a peltate apex and a large number of stamens (Fig. 10). The column varies in length (15–25 mm long), as do its stamen-bearing part (8–12 mm) and its stalk (5–13 mm). The ratio between these two components also varies. The peltate apex varies in width (4–6 mm). When viewed from above, this latter appears clearly sunken (Fig. 11) or more or less flat. Its shape also varies, being slightly triangular, elliptic, or rectangular. Its margins are bordered with processes that are either very distinct or just perceptible, but each generally bears a stamen. The processes are brown, like the peltate apex, and contrast with the stamens, which are white; the similarity of the processes with the peltate apex seems to indicate that they are parts of the latter. In the stalk, 2 or 3 concentric circles of vascular bundles are observed, but there are no other lignified elements. The stamens are 2–2.5 mm long and have an acumen c. 0.4 mm long and a very thin filament (c. 0.1 mm). The anthers have a connective that is lignified, except for the small cells around the vascular bundle; the pollen-sac walls comprise 1 or 2 layers of endothelial cells; the pollen is spinulose and oblong, with a pore generally located on the longer axis.

To date, only two types of staminate flowers with a peltate apex have been observed in *Pandanus*. In the first type, seen in sect. *Solmsia* B. C. Stone (subg. *Rykia*), the peltate apex is spinulose at the upper face, and the stamen filaments are thick and also spinulose (Stone, 1974: Fig. 2D). In the second type, the peltate apex is smooth as are the stamen filaments, which are thin. This type is found in some sections of subg. *Lophostigma*: sect. *Lophostigma* (Huynh, 1982: Figs. 1 and 70); sect. *Barrotia* (Brongn.) B. C. Stone (Stone, 1974: Fig. 6C; Huynh, 1982: Fig. 7; St. John, 1989d: Figs. 741b and 744b); sect. *Bernardia* B. C. Stone (Stone, 1974: Fig. 6A; St.

John, 1989d: Fig. 748b); and sect. *Brongniartia* B. C. Stone (St. John, 1989d: Fig. 756b).

In its smooth peltate apex and smooth, thin stamen filaments, the staminate flower of *P. whitmeeanus* (Fig. 10) shows similarity with those of subg. *Lophostigma*, and may indicate the existence of a close relationship between subg. *Coronata* and subg. *Lophostigma*. However, the peltate apex of *P. whitmeeanus* has marginal processes, which are absent in those of subg. *Lophostigma*. This peculiarity of the staminate flower of *P. whitmeeanus* seems to indicate that subg. *Coronata* forms a group of its own within the genus *Pandanus*. By contrast, no staminate flowers with a peltate apex have been observed in subg. *Pandanus*, which may indicate that subg. *Coronata* and subg. *Pandanus* are not closely related.

Further notes on *Freycinetia villalobosii*

In *F. villalobosii* Martelli, new essential specific characters were observed from specimen *Lorence & Flynn 8280* (PTBG), which is a pistillate plant collected on 16 February 1998 in Babeldaob (Palau), the type locality of this species. The berries have a thick central sclerenchyma and thin, fusiform-elliptic fibre-bundles (the presence/absence of a central sclerenchyma and that of fusiform-elliptic fibre-bundles in berries are two essential specific characters in *Freycinetia*: Huynh, 1997: 360). The leaves are c. 55 cm long and 2 cm wide at the middle and gradually attenuate from the middle to the apex where they are caudate along c. 2 cm; the blade is strongly revolute in the upper half; the pleats are unarmed; the longitudinal veins are very close, and distinct on the abaxial surface, less so on the adaxial surface; the transverse veins are invisible on both surfaces; the margins are armed from c. 4.5 cm above the base to the apex, the prickles are antrorse, near the base up to 1 mm long and 1.5 mm apart, above that level they are minute and much closer; the midrib is armed from c. 15 cm above the base to the apex with very close prickles; at intervals of c. 2–3 mm on the midrib, one prickle is 2–3 times longer and wider than the adjacent upper and lower prickles, which is an unusual feature.

Acknowledgements

The author is deeply indebted to the National Tropical Botanical Garden, Lawai (PTBG) for the loan of materials, and the Swiss National Science Foundation for a grant to study Pandanaceae (Grant no. 31-45707.95).

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