

A Synopsis of the Genus *Gulubia*

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Gulubia is a genus of nine known species in the *Areca* alliance of palms. The genus is distributed from the Molucas in Indonesia to the Palau Islands, New Guinea, the Solomon Islands, the New Hebrides, Fiji, and Australia. All are solitary, moderate, elegant palms with prominent crownshafts and clean trunks. Two species have leaves with essentially straight rachises and pendulous pinnae (Figs. 1-2), while the remaining species have strongly arched leaves with erect pinnae (Figs. 3-8). These palms are eminently suitable for cultivation in the tropics, but have not yet been widely planted. They seem to have little economic use, but in New Guinea at least are used for floorboards and sometimes for siding on buildings.

The genus is closely related to *Gronophyllum*, *Hydriastele*, and *Nengella*, with which it forms a natural subunit of the *Areca* alliance (Essig and Young 1979). From *Hydriastele*, *Gulubia* is separated only by its emergent, solitary rather than caespitose habit. Inflorescence and flowers are essentially indistinguishable. However it seems useful to provide an account of these distinctive emergent palms, even though their generic status may have to be reviewed in the future. From *Gronophyllum* and *Nengella*, *Gulubia* and *Hydriastele* are distinguished by a protogynous rather than protandrous mode of flowering and related morphology. In the protogynous genera, pistillate petals are short and the stigma is exposed at the time the inflorescence opens. Pistillate anthesis is immediate and staminate anthesis follows in 24 hours (Essig 1973). In the pro-

tandrous genera, petals of the pistillate flowers have long, tapered tips that are closed over the stigma at the time the inflorescence opens. Staminate anthesis is first (though not immediate), with pistillate anthesis following sometime later (details of timing have not been observed).

The present account summarizes what is known about *Gulubia*, but is clearly preliminary in nature. Specimens available for most species are meager and there is much that is not known. A large part of the range of the genus has not been adequately explored for palms, so new species may come to light in the future, just as two new species are described here. It is hoped that this paper will stimulate the further exploration that is needed.

Fruit Structure in *Gulubia*

The structure of the pericarp has been found to be of considerable taxonomic significance in the arecoid palms (Essig 1978, Essig and Young 1979), so a special section on the fruit of *Gulubia* is included here. The known species of *Gulubia* share several basic features: a prominent palisade layer derived from the locular epidermis, a series of fibrovascular bundles of various sizes and shapes, a prominent, dense zone of tanniferous parenchyma, and a subepidermal zone of compressed parenchyma. There are no sclereids or crystals in the outer pericarp, features that are common in other arecoid palms.

Representatives of all nine species of *Gulubia* were examined using standard histological techniques (see Essig 1978). Eight species are illustrated. Preparations



1. *Gulubia moluccana*, cultivated at Bogor (from Beccari, Ann. Jard. Bot. Buitenzorg 2, plate 7, 1885).
2. *Gulubia costata*, in lowland forest near the Frieda River.

from dried material of *Gulubia palauensis* were not adequate for drawing, but some information was obtained, which will be summarized below.

Variation in fruit structure is striking at every level, including the subspecific, so detailed conclusions about the fruit structure in particular species cannot be made based on limited samples. This is illustrated in the specimens of *Gulubia longispatha*, taken from three widely separated populations (Figs. 12-14). The following tentative remarks do seem to be warranted however:

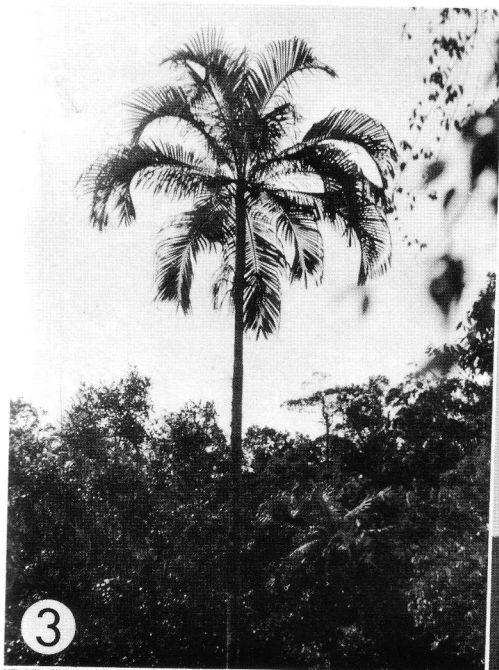
1. *Gulubia costata* clearly stands out because of the presence of very large fibrovascular bundles, alternating with much smaller ones, that give the fruit a ribbed appearance (Fig. 10). *Gulubia moluccana* clearly lacks this differentia-

tion of bundles (Fig. 9), which may be taken as a more generalized condition probably ancestral to that in *G. costata*.

2. *Gulubia longispatha* can be characterized by the presence of a distinct series of fibrous bundles located outside of the tanniferous zone and apparently not connected with the fibrovascular bundles to the inside of the tanniferous zone (Figs. 12-14).

3. *Gulubia valida* appears to be most similar to *G. longispatha*, but lacks the outer series of fibrous bundles, and has a broader zone of non-tanniferous parenchyma between the fibrovascular bundles and the tanniferous zone (Fig. 11).

4. *Gulubia hombronii* and *G. cylindrocarpa* appear to be very similar in their fruit structure (Figs. 15 and 18), with the latter species apparently having smaller,



3. *Gulubia longispatha*, growing on the slopes of Mt. Suckling.

4. *Gulubia longispatha*, type plant of *G. brassii*, from Bella Vista, Central Province. Photo by L. H. Brass, courtesy of the Arnold Arboretum.

5. *Gulubia longispatha*, in the mountains above the Frieda River.

6. *Gulubia valida*, from the Torricelli Mountains (type plant).



7. *Gulubia hombronii*, Santa Ysabel Island. Photo by H. E. Moore, Jr. (courtesy L. H. Bailey Hortorium).



8. *Gulubia microcarpa*, Viti Levu, Fiji Islands. Photo by H. E. Moore, Jr. (courtesy L. H. Bailey Hortorium).

more numerous and crowded fibrovascular bundles. This difference may not be reliable however as it is based on only one specimen from each species.

5. *Gulubia macrospadix* is distinctive, not only in having ruminant endosperm, but also in having a series of fibrous bundles in mid-pericarp, which appears to be distinct from the fibrovascular system, but not as widely separated as in *G. longispatha*. The fibrous bundles interrupt the tanniniferous zone rather than being external to it (Fig. 16). Also, the locular epidermis is wavy, following the uneven contours of the seed.

6. *Gulubia microcarpa* has the thinnest pericarp of all species, with markedly flattened fibrovascular bundles, and a locular epidermis only slightly modified in the direction of a palisade layer (Fig. 17).

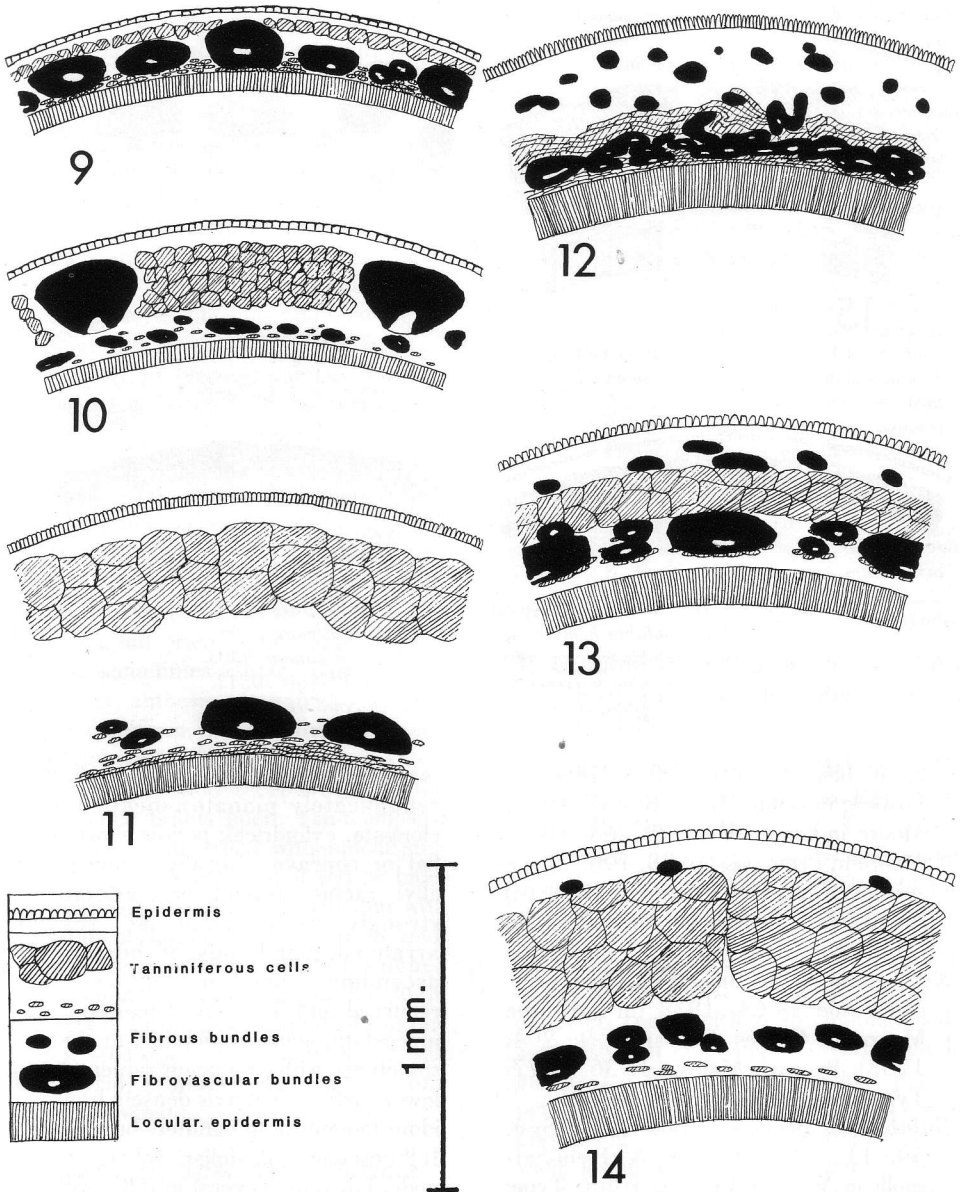
7. *Gulubia palauensis*, viewed in dried material from *Tuyama s.n.*, has a thin

pericarp similar to *G. microcarpa*, but with a much thicker locular epidermis, well developed as a palisade layer. There is no sign of fibrous bundles external to the tanniniferous zone (not illustrated).

In summary, it appears that each species of *Gulubia* possesses distinctive features in the pericarp, and isolated fruits might be identifiable. Subspecific variation appears to be significant, in at least one species however, and this may confuse the picture. Ultimately, pericarp structure may prove to be a sensitive marker for affinities at the subspecific and population level.

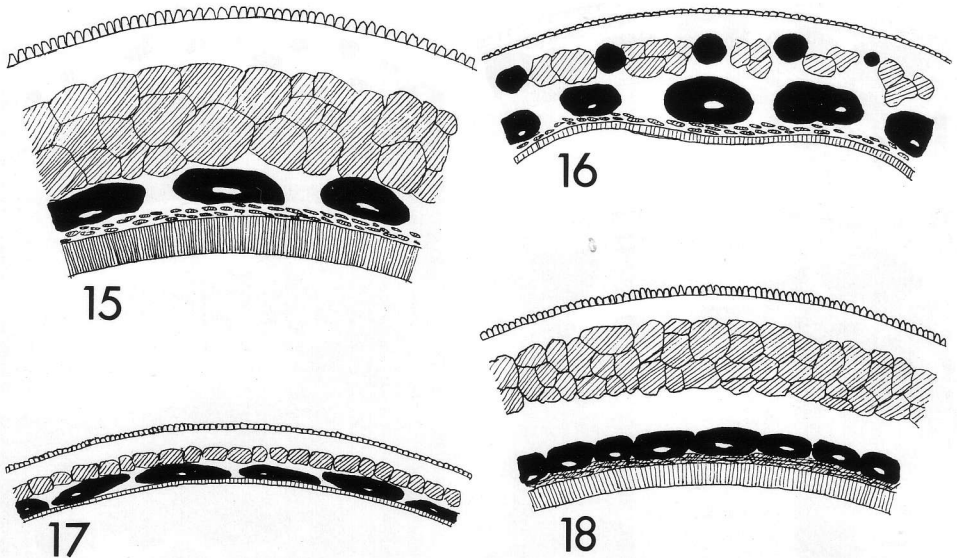
Taxonomic Treatment

Gulubia Beccari in Ann. Jard. Bot. Buitenzorg 2: 128, 131. 1885; Beccari in Martelli, Nuov. Giorn. Bot. Ital. II, 42: 84. 1935; Beccari and Pichi-Sermolli



Figures 9-14. Diagrams of typical segments of the pericarp in cross-section.

9. *Gulubia moluccana*, from *Beguín 2098*.
10. *Gulubia costata*, from *Essig s.n.* (Brahman River area, Madany Province).
11. *Gulubia valida*, from *Essig LAE 55099*.
12. *Gulubia longispatha*, from *Essig LAE 55231* (Mt. Suckling, Milne Bay Province).
13. *Gulubia longispatha* from *Brass 5457* (Central Province).
14. *Gulubia longispatha*, from *Essig LAE* (West Sepik Province).



Figures 15-18. Diagrams of typical segments of the pericarp in cross-section.

15. *Gulubia hombronii*, from Moore & Whitmore 9296.
 16. *Gulubia macrospadix*, from Moore & Whitmore 9305.
 17. *Gulubia microcarpa*, from Moore & Phillips 10543.
 18. *Gulubia cylindrocarpa*, from Raynal 16256.

in Webbia 11: 40. 1955; Moore & Fosberg in Gentes Herb. 8: 455. 1956; Moore in Gentes Herb. 9: 263. 1963; Moore in Principes 10: 88. 1966. Type species: *Gulubia moluccana* (Beccari) Beccari (see Beccari & Pichi-Sermolli, *op. cit.*).

Kentia Blume in Bull. Sci. Phys. Nat. Neerlande 1: 64. 1838 (in part, see Moore in Gentes Herbarum 9: 264. 1963); Beccari, Malesia 1: 36. 1877. Type: *Kentia moluccana* Beccari

Gulubiopsis Beccari in Bot. Jahrb. Syst. 59: 11. 1924; Beccari & Pichi-Sermolli in Webbia 11: 40. 1955. Type: *G. palauensis* Beccari

Paragulubia Burret in Notizbl. Bot. Gart. Mus. Berlin-Dahlem 13: 84. 1936; Beccari & Pichi-Sermolli in Webbia 11: 46. 1955. Type: *P. macrospadix* Burret.

Tall, solitary, unarmed, monoecious palms; trunks smooth, with annular leaf

scars; crownshaft well-developed; leaves reduplicate pinnate; sheath tubular, elongate, cylindrical; petiole short, almost flat or concave adaxially, convex abaxially; rachis straight or moderately to strongly arcuate, pinnae regularly arranged, pendulous or horizontal to ascending, sometimes upper leaflets recurved and drooping, linear-lanceolate, uncostate, acute or notched at the apex, sometimes with prominent ramenta on the lower surface; leaf axis densely brown-lepidote-tomentose to minutely brown-dotted. Inflorescence infrafoliar, solitary at each node, but often several in different stages of flowering and fruiting at one time, paniculate, branching to 1-3 orders, peduncle short, often becoming bulbous in fruit, prophyll compressed, broadly oblanceolate, completely closed around the bud, rounded at the tip, second peduncular bract smaller, incomplete, triangular to lanceolate, or rudimentary in a horizontal

scar, rameal bracts rudimentary, axes glabrous to slightly glaucous, whitish, rachillae elongate, straight or somewhat flexuous. Flowers white to rose-pink in decussate triads for most of the length of the rachillae. Staminate flowers one on either side of the central pistillate flower, asymmetrical, inserted at an angle to the rachilla, with the outward-facing petal substantially larger than the other two, sepals 3, short, gibbous, pointed, briefly united at the base, petals 3, 4-5 times longer than the sepals, valvate, broadly lanceolate, tapering to a fine point, not tightly closed in bud, stamens 6-24, erect, basifixed, somewhat shorter to somewhat longer than the petals, pistillode lacking or rudimentary and represented by 3 small papillae. Pistillate flowers globose, much smaller than the staminate flowers, sepals broadly rounded, imbricate, gibbous, petals similar but briefly mucronate and not gibbous, sometimes ciliate, parting only slightly at anthesis, staminodes usually 3(1-6), dentiform, opposite the inner petal only, pistil conic-globose, stigmas 3, short, sessile, exposed and receptive when the inflorescence bracts open. Fruit ellipsoid to globose, symmetrical with apical stigmatic residue, bright to dull red or blue-gray with pale stripes, pericarp thin with a prominent tanniferous layer in mid-pericarp, and straight, little-branched fibrovascular bundles running longitudinally, these forming prominent ribs in one species; seed ellipsoid-ovoid, embryo basal, endosperm homogeneous or (in one species) ruminate.

Key to the Species of *Gulubia*

1. Pinnae pendulous on slightly bowed rachis.
2. Fruit 9 × 4 mm (dry), not conspicuously ribbed; leaf blade of about 45 pinnae on each side. Moluccas. *G. moluccana*.
2. Fruit 7-8 × 4 mm (dry), conspicuously ribbed; leaf blade of usually 65-77 pinnae on each side. Widespread in New Guinea, Aru Islands, northeastern Australia. *G. costata*.
1. Pinnae ascending on strongly arcuate rachis.

3. Pinnae more than 50 on each side of the rachis.
4. Fruit ca. 10 mm long, with very thin pericarp; incompletely known species from Fiji. *G. microcarpa*.
4. Fruit usually larger with thicker pericarp; species from New Guinea, New Hebrides and Solomon Islands.
5. Stamens 6. *G. cylindrocarpa*.
5. Stamens 9-24.
6. Pinnae stiff, not drooping at tip; fruit dark red. *G. valida*.
6. Pinnae lax, drooping at tips; fruit bright red. *G. longispatha*.
3. Pinnae 30-40 on each side of the rachis.
7. Flowers cream-white; staminate flowers 3.5-4 mm long with 6 stamens; fruit 9 × 4 mm. Palau Islands. *G. palauense*.
7. Flowers pink to rose-red; staminate flowers 8-11 mm long.
8. Fruit dull red; endosperm homogeneous; stamens 10-12. *G. hombronii*.
8. Fruit bright crimson; endosperm ruminate; stamens 6-9. *G. macrospadix*.

1. ***Gulubia moluccana*** (Beccari) Beccari in Ann. Jard. Bot. Buitenzorg 2: 131. 1885.

Kentia moluccana Beccari, *Malesia* 1: 35. 1877; H. A. Wendland in Kerchove, *Les Palmiers*: 248. 1878. Type: *Beccari s.n.* 1874 (11 sheets filed under accession numbers 11150, 11151) (holotype FI, photos at BH).

Solitary palm 20-30 m high (to 55 m high *vide de Vogel*), stem to 30 cm in diameter. Leaf sheath to 95 cm long, blade 250-300 cm long, upper sheath, petiole and rachis finely brown-lepidote, pinnae pendulous, ca. 45 on each side (from photo, Fig. 2), to 105 cm long, 3.3 cm wide, lower surface with prominent, basifixed, pale brown ramenta along midrib at base. Inflorescence branching to 2 orders, rachillae to 39 cm long, ca. 2 mm thick, bearing up to 240 triads; staminate flowers cream-colored, ca. 6 mm long, stamens 6; pistillate flowers reddish at base, cream-colored at tip; fruit 7-9 × ca. 4 mm, lacking prominent ribs, color unknown.

Distribution: Moluccas—Halmahera, Ternate, Bacan, on hillsides up to 1,200 m altitude.

Local name: *ifu* (Ternate language).

SPECIMENS EXAMINED: INDONESIA.

Ternate: abundant "sul Picco di Ternate ad Aequi Conora," alt. 600–1,200 m, November 1874, *Beccari s.n.* (accession numbers 11150, 11151) (FI, type); Halmahera: Loci Tabaroi, alt. ca. 800 m, 29 July 1922, *Beguin 2098* (K); Gunung Jailolo, rather dense primary forest, 20 m high with little undergrowth, steep hillside with deep, loose, porous, black, volcanic soil; solitary, emergent palm from 650–900 m alt., 12 October 1974, *de Vogel 3386* (K); Bacan Island: Gunung Sibela, near Waiaua, alt. 1,050 m, rather dense primary forest 35 m high, with little undergrowth, steep hillside, rather dry, on shallow, clayey soil with stones, bedrock gray schists, 26 October 1974, *de Vogel 3681* (K).

The several recent specimens of *de Vogel* have improved our understanding of this species, which in general is very similar to *Gulubia costata*. The principal difference is in the fruit, *Gulubia moluccana* lacking the very prominent series of fibrovascular bundles that give the fruit of *G. costata* its distinctive ribbed appearance. The inflorescence of *G. moluccana* appears smaller, from *de Vogel*'s specimens, with rachillae only half the length of those in *G. costata*. It is likely that *G. moluccana* represents a relictual, more generalized species directly ancestral to the widespread *G. costata*.

2. ***Gulubia costata*** (Beccari) Beccari in *Ann. Jard. Bot. Buitenzorg* 2: 134. 1885.

Kentia costata Beccari, *Malesia* 1: 36. 1877. Type: *Beccari s.n.* 1873 (filed under accession number 11152 in FI) (holotype FI, photos at BH).

Gulubia affinis Beccari in *Bot. Jahrb. Syst.* 58: 444. 1923. Type: *Leder-*

mann 8228 (holotype B, believed destroyed).

Gulubia costata var. *minor* Beccari in *Ann. Jard. Bot. Buitenzorg* 2: 135.

1885. Type: *Beccari s.n.* 1875 (filed under accession number 11153 in FI) (holotype FI).

Gulubia costata var. *pisiformis* Beccari *op. cit.*, p. 136. Type: *Beccari s.n.* 1878 (filed under accession numbers 11149 in FI) (holotype FI).

Gulubia costata var. *gracilior* Burret in *Notizbl. Bot. Gart. Berlin-Dahlem* 13: 81. 1936. Type: *Brass 5887* (holotype B, believed destroyed; isotypes NY, A).

Tall, moderate palm to 20 m or more in height; stem 20–30 cm in diameter; leaf sheath 75–150 cm long, green, tinged with lilac, glabrous to finely light-brown-tomentose near the tip, petiole 35–60 cm long, blade 220–420 cm long, petiole and rachis finely white-woolly and brown-lepidote above and below, pinnae pendulous, 43–77 on each side, 97–127 cm long, 5.5 cm wide with the apex deeply bifid (or hooded in life), upper surface glabrous, lower surface minutely brown-dotted and with large, whitish, basifixed ramenta along the lower third of the midrib. Inflorescence branching to 2–3 orders, 70–125 cm long, the upper peduncular and rameal bracts rudimentary, triangular, to 6 mm long or represented only by horizontal scars; rachillae straight or sometimes somewhat flexuous, to 62 cm long, 2–3 mm thick, bearing up to 280 triads. Staminate flowers cream-colored, soapy-scented, 6–7 mm long, stamens 6, shorter than the petals, pistillate flowers 1.5 mm high, flushed with pink; fruit 7–9 × 4.5–5 mm, blue-gray with whitish stripes over prominent fibrous ribs; endosperm homogeneous.

Distribution: Ubiquitous in lowland New Guinea, also found in the Aru Islands, Bismarck Archipelago, and northeastern Queensland.

SPECIMENS EXAMINED: INDONESIA.

Aru Islands: Vokan, April 1873, *Beccari s.n.* (11152 in FI) (type number), s.n. (11152A-F) (FI, photos at BH); Ansum, April 1875, *Beccari s.n.* (11153) (type of *G. costata* var. *minor* (FI); Java (cultivated): Buitenzorg (Bogor) Botanical Garden, May 1878, *Beccari s.n.* (11149) (type of *G. costata* var. *pisiformis*), s.n. (11149) (FI); Irian Jaya: Aria, near Uta, alt. 4 m, 28 June 1941, *Aet* 386 (K); PAPUA NEW GUINEA. West Sepik Province: Aitape Subprovince, near Sumo Village, Rhinbrum River, in tall forests on river flats, alt. ca. 50 ft, 5 July 1961, *Darbyshire & Hoogland* 8087 (CANB, BH); near Walwali Village, along Pieni River, in forest, alt. 100 ft, 20 June 1961, *Darbyshire & Hoogland* 7971 (CANB, BH); East Sepik Province: alluvial forest along a creek near Mt. Hunstein, 200 m, July–August 1912, *Ledermann* 8228 (type of *G. affinis*, B, believed destroyed; along Frieda River, a few miles downstream from Carpentaria Exploration Pty. airstrip, swampy forest, 27 April 1978, *Essig & Young* LAE 74053 (LAE, BH, USF); Wewak Subprovince, 2 miles west of But Village, alt. 20 ft, disturbed lowland forest, 12 January 1972, *Essig* LAE 55129 (LAE, BH); Angoram Subprovince, near Kabriman Village, along the Blackwater River, in a sago swamp, alt. 30 m, 29 October 1972, *Leach* NGF 34312 (LAE, BH); Morobe Province: Kaiapit Subprovince, base of Kassam Pass, gallery forest along stream in broad, open ravine, alt. 600 ft, 3 June 1971, *Stone* 10249 LAE 53549 (LAE, BH); Lae Subprovince, wet lowland forest along Markham River on Lae–Bulolo Road, 7 March 1964, *Moore* 9273 (LAE, BH); Milne Bay Province: Raba Raba Subprovince, between Kwagira and Moi Biri, coastal rain forest, alt. 50 ft, 7 July 1972, *Essig* LAE 55521 (LAE, BH); Central Province: road from Mori River to Yanu Village, ca. 15 km N.E. of Cape Rodney, rain forest on gently undulating terrain, alt. ca. 30 m, 5 September 1969, *Pullen* 8218 (CANB,

BH); Port Moresby Subprovince, along the Subitana Road, near the Musgrave River, disturbed rain forest in hilly country, alt. 1,800 ft, 23 February 1972, *Essig* LAE 55178 (LAE, BH); Western Province: near Wuroi, along the Oriomo River, common, a conspicuous feature of the riverbank forest, January–March 1934, *Brass* 5887 (type of *G. costata* var. *gracilior*, holotype B, believed destroyed; isotypes NY, A); common among river banks, Palmer River, 2 miles below junction with Black River, July 1936, *Brass* 7245 (A, BH); occasional in rain forest near Lake Daviumbu, August 1936, *Brass* 7951 (A, BH); West New Britain Province: Hoskins Subprovince, cutover rain forest at the foot of Mt. Otto, 26 April 1972, *Essig* LAE 55213 (LAE, BH).

Gulubia costata is one of the most common and abundant palms in lowland New Guinea. The species occurs on mesic, well-drained soils in hilly terrain as well as in swampy or seasonally flooded situations. *Gulubia affinis* was described from a specimen collected in the Sepik River Basin in an alluvial forest near Mt. Hunstein. It differed from *Gulubia costata* supposedly in that the petals of the staminate flowers were drawn out into long bristle-like tips. Fruit were lacking from the specimen, but in other important respects, *Beccari's* description conforms to *Gulubia costata*. The habitat, overall dimensions, nature of the foliage, number of stamens, size of the flowers, plus the fact that *Gulubia costata* is abundant in the upper Sepik Basin, all suggest that the unusual shape of petals in *G. affinis* represents a minor variation in the broadly distributed species. The several varieties that were described also appear to be based on minor variations of no taxonomic significance. *Gulubia costata* var. *minor*, collected from the Aru Islands, not far from the type locality of the species, has somewhat smaller overall dimensions, as well as smaller fruit. *G. costata* var. *gracilior* was based on a very similar speci-

men from western Papua. In the collection notes for the latter specimen, Brass indicated that the individual was extremely tall. Leaves, inflorescences and fruit frequently become smaller as palms get taller. *G. costata* var. *pisiformis* was based on a specimen cultivated at Bogor, which had fruit somewhat more globose than the typical form. There is no evidence that this corresponds to a naturally occurring variation worthy of taxonomic status.

3. ***Gulubia longispatha*** Beccari in Bot. Jahrb. Syst. 52: 25. 1914. Type: *Schultze 323* (holotype B, believed destroyed).

Gulubia crenata Beccari in Bot. Jahrb. Syst. 58: 445. 1923. Type: *Ledermann 8449* (holotype B, believed destroyed).

Gulubia obscura Beccari, *op. cit.*, p. 447. Type: *Ledermann 9133* (holotype B, believed destroyed).

Gulubia brassii Burret in Notizbl. Bot. Gart. Berlin-Dahlem 12: 336. 1935.

Type: *Brass 5457* (holotype B, believed destroyed; isotypes A, NY).

Tall slender palms to 24 m or more in height; stem 10–25 cm in diameter; leaves 16–19 in a crown, strongly arcuate, sheath 95–120 cm long, petiole 12–20 cm long, blade ca. 240–250 cm long, petiole and rachis thickly brown-lepidote above and below; pinnae erect, but drooping at the tips, 50–69 on each side of the rachis, 65–95 cm long, 2.1–4 cm wide, deeply bifid at the apex, with the upper margin much prolonged, upper surface minutely and sparsely dotted, the lower surface the same and with several to many large, pale ramenta on the midrib (lacking in Mt. Suckling population). Inflorescence 60–90 cm long, branching to 2 orders, axes and flowers white, glabrous; rachillae ca. 50–60 cm long, 1–4 mm wide, bearing 80–185 triads. Staminate flowers 10–18 mm long, with 9–24 stamens. Pistillate flowers 2–3.5 mm high, with 2–3

staminodes; fruit bright red, subglobose, 7–13 × 4–9 mm when dry; endosperm homogeneous.

Distribution: Widespread in mountainous regions of Papua New Guinea, between (?197) 600 and 1,450 m elevation, often in small, isolated populations on steep ridges.

SPECIMENS EXAMINED: PAPUA NEW GUINEA. West Sepik Province: on steep slopes of mountains south of Frieda River, Carpentaria Exploration Company helicopter pad # K-27, alt. 1,000 m, 1 May 1978, *Essig & Young LAE 74081, 74083* (BH, LAE, USF); East Sepik Province: Ettapenberg, alt. 850 m, *Ledermann 9133* (B, holotype of *Gulubia obscura*, photos only seen at BH); Hunstein Mtns. alt. 1,050 m, *Ledermann 8449* (B, holotype of *Gulubia crenata*, photos only seen at BH); Sepik River, alt. 197 m (location dubious), November 1910, *Schultze 323* (B, holotype of *Gulubia affinis*, photos only seen at BH); Morobe Province: Mountains above Mo River, 5 hours walk from Ana Village, 29 January 1972, *Essig LAE 55166* (BH, LAE); Milne Bay Province: on *Castanopsis* dominated ridge, junction of Ugat and Mayu Rivers, near Mayu I camp (Mt. Suckling Expedition), alt. 700 m, 15 July 1972, *Essig LAE 55231* (LAE, BH), same locality, 17 July 1972, *Streimann NGF 28921* (LAE, BH); Central Province: Bella Vista, common, sporadic in forests, surviving on cleared land, alt. 1,450 m, November 1933, *Brass 5457* (A, NY, isotypes of *Gulubia brassii*). INDONESIA. Irian Jaya: plentiful in mossy forest, 4 km southwest of Bernhard Camp, Idenburg River, alt. 900 m, March 1939, *Brass 13099* (A).

Having carefully examined the cited specimens, in comparison with the type descriptions for *Gulubia longispatha*, *G. crenata*, *G. obscura* and *G. brassii*, I have reached the conclusion that they all represent elements of a single, variable, and widespread species. The examination of

the pericarp anatomy of several of the specimens, representing widespread populations, reinforced this conclusion. The specimens examined shared a unique feature in the genus, namely a distinct series of fibrous bundles in the outer pericarp, similar to that found in some species of the closely related genus *Gronophyllum*. As far as can be determined, the fruit in this species are all bright red at maturity. Leaves are characteristically strongly arcuate, with pinnae ascending but soft and drooping at the tips. The habitat preference of mountainous terrain for this species contrasts with the lowland habitat of *Gulubia costata*.

In this regard, however, the locality given for the type collection of *Gulubia longispatha* is troublesome and possibly an error. The locality is given vaguely as "the Sepik River, altitude 197 m, November 1910." At 200 m, one is still in lowland alluvial forest, the wrong habitat for this species as currently understood. It is recorded, however (Flora Malesiana 1: 478. 1950), that during November (Nov. 2-13) Schultze made a side trip to the mountains south of the Sepik, ascending to Peripetus Peak (alt. 1,492 m), which I have not located, but which apparently is in the vicinity of the Leonard Schultze River, 10-15 miles east of the Frieda River. This, then would be very close to where I collected the species and observed it in great abundance. It is possible and likely that the type of the species was collected on this side trip at an altitude considerably above 197 m.

The populations in the Sepik Basin are homogeneous with respect to stamen number (9), but those in the southern part of the range are more variable. *Gulubia brassii* has 20-24 stamens, which at first prompted me to maintain it as a separate species. Other populations bridge the gap, however. The specimen from the Morobe Province has 12 stamens, and the specimens from the Mt. Suckling area have 18. With the addition of the anatomical data

from the pericarp, it became evident that *Gulubia brassii* could no longer be maintained.

4. ***Gulubia valida* Essig sp. nov.** *G. longispathae* affinis sed robustior, foliis rigidioribus, pinnis erectis, apicibus non pendulis, staminibus 12, fructu atrosanguineo vice pallide-rubro differt. Typus: Papua New Guinea, *Essig LAE 55099* (holotypus BH; isotypi A, BRI, CANB, K, LAE).

Solitary palm, with stems 15-20 cm in diameter; leaves about 22 in a crown, strongly arcuate, with pinnae ascending and rigid, not drooping at the tips, sheath 110 cm long, petiole 40 cm long, blade 210 cm long, petiole and rachis brown-lepidote above and below, pinnae about 57 on each side, to 80 cm long, 2.2 cm wide, glabrous above, brown-dotted below, lacking ramenta. Inflorescence branching to 2 orders, with 6-7 secondary axes, these white, glabrous; upper peduncular bract present, 20 cm long, narrow, triangular; rachillae 48 cm long with ca. 134 triads. Staminate flowers white, 17 mm long and 4.5-6.5 mm wide, stamens 12, pistillode lacking; pistillate flowers white, 3 mm high, staminodes 3, dentiform; fruit 11 × 7 mm, dark red to purple; endosperm homogeneous.

Distribution: Elevations around 1,000 m in the Torricelli Mountains of north central New Guinea.

SPECIMENS EXAMINED: PAPUA NEW GUINEA. West Sepik Province: Lumi Subprovince, Torricelli Mtns., near the village of Fatima, beside the road running eastward from Lumi, alt. ca. 3,000 ft, 26 November 1971, *Essig LAE 55099* (holotype BH; isotypes A, BRI, CANB, K, LAE).

Gulubia valida appears to be most closely related to *Gulubia longispatha*, but there are clear differences in the foliage and fruit. The leaf rachis is not as strongly arcuate as in *G. longispatha* and

the pinnae are stiff and erect, not drooping at the tips as in that species. The epithet *valida* refers to the strength and robustness of the foliage. The fruit lack the series of fibrous bundles in the outer pericarp characteristic of *G. longispatha*, but otherwise the pericarp structure is very similar (Fig. 11). The fruit also ripen to a dark red color, as opposed to the bright red of the neighboring species. In addition, *G. valida* has staminate flowers with 12 stamens while the nearest populations (all those in the Sepik Basin) of *G. longispatha* have staminate flowers with 9 stamens.

The new species might be confused with a species of *Gronophyllum* (*G. cf. mayrii*) that occurs in the Torricelli Mtns. at somewhat higher elevations (*Darbyshire 464* at CANB, LAE), and which apparently has a similar overall appearance. The generic distinction (of longer, valvate petals in the pistillate flowers) is clear, however. Also, the *Gronophyllum* has fewer pinnae per leaf (38 per side as opposed to 57 per side in the *Gulubia*), and the pinnae of the *Gronophyllum* possess numerous conspicuous ramenta on the lower surface. Flower color is not known in the *Gronophyllum*, and the fruit color was recorded by *Darbyshire* as pale brown.

5. ***Gulubia macrospadix*** (Burret) H. E. Moore in *Principes* 10: 88. 1966.

Paragulubia macrospadix Burret in Notizbl. Bot. Gart. Berlin-Dahlem 13: 84. 1936. Type: *Kajewski 1787* (holotype B, destroyed; isotype A).

Gulubia niniu H. E. Moore ex T. C. Whitmore, Guide to the Forests of the Solomon Islands, 1966, name only.

A tall, solitary palm to 20 m in height; stem ca. 11–12 cm in diameter; leaves ca. 20–25 in a crown, arcuate, with pinnae drooping at the tips, sheath ca. 60–90 cm long, petiole 35–50 cm long, blade ca. 150–195 cm long, petiole and rachis

brown-dotted, pinnae ca. 30 on each side, 82–100 cm long, 2.5–3.5 cm wide, tip very briefly praemorse or notched, lower surface glaucous, with ramenta lacking or few and inconspicuous at the base of the midrib. Inflorescence, 40–90 cm long, branching to 2 orders with 7–11 primary branches and 11–24 rachillae, upper peduncular and rameal bracts lacking; rachillae 25–36 cm long, ca. 2 mm wide, glabrous, bearing ca. 150 triads. Flowers red to rose in color. Staminate flowers 8 mm long, 3 mm wide, with 6–9 stamens. Pistillate flowers globose-pyramidal, 3.5 mm high, with 3 dentiform staminodes. Fruit 12–16 × 8 mm, bright crimson, seed with ruminant endosperm.

Distribution: Bougainville and Santa Ysabel in the Solomon Islands.

Local names: *niniu* (Kwara'ae language), *kuritu* (Bougainville).

SPECIMENS EXAMINED: PAPUA NEW GUINEA. Bougainville Province: Kugumara, Buin, 28 May 1930, *Kajewski 1787* (holotype B destroyed, isotype A); SOLOMON ISLANDS. Santa Ysabel: Bogotu Peninsula, slopes of ridge on mainland opposite Horara Village near Tatamba, alt. 0–500 ft, 22 March 1964, *Moore & Whitmore 9305* (BH, BSIP); Maringe Lagoon, near Tiratona Village, on a broad ridge, alt. 1,600 ft, 23 October 1963, *Whitmore BSIP 2325* (BSIP, K).

This treatment is based essentially on that of Moore (1966), as I have not seen any specimens other than those used in his analysis. *Gulubia macrospadix* is distinguished from all other species in the genus by the ruminant endosperm of its seed. This prompted Burret to erect a new genus for the species, a move which he believed was bolstered by the praemorse character of the pinnae. Moore rejected the new genus, pointing out that ruminant and homogeneous endosperm coexist in many genera, and that other species of *Gulubia* also have slightly praemorse tips. The fruit is also distinctive by virtue of a

ring of fibrous bundles that interrupts the tanniferous zone in mid-pericarp.

6. ***Gulubia hombronii*** Becc. in *Webbia* 3: 161. 1910. Type: *Hombron s.n.*, 1838-1840 (holotype P).

A tall, solitary palm, to 15-20 m in height; stem 12-15(-28) cm in diameter; leaves 12-20 in a crown, strongly arcuate with pinnae erect, sheath 50-75(-90) cm long, petiole 18-20(-30) cm long, blade 100-140(-180) cm long; petiole and rachis glabrous, slightly glaucous above; pinnae 36-38(-46) on each side, 45-67(-75) cm long, 2-3.7 cm wide, with apex briefly notched, lower surface with many small, pale, basifixed rammenta on the lower 10-12 cm of the midrib. Inflorescence 40-55 cm long, simply branched or the 1-2 lower branches forked, with 7-9 rachillae; peduncular and rameal bracts lacking; axes white, glabrous to finely brown-dotted; rachillae 36-50 cm long, 2.5-4 cm in diameter, bearing up to 138 triads. Staminate flowers 11 mm long, 4 mm wide, deep rose in bud, becoming rose-pink shading to ivory at the tips when expanded, fragrant, calyx white, stamens 10-12. Pistillate flowers pinkish. Fruit 14-17 × 6-6.5 mm, ripening dull red; seed with homogeneous endosperm.

Distribution: Widespread in the Solomon Islands.

Local names: *bulatari* (Kwara'ae language), *bombua* (Longu language).

SPECIMENS EXAMINED: SOLOMON ISLANDS. St. Georges Island: "durante il viaggio dell'Astrolabe e della Zelee" (1838-1840), *Hombron s.n.* (holotype P, not seen, photo at BH of fragment at FI); Santa Ysabel Island: Cape Prieto, plentiful on crests of steep, scantily vegetated mountain spurs, alt. 200 m, 14 January 1933, *Brass 3749* (A); Bogotu Peninsula, on ultrabasic ridge due west of Tatamba, alt. 0-500 ft, 19 March 1964, *Moore & Whitmore 9296* (BH); poor casuarina forest on ultrabasic soil, Tatamba Bay, 6

November 1965, *Corner 2892* (K, BH); Choiseul (easternmost): Ultrabasic hill on coast opposite Bembalama Island, forest with much casuarina and thick leaf litter layer, 3 March 1964, *Whitmore BSIP 4009* (K); Big Nggela Island: west of Haghela School, ridge top, alt. 350 ft, well-drained primary forest, 28 June 1969, *Gafui & collectors BSIP 15257* (K); Guadalcanal: on ridges above Tambahusu on Suta-Kiki River, alt. 2,000-3,000 ft, 3 November 1965, *Corner 195* (K, BH).

Gulubia hombronii appears to have somewhat smaller dimensions than *G. macrospadix*, and both, in turn, are significantly more diminutive than any of the species in New Guinea. The arcuate form of the fronds suggests a relationship with *Gulubia longispatha*, but the rosy color of the flowers is distinct from the cream-white of that species, and the pericarp structure is different (Fig. 15).

7. ***Gulubia cylindrocarpa*** Beccari in *Webbia* 3: 156. 1910. Lectotype: *Harland s.n.*, 21 June 1905 (FI).

Solitary palm to 27 m in height; stems to 15 cm in diameter; leaves ca. 18 in a crown, strongly arcuate, with pinnae erect; sheath to 95 cm long, petiole to 25 cm long, rachis ca. 2-2.5 m long; upper sheath, petiole and rachis lepidote with reddish and white scales; pinnae ca. 55 on each side, to 95 cm long, to 3.3 cm wide, apex notched, lower surface with a few whitish rammenta near the base on the midrib. Inflorescence branching to 2 orders, the lower primary branches divided into ca. 4 rachillae, with ca. 25-32 rachillae altogether; rachillae to 43 cm long, 2-2.5 mm wide, bearing up to ca. 190 triads. Staminate flowers (mature?) 2.5 mm long (*Kajewski 611*), stamens 6. Pistillate flowers 2.5-4 mm high, 2.25 mm broad, staminodes 2-6. Fruit apparently yellowish at maturity, cylindrical to somewhat ovoid, slightly curved, 12-13 × 5-

6 mm, cupule ca. 3.5 mm high; seed with homogeneous endosperm.

Distribution: New Hebrides.

Local name: *motoval* (fide Harland).

SPECIMENS EXAMINED: NEW HEBRIDES. Vanua Lava: nr. Mt. Garigona, alt. 1,000–1,500 ft, 21 June 1905, *Harland s.n.* (FI lectotype, photo and fragments BH; isolectotype K); Erromongo: 11 miles west of Ipotia, with *Agathis*, *Calophyllum* and *Hernandia*, 28–31 May 1968, *Bernardi 13369* (K, BH); along forestry route, km 12, dense forest, 9 August 1971, *Raynal RSNH 16256* (K, BH); Malekula, South West Bay, east of Wentoua, along the ridge crests, alt. 250–300 m; SOLOMON ISLANDS. Santa Cruz Group, Vanikoro Islands: common in rain forest, alt. 800 m, 11 November 1928, *Kajewski 611* (K).

This species seems to be most closely related to *Gulubia hombronii*. Stamen number is different, and there may be a difference in ripe fruit color, but the cylindrical nature of the fruit does not seem to hold up well when specimens other than the type are examined. The anatomy of the pericarp is most similar to that of *Gulubia hombronii*.

8. *Gulubia palauensis* (Becc.) Moore & Fosberg in *Gentes Herb.* 8: 455, fig. 135. 1956.

Gulubiopsis palauensis Becc. in *Bot. Jahrb. Syst.* 59: 11, fig. 133. 1924. Holotype: *Ledermann 14149* (B, presumed destroyed).

A tall, solitary palm to 18 m in height; stem 15 cm in diameter; leaves apparently arcuate with erect pinnae (as judged from the attachment of the pinnae to the rachis), sheath ca. 57 cm long, petiole ca. 18.5 cm long, blade about 100 cm long, sheath, petiole and rachis thickly brown lepidote; pinnae 35 on each side, 54–59 cm long, 2.2–2.4 cm wide, apex deeply bifid, lower surface with large, pale brown ramenta along the lower 5–10 cm of the midrib. Inflorescence 52–60(–90) cm long, branching to 3 orders, with about

25 rachillae, upper peduncular bract triangular to strap-shaped, 3.8 to 8.5 cm long, axes glabrous, rachillae 30–32(–40) cm long, 1.5–2 mm thick, bearing about 90 traids. Flowers white. Staminate flowers ca. 4 mm long, 1 mm wide, stamens 6, somewhat exerted beyond petals in bud. Pistillate flowers globose-conic, 2–2.5 mm high; fruit ellipsoid, 9–10 × 4.5–5.5 mm, color not noted; seed with homogeneous endosperm.

Distribution: Palau Islands on limestone.

Vernacular names: *bugelangererals*, *subiia* (Palau).

SPECIMENS EXAMINED: PALAU ISLANDS. Urukthapel Island, east end, common on limestone ridge, less so on slopes, alt. 200 ft, 2 April 1950, *Fosberg 324391* (US, BH, BISH); Koror, in calcareous hills, 26 August 1939, *Tuyama s.n.* (fragments from TNS at BH); see also specimens cited by Moore & Fosberg (1956).

This treatment is distilled from Moore and Fosberg (1956), augmented with reexamination of the cited specimens. There apparently have been no more recent collections, and in fact, the species was said to be seriously threatened at the time of Fosberg's visit.

The genus *Gulubiopsis* was established on the basis of the presence in the pericarp of rigid, fusiform fibers, shorter than the entire length of the fruit. The fact that the staminate flowers expand early in bud has also been noted as a generic distinction. Moore and Fosberg did not find these characters to be distinctive enough to warrant generic status, as similar features could be found in other species of *Gulubia*. The species appears to be most similar to *Gulubia longispatha*, but with significantly smaller overall dimensions, including small, staminate flowers with only 6 stamens, and possible differences in pericarp anatomy. cursory examination of dried fruit from *Tuyama s.n.* did not reveal the short, fusiform fibers mentioned by Beccari, however.

9. *Gulubia microcarpa* Essig, **sp. nov.**

G. cylindrocarpae similis sed fructu minore, ca. 10×3 mm, pericarpio tenuissimo. Typus: Fiji, Moore & Phillips 10543 (holotypus BH).

Tall, slender palm to 15 m or more in height; stem 28 cm in diameter; leaves 17 in a crown, arcuate, sheath 76 cm long, petiole 30 cm long, blade 220 cm long; sheath (near top), petiole, and rachis minutely brown-dotted and thinly white-woolly, more thickly so above than below; pinnae erect, not drooping at the tips, 52 on each side of the rachis, to 110 cm long, 3.5 cm wide, bifid to briefly praemorse at the tips, lower surface with up to 4 small, pale ramenta scattered along the lower 15 cm of the midrib. Inflorescence ca. 50 cm long, with about 28 branches, the lower few again branched into several rachillae, incomplete peduncular bracts lacking; rachillae to ca. 42.5 cm long, ca. 2.5 mm wide, bearing ca. 280 triads. Staminate flowers unknown. Pistillate flowers ca. 2 mm high and broad. Fruit whitish when nearly mature, 10×3 mm, cylindrical and slightly curved; endosperm homogeneous.

Distribution: Fiji Islands, known only from the type locality.

SPECIMENS EXAMINED: FIJI ISLANDS: Viti Levi, cutover forest on ridge ca. 8.5 miles inland from Ngaloa, alt. ca. 260 m, 22 March 1980, Moore & Phillips 10543 (holotype BH); inland from Galoa (sic.), on steep slope, alt. 600–800 ft, 10 November 1977, Vodonaivalu L 30688 (SUVA, photo only at BH).

This species is not completely known yet. Staminate flowers have not been seen, and it is not clear what the color of the

mature fruit is. The species is distinctive in its small fruit with very thin pericarp and poorly developed palisade layer. It appears to be most closely related to *Gulubia cylindrocarpa*. The specific epithet was suggested by Professor Moore, to whose memory this paper is dedicated.

EXCLUDED SPECIES

- Gulubia liukiensis* Hatusima in Mem. Fac. Agric. Kagoshima Univ. 1: 39. 1964. Ryukyu Islands. = **Satakentia liukiensis** (Hatusima) H. E. Moore in Principes 8: 5. 1969.
- Gulubia ramsayi* Beccari in Webbia 3: 159. 1910. Northern Australia. = **Gronophyllum ramsayi** (Beccari) H. E. Moore in Gentes Herb. 9: 265. 1963.

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- AND BRADFORD E. YOUNG. 1979. A systematic histological study of palm fruits. II. The *Areca* alliance. *Systematic Botany* 4: 16–28.

ERRATA

Page 76, column 1, line 20: for Manatanai read Namatanai.

Page 84, column 1, line 3: for *Howea forsterana* read *H. forsteriana*;

column 2, line 41: for *Ptychosperma macarthurii* read *P. macarthurii*.