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Type plant of *Ceroxylon mooreanum*, a new species of wax palm from Antioquia, northwestern Colombia. See page 178.

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A Synopsis of the Genus Gulubia

FREDERICK B. ESSIG
Department of Biology, University of South Florida, Tampa, FL 33620

Gulubia is a genus of nine known species in the *Areca* alliance of palms. The genus is distributed from the Moluccas 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 protandrous 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 tanniniferous 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.

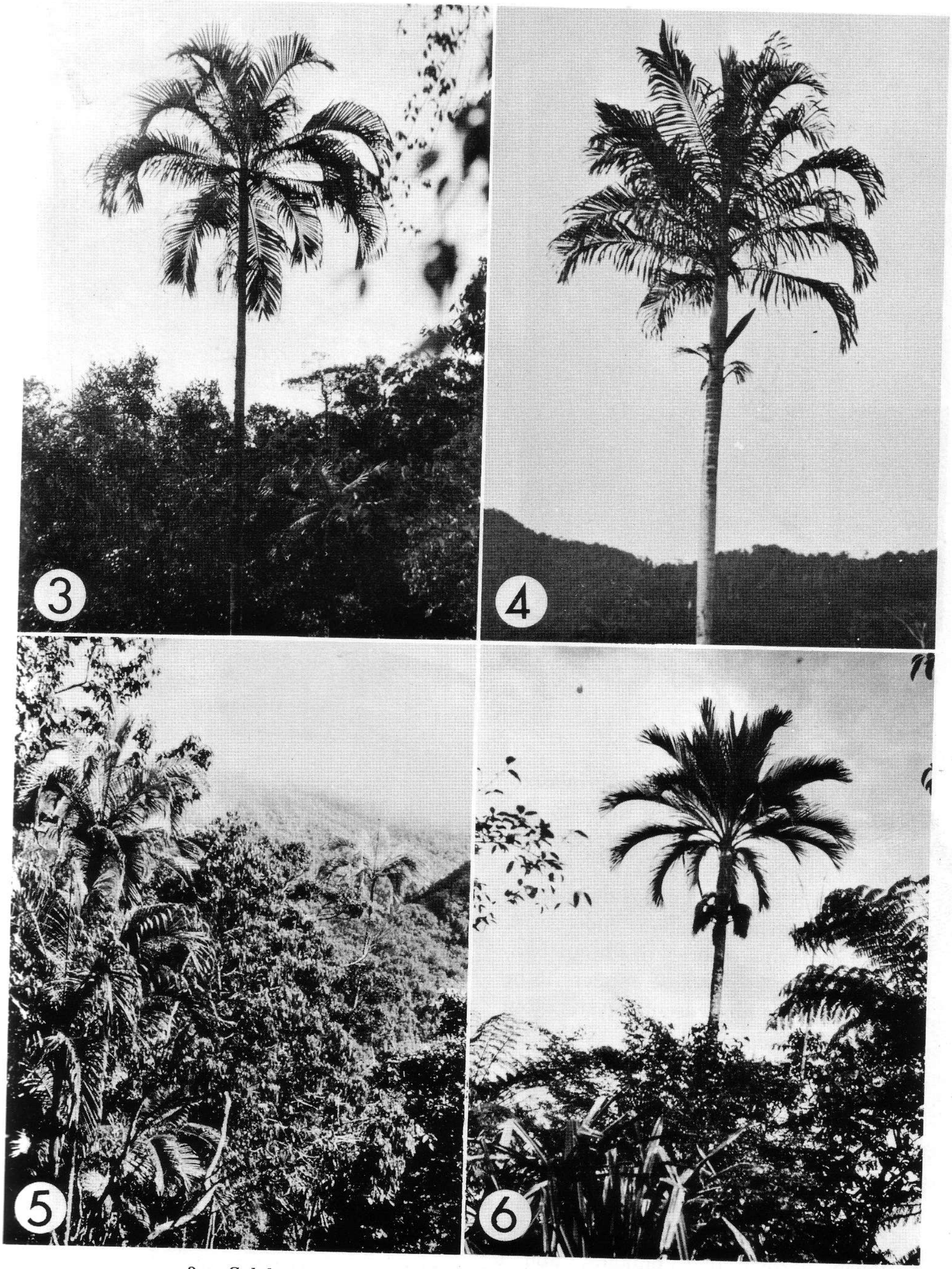
Variation in fruit structure is striking at every level, including the subspecific, so detailed conclusions about the fruit structure in particular species cannot be made based on limited samples. This is illustrated in the specimens of *Gulubia longispatha*, taken from three widely separated populations (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 differentiation of bundles (Fig. 9), which may be taken as a more generalized condition probably ancestral to that in *G. costata*.

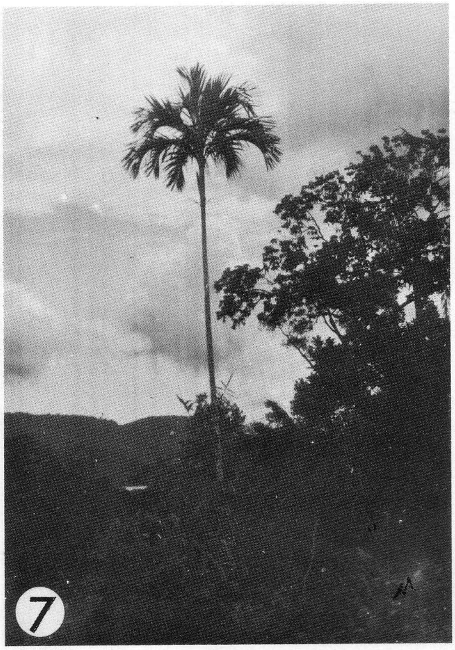
2. *Gulubia longispatha* can be characterized by the presence of a distinct series of fibrous bundles located outside of the tanniniferous zone and apparently not connected with the fibrovascular bundles to the inside of the tanniniferous zone (Figs. 12–14).

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-tanniniferous parenchyma between the fibrovascular bundles and the tanniniferous zone (Fig. 11).

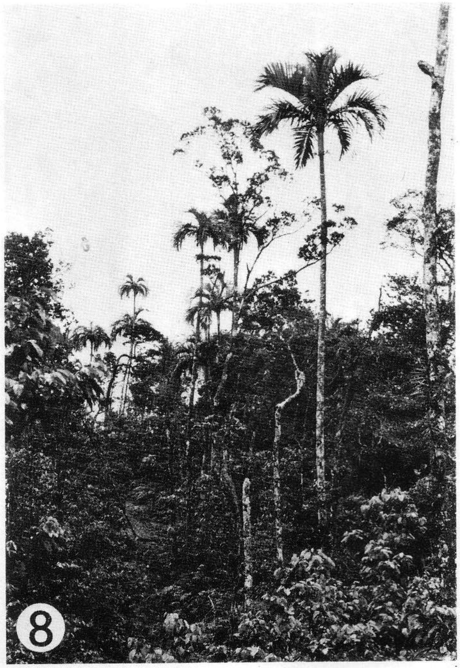
4. *Gulubia hombronii* and *G. cylindrocarpa* appear to be very similar in their fruit structure (Figs. 15 and 18), with the latter species apparently having smaller,



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 ruminate 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.

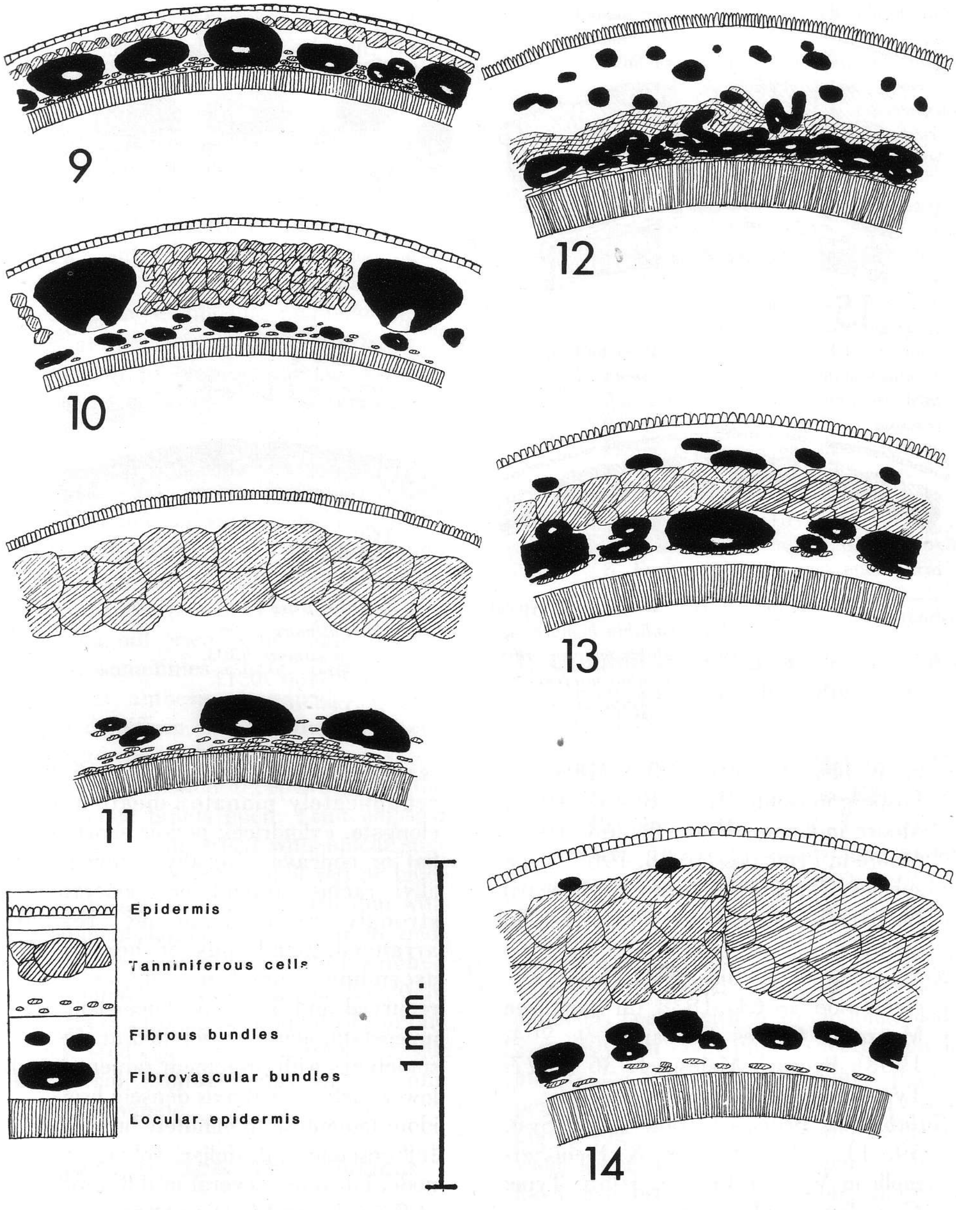
6. *Gulubia microcarpa* has the thinnest pericarp of all species, with markedly flattened fibrovascular bundles, and a locular epidermis only slightly modified in the direction of a palisade layer (Fig. 17).

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).

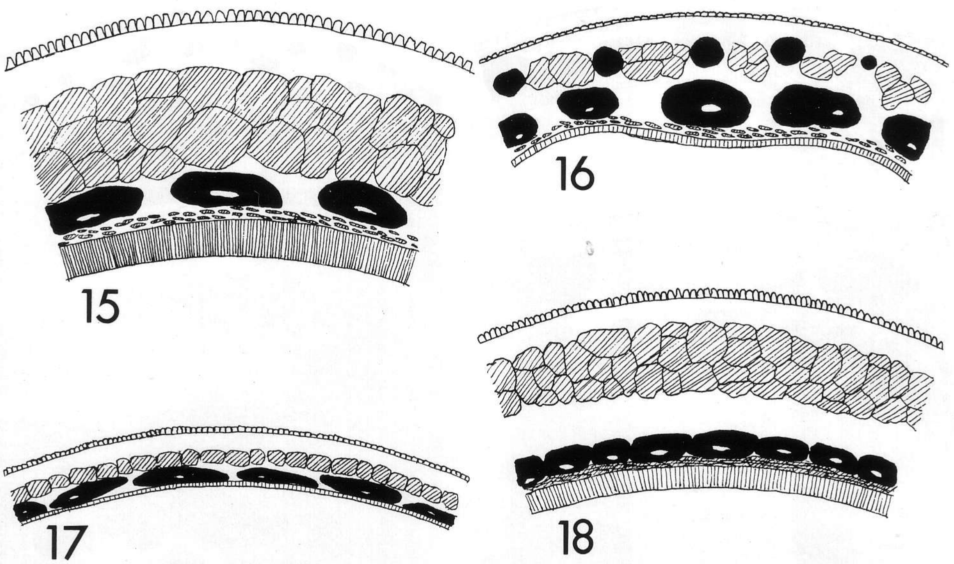
In summary, it appears that each species of *Gulubia* possesses distinctive features in the pericarp, and isolated fruits might be identifiable. Subspecific variation appears to be significant, in at least one species however, and this may confuse the picture. Ultimately, pericarp structure may prove 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 *Beguin 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 reduplicately 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, unicostate, 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 tanniniferous 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 *fide* 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: *Ledermann 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; istotypes 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); Ansus, 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 specimen 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 ruminate 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 ruminate 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 ruminate 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 tanniniferous 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 ramenta 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 Tambalusu 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 ramenta 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 traids. 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 Ipota, 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 exserted 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 liukiuensis Hatusima in Mem. Fac. Agric. Kagoshima Univ. 1: 39. 1964. Ryukyu Islands. = **Satakentia liukiuensis** (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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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. macarthuri*.

Principes, 26(4), 1982, pp. 174–177

Pogonotium moorei, a New Species from Sarawak

JOHN DRANSFIELD
Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AB, UK

In my article "A Day on the Klingkang Range" (Dransfield 1982) I mentioned the excitement of discovering a possible new species of *Pogonotium* from the summit of Gunung Gaharu in Sarawak. I have now been able to examine material of this curious rattan relative in detail and here describe it as new. I name it for Hal Moore, who was much in my thoughts on the day I discovered it and who, I hope, would have been equally excited by its strange morphology.

Pogonotium moorei J. Dransfield, **sp. nov.** (Fig. 1).

Palmijuncus exiguus a *P. ursino* et *P. divaricato* caule brevi, folio foliola c. 9, lata et remota divaricataque ferenti, fructu obpyriformi seriebus verticalibus 15–16 squamarum aliquantum convexarum tecto bene distincta. Typus: BORNEO, SARAWAK, G. Gaharu, *J. Dransfield et al. JD6102* (holotypus K; isotypi BH, BO, L, PNH, SAR).

Solitary, slender, pleonanthic, spiny, dioecious palm with short erect stem to 2 m only; stem without sheaths ca. 10 mm diam., with sheaths ca. 18 mm, internodes ca. 5 cm long. Leaf sheaths splitting opposite the petiole, armed with abundant, close, oblique and horizontal, complete or partial whorls of horizontal or reflexed spines and abundant, pale brown, floccose indumentum; spines varying from minute black spicules scarcely 1 mm long, to sinuous papery, black or straw colored spines to 22 × 1 mm with swollen bases; knee scarcely developed; auricles very conspicuous, one on each side of the petiole, erect, to 8.5 cm long, ca. 1.5 cm wide at the base, tapering to ca. 5 mm wide for much of the length, channeled adaxially, armed as the leaf sheath. Leaf to ca. 1.1 m; petiole to 50 cm, 7 mm wide at the base, tapering to ca. 5 mm, flattened adaxially near the base, rounded in distal region, covered with inflated hairs and scabrid due to papillae, and bearing sparse, mostly lateral or abaxial solitary or paired, short, reflexed, bulbous-based black-tipped spines to 5 mm; rachis as the petiole, tapering, very sparsely armed, sometimes ending in a minute cirrus to 15 mm; leaflets distant, very regularly arranged, ca. 9 pairs in all, alternate proximally, distally in opposite, divaricate pairs, ca. 20–32 × 2.2–2.5 cm, except for the smaller apical pair ca. 15 × 2.5 cm; leaflet margin armed with sparse short bristles; adaxial surface smooth, abaxial surface matt, minutely dotted, sparsely indumentose along the fold;

→

1. *Pogonotium moorei.* **A**, leaf sheath with base of petiole and auricles ×⅔; **B**, sheath with inflorescence removed from sheath in **A** ×⅔; **C**, petiole and base of first leaflet ×⅔; **D**, leaf tip ×⅔; **E**, tip of rachilla with pistillate flower ×4; **F**, sterile staminate flower dissected ×4; **G**, fruit ×4; **H**, vertical section of seed ×2; **J**, seedling ×⅔. Drawn from *Dransfield JD6102* by Mary Millar Watt.

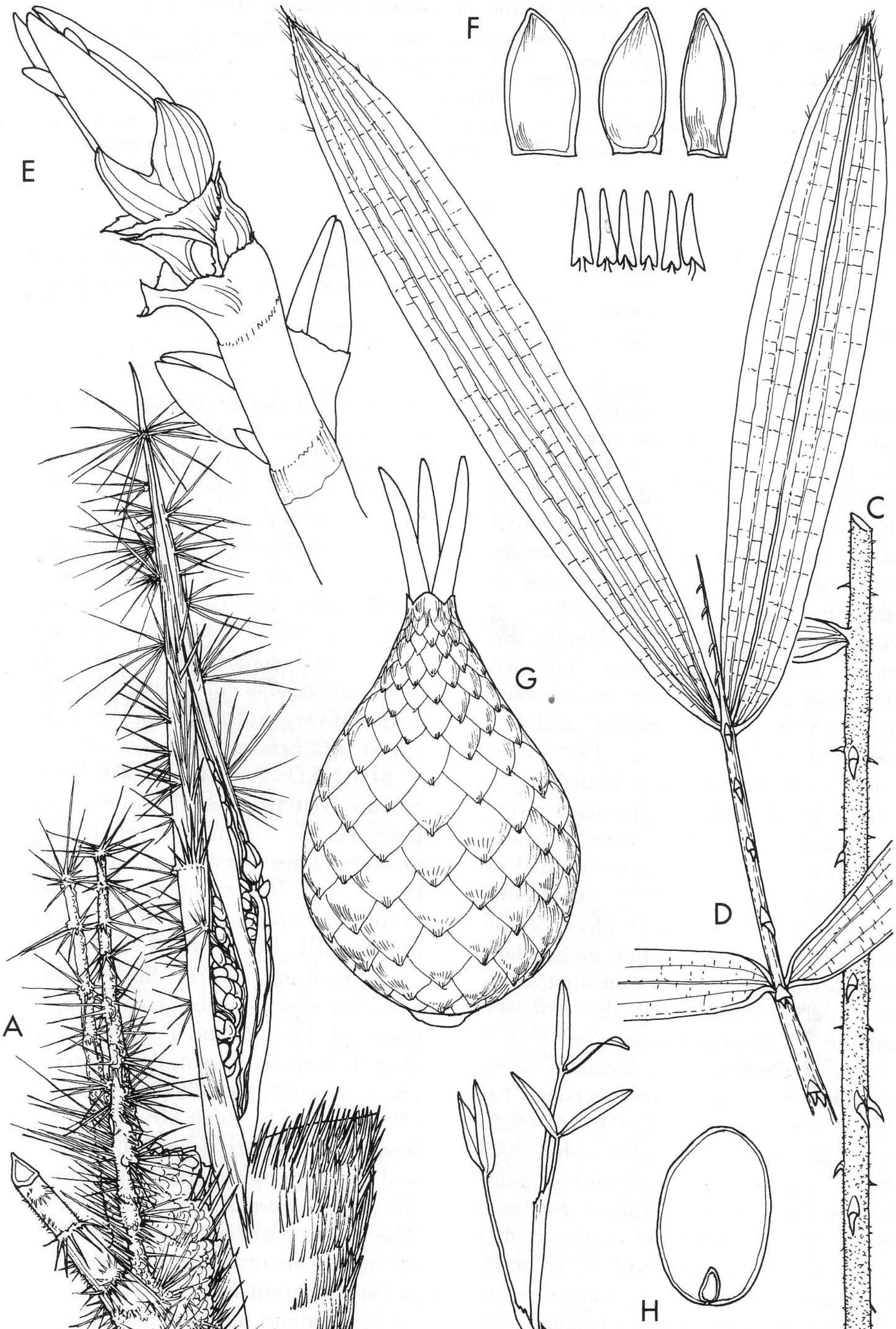
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Table 1. Comparison of species of Pogonotium

	Pogonotium ursinum	*Pogonotium divaricatum*	*Pogonotium moorei*
Leaflets	90–100	40–50	ca. 9
	close, ciliate bristly, limp	narrow, rather distant, sparsely bristly, rigid	broad, remote, very sparsely bristly, rigid
Mature fruit	± barrel shaped	globose	obpyriform
Scales	± flattened, pinkish-brown, in 16–17 vertical rows	grossly swollen and grooved, magenta, in 21–22 vertical rows	slightly convex, pinkish brown, in 16–17 vertical rows

transverse veinlets conspicuous. Inflorescence, only pistillate known, erect, held between the auricles, ca. 18 cm long; peduncle adnate to sheath of following leaf, with free portion 10 × 7 mm; prophyll beaked, ca. 17 cm, split longitudinally along adaxial (always?) face, covered in dense indumentum and in distal ⅔ bearing partial whorls of spines as on sheath; two primary bracts also present, included within prophyll and much smaller, and more sparsely armed; prophyll and primary bracts subtending 1st order branches, the inflorescence branching to 2 orders in all; rachillae sinuous, bearing short tubular, triangular tipped, striate, brown bracts each subtending a diad of sterile staminate and fertile pistillate flowers, all ± included in the prophyll. Sterile staminate flower ca. 4.5 mm long, trigonous; calyx striate, ca. 2 mm high, shallowly 3-lobed; corolla split almost to the base into 3 narrow triangular lobes to 4 × 1.5 mm; sterile stamens 6, filaments fleshy ca. 1.5 × 0.4 mm; anthers oblong ca. 0.9 × 4 mm, pistillode minute. Pistillate flower ca. 7.5 × 3 mm; calyx with a basal tube ca. 2.2 mm and 3 broad triangular lobes ca. 1.5 × 2 mm; corolla with a basal tube ca. 2.0 mm long and 3 striate lobes ca. 5 × 2.5 mm; staminodes 6, epipetalous, filaments flattened, ± triangular ca. 1.5 × 1 mm, empty anthers elongate, ca. 0.75 × 2 mm; ovary ovoid ca. 2.5 × 1.8 mm, covered in pale brown scales tipped with 3 sinuous fleshy stigmas ca. 3.5 × 0.5 mm. Mature fruit borne on persistent perianth whorls, obpyriform, ca. 13 × 9 mm, tipped with a short beak ca. 1 × 2 mm, and stigmatic remains; pericarp covered in 15–16 vertical rows of pinkish-brown scales; seed basally attached, ellipsoidal, ca. 11 × 7 mm; sarcotesta thin; endosperm homogeneous, embryo basal. Germination adjacent-ligular; eophyll with 2 small divergent leaflets, ca. 15 × 3 mm, tipped with bristles.

BORNEO: SARAWAK, 1st Division, Serian District, Sabal Tapang Forest Reserve, G. Gaharu, summit plateau, montane forest developed on sandstone blocks, alt. 700 m above sea level, *J. Dransfield et al. JD6102* (holotype K; isotypes BH, BO, L, PNH, SAR).

Pogonotium moorei differs from the two other species of the genus, *P. ursinum* (Becc.) J. Dransf. and *P. divaricatum* J. Dransf. in the low habit, the leaf with only about 9 broad, remote divaricate leaflets (*P. ursinum* has about 90–100 close leaflets and *P. divaricatum* about 40–50), and the obpyriform fruit with about 15–16 vertical rows of slightly convex scales. The seedling leaf of the new species with its single pair of minute divergent leaflets is very different from the pinnate eophyll of *P. ursinum*; unfortunately, the eophyll of *P. divaricatum* is not known. These diagnostic features of *P. moorei* may be contrasted with those of *P. ursinum* and *P. divaricatum* in Table 1 and in my account of *Pogonotium* (Dransfield 1980).

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Two New Species of Ceroxylon from Colombia

GLORIA GALEANO-GARCES AND RODRIGO BERNAL-GONZALEZ
Laboratorio de Dendrología, Facultad de Agronomía, Universidad Nacional de Colombia, Apartado 568, Medellín, Colombia

Ceroxylon is one of the most poorly studied genera of neotropical palms and a revision of it is highly desirable. With *Ceroxylon floccosum* Burret reduced to synonymy under *C. quindiuense* (Karst.) H. A. Wendl. (Galeano-G. and Bernal-G. 1982), some 19 species make up the genus at present. Most of the species are incompletely described; information about some of them includes scarcely more than the name. Nevertheless, the two species described below are very characteristic and do not seem to match any known taxon. Furthermore, the relatively narrow range of the known species, especially those growing on isolated mountains, suggests that endemism through altitudinal isolation may be common in the genus. This and the fact that very complete information about the two species is available has moved us to describe them as new.

Ceroxylon flexuosum Galeano & Bernal **sp. nov.** (Fig. 1).

Caudex 13 m altus, versus apicem flexuosus. Folia 12–15, crispa: vagina 72–79 cm longa; petiolus 24–31 cm longus; rachis 98–110 cm longa; pinnae utrinque 71–82, in fasciculos 2–7 aggregatae, subtus indumento tenui fusco-flavescenti obtectae, mediae usque ad 56 cm longae. Spadix ad 226 cm longus; bracteae pedunculares 7. Florum femineorum dentes calicis quam ¼ corollae tubo multo minores; staminodia 6. Fructus globosi, verruculosi, maturitate exocarpio rubro. Typus: Colombia, *Galeano & Bernal* 257 (holotypus COL; isotypus HUA).

Trunk to 13 m tall, 15–20 cm diam. at base, more slender and flexuous towards the apex, covered with a thin layer of wax; leaf scars oblique, internodes 21–36 cm long near base. Leaves 12–15, arranged in five vertical rows; sheath 72–79 cm long, 27–30 cm wide, with fibrous margins, covered with brown appressed scaly tomentum, a short distal portion appearing as the petiole; petiole 24–31 cm long, 3.3–3.6 cm wide at apex, green when fresh, scurfy, flat adaxially with a slight central ridge, the margins sharp, convex and greyish-green abaxially; rachis 98–110 cm long, scurfy like the petiole, greyish-green when fresh, flat adaxially to 39–46 cm from base, triquetrous thereafter, flattened abaxially; pinnae 71–82 on each side, irregularly arranged in clusters of 2–7, displayed in several planes, those of the distal ¼ of the leaf regularly arranged in one plane, all pinnae slightly tapering towards the entire usually inequilateral (sometimes almost symmetrical) apex, glabrous, waxy and glossy dark green adaxially, the midrib elevated, yellowish, with a deciduous, brown scurf, the lower surface covered with a thin, compact, persistent indumentum of yellowish-brown, elongate, medifixed scales arranged in longitudinal rows; lowermost pinnae almost filiform, 16–23 cm long, sixth pair of pinnae 29–38 × 1–1.5 cm, central pinnae 44–56 × 3.2–3.6 cm, apical pinnae 20–23 × 0.4–0.6 cm.

1. Group of *Ceroxylon flexuosum* at the type locality. The type specimens were collected from the tree in the center. The individual on the left is staminate.

2. Staminate inflorescence of *Ceroxylon mooreanum.*

Inflorescences up to 8, in different stages, 155 cm long at anthesis, 200–226 cm long in the fruiting stage; prophyll 2-keeled, 34–36 cm long, 8–8.5 cm wide, thin, buff, not entirely encircling the peduncle, with a brown rather deciduous scaly tomentum; peduncle slightly compressed, 80 cm long at anthesis, 137–185 cm long in the fruiting stage, ca. 3 cm wide at apex, with a brown scaly tomentum; peduncular bracts 7, with an indumentum like that of the prophyll, the proximal 4 bracts inserted within 15 cm from the base: first bract carinate, open apically, 51–52 cm long, 2nd bract carinate, open apically, 87–97 cm long, 3rd bract carinate, open ventrally to the middle, 129–130 cm long, 4th bract slightly bicarinate, ventrally split, 139–160 cm long, 5th bract thin, carinate, inserted ca. 37 cm above the base, 132–152 cm long, 6th bract incomplete, open, inserted within the distal ⅓ of the peduncle, 14–20 cm long, 7th bract much reduced, ca. 2 cm long; rachis 54–65 cm long, brown at base when fresh, the upper portion green, the basal ¼ covered with a scaly tomentum, otherwise glabrous; branches 43–47, up to 30 cm long, the longer branches inserted above the rachis base, with rachillae of the 3rd order, straw-colored. Pistillate flowers straw-colored, both fertile and sterile occurring on the same rachilla; fertile flowers 6–8 mm long: calyx teeth minute, triangular, 0.3–0.5 mm long, 0.2–0.3 mm wide, reaching less than ¼ of the corolla tube; petals ovate-triangular, long to very long-acuminate, 6.5–7.5 mm long, connate for slightly less than ⅓ their length; staminodes 6, one opposite each sepal and one opposite each petal; filaments 1–1.5 mm long, abortive anthers 1.2–1.5 mm long, sagittate; gynoecium 4.5–5.5 mm diam., minutely verruculose;

stigmas lateral, recurved on a short style. Fruits green when immature, ripening red; exocarp verruculose, mesocarp yellow; seed globose, dark brown, 1.3–1.5 cm diam.; hilum basal, round, raphe branches deeply depressed, anastomosing, hidden under the brittle adherent testa.

SPECIMEN EXAMINED: COLOMBIA, Departamento de Antioquia, Municipio de Bello, Inspección de San Félix, vía de Ascenso al Alto Los Baldíos, ca. 2,400 m altitude, 27 September 1980 *Galeano & Bernal* 257 (holotype COL; isotype HUA).

Ceroxylon flexuosum is very distinctive in its slender, apically flexuous trunk, the small leaves and the number of staminodes. It is necessary to compare this species with *C. utile* (Karst.) H. A. Wendl., a poorly known taxon.

Due probably to lack of pollination, the infructescence of the type specimen bears fruit which, although sterile, became red and increased in size. The description and measurements of the seed are based on old seed collected from the base of the palm.

The type plant, which we have climbed in order to collect specimens, is one of a group of three individuals cultivated near a farmhouse. These trees (one staminate and two pistillate) are the only known individuals of this species. They are said to have been brought last century from the Alto Los Baldíos, at somewhat higher altitudes, where once they were abundant. The practice of cutting the young leaves for use on Palm Sunday has endangered this species.

Ceroxylon mooreanum Galeano & Bernal **sp. nov.** (Fig. 2, Cover).

Caudex 8 m altus. Folia 17; vagina 107–110 cm longa; petiolus 43–47 cm longus; rachis 148–150 cm longa; pinnae utrinque 81–82, regulariter in eadem planitie insertae, patulae, subtus indumento tenui fusco-flavescenti obtectae, mediae usque ad 64 cm longae. Spadix ca. 230 cm longus; bracteae pedunculares 6. Florum masculorum calicis dentes quam ½ corollae tubo minores. Stamina 6–7(–8). Typus: Colombia, *Bernal & Galeano* 213 (holotypus COL; isotypus HUA).

Trunk 8 m tall, 18 cm DBH, rather uniform, brown, covered with a thin layer of grey wax; leaf scars oblique, internodes 20–31 cm long. Leaves 17; sheath 107–110 cm long, ca. 40 cm wide, costate-carinate, brown, fibrous along the margins, the fibers long and stout, covered with an indumentum of grey scales, the upper portion resembling the petiole; petiole 43–47 cm long, 3 cm wide at apex, green when fresh, adaxially flat, with a slight central ridge, brown-scurfy, abaxially convex, covered with grey medifixed scales, revealing the surface beneath in age; rachis 148–150 cm long, green when fresh, covered with an indumentum like that of the petiole, adaxially flattened to 64–68 cm from base, triquetrous thereafter, convex abaxially; pinnae 81–82 on each side, regularly inserted, almost horizontally arranged in one plane, tapering toward the inequilateral apex, glabrous, waxy and glossy dark green adaxially, the midrib elevated, yellowish, densely covered, like the proximal portion of pinnae, with purplish, white-margined, irregular, rounded, fimbriate, deciduous scales, the lower surface of pinnae densely covered with a thin indumentum of yellowish-brown, elongate, medifixed, persistent scales, arranged in longitudinal rows; lowermost pinnae 36–46 × 0.2 cm, almost triquetrous, fourth pair of pinnae 48–53 × 1–1.1 cm, central pinnae 53–64 × 4.9–5.8 cm, apical pinnae 23–25 × 0.7–0.8 cm, the pinnae of the right side of leaf 5–10 cm longer than those of the left side.

Inflorescences up to 3, almost in the same stage, ca. 230 cm long; prophyll 2-keeled, 43 cm long, 10 cm wide, coriaceous, covered with brown scales; peduncle 140–145 cm long, 3.5 cm wide, compressed, densely covered with yellowish-brown, medifixed, richly woolly-margined scales arranged in longitudinal rows; peduncular bracts 6, their outer surface covered with an indumentum of rufescent, medifixed, yellowish-centered, fimbriate-margined, appressed scales towards the bract margin, the indumentum becoming like that of the peduncle: first bract 95 cm long, 2nd bract 136 cm long, 3rd bract 154 cm long, 4th bract 162 cm long, 5th bract ca. 140 cm long, 6th bract incomplete, 37 cm long, inserted high on the peduncle; rachis 72–75 cm long, either glabrous or covered, only at base, with an indumentum like that of the peduncle; rachillae 53–55, glabrous, up to 32 cm long, subtended by an ovate-oblong abruptly long-acuminate bract, that of the lower branch 10 mm long, 6 mm wide, those of the upper branches smaller, the lower branches branched into rachillae of the 3rd order. Staminate flowers 6–8 mm long; pedicel ca. 0.6 mm long, subtended by an ovate-acuminate bract ca. 1 mm long; sepals ovate-acuminate, 0.9–1 mm long, connate for 0.4–0.5 mm, reaching less than ½ of the corolla tube; petals broadly elliptic, abruptly long-acuminate, 5–6.2 mm long, 2.5–3.2 mm wide, connate for 1.4–2 mm; stamens 6–7(–8), 1 opposite each sepal, 1–2 opposite each petal; filaments 1.9–2.2 mm long, anthers 3.7–4.2 mm long, 1–1.5 mm wide, basally bifid for 1.4–1.7 mm, shortly bifid at apex, slightly unequal; pistillode 1 mm long, long and narrow, 3-lobed, with long abortive stigmas, ca. 0.6 mm long.

SPECIMEN EXAMINED: COLOMBIA, Departamento de Antioquia, Municipio de Bello, Inspección de San Félix, vía de Ascenso al Alto Los Baldíos, ca. 2,400 m altitude, 12 August 1980. *Bernal & Galeano* 213 (holotype COL; isotype HUA).

Ceroxylon mooreanum is dedicated to the memory of Dr. Harold E. Moore, Jr., as an acknowledgment of the stimulus he gave to our study of Colombian palms, up until his very death. Through his lifelong love of palms and tireless field and herbarium work, he contributed greatly to a better knowledge of the family. His special interest in the genus *Ceroxylon* drove him to clear up finally the identity of *C. alpinum* Bonpl. ex DC., the type species of the genus (Moore and Anderson 1976).

Ceroxylon mooreanum differs from the remaining species with six stamens, in the regularly arranged pinnae and the dense woolly indumentum of the peduncle. Since the pinnae of the right side are usually longer than those of the left side, leaves bend to the right in the distal half, where the rachis is more slender and triquetrous (see cover photo). This bending of the leaves gives the palm a very characteristic appearance.

Two other species, *C. sclerophyllum* Dugand, from northeastern Colombia and *C. latisectum* Burret, from Peru, resemble *C. mooreanum* in their regularly arranged pinnae, but they can be told apart, *inter alia*, because the calyx teeth are almost as high as or higher than the corolla tube. This character has proved to be constant enough to be of taxonomic importance. Further knowledge of these species may reveal additional differences.

The type plant of this species is cultivated near a farmhouse less than one kilometer away from the type of *C. flexuosum* and it is also said to have been brought from the Alto Los Baldíos, where it is now rare.

A second individual, also a staminate plant, is cultivated in the main square of El Retiro, 33 kilometers east of Medellín. The trunk of this individual is some 16 meters tall, which suggests that the type plant is still not fully grown.

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Principes, 26(4), 1982, pp. 186–193

Tributes to Harold E. Moore, Jr.

Hal Moore: A Scientific Contribution

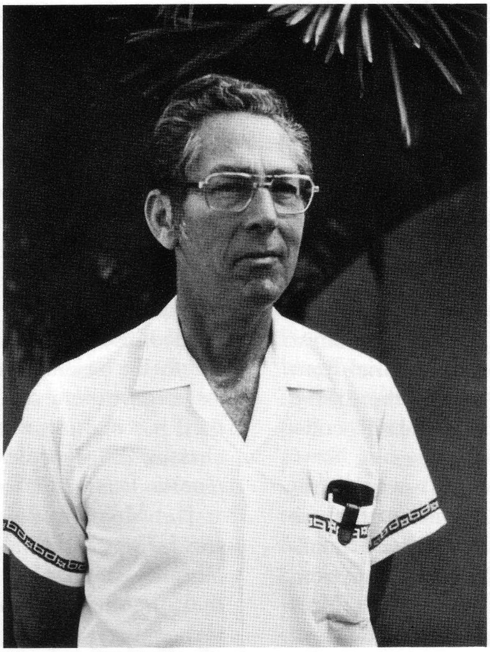
I first met Hal Moore when he was working in London at the Royal Botanic Gardens, Kew in the summer of 1956, a place I also was visiting at the time, on my first leave from West Africa. We had corresponded previously because I had already initiated studies on the systematic anatomy of palms as a student at Kew, prior to working on the family in Singapore and Ghana. Hal was eager to learn how my observations on the distribution of anatomical characters in palms correlated with his developing ideas about the systematics of the family. This was an early indication of Hal's appreciation that systematics should be broadly based. He later was to incorporate information from many other disciplines into the superstructure he was building and I was only one of a number of young scientists whom Hal encouraged in their particular field of specialization.

At Kew an instant rapport was established, not merely because we had much common ground to cover in our discussion, but also because his open spirit and free presentation of his thoughts made the communality of our interests quite clear. David Bates (*Principes*, Jan. 1982) has already indicated how this was a general response that Hal drew from a diversity of acquaintances from all walks of life and I am sure many other readers will be able to identify with these sentiments when they recall their first meetting with Hal.

Our conversations were not restricted to palms and frequently were quite philosophical. We discussed at one stage the intellectual satisfaction of scientific research and the process of discovery which it involved, a satisfaction which was more than adequate compensation for the frequent lack of monetary reward. At one point he spread his fingers on the table before him and said with a twinkle in his eye "Yes, I have no diamonds on my fingers, but the diamonds in my mind's eye are far more valuable."

This continuing frankness and enthusiasm had the infective consequence that I subsequently scarcely ever published a scientific paper on palms without first sending this to Hal for his evaluation. Sometimes this got me into trouble because he did not always agree with my conclusions or even observations, but even if his criticisms were penetrating they were also well reasoned and fair, just the thing to make those diamonds in the mind's eye sparkle. In addition if he could be won over to your point of view he became as staunch an advocate as he had been a critic and if I lost some battles, I also won a few too and I treasure those victories as triumphs of rationality.

Our meeting in London that year was very influential to my own career. Hal mentioned that Fairchild Tropical Garden was looking for a scientist who was interested in the development of their research program and that it would be particularly appropriate for somebody working on palms to be involved. Subsequently I visited the United States, with Hal as my primary contact; we drove from Ithaca to Miami where I had the chance to see at first hand the splendid opportunities for research on tropical plants that the Garden's rich collections offered. It did not take much deliberation to make up my mind and I was established at Fairchild late in 1960—as soon as my existing commitments and the U.S. Immigration Service allowed. During those early days Hal continued to be a frequent visitor; we worked together on a number of problems



1. Harold E. Moore, Jr. at Fairchild Tropical Garden, July 1973. Photo by G. R. Proctor.

and a steady stream of his students were drawn as best we could into the developing program. I think neither Hal nor the Garden's administration could have had a clear idea of how the program would develop but history suggests that they got it right because the Garden's research activities have gone from strength to strength and become quite diversified so that an international reputation has been established quite out of proportion to the number of people involved and the size of the facility. His direct influence was very strong.

My own professional development depended much on the opportunities that Hal had effectively laid before me, opportunities which could scarcely be equalled elsewhere. Further advancement took me away from the environment which first nurtured me in the United States, but the initial debt is obvious. This, I am sure, documents just one example of the way Hal's generous and positive friendship was individually beneficial, the ultimate outcome was that scientific endeavor was facilitated. But these are personal recollections; I would like to go on to exemplify Hal's scientific contribution by putting his work on the systematics of palms in a historical context in a way which has obvious relevance to readers of *Principes*, especially as David Bates has eloquently outlined the main features of Hal's scientific achievements.

Palm systematics—a historical overview

Linnaeus knew the palms only from the 12 species he described, but this was sufficient to circumscribe the family and suggest it to be unique and therefore isolated, a fact with which most systematists still concur. A number of monocotyledonous families have some relationships, but modern research tends to set the palms even further apart from them, rather than suggest a particular group with close affinity.

Most significant developments have therefore been concerned with the subdivision of the palm family. The foundation for this was that developed by K. F. P. von Martius in his sumptuous "Historia Naturalis Palmarum," published in three volumes over the period 1829–1853. This work was based partly on material assembled by von Martius himself during his own travels in South America, together with information provided by several specialist contributors, notably that of the anatomist Hugo von Mohl. Additional material from other parts of the tropics was either in the form of dried collections or plants cultivated in the great stove houses of Nineteenth-Century Europe. The essential tradition, however, was established that the systematist needed extensive field familiarity with the palms in natural environments if he were to know them well. Martius recognized many major groups of palms whose discreteness is still accepted and he was able to document his subdivision with a wealth of detail which reflected his great familiarity with palms as growing organisms. That tradition has been maintained, by and large, to the present since palms are totally unsuited to herbarium study, consequently the most significant advances have been made by botanists who made many of their own collections.

A process of refinement of the von Martius system was carried out by a number of systematists notably Bentham and Hooker (1883) and Drude (1889). The basis for Hal Moore's own beginnings was perhaps the system provided by the German botanist Burret (1953) and particularly by the great Italian botanist Odoardo Beccari. Beccari made extensive contributions in the form of several large monographs and had field familiarity with palms resulting from his extensive journeys in southeast Asia. He never published his final views in his own lifetime, but a synopsis prepared by R. E. G. Pichi-Sermolli dealing specifically with the arecoid alliance was published in 1955.

This was the legacy which Hal Moore inherited when he began his studies on palms in the early 1950's. It was founded on classical botanical lines and used evidence derived from external morphology in its assessment. Even so the historical basis was broad, because not only features of flowers and fruits but seedling morphology, inflorescence structure and leaf form were incorporated. Von Martius, for example, recognized that palms could be divided into two major categories according to the orientation of the folds of the leaf segments, a seemingly subtle distinction, but one more fundamental than the obvious difference between palmate and pinnate leaves.

Hal Moore built on this foundation in several ways. He broadened the scope for morphological study and showed clearly that the inflorescence *in toto* provided taxonomic features, which were only evident when the whole branch complex was dissected from the crown, and seen at different developmental stages. This dynamic approach characterized much of his morphology; few systematists have emulated him in this respect. He travelled extensively to assemble as much research material of palms as possible. In doing so he probably saw more palm species in natural environments than any previous botanist. He regretted not having seen every genus in nature but he came very close to it. He also established new standards of collecting, following the advice and example of his mentor, L. H. Bailey. He not only selected material for the herbarium with skill and care, but documented information with photographs and extensive field notes. In addition every effort was made to provide material for cytological research, systematic anatomy and, in later years, material for the study of aspects of floral and fruit development. This kind of extension is difficult for the field worker who has not only to find his way to the site, but now has to carry bulky collecting equipment including rather objectionable fixation fluids and once the task is completed transporting the collections safely back to the ultimate base. Finally arrangements for shipment to the herbarium and laboratory must be made. Anyone who has worked with Hal Moore in the field knows that his physical involvement was total and he always seemed to reserve the most difficult and tedious tasks for himself. Out of this came the full and careful descriptions which characterize his published work, the insights into biological features and assessments of ecological requirements, which could be essential to the successful cultivation of the living material that was frequently brought back. Here Hal's concern was not just for the possible horticultural value of his living collections, but the appreciation that further studies would best be promoted by having living specimens accessible for other workers.

Much of the material he assembled he turned over to his students and associates because he recognized the need for special techniques and approaches if his broadly-based synthesis of palm systematics was to be successful. The summation of this incorporation of new information into the systematics of palms is reflected in his publication "The major groups of palms and their distribution" (Gentes Herbarum 11: 27–141, 1973). The synthesis is here preliminary and will be completed in his "Genera Palmarum" by Natalie Uhl and John Dransfield, but was sufficient to show how information from adjacent disciplines of cytology, anatomy, development, geography and paleobotany could be incorporated into the existing grander scheme. The classical morphological details are still included, but displayed with great precision and uniformity. The subdivision of the groups is carried out to a consistently refined degree. The skeletal system of von Martius is now fleshed out with the solid substance of Twentieth Century science.

Nevertheless the caution of the critical scientist is still evident because there are frequent indications of where the gaps in our knowledge lie and the scope for continued work is continually stressed. The concept of systematics as an "unending synthesis" was very clear in all Hal's research, no systematic work is ever complete and the continual need to examine conclusions in the light of new evidence was always strong in his mind. He had discussed the possibility of doing serological work when these techniques were first developed in relation to systematics, other kinds of chemical systematics interested him, he was always sure that the structure of the pollen still had much to reveal about palm systematics. It was only lack of manpower and available expertise that prevented him from directly adding information from these disciplines to elaborate his systematic studies. But since the synthesis is indeed unending, they surely will find their place in future studies. The quintessence of this caution was that he was still unprepared to recognize his groups as formal categories in the sense of an established hierarchy bound by the rules of precise nomenclature, but his intentions were quite clear in the conspectus that was presented.

Apart from the sheer volume of new evidence that was brought to bear in the development of his new framework for palm systematics, and the diversity of disciplines from which information was drawn, a unique feature of his taxonomic scheme was the strong evolutionary emphasis that was evident in his classification, as in his thinking. The precursory natural grouping of von Martius is here largely transformed into 5 major evolutionary lines within which further degrees of specialization could be recognized. He made a distinction between primitive and advanced characters, and to some extent even groups, which largely reflected his knowledge of current evolutionary ideas. He had strong beliefs about the evolutionary status of palms and considered them an ancient, but not necessarily primitive group. He was able to place his discussion of the geographical distribution and even ecology of palms in an evolutionary context, and continually lamented the fact that the fossil records of palms was so imperfect and incompletely studied as to give little help in analyzing the phylogeny of palms.

Other systematists had had the concept of phyletic relationships built into their schemes, but nobody had the breadth of knowledge to relate information derived from a study of the flowering plants as a whole to the special example of the palm family. His biological approach, based so clearly on his intimate knowledge of palms in the field, was brought to bear in these evolutionary discussions. He promoted a number of studies on floral biology and was particularly enthusiastic about the possibility of beetle pollination existing in palms, since this is a presumably primitive method of pollen transfer. Continued studies have tended to support his ideas.

The summation of this vigorous scientific life is that we will always see his activities as representing a watershed in our understanding of the palms. Pre-Moore we had a classical botanical concept of the systematics of palms, post-Moore we have a biological and evolutionary classification which will continue to develop. This was biosystematics of a high order in every meaning of the word.

Systematics is foundational to biological understanding but like a firm foundation often lies out of sight and little appreciated. Hal Moore's contribution to the systematics of palms is best measured by some of its practical consequences. It was not just that he was a person to whom horticulturalists could turn for a reliable scientific name; a better indication is the concern expressed when the disease known as lethal yellowing of coconuts reach epidemic proportions in South Florida. At an early meeting where experts discussed the disease, Hal was able to point out the need for a reliable systematic overview as a background to studies on the susceptibility of palms to the pathogen. Subsequent research was soon to show that the disease transcended systematic boundaries in an alarming way, there were no confines within which the disease might be restrained. The foundation for this conclusion was the systematic framework which generations of palm scientists, culminating in Hal Moore himself, had established.

The current information explosion is all too familiar to active research workers, which in some ways is appropriate, since there are no limits to useful knowledge. Recently I had occasion to survey the scientific literature which relates to palms. Setting a mid-point of 1960, I discovered that more than half the literature on palms ever produced had appeared since 1960. It seems no accident that these last 20 years coincided with Hal Moore's own scientific productivity and it is quite clear that a substantial part of that literature was generated by himself directly or indirectly through his associates. This knowledge is his monument which has absolute permanence so long as men relish those "diamonds which sparkle to the mind's eye."

It seems appropriate that Linnaeus named the palms "Principes:—the princes among plants" for in Hal Moore, one of their foremost students, we had a prince among men.

P. B. TOMLINSON

Harold E. Moore, Jr.
A Student's Appreciation

Professor Harold E. Moore, Jr. was known throughout the world as the premier student of the palms. The prominence he achieved in his careful and exhaustive studies of the family will ensure that his name will be remembered and honored by generations of botanists yet to come. Perhaps a more ephemeral aspect of his reputation, particularly since it is less likely to be noted by future historians of science, was his abilities as a teacher. However, the impact that Hal Moore had on students at Cornell and at other institutions was significant and he contributed to the professional development of many botanists. As an example of the impact that Hal had on students, I would like to offer my own experiences.

My first contact with Hal was through a course he taught on the families of tropical flowering plants. Although not a Cornell student, I saw a circular for the course at the Gray Herbarium, and after receiving an enthusiastic endorsement of both the proposed field course and the instructor from Professor Carroll Wood, I prepared to depart for the course in Costa Rica which was to begin the day after Christmas, 1977.

I was somewhat startled to hear after arriving in San Jose that Hal had been taken seriously ill on the way to Costa Rica and had been hospitalized in the southeastern United States. The other students in the course and I felt somewhat like academic orphans alone in a strange country, but fortunately Gary Hartshorn adopted us for a few days and introduced us to the forest at La Selva. Tom Croat, from the Missouri Botanical Gardens, was pressed into service as a substitute and arrived the next week with several large crates of materials that Hal had prepared for us.

When they were eagerly unpacked the contents of the crates were most revealing of Hal's qualities as a teacher. The first item to be unpacked was a box of large books, one for each of us, that Hal had written especially for the course. Titled simply "Biological Sciences 646," this book which is about the size and weight of an unabridged dictionary, has proved to be a veritable cornucopia of information on tropical plant families. Some of the material Hal had assembled from other sources, but much of the book had been written by Hal alone. There were synopses of every conceivable family of plants we were likely to encounter in Costa Rica and Panama, numerous line drawings, checklists, vegetative and floral keys, and of course a rather exhaustive treatment of the palms at La Selva and Las Cruces. Although I have been privileged to attend several fine institutions in both the U.S. and Britain I have yet to see any instructor prepare a more carefully designed and exhaustive course syllabus for his students. The value of the book to me has increased with the years and I have carried it with me on travels throughout Central and South America and the Pacific. The second item unpacked was a crate of good quality dissecting scopes—Hal believed in using good equipment for students. Also unpacked were boxes full of film, dissecting tools, and drawing supplies. Although Hal didn't teach the course, his influence was felt throughout it.

My second contact with Hal was through a paper I published in *Principes* on Samoan palms. Hal was helpful and very encouraging—his suggestions on my manuscript were substantial but never discouraging. I have since found from other students that Hal had a well-developed critical ability, and was able to offer criticisms to students in an encouraging rather than discouraging manner, even though his standards for quality of thought and writing were high indeed.

My third, and perhaps most substantial contact with Hal was during a 1980 field trip to Samoa that unfortunately proved to be his last. Having preceded him to Samoa for some studies on *Freycinetia*, I met Hal in Pagopago at the Rainmaker Hotel in March. We both had an interest in the palm genus *Clinostigma*. Although several species had been described from Samoa throughout the years both Hal and I were of the opinion that only one species occurred in the archipelago, particularly on Upolu Island. Art Whistler, a graduate student in Hawaii who also had a lot of field experience in Samoa, also shared our view, so Hal and I hoped to make the critical collections and observations that would resolve the problem. Although *Clinostigma* had reportedly been collected by the U.S. exploring expedition from Tuutuila Island, no recent collections had been made. However, I remembered seeing in my wanderings past the high village of Aloao, a *Clinostigma* tree and Hal had reports of *Clinostigma* growing in a coconut plantation near the village of Iliili. We started off that morning in a rented car and taking the left turn at Iliili, started to drive towards the ocean. Suddenly we both saw the distinctive crown-shaft of *Clinostigma* mixed in with cultivated coconuts behind a small hut. With me acting as interpreter, Hal asked the old woman who lived in the hut how she came to have *Clinostigma* growing in her garden. The woman, delighted by our visit, immediately invited us into her modest hut for refreshments while she told us the story. I was somewhat nervous at the way Hal might treat her invitation because in the Samoan culture an outright refusal of an invitation to eat is considered an insult, and occasionally expatriates and foreigners inadvertently offend Samoans by not accepting invitations to eat in the somewhat less than sanitary conditions. Hal, however, was very gracious and accepted the warm punch in a cracked and dirty glass as if it had been given him by royalty. The woman was delighted with Hal and although his conversation with her was of necessity channeled through me, I was impressed with the sincerity that Hal communicated to the old woman and her family. After collecting some of the inflorescences, the fruits of which matched the description of *Clinostigma samoense* H. A. Wendl., Hal took a group portrait of the woman and her family, an enlargement of which he mailed to her after his return to Ithaca.

The next day Hal and I started to climb through the cloud forest past the village of Aloao. The day was very foggy with intermittent rain. After traveling through the forest for about two hours, we found a large single individual of *Clinostigma* aff. *samoense.* We looked about for seedlings but could find only the single tree. This tended to confirm the story of the woman in Iliili who had explained to us that seeds of *Clinostigma* were brought by her father to Tuutuila from Upolu when she was a little girl. Her father had felt the leaves to be superior to coconut leaves for thatching. Since she was 75 years old when wet met her, we estimated the introduction to have occurred around 1910 or so. Venturing on past the *Clinostigma* palm in search of perhaps other *Clinostigma* individuals, I contemplated the numerous travels that Hal had made in his career. Hal was known throughout the world to botanists and foresters and had succeeded in seeing all but a few genera of palms in their native habitats, an achievement which I suspect may never again be equalled. As we walked through the traditional Samoan drizzle, I asked Hal if he had ever been lost on any of his field trips. Hal replied that he never had been.

As fate would have it, less than an hour later Hal and I found we were hopelessly lost. The combination of an overcast sky, the dense cloud forest, and my failure to note our compass bearings as we made our way through the forest all combined to produce a rather embarassing result: on a rather small Pacific island I had succeeded in getting Professor Harold Moore, who had traversed the vast forests of Amazonia and Africa without difficulty, completely lost. Although the situation was not grim, since we were after all on an island, it was alarming since only one side of Tuutuila Island is inhabited. If we descended from the mountains in a direction different from the one in which we came we would certainly be forced to spend a miserable night bivouaced with the rain and legendary Samoan mosquitoes as our only companions. After reluctantly admitting to each other that we were lost we decided to mark a central point from which we would explore transects along all four points of the compass in the hopes of finding the path back out of the mountains. "Point x," denoted by crossed stems of *Cordyline terminalis,* was duly christened, and we began our first journey of half an hour along one of the four points of the compass, through the now heavy rain. Two hours and three transects later we had still not found the path, when finally Hal yelled that he had found the trail only about 80 meters from point "x."

As we continued our trip into Western Samoa, I continued to be impressed with Hal's knowledge, generosity, and kindness. Each night Hal would patiently answer my numerous questions about the ecology and systematics of palms. He also showed a genuine interest in my own studies of the Pandanaceae and made many useful suggestions on my work. As we traveled about the islands in search of *Clinostigma* his courtesy and respect for the local people made him very popular. Hal's kindness to me did not prevent him from offering useful criticism of my studies, however. For example, Hal treated somewhat skeptically my report to him that I had seen *Musa acuminata* subsp. *banksii,* a wild diploid banana, in the remote interior of Upolu. Together we made the long hike to Lake Lanoataata, so he could examine the plant. On examining the plant, Hal cheerfully admitted he was wrong, and spent almost an hour in a torrential rain helping me collect seeds to be sent to botanical gardens for cultivation. In general he seemed to combine a highly developed critical ability with a deep sense of humility and a generosity of spirit; individuals possessing all three of these virtues in such a high degree are rare.

On Hal's final night in Samoa we attended a *fiafia* or native celebration hosted by Aggie Grey. At the conclusion I noticed that Hal was somewhat misty-eyed; this was very unusual since he did not tend to be a very emotional person. I asked Hal if something was wrong. He replied that Samoa was very beautiful and he only wished that he could see it again.

Several months after my return to Harvard, I was stunned to receive a call from Natalie Uhl who told me that Hal was in poor health and had been hospitalized. My young family and I traveled that weekend to Ithaca where I visited Hal in the hospital. On entering his room I could tell that he was very seriously ill. Although my concern was with Hal, his concern was with my work. He had me tell him in detail about the progress on my studies on the Pandanaceae. I was very touched that this great scientist, although seriously ill, would take the time to inquire concerning the studies of a rather unnoteworthy graduate student.

The following week I found myself again in Ithaca, but this time the voices in the Cornell chapel, although kind and comforting, seemed to me to be filled with emptiness because Hal was gone. Science had lost a great talent, Cornell had lost a great teacher, and his associates and colleagues had lost a true friend. Even though I had been asked to make a few remarks at the memorial service, I had difficulty controlling my own disconsolate feelings. At the service, however, Natalie Uhl concluded her remarks with a comment I felt most appropriate, particularly for those of us who knew Hal as a teacher: "If Hal were here, his most likely statement to us all would be, 'Go back to work'."

Knowing Hal and his disdain for sentimentality, I suspect he would indeed have said something like that. Hal has laid a most valuable foundation for all of his former students and colleagues to go back to work. His published papers are hallmarks of meticulousness, his reviews demonstrate a high standard of thought and criticism, and the example he set and the generosity he showed for younger botanists will insure that his name and work will be remembered and respected for generations to come.

PAUL A. COX
Department of Botany
University of California
Berkeley, CA 94720

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Goethe's Palm

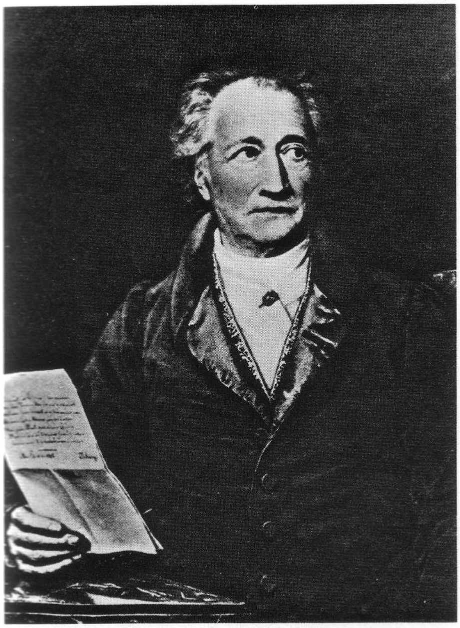
W. H. HODGE
3 Cayuga View Road, Trumansburg, N.Y. 14886

Palms and Goethe—best known for his epic, Faust—would seem to be an unlikely association. How could that famed 18th century poet-philosopher have known any palms first-hand? Born in Frankfurt in 1749, his adult life was mainly spent in Germany at the court of the Duke of Saxe-Weimar, far from palm habitats, and at a time when the tropical world of palms was still but sketchily known. However at the Duke's court Goethe developed interest in many fields of human endeavor including botany. And as we shall see, a palm had a part to play in the development of one of his concepts in natural philosophy.

As a boy Johann Wolfgang von Goethe showed a keen interest in plants, especially in the varying forms of their flowers. His lifetime overlapped that of the pioneer systematist, Linnaeus, whose writings, the poet admitted, had influenced him as much as had those of his favorite philosophers, Rousseau and Spinoza. But whereas Linnaeus' primary concern was with plant classification, Goethe (Fig. 1) was more intrigued with the form and structure of plant parts, the area of botany now called plant morphology. Indeed, Goethe first used the term "morphology" and because of that he is considered by some the founder of that discipline. His classic essay in morphology (Die Metamorphose der Pflanzen, 1790) dealt with metamorphosis, or change in plants. For example, it was his belief that all the distinct parts of a flower (sepals, petals, stamens, and carpels) are actually leaves which have been transformed or metamorphosed into the several different floral structures. Goethe's thesis is still generally accepted today.

Although Goethe had been looking inquiringly at flowers ever since boyhood, his essay on metamorphosis appears to have been stimulated by a trip to Italy, his sole visit to that warm Mediterranean land. There at age 37 he apparently first encountered a living palm, one whose close study helped him in the development of his ideas about plant metamorphosis. The year was 1787, the place was the Orto Botanico (Botanic Garden) at Padua, and the palm was a garden specimen of *Chamaerops humilis.* This is the dwarf fan palm of the Mediterranean area, and the only palm whose natural range includes some of the milder parts of southern Europe. Exotic sub-tropical palms—like *Butia, Jubaea, Phoenix, Trachycarpus,* and *Washingtonia*—now so commonly planted in the area, were yet to be introduced.

The same palm clump that Goethe studied nearly 200 years ago still thrives at the same site. Ever since his visit it has been known as "Goethe's Palm." This seems appropriate for at the time of his visit to Padua, Goethe was already a well known and widely acclaimed scholar. In 1787 the palm was growing without shelter within the old walled garden. The association with Goethe eventually assured the palm of special care. Nearly a century ago a tall glass house was built to protect the Garden's most famous plant, and in it the palm flourishes today (Fig. 2). It remains seen mainly by students, for as with most



1. Johann Wolfgang von Goethe in 1828. Founder of the Romantic School of natural history and philosophy. J. K. Stieler

2. The shelter for "Goethe's palm," in the Orto Botanico, Padua.

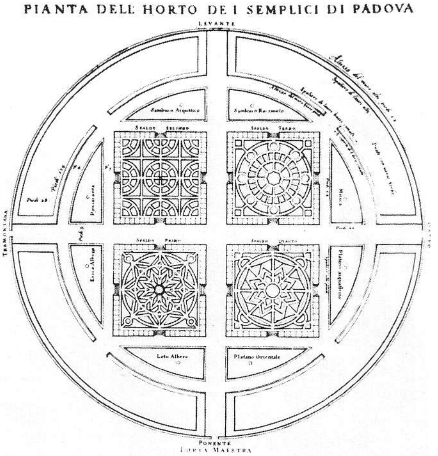
Italian botanic gardens, this one is not open to the general public.

But even had Goethe never visited Padua in 1787, the clump of *Chamaerops humilis* would still merit special interest. For probably no other individual living palm plant has been maintained by man in cultivation for so many years. Its history is to be found in the publications of Padua's Orto Botanico, which, established in 1545, is the world's oldest botanic garden still functioning at the site of its founding. Actually a botanic garden at Pisa began two years earlier, but its site was subsequently moved. Like early botany itself, these first European botanic gardens arose out of man's primary concern with the culture and study of medicinal plants, the so-called "simples." Reflecting this original interest, the garden's earliest name was "L'Horto de i Semplici di Padoua" (Fig. 3), or "Garden of Simples of Padua" (1591).

L'HORTO
DE I SEMPLICI
di Padoua,
Oue si vede primieramente la forma di tutta
la Pianta con le sue misure : & indi i
suoi Partimenti distinti per Numeri in ciascuna
Areila,
Intagliato in Rame.
Opera, che serue mirabilmente alla memoria de gli Studiosi.
CON PRIVILEGIO.

IN VENETIA,
Appresso Girolamo Porro. 1591.

3. Title page of the 1591 account of the Padua garden.



4. The design of the Padua garden from the 1591 account.

The 16th century design of Padua's old botanic garden is unique. The main circular garden plot is divided into four quadrants of patterned stone-edged beds, while the whole area is surrounded and protected by a high masonry wall (Fig. 4). Atop the wall is a balustrade decorated here and there with busts of early garden officials. Massive iron gates, sited at the cardinal compass points in the wall, serve as entrances. Protection was of much interest, for a number of new potentially valuable plants, obtained from distant lands, found their way first to gardens like this. Among such exotics introduced to Italy via Padua were the white potato (in 1590), sesame (in 1590), and the lilac (in 1665).

As in the past, the majority of species grown today are herbaceous, and as is still the custom in European botanic gardens they are planted in phylogenetic sequence, that is, with related plants together. Woody taxa occupy peripheral positions in beds at the base of the wall. In such a protected site, in the second quadrant near the Tramontana or "north-wind" gate, *Chamaerops* was originally planted. The year was 1585. Thus when Goethe visited Padua

5. *Chamaerops humilis* in the palm shelter has several stems.

the palm was already two centuries old, and doubtless a splendid horticultural specimen. In 1985 Goethe's palm will be a venerable 400 years old. In the garden it is surpassed in age only by an obviously frail Chastetree (*Vitex agnus-castus*), planted in 1550.

A characteristic of *Chamaerops humilis* is its suckering habit (Fig. 5). This produces a plant with attractive clumps of stems. As the stems age and die, new ones grow to replace them. This type of growth insures a sort of immortality to suckering species, especially when they grow in favorable sites. It is unlikely that single-stemmed palms can grow to such a ripe old age. The suckering habit helps explain why Goethe's palm has thrived for so many years. Of course it is not uncommon for woody trees to grow for centuries or even for millenia with positive evidence of their age given by a simple count of the annual rings of wood. As monocots, palms lack such rings. So although we have historical proof that Goethe's palm has been growing since 1585, it is unlikely that any of the individual trunks originally produced still stand today, or were even existent at the time of the poet's visit. Only a continuing program of systematic marking and recording of all trunks as formed could give an idea of how long they tend to live.

When Goethe's palm was first planted it probably bore the simple garden label of "Palma humile" meaning dwarf palm. We can assume this because this name appears in the garden's first printed guide published in nearby Venice in 1591 (Cortuso). Besides giving a detailed description of the botanical garden, the guide lists alphabetically in a curious assortment of names the 1,168 kinds of plants grown in the garden at the time. The first entry under the letter "P" is "Palma humile," the only palm (Fig. 6), and one of relatively few names given in binomial form. This is of course a pre-Linnean epithet, for a formal system of bionomial nomenclature had not yet been established.

De i Semplici.

Origano ſaluatico
Oriola
Ornithogalo
Orno
Orobanche
Orobi, & loro ſpecie
Ortica
Oriza
Orzo Murario
Orzo ſenza ſcorza
Oſiride
Oſmonda
Oxiacantha
Oximirſine
Oxis

P

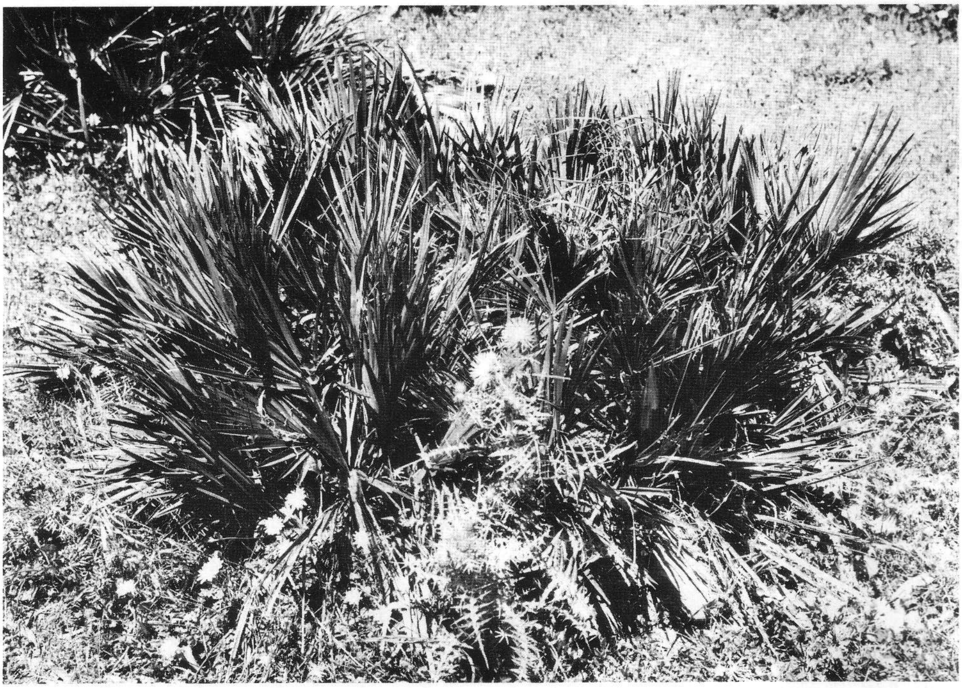
Palma humile
Paliuri, & loro ſpecie
Panporcino
Panace Aſclep.
Panace chironio
Panace Heracleotico
Pancratio
Panico
Papaueri, & loro ſpecie
Parietaria

C Paris

6. The listing of "palma humile."

The name "Palma humilis" apparently originated with Caspar Bauhin (1550–1624), a Swiss botanist-physician and author of one of the first natural classifications of plants. Bauhin used genus-names in much the same way that botanists do today, and he also practiced a kind of binomial nomenclature. According to Gola (1947) Bauhin studied at the Orto Botanico, and thus may have become acquainted with this Mediterranean species at the time, resulting ultimately in his giving the palm its first scientific name. In any event, when Linnaeus established the generic name *Chamaerops* in 1753, he listed several of Bauhin's earlier binomial names as synonyms, and borrowed one of his predecessor's earlier specific epithets to complete the name *Chamaerops humilis* that we use today.

One may wonder why the Mediterranean dwarf palm was originally introduced into Padua's Garden of Simples. The palm is not an herb nor probably a "simple." Perhaps at the time its fruits were believed to have medicinal properties, though I know of no references to such. However, as is the case with certain other palms, *Chamaerops* produces tough leaf fibers that have local use for making simple brushes and rope (Polunin and Huxley, 1970). Thus the palm may have been considered an economic plant and appropriate to join similar utilitarian species that soon were being cultivated, along with the "simples," in the beds of the developing garden. However, my own guess is that the palm was added to the plant collection because at the time it was the only representative available of a unique and then little-known family of plants. Finally it must also have appealed because of its obvious potential as a fine garden ornamental.



7. *Chamaerops humilis* growing in the wild, in "maqui" vegetation near Algeciras, Spain.

Actually, in the environs of Padua, *Chamaerops* was probably not too well known. In nature the species thrives farther south, especially in warmer parts of the western Mediterranean basin—in southern Spain and Italy and in adjacent parts of North Africa. Perhaps because the better soils have been claimed for agriculture, one finds it today typically growing in dry sandy or rocky sites (Fig. 7). In such places it is more often than not a low scraggly plant, truly a "palma humile." However, the species is polymorphic, and the variations in nature include among others considerable contrasts in size. Goethe's palm is typical of a tall variation called "arborescens." When grown under the favorable conditions of a garden, *Chamaerops* may be transformed into an ornamental of outstanding beauty, a beauty so well described by Dolby (1981). Certainly that is what has happened at Padua's Orto Botanico. In Goethe's day the palm clump must already have developed into an outstanding and beautiful specimen. It is no less so today, spurred perhaps into even more exuberant growth by the fact that it is now growing in a protective glass-house. Some of the individual stems appear to approach twenty-five feet in height. The palm currently bears two simple labels. One reads: "*Chamaerops humilis* L. v. arborescens. a. 1585. Palmae"; while the other states (in translation): "Goethe's palm. Studied by Goethe in 1787 during his trip to Italy." Nearby on the conservatory wall is a plaque commemorating more formally the fact that this living palm was the one studied by the great-naturalist, and which resulted in publication of his Metamorphosis of Plants. But these labels leave much unsaid, for the *vita* of this palm is truly amazing. Its life spans the centuries during which most of our knowledge about palms has been gathered, from before the earliest published accounts of the Dutch on the palms of Malabar and Amboina to those published in the most recent issues of *Principes*. Perhaps Bauhin, certainly Goethe, and who knows how many other plantsmen have enjoyed this historical plant. It is without doubt a Methuselah among living palms.

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PALM RESEARCH

Francis E. Putz and Noel M. Holbrook, Department of Botany, University of Florida, Gainesville 32611, have initiated a multidisciplinary study of the taxonomy, ecology, and economic history of the phytelephantoid palms. This major group, composed of three highly evolved genera, forms a distinct subgroup within the Palmae. These palms are so distinct, in fact, that up until the turn of the century, their inclusion in the Palmae was debated, being alternately placed in the Cyclanthaceae or the Pandanaceae. The taxonomy within the phytelephantoid group remains much confused at present. The ivory-like endosperm from these palms was once well known in commerce as vegetable ivory, "tagua," or "marfil vegetal." Millions of dollars worth of seeds were exported every year from Ecuador, Colombia, and Panama to factories in Europe and the United States where they were carved into buttons and small ornaments. This thriving industry virtually disappeared with the advent of cheap plastics.

Along with trying to unravel the taxonomy of the phytelephantoid palms, the ecology of these unusual plants will be examined. These studies will be supplemented by a historical account of the vegetable ivory industry, tracing its growth and decline. Present uses of vegetable ivory and the potential for development of a cottage industry will be pursued. Such an industry would stimulate local economies, help preserve the tropical forests where the palms abound, and make vegetable ivory once again available to world markets. The investigators will appreciate information and suggestions concerning the biology and economics of vegetable ivory palms.

Principes, 26(4), 1982, pp. 200–204

Observations on Leaf Color, Epiphyll Cover, and Damage on Malayan Iguanura wallichiana

RUTH KIEW

Department of Biology, Agricultural University of Malaysia, Serdang, Selangor, Malaysia

Iguanura wallichiana (Wall. ex Mart.) Hook.f (formerly known as *I. geonomaeformis* Mart.) is a common palm throughout the lowlands of Malaya (Kiew 1972a, 1976) growing to about 2 m in height and bearing a crown of about seven to nine leaves.

A population of 18 plants of *Iguanura wallichiana* subsp. *malaccensis* (Becc.) Kiew in the Gombak Field Station, Selangor was observed over a period of 15 months and the age of leaves derived from weekly measurements of increase in length of the developing apical leaf until expansion, and the persistence of the old leaves on the stem (Kiew 1972b). Leaf production is regular and the average interval between leaf production is seven months, with a range of 5½–10½ months. The time span (plastochrone) between the emergence of the sword leaf (unexpanded leaf) and the expansion of the first leaf (leaf 1) was found to be seven months; successive leaves down the trunk are increasingly older by seven months, as shown in Table 1. This species of *Iguanura* has leaves which do not absciss but persist on the trunk until they rot. From the ninth leaf onward, the decaying leaves turn pale brown, droop but are still attached to the plant by the very fibrous leaf base. Eventually the lamina falls leaving the persistent leaf base. A few plants have up to 12 leaves in the crown.

To assess the increase with age in the amount of damage (including insect predation) and cover by macroscopic epiphyllae (lichens, algae, and bryophytes), a sample of ten plants was chosen at the Pasoh Forest Reserve, Negri Sembilan. A 10×10 cm grid of transparent plastic marked into 1 cm^2 squares was placed on one of each of the apical, middle and basal leaflets of each leaf in the crown and the percentage cover of the epiphyllae and the area of damage was estimated. Three types of damage were distinguished: 1) holes produced by falling twigs (these were large holes, wider than the space between two lateral veins, and in most cases the twig remained suspended in the hole); 2) small, almost circular holes (less than the width between the lateral veins) or small discrete brown patches attributed to insect damage; and 3) large irregular brown areas where the leaflet had lost its rigidity were attributed to fungal attack.

Color

The young leaves undergo a conspicuous color change; opening pale pink, rapidly becoming bronze-colored and, after about two weeks, turning bright rice green and finally, after another three weeks, turning dull green. During these five weeks the leaf increases in length by about 10 cm (Kiew 1972b).

Stone (1979) has suggested that the bronze color of the new leaves "mimics the drab color of dying or withered dead leaves" which he considers could be of adaptive value for avoiding predation from animals which rely on eyesight for recognition of suitable food plants. This is not supported by quantitative observations on *I. wallichiana* subsp. *malaccensis* (Table 1). The youngest leaf, whether a drab bronze color or conspicuously light green or dull green, does not show any damage. Significant damage (more than 5%) is observed in the sixth and lower leaves (which are about 3½ years old or older). The most common type of damage on the first six leaves is caused not by insect predation but by falling twigs which pierce the leaves. It seems more likely that the fibrous nature of the leaf rather than its color deters animal predation. The final necrosis of the lower leaves is caused by fungal attack.

1. First leaf (about 7 months old) of *Iguanura wallichiana* with lichen colonies.

Epiphyllae

A succession in the colonization of the macroscopic epiphyllae is conspicuous, beginning with lichens and algae, followed by bryophytes. Crustose lichens were more numerous than algae or bryophytes (Fig. 1, 2). Kappen (1973) reported there are 236 species of epiphyllous lichens (mostly crustose). Allan (1928 cited by Kappen 1973) recorded 45 different lichens on a large palm leaf in New Guinea. The two common macroscopic genera of algae in Malaysia both belong to the Trentopohliaceae (Tan 1976). One, *Trentepohlia* sp., produces a horizontal branched thallus attached to the edge of the leaf; the other, *Phycopeltis* sp., (Fig. 2) forms a dense round thallus up to 5 mm across on the upper surface of the leaf. Bryophytes include the leafy liverworts (Fig. 2), *Cololejeunea angulata* (Et.) Mizert, *C. floccosa* (Lehm. & Lindenb.) Schiffner var.

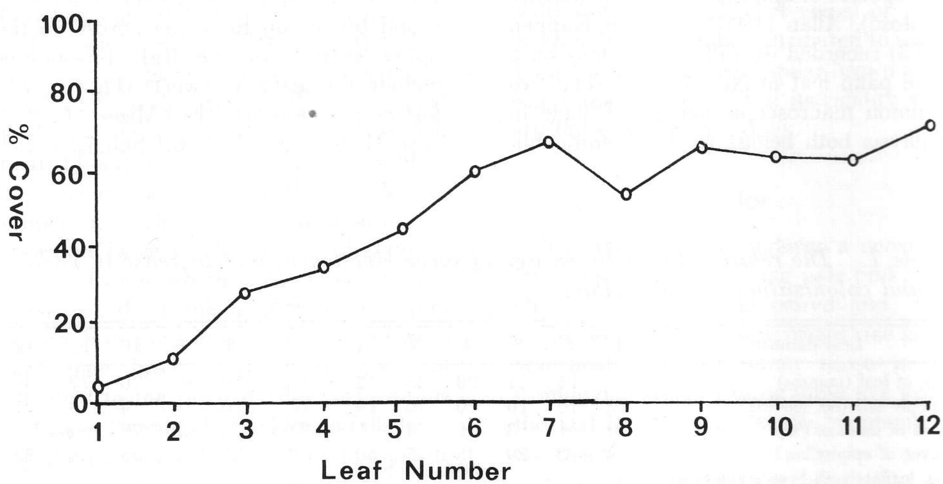
Table 1. The relationship between age of successive leaves and increase in damage and colonization by epiphyllae.

Leaf number	1	2	3	4	5	6	7	8	9	10	11	12
Age of leaf (months)	7	14	21	28	35	42	49	56	63	70	77	84
Sample size (no. leaves)	10	10	10	10	10	10	10	10	7	4	3	1
Area of damage (%)	0	½	3	½	4	5½	32½	25	45	78	dead	
Cover of epiphyllae (%)	2	12	29	35	45	60	68	53	67	65	64	73
No. leaflets with bryophytes and *Phycopeltis* colonies (%)	0	0	0	8	23	23	39	39	46	67	78	100

2. Old leaf (about 5 years old) of *Iguanura wallichiana* with lichen (L), bryophyte (B) and *Phycopeltis* (P) colonies.

aurita Benedix and less commonly *Drepanolejeunea spinistipula* Herzog which Dr. Masami Mizuntani of the Hattori Botanical Laboratory kindly identified.

Figure 3 shows that the percentage cover of living epiphyllae increases steadily with age up to the seventh leaf (about four years old), with an average of 68% cover, although initial establishment and/or growth is slow. After the seventh leaf, there is little increase and even a decrease in the percentage cover, which can be explained by the position of the leaf in relation to the amount of light it intercepts. The upper leaves are more or less horizontal and shade the lower leaves which probably retards the rate of growth of the epiphyllae. The importance of light for the growth of the epiphyllae is also shown by the difference between the percentage cover of epiphyllae on the apical leaflets (which are more exposed to light) than the middle and basal leaflets: 68% of the apical leaflets have more epiphyllae than the lower leaflets. Bryophytes and the discoid thallus of *Phycopeltis* are the latest to become established; they are apparently less affected by shading and



3. Colonization of successive leaves of *Iguanura wallichiana* expressed as percentage cover of all macroscopic epiphyllae.

their percentage cover of the leaf continues to increase with time, although the percentage cover for all epiphyllae is unchanged (Table 1).

Watson (1970) obtained similar results from another palm, *Euterpe globosa* Gaertn. in Costa Rica. He noted that lichens were more common on the first three leaves (up to 18 months old), but thereafter algae predominated. As in Malaysia, the common macroscopic algae included species of *Phycopeltis* and *Trentopohlia.* Bryophytes were less common. He counted the number of colonies rather than their percentage cover. This method showed the same broad results—the slow establishment on the first three leaves, a linear increase in the number of epiphyllous colonies from the third to the fifth leaf (aged 2½ years) followed by a decline as the lower leaves (up to 4 years old) are shaded by the upper. Epiphyllae succession on *I. wallichiana* is slower (6–7 years) compared with *E. globosa* (4 years).

Conditions of high relative humidity in the undergrowth of the tropical forest are important in supporting this flora of epiphyllae. In Costa Rica, Odum et al. (1970) recorded the relative humidity above the forest where *Euterpe globosa* grows as usually about 95% (with a range of 89–97%) with slightly higher values recorded within the forest. At Pasoh the relative humidity is usually above 95% and rarely falls to 90% (Aoki et al. 1978). Epiphyllae are able to grow in deep shade for at Pasoh at 4 m above the ground the average light intensity is only 1% of full sunlight (although the variance may be very great) (Yoda 1978).

Epiphyllae on *Iguanura* must be detrimental to the growth of the palm as they increase the shading of the palm leaves. The fifth leaf has almost half its surface covered by epiphyllae and this must seriously reduce the light penetrating the leaf for photosynthesis. The effective life of a leaf is probably about three years, during which it contributes as a photosynthesizing unit; after this (sixth leaf onwards) there is a noticeable increase in the amount of fungal damage which might indicate that the leaf is functionally dead. Senescence of leaves is marked by a loss of chlorophyll and protein (Baddeley 1971) and it is expected that the degree of shading by these epiphyllae will hasten the loss of chlorophyll. The rapid increase in damage from the sixth leaf onwards (which is caused mostly by fungi) could be caused by the increase of leachates from the senescent leaf which encourages the growth of saprophytic fungi (Kerling 1964 cited by Sinha 1971).

Against epiphyllae this species apparently has no defense such as hairs or an unwettable surface. It is noticeable that the algae and bryophytes tend to become established along the veins where water collects after rain. The steady increase in initial establishment of colonies on the leaf surface probably results from increasing deposition of propagules with time. For long-lived leaves, such as those of *Iguanura wallichiana*, epiphyllae are probably more damaging than is insect predation.

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PALM BRIEF

Principes, 26(4), 1982, pp. 204–205

Geonoma tenuissima*

H. E. MOORE, JR.
L. H. Bailey Hortorium, Cornell University, Ithaca, New York 14853

Geonoma tenuissima H. E. Moore, **sp. nov.**

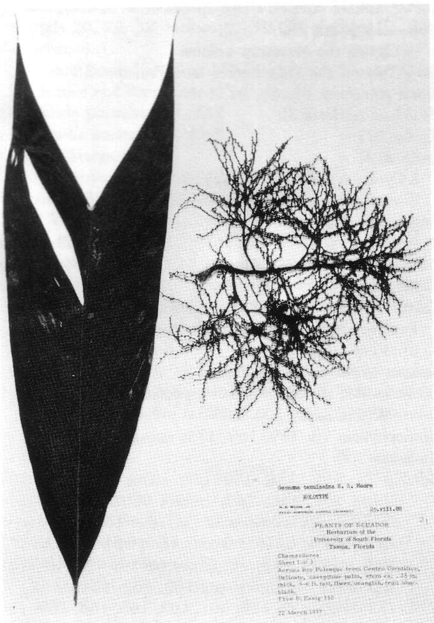
Ab omnibus speciebus *Geonomae* foliis anguste cuneatis inflorescentiis latioribus quam longis rachillis tenuissimis alveolis bilabiatis remotis spiraliter dispositis differt.

Stems cespitose, slender, to ca. 1.8 m high, 0.6 cm in diam. Leaves undivided laterally; petiole 15 cm or more long, deeply channeled above, rounded beneath; rachis 25–31 cm long, rounded and glabrous beneath, angled above and margined toward base with translucent, glistening, mostly branched scales, the branches inflated distally; blade narrowly cuneate in outline, divided ca. ⅓ at the apex with acuminate lobes 14–15 cm long on inner margin, 11.2–12.8 cm wide at apex of rachis, primary ribs ca. 22 at an angle of 19–24° with the rachis. Inflorescences wider than long, paniculate, 16–20 cm long, 21–28 cm wide, glabrous, but all axes more or less minutely tuberculate; peduncle short, 2.4–3.2 cm long; prophyll and peduncular bract not seen; rachis 11–13 cm long, with ca. 13–16 branches, the lower 3 times branched into very slender rachillae ca. 0.5 mm wide, to 6.5 cm long, spinose-tipped, bearing widely dispersed pits in a spiral, the pits about twice as thick as rachillae, bilabiate, the lips entire, the orifice ca. 1 mm long and wide. Flowers tinged orange, ca. 1.5 mm long: staminate flowers with sepals ca. ¾ as long as petals; stamens 6, filaments spreading, locules borne at an acute angle with the filament, the sterile base short: pistillate buds acute; staminodial tube truncate. Fruit globose, blue-black at maturity, ca. 5 mm diam., not drying pebbled.

* This description was beside Hal's dissecting scope when he died in October 1980. He had asked for a photo (Fig. 1) of the specimen and the manuscript was marked for the printer. It is one of several of his unpublished papers that we have included in this memorial volume.—N. W. Uhl.

ECUADOR: LOS RIOS PROVINCE: across Rio Palenque from Centro Cientifice, 150–220 m, 22 Mar 1977, *F. B. Essig 350* (USF, holotype).

Geonoma tenuissima keys to *G. leptospadix* Trail in both Burret's treatment of *Geonoma* (1930) and Boer's monograph (1968). It differs from that species in the more highly ramified, short-pedunculate inflorescence (Fig. 1) and smaller fruit (5 vs. 8 mm in diam.), which does not dry with the pebbled surface characteristic of *G. leptospadix*. A third species characterized by very slender rachillae with widely separated, prominent pits is *Geonoma gastoniana* Glaziou ex Drude from which *G. tenuissima* differs not only in the highly ramified, short-pedunculate inflorescence but also in the undivided leaf blade with primary ribs departing at an angle of 19–24° from the rachis. Although collected across the river from the Rio Palenque Science Center, *G. tenuissima* apparently does not occur on the property of the center (cf. Dodson and Gentry 1978).



1. Photograph of the type specimen of *Geonoma tenuissima* (*Essig 350*).

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In Closing the Memorial Volume

This issue closes the Memorial Volume of *Principes* dedicated to Harold E. Moore, Jr. Certainly it will not end his influence and contributions on studies of palms. We have not had space to publish all that was submitted in his honor. Some articles promised have not been received; others are not yet written. Finally we and others are working to continue and complete research on palms that he had so carefully begun.

It may seem strange that the two of us have not contributed personal appreciations to the Memorial Volume. Indeed, at its onset we each intended to write. However, letters and articles from many have attested to Hal's greatness: to his dedication, to his humility, to his concern for people, to his excellence as a scientist. It now seems most appropriate for us to write jointly, and primarily of plans for continuing the work on palms.

When Hal died, we were scarcely able to accept the fact that he was no longer present—to answer questions patiently and thoroughly, to share exciting discoveries, to suggest new approaches. We were awed by the size of the task of finishing his classification of palms, *Genera Palmarum.* Now after our first year of work towards the book we realize that the quantity and quality of his notes and specimens make our task possible.

Furthermore, as we edit *Principes,* we are impressed with what a very fine journal Hal had developed. We aspire to continue the tradition he established—a periodical that provides knowledge about palms and reflects its current status at every level. As we write, manuscripts continue to arrive attesting to an international reputation which Hal had fostered.

Principes itself will, we hope, continue to commemorate the remarkable man who made it what it is.

JOHN DRANSFIELD
NATALIE W. UHL