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Cover Picture

Nenga pumila in the forest at Tapan, West Sumatra. See pp. 55–70. Photo by J. Dransfield.

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A Revision of the Genus Nenga

EDWINO S. FERNANDO

Department of Forest Biological Sciences, College of Forestry, University of the Philippines at Los Banos, College Laguna, Philippines

Nenga is a small genus of arecoid, forest undergrowth palms confined to the perhumid areas of West Java, Sumatra, Bangka, Borneo, Singapore, Malay Peninsula, S. Thailand and Indo-China. It was established by Wendland and Drude in 1875 based on *Pinanga nenga* Bl. This type species was earlier fully described and illustrated by Blume (1839) in his Rumphia based on material from West Java. Scheffer (1876) later made two new combinations in the genus from *Areca* and *Pinanga*, and also provided the new name *Nenga wendlandiana* Scheff. for the type species *Pinanga nenga*. Beccari (1877) subsequently described six new taxa and transferred one more species from *Pinanga*. Wendland (1878) listed only seven species and one variety in *Nenga* and made a new combination, *N. pumila* (Mart.) H. A. Wendl., citing *Areca pumila* Mart. as the basionym and *Pinanga nenga* Bl. as a synonym. (The nomenclature of the type species is discussed further below).

In 1855 Beccari published the first revision of the genus where he separated all his five new species and one new variety described in 1877 into three distinct genera (*Gronophyllum*, *Adelonenga*, *Leptophoenix*). In the same revision Beccari also reinstated his new combination, including Scheffer's (1876) species in *Areca* and *Pinanga*. He further described two new species, *N. schefferiana* Becc. from Sumatra and *N. intermedia* Becc. also from Sumatra but extending to the Malay Peninsula. Four years later (1889), a new species, *N. macrocarpa*, was added. A new variety, *N. wendlandiana* Scheff. var. *malaccensis* Becc., and a morphological form (forma *hexapetala*) were also described by Beccari. All three taxa were based on specimens collected in the Malay Peninsula.

Drude (1889), in his brief treatment of *Nenga* in Engler and Prantl's "Die naturlichen Pflanzenfamilien", recognized 11 species and included Beccari's *Adelonenga*, *Leptophoenix*, *Nengella* and *Ophiria* in the genus. Drude had obviously overlooked Beccari's (1885) revision.

From 1889 until 1936, three more species were added to *Nenga*. Lauterbach in 1911 described *N. novo-hibernica* Lauterb. from the Bismarck Archipelago. In 1936 Burret transferred two species in *Pinanga* (later *Areca*) to *Nenga*, namely *N. banaensis* (Magalon) Burret and *N. nannospadix* (Burret) Burret, both from Indo-China.

In Beccari's posthumously published account of the arecoid palm genera edited by Pichi-Sermolli (Beccari and Pichi-Sermolli 1955), the genus was redescribed and only four species recognized, one species (presumably *N. pumila*) being referred to as very variable. Moore (1973) in his survey of the major groups of palms recognized only two species in *Nenga*. In both these accounts, however, no indication is given as to which species are recognized and which are synonyms. The most recent addition in *Nenga* is *N. gajah*, a species with remarkable features collected in Sumatra and described and illustrated in detail by Dransfield in 1975.

Recent collections have revealed a

much wider range of variation within *Nenga* and also have extended its geographical range to include Borneo and Thailand. A new species related to *N. macrocarpa* has also been found in the Malay Peninsula and is described below.

Relationships with Other Genera

Nenga is one of the genera belonging to the *Areca* alliance of arecoid palms (Moore 1973). The genus is most closely related to *Pinanga* and *Areca* in general features of the inflorescence, flowers and fruits. *Nenga* is characterized by the spirally arranged flower groups (one pistillate between two staminate flowers) along the rachilla, with the distal portion being mostly entirely male, and the lateral attachment of the ovule which is evident in the seed as a lateral raphe.

The chracteristic spiral arrangement of the flower groups, however, is also found in some species of *Areca* (Sections *Microareca* and *Mischophloeus*) and some species of *Pinanga* (Section *Spirantheae*). In some of the *Areca* species with spiral flower groups, the distal terminal portions of the rachillae are also entirely male. Thus the infructescence often bears long, dead, tail-like branch tips as in *Nenga*. This particular feature is unknown in *Pinanga*. The inflorescence structure in *Nenga*, however, appears to be more like *Pinanga* in aspects of its branching patterns.

The most striking feature distinguishing *Nenga* from *Areca* and *Pinanga* is the lateral attachment of the ovule. Both *Areca* and *Pinanga* have basal ovular attachment.

In general, *Nenga* seems most closely related to *Pinanga*, especially in the branching of the inflorescence, the often pendulous infructescence, and in features of the habit.

Morphology

The species of *Nenga* are slender or moderate, unarmed, erect, solitary or caespitose palms confined to the undergrowth of the rain forest. They reach up to about 9 m tall. The stems are distinctly annulate because of the horizontal leaf scars, and range from 2 cm to 15 cm in diameter, to a mere 2 m long, often with very short internodes, or up to 8 m long with longer internodes. At least one species, *N. gajah*, develops prominent stilt roots near the stem base. Recent collections from Sumatra of *N. pumila* var. *pachystachya* also indicate the presence of stilt roots. These adventitious roots are apparently common in most *Nenga* species, although often not properly observed and recorded by collectors.

The only known caespitose species in *Nenga* so far is *N. pumila* and its variety *N. pumila* var. *pachystachya*.

As in many arecoid palms, the tubular leaf sheaths tightly enclose the uppermost portion of the stem and form a crownshaft, except in *N. gajah* which does not form a well-defined crownshaft due to the tardily abscising leaves; the sheaths are thus usually obscured by detritus. The exposed area of the leaf sheath in *Nenga* is often pale green or yellowish-green to slightly purplish-green and covered with brown scale-like indumentum. The inner surface is usually smooth and shiny.

About 5 to 10 wide-spreading pinnate leaves, 1–3 m long, form the crown. The young and developing leaves are generally erect at first. The petiole in *Nenga* possesses a prominent adaxial groove and is rounded and smooth abaxially, and pale green or yellowish-orange with sparse brown scale-like indumentum. Petiole length is very variable and may range from a mere 4 cm up to 50 cm, even within the same taxon. (The longest petiole belongs to *N. gajah* which reaches up to ca. 75 cm long.) The rachis is often subangular to triangular and tapers gradually towards the apex. The leaflets are regularly arranged, opposite to subopposite or alternate. They are generally linear-elliptic or sigmoid to subfalcate, glabrous, and coriaceous; the adaxial surface is dull green

to bright green, and the abaxial surface much paler, with ramenta prominent along the costae. There may be up to about 30 leaflets on each side of the rachis, but sometimes many fewer (8–10) as occasionally in *Nenga gajah*. The basal leaflets are often 1–2 costate, narrower than the rest, and with long-acuminate tips. The middle leaflets are 1–5 costate and are generally the longest; the tips are likewise long-acuminate. The terminal leaflet pair may be 1–8 or 10 costate and is about as long as the basal leaflets. The tips may be long-acuminate or slightly toothed, the lobes corresponding to the major costae. The terminal leaflet pair may sometimes be joined at the base along the rachis.

The inflorescence in *Nenga* is infrafoliar and pendulous, except for *N. gajah* which has an interfoliar and erect inflorescence. Because of its interfoliar inflorescence, *N. gajah* has other associated features in its inflorescence structure not shared by other species. Apart from the inflorescence being erect, the peduncle is also very long (22–30 cm) and the prophyll is thick, coriaceous, almost woody, and persistent through anthesis. The bracts subtending the rachillae are likewise thick and stiff. In the rest of the genus, the peduncle is short (only 1–5 cm), the prophyll is rather thin and caducous, and the bracts subtending the rachillae are thin and membranous. The number of rachillae in the inflorescence and their length may vary considerably even within the same species, although it is rather consistent in at least one species. In *N. pumila* var. *pumila* the inflorescence may have 3–7 rachillae, often 3–4; *N. pumila* var. *pachystachya*, 2–6, often 2–4; *N. banaensis*, 4–6; *N. macrocarpa*, 3–5, often 3–4; and *N. gajah*, 3–5. In *N. grandiflora*, however, the inflorescence has consistently only 2 rachillae. Each rachilla usually bears both staminate and pistillate flowers in triads (1 pistillate between two staminate), especially along the proximal portion. The distal terminal portion often consists purely of staminate flowers. Occasionally, some rachillae may bear only staminate flowers throughout. In *N. gajah*, up to 4 rachillae may be entirely staminate.

As in the other arecoid palms, *Nenga* flowers are unisexual and dimorphic. The staminate flowers are generally triangular, or sometimes angular and oblong. The pistillate flowers are globose to subglobose, often shorter than the staminate flowers. The staminate flower bears 3, free, valvate, usually subulate, dorsally carinate, flexuous sepals. The petals are elliptic to narrowly ovate or lanceolate, much shorter than or equal to subequal with the sepals. *N. gajah* differs in its staminate flowers from all other species; the sepals in this species are oblong-ovate to broadly ovate, but minute (only to 1 mm long), sometimes almost inconspicuous; the petals are oblong to slightly obovate, rather thick and marked within with impressions of the 6 stamens. Filaments are very short; the anthers are erect, basifixed, linear, and usually sagittate at the base. A pistillode may be present in the form of a minute conical structure but it is sometimes indistinct. In the pistillate flower the sepals and petals are very similar, being free, imbricate, usually broadly ovate, concave, and ciliolate along the margin. The ovary is ovoid to spherical with a conical 3-lobed stigma and parietal ovule. Staminodes may be present as 6 minute conical structures or may occasionally be indistinct. *Nenga* flowers when fresh are generally cream-colored or greenish-cream.

Pollen in *Nenga* is monosulcate, with a very coarse to slightly fine reticulate exine. The amb shape is generally broadly elliptical (spherical in *N. gajah*). The exine is tectate. Pollen will be described in detail elsewhere (Fernando, in prep.).

The infructescence in *Nenga* is usually pendulous; the branches are densely covered with fruits except for the withered tips (the remains of the entirely staminate portions). In *N. gajah*, the infructescence is a single clublike head of fruits. The fruit varies from oblong or oblong-ellipsoid to

ovoid or obclavate or obpyriform to fusiform, ranging in size from 1.8–2.0 cm × 0.8–1.0 cm to 5–8 cm × 1.5–2.5 cm. *Nenga* fruits ripen orange-brown or brick-red, or purplish-brown to purplish-black. The fruit is often distinctly tipped by the remains of the 3-lobed stigma and is also usually beaked as in the large-fruited species. The epicarp is smooth and glabrous and the mesocarp is fibrous. In most species of *Nenga* the fibers of the endocarp are free at both ends when the mesocarp has eroded away. In *N. gajah*, however, the fibers do not become free (Dransfield 1975). The pericarp structure in *Nenga* fruits (based on an unidentified species from the Malay Peninsula) is described by Essig and Young (1979).

The seed in *Nenga* is laterally attached along its length to the endocarp by a raphe, and is cylindrical-ellipsoid or ovoid, the apex acute to acuminate or spinescent and the base rounded-truncate or concave. In *N. gajah* the seed is more or less fusiform with a rounded to obtuse base. The seed surface in *Nenga* is also characterized by narrow, shallow anastomosing grooves, and the endosperm is deeply ruminate with the embryo basal.

Geographical Distribution and Ecology

There are 3 taxa in the Malay Peninsula, 1 in Singapore, 2 in Sumatra, 1 in West Java, 1 in Borneo, 2 in S. Thailand, and 1 in Indo-China. The Malay Peninsula, Sumatra, and Indo-China have each 1 endemic species and West Java 1 endemic variety.

Beccari and Pichi-Sermolli (1955) also cited S. Burma as within the natural range of *Nenga*, although I have not seen any specimen nor literature reference to confirm this. It is, indeed, very likely that it may extend to S. Burma, especially near the Thai border.

The species of *Nenga* are usually found in the undergrowth of dense humid forests, along streams or in river valleys or hill slopes up to ca. 1,300 m alt. *N. pumila* var. *pachystachya* is sometimes found along the landward edge of mangrove swamps. In Borneo, it is also found in heath forest on sandstone or granitic sand. *N. pumila* var. *pumila* is known to tolerate limestone soils (Backer and Bakhuizen 1968), while *N. banaensis* is reported only from granitic soil. *N. macrocarpa*, *N. grandiflora* and *N. gajah* seem to be strictly limited to humus-rich soils of the Dipterocarp forest.

Taxonomy

Nenga H. A. Wendl. & Drude in Linnaea 39: 182 (1875); Becc., in Malesia 1: 24 (1877) (pro parte); Benth. & Hook. f., Genera Plantarum 3: 888 (1883); Drude in Engl. & Prantl, Die naturlich. Pflanzenfam. 2(3): 75 (1889) (pro parte); Becc. & Hook. f., in Hook. f., Fl. Br. India 6: 412 (1892); Ridley, Mat. Fl. Mal. Pen. 2: 144 (1907) and Fl. Mal. Pen. 5: 12 (1925); Becc. & Pichi-Sermolli in Webbia 11: 37 (1955); Backer & Bakh., v.d. Brink, Jr., Fl. Java 3: 192 (1968); Whitmore, Palms Mal. 79 (1973); Moore in Gentes Herb. 11: 134 (1973).

Solitary or caespitose, slender or moderate, unarmed, pleonanthic, monoecious, undergrowth palms. Stem erect, sometimes stilt-rooted; nodes prominent. Crownshaft well-defined (except in *N. gajah*), elongate, slender or swollen, sometimes slightly angular, leaf sheath covered with brown scale-like indumentum, pale green, yellowish-green or purplish-green. Petiole adaxially grooved, rounded abaxially, smooth, with scattered brown indumentum. Leaves pinnate; rachis subangular, tapering towards apex, triangular in cross section; leaflets regular, opposite to subopposite or alternate; linear–elliptic or falcate-sigmoid; lamina dull to bright green, paler beneath, drying greyish-green or brown, glabrous, coria-

ceous, with sparse to numerous ramenta along costae on abaxial surface; basal leaflets often narrower than the rest, usually 1–2 costate, long-acuminate at tips; middle leaflets 1–5 costate, long-acuminate at tips; terminal leaflet pair 1–8 costate, sometimes joined at the base to several cm along the rachis, long-acuminate or gradually narrowed or slightly toothed at tips. Inflorescence infrafoliar or rarely interfoliar; pendulous or erect, protandrous (Dransfield, pers. comm.); prophyll ensiform or lanceolate, usually soon caducous or rarely long-persisting through anthesis, peduncular bract triangular, acuminate or ovate, often membranous; peduncle often not more than 5 cm long (much longer in *N. gajah*), flattened; rachillae 2–4, sometimes 5, but rarely to 6 or 7, each subtended by a triangular, often membranous bract; triads (one pistillate between two staminate) spirally arranged to more than half of axis length from proximal end, distal portion all staminate, or rarely all staminate throughout. Staminate flowers soon caducous, very shortly pedicellate or sessile, the whole flower angular, often trigonous, asymmetric; sepals 3, free, valvate, linear-subulate to very narrow lanceolate, usually carinate dorsally, flexuous, unequal, or rarely minute and triangular (as in *N. gajah*); petals 3, free, valvate, elliptic or narrowly ovate to lanceolate, generally shorter than or equal to subequal to sepals (oblong, plane or cucullate and much longer than sepals in *N. gajah*); stamens 6, filaments short, anthers erect, linear-oblong, sagittate at base or nearly so, basifixed; pistillode conical, minute. Pistillate flower sessile, ovoid to globose or subglobose, much shorter than or subequal to the staminate flower; perianth not clearly differentiated into calyx and corolla, often long-persisting through fruiting stage; sepals 3, free, imbricate, broadly ovate, concave, sometimes cucullate at tips, ciliolate along the margins; petals 3 as the sepals, slightly shorter; ovary unilocular, ovoid to spherical or subglobose; stigma conical, 3-lobed; ovule parietal; staminodes short or indistinct. Infructescence pendulous, with 2–4, rarely 5–7 branches densely covered with fruits or with a single clublike head of fruits. Fruit ripening orange-brown to brick red or purplish-black, oblong to ellipsoid or ovoid to fusiform, usually prominently beaked and tipped with the 3-lobed stigma; epicarp smooth, glabrous; mesocarp fibrous; endocarp smooth, shiny within. Seed attached laterally to the endocarp, cylindrical-ellipsoid to ovoid, abruptly or gradually acute to acuminate or spinescent at tip; base shallowly or deeply concave intruded, rounded-subtruncate to truncate; endosperm ruminate; embryo basal. Type species: *Nenga pumila* (Mart.) H. A. Wendl.

Key to the Species of *Nenga*

1. Inflorescence interfoliar, peduncle long, to ca. 25 cm; prophyll long-persisting through anthesis; sepals of staminate flower minute, triangular or broadly ovate, much shorter than petals, not more than 1 mm long. ..... *N. gajah.*
– Inflorescence infrafoliar, peduncle short, to ca. 5 cm; prophyll caducous; sepals of staminate flower subulate to narrowly triangular, much longer than, equal or subequal to petals, more than 3 mm long. ..... 2.
2. Stem caespitose; calyx of staminate flower much longer than corolla. ..... *N. pumila.*
– Stem solitary; calyx of staminate flower equal or subequal to corolla. ..... 3.
3. Infructescence usually not more than 20 cm long; stem not more than 4 cm in diameter. ..... *N. banaensis.*
– Infructescence usually more than 20 cm long; stem often more than 4 cm in diameter. ..... 4.
4. Inflorescence with 3–4, rarely 5 branches; fruit ellipsoid; remnants of stigma less than 5 mm long, trilobed; seed short-ovoid, usually less than 2 cm long, abruptly acute at apex. ..... *N. macrocarpa.*
– Inflorescence with 2 branches; fruit ovoid to obclavate or obpyriform; remnants of stigma 5 mm or longer, only the upper half trilobed, the lower half entire; seed long-ovoid, usually more than 2 cm long, gradually acute to acuminate or slightly spinescent at apex. ..... *N. grandiflora.*

1. **Nenga pumila** (Mart.) H. A. Wendl. in Kerch., Palm. 251 (1878) and in

List of Palms in Kew Rep. 1882: 54 (1884); Koord., Exk. Fl. Java 1: 242 (1911) (cited as *N. pumila* (Bl.) Wendl.); Backer & Bakh. v.d. Brink Jr., Fl. Java 3: 193 (1968).

Areca pumila Mart., Hist. Nat. Palm. 3: 177, t. 153 (1838) (non Bl., in litt. et non Griff.) (infructescence erroneously shown as erect), 312 (1853) (excl. synonym *Areca* (*Anaclasmus*) *pumila* Griff.); Miq., Fl. Ind. Bat. 3: 14 (1855) (excl. var. *pachystachya* Bl.) and De Palm. Arch. Ind. 23 (1868). Type: t. 153 in Mart., *l.c.*

Areca nenga Bl. ex Mart., Hist. Nat. Palm 3: 179 (1838) (pro parte); Scheff. in Natuurk. Tijdschr. Ned. Ind. 32: 166 (1873) (as *A. 'nengah'* Bl.).

Pinanga nenga (Bl. ex Mart.) Bl. in Rumphia 2: 77, t. 107 (1839) (excl. var. *pachystachya*) (pistil erroneously drawn with 2 locules).

Nenga wendlandiana Scheff. in Ann. Jard. Bot. Buitenz. 1: 153, tab. 9–10 (1876) (excl. synonym *Areca hexasticha* Kurz); Becc. in Malesia 1: 25 (1877) (cited as *N. wendlandiana* (Bl.) Scheff.) and in Ann. Jard. Bot. Buitenz. 2: 83 (1885)—nomen illegit.

Pinanga neglecta Burret in Notizbl. Bot. Gart. Mus. Berlin-Dahlem 15: 204 (1940). Type: Java, Reservat Depok, *Burret 330* (Holotype B).—**synon. nov.**

(a) *Var. pumila*

Slender palm with stems ca. 2–3 m long, rarely more, 2.5–5 (8) cm diam., clustering at the base; leaf scars prominent; internodes to 8 cm long, smooth, green to greenish-brown. Crownshaft elongate, cylindrical, to ca. 50 cm long, rarely swollen. Leaves 5 to 6 in crown, leaf sheath ca. 40 cm long, dull greenish or yellowish-brown, petiole ca. 30–50 cm long, to 1.5 cm diam. Leaflets to 25 on each side of the rachis, often drying greyish-green or light brown; basal leaflets usually narrower than the rest, 1 costate, ca. 30–35 × 1 cm, long-acuminate; middle leaflets 2–3 costate, ca. 35–50 × 2.5–4.5 cm, gradually narrowed at tips; terminal leaflet pair 3–7 costate, ca. 10–25 × 2–4.5 cm, acuminate or slightly toothed at tips, sometimes joined to 7 cm long at base along the rachis. Inflorescence infrafoliar, pendulous; prophyll ensiform or lanceolate, rather thin, drying chestnut-brown, caducous; peduncle short, ca. (1) 1.5–3 (4.5) × 1.6 cm, flattened, glabrous; peduncular bract triangular-acuminate, to 1.5 cm long, 1.0 cm at the base, membranous; rachillae usually 3–4, rarely to 7, ca. 20–30 cm long, each subtended by a triangular membranous bract to 5 mm long. Staminate flower triangular, or trigonous, asymmetric, flexuous; sepals subequal, linear-subulate or very narrowly lanceolate, dorsally carinate, very flexuous, ca. 1.0–1.5 cm long; petals narrowly ovate to lanceolate, straight to subfalcate, acuminate at tip, much shorter than sepals, ca. 5–7 × 1.5–2 mm; filament short, to 1 mm long; anthers erect, linear, to 2 mm long, sagittate at base; pistillode conical, minute. Pistillate flower ovoid to subglobose; sepals to 3 × 3 mm; petals as the sepals or only slightly smaller; ovary ovoid to spherical to 1.5 × 2 mm; stigma 3-lobed; staminodes indistinct. Infructescence pendulous, branches densely covered with fruits. Fruit ripening orange-brown, oblong to oblong-ellipsoid, ca. 1.8–2.0 × 0.8–1.0 cm, tipped with a circular, cushion-shaped stigma, the stigmatic lobes not prominently erect and parted or only slightly so; epicarp drying with longitudinal, slightly anastomosing ridges. Seed oblong-ovoid, ca. 8–11 × 5–7 mm, abruptly acute to acuminate at tip; base rounded-truncate, shallowly concave-intruded.

Distribution and Habitat. West Java; in mixed hill forest, also on limestone, ca. 150–1,300 m alt. Endemic.

Vernacular Names. Djambe ngenge, Ngenge (Sundanese); *Ngingi* (Javanese).

Specimens Examined: WEST JAVA: Pandeglang, Mandalawangi, G. Pulosari, 600 m alt., fl. and fr., *Dransfield 4184* (K); Ciapus, ster., *Herb. Lugd. Bat. 329* (L); G. Salak, fl. and fr., *Herb. J. C. Schoute* (L); Batavia, Ciampea, 150–200 m alt., fl., *Koorders 30777B* (L), Preanger, Takoka, ca. 1,200 m alt., fr., *Koorders 33370B* (L); Localities unknown, ster., *Herb. Lugd. Bat. 202, 328, 330–335* (L), fl., *Herb. Lugd. Bat. 197–199, 201*, fr., *Herb. Lugd. Bat. 203* (L), fr., *Blume s.n.* (*Herb. Lugd. Bat. 337*) (Type of *Pinanga nenga* Bl. var. *β hanjawar*; Holotype L).

Note. Pinanga neglecta Burret was based on a collection from Reservat Depok near Bogor in West Java. The holotype (*Burret 330*) has not been found among the remaining Burret palm collections in Berlin. However, the original description matches *N. pumila* var. *pumila* and cannot be referred to any known Javanese *Pinanga* (Dransfield, pers. comm.). *P. neglecta* is, thus, here reduced to synonymy under *N. pumila* var. *pumila*.

Nomenclatural Notes. Until 1935, this species was commonly known as *Nenga wendlandiana*. The name was proposed by Scheffer in 1876 for the type species of the genus, originally designated by Wendland and Drude (1875) as *Pinanga nenga* Bl., but unfortunately no new combination was made. The name *N. wendlandiana* Scheff. is, however, illegitimate as was discussed by Furtado (1935). Wendland (1878) who strictly followed the rule of priority, provided the correct and valid combination—*Nenga pumila* (Mart.) H. A. Wendl.—based on *Areca pumila* Mart., which is an earlier validly published name for *Pinanga nenga* Bl. Furtado (1935) discussed in detail this particular nomenclatural problem and gave satisfactory reasons why *N. wendlandiana* should be rejected and *N. pumila* accepted.

(b) *Var.* **pachystachya** (Bl.) E. Fernando, **comb. nov.**

Pinanga nenga (Bl. ex Mart.) Bl. var. *pachystachya* Bl. in Rumphia 2: 78 (1839). Lectotype: Sumatra (locality unknown), *Korthals Sumatra No. 16* (L).

Areca (*Anaclasmus*) *pumila* Griff. in Calc. J. Nat. Hist. 5: 456 (1845) and Palm. Br. India 151 (1850).

Areca pumila Mart. in Miq., Fl. Ind. Bat. 3: 14 (1855) and Prodr. Fl. Sum. 253 (1860).

Areca nenga sumatrana Scheff. in Natuurk. Tijdschr. Ned. Ind. 32: 168 (1873) (as *A.*"*nengah*").

Nenga schefferiana Becc. in Ann. Jard. Bot. Buitenz. 2: 84 (1885). Type: Sumatra (locality unknown), *Scheffer s.n.* (Holotype FI).—**synon. nov.**

Nenga intermedia Becc. in Ann. Jard. Bot. Buitenz. 2: 85 (1885) Type: Sumatra, Padang, Sungei Bulu, *Beccari PS 942* (Holotype FI; Isotypes BM, K).

Nenga wendlandiana Scheff. var. *malaccensis* Becc. in Malesia 3: 182 (1889); Becc. & Hook. f. in Hook. f., Fl. Br. India 6: 142 (1892). Type: Malay Peninsula, Perak, Larut, *Kunstler 4022* (Holotype CAL (not seen); Isotypes BM, K, L).

Nenga wendlandiana Scheff. var. *malaccensis* Becc. forma *hexapetala* Becc. in Malesia 3: 183 (1889). Type: Malay Peninsula, Perak, *Scortechini s.n.* (Holotype FI).

Nenga wendlandiana Scheff. in Ridley, Mat. Fl. Mal. Pen. 2: 144 (1907) (excl. synonyms *Pinanga nenga* Bl. et *Nenga pumila* Wendl.) and Fl. Mal. Pen. 5: 12 (1925).

Caespitose, slender to moderate palm with stems sometimes stilt-rooted at the base, ca. 3–5 m long, (2) 3–6 (8) cm diam.; internodes to ca. 10 cm long, smooth, bright green to brown. Crownshaft elongate, cylindrical, ca. 35–80 cm long, only slightly swollen. Leaves to 7 in crown, leaf sheath ca. 25–60 cm long, pale green to greenish or yellowish-white;

petiole ca. 4–50 cm long, to 1.5 cm diam. Leaflets to 30 on each side of the rachis, often drying dull reddish-brown; basal leaflets 1 costate, ca. 25–40 × 0.5–1.0 cm, long-acuminate; middle leaflets 2–3 costate, rarely 4 or 5 costate, ca. 35–70 × 2–4 (5) cm, long-acuminate; terminal leaflet pair 3–6 costate, rarely to 10 costate, ca. 20–40 × (1.5) 2–2.5 (4) cm, acuminate or slightly toothed at tips, sometimes joined to 4 cm at the base along the rachis, rarely more. Inflorescence infrafoliar, pendulous; prophyll ensiform or lanceolate, ca. (18) 20–25 (70) × 1.5–3.0 cm, drying chestnut-brown, caducous; peduncle ca. 1.5–3.0 (4) × 0.4–1.3 cm, flattened, glabrous; peduncular bract triangular to narrowly triangular, acuminate, ca. 8–15 × 8–10 mm, membranous; rachilla 2–4, usually 3, rarely to 6, ca. (15) 20–35 (50) cm long, to 6 mm thick, each subtended by a membranous triangular bract to 10 mm long. Staminate flower triangular, asymmetric, flexuous; sepals subequal, linear-subulate or very narrowly lanceolate, dorsally carinate, very flexuous, ca. 9–13 (20) mm long; petals elliptic to lanceolate, acuminate, straight to subfalcate, much shorter than sepals, ca. 5–7 (9) × 2–2.5 mm; filaments 1–2 mm long; anthers erect, linear, ca. 1.5–2 mm long, sagittate at base; pistillode conical, minute. Pistillate flower ovoid to subglobose, shorter than the staminate flower; sepals ca. 3–4 mm × 4 mm, petals as the sepals, or sometimes only slightly smaller; ovary ovoid to spherical, to 1.5 mm × 2 mm; stigma distinctly 3-lobed; staminodes indistinct. Infructescence pendulous, branches densely covered with fruits. Fruit ripening brick-red, oblong to oblong-ovoid or ovoid-ellipsoid, ca. (2) 2.4–3 × 1–1.5 (1.8) cm, beaked, tipped with a prominent 3-lobed stigma to 2 mm high, the lobes erect; epicarp often drying with shallow dimples. Seed broadly ovoid, ca. 10–15 mm × 7–9 mm, acuminate to spinescent at tip, base rounded-truncate, shallowly concave-intruded.

Distribution and Habitat. S. Thailand, Malay Peninsula, Singapore, Sumatra, Bangka, and Borneo; along the landward edge of mangrove or in dense humid Dipterocarp forest on hillslopes or river valleys, also in heath forest on sandstone or granitic sand, to ca. 1,100 m alt.

Vernacular Names. Kache (Thailand); *Rasau, Pinang horaiung* (Borneo); *Keredan, Pinang muring* (Malay Peninsula); *Pinang unoo* (Singapore); *Kajoe djambe* (Sumatra).

Specimens Examined. S. THAILAND: Pato: Langsuan, 100 m alt., fr., *Kerr 12122* (BM, K); Ranawang: Lam Lieng, 50 m alt., fr., *Kerr 11727* (K), Ja-un, 150 m alt., fr., *Kerr 16483* (BM, K), Muang Len, 150 m alt., fl., *Hansen & Smitinand 11944* (L); Terutao: Satul, fl., *Kerr 14227* (BM, K).—MALAY PENINSULA: Langkawi Is.: Burau, fl. and fr., *Robinson 6264* (K); Kelantan: Sungei Keteh, fr., *Md. Nur SFN 12001* (K); Perak: Larut, fl. and fr., *Kunstler 4022* (Type of *N. wendlandiana* Scheff. var. *malaccensis* Becc.; Isotypes BM, K, L), Gopeng, G. Cantek, fr., *Furtado SFN 33084* (BH, K, L).—Locality unknown, fl., *Scortechini s.n.* (Type of *N. wendlandiana* Scheff. var. *malaccensis* Becc. forma *hexapetala* Becc.; Holotype FI); Pahang, Temerloh, Kemansul Forest Reserve, fl., *Hamid 10580* (K) Selangor: Klang, Bt. Canggang, fl. and fr., *Md. Nur SFN 33998* (BM, K), Ulu Gombak, fl. and fr., *Ridley s.n.* (K), Lampang Mines, fr., *Ridley 15880* (K); Negri Sembilan: G. Angsi, fr., *Md. Nur SFN 11707* (K); Johore: between G. Blumut and G. Bacya, fl., *Holttum SFN 10843* (K), Telerau, Bunei, fl., *Ridley 13236* (BM, K), Mersing, Jemeluang Forest Reserve, 100 m alt., fr., *Dransfield 895* (K) fr., *Moore & Pennington 9053, 9056, 9071* (BH), Kluang Forest Reserve, ster., *Tan Ah King 16, 17* (K); Locality unknown, fr., *Furtado s.n.* (BH).—SINGAPORE: Seletar: Nee Soon area, fl. and fr., *Maxwell 77–80* (L), fr., *Ridley 3164* (BM, K);

Jurong: fr., *Corner SFN 26101* (BH, BM, K); Chenchu Kang: fl., *Corporal 3162* (BM), fl., *Ridley s.n.* (BM); Mandai Rd: fr., *Sinclair s.n.* (K).—SUMATRA: Langkat: Bohorok, Bt. Lawang, 450 m alt., fr., *Dransfield 3147* (K, L); Sigamata: near Rantau Parapat, fl., *Toroes 3244* (L); Payakumbuh: Taram, 500–1,000 m alt., fl. and fr., *Meijer 6880, 6972* (L), fl., *Meijer 7010* (L); Padang: Sungei Bulu, fl. and fr., *Beccari PS942* (Type of *N. intermedia*, Holotype FI; Isotypes BM, K); Jambi: Sungei Penuh, Tapan, 700 m alt., fl., *Dransfield & Mogea 4130* (L); Palembang: Bt. Seburong, Negeri Batin, Muara Dua, 250 m alt., fl. *Dransfield & Saerudin 2438* (L), Locality unknown, fr., *Kostermans 12081* (L); Bengkulu: Kepahiang, 700 m alt., fl. and fr., *Dransfield 3571* (K, L), *3572* (L); Kerang Berak: S. Sumatra Ist Nature Reserve, 100 m alt., fl. and fr., *Dransfield 1256* (L); Localities unknown: *Korthals? 16* (Lectotype of *Pinanga nenga* Bl. var. *pachystachya*, L), *Korthals s.n.* (L) (fragments of inflorescence only); ster., *Blume s.n.* (*Herb. Ludg. Bat. 335–336*) (L).—BANGKA IS: Lobok Besar: G. Pading, fr., *Kosterman & Anta 913* (L).—BORNEO: Sabah: Semporna Mapat Reserve, Timbun Mata F.R., fl. and fr., *Puasa BNB For. Dept. 7412* (K); Sepilok, Kabili, Bakarit, fr., *Agama BNB For. Dept. 7265* (L); Keningau, 100 m alt., fl., *Dransfield 5517* (K); Elphinstone Prov., near Tawau, fr., *Elmer 21256* (BM, K); Sarawak: Niah, G. Subis, fl. and fr., *Mohidin S21628* (K); 1st Division, Lundu District, G. Pueh Forest Reserve, near Bahuching, fr., *James et al. S34611* (BH); 4th Division, Ulu Koyan, Mt. Dulit, 800 m alt., fl., *Richards 2020* (K); 5th Division, Lawas, Ulu Sungei Masia, Kota F.R., 1,100 m alt., fl. and fr., *Tong & Jugah S32923* (BH); Baleh, Ulu Mujong, 950 m alt., fl., *Ashton S13996* (BH, K); Kalimantan Selatan: Barabai, Pergunungan Meratus, 800 m alt., fl., *Dransfield 2829* (L); Locality unknown: fl., *Low s.n.* (K).—CULTIVATED: Singapore Bot. Gard., fr., *Flippance s.n.* (K).

The two varieties in *N. pumila* may be keyed out as follows:

- Fruit usually smaller, ca. 1.8–2.0 × 0.8–1.0 cm, ripening orange-brown, tipped by a circular cushion-shaped stigma, mature pericarp drying with longitudinal ridges; seed often narrower, ca. 5–7 mm wide, oblong or narrowly ovoid, abruptly acute to acuminate at tip. ..... *N. pumila* var. *pumila*.
- Fruit usually larger, ca. (2.0) 2.4–3 × 1.0–1.5 (1.8) cm, ripening brick-red, tipped by a conical, prominently trilobed stigma, mature pericarp drying with broad shallow dimples; seed often broader, ca. 7–9 mm wide, broadly ovoid, acuminate to spinescent at tip. ..... *N. pumila* var. *pachystachya*.

Notes: Nenga pumila var. *pachystachya* is the most widespread of the taxa in the genus; until recently it was regarded as inseparable from the typical variety from West Java.

N. schefferiana is here reduced to synonymy under the variety. Figures of flowers, fruit and seed (based on the type of *N. schefferiana* collected by Scheffer) mounted on a herbarium sheet at Kew show staminate flowers with extremely long sepals. A specimen in Leiden (? *Korthals Sumatra No. 16*) also cited by Beccari (1885) in the original publication of *N. schefferiana*, containing only a fragment of an inflorescence branch, likewise has staminate flowers with immensely long sepals. This is apparently only a size difference; similar specimens have never been collected again. Moore (1963) had earlier hinted that *N. schefferiana* might be no more than a variety of *N. pumila*. *N. intermedia* was based on a collection by Beccari himself from Sungei Bulu near Padang (*Beccari PS 942*) with leaves having very short petioles. To this species Beccari (1885) also referred a collection from Ching Forest in Malacca, Malay Peninsula, earlier described by Griffith (1845) as *Areca* (*Anaclasmus*) *pumila*, also with a short petiole. Griffith's species was later cited by Beccari (1889) as a synonym of

N. wendlandiana var. *malaccensis*, but Beccari preferred to maintain *N. intermedia* from Sumatra as a distinct species. More recent collections have, however, revealed much overlapping in variation between the Malayan and Sumatran populations. Ridley (1907) had much earlier recognized this by reducing *N. intermedia* to synonymy under *N. wendlandiana*.

Beccari (1889) described *N. wendlandiana* var. *malaccensis* forma *hexapetala* based on a single collection (*Scortechini s.n.*) from Perak with staminate flowers having 6 petals in two series. This must be considered as a monstrosity. The material from South Thailand and Borneo represent the first published records of the genus in these areas. *N. pumila* var. *pachystachya* does not appear to me sufficiently disjunct in reproductive characters to justify its separation as a distinct species from *N. pumila*.

2. **Nenga banaensis** (Magalon) Burret in Notizbl. Bot. Gart. Mus. Berlin-Dahlem 13: 347 (1936).

Pinanga banaensis Magalon, Contrib. Etude. Palm. Indochine. Franc. 149 (1930) and in Feddes Repert 28: 112 (1930). Type: Indo-China, Tourane, Mt. Bana, *Magalon s.n.* (Holotype P).

Areca banaensis (Magalon) Burret in Notizbl. Bot. Gart. Mus. Berlin-Dahlem 13: 198 (1936).

Nenga nannospadix (Burret) Burret in Notizbl. Bot. Gart. Mus. Berlin-Dahlem 13: 347 (1936)—**synon. nov.**

Pinanga nannospadix Burret in Feddes Repert. 32: 116 (1933). Type: Indo-China, Annam, Mt. Bani, *J. & M. S. Clemens 4398* (Isotype K).

Areca microspadix Burret in Notizbl. Bot. Gart. Mus. Berlin-Dahlem 13: 198 (1936).

Solitary, slender palm, with stem to ca. 3 m long, 3.5 cm diam. Crownshaft elongate, cylindrical, slightly robust. Leaves spreading in crown; leaf sheath ca. 15–20 × 3–4 cm, green; petiole ca. 20–30 × 1 cm. Leaflets often drying dark greyish-green to greenish-brown; basal leaflets narrow, 1–2 costate, ca. 23–37 × (0.6) 1.0–2 (2.3) cm, long-acuminate; middle leaflets 2–3 costate, ca. 30–40 × 2.5–5 cm, long-acuminate; terminal leaflet pair 2–6 costate, ca. 21–35 × 1.7–5.5 cm, acuminate or slightly toothed at apex. Inflorescence infrafoliar, pendulous; prophyll ensiform or lanceolate, ca. 10 × 3.5–4.0 cm, caducous; peduncle short, ca. 1.0–1.5 × 8 mm, flattened, glabrous; peduncular bract triangular or ovate, to ca. 6 mm long, membranous; rachillae 4–6, ca. 5–20 cm long, to 5 mm thick, glabrous, each subtended by a triangular, membranous bract to 2 × 4 mm. Staminate flower triangular, asymmetric; sepals equal or subequal, subulate, dorsally carinate, ca. 4–7 mm long; petals broadly elliptic, obtuse at tip, equal to sepals; filament short, ca. 0.5–1.0 mm long, anthers erect to ca. 1.5 mm long, slightly cordate-sagittate at base; pistillode indistinct. Pistillate flower globose to subglobose, slightly shorter than the staminate flower; sepals ca. 3–5 × 3–4 mm, petals as the sepals, sometimes smaller; ovary subglobose, ca. 1.5 × 1 mm; stigma obscurely 3-lobed; staminodes indistinct. Infructescence pendulous, the branches often with rather short dead tips. Immature fruit oblong-ellipsoid, ca. 10 × 5–6 mm, tipped with a prominent 3-lobed stigma; endocarp apparently smooth. Seed not known.

Distribution and Habitat. Indo-China; in humid forest on granitic soil. Endemic.

Vernacular Name. Cay cau rung.

Specimens Examined. INDO-CHINA: Tourane: Mt. Bana, fl. and fr., *Magalon s.n.* (Holotype P); Mt. Bani, fl. and fr., *J. & M. S. Clemens 4398* (Type of *N. nannospadix* (Burret) Burret; Isotype K); Locality unknown: fl., *Polaine 7246* (K).

Notes. This species is still incompletely known; mature fruits and seeds have never been collected. The specimens representing this species in the herbarium contain

only juvenile fruits. The species referred to as *N. nannospadix* (first described in *Pinanga*) for the short inflorescence (only 4.5 cm long) fits quite well within the range of variation of *N. banaensis*. The isotype of *N. nannospadix* (*J. & M. S. Clemens 4398*) at Kew has a rachilla reaching approximately 13 cm long, very much longer than as originally described by Burret (1933). Inflorescence length in this species is variable. The holotype of *N. banaensis* (*Magalon s.n.*), for example, also has two inflorescences with rachillae reaching only 6–7 cm long. The holotype of *N. banaensis* was not seen by Burret as he had indicated (Burret 1936a, 1936b). The type specimens of both *N. banaensis* and *N. nannospadix*, moreover, were collected from about the same area near Tourane on granitic soil. There is so much overlap in variation between the two taxa that I have no doubt that they are conspecific.

3. **Nenga macrocarpa** Scort. ex Becc. in Malesia 3: 180 (1889); Becc. & Hook. f. in Hook. f., Fl. Br. India 6: 42 (1892); Ridley, Mat. Fl. Mal. Pen. 2: 145 (1907) and Fl. Mal. Pen. 5: 12 (1925); Whitmore, Palms Mal. 79 (1973) (excl. Figs. 66 and 68a). Lectotype: Malay Peninsula, Perak, Maxwell's Hill, *Scortechini 547a* (chosen by H. E. Moore, Jr. in annot. FI).

Solitary, robust palm. Stem ca. 2–6 m long, 4–6 cm diam.; internodes to ca. 15 cm long, smooth, green to greenish-brown. Crownshaft elongate, cylindrical or slightly angular, to ca. 60 cm long, often swollen. Leaves to 7 in crown; leaf sheath ca. 20–45 cm long, pale green with dull purplish-brown specks; petiole ca. 10–55 × 1.5 cm. Leaflets to 30 on each side of the rachis, drying brown; basal leaflets narrowly linear-acuminate, 1 costate, ca. 30–40 × 0.7–1.3 cm; middle leaflets 2–3 (5) costate, ca. 30–65 × 1–3 (5) cm, long-acuminate; terminal leaflet pair 2–4 (6) costate, ca. 25–40 × 1–3 (4) cm, long-acuminate or slightly toothed at tips, the pair sometimes joined to 9 cm at the base along the rachis. Inflorescence infrafoliar, subpendulous to pendulous; prophyll ensiform or lanceolate, ca. 20–30 × (3.5) 4–5 cm, slightly purplish, drying brown, caducous; peduncle ca. (1.5) 2–3 (3.5) × 1–1.8 cm, flattened, glabrous; peduncular bract narrowly triangular, to ca. 3.5 cm long, 8 mm wide at the base, membranous; rachillae 3–4, rarely to 5, ca. 25–45 cm long, to 8 mm thick, glabrous, each subtended by a membranous, triangular bract to 5 × 5 mm. Staminate flower triangular, asymmetric, flexuous; sepals equal or subequal, subulate, acutely and dorsally carinate, flexuous, ca. 6–13 mm long; petals elliptic to elliptic-lanceolate, acuminate, equal or subequal to the sepals; filaments ca. 2 mm long; anthers erect, linear, ca. 3–4 mm long, sagittate at base; pistillode of 2–3 tubercles. Pistillate flower shorter than the staminate flower; sepals ca. 4–6 × 5–6 mm, petals as the sepals, often smaller, ca. 4 × 3–4 mm; ovary ovoid to subglobose, to 3 × 2 mm; stigma distinctly 3-lobed; staminodes of 6 minute teeth. Infructescence pendulous. Fruit ripening purplish-black, ellipsoid, ca. 3–4 (4.5) × 1.3–1.7 cm, prominently beaked, tipped with a distinct 3-lobed stigma to 3 mm high, the lobes erect; epicarp often drying with longitudinal ridges; the inner apical part usually with a distinct cylindrical or conical, corky solid tissue. Seed broadly ovoid, ca. (1.2) 1.5–1.6 (1.8) × (0.7) 1–1.2 cm, abruptly spinescent at tip; base truncate, shallowly concave.

Distribution and Habitat. S. Thailand and Malay Peninsula; in dense humid forest; ca. 150–1,300 m alt., more widespread in the Malay Peninsula where it is common at higher altitudes.

Specimens Examined. S. THAILAND: Koh Gah: fr., *Kloss 6589* (K); Labu Mine, near Banang Sta., 400 m alt., fl., *Whitmore 3123* (K).—MALAY PENINSULA: Kedah: Baling, Ayer Terjun Valley, fr.,

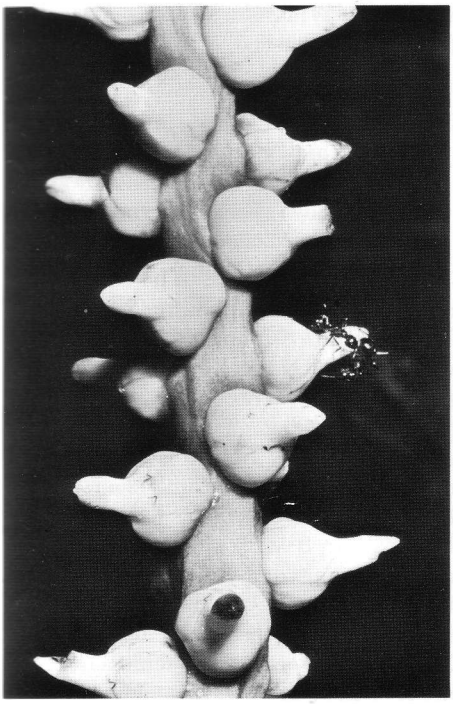
1. *Nenga grandiflora*, habit, G. Blumut, Johore, May 1968. Photo by J. Dransfield.

2. *Nenga grandiflora*, staminate and pistillate flowers in bud, G. Panti, Johore, June 1977. Photo by J. Dransfield.

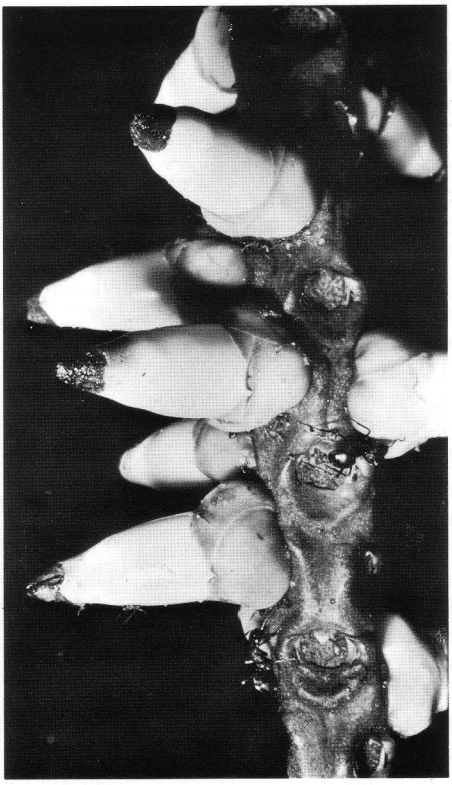
Furtado SFN 33048 (BH, K, L), G. Hang, 760 m alt., fl., *Furtado SFN 35024* (BH); Perak: Maxwell's Hill, 1,000–1,300 m alt., fl. and fr., *Scortechini 547a* (Lectotype FI), fl. and fr., *Scortechini 302b* (Paratype FI), ca. 975 m alt., fr., *Burkill & Haniff 12790* (K), Gopeng, fl. and fr., *Dr. King's Coll. 4775* (BM, K), G. Batu Putih, ca. 1035 m alt., fl. and fr., *Wray 930* (K), G. Kerbau, ca. 1,050 m alt., fr., *Robinson s.n.* (K), G. Bintang Hijau, fl., *Dransfield 5386* (K), Semangko, fr., *Ridley 14715* (BM); Pahang: Bentong, ca. 580 m alt., fl., *Furtado SFN 33110* (K); Kemaman: Ulu Bendong, ca. 150 m alt., fl., *Corner SFN 30065* (K); Selangor: G. Bunga Buah, ca. 850 m alt., fl. and fr., *Whitmore FRI 0322* (BH, L), Ulu Langat, Menuang Gasing, fl., *Kloss s.n.* (K); Negri Sembilan: G. Tampin, fl., *Ridley s.n.* (K), ca. 400 m alt., fl., *Burkill SFN 2849* (K).

Notes. This species is apparently a strictly solitary palm, although it has sometimes been erroneously reported as occurring in clumps. *Nenga macrocarpa* is easily distinguished by its staminate flowers with equal or subequal perianth parts, and its large ellipsoid fruits which are prominently beaked and tipped by a distinct 3-lobed stigma.

4. **Nenga grandiflora** E. Fernando, **sp. nov**; *N. macrocarpae* affinis, sed floribus masculis majoribus, fructu ovoideo, obclavato vel obpyriformi, valde longirostrato, inflorescentia duas rachillas semper ferenti differt. Typus: Malay Peninsula, Johore, Kota Tinggi, Panti East, 400 m alt., fl. et fr.,



3. *Nenga grandiflora*, details of pistillate flowers at anthesis with ant collecting nectar, G. Panti, Johore. June 1977. Photo by J. Dransfield.



4. *Nenga grandiflora*, young fruit, G. Panti, Johore, June 1977. Photo by J. Dransfield.

Dransfield & Fong 5048 (Holotypus K; Isotypi KEP, L).

Solitary, robust palm. Stem ca. 2 m long, 8 cm diam.; internodes to 5 cm, brown. Crownshaft elongate, cylindrical, to 75 cm long, very swollen. Leaves 7–8 in crown, leaf sheath ca. 30–60 cm long, dull green to slightly purplish; petiole ca. 32–54 × 1.6 cm, slightly yellowish-orange, rachis angular, rather sharp along the edges. Leaflets to ca. 30 on each side of the rachis, drying light brown; basal leaflets 1–2 costate, ca. 25–42 × 0.8–1.2 cm, long-acuminate; middle leaflets 3–4 costate, ca. 40–82 × 5–6.5 cm, long-acuminate; terminal leaflet pair 3–6 costate, ca. 30–56 × 3–5.5 cm, acuminate or slightly toothed at tips, the pair sometimes joined to 10 cm at the base along the rachis. Inflorescence infrafoliar, pendulous; prophyll ensiform or lanceolate, ca. 28 × 2.7 cm, drying brown, caducous; peduncle ca. 1.7–4 × 0.8–1.5 cm, flattened, glabrous; peduncular bract triangular, to ca. 5 mm long, 4 mm at the base, membranous; rachillae always 2, ca. 24–30 cm long, 7–10 mm thick near the base, glabrous, each rachilla subtended by a membranous, triangular bract to ca. 5 mm long. Staminate flower triangular, trigonous, asymmetric, slightly flexuous; sepals equal or subequal, subulate, acutely and dorsally carinate, flexuous, ca. 1.3–1.6 cm long, to 3 mm wide; petals elliptic or elliptic-lanceolate, acute to acuminate at tips, equal or slightly subequal to the sepals; filaments ca. 2–2.5 mm long;

anthers erect, linear, ca. 6–7 mm long, deeply sagittate at the base; pistillode conical, minute. Pistillate flower shorter than the staminate flower; sepals ca. 5–8 × 5–7 mm, petals as the sepals, slightly smaller, ca. 4–6 × 4–5 mm; ovary broadly ovoid or subglobose, to 3 × 3 mm; stigma distinctly 3-lobed; staminodes of 6 minute teeth. Infructescence pendulous, densely covered with fruits. Fruit ripening deep red then purplish-black, ovoid to obclavate or obpyriform, ca. 3.8–5.4 × 1.5–2.0 cm, prominently long-beaked and tipped by a stigma 5–7 mm long, the upper half deeply 3-lobed; epicarp drying with longitudinal ridges; seed narrowly ovoid, ca. 2.3 × 1.2 cm, acute to acuminate or shortly spinescent at tip; base truncate, slightly concave intruded.

Distribution and Habitat. Malay Peninsula (Johore); in dense humid forest on steep rocky hillslopes or river valley bottoms; ca. 180–500 m alt. Endemic.

Specimens Examined. MALAY PENINSULA: Johore: Kota Tinggi, Panti East, 400 m alt., fl. and fr., *Dransfield & Fong 5048* (Holotype K; Isotypes KEP, L), G. Blumut, below Camp 2, ca. 500 m alt., fr., *Dransfield 841* (K), Sungei Kayu, fr., *Corner & Furtado SFN 29482b* (K), Kluang, Lenggor Forest Reserve, ca. 180 m alt., fr., *Dransfield 810* (BH), Mersing Forest Reserve, fl. and fr., *Moore & Pennington 9061* (BH).

Notes. This species is very distinctive in its very large staminate flowers, the consistently 2-branched inflorescence, and the prominently long-beaked, ovoid to obclavate or obpyriform fruit tipped with a distinctly long, 3-lobed stigma. It is most closely related to *N. macrocarpa* in vegetative features, as well as in the staminate flowers with equal or subequal perianth parts. *N. macrocarpa* is, however, easily distinguished from *N. grandiflora* by its inflorescence with often 3–4 rachillae, the much smaller staminate flowers, and the more ellipsoid fruits. Figures 66 and 68a in Whitmore's 'Palms of Malaya' (1973: 80) labelled as *N. macrocarpa* belong to this new species.

5. **Nenga gajah** Dransf. in Principes 19: 27 (1975). Type: Sumatra, Bengkulu, Kepahiang, Cagar Alam, near Curup, *Dransfield 1234* (Holotype BO; Isotypes K, L).

Solitary, stem stout, stilt-rooted, to 2 m long, 15 cm diam.; internodes short, to 1 cm long, greyish-brown. Crownshaft not well-defined. Leaves 8–10 in crown, leaf sheath ca. 50–60 cm long, pale yellowish-green, not falling off but rotting on the stem; petiole ca. 50–75 × 2.5 cm, circular in cross-section, with sparse dark brown indumentum; rachis to 8 mm thick. Leaflets ca. 8–27 on each side of the rachis, drying dull greyish-brown; basal leaflet 1 costate, ca. 34 × 1 cm, long-acuminate; middle leaflets 3–6 costate, ca. 32 × 4.5–8.0 cm, long-acuminate; terminal leaflet pair 3–5 costate, to ca. 32 × 3–4 cm, acuminate or bifid to slightly toothed at tips, the pair joined to ca. 4 cm at the base along the rachis. Inflorescence interfoliar, erect; prophyll ensiform, ca. 25–35 × 4 cm, coriaceous or woody and fibrous, hard, covered with scurfy brown indumentum especially along the margins, long-persisting through anthesis; peduncle ca. 22–30 × 1 cm, flattened, covered with sparse brown hairs; peduncular bract triangular ca. 6 mm long, thick and stiff; rachillae 3–5, ca. 10–12 cm long, 5–8 mm thick, each rachilla subtended by a short, thick, stiff, triangular bract to 5 × 5 mm; the lower 2–4 rachillae all staminate, the terminal or apical rachilla staminate and pistillate, or rarely all staminate only. Staminate flowers arranged in 5–7 vertical rows, or in tight spirals, angular, oblong; sepals minute, triangular, oblong-ovate or broadly ovate, slightly concave, to 1 mm long, often shorter; petals oblong to slightly obovate, unequal, ca. 4.5–5 × 2–2.5 mm,

rounded-truncate or cucullate at apex, rather thick, the inner surface marked with impressions of stamens; filaments to 1 mm long; anthers erect, linear-oblong, ca. 2–2.5 mm long, deeply sagittate at the base; pistillode indistinct. Pistillate flower with sepals to 7 × 6 mm, coriaceous, persistent; petals as the sepals; ovary spherical, to 3 × 4 mm; stigma obscurely 3-lobed; staminodes 6, minute, triangular, to 0.5 mm long. Infructescence pendulous, a single club-like head of fruits. Fruit ripening dark purplish-brown, fusiform, ca. 5–8 × 1.5–2.5 cm, beaked, tipped by a short blunt stigma; epicarp drying with few longitudinal ridges. Seed narrowly ovoid to fusiform, to ca. 4.5 × 1.8 cm, acute to acuminate at tip, base rounded to obtuse.

Distribution and Habitat. Sumatra; in hill Dipterocarp forest on hillslopes, valley bottoms, and streamsides; ca. 800 m alt. Endemic.

Vernacular Name. Pinang gajah.

Specimens Examined. SUMATRA: Bengkulu: Kepahiang, Cagar Alam, near Curup, 800 m alt., fl. and fr., *Dransfield 1234* (Holotype BO; Isotypes K, L), G. Pagar, 850 m alt., fl. and fr., *Dransfield 3625* (K, L). (Dransfield (1975) also cites *Bunnemeijer 295, 296, 417, 1013a* (BO) from the N.E. slopes of G. Talakmau, Bukittinggi).

Notes. This species differs from all other species of *Nenga* in its interfoliar, erect inflorescence with a long peduncle, and bearing a persistent, coriaceous, woody prophyll, the club-like head of fruits, and the structure of the male flowers with minute sepals. This species possesses many aberrant characters; however, despite the peculiar nature of this taxon, it seems to fit more reasonably in *Nenga* than in any other closely related genus. The laterally attached ovule, the spirally arranged triads near the proximal end of the rachilla, and the distal terminal portion being entirely of staminate flowers are distinctive features of *Nenga* (see Dransfield 1975).

Excluded Species

Nenga affinis Becc. in Malesia 1: 29 (1877); H. A. Wendl. in Kerch., Palm. 251 (1878) = **Nengella affinis** (Becc.) Burret in Notizbl. Bot. Gart. Mus. Berlin-Dahlem 13: 316 (1936).

Nenga calophylla Lauterb. & K. Schum., Fl. Deutsch. Sudsee 208 (1900) = **Nenga calophylla** (Lauterb. & K. Schum.) Becc. in Engl. Bot. Jahrb. 52: 27 (1914).

Nenga geelvinkiana Becc. in Malesia 1: 28 (1877); H. A. Wendl. in Kerch., Palm. 251 (1878) = **Hydriastele geelvinkiana** (Becc.) Burret in Notizbl. Bot. Gart. Mus. Berlin-Dahlem 13: 484 (1937).

Nenga gracilis (Roxb.) Becc. in Malesia 1: 28 (1877); H. A. Wendl. in Kerch., Palm. 251 (1878) = **Pinanga gracilis** (Roxb.) Bl. in Rumphia 2: 77 (1839).

Nenga latisecta (Bl.) Scheff. in Ann. Jard. Bot. Buitenz. 1: 20 (1876); Becc. in Malesia 1: 25 (1877) = **Pinanga latisecta** Bl. in Rumphia 2: 79 (1839).

Nenga nagensis (Griff.) Scheff. in Ann. Jard. Bot. Buitenz. 1: 120 (1876); Becc. in Malesia 1: 25 (1877) = **Areca triandra** Roxb. ex Buch.-Ham. in Mem. Werner. Nat. Hist. Soc. 5: 310 (1826).

Nenga novo-hibernica Lauterb. in Engl. Bot. Jahrb. 45: 357 (1911) = **Areca novohibernica** (Lauterb.) Becc. in Engl. Bot. Jahrb. 52: 23 (1914).

Nenga pinangoides Becc. in Malesia 1: 28 (1877); H. A. Wendl. in Kerch., Palm. 251 (1878) = **Nengella pinangoides** (Becc.) Burret in Notizbl. Bot. Gart. Mus. Berlin-Dahlem 13: 314 (1936).

Nenga selebica Becc. in Malesia 1: 30 (1877); H. A. Wendl. in Kerch., Palm. 251 (1878) = **Gronophyllum selebicum** (Becc.) Becc. in Ann. Jard. Bot. Buitenz. 2: 82 (1885).

Nenga variabilis Becc. in Malesia 1: 26 (1877); H. A. Wendl. in Kerch., Palm. 252 (1878) = **Hydriastele variabilis** (Becc.) Burret in Notizbl. Bot. Gart. Mus. Berlin-Dahlem 13: 483 (1937).

Acknowledgments

I am most grateful to Professor D. M. Moore, Department of Botany, University of Reading, for supervising this research study; and to Dr. J. Dransfield of the Herbarium, Royal Botanic Gardens, Kew for his helpful advice and guidance during my work at Kew, for providing the black and white photographs of *Nenga grandiflora* and for assistance in various ways.

I am also indebted to the Director, Royal Botanic Gardens, Kew (K) for giv-

ing me access to palm collections, for the use of library facilities, and for making possible the loan of specimens from Florence and Paris; to Dr. S. L. Jury, Curator, The Herbarium, University of Reading (RNG) for facilitating the loan of specimens from Ithaca and Leiden and for various other help; to the Directors of the following herbaria for the loan of specimens: L. H. Bailey Hortorium, Ithaca (BH), Herbarium Universitatis Florentinae, Florence (FI), Rijksherbarium, Leiden (L), and the Museum National d'Histoire Naturelle, Paris (P); and to the Keeper of Botany, British Museum (Natural History), London (BM) for access to palm collections.

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Juania australis Revisited in the Juan Fernández Islands, Chile

TOD F. STUESSY, ROGER W. SANDERS[1] AND OSCAR R. MATTHEI

Department of Botany, Ohio State University, 1735 Neil Avenue, Columbus 43210; and Departamento de Botánica, Universidad de Concepción, Concepción, Chile

The Juan Fernández (or Robinson Crusoe) Islands lie in the Pacific Ocean 400 miles west of continental Chile at latitude 33° S. These islands are botanically of great interest because over 68% of the native species of flowering plants and 19% of the genera are endemic (Skottsberg 1922). Even one endemic family, the Lactoridaceae, survives. Among the endemic taxa, one monotypic genus stands out for its striking appearance: *Juania* Drude of the Palmae (Ceroxyloid major group). The systematic affinities of this unusual genus comprising a single species, *Juania australis* (Martius) Drude ex J. D. Hooker (Fig. 1), have been obscure. It has also been exploited commercially for its attractive stems with black vascular traces.

The late Harold E. Moore, Jr. of Cornell University, well-known to readers of this journal, was a member of the 1965 Chile–United States Botanical Expedition to the Juan Fernández Islands. This expedition consisted of 12 scientists and resulted in many useful collections (Meyer 1966). Dr. Moore was particularly interested in *Juania australis*, and he paid special attention to its collection and preservation, including FAA liquid-preserved material for anatomical study. These materials were examined carefully and the results were published by Moore (1969), Tomlinson (1969), and Uhl (1969).

Our recent expeditions during January–March and November–December of 1980 were also joint Chile–United States cooperative investigations, this time between the Departments of Botany of the Universidad de Concepción and The Ohio State University. The objectives were: (1) to obtain new collections for the herbaria of the Universidad de Concepción and The Ohio State University for continued studies on the flora of Chile; (2) to determine the patterns of evolution of the tree-Compositae and other genera in different families which have speciated most extensively on the islands (e.g., *Blechnum*, *Gunnera*, *Peperomia*, *Wahlenbergia*, etc.); (3) to examine the phytochemical resources of the entire flora with special emphasis on the evolution of chemical systems in the tree-Compositae; and (4) to re-evaluate the phytogeography of the entire flora (earlier presented by Skottsberg 1956).

Although our main focus in these recent expeditions was not primarily on *Juania* (Moore and associates having already completed detailed investigations), we did make two collections (*Ugarte & Parra 9173*; *Stuessy & Sanders 5098*) of juvenile individuals and numerous observations on the largest island, Masatierra. We photographed the species in its native habitat and witnessed the attempts of CONAF (Corporación Nacional Forestal, the Chilean equivalent of our Department of Interior) to preserve this rare palm. The purposes of this paper, therefore, are: (1) to comment on the present status of the species on Masatierra; and (2) to indicate

[1] Present address: Fairchild Tropical Garden, 10901 Old Cutler Road, Miami, FL 33156.

1. *Juania australis.*

2. *Juania australis* growing in Corrales de Molina, Masatierra.

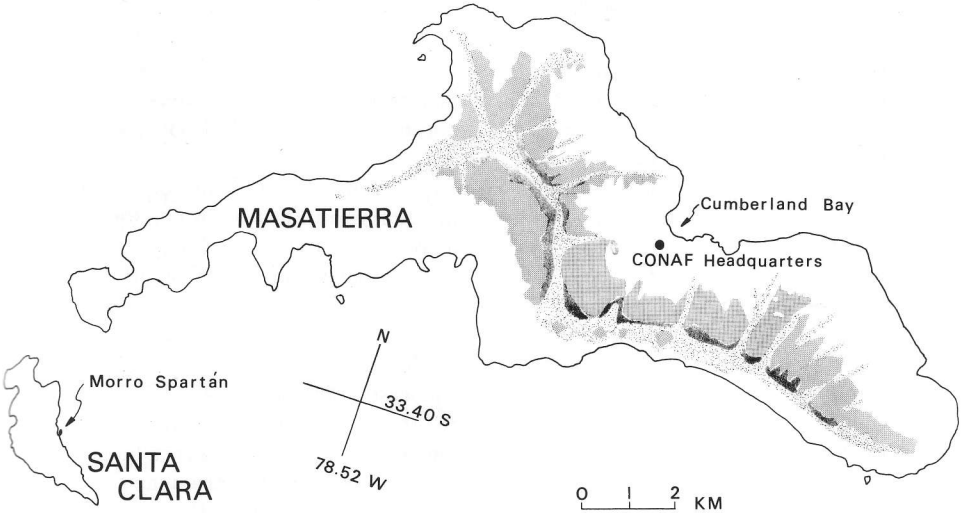
what steps have been taken by CONAF for its continued preservation.

Present Status

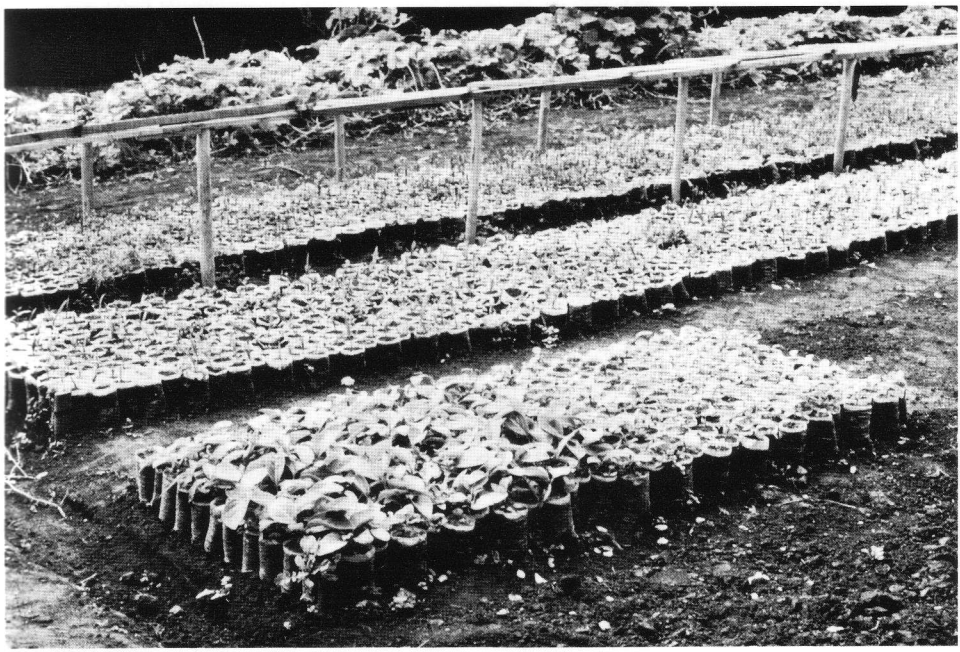
Moore (1977) estimated that about 1,000 individuals of *Juania australis* remained on Masatierra in 1965. At that time the prognosis was not good because the stems were being sought for the manufacture of decorative items because of the attractive dark vascular strands. This destruction has now been stopped because of the conscientious and laudable efforts of CONAF (see plan for development of the islands; Anonymous 1976). Our observations show individuals occurring principally in the upper montane hardwood and tree-fern forests at higher elevations on Masatierra (Figs. 2,3). It is still commonly encountered, but it is never abundant—"scattered" would be a better description. All ages of the species are present, which gives evidence of natural regeneration and augers well for survival. According to Bernardo Ackermann (pers. comm.), the Chief of the Juan Fernández National Park, about 1,000 individuals remain, the same figure as quoted by Moore (1977). There appears to be no immediate danger, therefore, of the species becoming extinct. There is, however, a general pressure from domesticated animals on the native forest, which now covers only the upper one-third of the island (Fig. 3). Hundreds of cattle, horses, sheep, rabbits, and coatis create unnatural disturbances which reduce the native vegetation (Sanders, Stuessy, and Marticorena 1982).

Steps Toward Preservation

In addition to prohibition of cutting stems of *Juania* for the handicraft industry, CONAF has begun a program of artificial cultivation. At the CONAF headquarters in San Juan Bautista on the southwest side of Cumberland Bay (Fig. 3) is a field plot in which seedlings of *Juania australis* are being grown successfully (Fig. 4). Local employees of CONAF, who know well the trails and terrain, collect kilogram quantities of ripe



3. Map of Masatierra, showing generalized vegetation zones and points of interest cited in text. Unshaded, native grassland, introduced weeds, maqui thickets, and eroded areas; light gray, lower montane hardwood forest; black, upper montane hardwood and tree-fern forests; stippled, scrub and exposed ridges.



4. Field plot of seedlings of *Juania australis* (background) growing at the CONAF headquarters, San Juan Bautista, Masatierra. Seedlings of *Dendroseris litoralis* are in foreground.

seeds and return these to the headquarters. Here they are germinated in sand in a plastic-covered greenhouse and the young seedlings are set out in the open in pots. Despite the success of seed collection, germination, and seedling establishment, poor achievement exists in attempting to maintain the young plants in good condition. Almost all of the seedlings die in the field plot, in transfer to another location on the CONAF property, or in replantings in the forest. Some problems relate to insect and herbivore predation and others to water stress. What is needed is a professional propagator familiar with the cultivation of palms to help these excellent efforts of CONAF to become even more successful.

CONAF efforts *have* succeeded completely with cultivation of *Dendroseris litoralis* Bert. ex Dcne. of the Compositae. Hundreds of seedlings are growing well (Fig. 4) and these do establish themselves without problems on the CONAF property and elsewhere in San Juan Bautista. The species also has been cultivated successfully on the Chilean mainland near Viña del mar (*Stuessy s.n.*; OS). This is extremely fortunate because our observations showed only two individuals left in the wild, and both are juvenile plants on Morro Spartán, a small isolated rock near Santa Clara Island (Fig. 3). The survival and reproduction of these two remaining plants is highly unlikely.

Acknowledgments

It is a pleasure to give thanks to: CONAF of Chile for permission to collect on the Juan Fernández Islands; Universidad de Concepción, Vicerectoria de Investigaciones to O.R.M. and NSF Grant INT 77-21637 to T.F.S. for financial support for the field expedition; Mario Silva for numerous financial and academic arrangements in support of this second expedition to the islands (and Co-Principal Investigator of the entire project); our collecting associates J. Arriagada, C. Marticorena, O. Parra, R. Rodríguez, and E. Ugarte for help and support on the first expedition; Hugo Valdebenito for his unflagging enthusiasm in making field collections on the second expedition; Bernardo Ackermann, Chief of the Juan Fernández National Park, whose support with guides, pack animals, lodging, storage facilities, and work space was essential for successful completion of the research; and to the numerous CONAF guides who cheerfully contributed extra hours in the collecting efforts, in particular Oscar Chamorro, Alvis González, Domingo Retamal, and Ramón Schiller.

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O. F. Cook's Itinerary

1. O. F. Cook, October 28, 1947, from the O. F. Cook Files, courtesy Department of Botany, Smithsonian Institution, Washington, D.C.

Principes, 27(2), 1983, pp. 77-80

O. F. Cook and Palms*

VELVA E. RUDD

Senior Research Fellow, Department of Biology, California State University, Northridge, California 91330

I first met Dr. O. F. Cook in the fall of 1938 when I signed up for a course in the History of Botany that he was offering in the United States Department of Agriculture Graduate School. This was shortly after I arrived in Washington, D.C. to work in the U.S.D.A. Cotton Laboratory. Dr. Cook had been retired from the Department in the spring of 1937 but continued to maintain an office and come to work every day.

Our course in the History of Botany started out conventionally, paying the usual respects to Theophrastus, the herbalists, Linnaeus, and other early botanists, but by the second session it developed into a history of the U.S. Department of Agriculture, especially of the Bureau of Plant Industry. It was a wonderful orientation course for a new employee.

Dr. Cook was one of the pioneer members of the U.S.D.A. staff, having joined the Department in 1898. During his many years of employment there, he was variously concerned with cotton, rubber, and plant introduction in general, especially of tropical plants. He traveled extensively in tropical America and also the Old World, at least Africa, China, and Japan. His interests and curiosity were unlimited. In addition to his work with economic plants like rubber and cotton, he became an authority on such diverse subjects as fungi, genetics, sociology, linguistics, ethnology, millepedes, and palms.

The study of palms early became one of Dr. Cook's favorite fields of interest. As a native of New York State he probably saw his first live palm trees, other than potted palms, in Liberia in connection with one of his trips there for the New York State Colonization Society. I have not seen his reports to the Society, so do not know what mention he may have made. I have seen photographs that he took of Liberian palms.

So far as I know, Dr. Cook's first published paper on palms appeared September 24, 1901, on the "Origin and Distribution of the Cocoa Palm." In this he presented his theory that the coconut plam is an American species and that the original habitat might be in northwestern South America. The paper is interesting to read whether one agrees with his ideas or not.

Dr. Cook's second paper on palms appeared a month later, October 26, 1901. It was "A Synopsis of the Palms of Puerto Rico." In this he appears to have published his first new genera and new species of palms. Not all the names have stood up against the opinion of other palm taxonomists. In general, Dr. Cook was what we call a splitter. He recognized more species and genera than most botanists and divided the palms into 13 families. As he explained to me once, "I think I notice differences more than other people." The thickness of the trunk or the droop of the leaves would catch his eye. Sometimes a new species or genus was indicated, sometimes not.

The third paper on palms published by Dr. Cook was "Palms from the Bahamas," included in the Flora of New Providence and Andros by Mrs. Alice R. Northrop. In this he recognized five gen-

* Modified from notes for a brief talk on O. F. Cook at The Palm Society meeting at the Fairchild Tropical Garden in 1966.

era and five species, two of the genera and three of the species new to science. Two other species were not named beyond the genus due to inadequate material.

By looking at Dr. Cook's bibliography it is obvious that his work on palms could not have been pursued on a full time basis. Of a total of nearly 400 papers published during the 60 years 1887–1947 only 44 were on palms. Of these more than a third were published during the decade after he retired and could choose his subjects.

I will not enumerate here all the papers written by Dr. Cook, as they appear in a following list. They deal with a great range of genera, including the coconuts, ivory palms, palmettos, royal palms, washingtonias, and numerous new ones. Apropos of *Washingtonia*, he horrified some of his botanical colleagues by publishing the name of a new species, *Washingtonia arizonica*, in a newspaper, The Morning Sun, Yuma, Arizona. These same colleagues were much cheered when they found that the Arizona species was the same as *Washingtonia filifera* of California. The *International Code of Botanical Nomenclature* now states definitely that publication in nonscientific newspapers does not constitute effective publication. (Actually, Dr. Cook intended to publish a longer paper about *Washingtonia arizonica* and I have seen his rough draft notes on the species and how it compares with the other washingtonias.)

One new taxon that especially seemed to please Dr. Cook was his *Rooseveltia frankliniana* from Cocos Island off the coast of Costa Rica. The island was so named because it was thought to be covered with coconut palms. Later it was reported that the palms in the interior of the island appeared to be different. No collections of specimens were made except for one leaf. One day in 1938 Dr. Cook happened to mention to Dr. Waldo Schmitt, a zoologist at Smithsonian Institution, that he had seen in the herbarium in San Francisco that single leaf from Cocos Island that he believed was a new species. "What a coincidence," Dr. Schmitt exclaimed, "tomorrow I leave for Cocos Island on a cruise with President Roosevelt!" As a result of that conversation, with the aid of members of the Navy crew, a large amount of specimen material was obtained. That palm is now generally conceded to be a *Euterpe*, as, indeed Dr. Cook had referred to it earlier, but he seemed to be tickled by his name *Rooseveltia*. He had wanted to make it "*Franklinia rooseveltii*" but there already was another tree named *Franklinia*.

Dr. Cook was very interested in the use of palms as ornamentals. At least two of his last papers were on household palms. He was pleased with the palm room at the Botanical Garden in Washington, D.C. which, I gathered, he had helped to arrange. He also must have been hopeful that some palms could be grown out of doors in the Washington area. I have found among his miscellaneous papers a yellow sheet of notes entitled "Palms outdoors in Washington City." He apparently was speculating that palmettos hardy enough for North Carolina might also survive in Washington. Attached to those notes is a newspaper clipping (undated) headed "Washington parks testing ground for exotic shrubs." The article stated, "Washington parks will become a proving ground for many varieties of exotic South American shrubs, vines, and flowering plants this summer as a result of President Roosevelt's visit to the Pan-American Conference in Buenos Aires in December, 1936. . . . President Roosevelt expressed interest in the parks of the countries visited. . . . Upon his return to Washington he asked Secretary of the Interior Ickes and Secretary of Agriculture Wallace to send experts of their departments to South America to survey park planting and landscaping there and to study the possibilities of importing foreign plants for use in the

parks of this country. . . ." (This was an earlier beautification project sponsored by the U.S. government before Lady Bird Johnson.) Apparently Dr. Cook never did finish the paper. Probably all those exotic plants froze and ended the project.

Whether or not Dr. Cook's classification of the palms was correct, he made a great contribution in the collection of material, living plants for the greenhouse, and herbarium specimens with copious field notes and excellent photographs so that the taxa could be studied scientifically. He collected pickled material for morphological studies but lacked the time and help to work on it. (He tried to persuade the management to put me on as his assistant but was unsuccessful; being retired, he did not rate staff assistance.) Much of the material (specimens, photographs, and notes) has been unavailable for some time but is now in the Smithsonian Institution.

After Dr. Cook retired he suffered the usual fate of a retiree and was moved to successively smaller offices, so that it was increasingly difficult to keep his books, papers, and specimens in convenient order. He was further handicapped because the administrative people looked upon files of any sort—plants, notes, photographs—as storage material to be relegated to the limbo of a basement or attic and, eventually, discarded. Some of Dr. Cook's specimens were at U.S.D.A., others at the Smithsonian in cases labelled, "Do not disturb. Mr. Cook working on them." After he died, I took charge of them. Subsequently, the late Dr. W. A. Archer, then at the National Arboretum Herbarium, U.S.D.A., helped to retrieve more of Dr. Cook's material that was scheduled for oblivion.

I became better acquainted with Dr. Cook in about 1941 when I went to work in the herbarium of the Division of Plant Exploration and Introduction of the U.S.D.A. and was assigned an office next door to Dr. Cook's. Then I found out more about how he worked and organized his reference material. That was when he tried to persuade B. Y. Morrison to assign me to him.

At best, Dr. Cook maintained a messy office. (I say, at best—actually I never did see it when he was a regular staff member and had a secretary.) However disorganized it appeared, though, he knew where everything was. At home his wife tried to tidy his things, much to his distress. As he said, "my wife is neat, but I am orderly." Because my own style is somewhat similar to Dr. Cook's I was cheered by his remarks. From him I learned that no matter how high papers were piled on one's desk, if just one slider was kept clear, one could carry on comfortably.

Dr. Cook's method of working, at least in the later years when I knew him, was to sit at his cluttered desk, with the one slider clear of all but pencil and yellow paper and a knife and pine knot or branch that he had picked up in the woods at home. As he meditated on his ideas and choice of words, he would carve away, shaping those pieces of wood, sometimes producing a little bowl, sometimes making a picture frame, or, more often, just an interesting, artistic piece, that he would take home to grace the parlor, dining room, etc. When he was trying to promote the idea of my being his assistant some irreverent person said, "you would probably both sit and whittle." Unfortunately, I did not have a chance to try my hand at it.

Publications on palms by Orator Fuller Cook (1867–1949) compiled from Bibliography of Palms and Cycads on punch cards at the L. H. Bailey Hortorium, Cornell University, and Fairchild Tropical Garden.

COOK, O. F.

1900. The method of types in botanical nomenclature. Science, ser. 2, 12: 478–479.

1901a. The origin and distribution of the cocoa palm. Contr. U.S. Natl. Herb. 7: 257–293.

1901b. A synopsis of the palms of Puerto Rico. Bull. Torrey Bot. Club 28: 525–569, *pl. 43–48.*
1902. Palms of the Bahamas. In Alice R. Northrop, Flora of New Providence and Andros. Mem. Torrey Bot. Club 12: 19–26.
1903. Economic plants of Porto Rico. Contro. U.S. Natl. Herb. 8: 57–269, *pl. 13.*
1904. The nomenclature of the royal palms. Bull. Torrey Bot. Club 31: 349–355.
1910a. Relationships of the ivory palms. Contr. U.S. Natl. Herb. 13: 133–141, *fig. 42–44.*
1910b. History of the coconut palm in America. Contr. U.S. Natl. Herb. 14: 271–342, IX–XIII, *pl. 52–66.*
1913a. A new ornamental palmetto in southern Texas. U.S.D.A. Bur. Pl. Industry Circ. 113: 11–14.
1913b. Ivory palms in Panama. J. Washington Acad. Sci. 3: 138–143.
1913c. Relationships of the false date-palm of the Florida Keys, with a synoptical key to the families of American palms. Contr. U.S. Natl. Herb. 16: 243–254, *pl. 74–77.*
1915a. Date palm allies in America. J. Heredity 6: 117–122, *fig. 8–10.*
1915b. A new genus of palms allied to *Archontophoenix.* J. Washington Acad. Sci. 5: 116–122.
1915c. *Glaucothea*, a new genus of palms from lower California. J. Washington Acad. Sci. 5: 236–241.
1917a. The Mascarene cabbage palm as a new genus. J. Washington Acad. Sci. 7: 121–127.
1917b. Seedling morphology in palms and grasses. J. Washington Acad. Sci. 7: 420–425.
1923a. *Opsiandra*, a new genus of palms growing on Maya ruins in Peten, Guatemala. J. Washington Acad. Sci. 13: 179–184.
1923b. *Pseudophoenix insignis*, a new palm from Haiti, and two other new species from the West Indies. J. Washington Acad. Sci. 13: 397–408, *fig. 1.*
1923c. *Washingtonia arizonica.* In Anonymous. Find new species palm Yuma County; botanist from Washington establishes existence of genuine palms at Quartzite. The Morning Sun, Yuma, Arizona, 17(280): 1. 5 Dec 1923.
1926. A new genus of palms based on *Kentia Forsteriana.* J. Washington Acad. Sci. 16: 392–397.
1927a. New genera and species of ivory palms from Colombia, Ecuador and Peru. J. Washington Acad. Sci. 17: 218–230.
1927b. *Kentia* palms in California. J. Heredity 18: 297–419, *fig. 16–25.*
1935. Juvenile characters of royal palms. Science 81: 590.
1936. Royal palms in upper Florida. Science 84: 60–61.
1937a. A new household palm, *Neanthe bella.* Science 86: 120–122.
1937b. Hurricane palms in Florida, including a new genus *Simpsonia.* Science 85: 332–333.
1939a. *Bornoa*, an endemic palm of Haiti. Nat. Hort. Mag. 18: 254–280, *fig. 1–12.*
1939b. A second household palm, *Omanthe costaricana.* Science 90: 298–299.
1939c. A new palm from Cocos Island collected on the presidential cruise of 1938. Smithsonian Misc. Collect. 98: 1–26, *pl. 1–26.*
1939d. Young royal palms. Natl. Hort. Mag. 18: 100–115, *fig. 1–8.*
1940a. Aublet the botanist, a pioneer against slavery, with a memorial genus of palms. J. Washington Acad. Sci. 30: 294–299, *fig. 1.*
1940b. Oil palms in Florida, Haiti, and Panama. Natl. Hort. Mag. 19: 10–35, *fig. 2–11.*
1940c. An endemic palm on Cocos Island near Panama mistaken for the coconut palm. Science 91: 140–142.
1941. A Haitian cactus palm adapted to Florida. Natl. Hort. Mag. 20: 21–52.
1942a. A new commercial oil palm in Ecuador. Natl. Hort. Mag. 21: 70–85, *fig. 1–6.*
1942b. The Brazilian origin for the commercial oil palm. Sci. Monthly 54: 577–590, illus.
1943. Household palms and related genera. Natl. Hort. Mag. 22: 93–102, 134–152, *fig. 1–15.*
1946. Africa needs palms as tree crops. Sci. Monthly 62: 131–139.
1947a. Cascade palms in southern Mexico. Natl. Hort. Mag. 25: 10–34, *fig. 1–10.*
1947b. Climbing and creeping palms in Mexico and Guatemala related to household plants. Natl. Hort. Mag. 26: 215–231, *fig. 1–8.*

COOK, O. F. AND C. B. DOYLE

1913. Three new genera of stilt palms (Iriarteaceae) from Colombia, with a synoptical review of the family. Contr. U.S. Natl. Herb. 16: 225–238, *pl. 54–65, fig. 41.*
1916. Germinating coconuts. J. Heredity 7: 148–157, *fig. 1–6.*
1939. The edible pacaya palm of Alta Vera Paz. Natl. Hort. Mag. 18: 161–179, *fig. 1–9.*

COOK, O. F. AND J. F. JOYNER

1938. A diminutive palm from Mayaland. Natl. Hort. Mag. 17: 1–12, *fig. 1–8.*
1939. *Neanthe*, a palm for genetic study. J. Heredity 30: 93–103, *fig. 16–21.*

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Notes About O. F. Cook

D. S. CORRELL

Fairchild Tropical Garden, 11935 Old Cutler Road, Miami, FL 33156

In the fall of 1943, a few weeks after my return to Harvard University from a 3-month's trek along the newly created Alcan (Alaska) Highway, I received a letter from Carl O. Erlanson in which he offered me a position in the United States Department of Agriculture's Division of Plant Exploration and Introduction at Beltsville, Maryland. Since orchid research, in which I was engaged at the time, was a far-cry from our war effort, I eagerly accepted what I thought should be a more useful and productive job with our government.

I was soon on my way to work at Beltsville and to live mostly alone for more than six months in a spooky, isolated farmhouse that sat in a grove of trees on Plant Industry Station property, and which served as "bachelor's quarters" for such as I. To have moved my family from New England to the Washington area at the time was out of the question.

It so happened that I was thus introduced to Orator Fuller Cook during his 76th year. Although he was retired, he maintained an office, which was the custom, adjacent to mine. We were on the second floor of the North Building at Plant Industry Station. Just across the hall from us were offices of the taciturn Fred Hermann and the sensitive, gentle Sidney Blake. Down the hall Walter Swingle and Robert Young, both retired, occupied other offices.

Though at first it was unknown to me, I soon learned that I had been brought to Beltsville with the express purpose, as well as with the hope and expectation, that I would absorb as much knowledge as possible from Dr. Cook, and thus I would then be qualified to carry on his work as a palm specialist. Therein, one might say, lay a tale. To be honest, officialdom had delayed too long the installation of an understudy. Although I spent an inordinate amount of time with Dr. Cook, at our final parting I knew as much about palms as I did when I first arrived in Beltsville.

Dr. Cook, who was born in 1867, had by 1943 become somewhat feeble, and, because of the relatively recent death of his wife, his interest in what had been his lifelong work was obviously diminished. He was a small, rather firmly built man, scarcely more than 5 feet 4 inches tall. He walked with a slow, inquisitive manner, always seeming to observe closely his surroundings. He would suddenly appear in the doorway of my office, a subtly gentle smile on his weathered face, with owlish eyes peering at me over wire-rimmed spectacles, his thin white hair neatly combed. He stood there quietly. If I kept on working he would unobtrusively turn and slowly return to his office. If I raised my head and looked at him he accepted it as an invitation, and he would come in, sit down, and begin a philosophical monologue. His favorite subject always was Goethe, who in his opinion preempted Darwin in the matter of evolution.

In spite of all my efforts, I could never draw Dr. Cook into a discussion of palms. He gave me the feeling that, to him, the subject of palms was a very private and personal matter and concern to him, and that concern had been terminated. For instance, one day I found him in the palm section of the National Arboretum Her-

barium, at that time housed with our offices at Beltsville. He was holding a sheet of an unidentified palm specimen. With a sly glance at me, as a little boy with his hand in the cookie jar, he slithered the sheet into a pigeonhole with the comment—"If one asked me what this is I'd say it's . . . ." I did not hear the name because I was busily fumbling for a pencil to offer him, which probably anyway would have been to no avail. This incident tells the story of my success as an understudy.

During the winter of 1943–44 I spent a number of week-ends as a guest of Dr. Cook at his home in the countryside at Lanham, Maryland. He lived well, and his housekeeper was an excellent cook, especially where heavy beef was concerned. The house was filled with primitive artifacts that Dr. Cook had picked up during his worldwide botanical travels in out-of-the-way places. He preferred objects that were made of wood. During our afternoon strolls through the woods about Lanham Dr. Cook would pick up a small knot or oddly shaped root, or piece of wood lying among the leaves and begin scraping it. In this way he personally made many kinds of articles, from knickknacks to walking sticks. After a hearty dinner I would soon make my way down a long upstairs hallway that was gorged with hundreds of books of all descriptions to a frigid, unheated bedroom. It was real country living in the old style—the kind than can arouse nostalgia with the passage of time.

In his office Dr. Cook sat only to think. When he was actively working he always stood up to an old-fashioned Bob Cratchet type of clerk's desk. With the passing of years before and after his retirement his usually unopened mail, government circulars, directives, and other bric-a-brac began piling up on top of the old clerk's desk. With his short height, he stretched himself as long as possible in order to scribble on top of the mounting accumulation. Finally, he could stretch no farther. He then had a broad plank rectangular stool made exactly 7 inches high upon which he could stand and continue to scribble on the top of his mountain of paper. I can say 7 inches because I just went over to the stool nestled in a corner of my room to verify its height.

Upon Dr. Cook's death, my friend, W. Andrew Archer, was given the task of clearing out his office. He found the pile of mail, circulars, scribbled notes, and other items to be nearly two feet high on the clerk's desk. Andy thought that, because of my friendship with Dr. Cook, I should inherit his footstool and several sturdy walking sticks that he had made.

I have often wondered what might have happened to me if I had met Dr. Cook in his heyday as an arecologist!

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Orator Fuller Cook: His Itinerary

ROBERT W. READ
Dept. of Botany, Smithsonian Institution, Washington, DC 20560

As a result of my acquaintance with Drs. Velva Rudd, Donovan Correll and W. Andrew Archer, I feel I know a little about the almost mythological character, O. F. Cook. A myth he definitely is not, as I have inherited piles of notebooks, files, photographs, photostats and specimens, which have taken a considerable amount of stolen time to sort and assimilate over the past ten years. I know that Dr. Cook was a thinker—witness the range of titles and subjects in his bibliography. He pondered the philosophy of taxonomy, nomenclature, "kinetic evolution," origins of agriculture, "biological evolution of language," racial problems in America, eugenics and education, and he wrote copiously of both botany and zoology. I also know that he was a prolific notemaker because I have yet to sort out the piles of scratch sheets, upon which he rewrote and revised everything several times.

I first became aware of Cook's work while I was preparing my material for "A Study of *Pseudophoenix*" in 1958. Dr. Cook had described the genus *Cyclospathe* with a single species, *C. northropii* of the Bahamas, and several species in the genus *Pseudophoenix*, *P. saonae*, *P. linearis*, and *P. insignis*, all of which unfortunately had to be reduced to synonymy. Another species name which he placed on an herbarium sheet of an undescribed species was later published by Max Burret in synonymy, making it illegitimate so I could not use it; instead I named that species in honor of Dr. R. Bruce Ledin. Another undescribed species of a most unusual palm collected by Dr. Cook, and found among his collections at the U.S. National Herbarium, was *Colpothrinax cookii*, named in his honor many years after its original discovery in Guatemala. Time and rules of nomenclature have been unkind to many of Cook's described species and genera. Dr. Cook strenuously objected to the requirement of Latin diagnoses, and attempted to make his point of view known but some of his species suffered as a result. An annotated list of his published palm names is in preparation.

In due course I plan to publish some notes regarding Dr. O. F. Cook's palm studies along with some of the photographs found among his papers. Many of the photographs (not necessarily taken by Cook) are of excellent quality, having been taken by means of a large cumbersome portrait or press camera. Some are from glass plates which I hope to reproduce.

An obituary was published by Harold F. Loomis in the Journal of the Washington Academy of Sciences (40: 173–175) in 1950. A few of the pertinent details of his life are taken from that article and presented herewith.

"Dr. Orator Fuller Cook, agriculturist, botanist, and zoologist, was born at Clyde, N.Y. on May 28, 1867. He died in his home at Lanham, Md. on April 23, 1949, following a short and supposedly minor illness. Cook was graduated from Syracuse University in 1890. . . . In 1930 the University honored him with the D.Sc. degree. From 1891 to 1898 Dr. Cook was employed as a special agent of the New York State Colonization Society and spent much of the time in Liberia." In 1898 he joined the U.S. Department of Agriculture, in association with David Fairchild.

For several years he was in charge of seed and plant introduction and tropical agriculture investigations. Retirement came in 1937 at the age of 70, "but this did not mean cessation of work, for he continued to appear at his office with almost as great regularity as had been his wont." Note that most of his palm work appeared during this retirement period. "Few men of his time had wider interests or more profound knowledge of so many biological subjects, and these led to extensive travel."

"Dr. Cook was a tireless worker and a remarkably keen observer, never without a sheaf of small note paper on which observations and ideas were recorded, later to be filed under their proper headings. Dr. Cook lived simply and with an unbounded love for the country. He disliked the restraint and artificiality of city life and shunned large crowds and social gatherings."

Cook's travels took him to Africa, the West Indies and Central and South America. For the record I attach a greatly condensed version of Archer's manuscript concerning Cook's Itinerary between 1892 and 1930. The Archer manuscript comprises some 71 pages of dates and specific places visited. It was not published but a copy is filed at the Smithsonian Institution.

Itinerary—O. F. Cook

(From a manuscript compiled by W. Andrew Archer, 17 November 1951)

1892	January–June	Liberia
1893–1894	November–March	West Africa and Liberia
1896–1897	April–May	Liberia
1899	November–December	Puerto Rico
1901	June–July	Puerto Rico
1902	March–May	Mexico and Central America
1903	April–May	Costa Rica
1904	April–July	Central America
1905	March–May	Central America and Mexico
1906	March–July	Central America, Cuba, and Mexico
1907	May–July	Guatemala
1910	May–July	Via boat (S. S. Venezia) to Italy, Palestine, and Egypt
1914	April–June	British Honduras and Guatemala
1915	March–August	Jamaica, Central America, and South America
1917	August–September	Haiti
1919	July–October	Hawaii, Japan, and China
1922	February–March	British Honduras
1923	March–July	Panama and Haiti
1924	August–September	Haiti
1925	March–April	Panama and Haiti
1925	December	Mexico
1926	March–June	Haiti, Colombia, and Panama
1927	June–September	Haiti
1930	February–April	Haiti and Panama

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PALM LITERATURE

A Bibliography of Graduate Theses on Palms

Theses on palms represent primary sources of information about original research, but often are unknown or overlooked because as unpublished works they are not indexed in standard science references. The problem is compounded in dealing with palms because at least a half-dozen disciplines, bridging the natural and social sciences, are involved.

This world bibliography of 101 items has been compiled to present doctoral and master's theses concerned with the general subject matter of palms. Included are botanical and agronomical studies, which represent the majority, and investigations in the social sciences on palm utilization and palm products. Excluded are highly technical theses on subjects such as the chemical properties of palm oil.

The theses were completed at universities in 17 countries. India is the leader with 23, followed by The Philippines with 18, the United States with 15 and the United Kingdom with 13. The coconut palm is the subject, exclusively or in combination with other palms, of 34 of the theses and the oil palm of 27; a clear reflection of these two most important economic palms in academic studies. The number of palm theses has accelerated in the past three decades. In the 1950s, 13 were completed; in the 1960s, 33; and in the 1970s, 44. In what is possibly an incomplete total, 8 theses were done in 1980.

I am indebted to many palm specialists and librarians around the world who so generously provided me with thesis titles. It was not possible to verify the accuracy of each entry; therefore, some minor errors in title may be included. In the listing, where appropriate, I have added in parentheses the palms involved in the study when they are not part of the title.

Doctoral Theses

Aderungboye, F. O. 1972. Studies on the blast disease of seedlings of the oil palm (*Elaeis guineensis* Jacq.). Ibadan University, Nigeria.

Apavatjrut, P. 1975. Factors influencing the initiation and growth of callus on *Cocos nucifera* L. stem tissue. Wye College, University of London, England.

Biradar, N. V. 1967. Studies in fossil plants from Kota-Maleri beds, and embryology of the genus *Phoenix* Linn. University of Poona, India.

Broeshart, H. 1955. The application of foliar analysis in oil palm cultivation. Agricultural University, Wageningen, The Netherlands.

Brown, K. E. 1973. Ecological life history and geographical distribution of the cabbage palm, *Sabal palmetto*. North Carolina State University, Raleigh.

Campo, E. J. à. 1936. Mathematical evaluation of labour output. (oil palm estate) Agricultural University, Wageningen, The Netherlands.

Chennaveeraiah, M. S. 1955. Cyto-embryological studies on the genus *Dipcadi* Medic (family Liliaceae) and *Hyphaene* Gaertn (family Palmae). University of Poona, India.

Dabek, A. J. 1973. Some physiological and anatomical aspects of the lethal yellowing disease of coconuts. University of the West Indies, Mona, Jamaica.

Deshpande, J. V. 1954. Studies on the family Sonneratiaceae and its fossil allies and on the anatomy of palms—*Sabal* and *Chamaerops*. University of Poona, India.

Deshpande, S. R. 1962. A study of the silicified fossil plants (*Palmophyllum eocenum, Palmocaulon mohgaoende, Rhizopalmoxylon sundaram*). University of Poona, India.

Dransfield, J. 1970. Studies in the Malayan palms *Eugeissona* and *Johannesteijsmannia*. University of Cambridge, England.

Essig, F. B. 1975. A systematic study of the genus *Ptychosperma* (Palmae). Cornell University, Ithaca.

Fagan, H. J. 1977. Leaf spot disease of coconut in Jamaica. University of the West Indies, Mona, Jamaica.

Ferwerda, J. D. 1955. Questions relevant to replanting in oil palm cultivation. Agricultural University, Wageningen, The Netherlands.

Forde, S. M. 1969. The dynamics of soil potassium in relation to the nutrition of the oil palm (*Elaeis guineensis* Jacq.). Ibadan University, Nigeria.

Ganapathy, P. M. 1959. Anatomy of palms. University of Madras, India.

Gray, B. S. 1969. A study of the influence of genetic, agronomic and environmental factors on the growth, flowering and bunch production of the oil palm on the west coast of West Malaysia. University of Aberdeen, Scotland.

GUNAMANI, M. 1980. Developmental studies on axillary growths in some palms. (*Phoenix farinifera, Bentinckia condapanna*) Madurai Kamaraj University, India.

HENRY, P. 1957. Recherches sur la croissance et le développement chez *Elaeis guineensis* Jacq. et chez *Cocos nucifera* L., comparaison avec d'autres palmiers. University of Paris, France.

HILGEMAN, R. H. 1951. The differentiation, growth and anatomy of the axis leaf, axillary bud, inflorescence and offshoot in *Phoenix dactylifera* (Linnaeus). University of California, Los Angeles.

HILMON, J. B. 1969. Autecology of saw palmetto [*Serenca repens* (Bartr.) Small]. Duke University, Durham, North Carolina.

JAVALGEKAR, S. R. 1979. Comparative studies on palms: *Borassus flabellifer* L., *Latania verschaffeltii* Lem., *Hyphaene indica* Decc., *Cocos nucifera* L. University of Poona, India.

KHERA, H. S. 1973. Some economic aspects of the oil palm industry of West Malaysia. University of Hull, England.

KIEW, R. 1972. Taxonomy and ecology of *Iguanura* (Palmae). University of Cambridge, England.

KLOTZ, L. H. 1977. A systematic survey of the morphology of tracheary elements in palms. Cornell University, Ithaca.

KULKARNI, A. R. 1965. Studies on palms: genus *Cocos* L. in India. University of Poona, India.

KULKARNI, K. M. 1970. A comparative study of the palm genus *Livistona* R.Br. and two tertiary fossil palms. University of Poona, India.

LA-ANYANE, S. 1966. The oil palm industry of Western Tropical Africa. Stanford University, California.

LOCKE, T. 1972. A study of vascular wilt disease of oil palm seedlings. University of Manchester, England.

MADULID, D. A. 1980. Systematic studies in the genus *Plectocomia* Mart. ex Blume (Palmae: Lepidocaryoid group). University of Reading, England.

MBAGWU, T. C. 1971. The oil palm economy in Ngwaland, Eastern Nigeria. Ibadan University, Nigeria.

MORROW, L. O. 1965. Floral morphology and anatomy of certain Coryphoideae (Palmae). Cornell University, Ithaca.

MURRAY, S. G. 1971. The developmental anatomy of certain palm fruits. Cornell University, Ithaca.

MURTHY, M. H. S. 1972. Studies on palms with special reference to members of Ceroxylinae. University of Poona, India.

NAIR, P. K. R. 1978. Intensive multiple cropping with coconuts in India: principles, programmes and prospects. University of Göttingen, Germany.

OTEDOH, M. O. O. 1976. Systematic studies in *Raphia* palms. University of Reading, England.

PARTHASARATHY, M. V. 1966. Studies on metaphloem in petioles and roots of Palmae. Cornell University, Ithaca.

PATEL, H. K. 1978. Studies on palms: I *Thrinax parviflora*, SW., II *Trachycarpus maritana* H. Wendl., III *Borassus flabellifer* L. South Gujarat University, India.

PUSHPAVENI, S. 1980. Ontogenetic and developmental studies on some palms of South India. (*Calamus rotang, C. thwaitesii*) Madurai Kamaraj University, India.

RAJANAIDU. 1980. Variation in the natural population of oil palm (*Elaeis guineensis* Jacq.) from Nigeria. University of Birmingham, England.

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DENNIS JOHNSON

Revision of Euterpe

Jeremy J. Strudwick is working on a revision of the genus *Euterpe* at the New York Botanical Garden. He would be most grateful for any natural source herbarium collections (if possible with flowers collected before bracts open), seeds for growing, pickled material, photographs, etc. Any information on *Euterpe*, especially regarding ethnobotanical or economic uses, current research, and living collections would also be appreciated.

Address: Jeremy J. Strudwick
The Herbarium
New York Botanical Garden
Bronx, N.Y. 10458

Principes, 27(2), 1983, pp. 89–93

Lister's Palm, Arenga listeri, on Christmas Island: A Rare or Vulnerable Species?

DAVID POWELL AND JEANETTE COVACEVICH
Christmas Island and Queensland Museum, Brisbane, Australia

Christmas Island lies in the eastern Indian Ocean (10°25′S, 105°40′E), 190 nautical miles from Java and 850 nautical miles northeast of the northern coast of Western Australia. The island is built around a core of volcanic rock—thought to be the summit of an extinct submarine volcano which rises steeply from the floor of the ocean—some 14,500 feet below the existing sea level. The oldest known sedimentary rock is a bed of Eocene limestone located on the beach at Flying Fish Cove. This has been succeeded by a series of basaltic flows and palagonite tuff, which is then capped by Miocene orbitoidal limestone. In post Miocene times, atoll conditions are thought to have prevailed. During this time detrital limestones were laid down and deposits of phosphate were formed.

From sea level the terrain rises steeply in a series of wave cut terraces and limestone cliffs, reaching a height of about 700 ft. Beyond this elevation the topography is more undulating with several minor "hills" only about 150 ft higher. The island's highest point is Murray Hill, located in the western area, which has an elevation of 1,175 feet. Forming an almost unbroken feature around the entire island are 50–60 ft sea-cliffs. They are absent from the immediate vicinity of Flying Cove, which is the island's only safe anchorage.

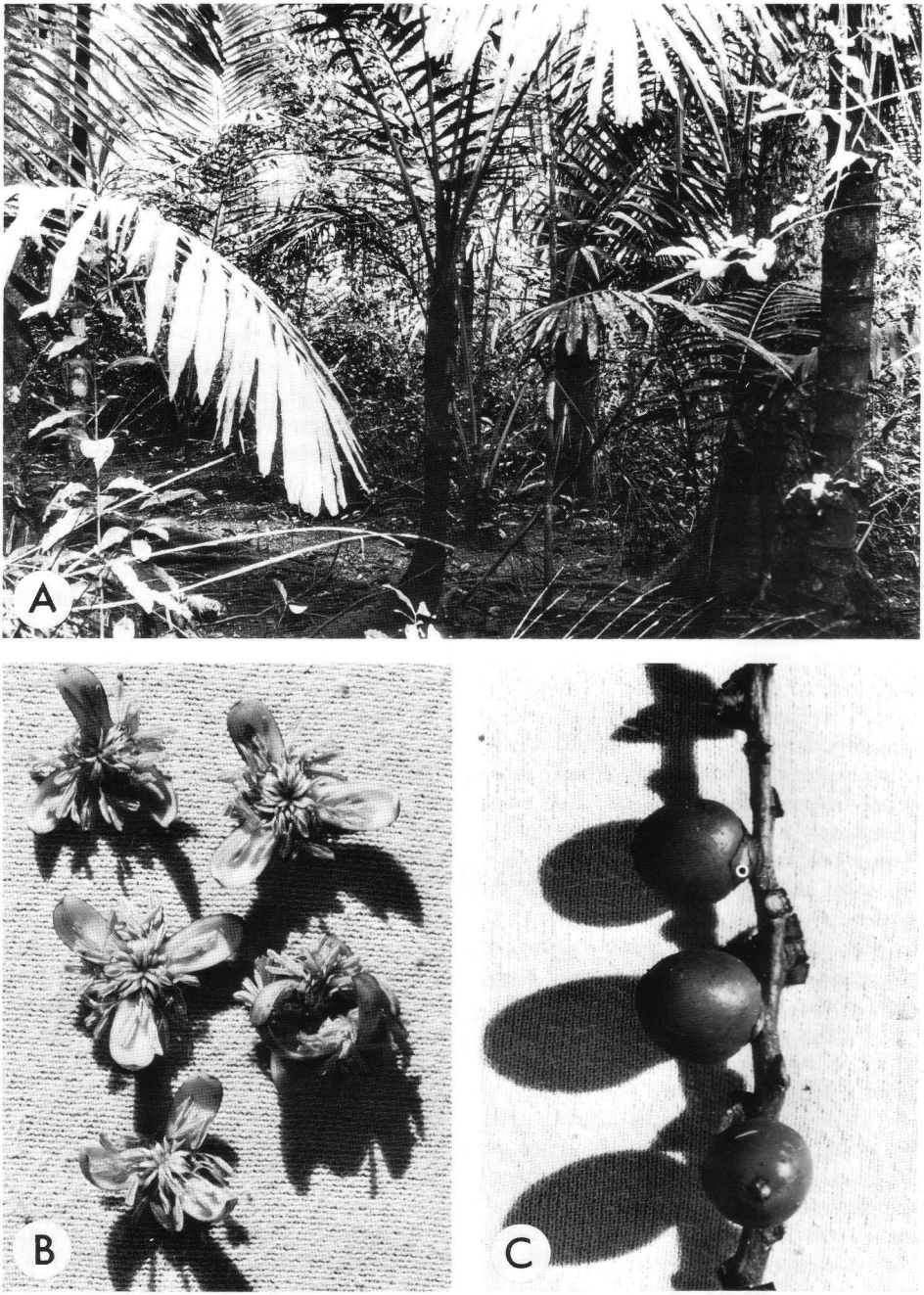
Dense rain forest covers most of Christmas Island. Superficially it resembles other tropical rain forests like those in southeast Asia and northeast Australia, but the island's long isolation and unusual geology are stamped on its finer structure and composition. The Christmas Island rain forest is unique. It is composed of an incredibly diverse flora including about 185 species of flowering plants in the stable, climax community rain forest (Ridley 1904). Structurally the forest is more open than any of the Malayasian or Indonesian lowland forests, for in most parts it lacks any complex understory shrubbery. Only on the low terraces is access impeded by thickets of *Pandanus*.

Writing on the botany of Christmas Island, Ridley (1905), who had visited the island the previous year, listed 34 species of plants as being endemic. This number has been reduced by almost half, due to increased knowledge of the flora in the Southeast Asian region. Most of the island's flora has recently been re-collected by Powell and H'ng Kim Chey in 1980–81. Included in the material sent to the Royal Herbarium, Kew, were fruit and flowers from *Arenga listeri*.

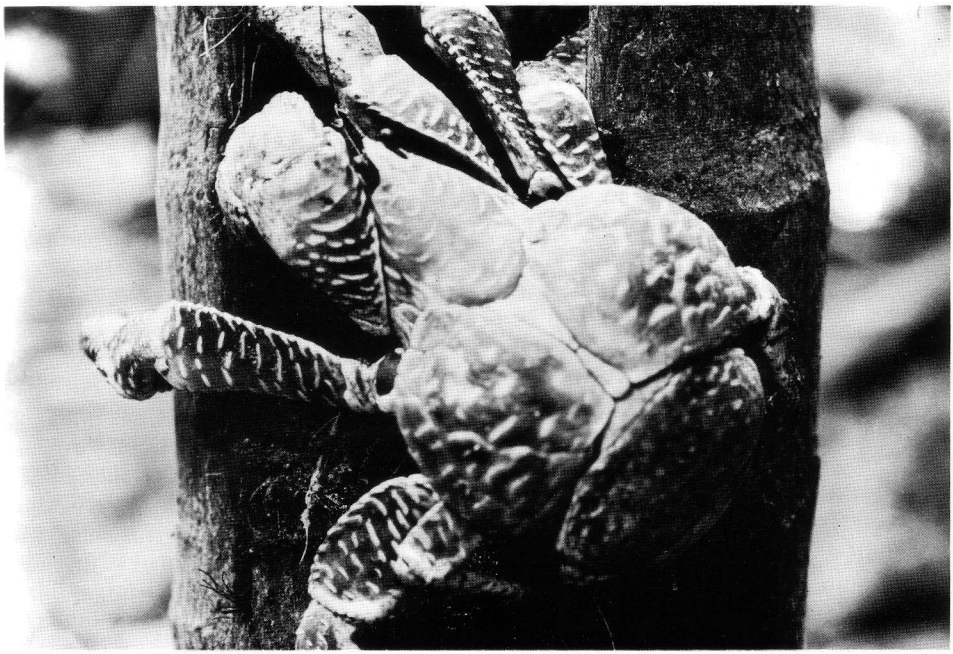
The Palm

It was at Flying Fish Cove that J. J. Lister, naturalist on board H.M.S. "Egeria," under the command of Captain Pelham Aldrich, landed to make his collections in September 1887. In the ten days he spent on the island Lister collected extensively and recorded several new species of animals and plants, including the endemic palm, *Arenga listeri*.

This palm occurs occasionally but not



1. A. *Arenga listeri* in the National Park on Christmas Island. B. Flowers. C. Fruit of *Arenga listeri*.



2. *Arenga listeri* has a terminal inflorescence. After the tree dies the trunk begins to rot. When this happens Robber Crabs eat the soft sugary mulch inside.

uncommonly throughout the rain forest on the main plateau. It is more common on the terraces, but only where slips and faulting have exposed the underlying volcanic profile. In these areas, where the soil has been directly formed from the weathering of these volcanics, the densest stands of palms flourish. A "preference" for this particular type of soil profile inhibits the distribution of the palm, a problem compounded by the island's large population of land crabs and by its human population. Both the Red Crab, *Gecarcoidea humei natalis* and the Robber Crab, *Birgus latro* scavenge beneath the palms collecting any fallen fruit. Robber Crabs are most noticeable, for they gather in large numbers around the base of a palm, waiting for the ripening fruit to fall. This process is often hastened by two or three crabs climbing the palm to gather the fruit directly. Because they lack dexterity, a large proportion of the "picked fruit" falls to the ground. There it is seized, crushed, and eaten by crabs, so that only a very small proportion of ripe berries fall into inaccessible spots and escape destruction. Should such seeds prove viable, they have to survive further depredation, for cotyledons form another part of the Robber Crab's diet. The ripe fruit of *Arenga listeri* is also a major item on the "bill of fare" for the Christmas Island Imperial Pigeon, *Ducula rosacea whartoni*. These birds obviously transport the seed, which probably accounts for its random distribution within the main rain forest.

Most Christmas Islanders are aware of the irritant nature of the fruit and avoid contact with it, knowing that even the juice will cause a lasting and painful itch. However, Robber Crabs are attracted to the coarse fiber found in the stem as well as in the fruit, and local fishermen use

knowledge of this habit to their advantage. They fell a palm and then split open the stem leaving the exposed pith to be found by the crabs. A few days later, when requiring bait for fishing, they return to the site and collect the crabs that are feeding on the fibrous pith. The palm is probably no longer cut to obtain the cabbage, but before fresh vegetables were readily available on the island, some members of the labor force were known to collect the palm's center for food. Ridley (1904) writes "we felled an *Arenga* Palm for the sake of the refreshing cabbage of the bud." Other members of the genus *Arenga* occur in southeast Asia, New Guinea, and northeastern Australia (McCurrach, 1960).

Threats to Survival

Christmas Island supports a multi-million dollar phosphate mining industry. Current production is set at over one million tons per annum by the miners, the Phosphate Mining Company of Christmas Island.

At this level of exploitation the island's high grade phosphate reserves will be depleted in another five to six years. By then, about 20% of the island will have been completely cleared and mined. High grade reserves and thus present mining are concentrated on the island's main plateau, the area least favored by *Arenga listeri*. The future of the palms is, however, by no means secure despite the fact that they are concentrated in areas of weathered volcanic soils on the island's terraces, where phosphate reserves are of lower grades.

The future of the Phosphate Mining Company of Christmas Island beyond the late 1980s is not known but it seems reasonable to assume that mining may be shifted to poorer quality phosphate and thus down to the terraces. For this, new roads will be necessary, another pressure on populations of *Arenga listeri*. Combine these two factors with the existing pressures imposed by crabs and fishermen and the future for *Arenga listeri*, a species confined to an isolated oceanic island of only 54 square miles, looks very shaky indeed.

Vulnerability?

Concepts of rarity and vulnerability have been discussed by Kubitzki (1977) and in the IUCN Red Data Books (e.g., Goodwin et al., 1972). Egeria Point National Park was gazetted in 1980. This affords protection to about 12% of Christmas Island. It is obvious that, although *Arenga listeri* is not under threat of immediate extinction, it is 'vulnerable' by any standards. Gazettal of more national parks will ensure its survival along with other unique elements of Christmas Island's biota.

Cultivation

The seeds of *Arenga listeri* germinate in 60 ± 4 days in Cairns, tropical Queensland, Australia. Here mid-summer temperatures are high on average (23.6–31.3° C) and winters are mild (mid-winter average 16.7–25.4° C). Like other *Arenga* spp., young *A. listeri* thrive in rich soils but grow slowly. In two years since germination seedlings have attained a total height of 40–45 cm under optimum (in the sense that they resemble the natural habitat) conditions of warmth and moisture.

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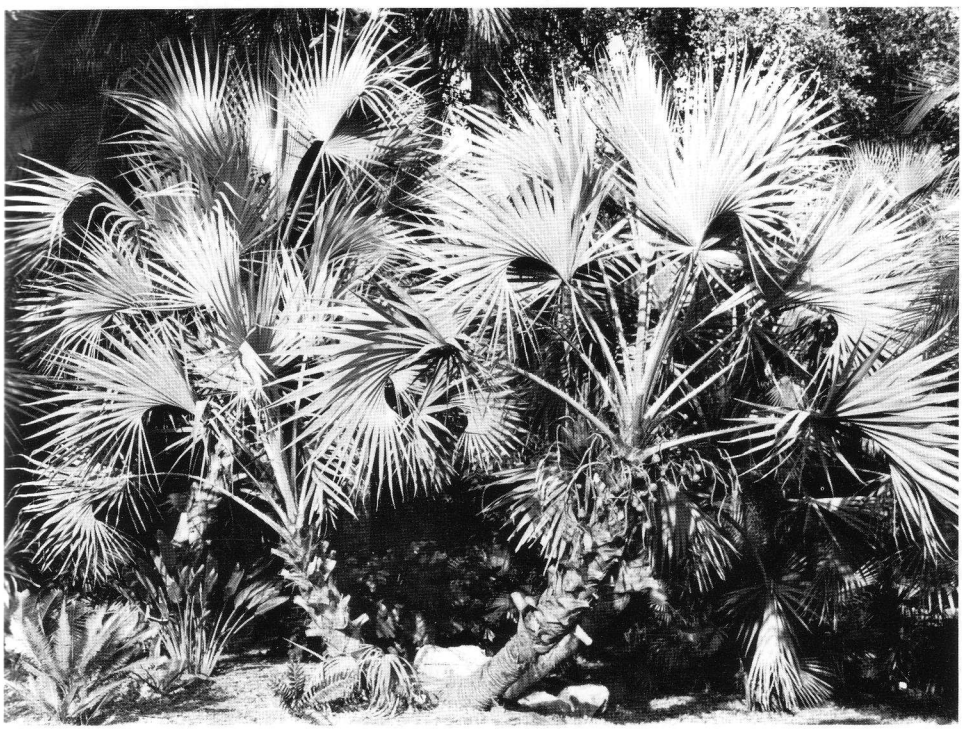
(*Eds. note: see the next issue of* Principes *for more about palms and robber crabs.*)

NEWS OF THE SOCIETY

1982 Biennial Meeting—Florida

For the many Californians who attended the 1982 Biennial Meeting of The Palm Society, the first event of the meeting was looking out the window of a jet liner to admire the exotic Florida landscape below. Upon arrival at the rendezvous in Tampa, Palm Society members from all over the world boarded the tour bus to begin the adventure.

Our first stop and one of the highlights of the tour was at the garden of Dr. U. A. Young, in Tampa. Dr. Young's garden was of particular interest to northern California members because like many of our own gardens it is prone to occasional winter frosts. It was inspiring to see so many species considered to be frost-tender growing so beautifully. One fine specimen of *Hyphaene* (Fig. 1) is perfectly staged against a backdrop of lush tropical foliage to create a striking effect. The next stop



1. *Hyphaene shatan* in Dr. U. A. Young's garden, Tampa.

2. *Sabal palmetto* with *Serenoa repens* in the foreground at Corkscrew Swamp. Photo by N. W. Uhl.

was for lunch in St. Petersburg at the Pier overlooking the bay followed by a tour of a public palm garden nurtured by member Tom Pavluvcik. It was good to see such a fine variety of palms in a public park. We then drove across the Sunshine Skyway Bridge and on to Sarasota for a late afternoon tour of Selby Botanical Gardens, a gem of a garden on Sarasota Bay. An evening supper on a patio by the bay was a delightful close to our first day.

Continuing down Florida's west coast on the second day, members saw immense stands of the native *Serenoa repens* and *Sabal palmetto* (see Fig. 2). Shortly after we crossed the Caloosahatchee River into Fort Myers, our guides explained that the river is the dividing line between the central and south Florida climates, as evidenced by the notable increase in numbers of coconut and royal palms.

Following a beautiful tour of the Edison Estate, our bus pulled out of Fort Myers for Sanibel Island. There members took the opportunity to explore the beach area in search of sea shells, and to swim in the warm water of the Gulf of Mexico.

The next morning we were bound for the east coast of Florida; enroute we had opportunity to admire the pristine landscape of interior Florida, where the seemingly endless swamplands—with beautiful birds, occasional alligators, and native plantlife—enhanced the beauty of the clear deep blue sky.

The day was perfect for our boardwalk tour of Corkscrew Swamp, Big Cypress Sanctuary of The National Audubon Society, a lovely spot where we could get closer to birds and plants and see some palms in a different setting. After a picnic lunch we rode across "Alligator Alley" to our convention headquarters in the Miami area.

Soon after our arrival and check-in at the hotel in Coral Gables, we again boarded the bus for Key Biscayne. That evening was one of the most memorable of the entire trip. After passing through the security gate of "Botanica," which is a mixture of condominium complex and botanical garden, both on a grand scale, we were welcomed and entertained royally. During a tour of the grounds our guides explained that many specimen plants, palms in particular, were brought in from all over the state. Quite often these 40 to 50 foot giants came from the gardens of private homes, from which they had been airlifted by helicopters to the pre-dug holes which became their new growing sites within the complex, all in accordance with a most artistic preplanned landscape design which particularly features many beautiful fountains, waterfalls, and palms. After the tour our group was led to a central courtyard where a banquet feast, drinks, and live entertainment carried us all into a spectacular storybook feeling of entrancement amidst beautifully lighted palms and a warm tropical night.

The following day brought us to such

famed palm meccas as the garden of Paul Drummond, our Society's President, the Jennings estate, and Chapman Field. At Chapman Field we were treated to a most interesting demonstration on the apparently already-successful effort to develop a variety of *Cocos nucifera*, full-scale in size, which is resistant to the effects of the lethal yellowing disease. Quite likely, within a couple of decades, south Florida again will be beautified by thousands of big coconut palms. For this we are glad.

That evening, the Biennial Meeting of the Society was convened at the Fairchild Tropical Garden, during which the results of the recent election were announced, and during which we were treated to a memorable and informative presentation by Dr. John Dransfield on palm taxonomy.

On Thanksgiving Day we enjoyed visits to the palm collection of DeArmand Hull who has many exotics and to the Parrot Jungle, where we studied the *Phoenix canariensis* × *roebelinii* hybrid, and were entertained by the dancing flamingo birds.

Also on Thanksgiving Day, we had a few hours for a more extensive tour of the Fairchild Tropical Garden, which displays mature living specimens of 500 species of palms, all in a beautifully landscaped setting. We should have been given a full week, instead of a couple of hours, to properly digest that truly outstanding scene. Even all alone, the Fairchild Tropical Garden would make a trip to Florida worthwhile.

That evening, as a super-super bonus, everyone in attendance enjoyed a delicious Thanksgiving dinner and garden tour at the palacial home of Dr. and Mrs. Jude on Java Head. Adding to the elegant atmosphere were live professional dinner-music performances by a harpist and by a pianist—the latter being Palm Society member Frank Hausman, from New York.

New discoveries continued from the Miami area right down to the tip of the Florida Keys. Enroute we saw abundant *Coccothrinax* and *Thrinax* palms in native stands by the roadside. On Sugarloaf Key we visited the beachfront property of the Baxter Gentry Estate and toured the very extensive grounds after a bountiful lunch which featured unusual tropical fruits grown on the estate. Key West proved especially intriguing with beautiful beaches, quaint Victorian architecture, and a relaxed leisurely tropical atmosphere which influenced us to slow our pace at this terminal spot of the Biennial Meeting. In retrospect I would sum up the 1982 Biennial Meeting as a huge success and an unforgettable adventure in an exotic land. Warm thanks are due to our gracious hosts of the South Florida Chapter. Special thanks for thoughtful planning of the meeting go to Paul Drummond, and special thanks for his huge volume of very helpful personal correspondence on reservation details go to Jeff Crandall. We thank all the Florida members of The Palm Society for having made the 1982 Biennial Meeting a memorable pleasure for all who were able to attend.

DAVID SYLVIA

News of the Central Florida Chapter

Thirty-six palm enthusiasts met at the home of Pat and Gordon Smith in Maitland on Sunday, October 31, 1982. On arrival, attendees were greeted by a driveway lined with tall, beautiful specimens of *Arecastrum romanzoffianum*. Some *Sabal causiarum* could be seen off to one side. While walking down the driveway, one could not help but notice a number of other palms; one in particular was a lovely, robust *Phoenix canariensis*. The blue-green leaves of *Sabal uresano* stood out in striking contrast to the surrounding vegetation.

After socializing a bit, interested persons were treated to a tour of the 1¼ acre grounds. Winding through the trails surrounded by lush vegetation, one got the

feeling of being in the tropics. Coconuts were even discovered lying on the ground (although no coconut palms could be found). Many *Livistona chinensis* and *Phoenix reclinata* were used as background plants. Old trees of *Acrocomia totai*, *Arenga engleri*, *Livistona australis*, and *Livistona dicipiens* were observed. Younger specimens of *Arenga pinnata*, *Attalea* sp., *Bactris gasipaes*, *Borassus flabellifer*, *Copernicia baileyana*, and *Latania* sp. were also to be seen. This latter group appeared to be somewhat marginal for the area.

After a picnic style lunch, a plant sale was held which netted $180.50 for the Central Florida Chapter. Included in the sale were 10 *Trachycarpus martianus*, 10 *Jubaea chilensis*, and 10 *Chamaedorea monostachys* that were donated by Jim Mintken of the Northern California Chapter.

NANCY HALL

News from South Florida

The South Florida Chapter of The Palm Society is presently helping to landscape the new Metrozoo in Dade County. They have donated five royal palms which are just beginning to form trunks. They are accepting plant donations from members. Any palms which are too small to be placed in the ground will be stepped up and held in the area provided for their use on the zoo grounds. Members wishing to contribute plants should contact Bill Steen at 305-255-7465.

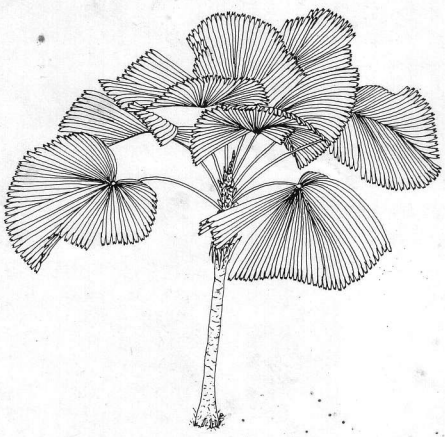
News from Texas

The Houston Area Chapter of The Palm Society met on December 9, 1982 at the home of Bonny and Erwin Ruhland, 2400 Bayou Dr., League City, Tx. at 7:30 p.m.

The meeting was called to order by Jim Cain. A short business meeting consisted of a discussion of our local chapter's renewals of memberships for the Fairchild Tropical Garden and to The Palm Society for 1983.

The program consisted of a report on the Biennial Meeting by Jim Cain, the Erdmanns and the Ruhlands, and slides of the tour. The biennial meeting was a wonderful experience for all who attended and a great success. Nine Texans attended this year and are already looking forward to Northern California in 1984.

BONNY RUHLAND



Licuala grandis. Drawn by Phil Elia.