# Palms

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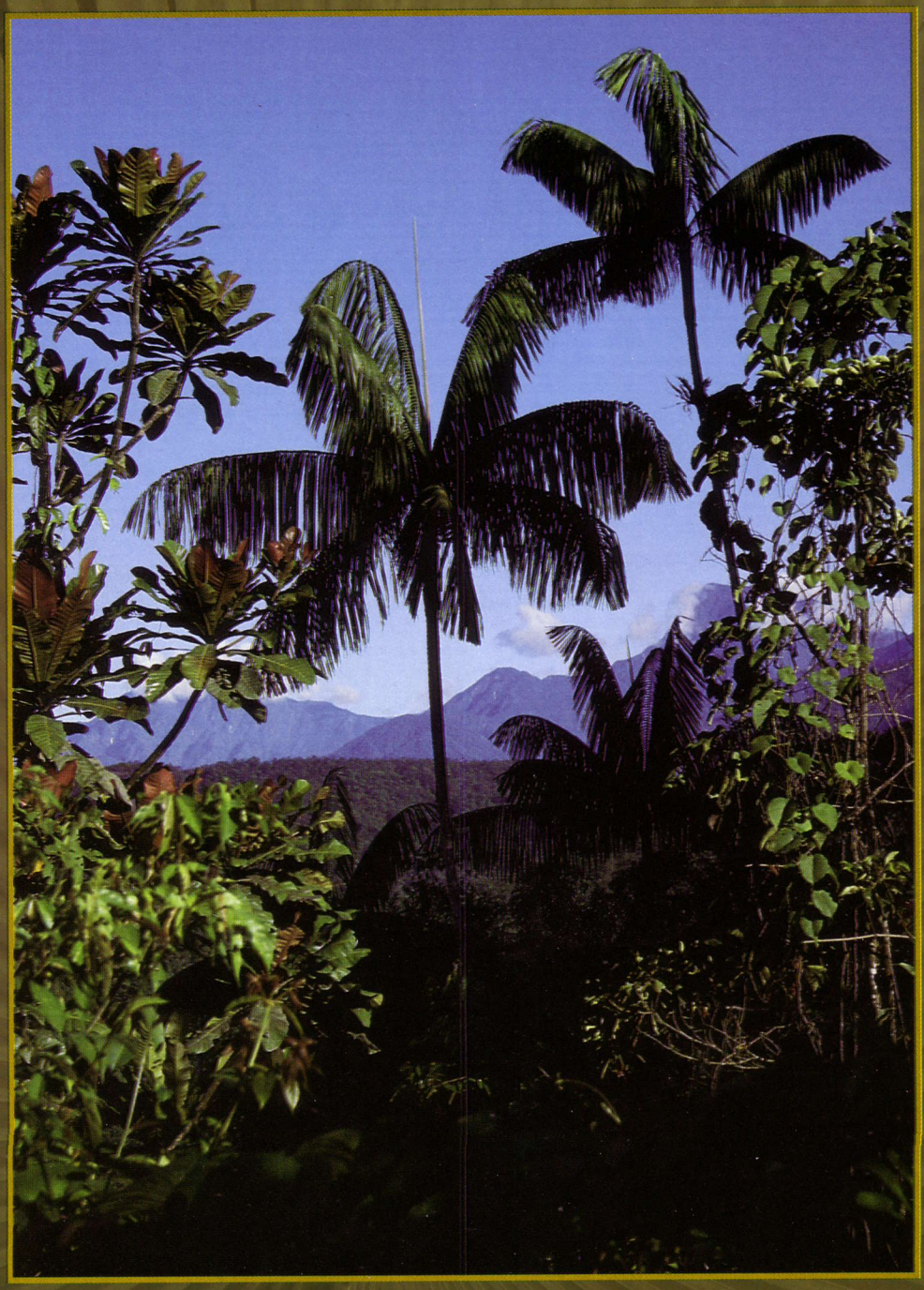

# THE INTERNATIONAL PALM SOCIETY, INC.

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**Founder:** Dent Smith

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**FRONT COVER**

*Cyrtostachys* sp. growing in heath forest south of Mt. Jaya, Papua, Indonesia. Photo: W. J. Baker.

## Palms (formerly PRINCIPES)

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# CONTENTS


**161** ***Gronophyllum cariosum*, an Ornamental New Species from Papua New Guinea**
JOHN L. DOWE AND MICHAEL D. FERRERO

**166** ***Orania regalis* Rediscovered**
WILLIAM J. BAKER, ARY PRIHARDHYANTO KEIM AND CHARLIE D. HEATUBUN

**170** ***Caryota zebrina***
JOHN DRANSFIELD, GREGORI G. HAMBALI, RUDI A. MATURBONGS AND CHARLIE D. HEATUBUN

**175** ***Siphokentia***
WILLIAM J. BAKER, RUDI A. MATURBONGS AND GREGORI G. HAMBALI

**184** **A Personal History of *Drymophloeus* in New Guinea**
SCOTT ZONA

**187** **In Search of *Caryota zebrina* – A Palm Expedition to the Cyclops Mountains**
CHARLIE D. HEATUBUN

**194** **A New Species of Rheophytic Palm from New Guinea**
JOHN L. DOWE AND MICHAEL D. FERRERO

**198** **A New Species of *Licuala* from New Guinea**
ANDERS S. BARFOD

**202** **The Palms of Mount Jaya**
JOHN DRANSFIELD, WILLIAM J. BAKER, CHARLIE D. HEATUBUN AND JOKO WITONO


**BACK COVER**

*Gronophyllum cariosum* in the forest undergrowth, Benwani, Sandaun Province, Papua New Guinea. See accompanying article p. 161. Photo by Anders Barfod.

## Features


| | |
|---|---|
| President's Message | 160 |
| The Palms of New Guinea Project | 160 |
| Palms of New Guinea Centerfolds | 182, 183 |
| Classified | 193, 201 |
| News of the Society | 201 |
| Horticulture Column | 209 |
| Index to volume 44 | 210 |


An attractive tree palm, most likely a species of *Gulubia*, growing above Fischhafen in Papua New Guinea. Photo by William J. Baker.

## In the next issue of PALMS...

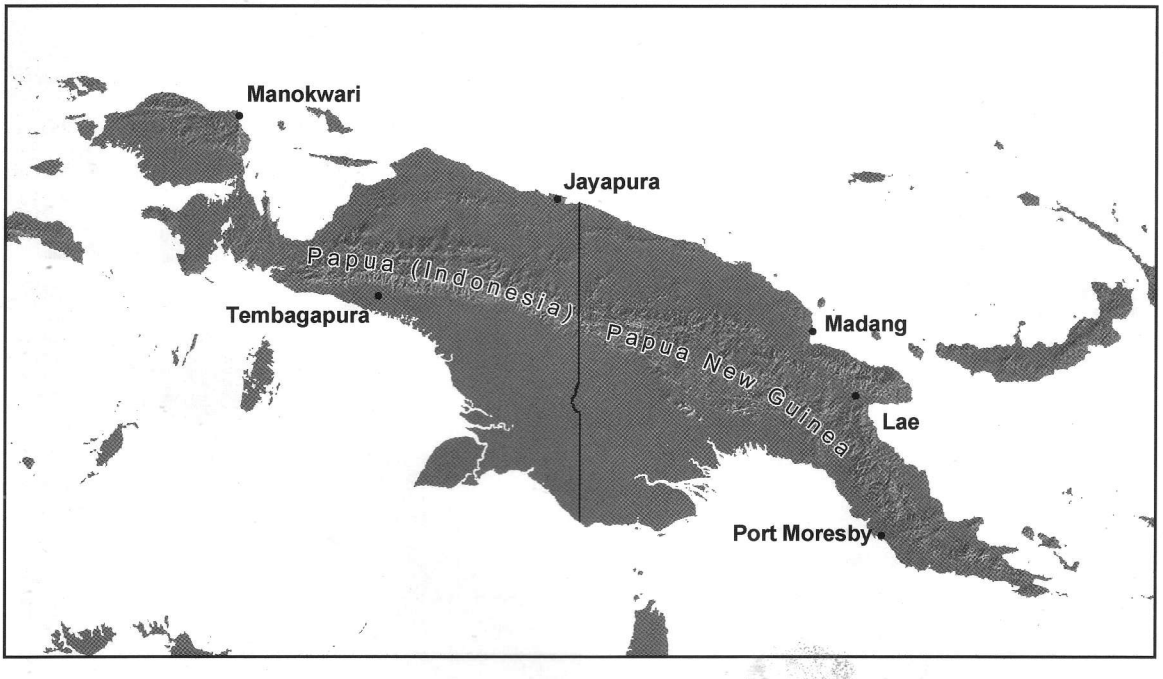
A profile of IPS Founder Dent Smith, a report on *Heterospathe* in cultivation, success with *Livistona carinensis* in Florida, analyses of *Astrocaryum* in South America and so much more!

## President's Message

I feel extremely fortunate to have been elected as your president during this time of prosperity for the IPS. Our membership is stable, our finances strong and our future is bright. Our editors have done an outstanding job of transforming PALMS into the publication that you desire while maintaining its stature among important botanical journals. We now have chapters all over the globe, and we have just concluded a phenomenal biennial meeting in New Caledonia.

My first order of business is to rave insanely over the October 2000 New Caledonian meeting and our hosts, Association Chambeyronia. Nous sommes echantés avec cette île, ces palmiers, la gastronomie, les montagnes et votre hospitalité. Our society is forever indebted to Philippe Cherrier, the Pierson family, the Leveques, Regis Babey, Marc Dumas and all of Association Chambeyronia, the New Caledonian government, the indigenous people of the island and our past president, Dr. Phil Bergman, for their exceptional efforts. We returned home very exited about the IPS in 2001, and the new board of directors and officers will work diligently to spread our enthusiasm. New officers Howard Waddell and Paul Craft will lead a new initiative to increase chapter support and membership, while Libby Besse and Don Kurth will work to solidify our operations. We all sincerely appreciate your support and will endeavor to make our organization more successful than ever.

HORACE HOBBS,
IPS PRESIDENT




## The Palms of New Guinea Project

This special issue of PALMS celebrates not only the palm diversity of the island of New Guinea but also the start of an exciting new initiative. The Palms of New Guinea Project is a collaboration involving 12 botanists from six different countries. The aim of the project is to explore and document the palms of New Guinea and to produce a richly illustrated book describing all known species, following a format similar to that of the highly acclaimed *Palms of Madagascar*.

New Guinea is the largest tropical island in the World. Positioned at the junction between Southeast Asia and the West Pacific, and separated from mainland Australia by a gap of only 150 km, the island supports a vast and unique assemblage of plants and animals.

*continued p. 165*

# *Gronophyllum cariosum*, an Ornamental New Species from Papua New Guinea

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**In the course of recent field-work undertaken in the Papua New Guinean West Sepik Province – the most biologically rich region of the island – a number of new palm species were identified. One such species is described here and notes provided.**

This species of *Gronophyllum* displays exceptional ornamental qualities, as well as some unique biological aspects.

**Gronophyllum cariosum** Dowe & Ferrero **sp. nov.**

Palma insignis *G. pleurocarpo* (Burret) Essig & Young et *G. rhopalocarpo* (Becc.) Essig & Young similis sed folio obovato indiviso vel rare bijugato, segmentis proximalibus distalibus multo angustioribus, floribus pistillatis petalis recurvatis, pagina adaxiali minute papilloso-verrucata cariosa aspectu, et fructu ellipsoidali, obovoideo vel fusiformi, 12–15 x 5–8 mm differt. Typus: Papua New Guinea, West Sepik Province, *J. L. Dowe et al. 514* (Holotypus BRI, isotypi K, LAE).

Solitary or clustering small palm. Stems 1–6, 1–4 m tall, 10–15 mm diam., green, internodes 65–95 mm long. Leaves 4–6 in the crown; leaf sheath tubular, 14–15 cm long, green with dark lepidote scales densest toward the apex; petiole 15–16 cm long, 3–4 mm wide, shallowly channeled adaxially, rounded abaxially, green with dense lepidote scales; lamina obovate in outline, 45–55 cm long, 20–30 cm wide, papyraceous, bullate, dark green adaxially, lighter green abaxially, simple or irregularly divided with a large bifid apical section, paired or single narrow basal segments, widely spaced on the rachis, ribs 11–13 in the apical section, single in the basal segments, prominent adaxially, less prominent abaxially and moderately ramentaceous throughout the length. Inflorescence spicate or 1-branched, protandrous, 12–14 cm long, rigid, erect becoming slightly curved in fruit; peduncle 2–3 cm long, basally dorsiventrally flattened and winged, distally terete in cross section, green, glabrous; prophyll 10–12 cm long, ca. 2.5 cm wide, cymbiform, ancipitous, light green, dark leprose scales in the apical portion; rachis 10–11 cm long, terete in cross section, glabrous, cream; peduncular bract 9–11 cm long, ca. 2 cm wide, sub-tubular, moderately dorsiventrally compressed, light green with dark leprose scales sparsely distributed toward the apex; rameal bract 2–3 cm long, ca. 8 mm wide, triangular, acuminate, light green, glabrous; triads borne throughout the length of the rachilla,

vertically ranked to slightly helical. Staminate flowers 8–9 mm long, asymmetrical, with a bubble-gum odor at maturity; sepals ca. 1 mm high, imbricate, fleshy, rounded, not keeled, cream, margins hyaline; petals 7–8 mm long, acuminate, irregular in length with 1 petal longer than other 2, apically loosely valvate, lavender with a cream base; stamens 6, as long as the petals, clustered, filaments short, anthers ca. 6 mm long, linear, basifixed, cream; pistillode short. Pistillate flowers ca. 3 mm high; sepals ca. 0.5 mm high, fleshy, cream; petals 3–4 mm long, recurved, violet becoming brown at receptivity, adaxially minutely papillose-warty, appearing decayed; stigma ca. 1 mm high, trifid, lobes erect to slightly recurved, light brown, minutely papillose-warty, appearing decayed. Fruit ellipsoidal to obovoid or fusiform, 12–15 x 5–8 mm, red; epicarp smooth, glossy; mesocarp thin, dryish, densely fibrous, endocarp crustaceous, dark brown. Seed ellipsoidal, 10–12 x 4–7 mm diam.; endosperm homogeneous, embryo basal. Eophyll bifid. (Figs 1–6).

SPECIMENS EXAMINED: PAPUA NEW GUINEA. West Sepik Province. Bewani Mts., Nuli River, 3°58.53′ S, 141°10.98′ E, 120 m, 12 Feb. 1998, *J. L. Dowe 514* (*with M. D. Ferrero & A. Bapa*) (Holotype BRI; isotypes K, LAE). Bewani Mts., Asai, near Apambo village, 13 Feb. 1998, *M. Mewa s.n.* (LAE).

DISTRIBUTION AND HABITAT. Papua New Guinea, West Sepik Province, Bewani Mts, in rainforest at 100–300 m. Locally uncommon, as an understorey element in undulating terrain that is very wet and otherwise prone to prolonged seasonal inundation, a habitat referred to as *brubinei* in Bewani language, and grows in association with *Sommieria affinis* Becc. and *Linospadix albertisiana* Becc.

ETYMOLOGY. The specific epithet is from the Latin *cariosus* – withered or decayed – in reference to the distinctive decayed appearance of the petals of the pistillate flower immediately prior to and during receptivity. This feature may be an adaptation to pollination by flies or other insects that are attracted to apparently decaying vegetative matter.

VERNACULAR NAME. *Fili awoi yamu*: the literal translation is as follows: *fili* – leaf; *awoi* – rounded; *yamu* – stick, stem or the name used for *Linospadix albertsiana*. This name is applied to the palm by the Bewani people and their respective clan groups of Iduli, Apambo, Raun haus, Somboi and Amoi. Nambis and Iliup villages are neighboring unrelated clans who also use the Bewani name.

USES. The palm is 'tended' in the forests at Bewani. Leaves are periodically harvested for wrapping sago and other food stuffs, for journeys into the bush when carrying the food or for important village functions where the leaves are used in the same way but judiciously so. Stems are used by children for practice bows to shoot arrows. It is an offense to touch, break or harvest another person's *filiawoi yamu* and is punishable under customary tribal law, which is accepted in courts of law in Papua New Guinea.

*Gronophyllum cariosum* is similar to a number of other small understorey clustering species, including *G. flabellatum* (Becc.) Essig & Young, *G. pleurocarpum* (Burret) Essig & Young and *G. rhopalocarpum* (Becc.) Essig & Young. *Gronophyllum cariosum* differs in the obovate-shaped leaf that is either simple or once divided, in which the proximal segments are much smaller than the distal, the spicate or 1-branched inflorescence, the staminate flower with lavender petals, the pistillate flower with recurved petals that are brown papillose-warty on the adaxial surface, and the fruit that is relatively shorter and broader. The condition of the pistillate petals, as described above, appears unique in the genus and is assumed to have some significance in attracting pollinators. The staminate flowers at anthesis have an odor that resembles grape-flavored Hubba-Bubba ® bubble-gum. Table 1 provides a list of comparative characters for *G. cariosum* and related taxa.

**Acknowledgments**

We thank the Bewani people who helped in many ways in the field and allowed us access to their forests. Dr Osia Gideon and staff (LAE), and Dr Gordon Guymer (BRI) are thanked for assistance with herbarium materials and depositions. Financial assistance for field work in Papua New Guinea for JD was provided by the Australia and Pacific Science Foundation and the Palm & Cycad Societies of Australia. Lucy T. Smith provided the illustration.

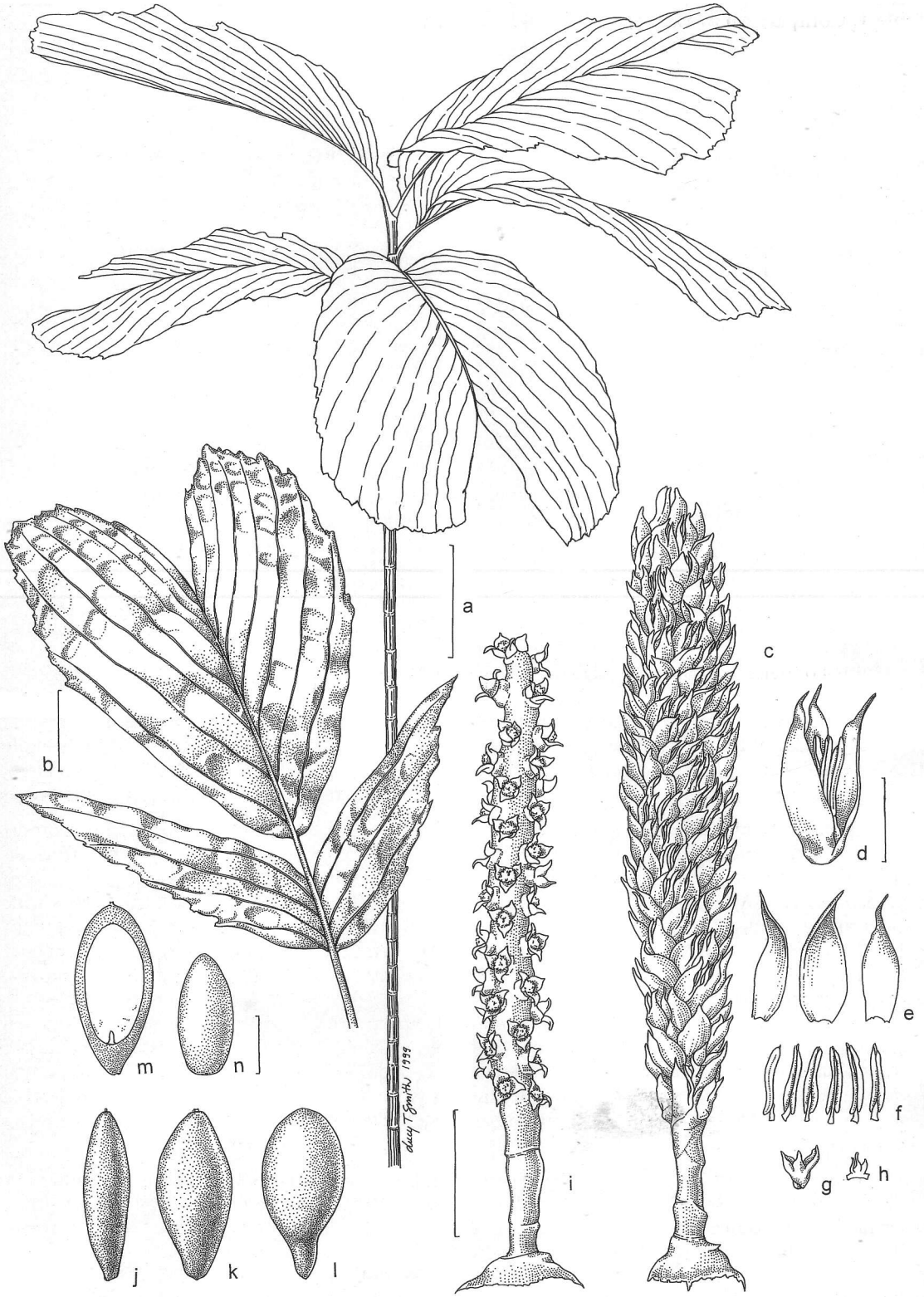
1 (facing page; top left). *Gronophyllum cariosum*: habit. Near Nuli River, Bewani Mts, West Sepik Province, Papua New Guinea.

2 (top right). *Gronophyllum cariosum*: leaf detail, segmented form.

3 (bottom left). *Gronophyllum cariosum*: leaf detail, entire form.

4 (bottom center). *Gronophyllum cariosum*: staminate flowers.

5 (bottom right). *Gronophyllum cariosum*: pistillate flowers.




6. *Gronophyllum cariosum*. **A** Habit; **B** Leaf; **C** Inflorescence with staminate flowers at anthesis; **D** Staminate flower; **E** Petals of staminate flowers; **F** Stamens; **G** Calyx; **H** Pistillode; **I** Inflorescence with pistillate flowers at anthesis; **J–L** Fruits; **M** Fruit in longitudinal section with embryo; **N** Seed. Drawn from *J. L. Dowe et al. 514* by Lucy T. Smith. Scale bars: **A** = 15 cm; **B** = 5 cm; **C, I** = 2 cm; **D–H** = 3 mm; **J–N** = 5 mm.

**Table 1. Comparison of *Gronophyllum cariosum* with similar species.**

| | *G. cariosum* | *G. flabellatum* | *G. rhopalocarpum* | *G. pleurocarpum* |
|---|---|---|---|---|
| **Height** | to 4 m | to 4 m | to 1.5 m | to 1.5 m |
| **Leaf** | obovate-bifid; or once divided | cuneate-bifid simple | irregularly pinnate; pinnae clustered sigmoid to cuneate | regularly pinnate; pinnae lanceolate |
| **Inflorescence** | spicate or 1-branched with 2 rachillae | spicate or 1-branched with 2 rachillae | 1-branched with 2 rachillae | 1-branched with 2–6 rachillae |
| **Staminate flower** | lavender; papillose on adaxial surface | color?; smooth on adaxial surface | pink | pink |
| **Fruits** | ellipsoidal, obovoid or fusiform | ellipsoidal or bullet-shaped | ellipsoidal, obovoid, fusiform or bullet-shaped | ellipsoidal, obovoid, fusiform or bullet-shaped |

*continued from p. 160*

New Guinea presents considerable challenges to the success of a project such as ours in which fieldwork is essential. Much of the island is highly mountainous, and few roads give access to this terrain. Furthermore, the island is still heavily forested; Papua province, for example, is said to retain 70% pristine forest cover today although much of this is under immediate threat. Penetrating these seemingly endless tracts of vegetation can be impossible. Despite these obstacles, project team members have already accomplished much successful fieldwork and have discovered many new species of palm in the process.

The Palms of New Guinea Project team is a unique collaboration. In New Guinea itself, Rudi Maturbongs and Charlie Heatubun form a strong link into Papua, Indonesia, conducting adventurous fieldwork with their colleagues from Universitas Cenderawasih, Manokwari, and studying the rattans and the endemic genus *Sommieria*. Roy Banka, Assistant Curator of the National Botanic Garden of Papua New Guinea, is undertaking exciting field trips too and is paying special attention to *Rhopaloblaste*. At the Indonesian national herbarium at Bogor, Dr. Johanis Mogea and Ary Keim are providing treatments of *Arenga* and *Orania* respectively. John Dowe at James Cook University, Townsville, Australia, is working on *Calyptrocalyx* and *Linospadix*, with assistance from Michael Ferrero, and will also provide the account for *Livistona*. *Licuala* and *Borassus* are being studied by Dr. Anders Barfod from Aarhus University, Denmark, while Dr. Scott Zona of Fairchild Tropical Garden, Miami, Florida, is bravely tackling *Ptychosperma*, *Ptychococcus*, *Drymophloeus* and *Brassiophoenix*. Dr. Sasha Barrow of the Global Diversity Foundation (UK) will discuss the ethnobotany of New Guinea palms. The project is co-ordinated from the Royal Botanic Gardens, Kew by Dr. John Dransfield and Dr. Bill Baker whose special interests include *Calamus*, *Gulubia*, *Gronophyllum*, *Hydriastele*, *Siphokentia* and *Areca*.

Work towards the book is already well underway. Some taxonomic accounts are nearing completion and illustrations are being prepared by Lucy Smith at Kew, thanks to a generous grant provided by the Australia Pacific Science Foundation. We expect to publish *The Palms of New Guinea* towards the end of 2004 and hope that botanists, ecologists and conservationists will find it to be an invaluable tool for their work in the region. It will also appeal to growers, not only as a means of identifying plants in their collections, but also as a tantalizing insight into the ornamental potential of many of New Guinea's wonderful palms.

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# *Orania regalis* Rediscovered

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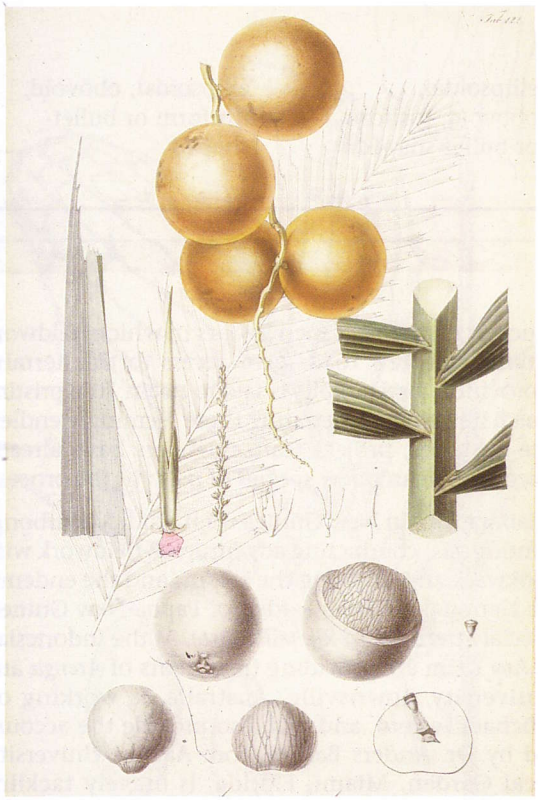

1. The type illustration of *Orania regalis* in *Rumphia*, volume 2, t. 122 (Blume 1937–1843).

**The genus *Orania* enjoys a wide and unusual distribution across Southeast Asia and Madagascar, but it is in New Guinea that it has diversified most extensively. Of the 25 species recognised in a new revision of the genus *Orania* (Keim, in prep.), 19 occur in New Guinea, 16 of which are endemic to the island. The species are not always common in their natural habitats and often occur as widely dispersed individuals rather than dense populations. Finding one of these handsome and distinctive palms in the wild is always exciting and makes the exertions of a day in the field seem well worthwhile.**

2 (left). *Orania regalis* growing in swamp vegetation on the Wandammen Peninsula. Photo: Sasha Barrow. 3 (right). Inflorescence of *Orania regalis*. Photo: Bill Baker.

The story of one of the most remarkable species of *Orania* is told in this article. *Orania regalis* Zipp. ex Blume was the first species to be described in the genus, which is notable enough, but it is for other reasons that it stands out from the rest. Unlike other species in which the inflorescence branches are spreading and rather diffuse, *O. regalis* produces extremely congested inflorescences composed of long peduncles topped with numerous sinuous branches which are swept forward. These brush-like structures arch out of the crown and often protrude below the leaves. Like almost all arecoid palms, both male and female flowers are found in the same inflorescence. The male flowers of *O. regalis* are unusual in the genus as they contain only three stamens. All other *Orania* species possess six or more. Occasionally, up to five stamens may be found in *O. regalis*, but this is not common. The stamens themselves are unusual, bearing only short filaments that are sometimes united. *Orania regalis* is instantly recognisable on account of these features, but despite this and the fact that it has been known to science for longer than any other species of *Orania*, the species has not been recorded in the wild for almost 130 years.

*Orania regalis* was first discovered by Alexander Zippel (otherwise known as Zippelius) in 1828. Zippelius, a German-born horticulturist, worked for the colonial administration in the Dutch East Indies and became assistant curator of the botanic garden at Bogor in 1823. In 1827, he joined the Commission for Natural Sciences and, the following year, set sail with other members of the Commission on an expedition to New Guinea led by Heinrich Christian Macklot. The expedition explored a large part of the south coast of New Guinea, reaching as far as Dolok Island near the mouth of the Digul river. Returning westwards, the team stopped at the neck of the Vogelkop Peninsula at one of a string of remarkable bays which intrude deeply into the island's interior. Having named their chosen bay after one of the expedition's ships, the Triton, they set about making scientific collections in the area. From a letter to Carl Ludwig Blume, then director of the herbarium in Leiden, the Netherlands, we know that Zippelius collected *O. regalis* near the village of Lobo. Sadly, on the return journey to Java, Zippelius died near Kupang in West Timor at the age of just 31.

In 1829, Blume published a series of letters sent to him by Zippelius. It is in one of these letters by Zippelius that the genus name *Orania* and the species name for *O. regalis* are used for the first time. However, it was not until Blume published the second volume of his magnificent series *Rumphia* (1837–1843), a richly illustrated account of Asian plants, that the name *O. regalis* was validly published for the first time along with two detailed plates. We know that many of the specimens collected by Zippelius reached Bogor and Leiden herbaria after his death, and Blume clearly stated that he had access to material of the palm. However, none of Zippelius' material of *O. regalis* can be found at either institution today. This has created a rather awkward situation in the nomenclature of the species because the type specimen, the original material used to describe the species, is apparently lost. Modern nomenclatural literature must satisfy a stringent set of criteria, including the designation of a type specimen at a specific herbarium. The International Code of Botanical Nomenclature is rather more relaxed in the case of historical literature and consequently, the diagnostic plate in *Rumphia* is regarded as the type of *O. regalis* and by default of the genus *Orania* itself (Fig. 1). The reader may be surprised to learn that this arcane and peculiar arrangement is not uncommon in the case of historical names!

In the absence of a type specimen, how do we know for certain that the palm we now call *Orania regalis* is the same species with which Zippelius was familiar? The first line of evidence comes from Zippelius' letter to Blume in which he describes some of the features unique to the species, such as the number of stamens. The second line of evidence can be found in the illustrations in Blume's *Rumphia* which are surprisingly accurate. The detailed diagnostic plate, regarded as the type, was prepared from specimens preserved in spirits, undoubtedly collected by Zippelius, and displays the unmistakable fruit morphology of *Orania* and the unique male flowers of *O. regalis* with only 3 stamens. The second plate shows the general habit of the palm and includes the congested, pendulous inflorescence so distinctive of *O. regalis*. Blume states that the plate was prepared from sketches of the living palm. Whether these sketches were made by Zippelius or by an accompanying artist is not clear, but it is very likely that they were produced in the field rather than from cultivated material which would have been immature at the time that the plate was drawn. The third line of evidence is more circumstantial, but nevertheless compelling. For many years, palms labelled as *O. regalis* have been cultivated at Bogor Botanic Garden. These palms are believed to have originated from Zippelius' 1828 collection, although it is probable that the specimens currently growing in Bogor represent a second or third generation. *Orania regalis* now grows in various botanic gardens, such as Singapore and Peredeniya, possibly from seed sent from Bogor. The characteristics of cultivated *O. regalis* match closely those described by Zippelius and Blume.

In 1873, Odoardo Beccari, the renowned palm taxonomist, visited Wokam Island in the Aru Archipelago. Technically part of the Indonesian province of Maluku (also known as the Moluccas), the Aru Islands lie only 100 miles south of the southern coast of the Vogelkop's neck. Beccari collected a species of *Orania* there which he described in 1877 as *O. aruensis*. In the course of a monographic study, one of us (AK) has discovered that *O. aruensis* is the same species as *O. regalis* and must be regarded as a synonym of the latter. Perhaps Zippelius' material of *O. regalis* was already lost when Beccari published the second name. If he had seen the specimen, he might not have described a second species.

Until very recently, *Orania regalis* had not been collected by any botanist since Beccari's expedition to Wokam. Both Triton Bay and the Aru Islands are difficult and expensive to reach and have received little or no attention from botanists. Despite intensive fieldwork in other parts of New Guinea by a number of palm experts, the species did not resurface. In our minds, *O. regalis* became almost mythical, as *Beccariophoenix madagascariensis* or *Ravenea lakatra* seemed legendary and at first unobtainable to *The Palms of Madagascar* team. However, unlike Madagascar, New Guinea is still heavily forested and it seemed to be only a matter of time before we struck gold.

As it happened, two of us struck gold almost simultaneously. In March 1999, one of us (CH) was collecting in the vicinity of Nabire, approximately 90 miles west of Triton Bay. An *Orania* specimen made on that expedition corresponded closely with *O. regalis*. In February 2000, during an expedition to the Wandammen Peninsula, some 80 miles north-west of Triton Bay, two of us (CH, WB) made specimens which, again, matched closely the palm described by Zippelius and Blume. Closer examination of the specimens in the herbarium confirmed our suspicion that, at last, *O. regalis* had been rediscovered in the wild.

All three specimens collected on the two expeditions were taken from palms growing in swampy, lowland forest. In one extreme instance, it was found apparently thriving in ground so inundated that the stems were surrounded by

4. Close-up of rachillae in *Orania regalis* with flowers in bud. Photo: Bill Baker.

standing water (a habitat also favored by savage mosquitoes). *Orania regalis* is a striking palm growing as a moderately robust, if not massive, solitary tree palm of the subcanopy, sometimes occurring in considerable numbers (Fig. 2). In many ways, it is typical of the genus with its large leaves with jagged leaflet apices. Its lack of a crownshaft and rather conspicuous leaf sheaths almost lend it the appearance of some kind of forest coconut. Although it is not exactly "regal" in terms of size, as one might have expected from the species name, its peculiar congested inflorescences are astonishing (Fig. 3). Initially cream-colored as the flowers develop (Fig. 4), the inflorescences later become crowded with large orange fruit and hang below the crown. The significance of the unique inflorescence structure is not known, but it is very likely to have some role in the reproductive biology of the palm. More fieldwork is required before *Orania regalis* gives up all its secrets and, for the time being, it remains a poorly known palm, inaccessible to most palm enthusiasts. The more inquisitive reader is encouraged to visit the Botanic Garden in Bogor where several mature specimens continue to flourish. This is clearly a splendid palm for a grower with a large garden and plenty of patience.

**Acknowledgments**

The authors thank Rudi Maturbongs and Jack Wanggai for organising the expedition to the Wandammen Peninsula, and for co-ordinating logistics in the field. We also thank Matthias Sagisolo, Sasha Barrow and Himmah Rustiami for their support and assistance during the trip. Markus D. Ngamel and Marthinus Taa helped CH in the field in Nabire. Fieldwork was funded by TOBU and the Royal Botanic Gardens, Kew.

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*Continued from p. 214*

*Rhapidophyllum* 23, 37, 38, 42, 101
*R. hystrix* 39, 42, 46
*Rhapis* 23, 153
*R. excelsa* 6, 153, 154
*R. humilis* 154
*R. laosensis* 154
*R. multifida* 154
*R. subtilis* 153, 154
*Rhopaloblaste* 165, 190, 192, 205
*R. ceramica* 205
*Rhopalostylis* 23, 139
Richard H. (Dick) Phillips (Obituary) 8
*Roscheria* 23
*Roystonea* 9, 23, 59, 69, 73, 81, 89
*R. lenis* 73, 81
*R. maisiana* 73, 78, 81
*R. regia* 56, 59, 73, 81, 85, 122
*R. regia* var. *maisiana* 73
*R. regia* var. *pinguis* 73
*R. stellata* 76, 81
*R. violacea* 76, 81
*Sabal* 23, 38, 39, 41, 42, 69, 73, 81, 89, 90, 101, 154
*S. bermudana* 43, 46
*S. causiarum* 9
*S. domingensis* 73, 81
*S. etonia* 9
*S. florida* 73
*S. maritima* 73, 81, 85
*S. mayarum* 73
*S. mexicana* 9
*S. minor* 9, 38, 39, 40, 42, 43, 46
*S. palmetto* 9, 38, 39, 42, 43, 45, 46, 73, 81, 154
*S. parviflora* 73
*S. umbraculifera* 9
*S. yapa* 73, 77, 81
*Salacca* 21
*S. glabrescens* 24
*S. ramosiana* 24
*S. rupicola* 24
*S. secunda* 99
*Satranala* 21, 23, 36, 139
*Scheelea cubensis* 69
*Schippia* 23
*Sclerosperma* 23

*continued on p. 174*

# *Caryota zebrina*

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1. *Caryota zebrina*: a young plant in cultivation at the Yatazawa Tropical Plant Research and Development Gardens, Bogor (Photo: William J. Baker).

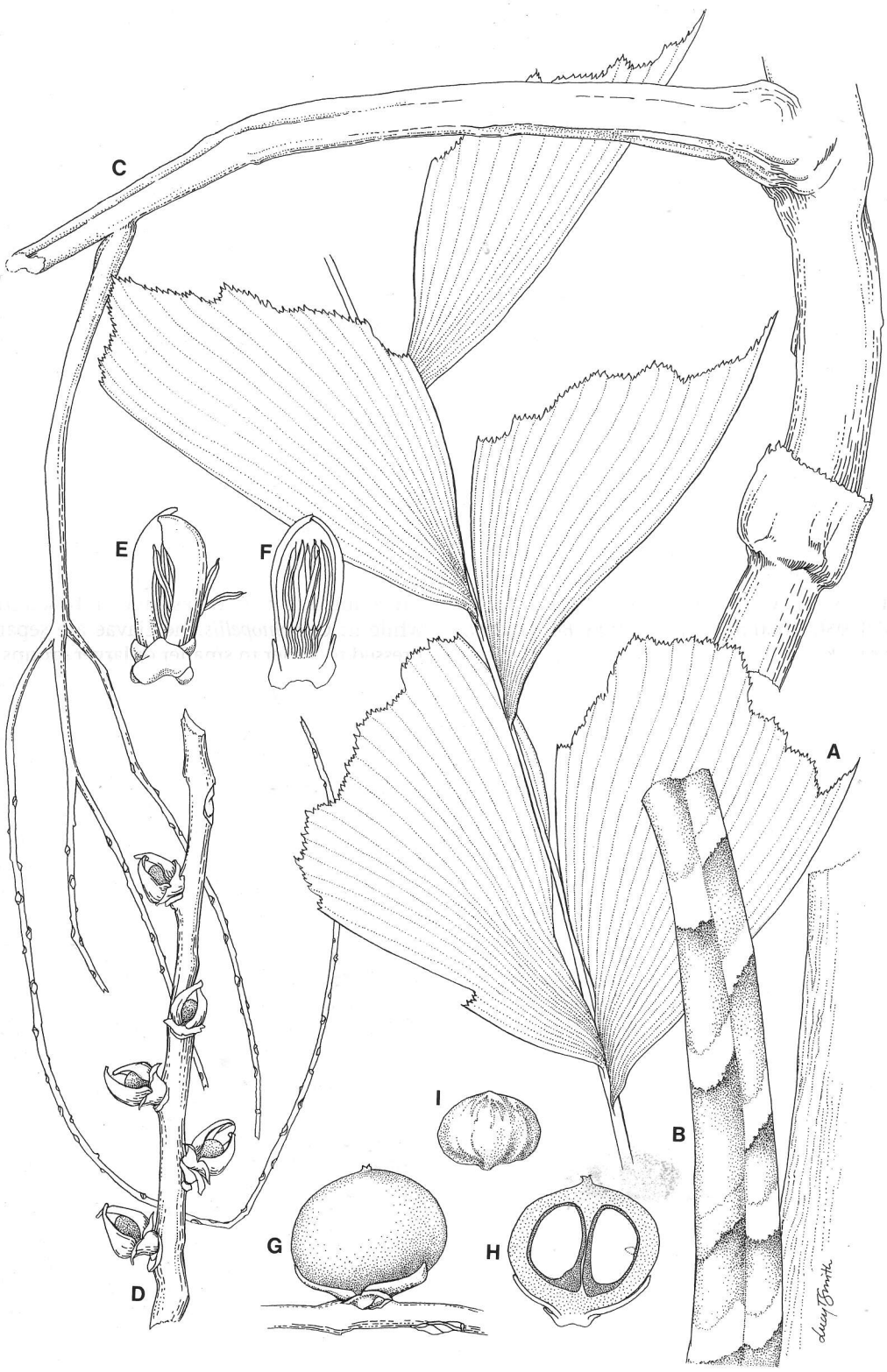
**This spectacular ornamental palm, widely distributed among enthusiasts, is now formally described and named.**

The remarkable palm that forms the subject of this paper was first collected by the botanists van Royen and Sleumer on the Cyclops Mountains near Jayapura in Irian Jaya. Their specimen, deposited in Leiden Herbarium, was originally labelled *Korthalsia*, and the specimen thus remained mislaid in among the unidentified species of the rattan genus from New Guinea, until one of us (JD) realized it was a species of *Caryota*. However, JD, concerned at the time only with *Korthalsia*, did not examine the specimen in detail. Independently and much later in 1992, another of us (GGH) saw it in cultivation, realized the palm was undescribed and gave it the informal name "*Caryota zebrina,*" by which it has become well known to palm growers (Fig. 1). Shortly after this, John Dowe discovered what appeared to be the same species in Vanuatu and described his Vanuatu palm as *Caryota ophiopellis* J. Dowe (Dowe & Cabalion 1996). Although the palm from New Guinea shares with *C. ophiopellis* some characters very unusual in the genus (Uhl & Dransfield 1987), they are indeed distinct. It is quite remarkable that two such strange and beautiful *Caryota* species should have remained undescribed for so long. Knowing that "*Caryota zebrina*" had been seen by GGH in the Cyclops Mountains, two of us (RAM and CH) made field trips to collect good complete herbarium collections, the first by CH in August 1998 and the second by RAM in September 1998, thus providing the necessary material for finalizing a description and to act as a type. The following paper is thus the result of a joint effort to provide a validly published name by which this now widely cultivated and highly desirable palm can be referred. The palm also occurs in Papua New Guinea (see Ferrero 1997) where it has been collected in the Torricelli Mountains.

**Caryota zebrina** G. Hambali, R. Maturbongs, C. Heatubun & J. Dransfield **sp. nov.**

inflorescentia in 2–3 ordines ramificanti, endospermio homogeneo, petalis floris feminei grandibus et petiolis fasciatis *C. ophiopellidi* Dowe similis sed fructu majore depresso-globoso, petalis floris staminati apice rotundatis staminibus 28 differt. Typus: Indonesia, Irian Jaya, Jayapura, Cyclops Mt Nature Reserve, Doyo Village *Maturbongs RAM586* (Holotypus K; isotypi BO, MAN).

Solitary monoecious hapaxanthic tree palm; stems 6–16 m tall, ca. 20–40 cm diam., bare near the base, distally covered with sheaths; internodes 30–40 cm long, nodal scars ca. 2 cm wide, internode surface cracking longitudinally and covered with a thick layer of dirty brown tomentum. Leaves 5–7 m long, ca. 1.5 m wide, young leaves pale green, older leaves dirty blackish green; sheath 1–2 m long, ca. 15 cm wide, markedly fibrous along margins, in mature leaves covered in dull brown tomentum, in juveniles strikingly tiger-striped with bands of pale and dark tomentum; ligule to ca. 25–60 cm long, covered in a dense layer of dirty brown tomentum, the ligule and sheath margins disintegrating into thin long black fibres; petiole ca. 1–2 m long, 2–6 x 2–3 cm in cross section, in young leaves tiger-striped with bands of pale and dark indumentum as the sheath, in older leaves dark olive green; rachis to 5 m long, to 20 x 28 mm in section in mid-leaf, adaxially with a strong flange ca. 8 x 5 mm, abaxially convex, covered in dense caducous dark brown tomentum; primary pinnae about 20 on each side if the rachis, up to ca. 20 cm apart, the basal primary pinnae ca. 80 cm long, the mid-leaf primary pinnae ca. 150 cm long, the distal to 100 cm long; secondary pinnae drying pale coloured, ca. 7–11 on each side of the secondary rachis, up to ca. 26 x 7 cm, irregularly wedge-shaped, leathery, veins radiating from the base, adaxially glabrous, abaxially with broad bands of caducous brown scales; transverse veinlets obscure. Inflorescences 1–2.5 m long, branching to 3 orders (always?); peduncle to 30 x 40 mm diam., the surface densely covered in dull brown tomentum; distal bracts tubular, circumscissile and leaving a low collar, splitting distally to form a triangular limb to 22 x 12 cm, edged with dark brown fibres and covered in caducous brown tomentum; basal first order branches with a conspicuous pulvinus to ca. 5 cm wide; rachillae of various lengths, the longest to at least 1 m, 3–4 mm diam., covered in dark brown indumentum; triads ca. 8–10 mm distant; rachilla bracts low, crescentic. Staminate flower at anthesis ca. 14 x 7 mm; sepals 3, dark green, strongly imbricate, irregularly gibbous, broad, rounded, entire or emarginate, the outermost 5 x 8 mm, the middle 5 x 7 mm, the innermost 5 x 7 mm, the three slightly connate basally; petals 3, free to the base, 12.0 x 4.5 mm, glabrous, smooth, almost spathulate with rounded triangular tips; stamens ca. 28, filaments 3.0 x 0.3 mm, anthers orange 5–7 x 0.6 mm, connective dark tanniniferous, projecting beyond the anthers as a short bifid tip to 0.5 mm; pollen monosulcate, exine semitectate with anastomosed clavae forming irregular islets of tectum (Harley, pers. comm.); pistillode absent. Pistillate flower in bud (*van Royen & Sleumer 6129*) superficially similar to staminate flower but narrower, ca. 10.0 x 3.5 mm except at base where 6 mm wide; sepals 3, rounded, broadly imbricate, irregularly gibbous, the outer 4 x 7 mm, the middle 4 x 7 mm, the innermost 3.5 x 6.0 mm; petals 3, free in bud, 9.0 x 2.8 mm; staminodes 3, antesepalous, filaments




2. *Caryota zebrina*. **A** Portion of leaf x 2/3; **B** Base of petiole x 2/3; **C** Portion of inflorescence x 1/3; **D** Portion of rachilla with pistillate flowers x 1; **E** Staminate flower x 2; **F** Staminate flower in longitudinal section x 2; **G** Fruit x 1; **H** Fruit in longitudinal section x 1; **I** Seed x 1. **A** from *van Royen & Sleumer 6129*; **B–D** from *Heatubun 273*; **E, F** from *Maturbongs 586*. Drawn by Lucy T. Smith.

to 4 x 0.3 mm; gynoecium conical, 2 x 3 mm with 2 stigmas to 1.2 x 0.5 mm, ovules 2. Pistillate flower (*Maturbongs RAM586*) post anthesin with petals basally connate for 2 mm with narrow triangular lobes to 7 x 5 mm; ovary 6 x 6 mm with 2 ovules. Fruit ripening white and then red, globose to depressed globose, to 15 x 25 mm, with apical stigmatic remains; epicarp minutely papillate. Seeds 2, hemispherical, ca. 12 x 15 x 8 mm, surface smooth, with scattered veins, with basal corky mass; endosperm homogenous; embryo lateral. (Fig. 2).

ECOLOGY: Rare tree in mountain forest at 850–1500 m.

SPECIMENS EXAMINED: INDONESIA. Irian Jaya: Jayapura, Cycloop Mountains, path Ifar – Ormoe, north of pass, alt. 1200 m, 1 July 1961, *van Royen & Sleumer* 6129 (A, CANB, L, LAE). Jayapura, Cyclops Mt Nature Reserve, Doyo Village, 1050 m, 23 Sept 1998, *Maturbongs RAM586* (Holotype K, isotypes BO, MAN); Cyclops Mt, 1180 m, 9 Aug 1998, *Heatubun CH273* (BO, K, MAN). PAPUA NEW GUINEA. West Sepik, Miwaute, 142° 07′ E, 03° 25′ S, 950–1000 m, 19 Nov. 1996, *Barfod et al. 386* (AAU, K, LAE).

LOCAL NAMES: *Palem belang* (striped palm) or *Palem tokek* (*Tokek* is the large house gecko)

USES: Apart the horticultural uses, the palm is probably too rare to be of much significance.

*Caryota zebrina* shares several features with *Caryota ophiopellis* Dowe that are unusual in the genus; these include homogeneous endosperm, inflorescences branched to more than one order, pistillate flowers with large petals similar to those of the staminate flower, unusual pollen and, of course, the extraordinary tiger-striped petioles (Figs 1, 2). At first we thought they might be one and the same. However, there are several clear differences between them. *Caryota ophiopellis* was described originally as having a tear-drop shaped seed but this has been shown more recently to be anomalous, and the seed (of a single-seeded fruit) is rounded, lacking the depression found in *C. zebrina*. There are also subtle differences in leaf texture between the two, with *C. zebrina* having thicker and shinier leaflets than those of *C. ophiopellis*. The pollen grains of the two species are very distinctive but different. Two different intectate pollen types were until recently known in *Caryota* – pollen with small, regular clavae (club-like processes) and pollen with spine-like processes, and, in fact, pollen appears to be of importance in the evolution of the genus as it clearly helps to define two major evolutionary lines (Hahn & Sytsma 1999). *Caryota zebrina* has clavae but they are anastomosed to the extent that the whole grain becomes irregularly semitectate, while in *C. ophiopellis* the clavae are separate or pressed together in smaller or larger groups, often in a loose reticulate pattern and occasionally are anastomosed. Pollen of the two species will be the subject of a more detailed study (Harley, in prep.). The known differences between the two species are summarized in Table 1.

This is the second species of *Caryota* to be recognized in New Guinea, the other being *C. rumphiana*. The latter species is instantly recognizable by larger stature, its inflorescences

**Table 1. Comparison of *Caryota zebrina* and *C. ophiopellis*.**

| *Caryota zebrina* | *Caryota ophiopellis* |
|---|---|
| Mottling pattern of petioles broken stripes | Mottling pattern of petioles blotches |
| Pinnae dry pale green | Pinnae dry dull dark green |
| Inflorescence branching to 3 orders | Inflorescence branching to 2 orders |
| Petals of staminate flower with rounded tips | Petals of staminate flower with pointed tips |
| Staminate flowers 14 x 7 mm | Staminate flowers 9 x 6 mm |
| Stamens 28 | Stamens 20–25 |
| Pollen semitectate with anastomosed clavae | Pollen intectate with grouped or closely ad-pressed, rarely anastomosed clavae |
| Fruit depressed globose | Fruit globose-ovoid |
| Stigmatic remains strictly apical | Stigmatic remains eccentrically apical |
| Seed of 1-seeded fruit hemispherical, 12 x 15 x 8 mm, with a depression | Seed of 1-seeded fruit rounded, 9 mm diam. |

branched to one order only and its seeds with the ruminate endosperm typical of the genus. Furthermore, juveniles of *C. zebrina* carry the distinct and beautiful banding of different shades of gray and brown indumentum that makes the species such a desirable ornamental.

In the Cyclops Mountains, *Caryota zebrina* appears to be confined to the western part, where it occurs at elevations of 850–1500 m above sea level. Its absence from the eastern part of the mountains is probably related to the fact that this part of the range is not so high. The palm may well occur at elevations higher than 1500 m. Below 850 m elevation scattered seedlings can be found, sometimes intermingled with those of *Caryota rumphiana*, from which *C. zebrina* can be distinguished by the presence of three stripes of brown indumentum on the undersurface of each leaflet, the more leathery texture and the fact that the two leaflets of the eophylls are much more widely divergent. Seeds have been discovered in the droppings of cassowaries, so these majestic birds may be responsible for dispersal. In the wild, the zebra striping of the petioles becomes less and less conspicuous as the plants become older. In cultivation in Bogor, there is considerable variation in the intensity of striping from one individual to the next.

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*continued from p. 169*

Searching for *Copernicia* in Cuba 88
*Serenoa* 23
*S. repens* 46
*Siphokentia* 165, 175, 176, 177, 181
*S. beguinii* 176, 177, 179, 180
*S. dransfieldii* 175, 176, 177, 178, 179, 180
*S. pachypus* 176, 177
*Sommieria* 165
*S. affinis* 161
*S. elegans* 203, 205
*S. leucophylla* 182
*Syagrus* 9, 27, 102, 154
*S. coronata* 10, 11
*S. romanzoffiana* 9, 154
*S. schizophylla* 10, 11, 12
*Synechanthus* 20, 23
*S. warscewiczii* 148
*Tectiphiala* 94
The Effects of Vitamin $B_1$ on Palm Seedling Growth 114
The Genus *Thrinax* in Cuba 63
The Palms and Cycads of Thailand, ed. D.R. Hodel, reviewed 98
The Palms of Mount Jaya 202
The Palms of New Caledonia, by D.R. Hodel and J.-C. Pintaud, reviewed 100
The Palms of New Guinea Project 160
The Rediscovery of *Calamus harmandii*, a Rattan Endemic to Southern Laos 29
The Successful Palm Sale 141
*Thrinax* 23, 35, 63, 64, 65, 66, 67, 69, 70, 81, 90, 102
*T. acuminata* 72
*T. compacta* 64, 65, 70, 81
*T. crinita* 72
*T. drudei* 70
*T. ekmaniana* 65, 66, 67, 70, 76, 81
*T. excelsa* 64, 65
*T. microcarpa* 70
*T. miraguana* 72
*T. morrisii* 63, 64, 65, 70, 81
*T. parviflora* 64, 70
*T. punctulata* 70
*T. radiata* 63, 65, 67, 70
*T. rigida* 72
*T. rivularis* 64, 66, 81
*T. rivularis* var. *rivularis* 66, 68, 70
*T. rivularis* var. *savannarum* 57, 66, 67, 70, 81
*T. wendlandiana* 70
*Trachycarpus* 23, 41, 42, 43, 44, 46, 101
*T. fortunei* 38, 39, 40, 43, 46, 101
*T. takil* 46
*Trithrinax* 23
Uhl, N.W., book review 100
*Veillonia* 101, 139
*Veitchia* 23, 102, 122
*Voanioala* 139
Waddell, H.: The Successful Palm Sale 141
*Wallichia* 14, 21, 23
Wanggai, J., as co-author 175
Warwick, D.R.N. and E.C. Leal: Occurrence of Coconut *'Lixas'* in Brazilian Native Palms in the Northeastern Coastal Plain 9
*Washingtonia* 48, 154
*W. filifera* 43, 46, 101
*W. robusta* 9, 154
*Wendlandiella* 20
*Wettinia* 23
Witono, J., as co-author 202
*Wodyetia bifurcata* 50
*Zalaccella* 29
Zona, S. A Personal History of *Drymophloeus* in New Guinea 184
Zona, S., D. Evans and K. Maidman: *La Palma Barrigona* 85

# *Siphokentia*

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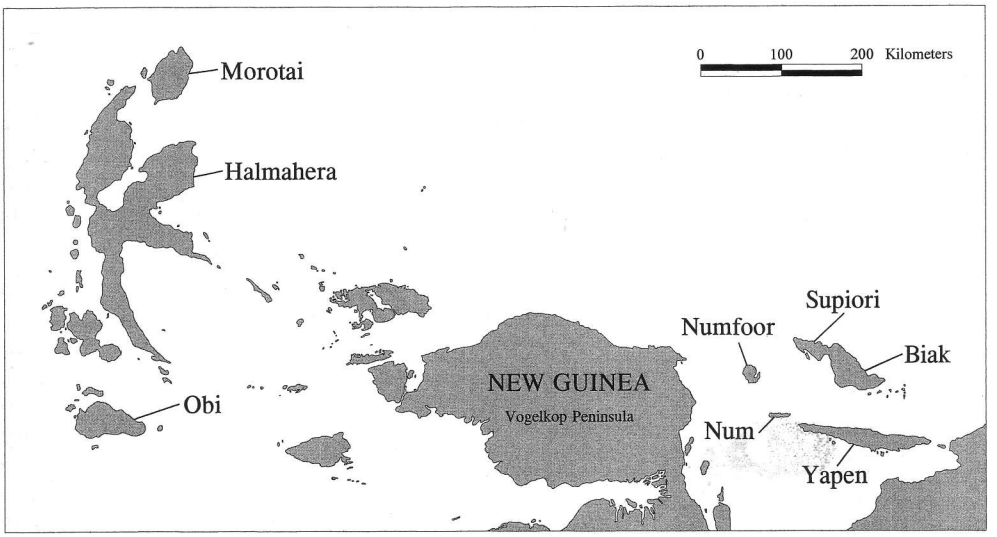



1. Map of the islands on which *Siphokentia* is known to occur.

**The genus *Siphokentia*, previously known only from the Moluccas, has yielded an exciting new species from Biak Island. A revision of the genus is presented here, including a description of the new species, *S. dransfieldii*.**

The genus *Siphokentia* has become an increasingly popular subject in gardens since its introduction to cultivation by the Fairchild Tropical Garden Expedition of 1940. Members of the expedition collected seed of *Siphokentia* on Kahatola Island off the northwest coast of Halmahera in June 1940 and distributed it to growers in Florida and the Bahamas. Just over a decade later, Harold Moore (1953) identified mature plants grown from this collection as *S. beguinii*, one of only two species described in the genus at that time, and, until recently, all plants in cultivation have been known by this name. In the early 1990s, one of us (GGH) discovered a species of *Siphokentia* quite different to *S. beguinii* growing in quantity on the island of Biak off the northwest coast of New Guinea. Although seeds were introduced to cultivation, no herbarium material was collected until 1998 when two of us (RAM and JW) organised an expedition to Biak to collect palm specimens. The specimens of *Siphokentia* made on this expedition do not match any other herbarium material of the genus, and thus we are describing the palm as a new species, *S. dransfieldii*.

Max Burret described the genus *Siphokentia* in 1927, along with two species, *S. beguinii* and *S. pachypus*, basing his descriptions on two specimens from Halmahera collected by the Dutchman Victor Beguin. Since then additional material has been collected from the vicinity of Halmahera, Obi and Morotai islands in the Indonesian province of Maluku. Burret recognised its close relationship to the largely Papuasian genus *Gronophyllum*. Indeed, in almost every way, *Siphokentia* resembles *Gronophyllum*, but is distinguished by its unique pistillate flower morphology [not "staminate flower petal shape" as asserted by Ferrero (1997)]. The petals in pistillate flowers of *Siphokentia* are united with one another, as are the sepals, whereas those of *Gronophyllum* and most other members of subtribe Arecinae are not united. The relationships among the members of subtribe Arecinae, which includes two other important Papuasian genera, *Gulubia* and *Hydriastele*, are still unclear, but once resolved, some changes to generic circumscription can be expected. It is quite possible, though by no means certain, that one such change might result in the inclusion of *Siphokentia* within *Gronophyllum*.

*Siphokentia dransfieldii* has been cultivated under that name for several years now, although the name has never been formally published. In the garden of one of the authors (GGH) in Bogor, *S. beguinii* is grown in great profusion alongside *S. dransfieldii*. Superficially, both palms look quite similar with moderately robust solitary stems and the leaf blade divided irregularly into narrow single fold leaflets and wide multiple fold leaflets. However, some subtle differences in vegetative morphology can be observed. The leaves of *S. dransfieldii* tend to include 3 pairs of wide, multiple-fold leaflets interspersed with few narrow, single-fold leaflets, whereas the leaves of *S. beguinii* are far more varied in their division. The leaflets of *S. dransfieldii* are held stiff and straight unless damaged, whereas those of *S. beguinii* tend to be somewhat recurved towards their apices, lending them a rather floppy appearance. Ferrero (1997) reported that *S. dransfieldii* is immediately distinguished from *S. beguinii* by its "robust nature and larger dimensions in all aspects" and that it is a very fast growing species. While this may be true in horticultural conditions, *S. dransfieldii* can be of rather small stature in the wild where it often grows on extremely depauperate soils, although specimens over 10 m tall have been recorded.

It is in reproductive morphology that most of the distinguishing features of *S. dransfieldii* can be observed (see Table 1). The most obvious of these is in the shape and size of the fruit. In *S. dransfieldii* the fruit is obovoid and approximately 1.5 times the size of the ellipsoid fruit of *S. beguinii*. The apex of the fruit bears a woody discoid region, approximately 5 mm in diameter, which is slightly depressed (the stigmatic remains are located in the centre of the depression). The same woody region exists in the fruit of *S. beguinii*, but it is smaller, convex and slightly pointed. The staminate flowers are also conspicuously different with 13–16 stamens in those of *S. dransfieldii* versus 9–10 stamens in those of *S. beguinii*. The staminate petals of *S. dransfieldii* are less than twice the length of the stamens whereas those of *S. beguinii* are roughly three times the length of the stamens. Other differences associated with rachilla bracts and pistillate flowers are listed in Table 1.

Exposed and eroded limestone is much in evidence on Biak island and, in many parts, the soils over the stone are thin or even non-existent. While *S. dransfieldii* has been recorded on deep, rich soils, it has also been observed growing on very much thinner soils and even directly into cracks in bare limestone. This observation does not necessarily imply that *S. dransfieldii* is dessication-tolerant, as the rainfall on Biak is very high. Nevertheless, it appears to thrive in a wide variety of environmental conditions from sea level to over 300 m, and is conspicuous throughout the island (it can be easily spotted from the road). Local people know the palm well and give it the name *ombrush*. They report that they use it as a substitute for betel nut when *Areca catechu* fruits are not available. The leaves are also said to be valuable for wrapping sago or meat.

Biak islanders claim that *Siphokentia dransfieldii* occurs also on Supiori, an island separated from north-west Biak by a narrow channel, as well as Numfoor island, some 90 km west of Biak. Curiously, the genus is not known from Yapen Island, which lies only 60 km south of Biak, or from mainland New Guinea. One cannot explain this absence by asserting that the areas have not yet been explored adequately, because both Yapen and the Vogelkop region of New Guinea have received considerable attention from palm botanists. The answer may lie in the behaviour of birds, the most likely dispersal agents of the *Siphokentia* seeds. Biak, Supiori and Numfoor are oceanic islands, whereas both Yapen and its close neighbour Num are land-bridge islands that have been connected to the mainland during periods of low sea level in the Pleistocene. Differences in bird faunas clearly reflect the different relationships between the oceanic and the land-bridge islands (Beehler et al. 1986). For example, a number of common mainland species, such as the Palm Cockatoo, are present on Yapen, but absent from Biak. Moreover, the oceanic islands which have been isolated for so long support a remarkable number of endemic birds. These differences can be explained by the fact that many New Guinea birds do not fly over salt water despite the fact that they are capable of sustained flight (Beehler et al. 1986). The behavior of fruit-eating birds may explain why *S. dransfieldii* has not reached the mainland, Yapen or Num, and hints at the possibility that more endemic palms may yet be discovered on the oceanic islands. Nevertheless, we cannot explain how the genus *Siphokentia* moved between the Moluccas and Biak, Supiori and Numfoor islands without colonising effectively any of the intervening land masses such as the Vogelkop Peninsula (Fig. 1).

So what of *Siphokentia pachypus*, the one species as yet unaccounted for? Burret (1927, p. 201) described the distinguishing features of *S. pachypus* as follows:

> Although the fruits [of *S. pachypus*] are less mature than in the previous species [*S. beguinii*], the rachillae are much more robust, the fruit scars are larger, the fruits are already somewhat longer and probably stay slimmer. The rachilla bract [of *S. pachypus*] is pressed closely to the floral bracts, while in *S. beguinii* it is curved and separated from the floral bract by a considerable space. The leaf mid-rib of *S. pachypus* bears white tomentum. According to the label, the base of stem is thickened in this species while in *S. beguinii* it is thinner below than on top.

We have examined type material of both *S. pachypus* and *S. beguinii* held at the herbarium in Bogor and can find no justifiable distinction between the two. In several cases, the differences given by Burret simply are not true. The rachillae in the type of *S. pachypus* are around 3 mm wide, whereas those in the type of *S. beguinii* are 2.0–2.5 mm wide, a negligible difference. Similarly the difference in the size of the fruit scars is very insignificant (1.5–2.0 mm diameter in *S. pachypus*, 1–2 mm diameter in *S. beguinii*). The fruit on both specimens are of a similar length (12 mm), not longer in *S. pachypus*, and it is impossible to assert that the fruit stay slimmer as only immature fruits are present in the specimen. The very limited differences between the features of the rachilla bracts and floral bracts are explained by the inflorescence material of *S. beguinii* being more mature and therefore a little more woody than the material of *S. pachypus*, causing the two specimens to distort differently on drying. There is no white tomentum (short matted hairs) in the specimen of *S. beguinii* because the leaf collected is rather older than that collected for *S. pachypus*. The tomentum that is so characteristic of the leaves of several genera in the Arecinae is very easily dislodged and is usually lost with age.

We cannot comment on the thickening of the base of the stem; further evidence is needed to clarify the consistency of this observation. Despite this one uncertainty, we do not recognize the distinction between *S. beguinii* and *S. pachypus*, and hereby render the latter into synonymy. Thus there are two species currently known and accepted in the genus *Siphokentia*, *S. beguinii* in Maluku and *S. dransfieldii* in Biak, both elegant subjects for horticulture.

**Taxonomic treatment**

**Siphokentia** Burret

Notizbl. Bot. Gart. Berlin-Dahlem 10: 198 (1927). Type: *Siphokentia beguinii* Burret.

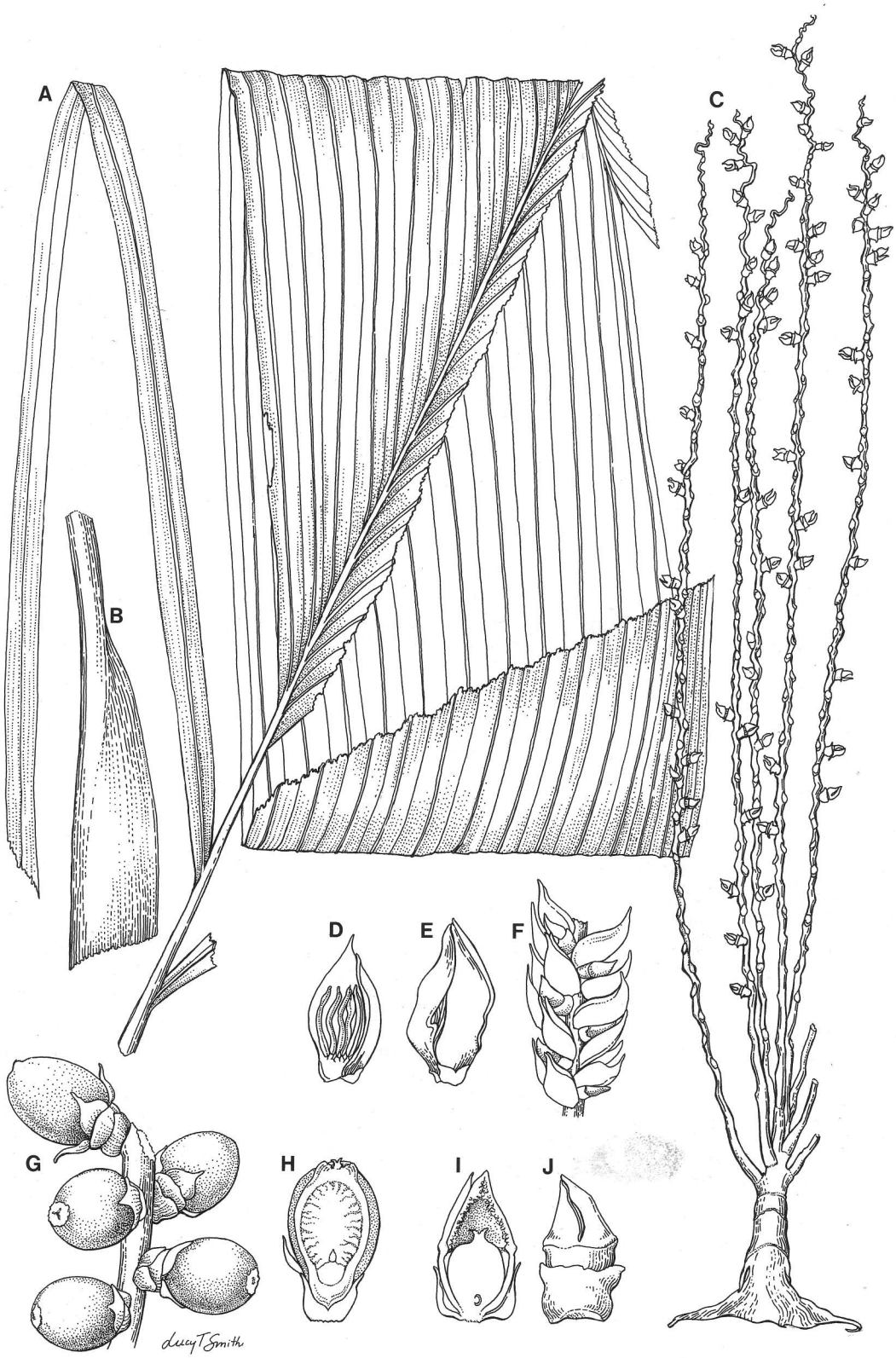
**1. Siphokentia beguinii** Burret, Notizbl. Bot. Gart. Berlin-Dahlem 10: 198 (1927).

Type: INDONESIA, Maluku, Halmahera, *Beguin 1995* (holotype B, destroyed; isotype BO!).

*Siphokentia pachypus* Burret, Notizbl. Bot. Gart. Berlin-Dahlem 10: 199 (1927). **synon. nov.** Type: INDONESIA, Maluku, Halmahera, *Beguin 2349* (holotype B, destroyed; isotype BO!).

DISTRIBUTION: INDONESIA, Maluku. Obi island, through Halmahera to Morotai, and nearby islands.

SPECIMENS EXAMINED: INDONESIA, Maluku. Halmahera: Soa Tobaroe, Jun. 1922, *Beguin 1995* (B, destroyed, BO!); Weda, Feb. 1923, *Beguin 2349* (B, destroyed, BO!); Pasir Putih, Jun. 1979, *Taylor*




2. *Siphokentia dransfieldii.* **A** Apical portion of leaf x 1/3; **B** Leaf sheath x 1/3; **C** Inflorescence x 4/9; **D, E** Staminate flower x 2; **F** Portion of rachilla prior to staminate anthesis x 1; **G** Portion of rachilla in fruit x 3/4; **H** Fruit x 1 1/3; **I, J** Pistillate flower x 2 (corolla slightly distorted due to drying). **A–C, I–J** from *Maturbongs 555,* **D–G, H** from *Hambali s.n.* Drawn by Lucy T. Smith.

3 (left). *Siphokentia dransfieldii* growing at the roadside at Marau, Biak. 4 (right). Ripe fruit of *Siphokentia beguinii* compared with almost ripe fruit of *S. dransfieldii* from cultivated specimens in the garden of GGH. The fruit of *S. dransfieldii* will turn red when fully ripe. Note the considerable difference in size and shape of fruit, and the remnants of petals which are tattered and persistent in *S. beguinii* but hardened and easily detached in *S. dransfieldii*.

*2857B* (BO!). Morotai: Kali Sangowo, May 1949 (BO!). Obi: Jikodolong, Nov. 1974, *de Vogel 4313, 4316, 4319* and *4322* (BO!, K!, L). CULTIVATED. Fairchild Tropical Garden: DF 386B, Jan. 1965, *Read 604* (FTG!); Plot 149, DF 386B (from seed collected on Kahatola Island, Maluku), Sep. 1978, *Fantz 3223* (FTG!); Plot 149, 59-969C, Jul. 1998, *Zona 799* (FTG!); Conservatory, 90-430, Jun. 2000, *Zona 852* (FTG, K!)

**2. Siphokentia dransfieldii** Hambali, Maturbongs, Wanggai & W. J. Baker **sp. nov.**

a *S. beguinii* Burret staminibus pluribus, petalis floris pistillati crassioribus tuberculatis, stigmatibus brevioribus et fructu maiore differt. Typus: INDONESIA, Papua, Biak, *Maturbongs 555* (holotypus K!; isotypi BO, MAN, L!, BH!)

Solitary, pleonanthic, moderately robust tree palm; stems up to 12 m tall, 5–12 cm diam.; internodes 3.0–11.5 cm long, nodal scars not always conspicuous. Leaves 6–10 in crown, pinnate, 1.3–3.0 m long (including petiole), neatly abscising; sheaths tubular, 35–80 cm long, covered with thin, finely floccose, dark brown indumentum; crownshaft well defined, up to 120 cm long and up to 20 cm diam.; petiole 10–65 cm long and 1.5–3.0 cm diam., channeled adaxially, rounded abaxially, indumentose at junction with sheath, otherwise with copious minute, dark scales; rachis somewhat arching, with adaxial longitudinal ridge, rounded abaxially, indumentose as sheath, indumentum sometimes more dense and coarse than on sheath, sometimes absent with only scattered scales remaining, indumentum possibly lost with age; blade variously divided into 1–19 fold leaflets, typically including 3 pairs of multiple-fold leaflets, interspersed with very few pairs of single-fold leaflets; leaflet with praemorse apical margin, 65–130 cm long, 1.5–30 cm wide, individual folds 1.5–3.5 cm wide, terminal pair of leaflets always multiple-fold (ca. 10–14 folds) forming flabellum with cleft apex; lamina with numerous minute brown dots on both sides, transverse veinlets inconspicuous, adaxial surface paler when dried, main veins with very few minute hairs adaxially and brown ramenta abaxially. Inflorescence

**Table 1. Comparison of selected features of two species of *Siphokentia*.**

| *Siphokentia dransfieldii* | *Siphokentia beguinii* |
|---|---|
| Inflorescence with 4–11 rachillae | Inflorescence with 11–16 rachillae (occasionally fewer) |
| Rachilla bract inconspicuous and rounded | Rachilla bract ca. 1 mm broad and minutely apiculate |
| Staminate petals less than 2 times length of stamens | Staminate petals ca. 3 times length of stamens |
| Stamens 13–16 (very rarely as few as 9) | Stamens 9–10 (very rarely as many as 12) |
| Pistillate corolla with distinct equatorial ridge below base of corolla lobes (in dry herbarium material) | Pistillate corolla lacking an equatorial ridge (in dry herbarium material) |
| Pistillate corolla lobes very thick, with adaxial surface thrown into folds and tubercles, becoming hard and often caducous as fruit matures | Pistillate corolla lobes quite thick and with adaxial surface uneven, but not thrown into folds and tubercles, becoming tattered as fruit matures, but persistent |
| Stigmatic lobes less than 1 mm long, not recurving between corolla lobes | Stigmatic lobes ca. 2 mm long, sometimes recurving between corolla lobes |
| Fruit obovoid, ca. 18x10 mm, ripening from green, through yellow and orange to red | Fruit ellipsoid, ca. 12x6 mm, ripening from green directly to red |
| Woody discoid region at fruit apex ca. 5 mm diam, shallowly concave | Woody discoid region at fruit apex ca. 3 mm diam, convex, slightly pointed |

infrafoliar, 37–41 cm long at anthesis, apparently growing to ca. 52 cm long in fruit, protandrous, branching to 1 order; peduncle 2–5 cm long, glabrous; prophyll 43–46 cm long, 5–8 cm wide, borne about half way up the peduncle, tubular, lanceolate, 2-keeled, membranous, glabrous, entirely enclosing the inflorescence, then splitting longitudinally and falling before staminate anthesis; peduncular bracts 1–3, first peduncular bract borne 8–10 mm above the prophyll, similar to the prophyll in shape and size, but lacking keels, remaining peduncular bracts inconspicuous and incomplete; rachis 1–2 cm long; rachis bracts inconspicuous, incompletely sheathing; rachillae 4–11, 30–36 cm long at anthesis, apparently growing to ca. 49 cm long in fruit, 2.0–3.5 mm wide, borne at a very acute angle to the rachis, apparently rather stiff and straight, or pendulous when heavy with fruit, sometimes sinuous in distal-most portion, bearing triads in opposite and decussate pairs, except in distal-most and proximal-most portion of rachilla where arranged spirally, triads 4–6 mm apart; rachilla bracts very inconspicuous, low, rounded; floral bracteoles low, rounded, similar to rachilla bract. Staminate flowers 9–11 mm long, asymmetrical; sepals 3, greenish white, connate, triangular, 2 mm long; petals 3, white, briefly connate at the base, falcate, acuminate, much exceeding the calyx, 1 petal much larger than the others, 10–11 x 4–5 mm, smaller petals 9–10 x 2–3 mm; stamens 13–16 (very rarely as few as 9); filaments slender, ca. 0.5 mm long, sometimes briefly epipetalous near base of petal; anthers linear, 5–6.5 mm long, ca. 0.6 mm wide, basifixed, dehiscence latrorse, connective prolonged into an acute appendage, ca. 0.5 mm long; pollen unknown; pistillode absent. Pistillate flowers ca. 9 x 5 mm long at anthesis, perianth apparently continuing to grow as fruit develops, flower scar 2.5–4 x 2–3 mm; calyx greenish white, synsepalous, forming cylindrical tube, ca. 3 mm long, ca. 5 mm wide, margin with 3 very short lobes; corolla white ca. 8.5 mm long, ca. 5 mm wide, sympetalous for half its length, with 3 free lobes, the two parts separated by a dark equatorial ridge (visible only in herbarium material); corolla lobes ca. 4 mm long, very thick, valvate, tightly closed during staminate anthesis, adaxial surface thrown into minute folds and tubercles, drying after pistillate anthesis, becoming hard and brittle, and often caducous; staminodes 3–5(6?), minute, triangular; gynoecium white, 5.5 mm long, 3.5

mm wide, obovoid, unilocular, uniovulate, locule located near the base of the ovary, ovary wall rather fibrous; stigmas 3, lobes less than 1 mm long, fleshy, slightly recurved, stigmatic surface forming deep, narrow invagination into the ovary wall at the junction of the 3 lobes. Fruit obovoid, ca. 18 mm long, ca. 12 mm wide, with conspicuous woody discoid depression at apex, ca. 5 mm diam., stigmatic remains persistent in centre of depression, perianth persistent, corolla lobes becoming hardened with age and often caducous; epicarp smooth, thin, ripening through yellow to red when mature, with copious tannin bodies beneath; mesocarp fibrous, ca. 1 mm thick, but much thicker below stigmatic remains; endocarp very thin, adhering closely to seed; seed subglobose, ca. 8 x 7 mm, with small basal depression and shallow longitudinal groove; endosperm deeply ruminate; embryo basal. (Figs 2–4).

DISTRIBUTION: INDONESIA, Papua. Biak Island. Reported from Supiori and Numfoor Islands by Biak islanders.

SPECIMENS EXAMINED: INDONESIA. Papua. Biak island: Sumberker Protected Forest, Sept. 1998, *Maturbongs 551* (K!, MAN, BO, L!, FTG!); Sumberker Protected Forest, Sept. 1998, *Maturbongs 553* (K!, MAN, BO, NY!); Sumberker Protected Forest, Sept. 1998, *Maturbongs 555* (K!, MAN, BO, L!, BH!); Sumberker Protected Forest, Sept. 1998, *Maturbongs 556* (K!, MAN, BO, AAU!); Adibai, eastern Biak, Sept. 1998, *Maturbongs 557* (K!, MAN, BO); Sansundi village, North Biak Nature Reserve, Sept. 1998, *Maturbongs 561* (K!, MAN, BO, AAU!); Sansundi village, North Biak Nature Reserve, Sept. 1998, *Maturbongs 562* (K!, MAN, BO); Sansundi village, North Biak Nature Reserve, Sept. 1998, *Maturbongs 563* (K!, MAN, BO, FTG!); Sansundi village, North Biak Nature Reserve, Sept. 1998, *Maturbongs 564* (K!, MAN, BO, NY!); Wari Village, northern Biak; Sept. 1998, *Maturbongs 566* (K!, MAN, BO, BH!). CULTIVATED. Fairchild Tropical Garden: Plot 132, 91-182A, Oct. 1999, *Zona 821* and *823* (FTG!), *826* (FTG!, K!); Conservatory, 92-331, Oct. 1999, *Zona 822* (FTG!, K!). Bogor: Private garden of G.G. Hambali, *Hambali s.n.* (K!).

HABITAT: In forest on limestone between sea level and 310 m, often growing in very thin soils and occasionally in cracks in limestone.

LOCAL NAMES: *Ombrush* (Biak language).

USES: Seed as substitute for betel nut, leaves for wrapping meat or sago.

The species is named for John Dransfield in recognition of his monumental contribution to the taxonomy of palms in Southeast Asia.

**Acknowledgments**

The authors are especially grateful to Scott Zona for collecting herbarium specimens and taking photographs of *Siphokentia* in Fairchild Tropical Garden. Fieldwork in Biak was funded by TOBU and the Royal Botanic Gardens, Kew. The Keepers of the herbaria at FTG and BO kindly provided specimens on loan, and Himmah Rustiami supplied information from additional material held at BO. Lucy Smith prepared the diagnostic plate. The illustration was funded by the Australia Pacific Science Foundation. Justin Moat produced the map. Lastly, John Dransfield deserves thanks for facilitating this most rewarding collaboration.

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**Centerfolds – Palms of New Guinea**

page 182. *Sommieria leucophylla*, named for the white undersides of its leaves, growing at the type locality, Andai, near Manokwari, Papua, Indonesia. Photo: J. Dransfield.

page 183. *Gulubia costata* and *Pigafetta filaris* emerging above the forest canopy on Biak Island. Photo: W. J. Baker.

# A Personal History of *Drymophloeus* in New Guinea

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1. The terminal leaf segment of *Drymophloeus oliviformis* is fan-shaped.

**I would not say that I was obsessed with *Drymophloeus*, but for many years I felt its continuous presence in both my professional and personal involvement with palms.**

*Drymophloeus* has had a compelling hold on my imagination for two decades. Indeed, it was the first palm I grew in my own garden. The story of its introduction into Florida by David Fairchild, told so seductively in his "Garden Islands of the Great East," fueled my desire to visit the exotic islands where these palms grow. Uhl and Dransfield (1987) piqued my professional curiosity further when they wrote, "No overall [taxonomic] treatment of species exists and obviously considerable field work will be necessary to produce one." Last year, I realized a long-held ambition and published a taxonomic revision of *Drymophloeus* (Zona 1999).

My interest in *Drymophloeus* began when I was still in high school. At that time, I was given a palm seedling labeled *Drymophloeus beguinii* (now properly called *D. litigiosus*) purchased at an IPS chapter palm sale. It was said to be a stilt-rooted palm, à la *Iriartea*. At that time, my only source of information on *Drymophloeus* was McCurrach's "Palms of the World," which made no mention of the stilt roots. Even the *Drymophloeus* palms growing at Fairchild Tropical Garden did not have any stilt roots. Indeed, nearly two decades would pass before I finally saw the stilt roots of *Drymophloeus litigiosus* in its natural habitat in New Guinea. In cultivation in Florida, where the

climate is not as wet as in New Guinea, *Drymophloeus* seems not to form stilt roots.

The genus *Drymophloeus* has a curious and inexplicable distribution in New Guinea. Two species occur in the westernmost tip of the island, the Doberai or Vogelkop (Kepala Burung) Peninsula of the Indonesian province of Papua (formerly Irian Jaya). A third species occurs on the island of New Britain, off New Guinea's northeastern coast. That vast areas of apparently suitable habitat on mainland New Guinea are *Drymophloeus*-free is, to recycle Darwin's famous phrase, an abominable mystery. *Drymophloeus* is abundant in the Maluku Islands of Indonesia to the west of New Guinea and in the Solomon Islands to the east, but New Guinea itself is largely bereft of these beautiful understory palms.

The two western New Guinea species are *Drymophloeus oliviformis* (Giseke) Miq. and *D. litigiosus* (Becc.) H. E. Moore. Synonyms of *Drymophloeus oliviformis* include *D. ceramensis* Miq., *D. bifidus* Becc. and *D. leprosus* Zipp. ex Becc.; synonyms of *D. litigiosus* include *D. oninensis* (Becc.) H. E. Moore, *D. beguinii* (Burret) H. E. Moore and *D. porrectus* (Burret) H. E. Moore. Why do these two species have so many synonyms? Many species were described from single specimens collected by European botanists during brief forays into the field in New Guinea and the Maluku Islands. Being small understory palms, they were easy targets for the collectors. Like most understory plants, individuals of these species vary in terms of leaf size, width and texture, even when the floral and fruit characters are uniform. Each variant was given a different species name by early botanists working with just a few specimens, but when I examined many more collections from a wide variety of habitats and saw many of them growing in the forests in Papua, I found that variation in foliage characters was continuous. Leaves varied from narrow to wide, glabrous to pubescent, small to large, and with no obvious discontinuities that could serve as species boundaries. For this reason, I "lumped" many species into these two.

*Drymophloeus oliviformis* is usually a single-stemmed palm, but at least one population of suckering individuals is known from western New Guinea. The stem may be several meters tall, but usually it is only 1–3 m tall and 2–7 cm diam. The crown holds six or seven leaves, which may have an almost rubbery texture. The terminal segments are united to form a single fan-shaped segment, which may or may not be cleft apically (Fig. 1). The inflorescence is sparsely branched with short, thick rachillae, often covered with brown scaly hairs (Fig. 2). The fruits are bright red, and the seed, most importantly, has a homogeneous endosperm.

*Drymophloeus litigiosus* is similar in size and stature to *D. oliviformis*, and likewise, a population of suckering individuals is known. The leaves of *D. litigiosus* have a less rubbery texture. The terminal segments of the leaves are broad but are not united into a single fan-shaped segment (Fig. 3). The inflorescence bears more rachillae, which are longer and thinner than those of *D. oliviformis*. The endosperm of the seed is ruminate.

The eastern New Guinea species from New Britain is *Drymophloeus hentyi* (Essig) Zona. This species was originally described as a species of *Ptychosperma*, but I transferred it to *Drymophloeus* [a different taxonomic history was reported in error by Ferrero (1997)]. I have not yet seen this species in the wild, but like others who attended the IPS Biennial in Thailand, I was delighted to see this species in cultivation at Nong Nooch Tropical Garden (Fig. 4). Particularly fine specimens can also be seen in Hawaii at the Ho'omaluhia branch of the Honolulu Botanical Gardens. It has leaves similar to those of *D. litigiosus*, with segments that are cuneate (wedge-shaped) and undulate, but the leaves are arching and gently recurved, giving the crown a distinctive appearance. The fruits are red, and the endosperm is ruminate.

A palm from the island of Biak, said to be an undescribed species of *Drymophloeus*, is known to horticulturists and collectors, but material is not yet available to botanists. I have not seen this palm in wild, so the reports of its existence are an audacious tease. The mysterious palm from Biak is now at the top of my "must see" list.

The New Guinea species of *Drymophloeus* are suitable for cultivation. *Drymophloeus hentyi* is particularly adaptable, even tolerating full sun when mature. My own little *Drymophloeus* thrived for many years before finally succumbing to a particularly severe drought in an area of the garden without irrigation, but my passion for this interesting genus of New Guinea palms lives on.

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2 (top left). The inflorescences of *Drymophloeus oliviformis* are sparsely branched, although they usually have more branches than does the individual shown here. The disintegrating peduncular bract, visible on the inflorescence on the right, is characteristic of the species.

3 (top right). The leaf of *Drymophloeus litigiosus* in western New Guinea.

4 (left). *Drymophloeus hentyi* in cultivation at Nong Nooch Tropical Garden, Thailand.

# In Search of *Caryota zebrina* – A Palm Expedition to the Cyclops Mountains

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1. The Cyclops Mountains from the south.

**The Cyclops Mountains on the north coast of the Indonesian province of Papua (formerly Irian Jaya) form a major barrier between the large lake Danau Sentani and the Pacific Ocean.**

The Mountains (Fig. 1) lie in a west to south-easterly direction and are about 80 km long and about 15 km wide at the widest point. Administratively, the Mountains, situated as they

are to the west of Jayapura, the capital of Papua Province, fall within the administrative boundaries of Jayapura and are bounded on the east by Humboldt Bay and Joutefa Bay while in the west they are bounded by Depapre Bay and Tanah Merah Bay. The Mountains have been designated by the Indonesian Government as Cagar Alam Pegunungan Cyclops (or Cyclops Mountains Nature Reserve), with an area of 22,500 hectares and the highest point, Mt. Raveni, 1880 m above sea level, lying at 2°31' S and 145°30' E.

The Cyclops Mountains were named by Louis Antoine de Bougainville in 1768 for the two peaks that attracted his attention from far out to sea; he was sailing at about 10 nautical miles from the coast and noted "les deux Cyclopes." These two peaks had actually been seen long before by Abel Tasman in 1643. Later in 1827 J.S.C. Dunont d'Urville observed that the Cyclops comprise two different massifs – the western massif called Cyclops and the eastern massif called the Bougainville Mountains (van Royen 1965).

The Cyclops Mountains have always attracted the attention of scientists, particularly botanists. Several attempts have been made by botanists to climb and survey the Mountains – Dumas in 1889, Wichmann, Atasrip and Djibdja in 1903, Gjellerup in 1911, Gibbs in 1914, Mayr and Brass in 1928, Cheesman in 1938, the Dutch-American Archbold Expedition in 1838–1839, van Royen in 1954 and Sleumer and van Royen in 1961. These surveys showed the presence of many interesting plants including one endemic genus and 19 endemic species (see Johns 1996). Essig (1977) reported seven species of palm as being first described from the Cyclops Mountains. *Calamus humboldtianus* Becc., *Paralinospadix leptostachys* (Burret) Burret (now regarded as a species of *Calyptrocalyx*), *Gronophyllum mayrii* (Burret) H.E. Moore, *Heterospathe glabra* (Burret) H.E. Moore, *H. pilosa* (Burret) Burret, *Ptychosperma cuneatum* (Burret) Burret and *P. schefferi* Becc. were all described from material collected on the Cyclops or nearby around Danau Sentani or the environs of Jayapura.

However, the real palm prize of the Cyclops Mountains remained unknown until Greg Hambali of Bogor introduced a remarkable *Caryota* into cultivation as an ornamental palm (Fig. 2). He gave this apparently new species the informal name of *Caryota zebrina*, because of the zebra-striping on its petioles (see p. 170). As this palm became known among horticulturists, the Cyclops Mountains rapidly became a major destination for palm hunting – the palm has great promise as an ornamental, especially for palm enthusiasts. With this in mind, we decided to make an expedition to the Cyclops to collect scientific specimens of the palm so that a description could be drawn up and the palm formally named and published.

This plan might have remained unfulfilled if we had not had a meeting with John Dransfield of Royal Botanic Gardens Kew, who enthusiastically encouraged us to go ahead. Through him we also obtained funding to cover the expenses of our expedition from a grant made to Kew from the John D. and Catherine T. Macarthur Foundation for field work in Papua. We made two trips in the Cyclops; the first was conducted by Charlie Heatubun in August 1998 while the second trip was conducted by Rudi Maturbongs in September 1998. The present article concerns the first trip made by the author during a two-week period spent in the field.

### Location of the fieldwork

The area of our field research included the central and eastern part of the Cyclops Mountains and the area around Jayapura and Danau Sentani. In the central part of the mountains we worked in an area from Kemiri (at the edge of a local transmigration scheme) to the north to the summit of Mt. Raveni and from the Ifar road to Ormue District. The eastern part of the Cyclops Mountains stretches from Angkasa in the west and from Pasir Enam, and this last locality is near Yoka, on the shores of Danau Sentani.

### Indigenous Palms of Cyclops Mountains

Our expedition began on 9 August 1998 in the eastern part of Cyclops (Angkasa westwards and the area around Pasir Enam). I was accompanied by Elisa Wally (from Universitas Cenderawasih in Manokwari), John Mambor (a palm enthusiast, also acting as a local counterpart) and two porters. We began by climbing past local farms and gardens at an altitude of 350 m above sea level along a footpath into the nature reserve on soils derived from the local ultramafic bedrock. Such soils, rich in iron and manganese, usually carry a very distinctive vegetation. The forest here was disturbed, with many gaps filled with secondary vegetation. We soon made our first collection at 375 m elevation – *Calamus humboldtianus* growing beside a dried-up riverbed. This very distinctive species has strongly clustered leaflets and a long chocolate-brown ocrea; the inflorescence is most peculiar being highly condensed. Not much further on, in a gap at 385 m above sea level we came across a fine *Hydriastele*. This species, as yet unidentified, reaches about 6 m tall and has an inflorescence shaped like a horse's tail; the ripe fruit are black. Higher up we found *Areca macrocalyx* with its characteristic erect brushlike

inflorescence. At 410 m above sea level the dominant palm in the undergrowth was a species of *Licuala* (Fig. 3) with distinctive fan-shaped leaves with many narrow segments borne on spiny petioles. The last collection we made in this area at about 450 m above sea level was a dainty species of *Linospadix* with pencil thin stems. The shiny green stems reach 2 m tall and have conspicuous nodes while the leaves are entire bifid like a fish tail. The inflorescences are, of course, unbranched and are held between the leaves and later carry numerous small elongate green and red fruits like small bird chillies. This species is often collected by palm enthusiasts for growing as an indoor ornamental, known locally as "Palem pensil," or Pencil Palm.

We then moved on 10 August to Kemiri, right at the edge of a transmigration scheme that was developed by local social services, and worked into the reserve towards the summit of Gunung Raveni. We were joined by three porters, and started our climb at 10 a.m., reaching the summit at 5 p.m. This was an exhausting climb as we had to work our way up a 45 degree slope, frequently having to scramble up slippery rocks with great care. When we reached a summit at 1880 m above sea level we looked for a good place to set up camp. In due course, we found an overhanging rock platform about 3 m long and about 1 m above the ground, providing excellent shelter and which became our "Sheraton Cyclops Inn." The sun soon went down and we quickly began to feel the cold, driving us into our sleeping bags. Early next morning after breakfast we began to explore the surrounding forest by working for about 5 km eastwards along the contours passing several summits and then making collections on the way back to camp.

The first palm to be collected in this area was *Caryota zebrina*. We found three trees about 10 m apart. The trunks reached about 15 to 20 m tall and the crowns consisted of about three to five leaves, most of which appeared to be tattered and ageing with the distinctive zebra stripes on the petiole already faded. One of the trees was fertile with three inflorescences produced basipetally. The topmost inflorescence carried many yellowish brown ripe fruit while the middle inflorescence was in full male flower with green petals and yellow anthers. The lowermost inflorescence was in tight bud. Near the foot of one of the trees we noticed piles of cassowary dung containing *Caryota* seeds among seeds of other trees. As we were at an elevation far too high for *Caryota rumphiana* (the last ones we saw were at 400 m and these were seedlings) it seems highly likely that the seeds belonged to *Caryota zebrina* and that cassowaries may thus be important in dispersing the palm.

After finishing our collecting we headed off back up towards camp. On the way, one of the porters pointed out a palm. From a distance it just looked like a rattan seedling but close to, we began to appreciate what an unusual and beautiful palm it was. Only 50 cm tall, it carried a crown of pinnate leaves with numerous slender, regularly arranged leaflets, a bit reminiscent of a seedling of *Elaeis guineensis*. Then we found an inflorescence with a long peduncle and 16 rachillae bearing small smooth round green fruit and its identity became obvious. It was obviously a species of *Heterospathe* that we could not identify.

Further back we found a distinctive clustering montane rattan with stems up to 5 m tall and then, just before we reached camp we came across a very interesting species of *Calyptrocalyx*. This beautiful palm has a crown of about 15 leaves at the tip of a slender stem about 3 cm in diameter. The emerging leaves are a wonderful deep red. What particularly interested us, however, were the inflorescences – five to seven inflorescences can be found in the axils of the leaves, each with its own separate prophyll enclosing the bases of the long slender peduncles. The handsome palm seems to dominate the undergrowth at about 1090 m above sea level.

So ended the collecting and we arrived back at camp after having filled every moment of the day with palm hunting, but of course, there was more to do as we still had to process our collections, pressing them and putting them in spirit.

In the following days we continued working in the mountain forest spreading out in several directions, but without adding further palms to our list. We decided to start our way back down the mountain adding a few more palms on the way. The first of these was a *Calyptrocalyx* that we found at 850 m above sea level. This was obviously different from the species we had found higher up; it had stems to 3 m tall and leaves with 12 to 13 sigmoid leaflets on each side of the rachis, each ending in a pendulous drip tip. The inflorescences of this species, in contrast to the species higher up, were solitary in each leaf axil. Then about 50 m lower down we collected an *Orania* with a striking 3.5 m long inflorescence; this had a prophyll about 80 cm long and a peduncle to 180 cm, branching to one order with only 19 rachillae each about 90 cm long. Perhaps this is *O. parva*, but its identity will have to wait until Ary Keim from Bogor finishes his study of *Orania* for his doctorate at Reading University. We spent a lot of time making

2. A leaf of *Caryota zebrina* in cultivation at Manokwari.

3. *Licuala* sp., detail of fruits, Cyclops Mountains.

collections of this species and of a *Cyrtostachys* that seems to be closely associated with the *Orania*. This *Cyrtostachys* is a canopy emergent palm to 25 m tall. Where *Orania* was dominant there were few *Cyrtostachys* and vice versa.

We continued to make our way down observing several other palms such as *Rhopaloblaste* sp., *Caryota rumphiana*, *Licuala* sp., and *Arenga microcarpa*. This last is a slender palm with basipetal inflorescences with the most distal inflorescence carrying striking red fruit like a giant bunch of grapes.

As we came down the very steep slippery footpath, we could not stop ourselves admiring the fantastic view over Danau Sentani (Fig. 4). Fields of *alang-alang* grass (*Imperata cylindrica*) and groves of sago palm (*Metroxylon sagu*) formed a great green carpet contrasting with the waters of the lake sparkling

4. The view over Danau Sentani.

5. *Gronophyllum* sp., cultivated from seed collected in Cyclops Mountains.

in the sunlight. This formed a wonderful ending to this part of the expedition.

The next day we made only a short trip to an area of secondary forest along the shores of Danau Sentani, near to the village of Yoka. This area lies on limestone, clearly indicated by the many limestone outcrops with low vegetation. We found only three palms species there – the ubiquitous *Arenga microcarpa*, *Hydriastele* sp. and *Ptychosperma cuneatum*; the last two we collected. The *Ptychosperma* is a truly beautiful palm; it is a clustering species with stems to 5 m tall, with a shiny green trunk with conspicuous nodes, a whitish crownshaft and very broad praemorse leaflets. The inflorescences are pendulous with about 13 violet-colored rachillae.

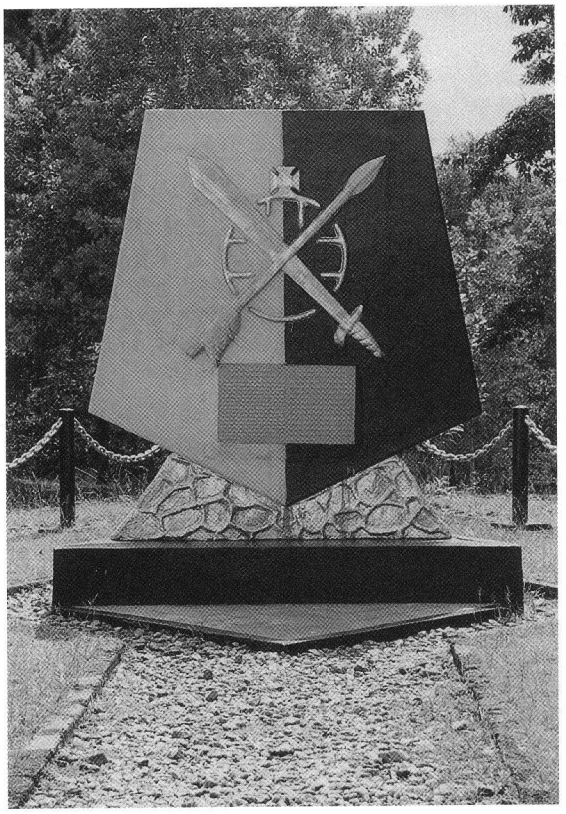
On the next day, 17 August, Indonesian Independence Day, we returned to the Cyclops Mountains, choosing the footpath through the mountains from Ifar to Ormue, on the north coast. We were very keen to start climbing into the mountains. Ifar Gunung in fact is an area where General MacArthur set up one of his headquarters during the Second World War. This area lies in a most strategic position from which one can see the whole of Danau Sentani, and the view of the lake with its many small islands must have given inspiration to the famous Five Star General for his campaign of leapfrogging the islands of the western Pacific. At this spot there is a memorial and other remains that are currently used as an exercise area for the Indonesian Army (Fig. 6).

Beforehand we had contacted several local people from Ifar Gunung to act as guides. Our group began to work into the forest, climbing up a small stream, observing interesting plants on either side. The first thing we noticed were several trees of *Areca catechu* planted by villagers in the remains of their gardens at about 500 m above sea level. The we noticed several trees of *Rhopaloblaste* sp., *Pinanga punicea*, the same *Orania* we had seen earlier, and *Areca macrocalyx*. We climbed up until Elisa Wally stopped us at the foot of a giant *Calyptrocalyx*, with a trunk 10 m tall. This palm had nine leaves in the crown, each 2.5 m long, but with short petioles not exceeding 25 cm long; the leaflets were regularly arranged and about 25 to 27 on each side if the rachis. The emerging leaf was reddish. The robust inflorescence was about 1.5 m long with two to three spikes emerging from the leaf axil within a single prophyll. The fruit were somewhat elongate, smooth, fleshy and reddish brown. After we had collected the *Calyptrocalyx* we returned back uphill, collecting a small rattan on the way at about 900 m elevation and then a *Gronophyllum* and another different *Calyptrocalyx* sp. at 1050 m above sea level. The *Gronophyllum* (Fig. 5) resembled *G. pinangoides* but was more slender, reaching 3 m tall, with a shiny crownshaft and only four leaves; the inflorescence was brushlike with only two rachillae, a beautiful bright red in color, followed by narrow red fruit like small chillies. The *Calyptrocalyx* had nine to ten pairs of sigmoid leaflets with long drip tips. We believe that this is the palm that is widely grown as "Dozyophoenix," now named *C. doxanthus* by John Dowe.

To reach the summit, we followed a gap about 500 m wide between two rock walls. Here there were many large trees with a dense canopy making it dark and very shady in the undergrowth, dominated by the stinging *Laportea* (Urticaceae) that grew as far as the eye could see. This obviously caused us problems but there was no choice but to go on, despite the danger of being stung. According to our plan, we were to reach Ormue on the north coast and then go on following the coast eastwards as far as Angkasa or Jayapura. However, at that time it was already beginning to get dark and our guides could not find the path to Ormue so that we had to spend the night in the forest. We thought we were about halfway between Ifar and Ormue. To make a camp, we had to find the nearest stream, and this meant going down about 200 m. We made camp in a hurry and when the night winds started to blow we realised we had chosen the wrong place to camp – we should have chosen a place facing towards the valley. That night, it was so cold that we had to build a bonfire in the middle of camp to keep warm. After we had had dinner, we discussed what possibilities we had for going on. In fact one of our team became ill, and with our limited logistics, and our guides not knowing the way forward, we were forced to abandon going to Ormue. Of course this was a big disappointment but there was no choice.

On the following morning we started down, noting the palms on the way, in particular the distribution of *Caryota zebrina*. After we had come down from the mountains and before going back to Manokwari, we had the opportunity to collect two more palms from plants cultivated by villagers in Angkasa – *Calamus hollrungii*, planted by the WWF office and *Calyptrocalyx* sp, from the garden of a palm enthusiast (Mr. Moiwen). The latter proved to be a palm we had not seen before. This species is a clustering, medium sized species up to 3m tall, with entire bifid leaves 1 – 1.1 m long with very short petioles with only very sparsely fibrous sheaths. The inflorescences are 80–85 cm long, solitary in each leaf axil, and with spherical fleshy fruits, green turning red. According to Mr. Moiwen, this *Calyptrocalyx* used to be common in the forest near to Angkasa; however, the species is now very rare and, in fact, we did not see it growing in the wild.

This ended the first phase of our Cyclops palm expedition. It had been extremely successful and, most importantly, we had collected excellent material of *Caryota zebrina* for the description and naming of this remarkable plant. However, we left the Cyclops worrying about the future of its palms, in particular *Caryota zebrina*. So many people have gone into the reserve collecting seeds and plants that the palm populations must surely have been adversely affected. Furthermore, villages are now encroaching into the reserve and the habitat of *Ptychosperma cuneatum* has been seriously affected



6. The MacArthur Memorial.

by the building of houses and *Ipomoea aquatica* ponds for vegetable production.

**Acknowledgments**

First we thank the John D. and Catherine T. MacArthur Foundation for funding this field work via a grant to the Royal Botanic Gardens Kew. We thank Elisa Wally and John Mambor for their help and company in the field. Jacobus Wanggai, head of the Biodiversity Centre in Manokwari, provided us with permission and time to make this trip. We also thank the authorities in Jayapura for giving us permission to enter the Cyclops Mountains. We thank John Dransfield, especially, for encouraging us to make the field trip, for arranging funding and for assistance in translation.

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# A New Species of Rheophytic Palm from New Guinea

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1. *Hydriastele rheophytica* growing in Cairns Botanical Garden, Queensland

**A new rheophytic palm, *Hydriastele rheophytica*, is described for New Guinea. Although other New Guinea palm species occur on the banks of fast flowing rivers, they also occur on adjacent slopes and in other locations. *Hydriastele rheophytica* is confined to stream edges as part of a rheophytic community. This elegant species has been in cultivation in north Queensland for several years, proving adaptable to, and thriving in, many conditions.**

Palms have been able to exploit many habitats, but possibly one of the most unusual is that associated with stream edges that receive frequent and persistent inundation with rapidly flowing water. A plant occurring in such a habitat is termed a rheophyte. Palm species that behave as rheophytes have been discussed by van Steenis (1981), Galeano-Garces & Skov (1989), Dransfield (1978, 1992), Hodel (1992), Beentje (1993), Barrow (1994), Dowe & Hodel (1994), Dransfield & Beentje (1995) and Baker (1997) who together list less than fifteen species that have adopted this habit.

Adaptation to the rheophytic habit is usually expressed in the morphology of the species, and modes of dispersal and establishment (van Steenis 1981). Stems are often thin and pliable and leaves are finely pinnate, offering little resistance to the forces of flowing water, and lack sclerotic tissues. Fruit and seeds may have structures that aid in dispersal and establishment.

New Guinea has a diversity of habitats in which palms occur. The mountainous topography of most of the island ensures the presence of many permanent fast flowing streams and rivers. Many species in such diverse angiosperm families as Araceae, Araliaceae, Costaceae, Moraceae, Myrtaceae, Pandanaceae and Zingiberaceae, and numerous Pteridophytes are adapted to this niche. Although palms are present in most habitats in New Guinea, few are adapted to an existence on the margins of fast flowing streams. The presence of a rheophytic palm in New Guinea was first noted by Brass (1941) when he collected "the clump palm *Actinophloeus* 13700" at Araucaria Creek on the Idenburg River in Papua (formerly Irian Jaya), as part of "a community of flood-resistant small trees". Subsequently, this palm was illustrated by a photo taken by Brass in "Rheophytes of the World" (van Steenis 1981), where it was named as *Hydriastele* sp. nov., following identification of Brass' specimens conserved in the Herbarium of the Arnold Arboretum by Harold E. Moore.

This species was brought into cultivation during the 1980s in north Queensland by nurseryperson Maria Boggs, who distributed it to botanic gardens and specialist collectors. The exact details of place of origin are not known, but it is known that Boggs had visited parts of Papua New Guinea around this time. The authors were able to locate a number of mature cultivated specimens that enabled a complete description to be made.

**Hydriastele rheophytica** Dowe & Ferrero, **sp. nov.** Figs 1–3.

Palma caespitosa ad 6 m caulibus flexuosisque, foliolis angustissimis ad 20 mm latis, infra ramentis numerosis, floribus staminatis roseis ad 6 mm longis, staminibus 6, antheris basifixis ad 4 mm longis, floribus pistillatis cremeis globosis ad 2.2 mm altis, stigmate trifido recurvato, fructu rubro, globoso vel late ellipsoideo ad 7 mm longo, endospermio non profunde ruminato bene distincta. Typus: INDONESIA. PAPUA: Snow Mts, Idenburg River, 4 km SW of Bernhard Camp, Araucaria Creek, 850 m alt., March 1939, *Brass 13700* (Holotypus A).

Clustering palm to 6 m tall. Stems up to 30, to 6 m long, laxly pliable, erect to mostly leaning, occasionally decumbent, 2.0–2.5 cm diam., initially cream colored with red patches immediately after leaf fall, becoming green; internodes to 14 cm long, nodes 4–5 mm wide. Leaves 4–12 in the crown, regularly pinnate, 95–120 cm long. Leafsheath tubular, 40–45 cm long, dark green with dense crustose scales becoming deciduous with age; petiole 20–30 x 1.5–2 cm wide, shallowly channeled adaxially, rounded abaxially, dark green with dense crustose scales becoming deciduous with age; lamina regularly pinnate, 75–90 cm long; pinnae 18–32 per side, widely spaced at 2–3 cm intervals in the proximal portion, becoming closer spaced at ca. 1 cm toward the apex; pinnae linear-acute, dark green adaxially, slightly lighter green abaxially, the most basal to 40 cm long, 1.2–2 cm wide, the most distal to 10 cm long, 0.7–2 cm wide; midrib adaxially prominent, with 1 rib per pinna except the apical pair that have 2–3 ribs; ramenta scattered along the abaxial midrib for most of the length of the pinnae. Inflorescence infrafoliar, 16–30 cm long, with 5–8 rachillae, at first erect but pendulous in fruit; prophyll boat-shaped, 2-keeled, laterally compressed, to 20 cm long, fully enclosing the inflorescence in bud; peduncular bract thin, papery, to 18 cm long, fully enclosed within the prophyll; peduncle 6–7 cm long, basally winged, constricted at the points of attachment of the prophyll and peduncular bract, green, glabrous, becoming terete distally; rachis 2–3 cm long, terete, green, glabrous; rachillae to 20 cm long, unbranched, cream-green, glabrous, bearing closely spaced spirally arranged triads throughout the length of the rachilla. Staminate flowers to 6 mm long; calyx tubular, trilobed, to 1 mm high, cream; petals triangular, apically pointed, unequal in length, shortest to ca. 5.2 mm, longest to ca. 6.6 mm, pinkish cream; stamens 6, to 4.5 mm long, anthers sagittate, basifixed, to 4 mm long, slightly twisted; pistillode lacking. Pistillate flower to 2.2 mm high; calyx trilobed, cream; petals slightly larger to1.5 mm long, cream, triangular,


2. *Hydriastele rheophytica*. **A** Habit; **B** Part of stem with leafbase removed to expose circular patterns on the internodes; **C** Infructescence; **D** Staminate flower. **E** Staminate flower with two petals removed to expose stamens; **F** Stamens; **G** Pistillate flower; **H** Fruit in longitudinal section showing ruminations and embryo; I fruit. All drawn from *J.L. Dowe 536* (BRI, JCT). Scale bars: **A** = 40 cm. **B** = 2.5 cm. **C** = 3 cm. **D–F** = 3 mm. **G** = 1.2 mm. **H–I** = 3.5 mm. Drawing by Lucy T. Smith.

imbricate basally, rounded apically; stigma trifid. Fruit globose to broadly ellipsoid, to 7 mm long, red; epicarp smooth, with slight longitudinal ridges, stigmatic remains apical; mesocarp thin, fibrous; endocarp thin, crustaceous. Seed globose; endosperm shallowly ruminate; embryo basal.

SPECIMENS EXAMINED. INDONESIA. Papua: Snow Mts, Idenburg River, 4 km SW of Bernhard Camp, Araucaria Creek, 850 m alt., March 1939, *Brass 13680* (A)PAPUA NEW GUINEA. West Sepik Prov.: Omasai Creek, tributary of Frieda River, 2.5 km from Wabia village, 04° 44.245′ S, 141° 56.786′ E, 25 Feb. 1998, *M. D. Ferrero 980038* and *980039* (BRI, LAE). CULTIVATED: Australia: Queensland, Babinda, garden of M. Daish, 7 Jan. 1999, *J. L. Dowe 535* (with M. D. Ferrero) (BRI, JCT); Gordonvale, garden of L. Squire, 7 Jan. 1999, *J. L. Dowe 536* (with M. D. Ferrero) (BRI, JCT).

DISTRIBUTION AND ECOLOGY. Known from the Idenburg River and its upper tributaries in Papua, Indonesia and West Sepik Province, Papua New Guinea, growing on rocky river banks where frequently inundated by fast flowing water.

*Hydriastele rheophytica* represents an unusual dimension to the palm flora of New Guinea. Although other palm species may be found on the banks of fast flowing rivers, they are often also found on adjacent slopes and other non-specific locations. *Hydriastele rheophytica* is known to occur only on stream banks as part of a 'rheophyte community'. Morphologically, it displays some interesting characters: thin pliable stems and petioles, and leaves with numerous thin soft pinnae, all of which can be interpreted as rheophytic characters. These characters are maintained in cultivated plants, and in north Queensland they can grow into elegant though somewhat untidy plants with prostrate stems.

The type, *Brass 13700* (A), collected during the Archbold Expedition of 1938-39, includes a full leaf, flowers and fruits.

**Acknowledgments**

We thank the staff at Harvard University Herbaria for their valuable assistance in locating the Brass specimens, and Mark Daish of Babinda, and Lyle Squire of Gordonvale for their hospitality. John Dransfield and Bill Baker provided valuable comments on the manuscript. Lucy T. Smith produced the line drawing.

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3 Leaf of *Hydriastele rheophytica* on a plant cultivated in the garden of Lyle Squire, Gordonvale, Queensland.

# A New Species of *Licuala* from New Guinea

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1. *Licuala crassiflora.* Habit; note the whitish stem, the fibrous leaf sheaths and the almost spineless petioles characteristic of the species.

**A new *Licuala* with an apparently restricted distribution is described from the Sandaun Province of Papua New Guinea, near the border with Papua Barat (Irian Jaya), Indonesia.**

The genus *Licuala* is widely distributed in the Old World tropics from India in the west to Vanuatu in the east. It is probably the second largest palm genus after *Calamus*. The last comprehensive revision of the genus was done in 1931 by Beccari who recognised 71 species. Based on a recent revision of the genus for the Malay Peninsula (Saw 1997) and field observations in Papua New Guinea in 1996 and 1999, I believe that *Licuala* comprises over 150 species. Thirty-eight species have been described from New Guinea (incl. the Bismarck Archipelago and Bougainville Island); however,

preliminary studies indicate that many of these will be reduced to synonymy.

**Licuala crassiflora** Barfod **sp. nov.**

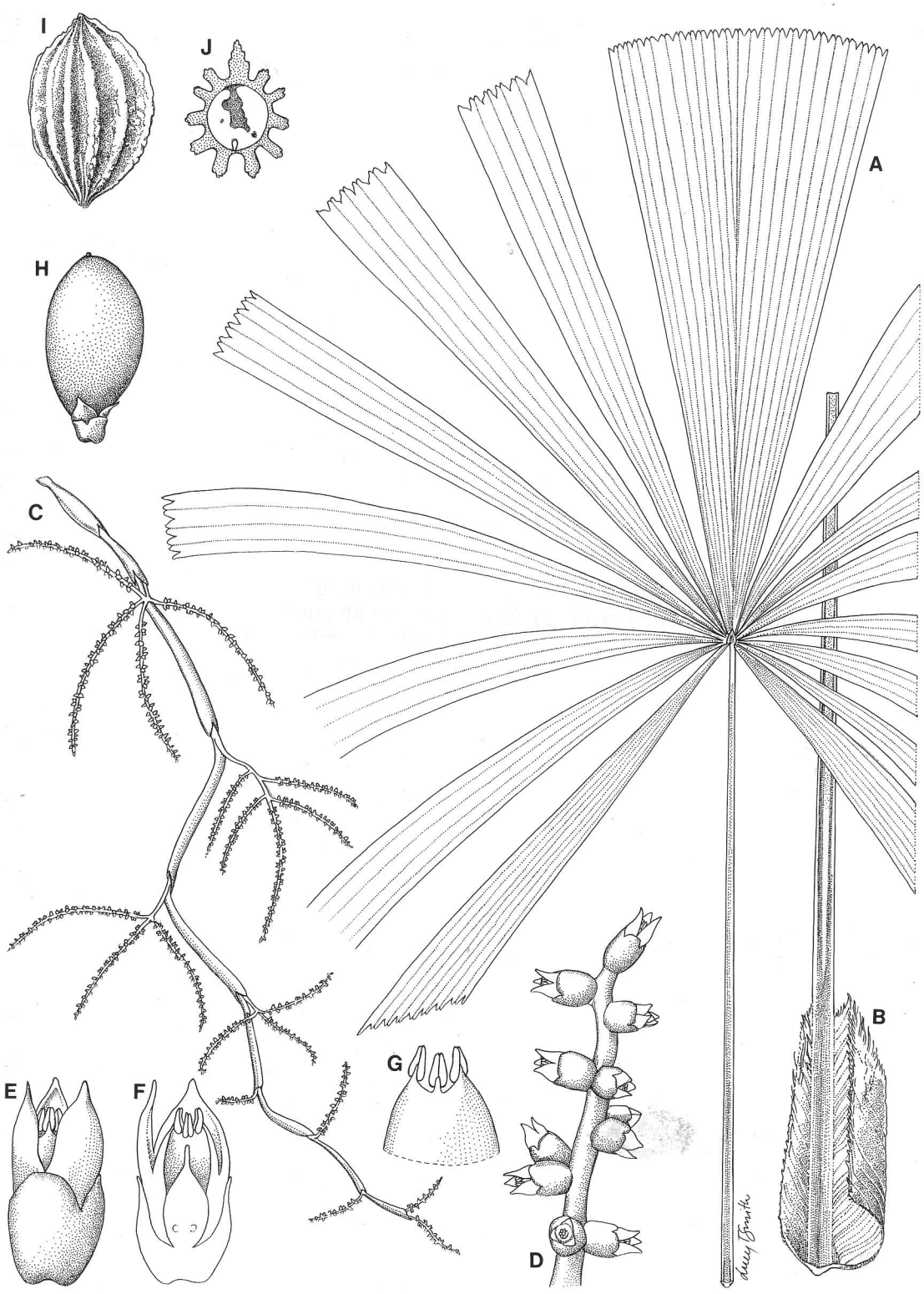
Arbuscula solitaria, habitu *L. lauterbachii* similis, a qua caule indumento coacto, spinis brevibus paucis basi petioli differt; inflorescentiae valde flexuosae, pilis ad instar caudae leonina tectae; flores quasi 12–14 mm longi, rotundati, glabri, carnosi, calyce viridi et corolla alba; fructus lutei maturitate, 3–4 x 2.0–2.5 cm, endocarpio longistrorsum sulcato. Typus: Papua New Guinea, Sandaun Province, *Barfod 402* (Holotypus AAU; isotypi LAE, K).

Solitary palm up to 7 m tall. Stem ca. 7 cm diam., whitish, covered with feltlike tomentum. Leaves 11 in crown; leaf sheath 50–60 cm long, tubular, disintegrating apically in older leaves, the distal one-half to three-quarters of the remnant sheath irregularly breaking up in a brown fibrous mesh; transition from leaf sheath to petiole gradual, petiolar part variable in length up to 225 cm long, with few minute spines at the base, adaxial face flattened, basally rough and brown with fibrous sheath remnants, distally green in the middle and flanked by two brown stripes, these gradually narrowing, not recognizable 40–50 cm above the petiole base, abaxial face rounded, covered with minute ferruginous, adpressed scales decreasing in density to patchy towards the middle portion; blade glabrous above, with ferruginous scales along major veins below, divided along abaxial ribs into about 15 segments, mid-segment with about 20 adaxial ribs, 90–95 cm long, truncate at the apex and 28–30 cm wide, the remaining segments with 4–5 adaxial ribs, basal segment 70–75 cm long, obliquely truncate at apex, splits of individual segments leading to abaxial ribs 3–10 mm long, splits leading to adaxial ribs 1–4 cm long, basal segments with generally deeper splits than the mid-segment. Inflorescences 3–5 in a single palm, interfoliar, bending forth and back immediately above insertion of the partial inflorescences in a zig-zag pattern, 170–190 cm long; prophyll 18–20 cm long, distinctly bicarinate, brownish chartaceous, splitting apically along abaxial and adaxial faces; peduncle 45 cm long, covered with patches of long ferruginous hairs splitting apically and shrivelling; peduncular bracts lacking; proximal rachis bract 15 cm long, inserted about 22–30 cm above prophyll, greenish, chartaceous to coriaceous, splitting more or less cleanly apically, covered with ferruginous tomentum, distributed in patches. Partial inflorescences about 7–9, gradually decreasing in size towards the distal end, covered with ferruginous tomentum decreasing in density towards the flower bearing parts; rachis of proximal partial inflorescence 5–6 cm long, with 4–5 rachillae, these 25–26 cm long and covered with minute stellate hairs; rachillae uniform in three basal partial inflorescences, the length gradually decreasing in the following ones. Flowers 80–90 on longest rachillae, inserted in pairs or solitary, borne on raised points or tubercles (these drying shiny, dark brown), ovoid, 12–14 x 6–8 mm, pointed apically in bud, fleshy; calyx 6–7 mm long, shiny green, glabrous, fused to receptacle in basal 2 mm, lobes rounded about 2 mm long, calyx and receptacle fused to immediately below the insertion of the corolla; corolla three parted, 7.5–8.5 mm long, glabrous, fleshy, whitish-green with reddish tinge at the base of the exposed parts, fused basally for 3–4 mm, moderately reflexed at anthesis; androecium 5–5.5 mm long, tubular, three-lobed apically, whitish, fused with the corolla in basal 2 mm, filaments 6, subulate, about 0.5 mm long, inserted at two levels, in between and on the tip of the lobes of the androecial tube, anthers elongate, about 1.5 mm long; gynoecium borne on about 1 mm long extension of the receptacle above the level of insertion of the corolla, 4.0–4.5 mm long, turbinate, glabrous; ovary 2.5–3.0 x 1.2–1.5 mm, reddish inside when cut open; style about 1.5 mm long; ovule hemianatropous. Flowering sequence erratic. Fruit yellow 3.5–4.5 x 2.0–2.5 cm, apically obtuse to rounded; endocarp about 3–4 cm long, lens-shaped in cross section with 10–11 longitudinal ribs, the one running along the raphe much larger to 7 mm wide, the remaining ones more or less regularly arranged, 2–4 mm wide. Seed attached basally; endosperm homogeneous, penetrated on the chalazal side by a large lobed intrusion of seed coat, this visible in young fruits as pink coloration, later brown, lined by a black layer, raphe conspicuous. (Fig.1, 2).

DISTRIBUTION: Known only from two collections from the Bewani region in the Sandaun province of Papua New Guinea.

SPECIMENS EXAMINED: PAPUA NEW GUINEA. Sandaun Province, Bewani subdistrict, near Ituly village, 3°02′ S, 141°08′ E, 200–250 m, 26 Nov. 1996, *Barfod 402* (holotype AAU; isotypes LAE, K); near Ituly village, 03° 01.471′ S, 141° 08.334′ E, lowland, 28 Feb 2000, *Barfod, Banka & Kjaer 492* (AAU, BRI, LAE, K).

LOCAL NAMES AND USES: *Brunei bral, Brubenei bral* (Bewani dialect). The stems are used for posts in houses. Occasionally, bows or digging sticks are produced from the peripheral part of the stem. The leaves are sometimes used for thatching of temporary shelters in the forest (Ferrero 1997).




2. *Licuala crassiflora*. **A** Leaf x 1/10; **B** Leaf sheath x 1/10; **C** Inflorescence x 1/18; **D** Apex of flowering branch x 1; **E** Flower at anthesis x 2; **F** Longitudinal section of flower at anthesis x 2; **G** Distal part of androecium x 3; **H** Immature fruit x 3/4; **I** Ripe endocarp, fleshy parts removed x 3/4; **J** Cross section of ripe endocarp (x 3/4). (**A**– **H** based on *Barfod 402;* **I**–**J** based on carpological collection by M. Ferrero).

NOTES: *Licuala crassiflora* is a distinct palm resembling *L. lauterbachii* Damm. & K. Schum. in its overall vegetative appearance but different from any known species of *Licuala* in its flowering and fruiting parts.

## DISCUSSION

*Licuala crassiflora* belongs to a group of New Guinean species that are characterized by having rather large fruits and furrowed endocarp. The latter is an interesting feature that was noticed recently by Ferrero (1997). In most species of *Licuala*, the smooth endocarp forms very late in the development of the fruit.

*Licuala crassiflora* shares large fruits and ornamented endocarp with *L. beccariana* Furt., a widespread species in northern Papua New Guinea. This understorey palm is solitary with a robust stem, often 40–50 cm long and pro-cumbent. The inflorescences elongate rapidly during early developmental stages. At the time of emergence, the inflorescence is often adpressed to the spear leaf in the center of the crown. The partial inflorescences are spicate or branched into 2 or 3 rachillae. Throughout development of the infructescence, the peduncle continues elongating. The large brown fruits acquire a reddish tinge when ripe. Their weight forces the entire infructescence downwards eventually bringing the fruits into contact with the ground. This feature combined with the reinforced endocarp and the short stem, suggests that the fruits of *L. beccariana* are dispersed by ground-dwelling animals. Jungle fowl and cassowary are common in the area where *L. beccariana* occurs. It needs to be verified, however, whether the seed can germinate after passage through the crops of these birds.

The dispersal mechanism probably differs in *Licuala crassiflora* given that it is a much larger palm and has pronounced differences in inflorescence structure. Similar adaptations such as large fruits and ornamented endocarps, however, suggest that dispersal by large birds is involved.

### Acknowledgments

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## News of the Society

A short time ago, the IPS received a generous gift from the estate of Mr. Gordon Clayton of Santa Ana, California. More recently, the IPS received a substantial bequest from the estate of Mr. John E. Swisher of Key Largo, Florida. These gifts allow the IPS to publish this larger issue of PALMS with more color photographs (a trend that will continue in the coming months). They also allow the IPS to provide more educational and research endowments. The IPS is grateful for these bequests and hopes other members will remember the IPS in their estate planning.

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# The Palms of Mount Jaya

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**Mount Jaya in the Indonesian Province of Papua (formerly Irian Jaya) is the highest peak on the island of New Guinea, and indeed, the highest in Malesia. At 5030 m tall, the mountain carries the remains of a glacier that sculpted the spectacular high altitude scenery during the Pleistocene epoch. Although the glacier is now retreating rapidly, fresh snow often falls on this and neighbouring peaks.**

It is hard to imagine an environment more different from tropical rain forest than the wild tundra-clad New Guinea Snowy Mountains. Yet, less than 60 km away lie some of the most diverse lowland tropical forests in New Guinea, carrying an abundance of wonderful palms. Early explorers in this part of New Guinea must have experienced extraordinary hardships and difficulties in reaching the mountains, a great contrast to the present day. Over the past 30 years a massive tract of land stretching from Mt. Jaya to the south coast has been opened up and access to major vegetation types at different altitudes is remarkably easy. All this is due to the existence of extensive gold and copper deposits in the peaks around Mt. Jaya. P.T. Freeport Indonesia (PTFI), a subsidiary of the American company Freeport McMoRan, operates the largest gold and copper mine in the World high up in the subalpine regions. The PTFI concession consists of a segment of the southern part of Papua, stretching from the mangroves on the coast of the Arafura Sea, through the coastal alluvial plains, the great sand and gravel terraces towards the foot of the mountain wall, and the slopes up to the peaks surrounding the mine at over 4000 m. The summit of Mt. Jaya itself towers over the mine, but lies outside the concession, falling just inside the boundaries of the vast and uncharted Lorentz Reserve. The mining company has developed access to the mine by the construction of a spectacular road that wends its way inland through the lowlands for 75 km until it hits the mountain wall, and then rises dramatically, following razor-sharp ridges, peaking at 2688 m before dropping down to the famous mining settlement of Tembagapura (Indonesian for "Copper Town") at 1871 m. From here the road rises again sharply until it becomes too steep for general transport. A road does continue upwards

1. *Sommieria elegans*, near Timika. Photo: A. McRobb

but most traffic to the mine transfers to a cable car that carries workers and equipment high up to the mine. At this altitude the air is thin and the snow-clad peaks glisten in the sun. One has to be reminded that scarcely 120 km away are nipah swamps!

In February 1998, we joined an expedition to New Guinea led by Professor Bob Johns, fern expert at the Royal Botanic Gardens, Kew, as part of a program of fieldwork to catalogue the plant diversity of the Mt. Jaya region. Collaborating with Kew staff were several Indonesian counterparts from Universitas Cenderawasih, Manokwari (Charlie Heatubun), Bogor Botanic Garden (Joko Witono) and Bogor Herbarium (Asep Sadili). Naturally, the authors of this paper, being palm botanists, were much more interested in the vegetation at lower elevations, so, while several of our colleagues collected in the upper montane, subalpine and alpine zones, we set up base with our Kew colleague Mark Coode at so-called Mile 38, a sprawling mining camp strategically placed for access into the lowland rain forest. Here, living in air-conditioned comfort and eating splendidly in the mess, we found it hard at times to believe we were in the midst of New Guinea forest. This was definitely the most luxurious field camp any of us had ever experienced! However, we had only to put one foot outside our cabins to see imposing mountains to the north and the seemingly endless rain forest stretching from the camp margin for hundreds of kilometers east and west. We soon developed a daily routine of driving from the camp to the chosen area of forest, collecting palm specimens in the morning and early afternoon and then spending the late afternoon and evening back at base, processing specimens, pressing and

drying them, preparing material for preservation in spirit and collecting leaf samples for DNA analysis. Despite the many creature comforts we enjoyed at camp, fieldwork was often tough, particularly when we ventured into the stifling coastal swamplands.

**Palms of the lowland alluvial forest**

The lowlands through much of the PTFI concession at elevations of about 50 to 200 m elevation are covered in diverse forest with huge emergent trees; the relief is largely flat and much of the area is swampy. Palms are conspicuous throughout and many widespread New Guinea species can be seen here. *Caryota rumphiana* is abundant, occasionally handsome, but more usually in various untidy stages of flowering itself to death. Another very common palm in this lowland forest is *Pinanga punicea*; it displays hands of small reddish fruit, conspicuous against the dark green of the crownshaft. It is a rather coarse palm that often confused us momentarily, but we soon became somewhat dismissive of it. Equally abundant, yet far more attractive is *Gulubia costata* whose elegant spherical crowns of long leaves with dangling leaflets emerge gracefully from the forest canopy. Another New Guinea favorite, *Actinorhytis calapparia*, with its distinctive slender crownshaft and elegant curved leaves, occurs scattered here and there. Perhaps the most abundant and conspicuous of all palms in this forest type is *Korthalsia zippellii*, a handsome rattan with striking diamond-shaped leaflets. Extraordinarily variable, this species so far evades a sensible taxonomic solution. Morphological features which work well for defining *Korthalsia* species in other parts of the range of the genus seem to mean nothing in New Guinea. For example, the structure of the ocrea, a pronounced extension beyond and above the mouth of the leaf sheath, is highly characteristic of certain Bornean species, but is wildly variable in the New Guinea *Korthalsia*. Although a second species, *K. brassii* has been described for New Guinea, the variation we observed in the PTFI concession left us even more perplexed as to how many species there are.

A plethora of rattan species can be found in these steamy forests. *Calamus hollrungii* is a robust species with each leaf ending in a conspicuous climbing whip known as a cirrus; the broad, dark green leaflets tend to be rather inconspicuous against the forest and despite its relative abundance, it is easily missed. We were familiar with this species from elsewhere in New Guinea. Growing with it and, from a distance very much like it, there was a second species of *Calamus* with similar leaves and general dimensions, but with sheaths densely covered with flattened and rather papery spines with strange shaggy tips. *Calamus warburgii* grows in spectacular stands in disturbed forest near rivers, scrambling over low undergrowth and sending up lush stems clad with long cirrate leaves bearing fine, pendulous leaflets. Its foliage conceals leaf sheaths densely covered with ginger-colored, needle spines. Two species, *Calamus macrochlamys* and *C. longipinna*, possess remarkable boat-shaped ocreas that clasp the stem providing accommodation for ant colonies. Even more fantastic is the ocrea of *C. steenisii* that extends to a length of a meter or so before disintegrating into straw-like fibers with age. Several other distinctive species of *Calamus* occur in this vegetation, some apparently undescribed; disentangling the taxonomy of this diverse genus in New Guinea is going to be one of the greatest challenges for the Palms of New Guinea project.

Two species of *Calyptrocalyx* grow in the area, one of which is a relatively common palm of lowland forest undergrowth. With its slightly scruffy, broad, irregularly-divided leaves and inflorescences comprising multiple spikes, this species superficially resembles a palm familiar to us from previous work in the area around Manokwari. This is the species originally called *Paralinospadix flabellatus* for which there is still no validly published name under *Calyptrocalyx*. After comparing them in the herbarium we have concluded, however, that they are, after all, not the same. Perhaps the Mt. Jaya species is *Paralinospadix geonomiformis* (similarly not yet transferred to *Calyptrocalyx*). Much more local was the beautiful *C.* sp. (*Paralinospadix micholitzii*) with undivided leaves of a rich, but slightly mottled dark green (Fig. 2). The inflorescences of this lovely palm are extremely slender and thread like. In the lowlands, this species grows only in well-drained forest on gravel deposits at the confluence of two large rivers, but it is also common at higher altitude in the heath forest, which provides similar good drainage.

The baffling complex of species that includes *Areca macrocalyx* is well represented in the lowland forests. Usually, individual populations are rather uniform, but each population seems different – sometimes their leaves lack petioles, at other times the petioles are pronounced; their leaflets can often be broad, but are sometimes very narrow. Near the Aikwa River, we chanced upon juveniles of a species of *Hydriastele*, as yet unidentified. We had first seen this curious species growing as a pot plant inside the canteen at Mile 38 and displaying large, narrow undivided leaves – unusual and quite handsome. The undivided leaves are, however, a feature of juvenile stems. As soon as the stems

reach about 1 m in height, the blade becomes regularly divided into narrow segments. We searched far and wide for fertile adult material of this palm, but to no avail. Towards the end of our visit, we were forced to purchase a plant grown in a nursery, but collected originally from the wild so that we could make good herbarium specimens from it. This ornamental palm, which produces tall and slender adult stems, may have been made rare in the area by excessive collection of mature plants by local growers; it is certainly a popular subject in the elegant landscaping around PTFI offices and amenity areas. Just occasionally in the alluvial forest we chanced upon sizeable individuals of *Sommieria elegans* (Fig. 1), a most attractive palm, with lustrous dark green undivided blades, brilliant chalky white on their undersurfaces and with elegant arching inflorescences carrying their strange pink corky-warted fruits.

New Guinea boasts some of the tallest tree palms in Malesia. We discovered one such giant growing alongside the man-made levee that flanks the eastern side of the Aikwa River, channeling its turbid waters loaded with tailings from the mine towards the coast. An enormous species of *Orania* thrives at this low altitude. Growing to over 25 m in height, it produces robust, spreading inflorescences with very large female flowers up to 2 cm in diameter. Ary Keim's monographic study of the genus has shown that this palm is new to science. We also saw scattered individuals of a tall slender tree palm with slender drooping leaflets. This is a species of *Rhopaloblaste*, as yet not identified, but very reminiscent of *R. ceramica*. A species of *Ptychococcus* also occurs here bearing large bright orange red fruit the size of small hen's eggs. In the undergrowth grows a small clustering *Licuala* reminiscent of *L. bacularia*, with sprays of bright orange fruit and rather broad leaf segments. Accurate naming of this plant will have to wait until Anders Barfod has finished his study of *Licuala* in New Guinea.

One of the most beautiful areas of lowland forest in the PTFI concession flanks the Kali Kopi (Indonesian for "Coffee River"), so-called because its waters, which drain though the peaty soils of the heath forest above, are stained dark brown with tannin. There are long views from the riverside through this pristine forest and many exciting plants are readily accessible from its gravel banks and on small islands. A couple of species of *Gronophyllum* can be found here. The first, *G. rhopalocarpum*, is a skinny undergrowth palm with leaves not more than 60 cm long, its few pairs of leaflets with jagged tips. The inflorescence is small and unbranched, and is very colorful when the pink male flowers are mature. The second species is more confusing as it appears so distinctive in the wild with its tall stems and characteristic leaflet arrangement, and yet examination in the herbarium suggests that it may be nothing more than the varied species *G. pinangoides*, a common palm of New Guinea lowland forest.

We found an unusual, undescribed rattan thriving along the banks of the Kali Kopi. Its spines are golden and its lower leaflets reflex across the stem, forming a safe haven for ants to build nests. Subsequent collections indicate that this species of *Calamus* is quite widespread in western New Guinea.

**Palms of the swamplands**

Between the lowland alluvial forest and the Arafura Sea lies a large area of freshwater swamp forest and a broad band of mangrove. Company roads pass through these swamp forests, allowing access that would otherwise be very difficult and unpleasant. Even with such good access, fieldwork in this area is trying as the ground is water-logged and swarms of biting horse flies hunt for blood persistently. We were obliged to endure the discomforts as some interesting palms relish these conditions. A handful of curious rattans grow here, such as *Calamus humboldtianus*. Its fleshy leaves, its giant purple ocrea and congested inflorescence make it quite unlike any other species of *Calamus*. An undescribed species related to *C. warburgii* is locally abundant, distinguished by the arrangement of its leaflets in spreading pairs and the rusty indument on the leaflet undersurfaces. Another species, horridly defended with stiff orange spines, is instantly recognizable by its unusually bulbous swelling on the sheath below the leaf petiole. We have known about this species for some time and it is apparently widespread, occurring both in east and west New Guinea. It would be surprising if such a striking palm had not been described already, but as yet we can find no good evidence for an existing name.

Of the tree palms in the swamplands, most interesting is a very robust *Cyrtostachys*, with clustering stems to 15 m tall. A species of *Rhopaloblaste* is also present, smaller than the one we had seen before, distinctive in the dense coating of pale grey indumentum on the leaf sheaths and the rather loose flopping leaflets. A curious lens of peat swamp about 200 m in diameter in the middle of swamp forest is marked out by a dense stand of *Gulubia costata*. Inside the forest on the peat, exposed tree roots trip up unwary botanists and large pitcher plants climb high into the canopy. *Gronophyllum pinangoides* is common here and another species of rattan, closely related to *Calamus hollrungii*, but with

paired leaflets, is present. As the ground becomes increasingly inundated with fresh water, the sago palm, *Metroxylon sagu* dominates the vegetation. Local families extract sago at the roadside, felling palms to chip out the pith and building cunning systems of gutters and tanks from petioles and sheaths to use in washing the starch from the sago pith.

### Palms of the heath forest

Heath forest, a most unusual vegetation type for New Guinea, is an important feature of the landscape to the south of Mount Jaya. A broad band of sand and gravel outwash, presumably glacial in origin, forms a dissected terrace ranging from 200 to 500 m altitude at the foot of the mountain wall. Here the rainfall is spectacularly high. The soils are very poor and leached, carrying a layer of peat at the surface. The forest developed on these soils is very similar to kerangas forest in Borneo or, indeed, to montane forest, with an abundance of conifers, *Gymnostoma* (a relative of *Casuarina*) and various trees with small leaves, such as myrtles, all contributing to a forest with a rather even canopy composed of small crowns. Screw-pines are highly conspicuous and diverse here, *Pandanus* itself displaying a multitude of colors and architectures. The climbing pandan genus, *Freycinetia*, is prominent also, crawling along the ground and clinging to tree trunks. Its inflorescences appear at the tips of branches and are surrounded by a whorl of strikingly colored bracts, sometimes yellow or coral pink, and occasionally pure white. These bracts are fragrant and fleshy and are said to attract fruit bats, which eat them, pollinating the flowers in the process.

2. *Calyptrocalyx* sp. (*Paralinospadix micholitzii*), near Timika. Photo J. Dransfield.

3. *Cyrtostachys* sp. emerging from heath forest on Mt. Jaya. Photo: J. Dransfield.

Some of the most unusual palms occur in the heath forest. A tall emergent arecoid palm, *Gulubia longispatha*, is abundant and sometimes gregarious. Its crowns of strongly curved leaves emerge through the forest canopy, displaying slender pale crownshafts and horse-tail like inflorescences (see front cover of PALMS 43(1)). Alongside this highly ornamental species grows an even larger palm, an unidentified species of *Cyrtostachys* (Fig. 3). The sight of these monumental palms against a backdrop of heath forest terraces and the rising mountain wall is one of the most memorable of the entire expedition (Front Cover). *Gronophyllum brassii*, a smaller, clustering palm reaching about 8 m in height and with very characteristic grouped leaflets, also occurs in the same habitat. Its basal and apical leaflets are closely grouped and displayed in a fan in the same plane, while the mid-leaf leaflets are also closely clustered and fanned, but held in several planes. The crownshaft is covered in powdery, granular hairs that are so common in *Gronophyllum*. The inflorescences resemble those of the *Gulubia* but are much smaller. So characteristic is the general appearance of *Gronophyllum brassii* that we were astounded by the discovery that another palm growing nearby, almost identical in general appearance has female flowers with rounded rather than pointed petals and hence has to be a species of *Hydriastele*.

The prize palm of the heath forest is a slender species of *Gronophyllum* growing to about 4 m tall,

with spectacular broad undivided leaves that are puckered and wavy. The leaves are a wonderful copper colour when newly emerged and then mature to a handsome steely green. It is apparently related to *G. pinangoides* and may in fact be a mere form of that species, but the leaf seems so distinctive that it is hard to accept that it does not deserve some formal taxonomic status. Even more confusing is another slender *Gronophyllum* with very slender leaflets of a curious blue grey colour and leathery texture. Again, this seems to be very closely related to *G. pinangoides*.

There are at least three species of *Licuala* in the heath forest, one perhaps the same small species with broad leaflets that we saw in the lowlands. A second species has short stems with large leaves divided into rather narrow segments. The third, *Licuala grandiflora*, seems to be confined to the lower, southern margin of the heath forest where it abuts the alluvial forest. Unfortunately we only saw this species with dead inflorescences, quite unique in structure in the genus. This species produces rather large fruit with mealy flesh surrounding a beautifully sculptured endocarp.

Although collecting in the heath forest was so much more pleasant than collecting in the swamps, there were still plenty of spiny rattans to keep us busy. The most characteristic of these is *Calamus eximius*, a robust species climbing to the forest canopy where it displays long curved leaves bearing regularly arranged leaflets that are curiously twisted into different planes. It took much tugging and pulling on a steep slope snagged with tree roots and slippery with peat to dislodge a flowering specimen from the canopy so that we could make specimens.

At the upper limit of the heath forest, at its transition with lower montane forest, a path runs for a few kilometers through pristine vegetation to a small, but vigorous river. The path leads into magical forest, dripping with moss and an abundance of epiphytic orchids and gesneriads. One expects this sort of vegetation at about 1500 m elevation, but here it occurs at only 550 m above sea level. The area is rich in exciting palms, some of which we saw in other areas such as *Calyptrocalyx* sp. (*Paralinospadix micholitzii*) with its handsome marbled leaves. The most striking palm along the path is a vast *Livistona* around 20 m tall with almost perfectly circular leaves that are held stiff and flat. This highly desirable palm will shortly be described as a new species by John Dowe. The unusual *Orania parva* is locally abundant along the path. Growing to only 4 m, it is the smallest of all species of *Orania* and unlike the others, its inflorescences branch to just one order. Nearby grows yet another form of *Areca macrocalyx*, this one with long petioles and few, broad, leathery leaflets.

### Palms of montane forest

One of the key attractions of the PTFI concession was that the company road would allow us access to the montane forests of the region. We imagined that we would find all sorts of exciting palms at high altitudes, species of *Heterospathe* or *Linospadix*, for example, or perhaps a *Calamus* growing at higher elevation than any other known rattan. As it happened, the real situation could not have been more different. Beyond the upper limit of the heath forest at 500 m, the mountain gradients become suddenly extreme and almost all evidence of palms disappears. *Gulubia longispatha* continues to occur sporadically for some distance and can be seen on distant ridges, towering above the forest canopy. Two species of rattan grow at quite high altitudes, the first, a very slender species, *Calamus arfakianus*, is abundant at 1500 m and a slightly more robust species, *C. klossii*, occurs frequently at altitudes well over 2000 m and is prized by local people for weaving and tying. Apart from these three species, however, we found no other palms in montane forests. Above about 2500 m elevation, even *Calamus klossii* is absent and the palm botanist is forced to look at other things, such as rhododendrons, orchids, tree ferns or montane bamboos.

Thoroughly disappointed by our findings, we have searched long and hard for an explanation and have come to the conclusion that the terrain is just too steep. The sharp mountain ridges are very unstable, making landslides commonplace and preventing the build up of humic soils. We believe that few palms are able to establish in such a dynamic environment and that this explains the impoverished montane palm flora of region.

Despite our frustrated search for elusive montane palms, our discoveries at lower altitudes more than rewarded our efforts. As can be expected in New Guinea, the expedition created more questions than it answered and it confirmed our belief that a concerted effort is needed to catalogue and understand completely the palm flora of the island.

### Acknowledgements

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# Horticulture Column

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**Q.** My *Dictyosperma album* has some dark brown or black spots that develop on the bases of the petioles of older leaves and on some of the leaflets as well. The plant seems fairly healthy otherwise. It is a potted specimen, and I would like it to look as perfect as possible. Does my palm have a disease? Ray Hernandez, Florida.

**A.** From your description it sounds as though your palm may have a fungus disease called *Pestalotiopsis palmarum*. Only in recent years have I become familiar with this disease, and now that I know its symptoms, I see it everywhere in Florida on potted palms and especially in nurseries. Fortunately it is usually not too serious and is the kind of disease that attacks plants that are already weakened or stressed by some environmental factor. Eliminating the factors that cause stress goes a long way toward controlling the disease. *Phoenix roebellinii* palms grown in containers in nurseries are often infected by *Pestalotiopsis palmarum* (Fig. 1). Usually the petiole is the area affected, and in some cases the plant is made unsalable by the unsightly damage. *Bismarckia nobilis* (Fig. 2) is another common host. One usually sees only a few spots on the older petioles.

*Pestalotiopsis palmarum* occurs most frequently on palms that are heavily irrigated, especially with overhead sprinklers and very often if they are irrigated during the night. Crowding the plants together or growing them in too shady of an environment only makes matters worse. Some growers have seen a correlation between the severity of the disease and the length of time that a palm has been in its container. The breakdown of the potting medium may be a stress factor that makes a plant more susceptible to this disease.

I cannot provide an actual diagnosis of the disease on your *Dictyosperma album*, but the following suggestions should be of some help in controlling foliar fungal diseases: 1. Determine the optimum light conditions for the palm species your are growing, and try to provide those conditions. 2. Give plants adequate space to allow for good air circulation. 3. Use drip irrigation if possible, rather than overhead irrigation. 4. Fertilize with an encaspsulated or time release product so the plants do not "starve" between applications. 5. Use a potting mix that is based on either sphagnum peat or coconut fiber peat rather than pine bark, especially if you intend to keep the plant in the same container for a long time. Soil mixes based on pine bark work well for fast-growing crops that will soon be planted out or repotted, but they break down too quickly for long term use. 6. Chlorothalonil fungicide, often sold as Daconil, is a broad spectrum fungicide and may provide some protection for your palms from foliar fungal diseases. As always, fungicides are more effective as a preventative measure than as a cure.

**Q.** I have a couple of *Archontophoenix cunninghamiana* palms with around 2 m of clean trunk. I have recently noticed that some deep and extensive splits, which are approximately 30–40 cm long and 5 cm deep, have developed in the lower portion of the trunk of each palm. These two palms were planted out of rather large containers two years ago and have grown well, gaining quite a bit of height since I planted them in my garden. They are watered and fertilized rather generously, and until now they have responded well. Except for the fissures in the trunks, they are beautiful. Is this splitting bad, and can it lead to infection of any sort? Christopher Jones, California.

**A.** This problem is described in the excellent little book, Diseases and Disorders of Ornamental Palms edited by A. R. Chase and T. K. Broschat (American Phytopathological Soc. Press, 1991), and is called "excessive water uptake." The book says that it is a rare disorder and usually occurs in areas with a very high rainfall, such as in parts of Hawaii.

I have seen similar problems in Florida. If a palm was allowed to begin to develop its woody stem while in a container and then planted into the more congenial conditions of a well-maintained landscape, splitting may occur. I am not sure whether this kind of splitting is also caused by excessive water uptake or simply the drastic change in growing conditions. It might be advisable, when planting palms that have

1 (left). Petioles of *Phoenix roebellinii* infected by *Pestalotiopsis palmarum*. 2 (right). *Bismarckia nobilis* is another common host of the disease in Florida.

achieved some maturity while still in a container, to avoid overfeeding and overwatering them. It is possible that the splits in the trunks of your *A. cunninghamiana* could become entry points for fungal disease or other harmful organisms. Keep these split areas clean and dry, but do not paint, seal or fill them. Make sure that your irrigation system does not spray directly into these areas. An occasional spraying with a fungicide might help prevent diseases from establishing, and ants or other insects should be discouraged from making homes in the splits.

# Index to Volume 44

A New Species of *Licuala* from New Guinea 198
A New Species of Rheophytic Palm from New Guinea 194
A Personal History of *Drymophloeus* in New Guinea 184
*Acanthophoenix* 22, 94
*Acoelorraphe* 72, 77, 116, 117
*A. wrightii* 9, 85, 72, 77, 115, 116
*Acrocomia* 70, 76, 77
*A. aculeata* 9, 76
*A. armentalis* 76
*A. crispa* 76
*A. intumescens* 10, 11
*A. lasiospatha* 76
*A. pilosa* 76, 77
*A. subinermis* 70
*Actinokentia* 136, 137
*A. divaricata* 122, 133, 137, 139
*A. huerlimannii* 136, 139
*Actinophloeus* 195
*Actinorhytis calapparia* 204
Additions to the Genus *Bactris* (Arecaceae) of Mesoamerica 146
*Aiphanes* 23
*Allagoptera* 23, 154
*A. arenaria* 155
*A. brevicalyx* 10, 11
*Alloschmidia glabrata* 137
*Ammandra* 23
An Introduction to the Palms of New Caledonia 132
Announcement 97
*Aphandra* 23
*Archontophoenix* 23, 102, 139
*A. cunninghamiana* 102, 209, 210
*A. purpurea* 28
*Areca* 23, 100, 165
*A. bifaria* 100
*A. catechu* 131, 192

*A. latiloba* 100
*A. macrocalyx* 188, 192, 204, 208
*A. recurvata* 100
*A. triandra* 100
*A. tunku* 100
*Arenga* 21, 23, 165
*A. engleri* 50
*A. hastata* 99
*A. micrantha* 14, 15, 16, 17, 18
*Arenga micrantha*: a Little-Known Eastern Himalayan Palm 14
*A. microcarpa* 190, 191
*A. pinnata* 14
*A. saccharifera* 14
*A. westerhoutii* 14
Asmussen, C.B., as co-author 19
*Asterogyne* 23
*A. martiana* 148
*Astrocaryum* 27
*Astrocaryum jauari* 26
*Attalea* 23
*A. funifera* 10, 11, 13
*A. speciosa* 27
*A. spectabilis* 3, 27
*Bactris* 26, 27, 69, 76, 77, 146
*B. ana-juliae* 146, 147, 148
*B. baileyana* 150
*B. bidentula* 27
*B. campestris* 26
*B. cubensis* 57, 66, 75, 76, 77, 79
*B. cuspidata* 27
*B. dianeura* 148
*B. elegans* 26
*B. ferruginea* 10, 11
*B. glandulosa* 148, 150
*B. herrerana* 148, 149, 150
*B. hondurensis* 146, 148
*B. longiseta* 146
*B. polystachya* 146
*B. riparia* 27
*B. simplicifrons* 27
Baker, W.J.: The Palms of New Guinea Project 160
Baker, W.J., as co-author 19, 202
Baker, W.J, A.P. Keim and C.D. Heatubun: *Orania regalis* Rediscovered 166
Baker, W.J., R.A. Maturbongs, J. Wanggai and G.G. Hambali: *Siphokentia* 175
*Balaka* 23
Barboza, N.M., as co-author 93
Barboza, N.M.: Broom-Making from Palms in Cuba 59
Barboza, N.M.: Searching for *Copernicia* in Cuba 88
*Barcella odora* 26
Barfod, A.S.: A New Species of *Licuala* from New Guinea 198
*Basselinia* 136, 137, 139
*B. deplanchei* 133, 134, 137
*B. gracilis* 122, 135, 136, 137, 139
*B. pancheri* 122, 133,134, 137
*B. sordida* 137
*B. velutina* 137
*B. vestita* 137
*Beccariophoenix* 23
*B. madagascariensis* 168
*Bentinckia* 22
*Bismarckia* 6, 102
*B. nobilis* 102, 131, 209, 210
*Borassodendron* 21, 23
*Borassus* 165
*B. sambiranensis* 131
*Brahea* 109, 110, 113
*B. aculeata* 112, 113
*B. decumbens* 110
*B. dulcis* 110, 112, 113
*B. nitida* 110
*B. sarukhanii* 105, 109, 110, 111, 112, 113
*Brahea sarukhanii*, a New Species of Palm from Mexico 109
*Brassiophoenix* 23, 165
*Brongniartikentia* 139
Broom-Making from Palms in Cuba 59
*Burretiokentia* 101, 139
*B. dumasii* 139
*B. grandiflora* 136
*B. koghiensis* 139
*B. vieillardii* 122, 136, 137, 138, 139
*Butia* 9, 154
*B. capitata* 43, 46, 154
*Calamus* 21, 23, 29, 31, 32, 99, 165, 198, 204, 205, 208
*C. acanthophyllus* 99
*C. acanthospathus* 99
*C. arfakianus* 208
*C. blumei* 99
*C. bousigonii* 99
*C. castaneus* 24
*C. conirostris* 24
*C. deeratus* 24
*C. erectus* 32
*C. eximius* 208
*C. harmandii* 29, 30, 31, 32, 33, 99
*C. hollrungii* 24, 192, 204, 205
*C. humboldtianus* 188, 205
*C. klossii* 208
*C. longipinna* 204
*C. macroclamys* 204
*C. nanodendron* 24
*C. pandanosmus* 99
*C. spectatissimus* 99
*C. steenisii* 204
*C. thysanolepis* 24
*C. tomentosus* 99
*C. warburgii* 204, 205
*Calospatha scortechinii* 24
*Calyptrocalyx* 139, 165, 188, 189, 192, 204
*C. doxanthus* 192
*Calyptrogyne clementis* 76
*C. dulcis* 76
*C. intermedia* 76
*C. microcarpa* 76
*C. occidentalis* 76
*C. swartzii* 76
*Calyptronoma* 23, 69, 76, 77, 90
*C. clementis* 77
*C. clementis* ssp. *clementis* 76
*C. clementis* ssp. *orientalis* 76
*C. dulcis* 76, 77
*C. intermedia* 76, 77
*C. microcarpa* 76, 77
*C. plumeriana* 76, 77
*Campecarpus* 137
*C. fulcitus* 122, 137, 138
*Caryota* 21, 22, 23 171, 173, 188, 189
*C. kiriwongensis* 98
*C. ophiopellis* 171, 173
*C. rumphiana* 173, 174, 189, 190, 204
*C. zebrina* 170, 171, 172, 173, 174, 187, 188, 189, 190, 192
Cascante, A.: Additions to the Genus *Bactris* (Arecaceae) of Mesoamerica 146
*Ceratolobus* 99
*C. concolor* 24
*C. glaucescens* 99
*C. subangulatus* 99
*Ceroxylon* 20, 23
*Chamaedorea* 20, 23, 26, 146
*C. microspadix* 7
*C. pinnatifrons* 148
*C. pumila* 148
*Chamaerops* 22, 23
*Chambeyronia* 136, 137, 139
*C. hookeri* 136
*C. macrocarpa* 135, 136, 137, 138, 139
Chapin, M.H. and D.H. Lorence: Developing a Tropical

Garden Palm Collection 121
Checklist of the Palms of Cuba, with Notes on their Ecology, Distribution and Conservation 69
*Chelyocarpus* 23
*Chuniophoenix* 23
Classified 28, 68, 113, 117, 193, 201
*Clinosperma* 137, 139
*Clinostigma* 22, 139
*C. ponapense* 122, 123
*Coccothrinax* 23, 59, 62, 63, 66, 70, 77, 80, 90, 102
*C. acuminata* 72
*C. acunana* 70
*C. alexandri* ssp. *alexandri* 70
*C. alexandri* ssp. *nitida* 70
*C. alexandri* var. *nitida* 70
*C. argentea* var. *guantanamense* 72
*C. baracoensis* 70, 80
*C. bermudezii* 70
*C. borhidiana* 70, 72, 76, 80
*C. brevicrinis* 70, 76, 80
*C. camagueyana* 70, 80
*C. clarensis* 59, 60, 62
*C. clarensis* ssp. *brevifolia* 70
*C. clarensis* ssp. *clarensis* 70
*C. clarensis* var. *brevifolia* 70
*C. clarensis* var. *perrigida* 70
*C. crinita* 72, 76, 77, 80
*C. crinita* ssp. *brevicrinis* 70
*C. cupularis* 72
*C. elegans* 72
*C. fagildei* 72, 80
*C. fragrans* 72
*C. garciana* 72
*C. guantanamensis* 72
*C. gundlachii* 72
*C. hiorami* 71, 72
*C. leonis* 72
*C. litoralis* 72
*C. macroglossa* 72
*C. microphylla* 72
*C. miraguama* 70
*C. miraguama* ssp. *arenicola* 72
*C. miraguama* ssp. *havanensis* 72
*C. miraguama* ssp. *miraguama* 72
*C. miraguama* ssp. *roseocarpa* 72
*C. miraguama* var. *arenicola* 72, 85
*C. miraguama* var. *cupularis* 72
*C. miraguama* var. *havanensis* 72
*C. miraguama* var. *macroglossa* 72
*C. miraguama* var. *roseocarpa* 72
*C. miraguano* 72
*C. moaensis* 72
*C. munizii* 66, 72
*C. muricata* 72
*C. muricata* var. *savannarum* 72
*C. nipensis* 72, 80
*C. orientalis* 72
*C. pauciramosa* 65, 72
*C. pseudorigida* 72, 80, 91
*C. pseudorigida* var. *acaulis* 72
*C. pumila* 72
*C. rigida* 72
*C. salvatoris* ssp. *loricata* 72
*C. salvatoris* ssp. *salvatoris* 72
*C. salvatoris* var. *loricata* 72
*C. savannarum* 72, 80
*C. saxicola* 72
*C. trinitensis* 72
*C. victorini* 72, 76, 80
*C. yunquensis* 72, 80
*C. yuraguana* 72
*C. yuraguana* var. *orientalis* 72
*Cocos* 9, 76
*C. nucifera* 9, 76, 131
*Colpothrinax* 72, 80, 85, 87, 91
*C. wrightii* 53, 72, 80, 85, 86
*Copernicia* 57, 59, 60, 61, 62, 69, 70, 72, 80, 88, 89, 90, 91, 92, 94, 102
*C. alba* 102
*C. baileyana* 56, 73, 76, 89, 90
*C. baileyana* var. *laciniosa* 73
*C. brittonorum* 73, 80
*C. brittonorum* var. *acuta* 73
*C. brittonorum* var. *sabaloense* 73
*C. clarensis* 73
*C. clarkii* 73
*C. cowellii* 73, 88, 89, 91
*C. curbeloi* 73, 80, 90
*C. curtissii* 73
*C. excelsa* 73
*C. fallaensis* 55, 73, 74, 80
*C. gigas* 73, 80, 89, 104
*C. glabrescens* 91, 92
*C. glabrescens* var. *glabrescens* 73
*C. glabrescens* var. *ramosissima* 73
*C. holguinensis* 73
*C. hospita* 73, 89, 91
*C. hospita* var. *clarensis* 73
*C. humicola* 73, 80, 90, 91
*C. longiglossa* 73
*C. macroglossa* 59, 73, 76, 90, 91
*C. molineti* 73
*C. oxycalyx* 73, 80
*C. pauciflora* 73, 92
*C. ramosissima* 73, 92
*C. rigida* 57, 58, 61, 62, 66, 73, 75
*Copernicia rigida* in Eastern Cuba 57
*C. roigii* 73, 80, 90
*C. textilis* 89, 90
*C. torreana* 73
*C. vespertilionum* 61
*C. wrigthii* 72
*C.* x *burretiana* 9, 73, 80
*C.* x *occidentalis* 73
*C.* x *shaferi* 73, 91
*C.* x *sueroana* 73, 80
*C.* x *textilis* 73
*C.* x *vespertilionum* 73, 80
*C. yarey* 89, 91
*C. yarey* var. *robusta* 73
*C. yarey* var. *yarey* 73
*Corypha* 21, 23
*Cryosophila* 23
*Cyphokentia macrostachya* 122, 133
*Cyphophoenix* 23
*C. elegans* 135, 136, 137
*C. nucele* 136
*Cyphosperma* 101, 136, 139
*C. balansae* 122, 137
*Cyrtostachys* 23, 157, 190, 205, 207
*Daemonorops* 32
*D. didymophylla* 24
*D. fissa* 24
*D. leptopus* 100
Developing a Tropical Garden Palm Collection 121
*Dictyospermum album* 209
DNA and Palm Evolution 19
Dowe, J.L. and M. D. Ferrero: *Gronophyllum cariosum*, an Ornamental New Species from Papua New Guinea 161
Dowe, J.L. and M.D. Ferrero: A New Species of Rheophytic Palm from New Guinea 194
Dransfield, J., book review 98
Dransfield, J., W.J. Baker, C.D. Heatubun and J. Witono: The Palms of Mount Jaya 202
Dransfield, J.D., G.G. Hambali, R.A. Maturbongs and C.D. Heatubun: *Caryota zebrina* 170
*Drymophloeus* 165, 184, 185
*D. beguinii* 184, 185

*D. bifidus* 185
*D. ceramensis* 185
*D. hentyi* 185, 186
*D. leprosus* 185
*D. litigiosus* 184, 185, 186
*D. oliviformis* 184, 185, 186
*D. oninensis* 185
*D. porrectus* 185
*Dypsis* 23, 128
*D. cabadae* 131
*D. hovomantsina* 131
*D. lanceolata* 128, 131
*D. madagascariensis* 122
*D. tsaravoasira* 131
Editorial 4
Effect of Microclimate Variation on Cultivation of Cold-Hardy Palms in Southwestern Ohio 37
*Elaeis* 23
*E. guineensis* 70, 189
*E. oleifera* 27
*Eleiodoxa* 21
*E. conferta* 24
*Eremospatha* 21, 23
*E. wendlandiana* 24
*Erythea* 109, 110
*E. pimo* 110, 112, 113
*Eugeissona* 21, 23, 100
*E. tristis* 24, 100
*E. utilis* 24
*Euterpe* 23
*E. oleracea* 27
*E. precatoria* 27
Evans, D., as co-author 85
Evans, T.: The Rediscovery of *Calamus harmandii*, a Rattan Endemic to Southern Laos 29
Ferrero, M.D., as co-author 161, 194
Francko, D.A.: Effect of Microclimate Variation on Cultivation of Cold-Hardy Palms in Southwestern Ohio 37
*Gastrococos* 69, 76, 89
*G. armentalis* 76
*G. crispa* 70, 76
*Gaussia* 20, 23, 69, 73, 80
*G. princeps* 73, 80
*G. spirituana* 73, 80
*Geonoma* 23, 26, 27, 139, 146
*G. baculifera* 26
*G. ferruginea* 148
*G. stricta* 26
*Gronophyllum* 23, 165, 176, 191, 192, 205, 207, 208
*G. brassii* 207
*G. cariosum* 161, 162, 163, 164, 165
*Gronophyllum cariosum*, an Ornamental New Species from Papua New Guinea 161
*G. flabellatum* 165
*G. mayrii* 188
*G. pinangoides* 192, 205, 208
*G. pleurocarpum* 161, 162, 165
*G. rhopalocarpum* 161, 162, 165, 205
*Guihaia* 23
*Gulubia* 159, 165, 176, 207
*G. costata* 183, 204, 205
*G. longispatha* 207, 208
*G. palauensis* 122
Hambali, G.G., as co-author 170, 175
Heatubun, C.D. In Search of *Caryota zebrina* – A Palm Expedition to the Cyclops Mountains 187
Heatubun, C.D., as co-author 166, 170, 202
*Hedyscepe* 23
*Hemithrinax* 63, 67, 70
*H. compacta* 70
*H. ekmaniana* 70
*H. rivularis* 70
*H. rivularis* var. *rivularis* 70
*H. rivularis* var. *savannarum* 70
*H. savannarum* 70
Henderson, A.: Palm Research in 1999 118
Henderson, A.: Palms of the Amazon Ecotours 25
*Heterospathe* 189, 208
*H. elata* var. *palauensis* 122
*H. glabra* 188
*H. pilosa* 188
Horticulture Column 50, 101, 153, 209
*Hydriastele* 23, 165, 176, 188, 191, 195, 204, 207
*H. rheophytica* 194, 195, 196, 197
*Hyophorbe* 20, 23, 93, 94, 95, 96, 97
*H. amaricaulis* 93, 94, 95, 96, 97
*H. indica* 93, 94, 95, 96, 97
*H. lagenicaulis* 93, 94, 95, 96, 97
*H. vaughanii* 93, 94, 95, 96, 97
*H. verschaffeltii* 93, 94, 95, 96, 97
*Hyospathe* 23, 27
*Hyphaene* 21, 23, 102
*H. coriacea* 131
Identity of the *Hyophorbe* Palms at the Botanical Garden of Cienfuegos, Cuba 93
*Iguanura* 23, 100
*I. myochodoides* 52
In Search of *Caryota zebrina* – A Palm Expedition to the Cyclops Mountains 187
Instructions to Contributors 7
*Iriartea* 23
*I. deltoidea* 27
*Iriartella setigera* 26
*Itaya* 23
*Johannesteijsmannia* 23
*Juania* 20
Keim, A.P., as co-author 166
Kennedy, J.D.: Palms 101: The Travelling Slide Show 5
*Kentiopsis* 23, 136, 137, 139
*K. oliviformis* 101
*K. piersoniorum* 101, 136, 139
*K. pyriformis* 101, 136, 137, 138, 139, 140
*Kerriodoxa* 23
*Korthalsia* 21, 32, 171, 204
*K. brassii* 204
*K. cheb* 24
*K. zippellii* 204
Kurth, D.J.: Natalie Uhl: A Portrait of a Scientist 34
*La Palma Barrigona* 85
*Laccospadix* 23
*Laccosperma* 21, 23
*L. acutiflorum* 24
*L. opacum* 24
*Latania* 102
*L. loddigesii* 122
*Lavoixia* 139
*L. macrocarpa* 136
Leal, E.C., as co-author 9
Leiva S., A.T., as co-author 69
*Lemurophoenix* 23, 36
*Leopoldinia* 23, 26
*L. major* 26
*L. piassaba* 26
*L. pulchra* 26, 27
*Lepidocaryum* 21
*L. tenue* 24, 26
Lewis, C.E. and N.M. Barboza: Identity of the *Hyophorbe* Palms at the Botanical Garden of Cienfuegos, Cuba 93
Lewis, C.E., W.J. Baker and C.B. Asmussen: DNA and Palm Evolution 19
*Licuala* 23, 100, 165, 189, 190, 198, 201, 205, 208
*L. bacularia* 205
*L. beccariana* 201
*L. crassiflora* 198, 199, 200, 201
*L. grandiflora* 208
*L. lauterbachii* 199, 201
*Linospadix* 23, 165, 189, 208
*L. albertisiana* 161

*Livistona* 23, 41, 102, 165, 208
*L. chinensis* 9, 40, 44
*L. decipiens* 154, 155
*L. saribus* 7
*Lodoicea* 21, 23
Lorence, D.H., as co-author 121
*Mackeea magnifica* 101
Maidman, K., as co-author 85
*Manicaria* 23
*M. saccifera* 27
*Marojejya* 23
*Masoala* 23
Maturbongs, R.A., as co-author 170, 175
*Mauritia* 21, 22, 23
*M. carana* 27
*M. flexuosa* 24
*Mauritiella* 21
*M. aculeata* 26
*M. armata* 24
*Metroxylon* 21
*M. amicarum* 122
*M. sagu* 24, 190, 206
*M. salomonense* 24
Migliaccio, C.P.: The Effects of Vitamin $B_1$ on Palm Seedling Growth 114
*Moratia* 137
*M. cerifera* 135, 136
Morici, C.: *Copernicia rigida* in Eastern Cuba 57
Morici, C.: The Genus *Thrinax* in Cuba 63
Moya L., C.E. and A.T. Leiva S.: Checklist of the Palms of Cuba, with Notes on their Ecology, Distribution and Conservation 69
*Myrialepis paradoxa* 24, 31
*Nannorrhops* 23
Natalie Uhl: A Portrait of a Scientist 34
*Nenga* 23
*Neonicholsonia* 23
News of the Society 201
Noltie, H.J.: *Arenga micrantha*: a Little-Known Eastern Himalayan Palm 14
Notice 28
*Nypa* 22, 23
*N. fruticans* 122
Occurrence of Coconut '*Lixas*' in Brazilian Native Palms in the Northeastern Coastal Plain 9
*Oenocarpus* 27
*O. bacaba* 27
*O. bataua* 27
*O. mapora* 27
*O. simplex* 27
On the Pruning of Palms 47
*Oncocalamus* 21, 23
*O. mannii* 24
*Orania* 22, 23, 165, 166, 167, 168, 189, 190, 192, 205, 208
*O. aruensis* 168
*O. parva* 189, 208
*O. regalis* 166, 167, 168, 169
*Orania regalis* Rediscovered 166
*Oraniopsis* 20, 23
*Oreodoxa regia* 73
Palm Brief 131
Palm Literature 98
Palm Research in 1999 118
Palms 101: The Travelling Slide Show 5
Palms of the Amazon Ecotours 25
*Paralinospadix flabellatus* 204
*P. geonomiformis* 204
*P. leptostachys* 188
*P. micholitzii* 204, 206, 208
*Pelagodoxa henryana* 107, 125
Peterson, B.: Horticulture Column 50, 101, 153, 209
Pfalzgraf, K.: On the Pruning of Palms 47
*Phoenicophorium* 22
*Phoenix* 23, 48, 99, 103
*P. canariensis* 6, 48, 101, 103
*P. dactylifera* 47, 49
*P. loureiri* 99
*P. paludosa* 99
*P. reclinata* 131
*P. roebelenii* 6, 209, 210
*Phytelephas* 23, 35
Pibot, A and O. Soumille: *Ravenea hildebrandtii* in Mayotte 127
*Pigafetta* 21, 22
*P. elata* 24
*P. filaris* 24, 181
*Pinanga* 100, 139
*P. insignis* 122, 125, 126
*P. punicea* 192, 204
Pintaud, J.-C.: An Introduction to the Palms of New Caledonia 132
*Plectocomia* 21, 22
*P. elongata* 24
*P. himalayana* 18
*P. mulleri*
*Plectocomiopsis geminiflora* 24
*Podococcus* 23
*Pogonotium ursinum* 24
President's Message 4, 56, 108, 160
*Prestoea* 69, 73, 81
*P. acuminata* var. *montana* 73, 81
*P. montana* 73
*Pritchardia* 121, 122, 124, 125
*P. affinis* 124
*P. arecina* 124
*P. aylmer-robinsonii* 124
*P. beccariana* 124
*P. forbesiana* 124
*P. glabrata* 124
*P. hardyi* 124
*P. hillebrandii* 124
*P. kaalae* 124
*P. lanaiensis* 124
*P. lanigera* 124
*P. limahuliensis* 124, 156
*P. lowreyana* 124
*P. martii* 124
*P. minor* 124
*P. munroi* 124
*P. napaliensis* 124
*P. pacifica* 124
*P. perlmanii* 124
*P. remota* 124
*P. schattaueri* 124
*P. thurstonii* 124
*P. viscosa* 1, 124
*P. waialealeana* 124
*P. wrightii* 72
*Pritchardiopsis* 101, 136, 139, 140
*P. jeanneneyi* 132, 133, 136
*Pseudophoenix* 20, 23, 69, 73, 81
*P. sargenti* ssp. *saonae* var. *saonae* 73, 81
*Ptychococcus* 165, 205
*P. ledermannianus* 122, 123
*Ptychosperma* 35, 116, 165, 185, 191
*P. cuneatum* 188, 191, 192
*P. lineare* 114, 115, 116
*P. paulauense* 122
*P. schefferi* 188
Quero, H.J.: *Brahea sarukhanii*, a New Species of Palm from Mexico 109
*Raphia* 21
*R. farinifera* 24
*Ravenea* 20, 23, 128
*R. hildebrandtii* 128, 129, 130
*Ravenea hildebrandtii* in Mayotte 127
*R. lakatra* 168
*Reinhardtia* 22, 23
*Retispatha dumetosa* 24

*continued on p. 169*

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