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Editor: Harold E. Moore, Jr., 467 Mann Library, Ithaca, N.Y. 14853.

Associate Editors: Dr. John Dransfield, The Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, England. Dr. Natalie W. Uhl, 467 Mann Library, Ithaca, N.Y. 14853.

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Cover Picture

A palm, probably a date palm, is figured on a gold cup from Greece. See page 85. Photograph by W. H. Hodge.

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Endangerment at the Specific and Generic Levels in Palms*

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

Palms are characteristic components of many tropical ecosystems (Moore, 1973a). They occur in a diversity of habitats, ranging from seacoasts, mangroves, desert oases, and open savannas to swamp forest, lowland and montane rain forests, and even to deciduous forests of warm-temperate parts of the world. Sometimes they form nearly pure stands of one species, as *Mauritia flexuosa* L.f. in the basins of the Amazon and Orinoco Rivers. At other times they may be abundant both in kinds and in numbers, as they are in the lowland rain forests of America and Indomalaysia, but they often are represented by very limited populations. Palms frequently serve as indicators of soil types, drainage patterns, or vegetation types (e.g., Eiten, 1974; Pérez Jiménez, 1974; Read, 1974; Romney, 1959), and they may also be very precise markers, such as the species of *Geonoma* in certain montane forest types of Venezuela (Otto Huber, pers. comm.). They occasionally are known to influence the formation of soil, as suggested by Furley (1975) for *Orbignya cohune* (Mart.) Dahlgr. ex Standl.

Though interrelationships between palms and animals are poorly documented, they certainly are important. Palm/insect relationships are perhaps best known, having been considered in general by Lepesme and Paulian (1947). The sometimes elegant methods of pollination, however, were not treated by the two authors and this subject has only recently begun to receive the detailed study it deserves (Brown, 1976a; Essig, 1971, 1973; Read, 1967, 1975; Schmid, 1970), as have the adaptive morphology and anatomy of the plants (Uhl and Moore, 1977). Palm flowers, inflorescences, and fruits are utilized by insects other than those that actually pollinate, as sources of food and sites for oviposition (Essig, 1973; Schmid, 1970). Bruchid beetles, for example, may feed on nectar of *Sabal palmetto* (Walt.) Lodd. ex Schult. & Schult. f. as adults and pass their larval instars in the endosperm of the fruit (Brown, 1976b).

The fruits of many palms are fleshy and colored, sometimes against bright red or orange inflorescence axes, and obviously adapted for dispersal by animals (Corner, 1966; Van der Pijl, 1969). Birds are probably the palm's chief feeders and disseminators (see Brown, 1976b; Keppler, 1970; Leck, 1969; Read, 1960), though mammals, from rodents to primates, including man, also feed on their fruits and disperse their seeds (Burtt, 1929; Enders, 1935; Janzen, 1971), even those such as *Caryota*, which are filled with irritant crystals (Dransfield, 1974).

Man benefits enormously from palms throughout the tropics, as accounts of many explorers amply demonstrate (for

* Reprinted with permission from G. T. Prance and T. S. Elias (eds.). 1977. Extinction is Forever: the Status of Threatened and Endangered Plants of the Americas. New York Botanical Garden, Bronx, N.Y. pp. 267–282. Footnotes added in reprinting.

example Wallace, 1853). They serve him in almost every aspect of life, ranging from shelter to clothing, food, drink, stimulants, medicine, arms, and religion (Braun, 1968; Burkill, 1935; Dransfield, 1976a; Gowda, 1951; Hodge, 1963; Miller, 1964; Schultes, 1974). Palm products also play an important role in our industrial society (Hodge, 1975; Kitzke and Johnson, 1975).

Many other examples can be cited to show the importance of palms in the ecosystem. The family also fulfills another important scientific, though less immediately obvious, role, as a subject for the study of evolution. Distinctive pollen of the Asiatic mangrove palm, *Nypa*, is one of the earliest fossils identified as to family and genus (Muller, 1970), dating from the Senonian (Upper Cretaceous), about 70 or more million years ago. Although contemporary *Nypa fruticans* Wurmb. seems to differ little from its fossil antecedents and retains some characteristics considered primitive (Moore and Uhl, 1973), it is advanced in other characteristics and must represent a significant span of evolutionary time beyond the origin of the even more primitive palm stock from which it evolved. This long history probably accounts for the great diversity we find at the subfamilial, tribal, and generic levels within the family today (Moore, 1973b, 1975).

Diversity at the specific level is less well understood, owing to the fact that in the past, species were frequently described from fragmentary specimens that are difficult to compare with the often more complete specimens of modern collectors. Moreover, the great size of many palms deters most botanists from including them in their collections at all. As a consequence, it is frequently difficult to assess endangerment at the specific level, especially in the Americas. Because palms also provide us with exceptional material for the study of evolution at the generic level, and because more than one-third are monotypic and nearly one-half have only one or two species, I have chosen, with permission of the organizers of this Symposium, to broaden my approach in order to call attention to endangerment in both hemispheres since some of the more clearly documented examples come from the Old World.

Despite their versatility in the ecosystem, palms as a group have a great disadvantage. A few are notable colonizers of disturbed habitats, examples being *Pigafetta filaris* (Giseke) Becc. after clearing in the Celebes (Dransfield, 1976b), *Prestoea montana* (Grah.) Nichols. ("*Euterpe globosa*") after hurricanes in the Lesser Antilles (Beard, 1945, 1976), an unidentified palm on volcanic flows in Costa Rica (Gary Hartshorn, pers. comm.), and *Acrocomia* in Costa Rican pastures (Janzen, 1971). Most palms, however, appear to require precise conditions for germination and establishment, although few adequate studies have been made in this regard, those of Bannister (1970) and of Vandermeer *et al.* (1974) being exceptions. Palms are often commanding presences left standing when the forest is cleared, but they do not regenerate until their requirements for shade and moisture are met by regrowth of forest following shifting agriculture. When cleared land is retained in pasture, as in the Sarapiquí Valley of Costa Rica or on the slopes of the Andes in Colombia and to an increasing degree elsewhere, regeneration is severely limited or fails to occur at all.

Palms have another disadvantage. They are often overutilized by man. Each stem has a single growing point, and when this is cut for the tender "heart" or terminal bud, the stem or the plant, when the stem is solitary, is de-

stroyed. Such destruction appears to have been a major factor in the virtual elimination of palms as wild plants on Mauritius and a similar elimination of *Euterpe macrospadix* Oerst. is at present taking place in Costa Rica (Balick, 1976). A less immediate threat, but one which in time is expected to become more serious, is the constant collection of fruit or seed in the wild for sale, or the continued cutting of young leaves to be used for hats, baskets, and other items. Another constant threat to palms is the excess cutting of mature leaves for thatch or for sale as greenery (Vosters, 1975).

Palms in cultivation (and potentially in the wild state) also are jeopardized by the increasing incidence of lethal yellowing, a disease attributed to the presence of mycoplasmalike organisms in the phloem of palms, transmitted by an as yet unknown vector (Fisher *et al.*, 1973; Parthasarathy and Fisher, 1973; Romney *et al.*, 1976).

The Threatened Plants Committee of the International Union for Conservation of Nature and Natural Resources has recently set up a Threatened Palms Subcommittee. Six species of particular interest are already listed as vulnerable —*Caryota no* Becc., *Johannesteijsmannia altifrons* (Rchb. f. & Zoll.) H. E. Moore, *Juania australis* (Mart.) Drude ex Hook. f., *Lodoicea maldivica* (J. F. Gmel.) Pers., *Maxburretia rupicola* (Ridl.) Furtado, and *Phoenix theophrasti* Greuter—and two—*Medemia argun* (Mart.) Wuerttemb. and *Neoveitchia storckii* (H. Wendl.) Becc.—as endangered. Five more, which are probably endangered or even extinct, have been documented for consideration by the Threatened Plants Committee, but our work has only begun, as the following comments on palms of America, Africa, Asia, and oceanic islands will suggest.

Endangered Palms in the Americas

There are so few proper monographic treatments of palms in the American tropics that it is difficult to assess endangerment in larger genera, many species of which can only be listed as insufficiently known; that is, they are suspected of being rare, vulnerable, or endangered, but current information is insufficient to categorize them. Too many species are still known only from a single collection and too much of the area still needs to be explored for palms.

The monotypic *Itaya amicorum* H. E. Moore from Peru may serve as an example. Discovered originally in 1960 while crossing from the Itaya River to the Amazon, and described twelve years later (Moore, 1972) after several attempts to obtain more complete material, the species is still known from fewer than 100 individuals in what constitutes, essentially, a single population adjacent to a clearing that is being extended into the forest and in the vicinity of some dwellings. If one judges from current evidence, *Itaya* must be considered endangered, yet there has been no effort to determine the extent of its range and any attempt to do so will be severely handicapped by the difficulty of travel in the region. The single introduction of this palm, truly one with potential as an ornamental, failed in 1974 when the entire shipment of fruit was "cooked" because some seeds were found to be infested with larvae.

Similarly, on the basis of current knowledge, at least three other species of Peru—*Chrysallidosperma smithii* H. E. Moore, *Iriartella ferreyrae* H. E. Moore, and *Socratea salazarii* H. E. Moore —may be endangered. Each is known from only two small areas in Peru, one near Aguaytía, the other near Yurimaguas. The region near Aguaytía

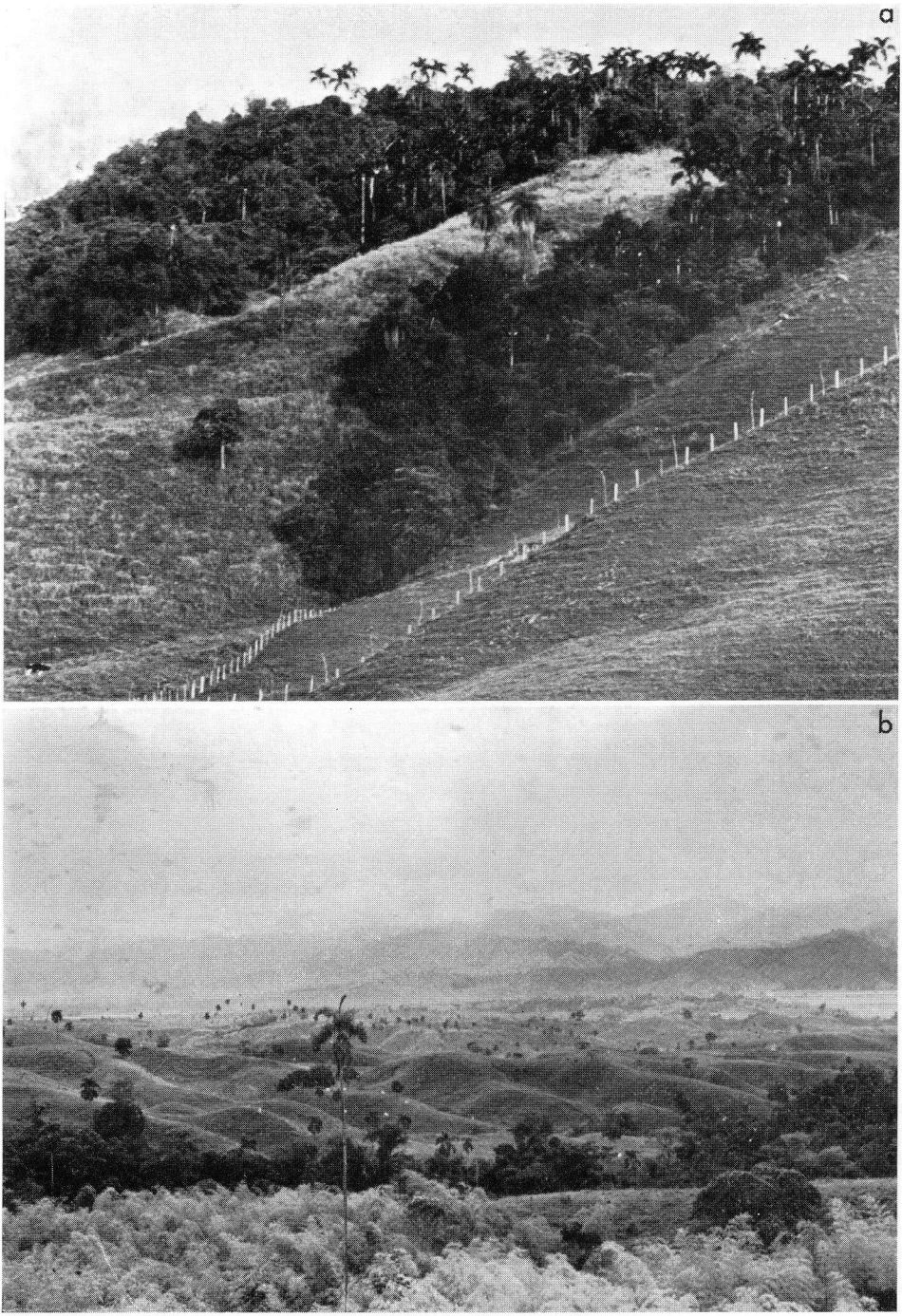
where these palms grew has been much modified since 1960, and although a few individuals of *Socratea salazarii* were seen in 1974 in a ravine much disturbed by debris from a road cut, the natural vegetation of the region where *Chrysallidosperma* had been found appears to have been cut down. It is likely that other populations exist, but the determination of the range and the size of populations is very difficult to ascertain.

Since I have just returned from field work in Colombia, let me introduce some situations that are clearer. Populations of wax palms (*Ceroxylon* spp.) in the Andes from Venezuela to Peru and Bolivia occur mostly at high altitudes, where forest has been or is being cleared and kept in grass, or more rarely at elevations as low as 1,500–1,900 m in the region where coffee is grown. Only recently has the identity of the original species, *C. alpinum* Bonpl. ex DC. from the Quindio Pass in Colombia, become clear (Moore and Anderson, 1976). Because of the forest, the 80 km journey from Ibagué to Cartago over the pass, required 10–25 days in the early 1800's (Bomhard, 1937), whereas a paved road now carries one there in hours. On the eastern side of the pass, the road winds through pastures where *Ceroxylon quindiuense* (Karst.) H. Wendl. (Colombia's national tree, once cut by the thousands for wax, [André, 1878]) is still extant though with little evident regeneration. On the western side, at lower elevations among coffee plantations, *Ceroxylon alpinum* is occasionally to be seen, though also with little evidence of regeneration. On the other side of the Cauca Valley, populations of *C. alpinum* share the same fate. One can still find specimens, but low population levels and lack of regeneration suggest that the species should be considered endangered.

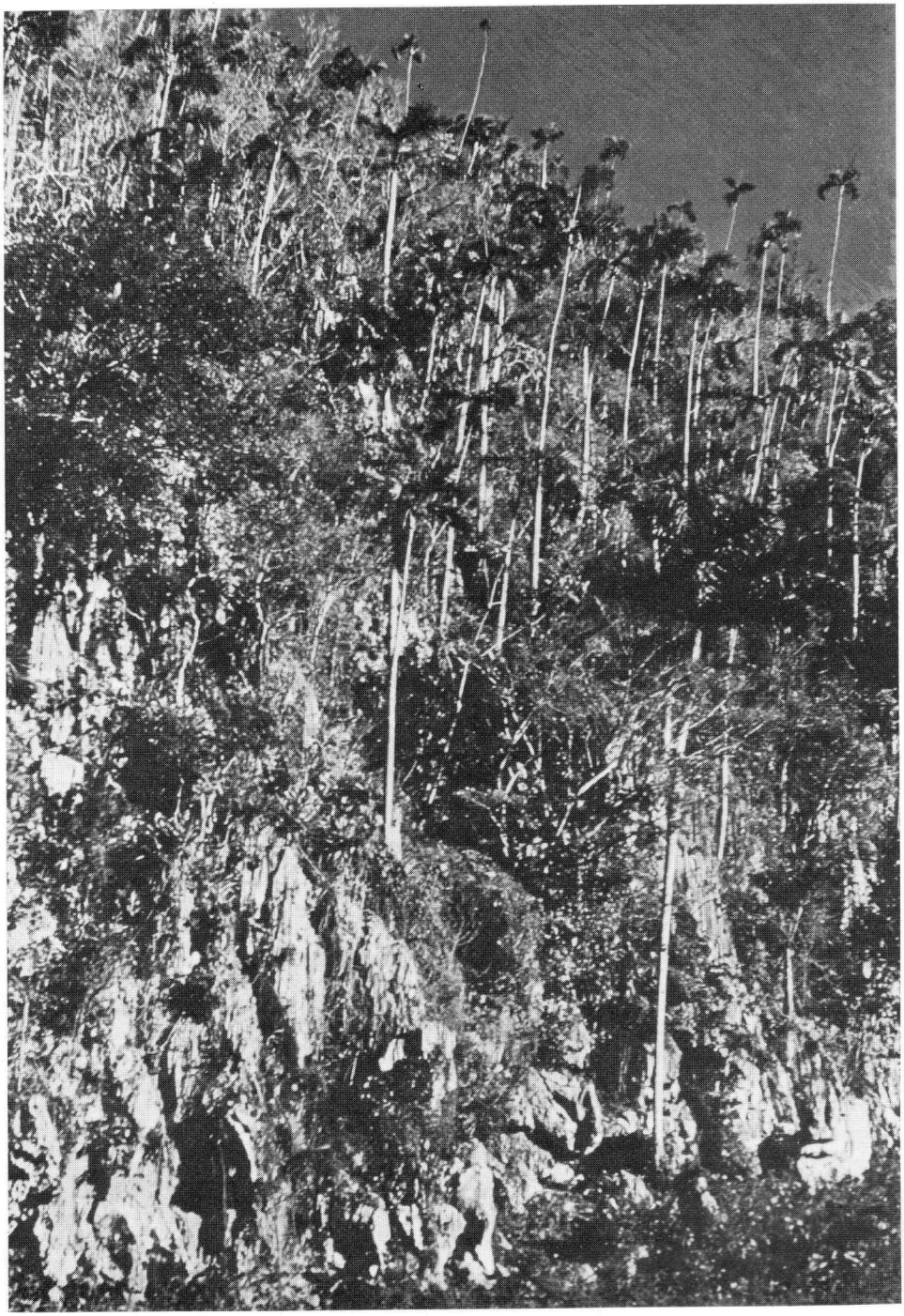
Ceroxylon quindiuense, growing as it does at higher elevations, may still be seen in small patches of forest, as at Tenerife in the Departamento del Valle, but it is vulnerable. A similar situation prevails in Peru where only very limited populations of the complex centered on *Ceroxylon crispum* Burret are known (personal observation, 1960, 1974). Because of their habitat and the difficulty of finding appropriate regions in which to cultivate them, all species of *Ceroxylon* appear increasingly endangered unless steps are taken to protect wild populations and to plant and protect young trees.

Slightly lower, on slopes bounding the Cauca Valley at elevations from 900 to 1,200 m, *Syagrus sancona* (HBK) Karst. once was abundant. Today the last remnants of forest where it occurs are being cut (Fig. 1a). The species is frequently left in pastures (Fig. 1b), where it does not reproduce. Though it is cultivated as an ornamental throughout the valley and even on the western slopes of the Cordillera Occidental, it is clearly endangered as a wild species. A comparable species is *Aiphanes caryotifolia* (HBK) H. Wendl., which is cultivated for the edible fruits, though it also is infrequent as a wild plant.

Elsewhere in South America, clearing of land, especially in montane areas, is reducing or eliminating palm populations. *Jubaea chilensis* (Mol.) Baill., the Chilean wine palm, once had a more extensive range along the west coast of Chile, but because it has been cut to extract the sap for honey and wine, the populations today are reduced to five from Cuesta Las Palmas in the north to El Almacigo in the south, and it is considered endangered by Chilean botanists. *Juania australis*, also monotypic, occurs only on the island of Masatierra in the Juan Fernandez Islands off the coast of Chile. Here, probably 500–1,000 or perhaps even more individuals still inhabit forests on the relatively undisturbed and



1. *Syagrus sancona* once was widespread in the Cauca Valley of Colombia in forest like the remnants (a) now being felled near Alcalá, Valle. Although still remaining in fields and pastures as at La Virginia, Risaralda (b), it does not reproduce effectively without the intervention of man.



2. *Gaussia princeps* is restricted to limestone haystack hills (mogotes) in Pinar del Río, Cuba, where it would be vulnerable if the hills were mined for lime, as they are in Malaya.

often inaccessible upper slopes of one part of the island (Moore, 1969b) where it regenerates well. The islands were declared a national park in 1935, and the palm therefore is now protected by law. So long as the sale of tourist items made from the hard black fibers of the trunk is controlled, *Juania* is probably only vulnerable, though possibly endangered.

In the West Indies, *Gaussia princeps* H. Wendl. is restricted to the *mogotes* (haystack hills) of dogtooth limestone (Fig. 2) in Pinar del Río province of Cuba (Leon, 1946) and must be considered vulnerable. If these hills were to be mined for limestone, as similar hills are in Malaya, the species would clearly be endangered. The related *Gaussia attenuata* (O. F. Cook) Becc. of Puerto Rico, occupies a more extensive limestone area in the north as well as limestone hills in the southwest (Little and Wadsworth, 1964) but it is considered endangered (Roy O. Woodbury, pers. comm.). *Calyptronoma rivalis* (O. F. Cook) L. H. Bailey, also from Puerto Rico, is known from only one locality three miles east of San Sebastián in the northwestern portion of the island (Little *et al.*, 1974) plus two recently discovered small Puerto Rican populations (Roy O. Woodbury, pers. comm.) or, if Wessels Boer (1968) is followed, from two additional localities in Hispaniola. It must surely be listed as endangered. Efforts should be made to introduce this species into cultivation in Puerto Rico as well as elsewhere.

Some other palms in the West Indies also occur in very limited populations and should be considered for conservation. On Hispaniola, *Zombia antillarum* (Descourt.) L. H. Bailey is known from a few localities (Bailey, 1939; Jiménez, 1960), *Coccothrinax ekmanii* Burret, sometimes separated as *Haitiella ekmanii* (Burret) L. H. Bailey, is reported from two or perhaps three localities, and *Pseudophoenix ekmanii* Burret and *P. lediniana* Read are known from very limited populations (Read, 1968). The genus *Coccothrinax*, now being studied by Read, may provide additional examples of species that require action on the part of our subcommittee.

The genus *Chamaedorea*, abundantly represented in Mexico and Central America, contains several species that are apparently very rare and presumably endangered—*C. stolonifera* H. Wendl. ex Hook. f., from Chiapas, *C. tuerckheimii* (Damm.) Burret from Guatemala being two examples. *Colpothrinax cookii* Read, is reported from two widely separated localities in Guatemala and Panama (Read, 1969) and is probably endangered in both localities. Two species of *Brahea*, *B. decumbens* Rzedowski and *B. moorei* L. H. Bailey ex H. E. Moore, occur in limited populations, the latter with *Chamaedorea radicalis* Mart. on limestone outcrops of eastern Mexico, where they may be considered vulnerable. As in South America, tropical North America still requires exploration and study of its palms before all the possibly endangered species can be listed.

At least two species in the United States are endangered. *Roystonea elata* (Bartr.) F. Harper, which was at one time quite abundant in Florida's Fakahatchie Swamp, is now much depleted and is protected only in a small area at Royal Palm Hammock in Collier County in that state. Further taxonomic study is desirable to determine whether this species is truly distinct from the more abundant Cuban (and probably Mexican) populations of *Roystonea regia* (HBK) O. F. Cook. The second species, *Pseudophoenix sargentii* H. Wendl. ex Sarg. subsp. *sargentii* is represented only by a few individuals remaining on Elliott Key, Long Key, and Sands Key, Florida, and probably at its two localities in Mexico and one in Belize as well. Other

populations in the Bahamas, Cuba, and Hispaniola represent a different subspecies (Read, 1968).

Africa and the Mediterranean

Africa is a continent with a limited complement of palms today, though the continent is considered to have been part of the original center of palms (Moore, 1973a). In the south, *Jubaeopsis caffra* Becc., a monotypic genus, is limited to the northern banks of two rivers in South Africa—the Msikaba and the Mtentu—where its status in terms of endangerment is presently being investigated. The genus is of particular interest both because of its apparently unspecialized nature among the cocosoid palms and also its disjunct distribution. All other genera except *Cocos* itself and one species of *Elaeis* are now restricted to the Western Hemisphere.

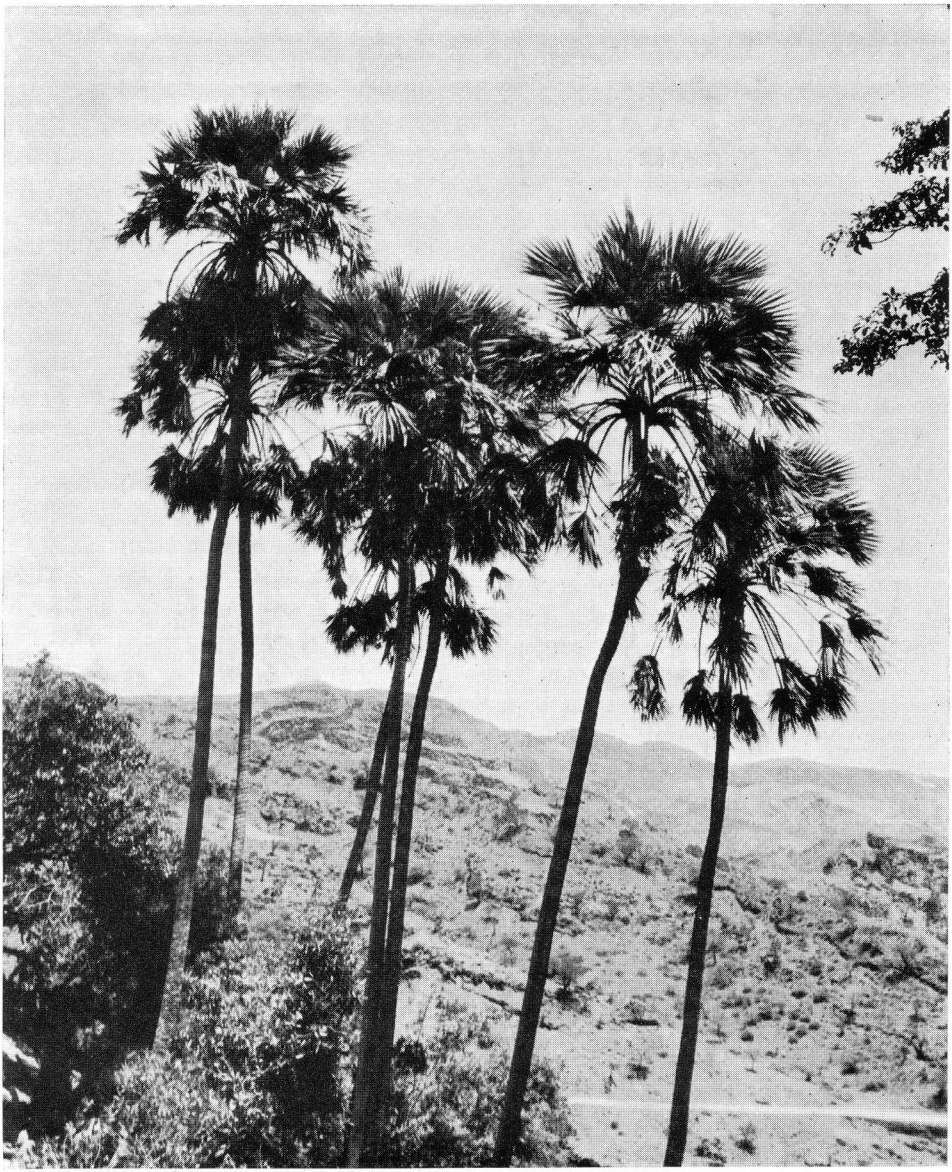
In the north, the monotypic genus *Medemia argun* is listed as endangered. It occurs as single or few individuals in three localities in Egypt and one in the Sudan (Ahti *et al.*, 1973; Boulos, 1968) and although fruits have been found in Egyptian tombs, the nature of staminate and pistillate flowers is insufficiently known. Thus the relationship between this species and *Bismarckia nobilis* Hildebrandt & H. Wendl. from Madagascar, which is sometimes considered a species of *Medemia*, cannot yet be fully understood and may never be understood if conservation is not effected.

Wissmannia carinensis (Chiov.) Burret (Fig. 3) is a third monotypic genus known from two limited regions in Africa—the Oasis of Uncad or Uncud in the Somali Republic, and a series of springs in the Monts Goda, in the Territoire Français des Afars et des Issas—and one in Arabia (Monod, 1955; Moore, 1971), although the species has recently been introduced into cultivation. The population at Uncad is reported to be much reduced while that in the Hadhramaut (Burret, 1943) is little known. If the principal population at Bankoualé is at all typical of the other six at Monts Goda, then the species is clearly endangered. At Bankoualé, about 90 individuals cluster by a trickle of water. All are mature and of substantial height. Reproduction is apparently absent because the ubiquitous goats eat every shred of green, including the fallen leaves. If a proposal to fence this population has been acted upon, then there may be some hope of limited regeneration. Since the palm has many of the ornamental attributes of *Washingtonia robusta* H. Wendl., it may ultimately be reproduced in cultivation.

The island of Crete is the home of *Phoenix theophrasti*, known from five localities along the coast, where use of the largest grove by tourists and campers prevents regeneration. Since other groves consist of only a few individuals (Barclay, 1974; Greuter, 1967), its status is vulnerable. The present extent of the sole European species, *Chamaerops humilis* L., has not been studied but its distribution is certainly more limited than formerly and a survey of localities and numbers is in order.

Asia and Indonesia

Several species of continental Asia and larger islands of Indonesia are vulnerable, endangered, or perhaps even extinct. The two species of the genus *Calospatha* from Perak, West Malaysia —*C. confusa* Furtado and *C. scortechinii* Becc.—are known only from the fragmentary type collections, each from a different mountain where some forest remains but where a recent effort to locate *C. confusa*, at least, met with



3. A small group of *Wissmannia carinensis* is framed against the forbidding desert hills among which it grows near Ronda, in the vicinity of the main population at Bankoualé, Territoire Français des Afars et des Issas.

failure. If these species are extinct, we will never have a complete understanding of the morphology or biology of the genus, which is a problematic one in terms of position among the scaly-fruited lepidocaryoid palms of the rattan group. If they are not extinct,[1] these species must surely be considered endangered.

[1] *Calospatha* was rediscovered by John Dransfield in 1977.

Ceratolobus glaucescens Bl., another rattan of more than usual interest is, so far as is known, now restricted to a single population at Sukawayana, West Java. It is estimated at 30 plants or fewer, and is about equally divided between staminate and pistillate individuals. The genus is a small one, characterized by a greatly reduced inflorescence enclosed within a prophyll that opens only at the tip. Both reproductive cycle and morphology are therefore of exceptional interest to the student of palm evolution.

One of the most primitive of palms, the monotypic coryphoid genus *Maxburretia rupicola*, is confined to three limestone hilltops within 40 km of Kuala Lumpur in West Malaysia (Whitmore, 1971), where probably fewer than 1,000 individuals now remain. These hills are relicts of an ancient calcareous mantle and have a rich endemic flora that is threatened by quarrying at Batu Caves and by fire at one or both of the other localities despite their protected status. Again, a genus now listed as vulnerable is threatened, and two of its closest relatives, also monotypic (and one as yet undescribed), are very rare indeed.[2]

All four species of another coryphoid genus, *Johannesteijsmannia* (Dransfield, 1972), appear to be threatened despite their occurrence in forest preserves and *J. altifrons* is listed as vulnerable. It does not survive clear-felling of trees, though it can survive with some damage when logging is selective. It does not appear in secondary regrowth.

The status of other species of continental Asia and Indonesia is presently being studied and a longer, perhaps much longer, list of vulnerable and endangered species is to be expected.

[2] All were combined by Dransfield into one genus, *Maxburretia*, with three species in Gentes Herbarum 11: 191. 1978.

Oceanic Islands

Some of the most unusual palms are endemic on both large and small islands, especially those of the Indian and Pacific Oceans. Two relatively large islands, Madagascar and New Caledonia, offer an interesting comparison. Madagascar, in the Indian Ocean, is about 1,000 miles long. It is of interest to the student of palms because of the large number of species there (about 115) that are described in relatively few genera. Of the 18 genera listed by Jumelle and Perrier de la Bathie (1945), five are also African (*Hyphaene*, *Borassus*, *Raphia*, *Elaeis*, *Phoenix*) and it is doubtful that even the species are distinct. One genus, the monotypic *Bismarckia*, is closely related to or sometimes even considered generically identical to the endangered *Medemia* of Africa. Twelve genera are endemic to the island or to its outliers as far north as Pemba. An added genus, *Marojejya*, was described by Humbert in 1955. Generic limits are not yet completely worked out and it is likely that there will be further consolidation among *Chrysalidocarpus*, *Neophloga*, *Neodypsis*, and *Antongilia*. Doubtless, many species of the larger genera are threatened by the unceasing destruction of forests, especially along the east coast, which in many areas has become a jungle of *Ravenala*. One of the classic localities for palms, the Forêt d'Analamazoatra near the railway station at Perinet, halfway between Tananarive and Tamatave, is now much degraded and reduced in size, with only remnants of its former palm flora remaining (Moore, 1965). *Vonitra utilis* Jumelle, known only from this forest, persists as fewer than half a dozen trees, according to my count in 1963: *V. fibrosa* (C. H. Wright) Becc. [*V. thouarsiana* (Baill) Becc.] is not to be found there, though it occurs elsewhere. *Louvelia lakatra*

Jumelle and *L. madagascariensis* Jumelle & Perr. have been searched for in vain on several occasions. *Ravenea robustior* Jumelle & Perr. is reduced to a few individuals, while *R. latisecta* Jumelle has not been seen, and the monotypic *Beccariophoenix madagascariensis* Jumelle & Perr. has apparently become extinct there, though it is reported on the Masoala peninsula.

It is the decimation of the generic representation that is particularly distressing. *Beccariophoenix* is apparently being exploited to near extinction in its remaining habitat on the Masoala peninsula, according to reports, even though it is not yet fully understood botanically. The monotypic *Masoala madagascariensis* Jumelle is known to me only from three individuals in the Forêt de Mahavinitra near Ambohitralanana, along with a limited population of the similarly monotypic *Sindroa longisquama* Jumelle, an exceptional palm that occurs elsewhere in limited numbers on the peninsula (Bernardi, 1974) and is related to *Orania* of Indomalaysia. The monotypic *Marojejya insignis* Humbert is known only from three localities—eastern slopes of Marojejy, rivière Anove on the east coast (Humbert, 1955), and in the Forêt d'Ankiririryra, where I visited the very small population in March, 1971, following directions given me by the late René Capuron. All of these monotypic genera, and probably *Louvelia* and *Vonitra* in their entirety as well, are apparently endangered.

New Caledonia in the Pacific is, in contrast, about one-fourth as long as Madagascar and much narrower. It has an extraordinary assemblage of 18 endemic genera, five of them as yet undescribed (Moore, in manuscript),[3] and about 30 species. Low population density, selective felling in the forested areas, poor agricultural quality of many soils, and the preservation of the Panié Massif in a botanical reserve, have thus far all served to relieve pressures on most New Caledonian palms. Even so, the only known population of *Kentiopsis oliviformis* Brongn. near Bourail, the small population of a new species of *Cyphophoenix* on Lifou, the populations of *Cyphophoenix elegans* (Brongn. & Gris.) H. Wendl., and an undescribed genus[4] from the Haute Mayavetch, as well as the two very limited populations of *Burretiokentia hapala* H. E. Moore, may be considered candidates for a list of protected species, all being somewhat vulnerable.

The exception to the above is the monotypic genus *Pritchardiopsis* that once grew near Prony. It was apparently cut by convicts for the cabbage and has been searched for on the ground and by helicopter without success. It must be considered extinct unless some very limited population elsewhere has escaped the intensive search.

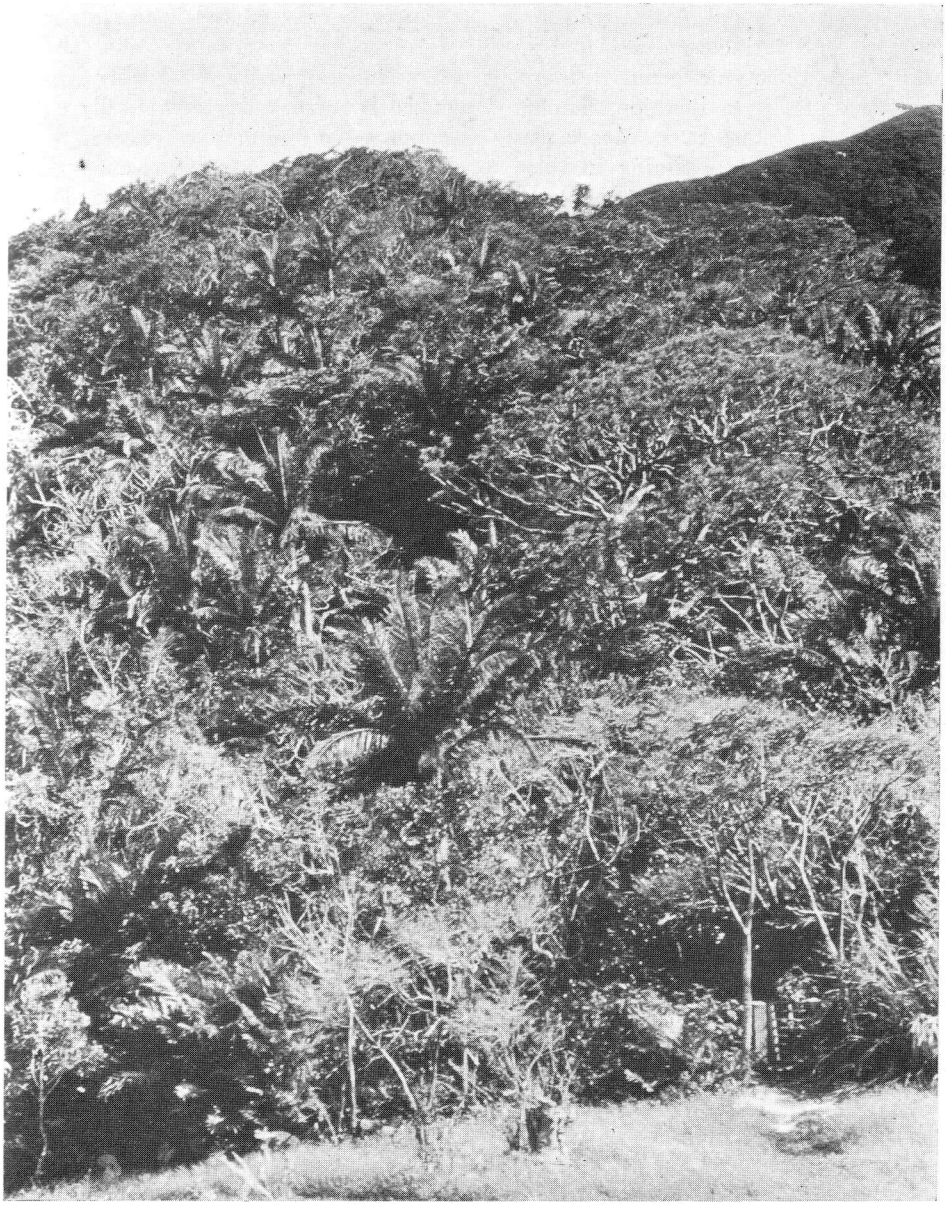
Among smaller islands, the four endemic palms of Lord Howe Island off the coast of Australia are examples of palms that are carefully husbanded by the local inhabitants as a source of commercial seed, although it is necessary to protect, with wire, the inflorescences of the small population of *Lepidorrhachis mooreana* (F. Muell.) O. F. Cook, in order to prevent loss of the seeds to rats. And in the Ryukyu Islands, the very small population of *Satakentia liukiuensis* (Hatus.) H. E. Moore (Fig. 4) on Iriomote is remote from habitations (Moore, 1969a), the population on Ishigaki (Fig. 5) has been set apart as a reserve, and plants appear to be doing well in cultivation. Although all are probably vulnerable, the indigenous palms of the

[3] Four genera have since been described in Gentes Herbarum 11: 291–309. 1978.

[4] Now described as *Mackeea magnifica*.

4. *Satakentia liukiuensis* in the wild on Iriomote, Ryukyu Islands.

Seychelles, including the extraordinary coco-de-mer, *Lodoicea maldivica*, are now protected in reserves at the Vallée de Mai and Fond Ferdinand on Praslin Island or occur (*Deckenia*, *Roscheria*) in proposed nature reserves on Mahé (Swabey, 1970). And it is to be hoped that *Neoveitchia storckii* will be protected in Fiji (Gorman and Siwatibau, 1975).



5. The population of *Satakentia liukiuensis* at Yonehara Village on Ishigaki Island consists of perhaps a thousand trees and is protected as a national monument.

Not so comforting is the situation in the Mascarenes, three islands set in the Indian Ocean, which once contained an apparently prominent complement of palms that were decimated by man many years ago for construction purposes and for food. Five genera are native to the islands—*Latania* with three dioecious species (which unfortunately hybridize in cultivation), *Hyophorbe* with five spe-

cies, *Dictyosperma* and *Acanthophoenix*, each with one variable species, and an undescribed monotypic genus (Moore, in manuscript).[5] On Réunion, *Latania lontaroides* (Gaertn.) H. E. Moore persists as individuals remaining in tilled land, *Dictyosperma album* (Bory) H. Wendl. & Drude ex Scheff. is planted and an exceptional specimen or two has been seen on nearly inaccessible cliffs. Both are endangered. Since *Hyophorbe indica* Gaertn. has a bitter cabbage and also grows in almost inaccessible places or on land unfit for agriculture, there is a series of small populations totalling more than 100 but probably fewer than 500 individuals. *Acanthophoenix* has natural populations in the Forêt de Bebour and in forested patches near the sea. Both are vulnerable, though *Acanthophoenix* is cultivated as an ornamental and is being investigated as a potential commercial source of palm heart.

Mauritius, the largest and oldest of the islands in the Mascarenes, had its own species of *Latania*, *L. loddigesii* Mart., which apparently was once abundant in coastal savannas. Today, only a few individuals persist on tiny islands off the coast—Coin de Mire and Round Island (where most regeneration is precluded by the activity of goats and rabbits)[6]—or in cultivation: its status is presently endangered. A few individuals of *Dictyosperma album* also persist on Round Island and in cultivation. Occasional young plants, in addition to an individual or two of *Acanthophoenix*, are rarely encountered in the low scrub forest at the center of Mauritius. Though these individuals were probably disseminated by birds, they are usually cut as soon as the bud is large enough to eat, and their status is therefore endangered. Three species of *Hyophorbe* are also endangered: *H. amaricaulis* Mart. is represented by a single individual (Fig. 6), which was recognized only recently; *H. lagenicaulis* (L. H. Bailey) H. E. Moore barely survives on Round Island, but is cultivated both on the main island and elsewhere; and four individuals of *H. vaughanii* L. H. Bailey are known, all in cultivation.[7] In the center of the island, 22 or 23 individuals of an undescribed genus[8] related to *Acanthophoenix* are endangered, although four of these have already been protected and many of the remainder occur in a reserve. The palm produces little fruit and has not yet been successfully brought into cultivation.

Worst of all is the island of Rodrigues, now a botanical "poorhouse." Perhaps only four or five individuals of *Hyophorbe verschaffeltii* H. Wendl. persist outside cultivation, where it is far from abundant; a few individuals of *Dictyosperma* remain in tilled land or are deliberately planted; and the few *Latania verschaffeltii* Lem. that remained in a tiny patch of forest appeared to be in distinct danger in 1972.

The Mascarenes provide a splendid example of man's destruction of genetic potential in both palms and other plants, and regrettably this example is being followed elsewhere in the world. In late 1974, I had as a field companion a recent graduate of a small college who, travelling on a fellowship, teamed up with me for two months. At one point in

[5] Now *Tectiphiala ferox* H. E. Moore in Gentes Herbarum 11: 285. 1978.

[6] An unpublished report of a study made in 1975 by five students from the University of Edinburgh indicates that there were then about 2,500 mature trees with adequate regeneration on the western slopes according to a recent communication from T. A. M. Gardner, Assistant Conservator of Forests on Mauritius.

[7] In 1977, Messrs. Andrew and T. A. M. Gardner discovered a population of about 44 wild individuals, cf. Gentes Herbarum 11: 243. 1978.

[8] Now *Tectiphiala ferox*.

6. The last individual of true *Hyophorbe amaricaulis* on Mauritius.

our travels, he asked me why I collected palms and I replied to the effect that I was trying to make a record for future generations of what had existed. There was no immediate reply, but nearly a year later, following the destruction for road materials of a *campina* area in Amazonian Brazil upon which the young man had worked, he wrote to tell me that he had thought my reply pompous at the time, but that now he understood exactly what I meant. I can only hope that enough additional humans also will understand this important message while there still is time to save some palms other than coconuts and African oil palms.

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I am indebted to the Threatened Plants Committee Secretariat for information on those palms that have been documented thus far and to John Dransfield and Victor Manuel Patiño for discussions while in Colombia. Howard H. Lyon and Donald C. Steinkraus assisted with illustrations and Lucille S. Herbert with the manuscript. Much of the background for this paper was obtained through field work undertaken in association with National Science Foundation grants GA-239, GB-1354, GB-3528, GB-7758, and GB-20348X.

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Re-evaluation of the Genus Butia With a Description of a New Species*

S. F. Glassman

Professor of Biological Sciences, University of Illinois, Chicago Circle, Box 4348, Chicago, Ill. 60680

On August 31, 1976, during a collecting trip in the state of Goias, Brazil, I was attracted by a number of medium-sized palm trees with conspicuously purplish flowers and fruits. The species was fairly common in the cerrado along both sides of the highway for a distance of about 25 km. It was especially interesting to me because of its strong resemblance to an undescribed cultivated palm (which later was considered to be an apparent hybrid) I had previously collected in the Fairchild Tropical Garden. Superficially, the palm from Goias appeared to be close to *Butia capitata*, and at first glance it was thought to be one of its varieties [var. *nehrlingiana* (L. H. Bailey) L. H. Bailey has violet-red staminate and pistillate flowers], but the petiole margins lacked teeth or spines characteristic of the genus *Butia*. Nevertheless, after searching the literature and eliminating other possibilities, I have decided to describe this palm as a new species of *Butia*.

Therefore, an amended description of the genus *Butia* is in order. The name *Butia* was originally used by Beccari (1887) as a subgenus of *Cocos*; later (1916) he elevated *Butia* to full generic status. In the latter article, he separated *Butia* from *Syagrus* by the smooth rather than sulcate spathes and spiny or toothed petiole margins instead of fibrous or smooth petiole margins.

In 1970a, I transferred the five species of *Butia* recognized by me at the time to the genus *Syagrus* because of difficulties I sometimes encountered in distinguishing smooth or striate spathes from sulcate (deeply grooved) spathes, especially in older fruiting specimens; and in 1970b, I included *Butia* as a section of the genus *Syagrus*. After completing a systematic survey of leaf anatomy in the genus *Syagrus* (Glassman, 1972b) I began to revise my thinking about having submerged *Butia* under *Syagrus*. In this study, it was revealed that all taxa with smooth or striate spathes showed a distinct arrangement of tissues, i.e., nonvascular fibers are attached to both single medium veins and separate smaller veins from both adaxial and abaxial sides (see Figs. 1–8); whereas, in most species with sulcate spathes the nonvascular fibers are not attached to medium and smaller veins from both sides. Another important fact emerged from the survey. Taxa with fibrous or smooth petiole margins, *S. archeri* and *S. hatschbachii*, seemed to have a pattern of leaf anatomy almost identical to that of species with toothed or spiny petiole margins (*S. yatay*, *S. paraguayensis*, *S. capitata*, *S. arenicola*, and *S. eriospatha*). Traditionally, *S. archeri* and *S. hatschbachii*

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would not be included in the genus *Butia* because of the fibrous or smooth petiole margins, but at the same time they would be included because of the smooth or striate spathes. In view of the above evidence (similar leaf anatomy and smooth spathes), however, it appears that the seven taxa listed above may have had a common origin and probably are more or less closely related.

Based on the above information, I am restoring *Butia* to full generic status, but emending the description to include species with fibrous or smooth petiole margins, as well as those with toothed or spiny petiole margins.

The eight species of *Butia* are treated below with all pertinent synonymy, listing of types, descriptions, citation of specimens, vernacular names, geographic distribution and discussion. One new species is described (*B. purpurascens*), one new combination is made (*B. archeri*), and a *species incertum* is restored to a "good species" status (*B. microspadix*). A total of 32 illustrations of types, other specimens, and habit photos of various species of *Butia* was published in Glassman 1970a.

BUTIA (Becc.) Becc., Agric. Colon. 10: 489. 1916; L. H. Bailey, Gentes Herb. 4: 21. 1936.

Cocos subgen. *Butia* Becc., Malpighia 1: 352. 1887.

Cocos sect. *Eucocos* Drude subsect. *Butia* Barb. Rodr., Sertum Palm. Bras. 1: 80, 89. 1903.

Syagrus sect. *Butia* (Becc.) Glassman, Fieldiana, Bot. 32: 235. 1970 (excluding *S. vagans* and *S. schizophylla*).

Lectotype: *Butia capitata* (Mart.) Becc. (vide Moore, Gentes Herb. 9: 251. 1963).

Trunks not or scarcely developed (usually with subterranean stem) or to 12 m tall, 20–50 cm in diam., covered with persistent petiole bases when erect, these eventually dehiscing; sheathing leaf base and petiole not always clearly separated, with combined length of 20–110 cm, margins of petiole armed with coarse spines 2–11 cm on lower part that gradually become shorter or tooth-like toward rachis, or margins merely fibrous and unarmed in some species; rachis of leaf 40–250 cm long, pinnae 20–83 on each side, mostly regularly arranged, middle ones 26–80 cm long, 0.4–2.5 cm wide, with obtuse, acute or acuminate, asymmetrical tips: expanded part of spathe 13–135 cm long, 2.5–16 cm wide, smooth or striate outside, mostly glaucous or brownish-pubescent, but densely brownish-tomentose in two species; branched part of spadix 10–100 cm long, rachillae 13–100 or more in number, each 6–60 cm long; flowers in groups of three, one pistillate with two adjacent staminate flowers, on lower part of rachilla, staminate flowers only on upper part of rachilla; pistillate flowers globose or globose-ovoid, 3–16 mm long, 3.5–10 mm in diam., sepals and petals more or less equal in length; upper staminate flowers 4–8 mm long, those in triads 6–13 mm long, sepals much smaller than petals; fruit globose or ovoid, 1.8–4.2 cm long, 1.0–2.8 cm in diam., persistent perianth 0.5–2.2 cm long, locules 1–3; embryo pores along sides near middle or sometimes toward base of endocarp; seeds conforming to shape of cavity, 0.7–3.0 cm long, 0.5–1.4 cm in diam.; endosperm homogeneous.

Key to Species

1. Petiole margins fibrous or smooth (without teeth or spines); fruit 1–2-chambered; pinnae mostly with acuminate tips.
   2. Small trees 1.2–4 m tall; middle pinnae 44–60 cm long, 1.6–1.8 cm wide, branched part of spadix 60–64 cm long; flowering and fruiting parts usually purplish ..... 1. *B. purpurascens*

2. Acaulescent or with very short trunk; middle pinnae 20–40 cm long, 0.3–1.0 cm wide; branched part of spadix 11–30 cm long; flowering and fruiting parts usually greenish.
   3. Spathes glaucous at maturity, expanded part 30–39 cm long; branched part of spadix 20–30 cm long; middle pinnae 36–40 cm long, 0.8–1.3 cm wide ..... 2. *B. archeri*
   3. Spathes densely brown-tomentose at maturity, expanded part 13–17 cm long; branched part of spadix 11–13 cm long; middle pinnae 20–26 cm long, 0.3–0.4 cm wide ..... 3. *B. microspadix*

1. Petiole margins spiny or dentate; fruit 1–3-chambered; pinnae mostly with obtuse or acute tips.
   4. Pistillate flowers 10–16 mm long, 6–10 mm in diam.; mature fruit 3.0–4.2 cm long; persistent perianth 1.5–2.2 cm long.
      5. Acaulescent or with trunk 1–2 m tall; leaf rachis 57–93 cm long; pinnae 40–42 on each side, middle ones 45–55 cm long, 0.8–1.5 cm wide; expanded part of spathe 40–60 cm long, 4–8 cm wide; persistent perianth of fruit 1.5–1.8 cm long ..... 4. *B. paraguayensis*
      5. Trees 8–12 m tall; leaf rachis 170–200 cm long; pinnae 68–72 on each side, middle ones 75–81 cm long, 2.0–2.4 cm wide; expanded part of spathe 115–125 cm long, 10–12 cm wide; persistent perianth of fruit 1.8–2.2 cm long ..... 5. *B. yatay*
   4. Pistillate flowers 3–8 mm long, 4–5 mm in diam.; mature fruit 1.5–2.6 cm long; persistent perianth 0.5–1.0 cm long.
      6. Spathes densely brown-tomentose at maturity, 120–135 cm long, 14–16 cm wide at anthesis ..... 6. *B. eriospatha*
      6. Spathes glaucous and glabrous or only brownish-pubescent at maturity.
         7. Acaulescent, or with very short trunk; middle pinnae 35–40 cm long, 0.8–1.1 cm wide; expanded part of spathe 30–33 cm long, 2–3 cm wide; spadix with 18–22 branches; petiolar spines short and toothlike, less than 2 mm long; fruit mostly 1-chambered ..... 7. *B. arenicola*
         7. Caulescent, with trunks to 5 m tall, 40–50 cm in diam.; middle pinnae 60–75 cm long, 1.5–2.5 cm wide; expanded part of spathe 80–100 cm long, 7.0–8.5 cm wide; spadix with 50–60 branches; petiolar spines coarse, the lower ones 8–11 cm long; fruit 1–3-chambered ..... 8. *B. capitata*

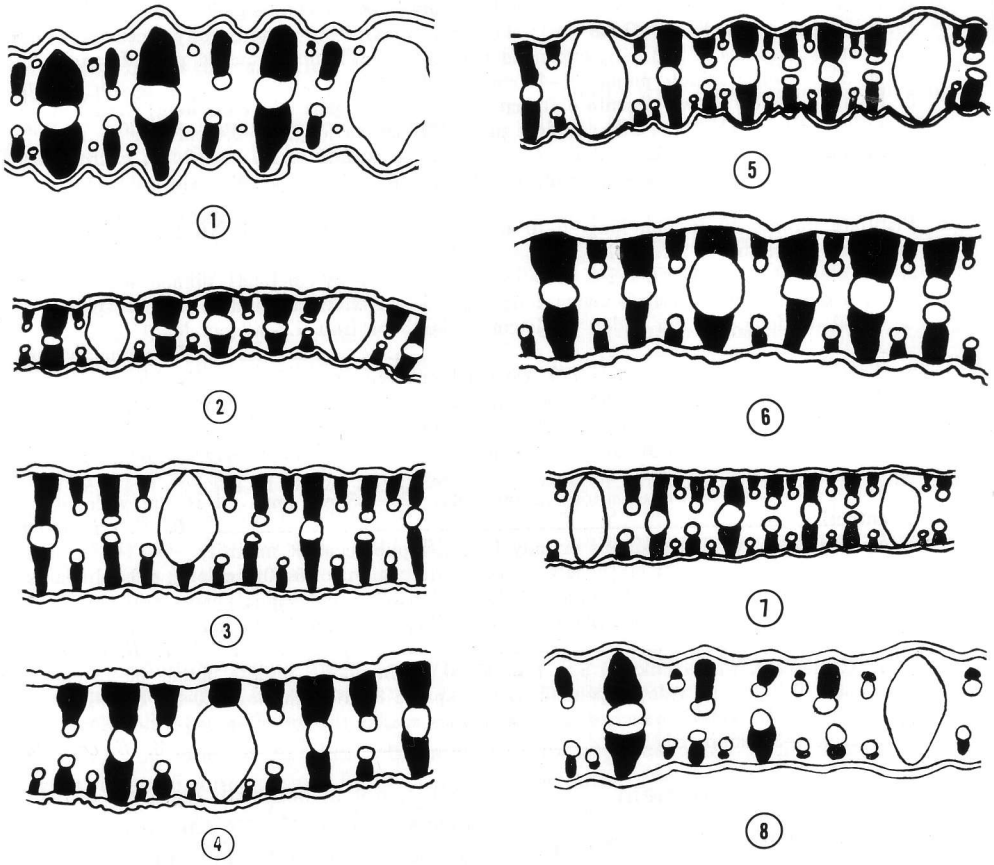
Taxonomic Treatment

1. **Butia purpurascens** Glassman, **sp. nov.**

Palma 1.2–4 m alta. Folia aequaliter pinnatisecta petiolo non dentato rachidi 84–122 cm longa pinnis utrimque 52–58. Spatha spadix flores fructus purpurascens. Spathae pars inflata non plicata 71–80 cm longa 8–9 cm lata. Flores masculi inferiores 6–7 mm longi superiores 4–4.5 mm longi; flores feminei 5–6 mm longi 4.5–5.0 mm lati. Fructus 2.3–2.9 cm longus 1.0–1.3 cm in diam.

Holotype: Brazil, Goias, near Jatai, *Glassman 13076* (CHI).

Small trees 1.2–4 m tall, about 15 cm in diam.; sheathing leaf base and petiole not clearly separated, combined length of about 49 cm; margins of petiole densely fibrous on lower half, becoming less fibrous toward base of rachis, not armed with teeth or spines; rachis of leaf 84–122 cm long; pinnae 52–58 on each side, more or less evenly spaced, middle ones 44–60 cm long, 1.6–1.8 cm wide, with long-acuminate, asymmetrical tips; expanded part of spathe frequently purplish, 71–80 cm long, 8–9 cm wide, smooth or striate, peduncular part 30–37 cm long; branched part of spadix frequently purplish, 60–64 cm long, peduncular part 41–48 cm long, rachillae about 50 or more, each 23–26 cm long; pistillate flowers more or less globose, frequently purplish, 5–6 mm long, 4.5–5 mm in diam., sepals and petals about equal in size; staminate flowers frequently purplish, lower ones 6–7 mm long, with prominent pseudopedicel and calyx 2–4 mm long, upper ones 4–4.5 mm long with calyx 1.5–2.5 mm long; fruit ovoid, usually purplish. 2.3–2.9 cm long, 1.0–1.3 cm in diam.,



1–8. Diagrams of cross sections of pinnae of various species of *Butia*. Double lines on upper (adaxial) and lower (abaxial) sides represent the upper and lower epidermis. Solid black areas represent clusters of nonvascular fibers, whereas the circles are diagrams of small-, medium- and large-sized veins. All other tissues have been omitted from the diagrams. Magnifications: Figs. 1, 3, 4, 5, 6, 8, ×55; fig. 2, ×33; fig. 7, ×42. 1, *B. yatay* from *Pedersen 4456* (GH); 2, *B. paraguayensis* from *Pedersen 3030* (GH); 3, *B. capitata* from *Glassman 8766* (CHI); 4, *B. eriospatha* from *Glaziou 8059* (K); 5, *B. arenicola* from *Hassler 3761* (G); 6, *B. archeri* from *Glassman & Gomes 8023* (CHI); 7, *B. microspadix* from *Hatschbach 11668* (F); 8, *Butia purpurascens* from *Glassman 13076* (CHI).

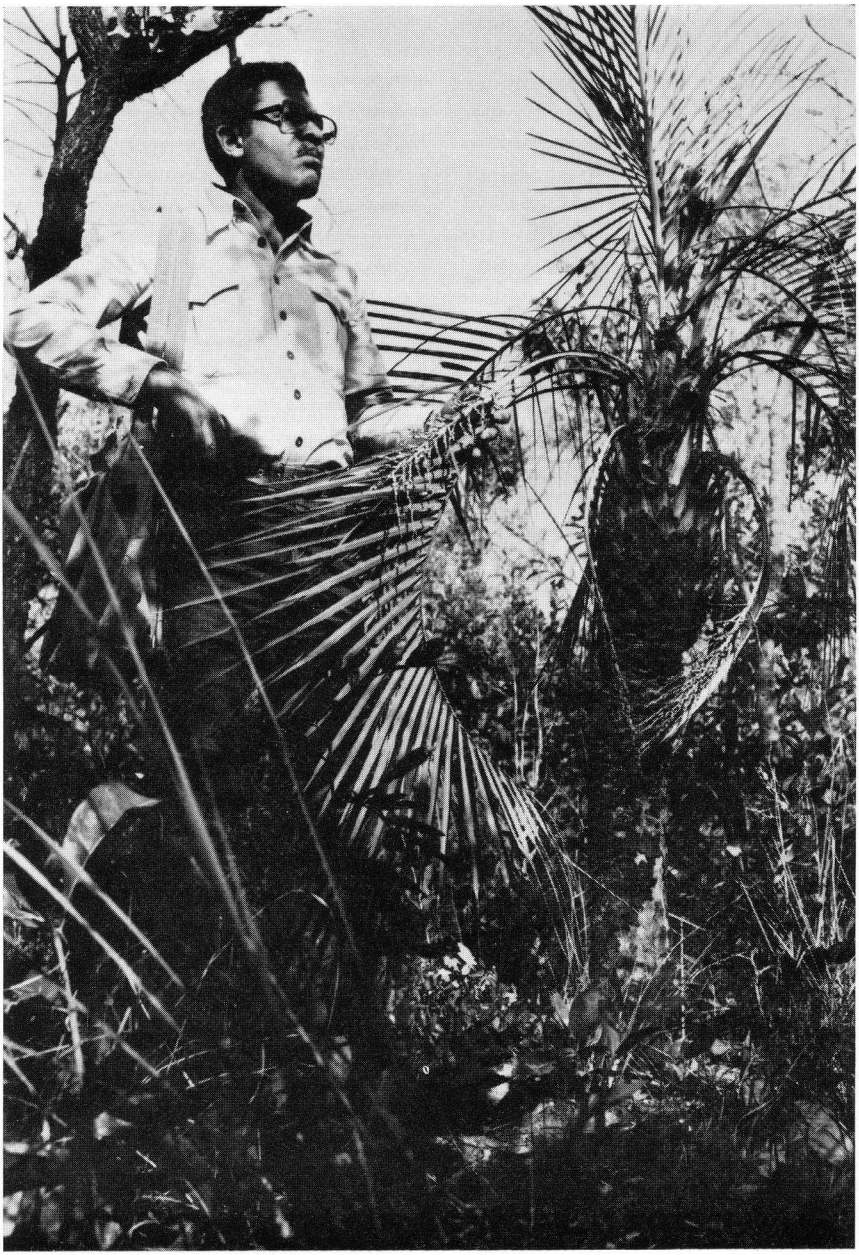
beak 4–5 mm long, persistent perianth 7–8 mm high, locules 1–2, mature seeds not seen.

Specimens examined: BRAZIL. GOIAS: 3 km N.E. of Jatai, in pasture and cerrado, common (about 400 trees seen) for about 25 km along both sides of road, spathes, spadices, flowers, and fruits mostly purplish, *Glassman 13076* (CHI, holotype); *Glassman 13075, 13077, 13079, 13080, 13081, 13082* (CHI, SP); 26 km N.E. of Rio Verde, along BR 060, dense cerrado, associated with *Syagrus flexuosa*, *Attalea*, and *Allagoptera*, rachillae and flowers purple, *Glassman 13071* (CHI, SP); and *probably* Balsamo, palma campestre, *Macedo 3321* (SP, US).

Vernacular names: none recorded.

Distribution: at present, only known from cerrados in the state of Goias.

Macedo 3321 also seems to belong to



9. *Butia purpurascens* in Goias, near type locality. Daniel Vital stands next to small but mature tree subjected to fire in the cerrado.

B. purpurascens. It is 2–4 m tall, has petiole margins free of spines or teeth, and has other morphological characteristics which match closely; but no information is given on the color of the flowers. Cross sections of the pinnae, however, reveal a tissue pattern very similar to *Butia archeri*.

The new species resembles *Butia capitata* superficially, but differs from it mainly in the smooth or fibrous rather than toothed petiole margins, the long-acuminate rather than acute or obtuse tips of pinnae, and the purplish rather than greenish spathes, spadices, flowers, and fruits. It is assumed that the purplish color is due to anthocyanin pigments. When specimens were dried, some lost all of their purple color whereas others retained some or most of their color.

From a morphological standpoint, *Butia purpurascens* seems to be most closely aligned to *B. archeri* because both taxa have smooth (not toothed) petiole margins, long-acuminate tips to the pinnae, staminate and pistillate flowers similar in size, and fruits similar in size, shape and number of locules. *Butia archeri*, as described by me (1968), differs primarily in being mostly acaulescent, in the smaller dimensions of leaves, spathes, and spadices, and in the lack of the purplish color in flower and fruit parts.

As I had expected, an examination of cross sections of the pinnae of *B. purpurascens* (*Glassman 13076*) reveals that its anatomical pattern matches the other seven species of *Butia* very closely, thus confirming its placement within this group.

2. **Butia archeri** (Glassman) Glassman, **comb. nov.**

Syagrus archeri Glassman, Fieldiana, Bot. 31: 235, *fig. 1.* 1967.

Holotype: Brazil, Minas Gerais, near Lavras, *W. A. Archer 4048* (A).

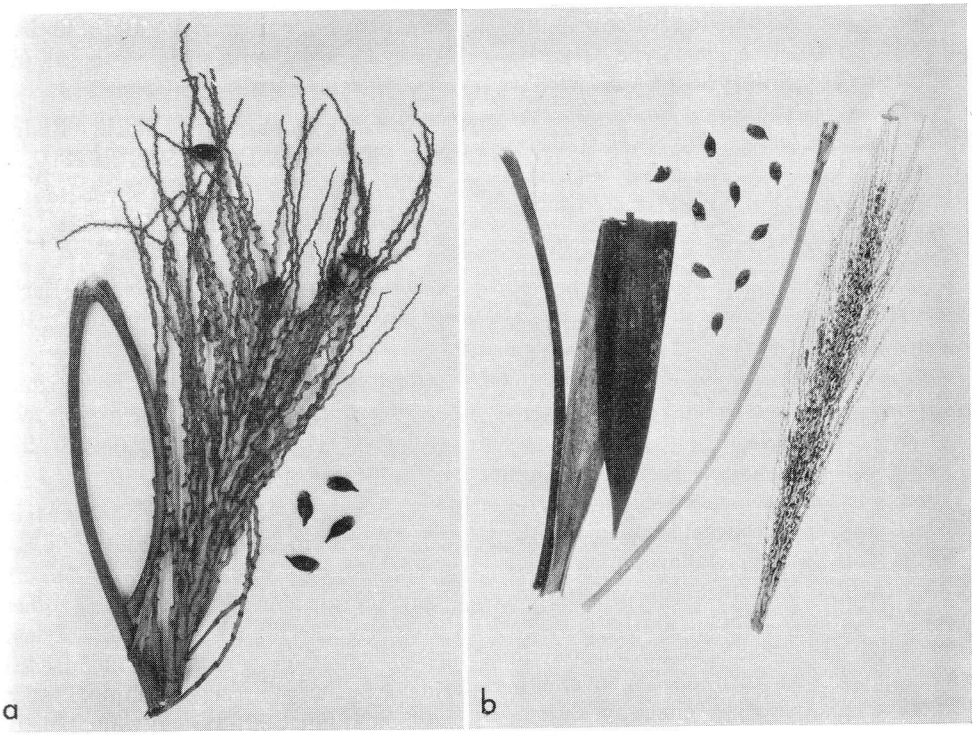
Acaulescent or sometimes with a short trunk up to almost 1 m high; sheathing leaf base 13–15 cm long; petiole 8–9 cm long and 1 cm wide, margins not spiny, merely fibrous; rachis of leaf 66–72 cm long; pinnae 28–44 on each side, regularly arranged, middle ones 36–40 cm long, 0.8–1.3 cm wide, mostly with acuminate, asymmetrical tips; expanded part of spathe 30–39 cm long, 3 cm wide, smooth or striate, glaucous, peduncular part 30 cm long; branched part of spadix 20–30 cm long, rachillae 15–31, each 10–19 cm long, peduncular part of spadix 36 cm long; pistillate flowers rounded or ovoid, 4–7 mm long, 4–6 mm in diam., sepals and petals with obtuse tips; staminate flowers 5–7 mm long on lower part of rachilla, 3–5 mm long on upper part; mature fruit 1.8–2.0 cm long, 1.0–1.4 cm in diam., short-beaked, persistent perianth 8–10 mm high, endocarp woody, 1–1.5 mm thick, locules 1–2; seed (when single) irregularly globose, 7–9 mm long and 7–9 mm in diam., or when two are present flattened laterally, 10 mm long, 6 mm in diam.

Specimens examined: BRAZIL. MINAS GERAIS, near Lavras, *Archer 4048* (A, holotype; BH, MO, NY, US, isotypes); 16 km N. of Lavras, campo natural, *Glassman & Gomes 8018, 8019, 8020, 8021, 8022, 8023, 8024* (CHI); 10 km N. of Diamantina, associated with *Allagoptera*, in campo rupestre, common, about 50 plants seen, *Glassman 13001* (CHI). SÃO PAULO, Casa Branca, *O. Handro 313* (SP). GOAIS, Serro do Caiapó, 35 km S. of Caiaponia, *H. S. Irwin & T. R. Soderstrom 7750* (BH, NY, US); 9.5 km S.E. of center of Brasilia, D. F., in tree and scrub woodland cerrado, *G. Eiten 13062* (CHI).

Vernacular names: none recorded.

Distribution: native to Brazil in the states of Minas Gerais, São Paulo, and Goias, in grassland pastures and cerrados.

This taxon can be easily distinguished from other acaulescent species of *Butia* (e.g., *B. arenicola* and *B. paraguayensis*) by its smooth rather than dentate petiole margins; and from *B. microspadix* by



10. *Butia purpusascens*. a, holotype, showing fruiting spadix and dark (purplish) fruits; b, part of flowering spathe of *Glassman 13081* (CHI), showing dark (purplish exterior and light brown interior, separate fruits, and flowering spadix with long stalk.

the more or less glabrous rather than densely tomentose spathes.

3. **Butia microspadix** Burret, Notizbl. Bot. Gart. Berlin-Dahlem 10: 1050. 1930.

Holotype: Brazil, without locality, probably state of São Paulo, *Sellow s.n.* (B, destroyed); Paratype: Brazil, campos, without locality, *J. N. Keller s.n.* (B, destroyed); Lectotype: Brazil, Rio Grande do Sul, *Luederwaldt s.n.* (SP 12267).

Syagrus hatschbachii Glassman, Fieldiana, Bot. 31: 240, *fig. 3.* 1967.

Holotype: Brazil, Paraná, Castro, Carambei, campo seco, *G. Hatschbach 11668* (F).

Acaulescent; sheathing leaf base not seen, petiole 9–10 cm long, 0.5 cm wide, margins not spiny, merely fibrous, rachis of leaf 41–74 cm long, pinnae 19–20 on each side, regularly arranged at intervals of 1.5–3 cm, middle pinnae 20–26 cm long, 0.3–0.4 cm wide, mostly with acuminate, asymmetrical tips; expanded part of spathe 13–17 cm long, 2.5–3.5 cm wide, smooth or striate, covered with dense dark brown tomentum; branched part of spadix 11–13 cm long, rachillae 13–15, each 6–11 cm long; pistillate flowers rounded or ovoid 4–5 mm long, 3.5 mm in diam., sepals and petals with obtuse and emarginate tips; staminate flowers 4–7 mm long, sepals unequal in size, 1–4 mm long; fruit 2 cm long, 1.1 cm in diam., beak 4 mm long, locule 1, endocarp woody, about 1 mm thick, cavity smooth within, trivittate, seed not seen.

Specimens examined: BRAZIL. RIO GRANDE DO SUL (see lectotype above); PARANÁ (see holotype of *S. hatschbachii* above); Munic. Ponta Grossa, Vila Velha, *Clarissa Rolfs s.n.* (BH); *L. B. Smith & R. M. Klein 14890* (US); Parque Vila Velha, Rio Arroio Guavirova, campo limpo. *G. Hatschbach 8091* (RB, US).

Vernacular names: none recorded.

Distribution: Brazil, mostly confined to the state of Paraná where it seems to be fairly common in grasslands; also in the state of Rio Grande do Sul, and perhaps São Paulo.

After describing *S. hatschbachii* I found a specimen labelled *Butia microspadix* that had been determined by M. Burret (see lectotype above for data). Even though immature, this specimen matches *S. hatschbachii* fairly closely, as well as Burret's description of *B. microspadix*. As mentioned above, the holotype and paratype cited by Burret were apparently destroyed in the Berlin herbarium. Burret also listed another specimen "very near to this species": Brazil, São Paulo, Raiz da Serra (leg. *Luederwaldt*—com. F. C. Hoehne n. 12267). Although the institutional herbarium sheet numbers are the same (12267) in both specimens, they may not be duplicates of each other because each one bears different collecting data. At any rate, I have not been able to locate the specimen cited by Burret (from São Paulo, Raiz da Serra); hence, I have designated the specimen which I have seen (from Rio Grande do Sul) as the lectotype.

Previously, I had designated *Butia microspadix* as *species incerta* (Glassman, 1968, 1970a) because the *Luederwaldt* specimen is immature and Burret's description did not match the specimen to my satisfaction. After examination of other collections, I am now convinced that this specimen is *Butia microspadix*.

4. **Butia paraguayensis** (Barb. Rodr.) L. H. Bailey, Gentes Herb. 4: 47. 1936.

Cocos paraguayensis Barb. Rodr., Palm. Nov. Parag. 9, *t. 2.* 1899.

Syagrus paraguayensis (Barb. Rodr.) Glassman, Fieldiana, Bot. 32: 151, *figs. 13–17.* 1970a.

Butia yatay var. *paraguayensis* (Barb. Rodr.) Becc., Agric. Colon. 10: 503. 1916.

Lectotype: Paraguay, in rupestribus Cordillera de Altos, *Hassler 896* (G). (Cf. Glassman 1970a, p. 151, *figs. 13–14.*)

Acaulescent, or with trunk 1–2 m tall, 10–20 cm in diam.; sheathing base about 20 cm long, petiole 45–48 cm long, margins mostly with short spines interspersed with fibers; rachis of leaf 57–93 cm long; pinnae 40–42 on each side, regularly arranged, middle ones 45–55 cm long, 0.8–1.5 cm wide, mostly with acute, asymmetrical tips; expanded part of spathe 40–60 cm long, 4–8 cm wide, smooth or striate, brownish-pubescent at first, becoming glabrous with age; branched part of spadix 35–38 cm long, rachillae 38–43, each 20–23 cm long; pistillate flowers ovoid, 10–16 mm long, 6–9 mm in diam.; lower staminate flowers 8–13 mm long, upper ones 4–7 mm long; mature fruit ovoid 3.0–3.7 cm long, 2.1–2.3 cm in diam., beak conspicuous, angled, persistent perianth 1.5–1.8 cm high, locules 1–3, mature seeds not seen.

Specimens examined: PARAGUAY. Cordillera de Altos, *Hassler 896* (G, lectotype; K, NY, isolectotypes); *Fiebrig 62* (G); Centurion, dry grassy area, *Fiebrig 4097* (G, GH, K, M); without locality, in campos, *Jorgensen & Hassler 4185* (A, C, F, NY, S). ARGENTINA. CORRIENTES: Dept. Mburucuyá, Loma Alta, *T. M. Pedersen 3030* (G, GH, K, NY, S): Dept. Ituzaingo,

3 km W. of Virasoro, campestre, *Maruñak 168* (F); Isla Apipe Grande, Puerto San Antonio, in palma yatay poñi, *Krapovickas et al. 24195* (F); 45 km E. of Ituzaingo, campos altos, *A. Schinini et al. 11255* (F): Dept. Capital, Arroyo Riachuelo, in lomadas arenosas, *A. Schinini et al. 9460* (F). BRAZIL. SANTA CATARINA, 35 km N. of Itajai, orillas del mar, *Krapovickas et al. 23078* (F); SÃO PAULO, Moji-Guaçu, Fazenda Campininha, cerrado, *Kuhlmann 3924* (SP); 4 km S. of Emas, cerrado, *Glassman 8746, 8747* (CHI): Pirassununga, Emas, cerrado desprotegido, *J. T. Costa 0178* (IPA); MATO GROSSO, 28 km S. of Sidrolandia, vic. of Fazenda Santa Luzia, pasture, associated with *Syagrus graminifolia*, browsed by cattle, *Glassman 13095, 13096* (CHI).

Vernacular names: *yatay guazu* (Paraguay), *yatay poñi* (Argentina), *coco amargoso* (São Paulo, Brazil).

Distribution: Paraguay, Argentina (province of Corrientes) and Brazil (states of Santa Catarina, São Paulo, and Mato Grosso) in campos, cerrados and pastures.

Butia paraguayensis is apparently closely related to *B. yatay*, and may only be a variety of this species. At present, it can be distinguished mainly by its generally smaller dimensions (except for the similarity in size of pistillate flowers).

5. **Butia yatay** (Mart.) Becc., Agric. Colon. 10: 498, *t. 6.* 1916.

Cocos yatay Mart., Palmet. Orbign. 93, *t. 1, fig. 1, t. 30B.* 1844.

Syagrus yatay (Mart.) Glassman, Fieldiana, Bot. 32: 157, *figs. 18–24.* 1970a.

Lectotype: Argentina, prov. Corrientes (Martius, 1844, *t. 30B*). (Cf. Glassman 1970a, p. 157, *fig. 18.*)

Trees (2–) 8–12 m tall, about 40 cm in diam., old petiole bases persistent on trunk when young, eventually dehiscing completely; sheathing base 58–60 cm long, petiole 50–70 cm long, margins armed with coarse spiny teeth about 3 cm long on lower part, teeth becoming gradually smaller on upper part; rachis of leaf 170–200 cm long, pinnae 68–72 in each side, regularly arranged, middle ones 75–81 cm long, 2.0–2.4 cm wide, mostly with acute, asymmetrical tips; expanded part of spathe 115–125 cm long, 10–12 cm wide, smooth or striate, more or less glaucous outside; branched part of spadix 78–82 cm long, rachillae numerous (100 or more), each 30–32 cm long; pistillate flowers ovoid, 10–16 mm long, 6–10 mm in diam.; lower staminate flowers 8–13 mm long, those above 5–8 mm long; mature fruit ovoid 3.0–4.2 cm long, 2.5–2.8 cm in diam., with prominent, conical beak, persistent perianth 1.8–2.2 cm high, locules 1–3, seeds 2.5–3.0 cm long, 1.2–1.4 cm in diam.

Specimens examined: ARGENTINA. CORRIENTES: Goya *Curran s.n.* (US); Dept. Santo Tomé, 8 mi E. of Virasoro, *Maruñak 173* (F); Dept. Capital, 2 km de R. 12, *Maruñak 180* (F); Dept. Mburucuyá, Estancia Santa Teresa, forming extensive groves, *T. M. Pedersen 4456* (GH, NY, S); ENTRE RIOS: Concordia, *Castellanos 31-974* (K); Dept. Loreto, Rio Yabebiry, *L. Ekman s.n.* (A). URUGUAY. PAYSANDÚ, N. of Quebracho, *H. H. Bartlett 21175* (US). CULTIVATED, *Herter 346* (F, G, NY, S, SP).

Vernacular name: *yatay.*

Distribution: native to northeastern Argentina in the provinces of Misiones, Santa Fe, Corrientes, and Entre Rios, forming great forests in sandy areas; and to Uruguay in the departments of Paysandú and Rio Negro, in sandy soils.

Butia yatay is easily distinguished from other arborescent species of *Butia* by the relatively large pistillate flowers

(10–16 mm vs. 3–8 mm long). Its geographic range apparently does not overlap with that of *B. capitata*, *B. eriospatha*, or *B. purpurascens*. However, *B. yatay* is sympatric with *B. paraguayensis* in at least part of its range (in Corrientes and probably Misiones) and may be confused with the latter species during its immature, acaulescent stage of growth.

Crovetto and Piccinini (1951) did an ecological study of 13 different stands (palmares) of *Butia yatay* in northern Argentina (provinces of Entre Rios, Corrientes, and Santa Fe). At first, they believed that these palmares represented a stage in the psammosere succession because the plants grew in sandy soil. After intensive studies, however, they concluded that the *Butia yatay* community was not involved in the formation of the regular climax of the region, but was independent of the typical succession of that area. Hence, these palmares were interpreted as being a relict climax, or an ancient vegetation type left over from a previous geological period when climate conditions were perhaps different than they are today.

6. **Butia eriospatha** (Mart. ex Drude) Becc., Agric. Colon. 10: 496. 1916.

Cocos eriospatha Mart. ex Drude in Martius, Fl. Bras. 3: 424. 1881.

Syagrus eriospatha (Mart. ex Drude) Glassman, Fieldiana, Bot. 32: 145. 1970.

Lectotype: Brazil, Rio Grande do Sul, *Glaziou 8059* (K). (Cf. Glassman 1970a, p. 145, *fig. 11.*)

Trees 3–6 m tall, 45–50 cm in diam.; sheathing leaf base partially covered with a dense brownish tomentum, petiole 90–100 cm long, margins of petiole armed with short teeth or spines 1–3 cm long; rachis of leaf 2.0–2.5 m long; pinnae 50–55 on each side, regularly arranged, middle ones 70–80 cm long, 2.0–2.3 cm wide, with acute asymmetrical tips; expanded part of spathe 120–135 cm long, 14–16 cm wide, smooth or striate, covered with a dense brownish tomentum; branched part of spadix 90–100 cm long, rachillae numerous, each 35–42 cm long; pistillate flowers rounded, 3–5 mm long, 3.5–5 mm in diam.; staminate flowers 6–8 mm long below, those above 4–5 mm long; fruit mostly globose, 1.8–2.0 cm long, 1.4–2.2 cm in diam., with short beak, persistent perianth 0.2–0.4 cm high, locules 1–3, seed globose, 1.4–1.6 cm in diam. or oblong, 1.5 cm long, 1 cm in diam.

Specimens examined: BRAZIL. RIO GRANDE DO SUL: *Glaziou 8059* (K, lectotype; C); SANTA CATARINA: Ponte Alta do Sul, *Krapovickas et al. 23065* (F). CULTIVATED. BRAZIL: *Luederwaldt s.n.* (SP 6.191), *A. S. Lima 6748* (SP), *Glaziou 8050* (G). UNITED STATES: Florida, *A. Rehder s.n.* (A). TANZANIA: Research Station, Amani, *P. J. Greenway 1039* (K). CUBA: *Jack 8296* (A, NY).

Vernacular names: *butia*, *macuma*.

Distribution: Brazil, in the states of Rio Grande do Sul and Santa Catarina, in woodlands and campos.

This taxon has a more restricted geographical range than *Butia capitata*, but can be readily differentiated from it by the densely tomentose rather than the more or less glabrous spathes.

7. **Butia arenicola** (Barb. Rodr.) Burret, Notizbl. Bot. Gart. Berlin-Dahlem 10: 1051. 1930.

Cocos arenicola Barb. Rodr., Sertum Palm. Bras. 1: 100, *t. 75B.* 1903.

Syagrus arenicola (Barb. Rodr.) Frambach ex Dahlgr., Field Mus. Nat. Hist., Bot. Ser. 14: 264, 1936; Glassman, Fieldiana, Bot. 32: 136, *fig. 1.* 1970.

Holotype: Paraguay, alto planitie arenosa ad Cordillera de Altos, *Hassler 3761* (G).

Acaulescent, subterranean stem 5 cm long and 8 cm in diam.; sheathing leaf base 17 cm long, petiole 20–23 cm long, 1 cm wide at base, margins mostly with short spines interspersed with fibers; rachis of leaf 80–93 cm long; pinnae 35–37 on each side, regularly arranged, middle ones 35–40 cm long, 0.7–1.1 cm wide, mostly with acute, asymmetrical tips; expanded part of spathe 30–33 cm long, 2–3 cm wide, smooth or striate, glaucous or brownish-pubescent on outside, becoming eglaucous or glabrous with age; branched part of spadix 26–28 cm long, rachillae 18–22, each 15–18 cm long; pistillate flowers rounded or ovoid, 5–8 mm long, 4–5 mm in diam.; lower staminate flowers 8–10 mm long, those above 4–7 mm long; fruit (immature) ovoid, 2.0–2.3 cm long, 1 cm in diam., short-beaked, persistent perianth 1.0–1.5 cm high; seeds not seen.

Specimens cited: PARAGUAY. Cordillera de Altos, *Hassler 3761* (G, holotype; NY, isotype); Moquinia Wald, *Chodat 740* (G); Valenzuela, *Balansa 4773* (G). BRAZIL. MATO GROSSO: Jaraguay, Campo Grande, *Archer & Gehrt 178* (US); MINAS GERAIS: Uberova, *Regnell 1288a* (S); Ponto Novo, *Macedo 2401* (US).

Vernacular name: *coquerinho.*

Distribution: Paraguay; and Brazil, in the states of Mato Grosso and Minas Gerais, in campos and pastures.

Butia arenicola is probably most closely related to *B. capitata*, and may only be an acaulescent variety of this species. At present, it can be distinguished mainly by its generally smaller dimensions.

8. **Butia capitata** (Mart.) Becc., Agric. Colon. 10: 507. 1916.

Cocos capitata Mart., Hist. Nat. Palm. 2: 114, *t. 78–79.* 1826.

Syagrus capitata (Mart.) Glassman, Fieldiana, Bot. 32: 143, *figs. 4–9.* 1970a.

Lectotype: Brazil, Minas Gerais, campis, *Martius s.n.* (M). (cf. Dahlgren, 1959, *pl. 83.*)

Cocos elegantissima Chabaud, Rev. Hort. 77: 516. 1905.

Butia capitata var. *elegantissima* (Chabaud) Becc., Agric. Colon. 10: 517. *t. 12.* 1916.

Lectotype: Cult. in garden of C. Lemarchand à l'Artaude, near Toulon, France, *Chabaud s.n.* (FI).

Cocos erythrospatha Chabaud, Rev. Hort. 77: 516. 1905.

Butia capitata var. *erythrospatha* (Chabaud) Becc., Agric. Colon. 10: 515, *t. 7A.* 1916.

Lectotype: Cult. on property of C. Lemarchand à l'Artaude, common in Pradet, near Toulon, *Chabaud s.n.* (FI).

Cocos lilaceiflora Chabaud, Rev. Hort. 77: 516. 1905.

Butia capitata var. *lilaceiflora* (Chabaud) Becc., Agric. Colon. 10: 518. 1916.

Lectotype: Cult. in public garden, Toulon, *Chabaud s.n.* (FI).

Butia nehrlingiana L. H. Bailey, Hortus 105. 1930.

Butia capitata var. *nehrlingiana* (L. H. Bailey) L. H. Bailey, Gentes Herb. 4: 33, *fig. 17.* 1936.

Lectotype: Cult. on residence of Mr. Henry Nehrling, Gotha, Florida, *Bailey 13122* (BH).

Cocos odorata Barb. Rodr., Pl. Nov. Cult. Jard. Bot. Rio de Jan. 1: 11, *t. 4A.* 1891; Sertum Palm. Bras. 1: 92, *t. 68A.* 1903.

Butia capitata var. *odorata* (Barb. Rodr.) Becc., Agric. Colon. 10: 513. 1916.

Lectotype: Brazil, in campis ad Rio

Grande do Sul, cult. in Jard. Bot. Rio de Janeiro no. 64 (Barb. Rodr. 1891, *t. 4A*). (Cf. Glassman 1972a, p. 92.)

Cocos pulposa Barb. Rodr., Pl. Nov. Cult. Jard. Bot. Rio de Jan. 1: 14, *t. 4B*. 1891; Contr. Jard. Bot. Rio de Jan. 2: 38, *t. 3, fig. B, a–c*. 1901; Sertum Palm. Bras. 1: 93, *t. 68C*. 1903.

Butia capitata var. *pulposa* (Barb. Rodr.) Becc., Agric. Colon. 10: 516. 1916.

Lectotype: Brazil, Rio Grande do Sul, in campis ab S. Sepé, Jaguarão et Caçapava and cult. in Jard. Bot. Rio de Jan. no. 454 (Barb. Rodr. 1903, *t. 68C*). (Cf. Glassman 1972a, p. 93.)

Butia capitata var. *strictior* L. H. Bailey, Gentes Herb. 4: 32, *fig. 18*. 1936.

Holotype: Cult. at home of Mrs. Danforth, Pasadena, Calif., *Bailey 389* (BH).

Butia capitata var. *subglobbosa* Becc., Agric. Colon. 10: 513, *t. 10A*. 1916.

Type: No locality or specimens listed. Based on a tree confused with *Cocos coronata* by Chabaud (1905, 1906).

Butia capitata var. *virescens* Becc., Agric. Colon. 10: 519. 1916.

Type: Cult. in School of Pomology and Horticulture, Cascine de Firenze (no specimens cited).

Trees 3–5 m tall, 40–50 cm in diam.; complete sheathing leaf base not seen, petiole 70–88 cm long; 4–7 cm wide at base, margins mostly armed with fairly short teeth on upper portion, coarsely spiny on lower part and adjacent sheathing base, spines 8–11 cm long; rachis of leaf 150–183 cm long; pinnae 63–80 on each side, regularly arranged, middle ones 60–75 cm long, 1.5–2.5 cm, with oblique, asymmetrical tips; expanded part of spathe 80–100 cm long, 7.0–8.5 cm wide, smooth or striate, more or less glaucous, becoming eglaucous with age; branched part of spadix 85–94 cm long, rachillae 50–60, 62–69 cm long; pistillate flowers rounded or ovoid, 4–8 mm long, 4–6 mm in diam.; lower staminate flowers 7–10 mm long, those above 4–7 mm long; mature fruit orange, with soft mesocarp when ripe, ovoid, 1.8–2.6 cm long, 1.5–2.2 cm in diam., with short beak, persistent perianth 0.4–0.6 cm high, locules 1–3, seed ovoid or triangular, 1.8–2.4 cm long, 1.0–1.4 cm in diam.

Specimens examined: BRAZIL. MINAS GERAIS: campis, *Martius s.n.* (M, lectotype—two spadix parts); Minas Gerais, *Martius s.n.* (M, leaf and spathe parts); PARANÁ: Tamandaré, in campo, *G. Jonsson 985a* (F, G, K, NY, S); SANTA CATARINA: Sombrio, in campo, *P. R. Reitz 2965* (G); RIO GRANDE DO SUL: *Glaziou 8047* (C, K); *Glaziou 9334* (FI). URUGUAY. ROCHA: Castillos, *Herter 346B* (F, G, GH). CULTIVATED. ARGENTINA: Tucuman, *Venturi 5594* (US). URUGUAY: Montevideo, *Herter 346a* (F, G, GH, LE, NY, S). BRAZIL: Rio de Janeiro, *Glaziou 9334* (C, LE), *16481* (C, G, K, LE), *20535* (C, K), *Dahlgren & Millar s.n.* (F—611648). UNITED STATES: Fairchild Tropical Garden, Coral Gables, Florida, *Glassman 8766* (CHI); Gotha, Florida, Nehrling's place, *Bailey 13122* (BH, lectotype of *Butia nehrlingiana*); Pasadena, California, Mrs. Danforth's home, *Bailey 389* (BH, holotype of *Butia capitata* var. *strictior*).

Vernacular names: *cabeçudo, guariroba do campo.*

Distribution: Brazil, in the states of Minas Gerais, Paraná, Santa Catarina, and Rio Grando de Sul, in woodlands and campos; and Uruguay, in the department of Rocha in woodlands.

This species is the most widely culti-

vated in *Butia* as evidenced by the large number of varieties described. Bailey (1936) constructed a key to six of the ten varieties of *Butia capitata* listed by me in synonymy. Until I can study these varieties more thoroughly in botanical gardens and other cultivated areas, I am not going to recognize them as distinct taxonomic entities.

DOUBTFUL OR UNCERTAIN SPECIES

Butia amadelpha (Barb. Rodr.) Burret, Notizbl. Bot. Gart. Berlin-Dahlem 10: 1050. 1930.

Cocos amadelpha Barb. Rodr., Palm Hassler. Nov. 7. 1900; Sertum Palm. Bras. 1: 98, *t. 72*. 1903.

Syagrus amadelpha (Barb. Rodr.) Frambach ex Dahlgr., Field Mus. Nat. Hist., Bot. Ser. 14: 264. 1936.

Holotype: Paraguay, Capibary, *Hassler 6083* (G, destroyed?).

Unfortunately, the holotype could not be found at Geneva where the bulk of Hassler's specimens are deposited. The description (acaulescent, smooth spathes and flowers 14–15 mm) is close to that of *Butia paraguayensis*, but petioles and fruits are neither described nor illustrated. Therefore, the identity of *Butia amadelpha* is uncertain.

Butia bonnetii Becc., Agric. Colon. 10: 504, *t. 5, figs. 4–6*. 1916.

Type: Cult. in Hyeres, France by Linden from seeds received from Mexico (no specimens cited).

Originally published under *Cocos bonneti* Linden by Wendland (1878) as a name only. Beccari (1916) validated the specific epithet by including a description of it under *Butia*, but no specimens were cited. He compares this taxon with *Butia capitata* as having smaller dimensions. Because of a lack of specimens and an inadequate description to distinguish it from *B. capitata*, I am considering *B. bonneti* as an uncertain species. A number of trees cultivated under this name probably belong to *B. capitata*.

Butia dyerana (Barb. Rodr.) Burret, Notizbl. Bot. Gart. Berlin-Dahlem 13: 696. 1937.

Cocos dyerana Barb. Rodr., Bull. Herb. Boissier, ser. 2 (3): 626. 1903.

Syagrus dyerana (Barb. Rodr.) Becc., Agric. Colon. 10: 416. 1916.

Holotype: Paraguay, in campis arenosis prope Concepcion, *Hassler 7166* (G).

The type specimen (consisting of parts of an inflorescence and a leaf) resembles *B. paraguayensis*, but I cannot be certain of its true relationships because this taxon lacks petioles, spathes and fruits.

Butia leiospatha (Barb. Rodr.) Becc., Agric. Colon. 10: 520. 1916.

Cocos leiospatha Barb. Dodr., Rev. Hort. 2: 23, *fig. 7*. 1877; Sertum Palm. Bras. 1: 81, *t. 61A, 62B*. 1903.

Cocos capitata var. *leiospatha* (Barb. Rodr.) Berger, Hort. Mort. 87. 1912.

Lectotype: Brazil, Minas Gerais, Serra do Aguapé (*t. 61A*, 1903). (Cf. Glassman 1972a, pp. 91–92.)

No specimens were cited by Barbosa Rodrigues in either article, hence the selection of *t. 61A* as lectotype. Originally, he described this palm as acaulescent, but illustrated a fairly large tree (1877, fig. 7). The description is close to that of *B. capitata* or *B. arenicola*, but not clear enough for either species.

This taxon belongs in the uncertain category because of the absence of authentic specimens, and the descriptions and illustrations are insufficient to delineate it as a clear cut species.

Butia poni (Haum.) Burret, Notizbl. Bot. Gart. Berlin-Dahlem 10: 1051. 1930.

Cocos poni Haum., Physis 4: 604, *figs. 1, 2.* 1919.

Lectotype: Argentina, Misiones, savannas and campos, San Ignacio (Hauman, *figs. 1, 2,* cf. Glassman 1972a, p. 93).

Besides its smaller dimensions, Hauman distinguished this palm from *Butia yatay* because it flowered and fruited before forming a trunk, whereas *B. yatay* does not flower until its trunk is about 2 m tall. Both species exist in the same campos of San Ignacio. Even though *B. poni* may be synonymous with *B. paraguayensis* ("*yatay-poñi*" is one of its vernacular names), I prefer to consider it as an uncertain species because of the absence of specimens and because of an inadequate description which essentially consists of a comparison with *B. yatay.*

Butia pungens Becc., Agric. Colon. 10: 523. 1916.

Holotype: Argentina, Campina de America, Feb. 1907, *Spegazzini s.n.* (FI, destroyed?).

This taxon is probably synonymous with *B. paraguayensis* since it matches its general description, but I hesitate to make this designation because of the possibility that *B. pungens* may represent an immature growth stage of *B. yatay.*

Butia stolonifera (Barb. Rodr.) Becc., Agric. Colon. 10: 492. 1916.

Cocos stolonifera Barb. Rodr., Contr. Jard. Bot. 2: 40, *t. 4, fig. 4.* 1901; Sertum Palm. Bras. 1: 89, *t. 62A.* 1903.

Type: Uruguay, Pan d'Azucar, pr. Montevideo. Cult. Jard. Bot. Rio de Janeiro no. 2259 (no specimens cited).

The description of this palm is incomplete (spadices, flowers and fruits were not seen by the author) and no specimens were cited. Therefore, *Butia stolonifera* has been designated as *species dubia.*

Butia wildemaniana (Barb. Rodr.) Burret, Notizbl. Bot. Gart. Berlin-Dahlem 10: 1050. 1930.

Cocos wildemaniana Barb. Rodr., Sertum Palm. Bras. 1: 101, *t. 75A.* 1903.

Syagrus wildemaniana (Barb. Rodr.) Frambach ex Dahlgr., Field Mus. Nat. Hist., Bot. Ser. 14: 270. 1936.

Holotype: Paraguay, Rio Apa, *Hassler 8554* (G, destroyed?).

Exact size of pistillate flowers were not given in the original description, hence this acaulescent palm could be either *B. arenicola* or *B. paraguayensis.* In view of this, plus the fact that type specimens could not be located, *B. wildemaniana* was designated as an uncertain species.

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PALM BRIEFS

My Palms

Teddie Buhler has asked me to write about my palms. I am happy to live with them. In 1941, when my husband and I bought the four-acre high pine land in Kendall, south of Miami, Florida for a fruit farm we started with a mango grove and about 30 varieties of tropical fruits (important, as we are vegetarians). We also planted flowering trees and palms.

We lined the entrance road with coconut palms (*Cocos nucifera*), made a rondel with 'Malayan Dwarf' and 'Makapuno' coconuts, the latter with jellylike meat. One-half acre we left natural, with pines, palmettos, and coral rock, for protection and firewood. In January–February 1977 we surely needed firewood. Two frost nights with 25 and 30 degrees F did a lot of damage to our palms. Long icicles sparkled in the morning sun where the sprinklers had been running all night.

It was a sad sight, as we walked through the garden at that time. The fishtail palm (*Caryota urens*) disappeared, though *C. mitis* had some life. All the taller palms, such as *Roystonea regia*, *Washingtonia*, *Arecastrum romanzoffianum* (*Cocos plumosa*), *Veitchia merrillii* and *V. winin*, *Neodypsis*, *Livistona*, *Coccothrinax*, *Dictyosperma*, *Cryosophila nana*, *Hyophorbe* (*Mascarena*), *Balaka*, *Phoenix reclinata*, *P. roebelenii*, *Chrysalidocarpus lutescens*, lost some leaves. The oil palm, *Elaeis guineensis*, is still struggling for life. All the coconuts came through except two.

I felt really sorry at losing the female *Salacca*. I had brought two seeds from Bogor, Java, collected on my world tour with The Palm Society in 1968. The male survived, but is lonesome.

When I look back on our start in 1943 I can say that we moved "to the land." High pine land is healthy to live on, but it is hard work to get something growing in white sand and limestone rock. A water system was the first thing we needed, then humus from seaweed, and organic fertilizer. That did it.

The first Christmas after we had electricity Alf, my husband, climbed a tall pine and put light bulbs among the twigs. Later we planted a cedar in the parking area and lighted it. It is now a marvelous tree as tall as our pines.

Since Alf's death in 1961 I take care of our farm and the palms with two faithful helpers. On November 18th, 1978, at The Palm Society meeting at the A. R. Jennings estate, we saw the largest private palm collection. In rich natural soil palms grow happily to the sky, while ours struggle so hard to live, even with much attention and water. They are still a wonder to me in their majesty and beauty.

ELSE MARGRAFF, age 81
November 1978

Principes, 23(2), 1978, pp. 80–83

Some Unusual Formations in Palms

T. ANTONY DAVIS
Indian Statistical Institute, Calcutta 700-035

A search for morphological variations in palms during the past three decades has yielded examples of some striking phenomena. Unusual stems and the strangling of palms by figs have been described in detail in earlier volumes of *Principes*. The present note is concerned with some unusual features noted in reproductive structures.

Multiple Inflorescences

A few palms normally produce more than one inflorescence in the leaf axil. Fisher and Moore have recently published a study of these as noted on page 80 of volume 22. Two examples are illustrated here in Figures 1 and 2.

Bulbil-shoots of Palm Flowers

Occasionally one comes across instances where either the entire spadix, or parts of it, or the pistillate flowers, or very rarely all the pistillate and staminate flowers develop into vegetative shoots. Virus pathologists seem to regard such transformations as the result of virus infection and such terms as formation of bulbil-shoots, chloranthy, phyllody, and vivipary have been used. Figure 3 shows four coconut "seedlings" or "bulbil-shoots" each having two or three partially developed carpels that develop into shoots. It is interesting that the palm in the Alleppey District of Kerala State, India, where these bulbil-shoots were collected, also produces one or a few normal fruits in each spadix.

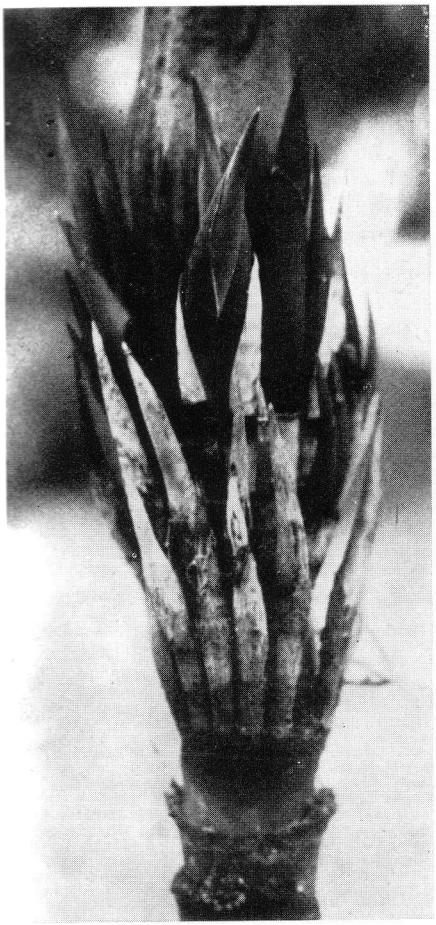
Additional Carpels

The palm gynoecium characteristically has three carpels but most often a seed develops from only one due to the abortion of ovules in the other carpels.

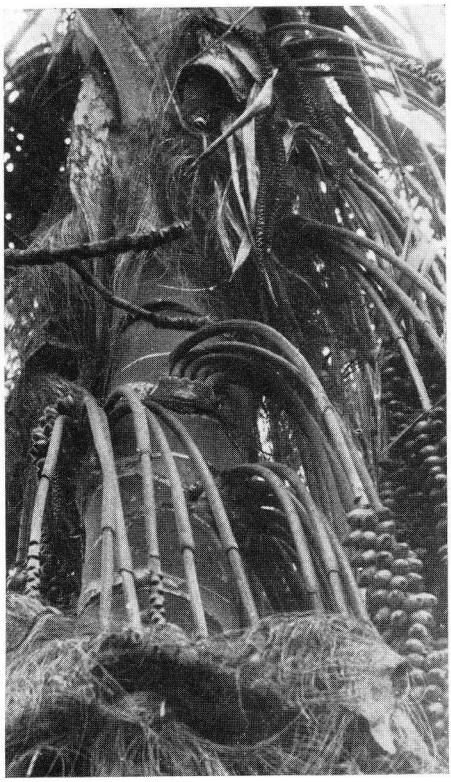
More than three carpels per fruit are natural in palms like *Phytelephas* or some species of *Orbignya* but are unnatural when they develop in some varieties of *Elaeis guineensis* and *Phoenix dactylifera*. In Figure 4, a young coconut fruits with four extra carpels is shown. The particular palm producing this abnormality grows near Cochin, Kerala State, India, and it continued to produce such fruits for several years. Between seasons/years the number of extra carpels would vary from one to six. Not all the extra carpels would develop into seed-bearing bodies. An examination of several fruits and flowers of different stages revealed that the extra carpels were developed staminodes, which in a normal pistillate flower are united in a thin ring with six projections, each representing a reduced stamen.

Several Seeds Versus Several Embryos in Coconut

The coconut fruit usually has a single seed. When a mature dehusked fruit is split into two halves so that the three "eyes" are in one side, the white edible endosperm is evenly distributed inside the endocarp. The only embryo is embedded in the solid endosperm just beneath the "soft eye." On close observa-



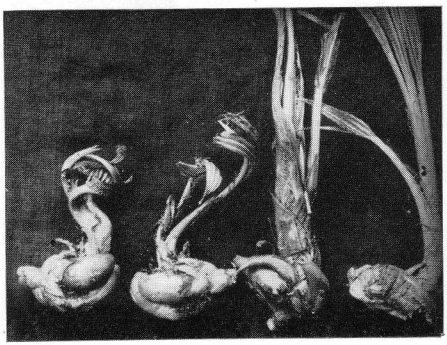
1. The staminate plants of a species of *Chamaedorea* bear multiple inflorescence buds at the nodes.



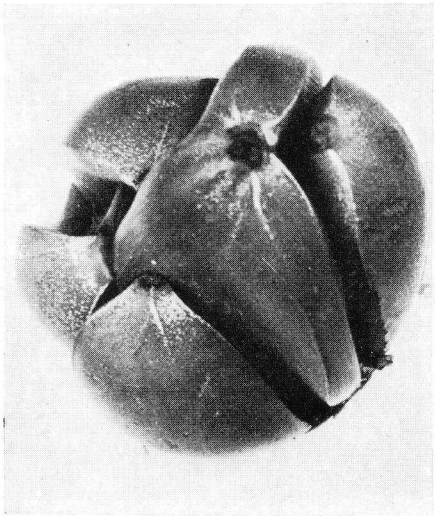
2. A portion of stem of *Howea forsterana* showing multiple inflorescences.

tion of the cut surface of the endocarp, the much reduced cavities of the two abortive carpels can also be made out. In exceptional fruits, there are two functional seeds, each separated by a thin layer of endocarp. When such fruits are sown, they produce two shoots, each through a separate "soft eye." Very exceptionally, one may come across three-seeded coconut fruits as in Figure 5, where each of three cavities is separated by the endocarp and a separate kernel is found in each cavity. The three "eyes" in this particular fruit cover embryos that may produce separate shoots.

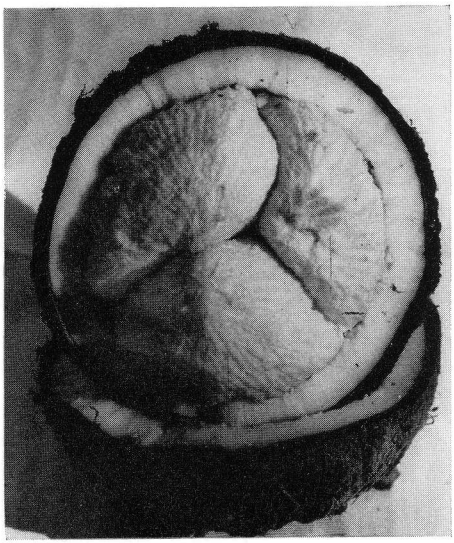
Figure 6, however, shows a germinating coconut fruit (whose fibrous husk



3. Young "fruits" of coconut transforming into vegetative shoots.

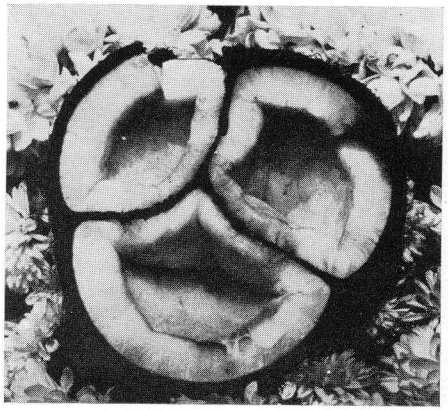


4. Developing coconut fruit bearing four additional carpels.



6. An instance of polyembryony in a coconut.

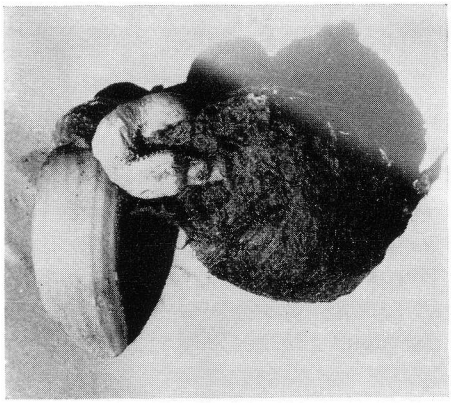
has been peeled off) split into halves. The cavity has been filled up by the cotyledonary haustoria of three seedlings. The endosperm surrounds the three haustoria collectively, and no endocarp separates one from another. Each cotyledon is part of a separate sprout and all three shoots emerge from a single "fertile eye," the other two "eyes" being infertile and hard. This is a case of polyembryony. Polyembryony producing two sprouts from one seed is fairly common in coconut. Three shoots are less common. Investigators have reported the production of over ten shoots from a single functional coconut seed. Since the different sprouts in polyembryony arise from a single fertilised egg, the individual shoots are identical, in contrast to seedlings of three-seeded fruits, which are not genetically similar since each functional ovule was fertilised by a separate pollen grain.



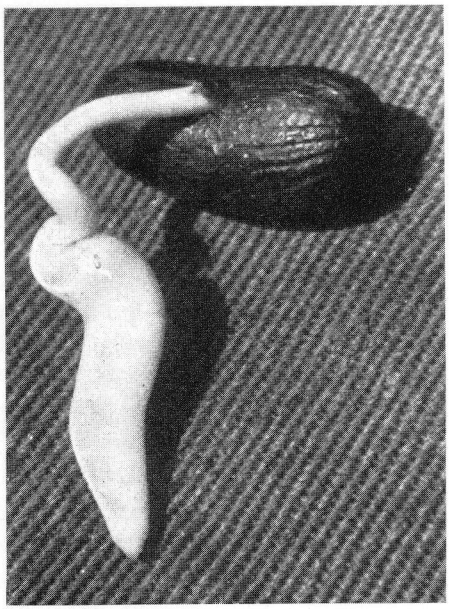
5. Coconut fruit having three developed seeds (Photo courtesy *The Hindu*, Madras).

Changed Shape of the Apocole

The two main types of germination noticed in palms, in the terminology of the eminent palmist, Martius, are admotive and remotive. In the former, the shoot develops upwards from the proximity of the seed/fruit as in the coconut. But in palms like *Lodoicea* or *Borassus*, where germination is remotive, the embryo is taken deeper into the soil through a long tubular sheath termed the apocole. The future stem developing from the



7. Germinating palmyra (*Borassus*) seed showing a stunted apocole.



8. Germinating seed of wild date (*Phoenix*).

apocole gets greater stability and greater scope for producing roots from the additional underground portion of stem. What would happen if the apocole is not allowed to penetrate into the soil was the question, the answer to which was obtained by raising *Borassus* and *Phoenix* seeds on a cemented floor. The seeds were just covered with sand and kept moist constantly. They germinated and the apocole struck the hard floor. With its expansion, the seeds were partially raised and even tilted. The apocole also developed twists at its upper region (Figs. 7, 8). The most striking formation resulting from the strong geotropic influence of the apocole was noticed in *Borassus*. The overall length of the apocole remained very short (less than 50 percent of the length of normal one) and the embryo also remained stunted, but developed unusual thickness as seen in Fig. 7. The leaves that came out of these seedlings had very clear spiral formation at the petiole and at the lamina region. About 50 percent of the seedlings showed right-handed twist and the rest left-handed twist. The seedlings were maintained for three years under the same condition. They remained very stunted and produced a much thicker and stubbier bole than those sown in normal soil.

In *Phoenix*, although a similar development was noticed, the effect was not as spectacular as in *Borassus*. Even the apocole in this species is relatively longer and capable of growing at a slant.

Principes, 23(2), 1979, pp. 83–84

PALM BRIEFS

Palms in the National Register of Big Trees

The American Forestry Association has, since 1940, had a program to locate and measure the largest specimen of American tree species. The first complete listing was published in *American Forests* in 1945, but contained no palms. The second complete listing appeared in 1951 and included a Cuban royal palm (*Roystonea regia*), which measured 95 feet in height. In subsequent complete

listings (1956, 1961, 1969, 1973) a few other palms were added and the Florida royal palm substituted for the Cuban species. Naturalized species were also admitted to the listing, which brought in the coconut palm in Hawaii.

The most recent complete listing was published in April 1978. Table 1 contains the seven palm species that are included. A comparison of the dimensions in Table 1 with those contained in the species descriptions in McCurrach (1960), shows that in all cases save one the "big tree" designation is appropriate. The exception is *Roystonea elata*, which reportedly reaches a maximum height of 100 feet.

Several other native American palms have never been reported in the National Register. *Acoelorrhaphe wrightii*, the paurotis palm; *Pseudophoenix sargentii*, the Florida cherry palm; and *Thrinax morrisii* and *T. radiata*, the thatch palms, all restricted to the southern portion of Florida, may reach heights of up to 30 feet and therefore qualify for admission. Even *Sabal louisiana*, the Louisiana palmetto, could be included since Bomhard (1950) states that it may reach 18 feet in height, well above the 12-foot minimum size required.

The American Forestry Association also maintains a register of Hawaiian trees, which contains numerous introduced palm species. The latest Hawaiian Big Tree list was published in the May 1974 issue of *American Forests*.

Palm society members who may wish to submit nominations of palms that have dimensions exceeding those on the National Register, or who wish to contribute new entries should consult the instructions for measuring a tree published with the April 1978 complete listing.

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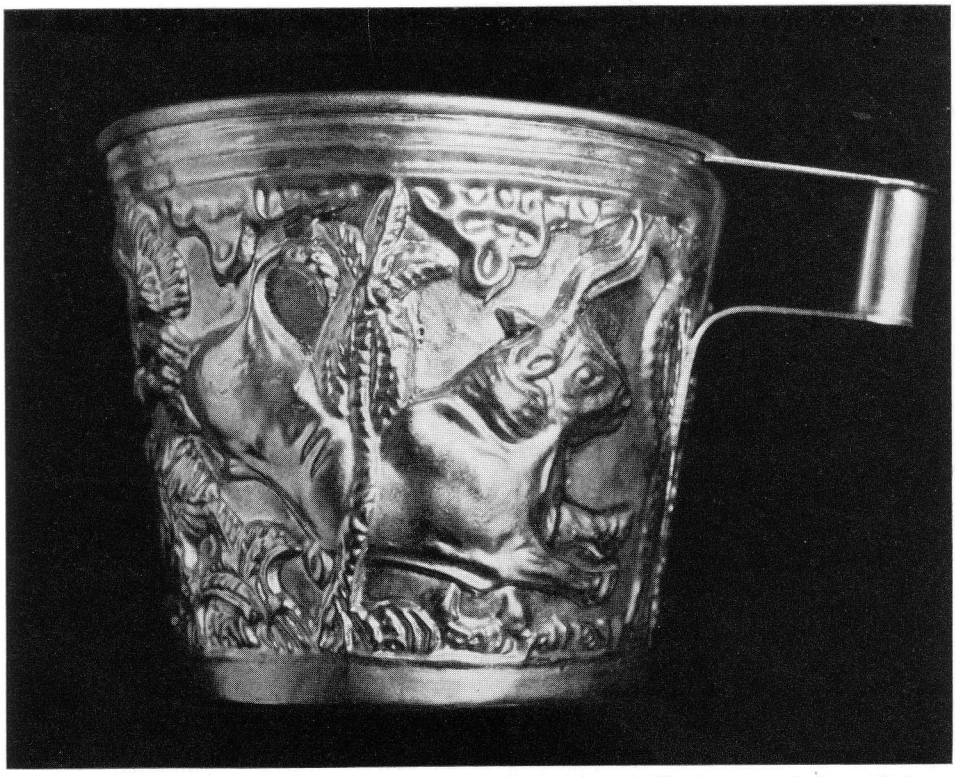
DENNIS JOHNSON
University of Houston
Houston, Texas 77004

Table 1. Palms in the 1978 National Register of Big Trees

Species and Year of Most Recent Measurement	Circumference at 4½ feet	Height	Spread	Location of Tree
Coccothrinax argentata, Silver palm (1976)	1 ft 10 in	22 ft	6 ft	Bahia Honda State Park, Florida
Cocos nucifera,* Coconut palm (1968)	4 ft 8 in	94 ft	28 ft	Hilo, Hawaii
Roystonea elata, Florida royal palm (1973)	6 ft 6 in	80 ft	32 ft	Homestead, Florida
Sabal mexicana,§ Mexican palmetto (1972)	3 ft 5 in	49 ft	12 ft	Cameron City, Texas
Sabal palmetto, Palmetto palm (1972)	3 ft 9 in	90 ft	14 ft	Highlands Hammock State Park, Florida
Serenoa repens, Saw palmetto (1976)	1 ft 3 in	14 ft	6 ft	Micanopy, Florida
Washingtonia filifera, California fan palm (1971)	11 ft	55 ft	13 ft	Hollywood, California

* Naturalized.
§ Probably refers to the Texas palmetto, *Sabal texana*.
Source: National Register of Big Trees, American Forests, Vol. 84 No. 4, April 1978, pp. 18–47.



1. One of two gold cups from Greece, this one showing a probable date palm in low relief.

Principes, 23(2), 1979, p. 85

PALM BRIEFS

Palms Featured on Gold of Ancient Greece

Some years ago a pair of gold cups of Minoan workmanship (dated ca. 1500–1400 B.C.) were found in a grave at Vaphio in the southern Peloponnesus of Greece. These became known to art historians as the "Vaphio cups" and are prized pieces in the museum in Athens. The cups measuring about 3½ inches high were made by fastening an inner smooth gold plate to an outer one decorated in low relief (repoussé). The design of the latter features a bull hunt. On one cup the bulls are grazing; on the other (partially illustrated here) three bulls are being captured in nets. Of interest to PRINCIPES readers is the fact that three trees, which appear to be date palms (*Phoenix dactylifera*), were included in the design by the ancient gold worker. One of these is to be seen in the present photograph, made of a copy of the original cup.

W. H. HODGE
Trumansburg, N.Y.

Seed Bank Notes

Lois Rossten succeeds Lucita Wait and DeArmand Hull as agent for The Palm Society Seed Bank. Correspondence concerning seeds or seeds themselves should be sent to Mrs. K. Rossten, 6561 Melbourne Dr., Huntington Beach, CA 92647, USA.

Principes, 23(2), 1979, pp. 86–87

NOTES ON CULTURE

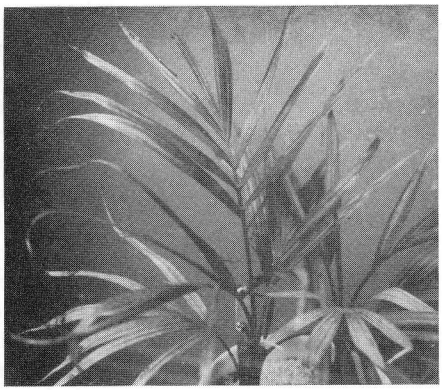
Boron Deficiency and Toxicity in *Chrysalidocarpus lutescens*

Chrysalidocarpus lutescens H. Wendl., commonly referred to as the areca palm by nurserymen, is an extremely popular tropical foliage plant that is grown in Central and South Florida for shipment to other parts of the United States and the world. Palms in general, including arecas, are plagued by a variety of leaf spots. Numerous spotted arecas, submitted by nurseries, have been examined and cultured in the laboratory for fungus pathogens. Although many of the cultures yielded pathogenic fungi, a large number yielded no fungi or bacteria. For this reason it was concluded that some spotting may be caused by horticultural malpractice, such as faulty nutrition. Therefore, a hydroponic experiment was devised (1, 2) to determine whether or not such symptoms resulted from nutritional disorders. The experiment was continued over a two-year period and all plants given no boron or excessive amounts expressed appropriate symptoms. The effects of insufficient or inordinate amounts of boron have not been previously described for areca palms.

The earliest symptoms of boron *deficiency* include a gradual slowing of apical growth. A very unusual discoloration of leaflets was also seen, consisting of transverse, narrow bands of yellow partially crossing the pinnae (Fig. 1). These streaks often are clustered, one above the other, and they may eventually coalesce and become tan as tissue dies. If the plants are growing slowly, the terminal leaf and bud die. By the time the stunted inflorescence has developed, its tip is killed and aborted fruits are shed.

1. Transverse, narrow, chlorotic streaks are symptomatic of boron deficiency in *Chrysalidocarpus lutescens*.

Boron *toxicity* symptoms begin as leaves become mottled with chlorotic areas. The most mature leaves are affected first and die prematurely. Severe leaflet tip-burn advances toward the midvein (Fig. 2). Unfortunately for purposes of diagnosis, this leaf tip die-back



2. Tip-burn is a symptom of boron toxicity in *Chrysalidocarpus lutescens*.

is indistinguishable from symptoms of insufficient water, salty soil, etc.

It is well known that the availability of boron to plants diminishes as a soil mixture becomes less acid. A pH of approximately 5 to 7 is most conducive to furnishing plants with this element in a mixture containing very little organic matter. In an organic medium, such as peat moss, boron is most available between pH 5 to 6, diminishing as pH increases. Boron toxicity most likely results from excessive application in order to remedy deficiency or irrigating with water containing excessive amounts.

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ROBERT B. MARLATT
Agricultural Research
and Education Center
University of Florida
Homestead, Florida 33031

PALM LITERATURE

LANGLOIS, ARTHUR C. Supplement to Palms of the World. 252 pp. The University Presses of Florida, Gainesville, FL. 1976. $25.00.

James C. McCurrach's *Palms of the World* was published in 1960; it set out to provide a guide, illustrated with photographs, to as many recognized palm genera as possible. Though the work has many errors, it immediately became popular with palm enthusiasts as a very convenient source of information, particularly about habit, concerning many, often little-known palms. McCurrach was unable to find illustrations of some of the rarer or more obscure palm genera at the time his book went to press, and encouraged by the popularity of his book, set out to collect material for a supplementary volume to illustrate the remaining genera. Arthur C. Langlois began to help McCurrach and on the latter's death in 1966, took over the task of bringing the *Supplement* to publication. Seven years after the late Mr. Langlois' preface to the *Supplement* was written (1969), the volume finally reached booksellers.

This book is certainly one that nearly all members of The Palm Society will wish to obtain if they have not already done so. It is relatively inexpensive (compared with the current prices of books), it forms a companion to McCurrach's book, and it is full of illustrations. Dent Smith has written a foreword, there is a long list of acknowledgments, and an index to the genera described is provided.

If *Palms of the World* and its *Supplement* are contrasted, the most obvious difference is in the standard of printing. Although McCurrach's book is replete with errors, the photographs are generally well printed and clear; unfortunately the *Supplement* is full of poor printing. In some instances, the original photographs were obviously of poor quality—as the only available photographs of often very rare palms, they were probably still worth printing; others, however, have been spoilt by overprinting and this is a great shame as many are of great beauty. Fortunately the standard of accuracy of determination of species is probably better than in McCurrach's work.

Although the preface to the *Supplement* is dated 1969, additions have apparently been made to the text at dates up to 1972. Had the volume appeared in 1969 its value might have been greater. Palm botany has made con-

siderable progress during the last ten years. Not only have many new genera been described, but others have been sunk into synonymy, or changed their names, and in some instances genera previously known only from types, are now well known and photographed. Furthermore, perhaps the most important postwar contribution to palm taxonomy, H. E. Moore's *Major Groups of Palms and Their Distribution*, appeared before the *Supplement* was published but presumably after it had gone to press. Consequently much of the *Supplement* is out of date. Though Mr. Langlois has given indications of synonymy, provided by H. E. Moore, the practice of giving full details of obsolete genera on an equal status as that given to accepted genera, will do nothing but prolong the use of obsolete names, especially as the *Supplement*, along with *Palms of the World*, will become the standard reference for many amateur palm enthusiasts.

The descriptions of individual genera are often extensive and filled with chatty detail provided by field workers, quoted verbatim. These are, however, marred by botanical jargon; as this book has been written primarily for amateurs, it would perhaps have been useful to provide a glossary of terms not found in *Palms of the World*. Some of the jargon is unnecessary—"loricate" could easily have been replaced by "scaly."

More serious, perhaps, is the misconception of some genera as exemplified by *Eleiodoxa*: *E. conferta*, transferred from *Salacca* by Burret, is a well-known palm, illustrated and well described by Furtado and others. Yet, in the *Supplement* it is described as possibly tufted, or climbing—it is tufted but is certainly not climbing.

It is easy for the professional palmologist to sit back and criticize this book; it is, however, an attractive book, and will almost certainly sell well and be much used. Like its predecessor, it will probably introduce more people to the delights of palmology and provide a useful convenient collection of palm habit illustrations. The palm enthusiast will no doubt use it to prepare desiderata lists for seed hunters, but the palm taxonomist will continue to struggle to try to introduce rationality and stability to palm nomenclature.

JOHN DRANSFIELD

RUDDLE, KENNETH, DENNIS JOHNSON, PATRICIA K. TOWNSEND, AND JOHN D. REES. Palm Sago: A Tropical Starch from Marginal Lands. 207 pp., including 26 figures and 32 tables. Published for the East-West Center by the University Press of Hawaii, Honolulu (and simultaneously by the Australian National University Press, Canberra). 1978. $7.50 soft-bound.

Starch is the principal form of stored food in the plant body. It accumulates primarily in seeds and other storage organs, such as roots, tubers or even, as in some palms, stems or trunks, where it provides a concentrated source of energy for seed germination, new vegetative growth, and development of flowers and fruits. Man exploits these starch reserves as a major component of his diet. In temperate regions the cereals, for example, wheats (*Triticum aestivum* L. and *T. turgidum* L.), barley (*Hordeum vulgare* L.), maize (*Zea mays* L.), and the white potato (*Solanum tuberosum* L.) are the major starch sources; while in tropical regions, rice (*Oryza sativa* L.), cassava (*Manihot esculenta* Crantz), yams (*Dioscorea* spp.), and sweet potatoes (*Ipomoea batatas* (L.) Lam.) are most widely grown and used.

Starch is not, however, simply a source of calories for man and beast. It is an

important raw material for industry, where it is used in amazingly diverse ways, among them, sizing for textiles, coatings for paper, adhesives, fillers in pharmaceuticals, additives to well-drilling coolants and lubricants, and base materials for the production of industrial glycosides and various modified foods and additives. Industrial starches are extracted from the same tissues that serve as food sources, and while starch from an individual species may be superior for a particular use, the primary factor that determines use is the cost of the raw material. At present, starch from maize dominates world markets with that of other species important principally for special uses or because it is readily available.

The term "sago" was originally applied to starch extracted from the trunk of species of *Metroxylon*, especially *M. sagu* Rottb. The genus includes eight species and extends westward from the South Pacific Islands through Melanesia to Indonesia, Malaysia, and Thailand. Sago now has a more general meaning, applying not only to starch of *Metroxylon* but also stem starch of other palms and some cycads, especially species of *Cycas*, *Encephalartos*, and *Zamia*, and even to starch of the tuberous roots of *Manihot*. In *Palm Sago*, Ruddle *et al.* focus their attention on *Metroxylon* but also discuss other starch-yielding genera from the Old World (*Arenga*, *Caryota*, *Corypha*, and *Eugeissona*) and from the New World (*Mauritia*, *Arecastrum*, and *Roystonea*). Mentioned in passing are *Acrocomia*, *Borassus*, *Manicaria*, *Phoenix*, *Pholidocarpus*, and *Raphia* which also may be starch sources but for which documentation of use is limited.

The rationale for writing *Palm Sago* seems to have been twofold—first, to provide an ethnographic account of sago as a staple subsistence item, principally among the rural peoples of the coastal mountains and swampy lowlands of Papua New Guinea, parts of Indonesia, the Philippines, Thailand, Malaysia, and the delta region of the eastern Orinoco River. Second, to consider the economic future of sago as an international commodity. The authors are most successful in the first endeavor, providing a fascinating, generally well-illustrated, fully referenced account of the methods used in extracting and processing sago, preparing and using it as a food, and its place in ritual and myth of various peoples.

The Warao of the Orinoco delta provide a vivid example of the techniques involved in extracting sago and also of the multiple uses which native peoples make of their resources, in this case the moriche palm, *Mauritia flexuosa* L.f. The Warao follow a ritualized behavior pattern in felling chosen trees, specifically, those that have not yet produced their annual inflorescences and which have starch grains that adhere to the axe blade when the trunk is slashed. (The adherence of starch grains to probes of various sorts seems to be a common, though not infallible way of testing a tree for starch content.) The woody layer is removed from the upper side of the fallen trunk, exposing the starch imbedded in a fibrous matrix. Using a wooden adze made from moriche wood, the starch is collected in moriche-leaf baskets and then filtered through a sieve, also made of moriche-leaf fibers and supported by the woody petioles of this same versatile palm. Depending on the area of the world and the palm species involved, filtering techniques vary but basically involve kneading or sometimes trampling the pith in an abundance of water. The loosened, insoluble starch grains are then carried by the water to containers where they settle out. The extracted starch may either be dried, or if longer storage is

desired, stored wet in containers placed under water or in mud where microbial activity is inhibited.

As a food, sago may be prepared in a variety of ways—with water to make a gruel, in combination with water, greens, and sometimes meat to make a soup, roasted in bamboo tubes or leaf wrappings, or flattened and cooked tortilla style on a griddle. In Southeast Asia much of the sago starch is consumed as pearl sago, a mixture of rice bran, grated coconut, and sago that is formed into pearl-sized balls and baked. Alone, sago provides poor nutrition, having a lower protein/calorie ratio than the other tropical starch staples: yams, cassava, sweet potatoes. Sago eaters in coastal and riverine habitats generally gain their protein from fish and shellfish, others from green vegetables and occasional meat, which includes the larvae of various insects that themselves feed on the starch of the palm trunks.

The second half of *Palm Sago* is largely devoted to the commercial aspects of sago production and is concerned almost exclusively with *Metroxylon*, which in earlier times enjoyed some success as a commercial starch source, particularly in the British textile industry. I found the brief case studies of sago production in Sabah, Brunei and Sarawak of interest from an ethnographic point of view. Others will find in these studies apt description of the problems that developing nations face in gaining markets for their commodities. The authors have attempted to show that *Metroxylon*, adapted as it is to hydric habitats that would require major capital investment if they were to be made suitable for rice or other crop production, offers peoples of these marginal lands an opportunity to produce a cash commodity in an environmentally sound manner. While this may be true, there seems little assurance, even in a world of chronic food problems, that sago will be able to compete profitably in world markets.

If *Palm Sago* has a major fault, it is in the length of the treatment devoted to the role that sago once played in international trade. In a chapter of 54 pages, nearly one-fourth of the book, 46 are given over to tables that I, at least, find unnecessary. The essence of their data could have been summarized in a few succinct paragraphs. From the viewpoint of the palm enthusiast, the book could have been strengthened by a more detailed discussion of the biology of the palm species used in producing sago. Intriguing but not mentioned is the relationship between starch accumulation and the formation of palm inflorescences, especially in the monocarpic palms, such as *Metroxylon* and *Corypha*. As Corner (1966, page 114) writes in *The Natural History of Palms* "A talipot palm *Corypha* is an enormous cabbage which flowers after some thirty or forty years and from its heart comes a panicle twenty feet high with branches ten and fifteen feet long, while the leaves drop off the trunk and there stands a seventy-foot pole ripening half a million fruits like green marbles in termination of the giant. What the gardener scarcely notices makes the palm botanist thunderstruck."

While the readers of *Palm Sago* may not be thunderstruck, they will find the book a delightful and informative account of the ethnobotany of sago.

DAVID M. BATES
L. H. Bailey Hortorium

NEWS OF THE SOCIETY

News from Texas

The Houston (Texas) Area Chapter of The Palm Society, Inc. held its first Fall Show and Sale on Saturday–Sun-

day, September 9–10, 1978 from 10 A.M. to 4 P.M. at the Houston Arboretum in Memorial Park.

Over 100 different palms from members' collections were exhibited with names, notes on native habitats, and cultural information attached. The highlights were a container of beautiful variegated *Rhapis excelsa* from the collection of Paul Offenhauser and a *Pritchardia* as well as a handsome *Licuala grandis* from Jack Staub.

A slide show and lecture series on "The Palms of the Houston-Galveston Areas" was given on both days to acquaint people with the palms that will grow in the area and what mature specimens look like.

An interesting exhibit area was set up with the following:

1) "Palm Seed Germination"—*Arecastrum romanzoffianum* (*Cocos plumosa*) was shown through its life cycle from fresh seed, bare seed, planted seed, sprout, 1-yr seedling, 2-yr seedling, 3-yr seedling, to 12-ft tree.

2) "Palm Products & Uses"—Shown were many common products with palm derivatives or fruits as an ingredient. (Soap, wax, cake mixes, coconut, puddings, dates, etc.).

3) "Coconut Seedling Exhibit"—A series of coconuts were displayed: in husk, planted, sprouted, sprouted 2 ft tall and a young tree 6 ft tall.

4) "The Palm Look Alike Exhibit"—Many examples of plants were shown that either resemble palms or have the word palm in their common name: sago palms, cycads, zamias, ponytail palms, palm grass, umbrella palm, palm fern, etc.

5) "Palm Books & Publications"—Copies of various books in print on palms were displayed. A beautiful exhibit of travel posters showing palms around the world was set up in the lecture room. Pamphlets on hardy palms printed by Texas A&M were distributed to interested parties.

A sale of indoor and outdoor palms was held both days. *Sabal texana* and *S. louisiana* seedlings were very popular, also arecas, fishtails, *Neanthe bella* (*Chamaedorea elegans*), *Cocos plumosa* (*Arecastrum romanzoffianum*), windmill, butias, *Washingtonia robusta*, *Veitchia merrillii* were sold along with packets of *Pritchardia* seed. The sale was a huge success. Our thanks to Paul Offenhauser who donated many of the nice plants for the sale.

Members had gathered various palm seeds which were packaged with germination instructions for free distribution at the show. The interest in these seeds was overwhelming.

Overall we were very proud of our first show and feel it was quite a success. The public interest was very impressive. Attendance was estimated between 750 and 1,000 persons. We felt when everything was said and done that we had spread this crazy disease, "palm fever," among others in our world in hopes that it will be a more beautiful place in which to live.

Submitted by BONNIE RUHLAND

Additional news from the very active Houston Chapter tells about the monthly donation by member Bob Maurice at the Chamber of Commerce Civic Affairs Luncheons, of a winter-hardy palm in a 6-inch or 8-inch pot. There is a drawing for the palm. In June of 1978 at the meeting for the "Annual Environmental Award for Civic Beautification" (architectural and/or landscape improvement visible to the public), the Mayor, Jim McCann, a room full of TV and news reporters, and a large turnout of guests including most of the City Council were all present. Bob drew the winning ticket from the envelope and the Mayor had

the stub! It had not been rigged, was absolutely honest, but what a marvelous coincidence. As Bob is fond of saying "God and I understand each other."

Another project started by Bob, with the cooperation of the city Parks Department and the Chamber of Commerce, is to get Houston residents to grow seedlings of sabals, washingtonias and other hardy palms which they are then to plant out in public areas where the grass is not mowed so that in time Houston will be known as the palm city. Bob is a real palm enthusiast. May he and God continue to understand each other.

News from Florida

As they have for the past several years, the Palm Beach Chapter of the society held a palm sale the first Saturday in October at the Mounts Agricultural Building in West Palm Beach. Again there were many rare seedlings and small palms offered for sale to those who had come from as far as 250 miles away to find these treasures. Attendance was good, sales were brisk and little was left to be taken away after it was all over.

Teddie Buhler

Costa Rica Trip

During the week of July 19–27, 1978, fourteen Florida members took a trip to Costa Rica where cooler climate was a welcome change from humid Miami. The first day ended in a real adventure on the way to former Miamian Bob Wilson's Las Cruces Botanical Garden. We had a minibus to ourselves which took us south along the Pan American Highway, with cliffs and mountains on one side falling away to deep valleys on the other. The views were breathtaking as we rounded the curves. At lower elevations dense tropical forests with raging rivers interrupted the green, interspersed with cultivated areas of bananas, agaves, corn, and other crops. It was impossible to miss the brilliant orange-red bracts of heliconias. Many *Bactris gasipaes* were in evidence with their loads of orange fruit. As we climbed the ridge, tree ferns appeared, huge trees were filled with fiery red bromeliads and even a plant northern gardeners will remember, *Digitalis*, the foxglove, with lavender blooms. There were many other palms as well, scheeleas, acrocomias and euterpes, sometimes left as scattered individuals where the land had been cleared. Lunch in San Isidro across from a park filled with *Elaeis guineensis* was most convenient for seed collecting.

The bus driver, thinking it best to remain as long as possible on the fairly well-paved Pan American Highway, drove to Villa Neily near the Panama border where we arrived just at dark. Continuing on we almost ended in a rain-swollen torrent across which the road out of town apparently led when the water was not so high. However, we stopped in time and after proceeding along a scary embankment, crossed a bridge which took us to what turned out to be a long, arduous, bumpy dark ride of some two and a half hours upwards to Las Cruces. Unwittingly we drove past the entrance in the black of the night, but finally were directed back by a helpful peon. Bob and Catherine Wilson had already retired, thinking we'd had the usual car trouble. Nevertheless, dinner was ready for us and we were certainly ready for it. We ended up laughing about the uneasiness we'd all felt on the dark, lonely trip in the wilds.

Las Cruces is incredible and fascinating and far too filled with both native and introduced plants to be completely explored in the two days we spent there. Bob guided us along the many terraced walks from which can be seen the over-

whelmingly many native chamaedoreas, geonomas, ferns, gesneriads, orchids, anthuriums, philodendrons and others, including one cycad that had been identified recently and named for the son of Dr. Fairchild. Among these natives Bob has set out his huge collection of exotics. One large area was devoted to heliconias and related plants. A swampy pond was being planted with suitable plants and the slat house bulged with fascinating things. We had time for a hike along a trail cut through the virgin forest area down to a raging river. We were fortunate in that we had only one misty shower. A bit more rain the last afternoon while we were cleaning plants and packing them did not cut much into our activities.

We were lavishly fed with delicious food, each meal including various dishes prepared in interesting ways. Chayotes were always served, mixed with other vegetables, in stews or alone, and we had our fill of marvelous fresh papayas, pineapples and melons.

The third day we drove to Golfito along big oil palm and banana plantations down to the Pacific. There we found several euterpes (these are native to Costa Rica) and many exotic palms such as cyrtostachys, aiphanes, coryphas, borassus and some 8-ft *Licuala grandis* with bunches of ripe seed we were allowed to harvest. Our driver took us to Chinese restaurants for lunch, claiming they were apt to be the cleanest ones! We decided he liked Chinese food, albeit with a Costa Rican flavor, but we thoroughly enjoyed the new dishes we tried. The fifth night was spent in a new hotel just south of San Isidro where it was interesting to see plantings of the "yellow shrimp plant" (*Tachystachys lutea*). This had been introduced from Peru by Bob Wilson. The next day's trip took us over the ridge again where, rounding a bend, we could see the Central Valley containing many palms—oil, scheeleas, bactris, and some euterpes. We also saw good stands of what we identified as iriartea, with several single specimens along the way, but we were unable to collect fruit. Descending towards Limón on the Atlantic Coast we saw anthuriums, ferns, and drove past a cocoa plantation. Fortunately for us, our hotel in town was unexpectedly full so that we were sent to one along the shore north of town. It proved to be a lucky change for the hotel was new, built over the edge of the Caribbean. Just here, and only here, was apparently a small area of coral reef where huge rollers crashed with echoing reverberations about 1,000 feet out, then came foaming in to again break nearer shore, and finally ended swishing water under the hotel which was built on pilings! It was quite fantastic and we all rushed to our balconies upon being shown to our rooms, everyone's head popping out over the railing in complete fascination at the never-ending display. We were lulled to sleep by the constant sound.

The following morning, after browsing through the open market in Limón, where much English can be heard, we headed for Turrialba and the Institute for Tropical Studies. Along the way, in the lowlands and the beginning of the rise, we saw individual plants of a magnificent palm and finally found some specimens accessible to us in a pasture lying in a small valley. The palm was a highly ornamental plant even if the spines along the undersides of the midribs, the petioles, and the fruit clusters made it an unfriendly one. The singly spaced large trees were of a very formal, rather compact shape with pinnate leaves that appeared solid, so regular and stiffly in place were their leaflets. Their top surface was dark green, the underside surface so light as to appear almost white. We collected seeds, some

even beginning to sprout. We identified it as an *Astrocaryum*, though not until returning home did we find out it was *A. alatum*.

Behind the Institute in Turrialba is a forest reserve rich in chamaedoreas and geonomas. *Reinhardtia gracilis* was a beautiful sight. It seemed strange to see these palms growing so large in the wild when we know them only from somewhat difficult-to-grow potted plants. The forest areas were fairly dark but it was possible to walk through them, then return to the path. On the landscaped grounds two large plants of *Areca triandra* yielded many seeds.

We spent the last night in San José, savoring the flavor of the city and the people, ending a delightful experience not to be soon forgotten.

Those on the trip were: Daphne Bettle, Teddie Buhler, Gertrude Cole, Sara Calvetto, Phil Elia, Carolyn and Juliette Judd, Norman and Ann Moody, the Gordon Smiths, Vera Simonson, and Mel and Phyllis Sneed.

Phil Elia and Teddie Buhler

A Tribute to Lucita Wait

Trying to telescope 20 years into a picture, the first one I see is Lucita sitting in the midst of her seed room surrounded by small piles of colorful mounds placed at intervals on the bed, the desk, soaking in the sink. Looking like a lady about to begin selling her wares in the bazaar, her hands are busily cleaning pulp from seeds in a bowl on her lap.

Consider that when foreigners or domestic members came to Florida, the only name they knew was Lucita Wait. Perforce, she was the unofficial hostess of The Palm Society. Many hours were spent with these visitors at Fairchild Tropical Garden, in her home, and often included driving the guests to their distant hotels. Need I add: the result was a lifelong friendship and gratitude.

We often had occasion to travel—around the state, to the West Coast, and abroad. No name in our roster was safe. Our purses heavy with change, if even near the vicinity of a member, we stopped to telephone. The format: "This is Lucita Wait of The Palm Society, Miami, Florida. I am in your area and I just wanted to say hello." It took a half hour to persuade the member that we couldn't come to dinner, spend the night, meet at some club, or even stay at the phone booth long enough for the family to come see us.

If anyone has earned the pleasure of retirement, it is Lucita. My guess is that she will work harder at keeping her hands idle than disposing of the largest shipment of seeds.

For The Palm Society: THANK YOU.

Ruth Shatz

PALM RESEARCH

Fong Foo Woon, Department of Zoology, University of Malaya, Lembah Pantai, Kuala Lumpur 22-11, Malaysia, is studying *Nypa fruticans* in relation to its environment, both physical and biotic. Natural stands of the palm in selected brackish water systems are examined on a comparative basis for early growth rates, biomass production and decomposition.

Dennis Johnson, Department of Geography, College of Social Sciences, University of Houston, Houston, TX 77004, is working on a paper entitled "Tree crops and tropical development: the oil palm as a successful example."

Harold E. Moore, Jr., L. H. Bailey Hortorium, Cornell University, Ithaca, NY 14853, is completing manuscripts on palms of the Mascarene Islands and on palms of New Caledonia. He has also

begun active work again on a monograph of *Chamaedorea* and continues studies directed toward a "Genera of Palms."

RONALD L. MYERS, Department of Botany, University of Florida, Gainesville, FL 32611, has accepted the challenge of studying *Raphia taedigera* swamps in Costa Rica for his doctoral dissertation and is currently located at Tortuguero, Costa Rica.

ERNESTO B. PANTASTICO, Director, PHTRC, Horticulture Department, UPLBCA, College, Laguna, Philippine Islands, has current research projects on palm mutation, the Philippine species of *Pinanga*, germination, palm seed storage and viability, and is also establishing a palm collection for the palmetum of the College of Agriculture, University of the Philippines.

JULIET PERKINS, Department of Biology, Boston University, Boston, MA 02215, has begun ecological studies of *Chamaedorea exorrhiza* at the La Selva Field Station of the Organization for Tropical Studies in Costa Rica as part of her program for a doctoral degree.

NATALIE W. UHL, L. H. Bailey Hortorium, Cornell University, Ithaca, NY 14853, is pursuing anatomical, morphological, and developmental studies of the palm androecium, palm ovules, spines, and leaves.

NATURAL HISTORY NOTES

Some palms may begin to rival Methuselah according to some recent studies on *Livistona* in Australia. *Livistona eastonii* in Western Australia is estimated to have an average maximum age of about 280 years, although exceptionally tall plants may be about 720 years old, according to R. J. Hnatiuk. Ages of 100 to 300 years are suggested for the oldest individuals of *Livistona mariae* in Central Australia by P. K. Latz, who compared photographs taken in 1917, 1918, and 1935 with others of the same groups of palms in 1973. *Livistona mariae* is now listed as a rare species with about 3,000 individuals, a sharp contrast to *Livistona eastonii* of which Hnatiuk estimates there are about two million individuals larger than seedlings in a total population numbering in the tens of millions.

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H. E. MOORE, JR.

PALM PORTRAIT

Burretiokentia hapala

One of the most handsome of New Caledonian palms is *Burretiokentia hapala*, which was described only a decade ago (*Principes* 13: 67). Its dark green trunk with striking pale nodal rings reaches a height of about 10 m (33 ft) and a diameter of 10 cm (4 in). The leaves are nearly 2 m (6 ft) long and spread gracefully above sheaths that are dark green covered with brown scales outside but are pale or pinkish inside. The inflorescence is unusual in having a very dense cover of woolly brown hairs that almost obscure the small flowers. Fruits about 16 mm (⅝ in) long are apparently brownish when mature and enclose a seed that is sculptured with ridges and furrows.

When first discovered, only a few individuals were found along the trail from Balade to Parari in northeastern New Caledonia. Subsequent exploration has shown the species to occur in gallery

1. *Burretiokentia hapala* photographed in gallery forest at the margin of a stream in Vallée des Palmiers, New Caledonia, early in November 1978 (*Moore 10459*).

forests by streams in the Vallée des Palmiers and Vallée de la Rade on the other side of the mountains. Still more recently it has been collected in wet forest at Paala in the upper reaches of the Diahot Valley. The species is apparently tolerant of both limestone, on which it occurs at Vallée des Palmiers, and micaschist, on which it occurs at Paala. The species has recently been introduced into cultivation in the United States where it should prove a distinct contribution to the list of ornamental palms.

H. E. MOORE, JR.