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PRINCIPES

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Beccariophoenix madagascariensis, the crown of a mature specimen projecting above the canopy in a Madagascar forest. See pp. 59–68. Photo by J. Dransfield.

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Indigenous Adaptation to Amazonian Palm Forests*

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Human "adaptation" usually refers to the process whereby people survive and reproduce in given environments. Many specialists have tended to consider that most modern Amazonian Indians are adapted to "natural," primary forests (see Hames and Vickers 1983). On the other hand, prehistoric Indians once cleared and burned what, to the naive observer, seem to be primary forests that, in fact, have not yet recovered from past human disturbance (Balée 1987, Huber 1909, Saldarriaga and West 1986, Sombroek 1966, Sponsel 1986). Palms often represent a major component of the vegetation of such previously utilized forests in Amazonia. The adaptation of modern Amazonian Indians to palm forests, especially those dominated by the babassu palm (*Orbignya phalerata* Mart.), may represent no mere adaptation to nature, but rather an adaptation to the residue of other cultures, some of which have been long extinct.

Anthropogenic Palm Forests

Palms appear to be one of the most common components of the vegetation of undisturbed archeological sites in Amazonia. Palms often associated with archeological sites on well-drained forest include *Astrocaryum vulgare* Mart., *Elaeis oleifera* (Kunth) Cortes, *Acrocomia eriocantha* Barb. Rodr., *Maximiliana maripa* (Corr. Serr.) Drude, and *Orbignya phalerata* Mart. To a lesser extent, at least two other palms are associated with archeological sites in Amazonia. The peach palm (*Bactris gasipaes* Kunth), which is usually seen only under cultivation, indicates prior human occupation when present in unoccupied forest or along riverbanks (Balick 1984). The moriche palm (*Mauritia flexuosa* L.f.) generally forms monospecific stands only in undisturbed swamp forest; yet at least some monospecific stands of this palm, in the Orinoco Delta, appear to have resulted from the subsistence activities of the foraging Warao Indians, who were heavily dependent on its starch (Heinen and Ruddle 1974). The palms of most interest here, however, are those that tend to be dominant in well-drained forest.

On a prehistoric Indian mound on Marajó Island, in the Amazonian estuary, a spiny palm, which was probably common tucumã (*Astrocaryum vulgare*) densely covered the surface (Meggers and Evans 1957). Groves of common tucumã also characterize an archeological site near the Atlantic coast in Pará state, eastern Amazonian Brazil (Corrêa 1985). Common tucumã is a major component of some advanced secondary forests in the habitats of the Ka'apor and Guajá Indians in the basins of the Gurupi and Turiaçu rivers, in northern Maranhão state, Brazil (*Balée, 2173, 3481*). Wessels Boer (1965) pointed out that *Astrocaryum vulgare* is never encountered in primary forest and that it indicates previous human settlement in Surinam.

Several palm species exist on undisturbed sites of "black earth" (*terra preta*).

* This is publication number 85 of the Institute of Economic Botany.

Black earth results from long term human occupation, during which human, animal, and vegetal by-products accumulated in garbage pits and hearths of prehistoric Indian villages, greatly enriching the original soil (Smith 1980). Where the vegetation of black earth sites has not been slashed and burned for modern horticulture (Hilbert 1955), palms tend to be common.

For example, a "strict association" obtains between groves of the oil palm, "caiauê" (*Elaeis oleifera*), and numerous black earth sites along the Madeira and middle Amazon Rivers in Brazil, suggesting that extinct indigenous cultures played some role in the distribution of this palm (Andrade 1983). Another oil palm, "mucajá" (*Acrocomia eriocantha*), frequently occurs on black earth Indian mounds in the Amazonian estuary and near the city of Santarém (Anthony Anderson, pers. comm.); its sub-fossilized seeds have been recovered from some of these mounds (Roosevelt 1985). Indeed, *Acrocomia* appears to be absent from primary forest (Wallace 1853). *Acrocomia* is so frequently associated with sites of human disturbance that Huber (1900) described it as being semi-domesticated. I have observed numerous individuals of "inajá" (*Maximiliana maripa*), which tend to indicate sites of prior human disturbance (Pesce 1985, Schulz 1960), growing on archeological sites in the middle Xingu River basin (*Balée, 1637*) and in the habitat of the Ka'apor and Guajá Indians of the Turiaçu River basin (*Balée, 3377*).

One of the most important palms in the vegetation of Amazonian sites that were long ago disturbed by human beings for horticulture is babassu (*Orbignya phalerata*). Because of its cryptogeal germination, whereby the apical meristem grows downward at first, stemless babassu palms can survive forest burning (Anderson 1983, Anderson and Anderson 1985, May et al. 1985*a*, 1985*b*). Upward growth begins only many years later (Anderson 1983). Although burning for horticulture eliminates trees and seedlings above ground, young babassu palms may subsequently emerge and form dominant and/or monospecific stands in former horticultural fallows (Anderson 1983, Anderson and Anderson 1985, May et al. 1985*a*, 1985*b*). With an estimated lifespan of 184 years (Anderson 1983), babassu is a long-lived disturbance indicator.

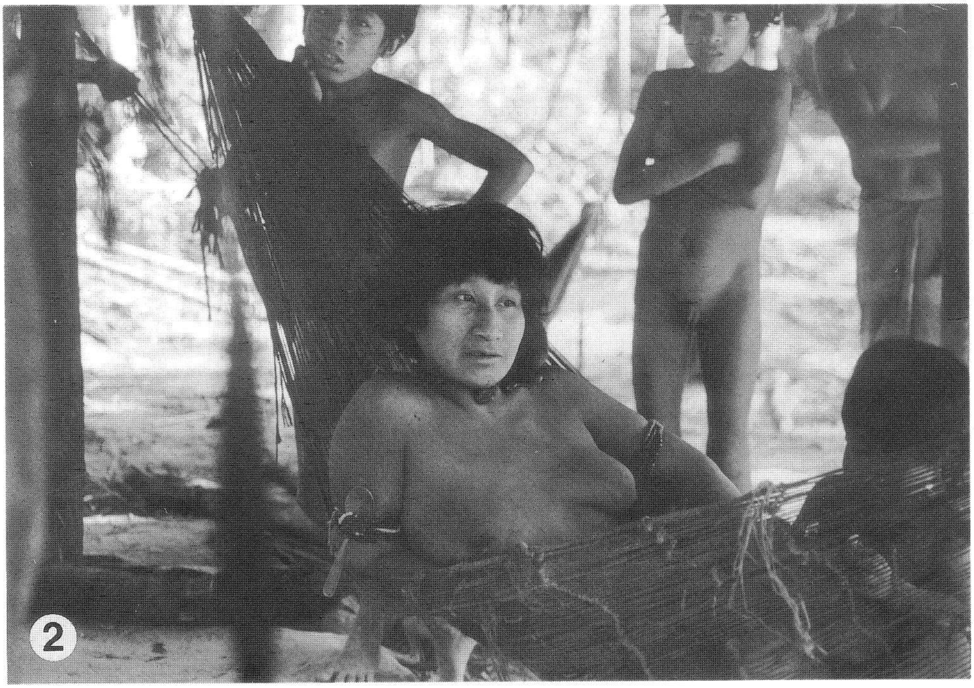
Babassu palm forests occupy about 196,370 km^2 in Brazilian Amazonia alone (May et al. 1985*a*), or about 5.9% of the well-drained land of that region (cf. Pires 1973). In terms of the adaptations of some modern Amazonian Indians, babassu is one of the most significant resources available to them. Babassu kernels are rich in protein, with especially high concentrations of the essential amino acids arginine, phenylalanine, and valine (May et al. 1985*a*, fig. 8). Babassu mesocarps, which are abundant in starch, supply carbohydrates in many indigenous diets (May et al. 1985*a*).

Babassu Palm Forests and Cultural Adaptation

The Guajá, Araweté, and Asurini indians of eastern Amazonia, who speak different languages of the Tupi-Guarani linguistic family (Rodrigues 1984/85), depend on babassu palms in their subsistence.

The Guajá (Fig. 2) are one of the last foraging (non-horticultural) peoples of South America. The Guajá population is roughly estimated at 226 people; at present, only about 60 Guajá Indians maintain unarmed contact with Brazilians at two government Indian posts, one in the Pindaré River basin and the other on the upper Turiaçu River.

The Guajá traditionally foraged in bands of 5 to 15 people across primary forests dominated by hardwoods in the families Lecythidaceae, Burseraceae, Sapotaceae,



1. The site on the upper Turiaçu River where the Guajá Indians were first contacted in 1975. Babassu palms (*Orbignya phalerata*) dominate the scene. 2. Members of a Guajá band. The hammock (foreground) and woman's skirt (right background) are made from the leaves of *Astrocaryum vulgare*, a spiny palm.

3. Araweté woman opening a babassu fruit to extract beetle grub (Bruchidae).

and Leguminosae (Balée 1986). Never felling and burning forest for horticulture, the Guajá always made camp only in enclaves of babassu palm forest. Babassu palms dominated the site on the upper Turiaçu River where authorities of the FUNAI (Brazilian National Indian Foundation) first made peaceful contact with some of the Guajá in 1974. The Guajá obtain much of their dietary protein from the kernels and many of their calories from the mesocarps of babassu palms. They supplement this diet by hunting, fishing, and the collection of less important plant foods. In addition, they thatch their houses with babassu fronds. Other disturbance indicator palms which occur in the babassu forest enclaves inhabited by the Guajá are *Astrocaryum vulgare* (*Balée, 3481*) and *Maximiliana maripa* (*Balée, 3377*). The Guajá use fiber from the young leaves of common tucumã to make hammocks, infant-carrying straps, rope, bowstring, and other objects. They make a thick porridge from the mesocarps of "inajá," which is an important dietary item.

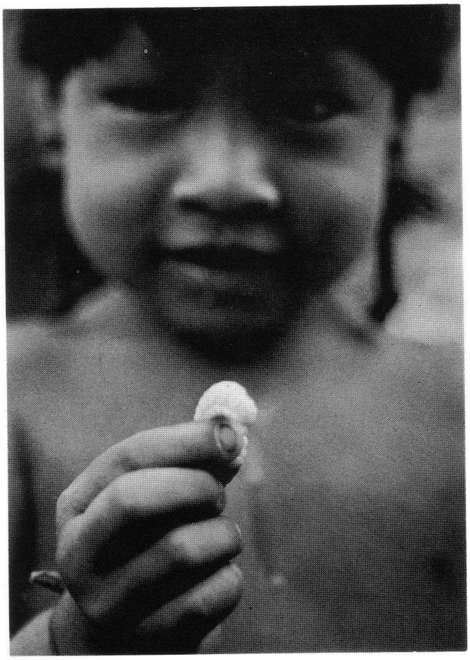
The babassu forest enclaves in which the Guajá make camp and between which they trek, nearly always conceal the vestiges of previous settlements and horticultural fields of other indigenous groups, such as the Ka'apor (whose language is also affiliated with Tupi-Guarani), who border the Guajá to the east and north. On the upper Turiaçu River, at the site where peaceful contact between the FUNAI and some of the Guajá first took place, the FUNAI workers recovered the remains of a ceramic manioc griddle of the Ka'apor. Ka'apor Indians told me that their ancestors abandoned this site two or three generations ago.

The Ka'apor historically raided the nomadic Guajá, mainly for women (Huxley 1957). In the 1870s, Dodt (1939) portrayed the Guajá of the Gurupi River as a people who were "persecuted" by all surrounding Indians, including the Ka'apor. According to a Ka'apor man, who killed five Guajá Indians in his lifetime, the Guajá could not clear and burn forest, plant and raise crops, and establish genuine villages because the Ka'apor, who were always more numerous, would not allow them to do so.

Although the Guajá could not practice horticulture, as did all other surrounding Indians, they did utilize the vegetation which resulted from the occupations of those other groups, namely, the enclaves of babassu palm forest. Insofar as the babassu forests which the Guajá occupy and exploit represent previous settlements and fields of other Indians, the Guajá have adapted to forests that are mainly cultural in origin. Such adaptations to cultural forests occur elsewhere in Amazonia.

The Araweté and Asurini of the Xingu River basin, who were traditional enemies, utilize forests which were inhabited by prehistoric Indian societies. The Araweté population is 155 and that of the Asurini, 55. The Araweté live on the Igarapé Ipixuna, a minor tributary of the Xingu; the Asurini live about 200 km downstream on the right bank of the Xingu itself. I recovered potsherds and stone axeheads from both settlements; these artifacts were made by cultures so long forgotten that the Araweté and Asurini believe them to be of divine origin. Moreover, black earth is found at both settlements. The forests which covered these settlement sites, before they were cleared in the late 1970s and early 1980s, were vine forests, which appear to be anthropogenic (Balée 1987). In two one-hectare inventories of vine forest, one near the Araweté and the other near the Asurini, which I carried out in 1985–86, babassu (*Balée, 1776a*) was respectively the sixth and second most ecologically important and dominant species.

Both the Araweté and Asurini depend on babassu. Both use babassu fronds to thatch their roofs. In addition, the Araweté raise *Pachymerus nucleorum* beetle grubs (Figs. 3,4) in rotting babassu fruits in their houses. They eat these grubs and rub their fat on their bows, to make these more elastic. The Araweté rarely eat the babassu mesocarp, since to them this practice is "near savagery" (Viveiros de Castro 1986), to be resorted to only in times of food emergencies. For example, an isolated Araweté family of seven, which was under siege by Kayapó Indians some 200 km distant from the Araweté village on the Ipixuna and which was contacted by the FUNAI in September 1987, was found to be relying on babassu mesocarps, as well as other uncultivated plant foods. The Araweté, in general, are most dependent on maize, which they prefer to plant in black earth.



4. Araweté boy holding beetle grub (family Bruchidae), an important source of fats in the Araweté diet.

Other than for roofing thatch (Fig. 5), the Asurini now only employ babassu to produce a highly effective insect repellent, from the oil of the kernels. In the recent

5. Asurini man thatching roof with leaves of babassu palm (*Orbignya phalerata*).

past, however, the Asurini depended on babassu for food. In the late 1960s, the Araweté raided the Asurini, killing many people and destroying their settlement. According to Asurini Indians, the survivors of this raid abandoned their settlement and horticultural fields, trekking through the forest for a few years until they made peace with Brazilian society in 1971 (Müller 1984/85). The Araweté themselves came to peaceful terms with the FUNAI and Brazilian society in 1976 (Viveiros de Castro 1986). During their period of trekking, without horticulture, the Asurini, like the Guajá, relied heavily on the babassu palm as a source of protein and carbohydrates. Given that the region where babassu palms are dominant evinces previous human disturbance, the Asurini depended on vegetation modified by an earlier culture. Like the Asurini and Guajá, the Araweté depend heavily on babassu kernels and mesocarps only in times of emergency, i.e., in the absence of a major horticultural enterprise.

As such, babassu, which is an eminently "historical" palm where it is dominant, replaces cultivated crops such as maize and manioc (cf. May et al. 1985*a*) for modern indigenous groups who cannot maintain settled villages because of endemic warfare. Indigenous dependence on this palm reflects knowledge of the supreme utility of a natural resource which is at once a cultural artifact of the past.

Conclusion

Palms are a major feature of the vegetation of many undisturbed archeological sites in Amazonia. Modern Indians who occupy and exploit such sites also depend on the vegetation therein. The Tupi-Guarani speaking Guajá, Araweté, and Asurini clearly utilize forests which manifest the residue—both vegetational and otherwise—of previous cultural occupations. In particular, the near total dependence of the Guajá and, historically, of the Asurini and Araweté on the babassu palm, which is one of the most dominant species in anthropogenic forests of their respective habitats, bespeaks a dependence not merely on nature, but on other cultures no longer present. The traditional view, therefore, that Amazonian Indians are adapted to primary forests, should be revised, to take into account those indigenous peoples that depend on and adapt to forests that resulted from cultural activities of the past.

Acknowledgments

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Effects of Different Conditions and Duration of Storage on the Germination of Babassu Seeds (Orbignya phalerata)

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The babassu palm (*Orbignya phalerata* Mart.) is one of the greatest extractive resources of Brazil (EMBRAPA 1984). The palms of this genus occur in almost 200,000 square km of area and offer benefits including cash, fuel, fiber, oil and food for approximately 500,000 families of small rural producers (May et al. 1985).

However, little is known with respect to the biology of these palms. The present experiment studied the periods of elapsed time from planting until the initiation of germination, the intervals of occurrence of germination and the viability of seeds of the species of *Orbignya phalerata* subjected to different conditions and lengths of storage.

The information obtained is of value for the ongoing work in building a babassu germplasm bank by EMBRAPA (The Brazilian National Agricultural Research Network) as well as for people interested in cultivating this and related species.

The seeds (in fruits) were collected directly from the mature panicles. Fruits were selected according to size and external condition, and sorted into random lots in order to obtain a high degree of uniformity.

The treatments utilized combined conditions of storage as well as duration of storage and subjected fruits to the following treatments.

I. Conditions of Storage

a. Fruits stored in the field, under the shade of a tree, directly on the soil.
b. Fruits stored in the shade, in a simple shed, on a cement floor.
c. Fruits stored in a conventional storage chamber for seed conservation, at a temperature of approximately 15° C.
d. Fruits stored in a conventional storage chamber for seed conservation, at a temperature of approximately 10° C.

II. Duration of Storage Prior to Planting

a. Control: planted immediately after collecting the fruits.
b. Planted three months after collection.
c. Planted six months after collection.
d. Planted nine months after collection.
e. Planted twelve months after collection.
f. Planted fifteen months after collection.
g. Planted eighteen months after collection.
h. Planted twenty-one months after collection.
i. Planted twenty-four months after collection.

Treat-ment	Condition of Storage	Duration of Storage (Months)	Initiation of Germination		Percentage (%) of Germination at Different Days									
			Days	%	90	120	150	180	210	240	270	300	330	360
01	Control[a]	—	70	6.7	6.7	8.3	8.3	8.3	30.0	35.0	48.3	51.7	51.7	51.7
02	Fruits stored in the field	3	97	30.0	—	60.0	68.3	70.0	70.0	70.0	70.0	70.0	70.0	70.0
03		6	83	18.3	18.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3	23.3
04		9	42	16.7	58.3	58.3	58.3	58.3	58.3	58.3	58.3	58.3	58.3	58.3
05		12	183	3.3	—	—	—	—	3.3	3.3	3.3	3.3	3.3	3.3
06		15	69	1.7	1.7	1.7	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
07		18	61	3.3	5.0	5.0	5.0	5.5	6.7	6.7	6.7	6.7	6.7	6.7
08		21	—	—	—	—	—	—	—	—	—	—	—	—
09		24	92	8.7[b]	—	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7
10	Fruits stored in sheds on a cement floor	3	97	23.3	—	48.3	53.3	53.3	56.7	56.7	56.7	56.7	56.7	56.7
11		6	83	6.7	6.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
12		9	74	1.7	1.7	1.7	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
13		12	88	1.7	1.7	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
14		15	69	1.7	1.7	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
15		18	—	—	—	—	—	—	—	—	—	—	—	—
16		21	69	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
17		24	—	—[c]	—	—	—	—	—	—	—	—	—	—
18	Fruits stored in a seed storage chamber at 15° C	3	97	11.7	—	21.7	26.7	26.7	28.3	28.3	28.3	28.3	28.3	28.3
19		6	—	—	—	—	—	—	—	—	—	—	—	—
20		9	127	1.7	—	—	3.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0
21		12	—	—	—	—	—	—	—	—	—	—	—	—
22		15	—	—	—	—	—	—	—	—	—	—	—	—
23		18	129	1.7	—	—	1 7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
24		21	70	3.3	—	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
25		24	—	—[d]	—	—	—	—	—	—	—	—	—	—
26	Fruits stored in a seed storage chamber at 10° C	3	139	1.7	—	—	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
27		6	—	—	—	—	—	—	—	—	—	—	—	—
28		9	—	—	—	—	—	—	—	—	—	—	—	—
29		12	—	—	—	—	—	—	—	—	—	—	—	—
30		15	—	—	—	—	—	—	—	—	—	—	—	—
31		18	—	—	—	—	—	—	—	—	—	—	—	—
32		21	—	—	—	—	—	—	—	—	—	—	—	—
33		24	—	—[e]	—	—	—	—	—	—	—	—	—	—

[a] Fruits planted after collection; [b] Number of fruits planted: 23; [c] Number of fruits planted: 57; [d] Number of fruits planted: 58; [e] Number of fruits planted: 59.

The control consisted of 60 fruits planted approximately two days after collection. The planting of the control was planned for the same day of collection, but this was not possible.

The rest of the treatments, 60 fruits randomly selected, stored under the various conditions outlined above, were planted after each period of treatment. The exceptions were treatments 9, 17, 25 and 33, and due to a deviation in the plan, these were planted in smaller groups conforming to the numbers mentioned in the footnote in Table 1.

The entire fruits were planted in the same way as in nature. The planting was in a greenhouse, in trenches with a spacing of 1.0 m × 0.2 m, in Teresina, Piauí. The seeds were irrigated during the dry season at intervals as necessary to maintain humidity in the soil. Generally, irrigation took place every three days. When there was sufficient rainfall, the irrigation was not needed.

Each entire fruit was considered as a single diaspore, capable of reproducing a new organism (Angely 1959). Generally, the fruits of babassu contain 2–6 kernels or seeds, covered by a very thick and woody endocarp. We consider that germination is established in the diaspore when there is the emergence of at least one plantlet. Even when two or more seeds produce plantlets on the same fruit, we only consider this as the germination of a single diaspore. The notes on germination were made, at a minimum, every week.

Table 1 lists the number of days from planting until the initiation of germination, the total percentage of fruits that germinated in this experiment as well as the percentage of fruits that had germinated over intervals of 30 days, from 90 to 360 days.

We found that there was a significant lack of uniformity in the germination. The range of the initiation of germination was 42–183 days, respectively, in treatments four and five, with an amplitude of 141 days. On the other hand, in treatment eleven, the duration from the initiation to the end of germination lasted 488 days.

The fruits that were stored in the field for three months (treatment two) gave the greatest percentage of germination (70%). The second highest percentage of germination was of the fruits stored in the field over a nine-month period (treatment four) which gave a germination rate of 58.3%. The third highest rate was from materials stored in a shed for three months (treatment ten) which resulted in a 56.7% germination. Finally, the fourth highest percentage, 51.7%, was obtained from the control group.

The control group (treatment one) nevertheless had seedlings germinating after 416, 468 and 521 days after planting, with a final germination rate of 56.7%. In treatment eleven, a single fruit germinated 571 days after planting. In general, we have found that there is a tendency for a reduced rate of germination in materials planted after the sixth month of storage. The only exception was from treatment four (fruits kept in the field over a nine-month period) and this was considered an unusual case.

One of the significant tendencies seen from this experiment was the negative influence that storage at lower temperatures (10° C and 15° C) had on germination, especially as the storage periods became longer. The fruits that were stored at 10° C had a germination rate of only 1.7% when the storage period was three months (treatment 26). After six months of storage at this temperature, there was no germination.

Based on the results of this experiment, the following conclusions and recommendations are presented:

1. It is best not to store fruits destined for planting for periods longer than three months.

2. It is best not to store fruits destined for planting in conventional seed storage

chambers at temperatures from 10° C–15° C.

3. Fruits collected for planting can be kept in the field, under trees, thereby reducing costs of storage.

4. Even though the non-uniformity of germination is an important characteristic for the survival of *Orbignya* in regions with irregular rainfall, it is of great disadvantage for the formation of seedlings in a nursery. For this reason, we suggest that planting of the entire fruit is not the method of choice for germination of babassu, and that other alternatives for the multiplication of this species be utilized.

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(Continued from p. 54)

Slides of Palms Needed for Palm Society Projects

The International Palm Society is in the process of building a slide library. Eventually, these will be available in carousels for use at society meetings and palm programs. Some photos will be included in the upcoming "Handbook of Palms," a special issue of *Principes.*

If you have slides or negatives which you wish to donate or have duplicated for this project, please send to *Lynn McKamey, Promotion Chairman, P.O. Box 287, Gregory, Texas 78359 USA.* Please attach the name of the palm(s), location of the picture, and your name.

Error in Palm Seed List

When a list is made up for distribution by many people it is inevitable that small errors appear which slip by the editors. Exactly that happened to our new seed list. Even though it is only meant for one year and will be updated as we go along, one mistake must be corrected:

ALL SEED SHIPMENTS AND PAYMENT FOR SEED ARE TO BE ADDRESSED TO: Palm Seed Bank, INGE HOFFMANN, 695 Joaquin Ave., San Leandro, CA 94577 USA.

Principes, 32(2), 1988, pp. 59–68

Beccariophoenix madagascariensis

JOHN DRANSFIELD
Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, U.K.

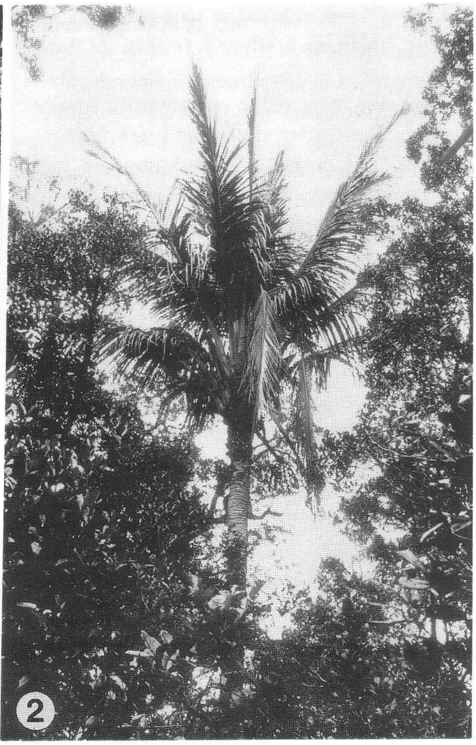
Of all the poorly known palms of Madagascar, one in particular, *Beccariophoenix madagascariensis*, has held a very great fascination for me over the last seven years. It was first described in 1915 by Jumelle and Perrier de la Bâthie, and in the first description of the palm the authors commented that the palm was extremely rare and on the verge of extinction. Very little herbarium material exists of this first collection. There is a meagre specimen in the herbarium at Paris and a duplicate of it in the herbarium at Florence in Italy that Perrier had sent to Beccari. The original description is quite detailed, and some sort of picture can be built up of how the palm looks from the notes on the habit. The author described how the constant harvesting of young leaves for the manufacture of hats was responsible for the decimation of the palm and also gave a local Malgache name, "manarano." As far as I know no further collections were made of this palm before Jumelle published his account of all the palms of Madagascar in the Flora of Madagascar and the Comores in 1945. In the meantime, presumably shortly before he died in 1921, Beccari had examined the specimen in Florence herbarium in some detail and had concluded that the palm belonged to the group of palms we now currently regard as tribe Areceae (Dransfield and Uhl 1986, Uhl and Dransfield 1987). Beccari's drawings and description were eventually edited and published in 1955 by Pichi Sermolli (Beccari and Pichi Sermolli 1955). This last account represented the best information we had at our disposal when Natalie Uhl and I started to write up "Genera Palmarum." How extraordinarily tantalizing it was. Here was an obviously distinctive genus known from miserable scraps, and probably already extinct in the wild. Hal Moore had looked for the genus on each of his visits to Madagascar but without success (see Moore 1965). The chances of understanding the genus better, let alone obtaining more material seemed very, very remote.

In 1983 we had reached the point in writing Genera Palmarum when it became essential to look at the material of Madagascar palms in the herbarium in Paris to try to understand better the genera *Louvelia*, *Masoala*, *Antongilia*, and *Beccariophoenix* itself. I was lucky enough to spend a week in the herbarium, and a very exciting week it proved to be. On looking at the type specimen of *Beccariophoenix madagascariensis* I was immediately struck by the great similarity of the flowers to those of members of the group of palms we now recognize as tribe Cocoeae, the tribe which includes the coconut and African oil palm, represented in Madagascar by these two common tropical crops which, presumably had been introduced long ago. The distribution of this tribe is such that the presence of a member in Madagascar would not be totally surprising. Having gone through the limited material, I was then allowed to go through the palm specimens which have not been incorporated in the main herbarium sequence. One of the first bundles I opened contained a marvellous specimen of *Beccariophoenix*, collected by Humbert in 1947. Here was just what was required to expand my poor description and to test whether the palm really did resemble a cocoid or not. I spent about a day examining the material and several things, some already noted by Perrier, became very obvious. The first was that we were dealing with a most peculiar and isolated genus. However, the affinities of the palm with tribe Cocoeae were strengthened. The single most important feature of the tribe is, of course, the possession of a thick endocarp in the fruit with three or more pores—the three eyes of the coconut—but of these, frustrated, I could not be convinced. There did seem to be a thin area in the endocarp, but all that was available were fragmented fruits so I could not be absolutely sure. The inflorescence, however, resembled in all respects but one those of cocoid palms. The major difference was the position of the big cowllike bract (the peduncular bract). In all cocoid palms known the peduncular bract is borne very near the base of the inflorescence; at the base it sheaths the stalk of the inflorescence (the peduncle) and it splits and expands, usually forming a cowl which partly covers the inflorescence. The familiar coconut itself displays the typical cocoid inflorescence perfectly. The specimen of *Beccariophoenix*, however, showed a quite different position of this bract. Instead of being borne at the base of the peduncle it seemed to have been borne at the very tip, and to have fallen off leaving a strange smooth wide collar all the way round the tip of the peduncle, just below the first flower bearing branches. The peduncular bract, apart from being extraordinarily thick (at least 3 cm in places) with its deep, close, parallel grooves strongly resembled that of a palm such as *Attalea*. I now felt convinced that *Beccariophoenix* was a member of tribe Cocoeae. Shortly after arriving back in Kew, Natalie Uhl arrived for one of our Genera Palmarum joint working sessions, and I can remember the excitement of describing the extraordinary inflorescence. Thanks to Humbert's specimen we included *Beccariophoenix* in tribe Cocoeae, but erected a new subtribe for it to emphasize its peculiarities. In November 1985 I visited Florence herbarium and was able to check the fruit of the specimen of *Beccariophoenix* in the Beccari palm herbarium. The endocarp did indeed have three thinner areas which, though not as clear as in a coconut, nevertheless just about qualified for being termed pores.

The first collection of *Beccariophoenix madagascariensis* had been made in forest at Analamazoatra, the type locality of many Madagascar palms and the site of the forestry station of Perinet. This is one of the most easily visited forest areas in Madagascar being on the railway line between the capital Tananarive and the main east coast port of Tamatave. Humbert's collection, on the other hand, had been made in the extreme south of the island in an area about 120 km north of Fort Dauphin. The two collections, one from the center and one from the south suggested that the palm might at one time have been common down the length of the eastern rain forests. Could it still occur in a surviving fragment of forest somewhere far from habitation? One more clue seemed to suggest that it might still be there. One day while I was in the Bailey Hortorium on another of our joint working sessions, I was idly going through a cupboard at the end of the sequence of herbarium specimens, looking at unidentified mystery specimens when I came across a single palm fruit together with a letter from Mardy Darian to Hal Moore written in 1965, asking Hal to identify the fruit which had been sent by a forest officer from Fort Dauphin in Madagascar. There was no record that Hal had identified the fruit, but it was quite obvious that it was that of *Beccariophoenix*. Although described as being on the verge of extinction in 1915, it had survived, at least near Fort Dauphin, until 1965. Was it still there? Mardy Darian indeed assured us that the palm still existed but that it was extremely rare, and we at any rate were none the wiser about its habitat, habit, or further details of its flowering.

Then the longed-for opportunity finally arrived. Thanks to continued funding from the National Science Foundation for our joint research on palms, Natalie and I were able to concentrate efforts on the geographical area least well known, Madagascar. At the same time thanks to the efforts of Dr. Peter Raven of Missouri Botanical Garden, and the enthusiasm of local Malgache biologists, new agreements were established which promised to make the procedure of obtaining permission to carry out research in Madagascar easier. We were strongly encouraged by Peter Raven and Dr. Voara Randrianasolo to go ahead with plans for me to visit Madagascar to collect palm specimens. After a delay of one year in order to finish the manuscript of Genera Palmarum, plans were eventually finalized for visiting Madagascar in autumn 1986. In late September, I, accompanied by David Cooke from Kew, and Pete Lowry and Jim Beach from Missouri Botanical Garden set off for Madagascar. On our arrival Dr. Voara Randrianasolo smoothed all formalities, provided us with the assistance of the experienced field botanist, Mr. Armand Rakotozafy, and off we went to the Masoala Peninsula, mecca for the palm botanist.

The story of our first month's very successful collecting will be told in the future. Suffice it to say here that we arrived back in Tananarive at the beginning of November having seen representatives of all known endemic genera of Madagascar except for *Beccariophoenix*. After this success it seemed to be too much to expect to find *Beccariophoenix* as well. In fact, I became very pessimistic about it. Time did not permit a visit to Fort Dauphin where it had last been seen with certainty and if it were already on the verge of extinction in 1915, surely there was no chance of finding it at the type locality. However, Dominic Halleux, a French agronomist and palm enthusiast, passed on the message to me that the palm was not really so rare as believed. At the beginning of November we headed off from the capital, eastwards down the new road constructed by overseas aid from the Peoples' Republic of China to Perinet where we put up, like so many botanists before us at the excellent Station Hotel. Our first two days were spent looking at palms in the vicinity of the forest station. Collecting was good and we were lucky enough to see a fine population of *Louvelia madagascariensis*, a strange squat palm, previously known only from its type specimen. Then unfortunately illness struck. An unpleasant bronchitic flu bug hit Jim and me, but this was of minor significance compared with an attack of malaria which hit David. On our last scheduled day in Perinet Jim and I had recovered sufficiently to go off into the forest again with Armand. We had been advised of an area of good primary forest a little further afield and we determined to head for that. David remained in Perinet, trying to sweat off his malaria. With the help of an excellent local guide, Jim, Armand and I drove off the beaten track along an old trail to the north of Perinet until a particularly vicious set of ruts made the going just too awful to contemplate. We then started to walk through disturbed forest and along the edges of units of shifting cultivation. After about one hour's walk we came to the end of the path, with a fine vista of untouched forest and a tempting ridgetop leading off to our right. No sooner had we gotten into the shade of the forest than we came across a large rosette palm, obviously the juvenile of a big tree palm. This palm seemed to be confined to the ridge tops. At first I thought it might be *Louvelia lakatra* but the leaflets had much more conspicuous cross veins, and, besides, *L. lakatra* seems to be confined to valley bottoms. Furthermore, the leafsheaths were strikingly fibrous and there was no petiole. Then, in a burst of inspiration I realized it just had to be *Beccariophoenix*. What

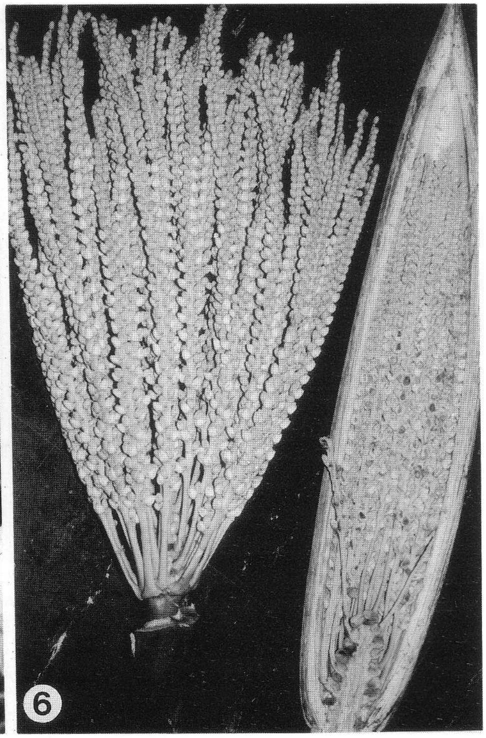



1. The remains of a huge tree of *Beccariophoenix* cut down for its cabbage. 2. A mature *Beccariophoenix* thrusts its crown into and beyond the forest canopy.

else could have so many features of a cocoid palm? However, the account in the Flora of Madagascar mentions that the undersurface of the leaflets of *Beccariophoenix* are covered with a thin layer of white wax and of that there was absolutely no trace. Notwithstanding I felt we were on to something very exciting indeed.

As we walked along the ridgetop I became more and more convinced but with no way of justifying my gut reaction as there was no sign of flowers or fruit. So we asked our guide. What was the palm? Had he seen mature trees in flowers? Oh yes indeed, he knew the palm, it was a big tree at maturity, and if we reached the next but one ridge (glimpsed by us through the haze in the far distance) we would almost certainly see it in flower and fruit. There and then we let him know that the priority for the day should be to reach that ridge. On hearing this, our guide leapt off the ridgetop and charged steeply down in a straight but pathless line through the forest to the distant ridge. He turned out to be a veritable tiger and a superb woodsman. I was soon struggling hard to keep up. The forest glimpsed as we rushed through it was very beautiful and at one point we passed right under a group of "indri" in the treetops, calling mournfully to each other. First we slithered down what felt like a vertical slope to a tinkling forest stream. Thank goodness there are no rattans in Madagascar! Slender climbing bamboos, however, were bad enough making our path perilous with snags and tripwires. From the stream we climbed steeply up onto a ridgetop. Here were several palms seen earlier on our trip. *Ravenea robustior*, a large tree palm contributing to the forest canopy, was quite abundant, some

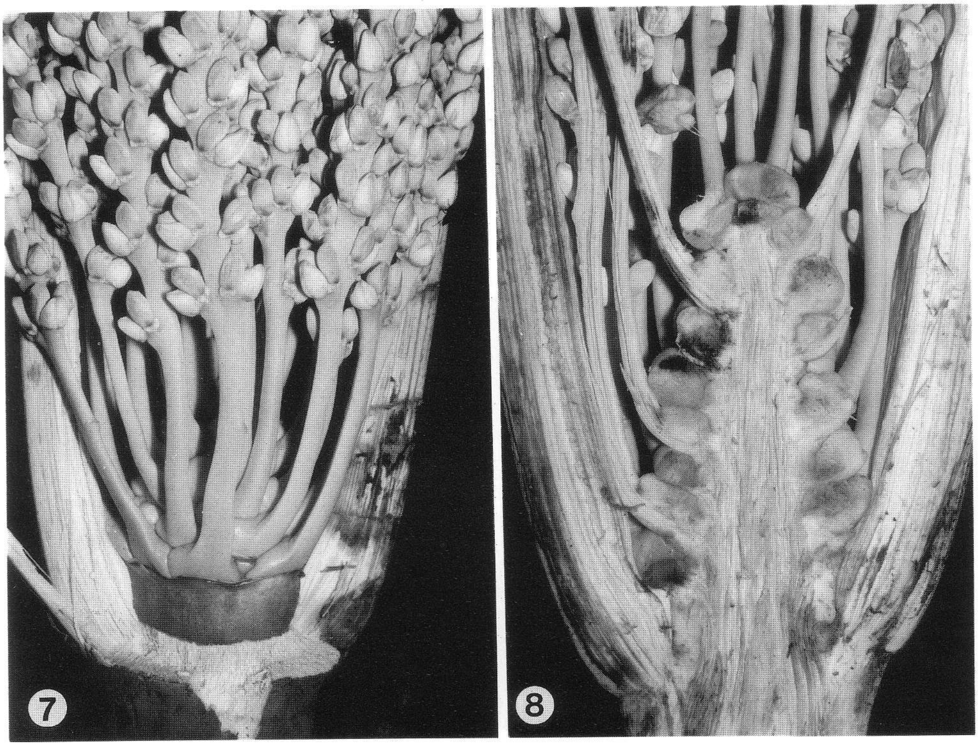
3. Jim Beach holds an inflorescence of *Beccariophoenix* in bud, showing the two-keeled prophyll. 4. An inflorescence of *Beccariophoenix* just before opening.



5. An expanded inflorescence of *Beccariophoenix*. Note how the peduncular bract has fallen, leaving the broad collar at the base of the rachis, and the widely spreading rachillae. 6. An inflorescence of *Beccariophoenix* split to show the thickness of the peduncular bract.

trees appearing tantalizingly like what I imagined *Beccariophoenix* to look like. Growing with it was another tree palm though not so large and with fewer leaves with broader leaflets; time did not permit us to stop long enough to look more closely, but I believe this was probably *R. latisecta*, a palm, as far as I know, known only from its type. In the undergrowth were *Neophloga concinna* and *Dypsis louvelii*. After over an hour of tramping up this interminable ridge I began to think we should never see a mature plant of *Beccariophoenix* and began to waste time further by demanding to check every tree palm, lest we should be missing a *Beccariophoenix*. The guide patiently waited, though as it transpired he knew all along that not far off there was a colony of the very palm we were after. At one minor summit as we stopped to catch our breath, we saw a strange squat palm with large partially undivided leaves borne in a shuttlecock at the end of a five meter tall stem. This we had time to investigate further and although it was not fertile, I feel certain it was *Marojejya insignis*, the first record away from the Marojejy Massif and Masoala Peninsula of the northeast.

About half an hour later, Jim, Armand and I were trailing in the rear, much in need of a rest, when our guide reappeared from in front clutching a huge unopened palm inflorescence, instantly recognizable as that of *Beccariophoenix madagascariensis*. Our first reaction was one of disbelief, then of jubilation. In fact the forest did not resound so much to the sound of "indri" but to the sound of jubilant botanists. In a few moments the guide had led



7. Close-up view of the artificially opened inflorescence of *Beccariophoenix*. 8. Close-up view of the rachis in section, showing the grossly swollen bases of the rachillae.

us past a fine mature tree of *Beccariophoenix madagascariensis* (Fig. 2) down a slope to a recently felled palm tree (Fig. 1). Again this was a mature tree of *Beccariophoenix*. I feel sure that our guide himself had been responsible for felling the tree about three weeks previously, for its "cabbage"—such is one of the major threats to the palms of Madagascar. However, the presence of a felled tree of the very palm we were looking for allowed the collection of beautiful material without further destruction of trees; with the sickness of David, we were without our usual tree climber. The felled tree provided several inflorescences (Figs. 3–5). Leaves, which in the felled tree were already shrivelled, we cut from another individual which had just begun to produce an aerial stem. Finally we saw half mature fruit on a tall individual (Fig. 10); our guide proved to be a fine climber and shinned up the tree to twist off a few fruiting rachillae. I searched very hard for mature fruit fallen under this last individual, but with only very disappointing results. I found three mature bare endocarps, each however with a beetle shothole. However, these endocarps each had three clear pores as in a coconut (or rather, as in *Jubaea chilensis*, the endocarp of which it more closely resembles).

This seemed to confirm the placement of *Beccariophoenix* in Cocoeae, but so many features of the palm are unusual within the tribe. The tree itself appears remarkably like many other big tree members of the tribe; particularly reminiscent is the leaf base with its lack of a true petiole. It is the inflorescence itself which is so distinctive. The peduncular bract is indeed borne at the very tip of the peduncle (Figs. 6–7). It is very thick, hard and

9. Close-up view of *Beccariophoenix* flowers in bud. 10. Immature fruit of *Beccariophoenix* are not unlike those of other cocoid palms.

woody on the outside, but strangely spongy on the inside, and splits longitudinally and then neatly slips off the peduncle leaving a broad collar at the base of the rachis (Fig. 5). The rachillae are very crowded on the very short rachis and each one is grossly swollen at the base (Fig. 8). It is possible that these swellings, which appear just like pulvini, may be partly responsible for the abscission of the peduncular bract. Maybe the pressure of the swelling pulvini forces off the bract. No other palm has such a strange peduncular bract. Other unusual features such as the anatomy of the peduncular bract and the development of the numerous stamens await further detailed study. In the field we were very conscious of the peculiarities of this splendid palm. How unfortunate that we were unable to collect any mature fruit for growing.

By the time we had made good herbarium collections and written copious notes and lunched, it was time to think about returning to the vehicle. Our guide tied up three unopened inflorescences into a bundle, hitching on to either end sacks of leaf and flower fragments, while Jim, Armand and I each staggered off with an unwieldy sack of specimens. The three inflorescences must have weighed at least 35 kg, a load which would have defeated me. Yet our guide proceeded to run up hill and down dale as if he were carrying nothing. We returned by a much longer but less arduous route. The crystal-clear stream in the first valley bottom allowed us to cool off and quench our thirst. From the summit of the next ridge we had a good view, despite the haze caused by the fires of forest clearance, of our ridge with a few emergent crowns of *Beccariophoenix madagascariensis* (Fig. 11). Then the rest of the eight kilometer walk back seemed

11. Our last view of *Beccariophoenix* was of a few shuttle-cock like crowns projecting from the ridgetop montane forest in the distance.

tedious. Eventually we reached the vehicle, just when I began to despair of ever doing so. How the guide managed his load I cannot imagine—I had to struggle to lift it into the back of the vehicle. We then inched our way along the apalling road back to Perinet and a great celebration in the bar of the Station Hotel. David was clearly very disappointed to have missed such an exciting day, but was feeling sufficiently recovered to join us at dinner.

Thus ended an extraordinarily exhilarating day. Not only had we refound *Beccariophoenix* in its type locality but we had seen about eleven mature individuals and about 70–100 juveniles. Furthermore we had the satisfaction of learning that the area of forest where this most splendid palm grows is to be protected by its owners and maybe the palm will survive. One final tantalizing thought is that there seems little peculiar about the forest at Perinet where *Beccariophoenix* grows. Who knows but there may be extensive populations of this little known palm in the patches of hill forest remaining in areas far from habitation along the length of the eastern rain forests of Madagascar.

Acknowledgments

I should like to thank Dr. Voara Randrianasolo of the Parc de Tsimbazaza, Armand Rakotozafy, M. Joseph, Manager of the Station Hotel, Perinet, and the owners of the stretch of forest containing the population of *Beccariophoenix*. This fieldwork was supported by NSF Grant no. BSR-8407029 to Natalie W. Uhl and the Royal Botanic Gardens, Kew.

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NEWS OF THE SOCIETY

Arizona Chapter

January 10th 1988. This "Social Meeting" of the year was held at the home of Fred Ruskin. A balanced diet was provided by the delicious pot-luck dishes brought by the members and guests. The attendance of 14 members and guests was due to the excellent calling committee of Hans Wiebe and Robert Claesgens.

Special Meeting. Mrs. Tamar Myers, a Director of our International Society, will be with us for a special meeting on January 27th. This will be at approximately 7:00 P.M. at the home of Hans Wiebe, 10635 N. 44th Court, Desert Gardens. This will be an excellent opportunity to get better acquainted with one of our international officials.

The book "Genera Palmarum" was displayed and discussed. Some disappointment was expressed that it was not more helpful in identifying the young, non-flowering palms most commonly encountered by members.

"Frost blanket," a non-woven white material for covering plants during cold weather was discussed. This can be left on through the days, and has been working well so far.

Richard Fife had been assigned the task of identifying the palms now growing in the Senate Palm Garden at the Arizona State Capitol complex. He presented a map with a key to the identities of the plants, plus an alphabetical listing of all the plants which could be identified. He was commended heartily by the chapter for this excellent work. This is now the most complete palm garden between California and Florida, according to our President Gallagher.

Native palm groves growing in canyons in Baja, California were described by some who had been there.

Having recently visited Hawaii, Mike Gallagher presented us with a list of palms which could be ordered from the Lyon Arboretum. He showed slides of his visit to Hawaii and the palms he found in gardens there for a colorful conclusion to a delightful meeting.

V. J. MILLER

Gulf Coast Chapter

The Fall 87 meeting of the Gulf Coast Chapter was held on October 18th at the home of Maxwell Stewart. The weather was beautiful and Maxwell's palms were an inspiration for all of us. Chapter members came from Georgia, Florida, and Louisiana, to attend the Mobile, Alabama meeting. As usual Maxwell served a beautiful buffet luncheon. A short business meeting was followed by the palm auction where extra interest was generated by some uncommon specimens donated by former chapter member, Dr. William Bechtel.

The quarterly meeting dates and locations for the next four meetings are: April 24th—Pensacola, July 24th—Panama City, October 23rd—Mobile, January 22nd 1989—Pensacola.

THOMAS G. MIGNEREY

Principes, 32(2), 1988, pp. 69–72

A New Species of Chelyocarpus (Palmae, Coryphoideae) From Peruvian Amazonia

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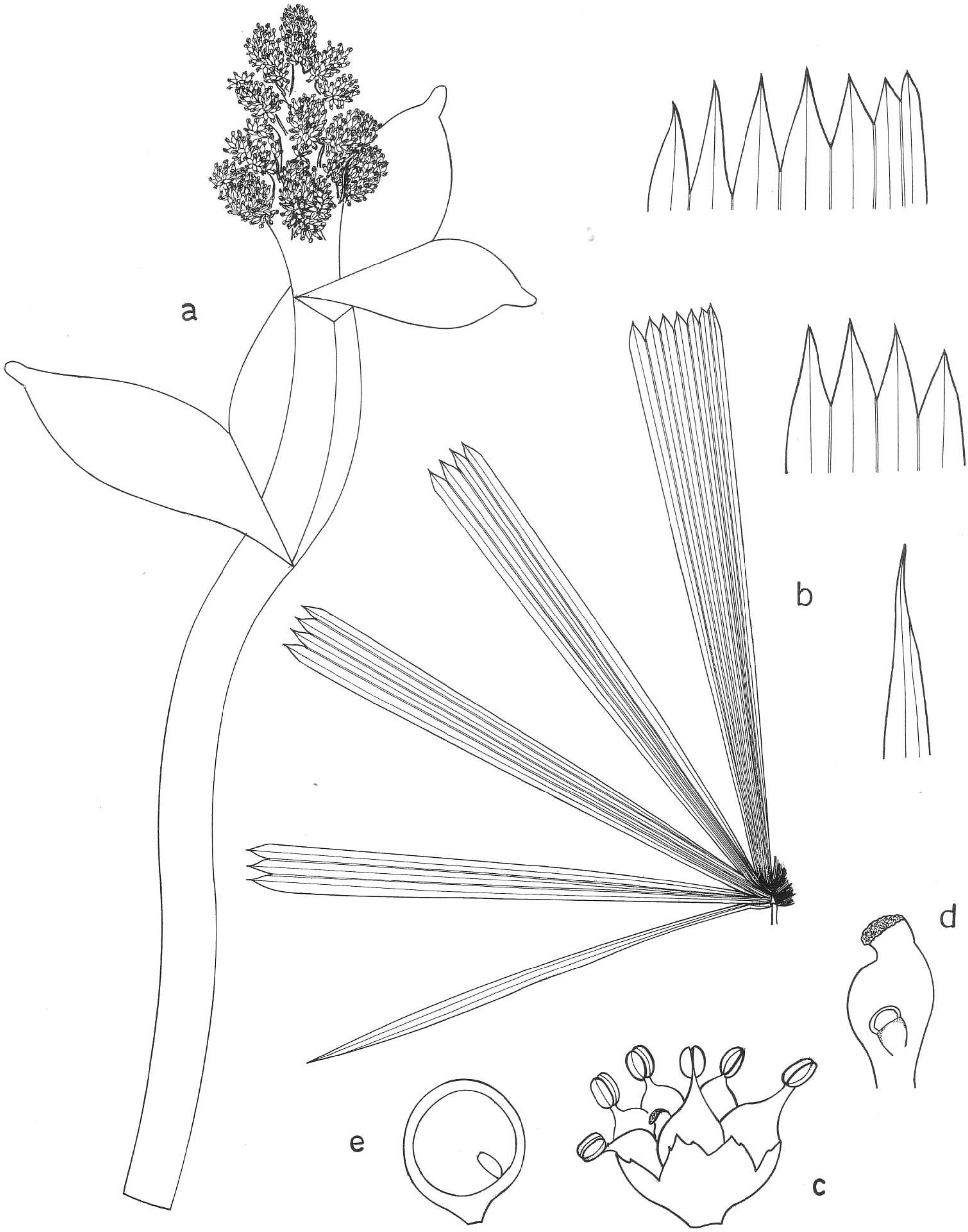
Species richness of palms is very high in "terra firme" forests of the Amazon basin, particularly in the central and western regions (Kahn et al., in press). Diversity at the generic level is clearly highest in the western part: 31 of the 35 native Amazonian genera are found in Peruvian forests, among them, twelve (*Aiphanes, Catoblastus, Chamaedorea, Chelyocarpus, Dictyocaryum, Iriartea, Itaya, Pholidostachys, Phytelephas, Prestoea, Wendlandiella*, and *Wettinia*) do not reach central and eastern Amazonia.

Two of the three species of *Chelyocarpus* occur in Peruvian Amazonia, as does the only species of the related genus *Itaya* (Moore 1972). Thus, discovering a new Peruvian *Chelyocarpus* is not very surprising, especially when the species is found in forests rarely explored by botanists. This new palm is, however, strikingly distinct from the three previously-known species.

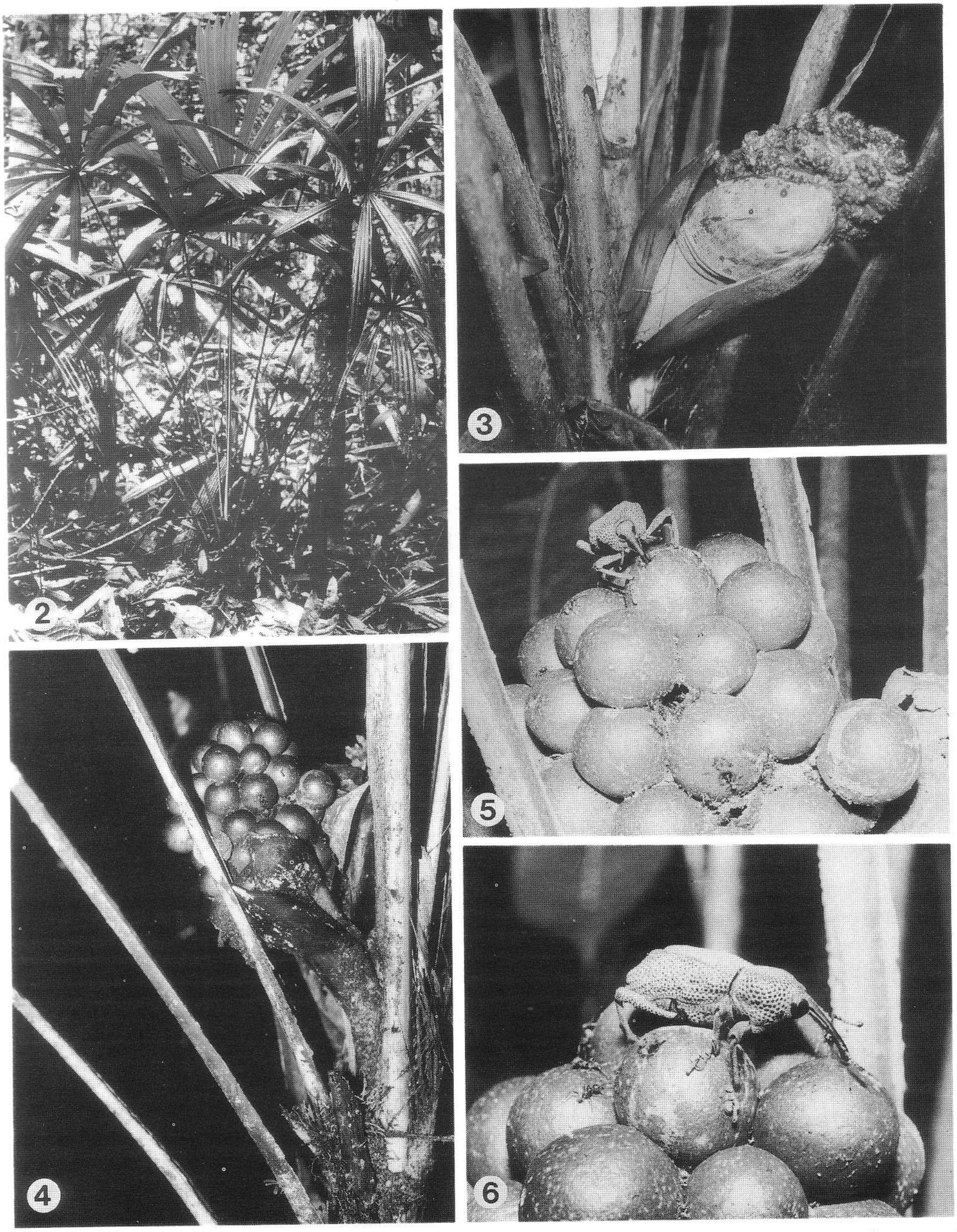
Chelyocarpus repens F. Kahn et K. Mejia sp. nov. (Figs. 1–6).

Caulis procumbens ad 1 m longus, foliis 10–20. Lamina 0.7 m longa, 1.2 m lata, bipartita, laterilater in 4–6 segmenta elongato-cuneata partita, supra viridis, subtus alba. Inflorescentia erecta, 0.35 m longa, bracteis sterilibus 2; rhachis 5–8 cm longa ad apicem compressa; rami 2 cm longi. Flores 4 mm alti; perianthium uniseriatum plerumque 6-lobatum, 2.5 mm altum; stamina 4–8 plerumque 6; carpella 3–5 raro 1, 2, 6. Fructus globosus, 2.5 cm diametro, epicarpio laevi. Embryo subter dimidium. Typus: Peru, *Kahn & Mejia 1974* (holotypus USM; isotypus NY).

Trunk pale-brown, procumbent, up to 1 m long and 6–8 cm diam., sometimes erect, up to 0.6 m high. Roots produced at the lower side along the trunk, with secondary, white, short, spiny roots. Leaves 10–20; sheath 0.25–0.3 m long, densely pale-brown appressed villous; petiole up to 1.8 m long, biconvex and rhombic in section with obtuse margins distally, furfuraceous lepidote on the lower side; hastula deltoid, up to 1.5 cm high 1 cm wide; blade green above, white below, lower surface covered with a continuous layer of thin, white, membranaceous scales, these rubbing off on contact, 0.75 m high 1.2 m wide, divided to within 1.5 cm of the base, laterally divided into 4–6 elongate-cuneate many-ribbed segments, to 0.75 m long and 0.2 m wide, the external often acute, each many-ribbed segment divided into 2–7 acute 1-ribbed segments, 2–8 cm long and 1.5–4 cm wide, these with the midrib prominent below with up to 3 lateral nerves and several finer tertiary nerves on each side. Inflorescence erect, 1 or 2, rarely more, among petiole bases, ca. 0.35 m long, branching to 1 or 2 orders; peduncle 0.24–0.28 m long, strongly flattened, pale-brown appressed villous, turning glabrate, bearing a prophyll at 0.18–0.20 m from the base, pale-brown tomentose then glabrate, 9–11 cm long, and a peduncular bract at 0.22–0.28 m from the base, whitish floccose tomentose at anthesis, 5–7 cm long; rachis flattened, 5–8 cm long, 1–2.5 cm wide at base, with 25–35 first order



1. *Chelyocarpus repens.* a—inflorescence with prophyll and one peduncular bract. b—palmate leaf with tips of many pointed and one-pointed segments. c—flower with uniseriate, lobed perianth, with basally broad, tapered filaments, and exserted anthers. d—inserted carpels, each with a hemianatropous ovule. e—fruit and seed with embryo in the lower third. (See description for scale.)



2. *Chelyocarpus repens*, an understory palm in Amazonian terra firme forests of Peru. Its procumbent stem creeps under the litter. 3. Inflorescence of *Chelyocarpus repens*. 4. Infrutescence of *Chelyocarpus repens*. 5. A curculionid has perforated the fruit and is eating the endosperm. 6. After the meal . . . .

branches, to 0.5 cm long, strongly flattened and wider next to the rachis, each subtended by a slender, flattened, tomentose bract, up to 1.8 cm long; rachillae up to 2 cm long, adnate to the first order branch, densely covered by flowers. Some flowers borne on rachis and branches.

Flowers strongly scented, creamy turning dark brown when dry, sessile, 4 mm high, with a slender bract, 2.5 mm long; perianth uniseriate, 2.5 mm high, often irregularly 6-lobed, each lobe irregularly denticulate; stamens 4–8, usually 6, filaments broad and thick basally, tapered to the exserted anthers, often connate basally or throughout; carpels 1–6, most frequently 3, ca. 1.5 mm high; style short, recurved; stigma papillate; perianth in fruit 2.5 mm high. Fruit greenish, globose, 2.5 cm high; epicarp rather smooth, not tessellate, mesocarp whitish, thin. Seed depressed globose to globose, ca. 1.8 cm high; embryo in the lower third. Only one carpel giving fruit, rarely two, then fruits connate basally.

Distribution and Ecology: Type locality is near Jenaro Herrera village (4°55′S; 73°40′W) in the lower Ucayali River basin, Loreto, Peru. This species was also collected in Yaguasyacu River (2°40′S; 72°00′W), tributary of Ampiyacu River (Plowman et al., no. 6772), Loreto, Peru. In the type locality, this understory palm occurs in high density on slopes (206 palms, among them 18 seedlings, were counted on 0.62 ha) in "terra firme" forest on acrisol (FAO), also found in limit with seasonal swamp forest, but in low density.

Specimens Examined: Kahn & Mejia 1974 (holotype USM, isotype NY), fl. fr., 13 Nov. 1986; *K & M 1973* (NY), fl. fr., 13 Nov. 1986; *K & M 1972* (BH, K), fl., 13 Nov. 1986; *K & M 2049* (P), fl. 6 May 1987; *Blanc 825* (USM), fr., Aug. 1985; *Mejia 707* (K), fr., Aug. 1985; *K & M 2003* (INPA), fr., 15 Dec. 1986; *K & M 2004* (MPEG), fr., 15 Dec. 1986; *K & M 2005* (AMAZ), fr. 15 Dec. 1986; *K & M 2006* (CAY), fr. 15 Dec. 1986; *K & M 2008* (AAU), fr., 15 Dec. 1986; *K & M 2021* (BH), fr., 20 Mar. 1987; *K & M 2068* (P), fr., 21 July 1987. All these vouchers were collected in the type locality. *Plowman et al. 6772* (BH), fr., Mar. 1977 (see above).

Chelyocarpus repens differs from the three other species. *C. chuco* (Martius) H. E. Moore, *C. dianeurus* (Burret) H. E. Moore, and *C. ulei* Dammer (Moore 1972) by its uniseriate perianth, its higher number of carpels, its smaller, erect inflorescence with only one peduncular bract and by its procumbent, short stem, creeping in the litter and rooting at the lower side. This character is recorded in the epithet.

C. repens is a beautiful, elegant palm with slender erect petioles, and palmate blades which are silvery-white below. This procumbent species could have a potential as an indoor ornamental. However, the species is not frequent. It has been collected in only two localities in Peruvian Amazonia. Moreover, fruits are not abundant, with at most 20–50 per infrutescence, and many fruits are perforated by a curculionid beetle which eats the endosperm and destroys the seed (Figs. 5, 6). Near Jenaro Herrera village, increasing deforestation by shifting cultivation and pasture extension threatens the type population with extinction.

Acknowledgments

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Attempted Rules for the Deployment of Palms

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It is sad that more palm lovers cannot travel about the world to see for themselves the magnificent palms which remain in the wild. Because the human animal does not control human population, wilderness is shrinking, changing, disappearing, as man-made environment is taking its place. Whether they are "Scandinavian" in concept, in which natural landscape is left with its original feeling more or less intact, or "Mediterranean," in which natural landscape is overcome with terraces and potted plants, rearrangements of nature by man are becoming increasingly necessary to his well-being.

There are many types of palm lovers, and they enjoy different intensities of involvement with palms. Some are trained in the art of landscape architecture. Some cause palms to be placed on highways, seashores, or great land projects. Others promote palms with urban or rural governments, or create or support botanic gardens. Most palm lovers, however, have their own personalized rearrangements of nature, which they believe will be recognizable and appreciated as gardens, as deserving "gardenhood." And if they have struggled with the joys and anguish of landscape design, they know that nature's demonstrations, however rich and wonderful, are not sufficient to resolve many of the problems and opportunities of man-made conditions. Perhaps man-made garden design problems suggest man-made rules to help with their solutions. Perhaps some palm lovers might enjoy ruminating on such rules.

Because the writer is an architect, he was recently approached by a man and his wife who had bought and intended to remodel an "old" house (early 1930s) on Miami Beach. They also bought an open and empty property adjacent to the house. Even on the first visit to the site, they were urged by the writer to create on the open property a collector's garden of palms, which could in time help to develop a rich outdoor space to expand the living areas of the house.

The idea of the palm garden was accepted with great enthusiasm. The writer was requested to help with a bibliography of writings which would provide the couple with rules or guidelines for designing their own garden, "over a period of years."

Disappointed not to be commissioned to design and help with the achievement of the garden, but understanding the financial wisdom of their course, the writer found several information sources on germinating, selecting, planting and growing palms, but no landscape theory dealing with designing a palm garden.

Fresh from Boston, the couple had brought with them keen minds, fine educations, and a desire to embrace everything tropical. Their determination to have white peacocks worried the writer because he thought it might indicate a lack of focus and persistence necessary to create a slowly developing palm garden. Important understandings were reached: that quieter exotic birds would better suit the neighbors, that any birds were preferable to dogs which dig in gardens, and that an open courtyard of the house should be shaded to become a palm nursery to supply the garden as it evolved. The requested rules were to be prepared by the author. Although design and working drawings of the garden would have proven to be a simpler task than writing rules, the palm garden would be their own work and a brave attack on the tabula rasa next door.

It is probable that few palm lovers would admit that they need design rules with which to locate palms or to create a garden other than those rules supplied by their common sense and native sensitivity. Not all palm planters are palm lovers, but palm lovers have, by definition, potential to treat palms better. There are, regardless, so many poorly placed palms and so many poorly designed gardens that too few palm planters realize that the locating of any palm, anywhere, is an act of design, and that they are, whether they choose to think on it or not, responsible for the consequence of their acts. Perhaps simplistic rules could provoke responsibility and jog some imaginations without offending those who are totally certain of their own competence. With hope that some of the rules might even be easily remembered, they are written as short imperatives with examples and supportive thoughts.

Rule 1: Define Objectives

Will the chess game be played at a square table or round? Will the atmosphere be formal or informal, architectural or natural? What is the mood already established, and can it be enforced, extended, or changed? What are the purposes of the design, one must ask himself, and what mood will suit the purpose best? Aside from knowing one's palms and the personalities they project, how does one achieve a chosen mood? Is there a mental picture which can be described?

Rule 2: Preordain Space

What the zero does for mathematics, negative space (where nothing occurs except space) does for landscape design. The crowded jungle or the crowded garden is enjoyable only because of the natural or man-made spaces which let one perceive it. If the negative space or spaces of a garden are well conceived and well understood, no palm will want to be planted which does such spaces harm. The opposite of the jungle garden is the open negative space of the Japanese Zen garden, where sparsely placed positive elements create tensions between them. (A Zen garden using palms is a challenge, perhaps not yet attempted.) Space is an indispensable design tool, and no growing things celebrate space better than palms.

Rule 3: Conjure Drama

Drama can be subtle, but the use of palms without a sense of drama is to lead them and their admirers into a "ho-hum" existence. Full blown palms are among the most innately dramatic devices in all of nature; planting with very young material can mean that the designer's drama must remain a private secret until the material begins finally to mature. To conjure drama is to create the most impact with the best devices at hand. Consider a few phrases among countless other possible ones which suggest the achievement of drama: the special subject brightly lighted, the powerful rhythm interrupted, the sculpture emphasized, the tall and slender made doubly so by reflection, the familiar form in astonishing repetition, a framed view of the unexpected.

Rule 4: Behold the Single Palm

It is easier for many palm lovers to be enthralled by the single palm, by the miracle of the palm itself, than to fully grasp that it must exist in a perceived space, in a particular place, and in relation to a set of visual circumstances. (So much for the care-free, spontaneous act of planting a palm.) While a magnificent individual palm can thoroughly qualify an expansive scene, too often an insufficient specimen or inad-

1. The median of arid highway U.S. 1 boasts miles of unhappy *Carpentaria acuminata*.

equate species is required to perform the task, looking incidental or even forlorn. The so-called "dooryard palm," labeled for those who might indulge a "pet palm" as a concession to living in a place where one can be grown, is too seldom selected to have sufficient character to deserve a dooryard. Single palms alone in an empty front yard or used as the only palm in the garden need size or character sufficient to handle the role. The most difficult garden to design must be the collection of singles typical of the collector who discovers and obtains one palm of each species and plants them all together. Some gardens offer special single gems in separated settings. David Fairchild grew a fifteen foot *Chamadorea metallica*, all by itself, with its one half inch diameter trunk, in the center of a shaded glade.

Rule 5: Stay with the Crowd

Although nature sometimes mixes palms which do not flatter and even become confused with each other, her usual example is the presence of many of the same kind of palm or palms placed together. Says Roberto Burle Marx, the celebrated Brazilian landscape architect who has worked extensively with palms in his urban parks and plazas, "They are marvelous, one kind at a time, but I do not like to see them all mixed up together." Grouping, however, cannot always solve the selection of an inadequate or ill suited palm. For example, someone with good intentions recently bought and planted groups of *Carpentaria acuminata* in the wild, dry median strips of Highway U.S. 1 south of Miami; their effect and their future is bleak (Fig. 1). Someone else saved the royal palms on Biscayne Boulevard when the new people mover was installed, but unfortunately preserved also the regular cadence of the rows with palms of irregular height; irregularly spaced, the same palms would have merely looked informal, rather than ill-matched because of inevitable damage, disease, or uneven growth (Fig. 2).

2. One of several ill-fated *Carpentaria acuminata* and regularly spaced, irregularly sized *Roystonea regia* on Miami's Biscayne Boulevard.

Rule 6: Co-mingle with Care

Who has not reached out for a prize at the smorgasbord without knowing where or how it could be used? Matching palm personalities takes the same ability needed to create a successful dinner party. Some palms will not even talk to each other. A list of antisocial palms should certainly include *Neodypsis decaryi, Wallichia disticha, Verschaffeltia lagenicaulis, Johannesteijsmannia altifrons* and the like, which are simply too elegant or eccentric to be matched with anything but their own species. Although their visual personalities are entirely at odds, coconuts are often unaccountably intermixed with washingtonias; *Washingtonia robusta* intermixed with *Sabal Palmetto* can put ones teeth on edge. Almost similar palms often detract from each other through confusion, and the otherwise sociable, oversized giants such as *Roystonea* have bad habits of throwing massive brown fronds down upon tender neighbors (Figs. 3,4,5).

Rule 7: Curb Polarization

In the parlor, the open field, or the garden, two identical design elements can create what is known as an unresolved duality, which "Polarizes" a composition, causing the viewer to look back and forth between the two without knowing why. The duality is resolved when the reason becomes clear, that the two elements announce and formalize an entrance, for example. The problem is commonly avoided by designers by the purposeful use of odd numbers of elements or of odd numbers or of family groups (mother and child, father, mother and child, etc.). All of the world's cultures carefully avoid matched pairs without a purpose.

Rule 8: Palms Grow

Even the most experienced grower sometimes loses the three dimensional chess game of what each palm should do and what each palm will in fact do. A palm garden is a study of hopeful probabilities and of avoiding future disasters (Fig. 6). The massive mango tree and the exploding *Corypha umbraculifera* planted beneath it at Fairchild Tropical Garden wish now to occupy the same space (Fig. 7). An enormous number of unhappy palms rise up to challenge the power lines of Miami, and in that city's downtown area, where palms are assisting with regional identity, a series of *Carpentaria acuminata* are mashing their crowns against the projecting beams of a major building under which they were planted (Fig. 2). Ignorance or dishonesty shows in landscape efforts where large numbers of small *Livistona chinensis* are used as a ground cover, only to grow into a mass of unhappy palms (Fig. 8).

3. In the department of total confusion, a young *Cocos nucifera* challenges an older *Syagrus schizophylla*.

Rule 9: Aggrandize the Superb

The elements of architectural infrastructure—terracing, walls, lighting, gates, paths, pools, objects of interest, places to sit—all are design opportunities, but however well done, these elements cannot substitute for the placing of palms in such a way that their best features become evi-

4. *Neodypsis decaryii*, popular in south Florida, wants to be alone.

5. *Hyophorbe lagenicaulis* and *Pseudophoenix sargentii* do their best visually to survive each other's company.

6. Poorly matched *Sabal* sp. and *Phoenix* sp. must contort to escape planted niche.

7. Fairchild Tropical Garden's teenaged *Corypha umbraculifera* challenges sheltering trees.

dent. If sculpture or individuality is to be shown, provide visual breathing space; if crown or fruit or fine trunk are the focus, they should be made to show. Some palms have exceptional feet: stilt roots, bell-shaped bases, or clamboring roots, like those of otherwise lackluster *Gaussia attenuata.* Someday a small garden within a fine building will be made of white gravel and three *Verschaffeltia splendida,* so compelling that it will fascinate the world.

Rule 10: Create Synergy

The truly enlightened deployment of palms requires several kinds of intelligence simultaneously energized, a simple matter of combining a logical, well thought out program, a knowledge of palms and how to grow them, and inspired design analysis—nothing more than that. After a generation of time observing the evolving results, one might one day have a sense

8. Originally used as a ground cover, these *Livistona chinensis* have grown into a competitive mass.

of how closely the effort had approached the sublimity of success.

These, then, are the attempted rules, to date. If the writer sounds as if he believes he is speaking from Mount Olympus, it should be understood that many of his rules were inspired by his own mistakes, and further, that he firmly believes any rule should be broken if it interferes with more powerful inspiration.

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Phoenix theophrasti on Crete

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"Crete is a region lying in the midst of the black deep, a fair and fruitful land, girt by the waters. Many are the men, nay, numberless, who make it their abode, and ninety are its cities. . . ."

This is how Homer (8th century B.C.) describes Crete in his famous work "The Odyssey." Indeed, in ancient times Crete was densely covered with forests but today very few of them remain due to the excessive human activity that has continued on for thousands of years. These remaining forests, however, are of some interest and well worth a visit (Zacharis and Flegas 1982).

Crete is the southernmost island of Greece and the southern limit of Europe, as well. It is situated in the eastern Mediterranean, just below 36° latitude, and is almost equidistant from the continents of Europe, Asia, and Africa. It covers an area of 8,330 km^2 and is 270 km long and from 12 to 61 km wide. The climate is mild and typically mediterranean. The winter is never harsh and the heat of the summer is tempered by northern sea-winds. The temperature averages 20° C (68° F) and very rarely rises as high as 40° C (104° F). Average precipitation is 400–600 mm. Frost is not common and rarely lasts more than a day or two. Snow is found only in the mountains, and the climate along the coast is pleasant all year long (Zacharis and Flegas 1982).

Crete's geographic location along with its climate make its flora of great interest. Crete has a great variety of plants—about 1,600 species, including some 150 endemics (Iatridis 1985). For a comparatively small island, these figures are impressive.

A very rare species of palm can be found growing on Crete, namely *Phoenix theophrasti* Greuter. Until recently it was thought to be endemic to Crete, but now it is known to grow further northeast in the Datca Peninsula, Turkey (Boydak 1985).

Phoenix theophrasti is closely related to the date palm (*Phoenix dactylifera* L.) and has almost the same appearance. It differs from the date palm in its flowers, which are short-stalked, and in its fruit which is smaller (1.5 by 1 cm) and inedible. It grows to about 15 m tall with leaves 2 m or longer (Polunin 1976). Very often it suckers to form clumps, and as Boydak (1985) mentions, it reproduces both vegetatively and by seed on Crete (Fig. 2) and in Turkey as well. Theophrastus, the ancient Greek botanist (372–287 B.C.) and the first man to study this plant, reported meeting palms having two, three, and even five "heads" (Theophrastus, De Historia Plantarum).

This palm was known to the Minoans, the ancient inhabitants of Crete (3,500–1,400 B.C.), who considered it a sacred tree and often represented it in their art (Zacharis 1977; Zacharis and Flegas 1982). Even though its presence was known since then, it has only recently been recognized as a distinct species. This palm was thought to be an escape from formerly cultivated date palms, but, according to Greuter's investigation in 1967, it should be regarded as a separate species as the differences are significant (Boydak 1985).

Isolated palm trees and small stands of this palm can be found in several coastal areas on Crete. The stands of this palm are the only ones in Europe (Zacharis and Flegas 1982). The largest grove on the island is found at Vai (Fig. 1) on the eastern tip of Crete. It covers a small valley of about 20 ha and runs down to the shore.

1. The palm trees cover the sandy beach of Vai.

2. *Phoenix theophrasti* in young fruit.

It is estimated that about 5,000 palms grow there. Cultivation in the area has reduced the size of the stand from about 80 ha to the present 20 ha (Zacharis 1977). To protect the palms from further abuse, the government declared the location a national park and erected a fence around the grove (Boydak 1985; Iatridis 1985).

In addition to the grove at Vai, Crete has two other smaller groves of this palm; one is located near the village of Achentrias, Iraklion District, and the other along the river in the gorge which is near the Monastery of Preveli, Rethymnon District (Zacharis and Flegas 1982).

There are also a few other even smaller stands; one is located near the village of Selia, Rethymnon District, one at Almyros west of Iraklion, and another at Stalida, Iraklion District (Zacharis 1977).

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An Unappreciated Native: Sabal palmetto

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Not long ago I found myself in animated conversation with a rough-hewn fellow, dickering over his fee for the removal of a lightning-killed pine. He happened to glance over toward a group of *Washingtonia robusta* and declared, "Them are good." Shifting his gaze to some *Sabal palmetto,* he made a face and pronounced, "Them ain't worth nothin'." Horribly enough, at one time I almost agreed with his point of view.

"A prophet is not without honor, save in his own land." These revealing words perhaps explain why my initial reaction towards what has become my favorite palm was less than enthusiastic. Twelve years ago, when I left the often icy concrete of Manhattan to settle in the warm sand of central Florida, I was overwhelmed by the profusion of tropical foliage and blooms. Friendly neighbors visited bearing gifts of plants, turning my yard into a lovely jungle of crotons, hibiscus, philodendrons, allamandas and many others. But it was the beauty of the palms that staggered me; they were so lovely and hailed from so many places on the globe. There were Washington palms, Rhapis palms, queen palms, Chinese fan palms, windmill palms, European fan palms, *Butia capitata* and many species of *Phoenix.*

There was also the cabbage palm. "What an awful name," I thought. Sabal palm and *Sabal palmetto* sound better, but a little voice always whispered "cabbage palm." No Floridian shopping mall, large or small, is complete without several of them stuck into tiny islands of dubious soil dotted here and there in the parking area. The golden arches of McDonald's are often overlooked by several grotesquely barbered *Sabal palmetto.* Therein lies another reason for my early disdain. It has become a tradition for many mall managers to call a tree maintenance firm once a year practically to defoliate these plants. The workers often leave very little, removing the majority of green leaves because they won't be back for a year. It is truly awful to see sixty-foot sabals with tiny heads trying in vain to sway gracefully in the breeze. The shopping malls may sidestep the expense of picking up an occasional fallen leaf, but the aesthetic cost is enormous.

It was only when I got a wider view that I began to appreciate *Sabal palmetto.* It is at its picturesque best when lining the meandering rivers and streams of the Southeast. Here, the trunks achieve serpentine shapes in the struggle for sunlight and often arch incredibly far out over the water. Some, having toppled into the water, but still managing a root-hold on shore, have curved their heads upward again, giving the impression of a palm growing straight out of the river. In the Everglades, the cabbage palm (now I love that name) forms large stands wherever there is slightly higher ground in the sea of sawgrass. I have also seen lone specimens, ragged but magnificent, standing up to the raging winds and constant salt spray on the barrier islands of Georgia.

I do not believe there is a tougher palm than *Sabal palmetto.* Huge trucks loaded with them roar down the highways, the root-pruned bases exposed to the sun and wind, the tops reduced and tied to protect the buds. I've noticed the trucks sitting in convenience store lots, with the trees broiling in the heat while the drivers have a cold drink and flirt with the clerks. Incredibly, almost all of these trees survive.

I have many cabbage palms on my property, but two of them have a story illustrating the adaptability of the species. I saw the pair in a small nursery and immediately wanted them. They had personality. There was no question of buying only one because they somehow seemed like buddies. Their trunks were blackened by fire (quite common) but the heads of both were lush. Neither palm had any roots, having just been stuck into the nursery ground a week or two earlier. When I bought them, the palms, both ten feet tall, were cut back to four or five leaves, yanked out of the ground, tilted into a small truck, delivered to my yard and slid out into holes waiting to receive them. A year elapsed before they regained full heads.

I'd always wanted to live on a lakeside, and when the opportunity presented itself, I moved to a lakefront home. My two favorite cabbage palms moved too. A maniac with a tree spade transferred them for me, knocking over a large steel road sign with the bud portion of one of them. The palm survived the thrashing, but I'll admit to murderous thoughts at the time. These two palms have traveled more than many people, but look so splendid now, they appear to have germinated and grown where they stand.

The large deeply-pleated leaves and "basket weave" leaf bases which make the cabbage palm pleasing to gaze upon also provide favored housing for tree frogs, lizards, and insects, something which, for me, increases their appeal.

Sabal palmetto is extremely easy to grow. The seeds germinate so freely that the aforementioned islands of soil in mall lots often contain hundreds of seedlings. If the soil is loose, you can simply tug tiny plants out. The seeds will germinate just as easily in moist sand or potting soil. Cabbage palms are relatively slow growers. On a good site with plenty of sun (they grow quite well in shaded locations too), water and fertilizer, you can go from seed to five feet in as many years. Shape is extremely variable. Some ten-foot cabbage palms are five feet of trunk and five feet of leaves, while others will have ten feet of leaves with no visible trunk. In the past, the only Sabals commercially available here were large specimens dug from the wild on order, but nurseries specializing in native flora have recently begun growing them for mined-land reclamation and for landscaping purposes.

Sabal palms have few problems. In my gardens, they withstood 14°F with no damage, and have laughed at light snowfalls on two other occasions. They occur naturally on the southeast coast as far north as Cape Fear in North Carolina. They don't like drought or flood, but established plants can tolerate prolonged periods of either. Various scales and caterpillars sometimes invade; large palms can cope, but smaller specimens should be treated appropriately. Small plants may be eaten by rabbits and rats, so I erect a protective circle of poultry wire for the first several years.

Occasionally in flea markets one sees a table heaped high with cabbage palm buds for sale. Obviously, this atrocious practice kills the tree, just so someone can taste "heart of palm." This is all the more barbarous because Florida is being "developed" and denuded at a sickening pace, and because the cabbage palm is our state tree. It deserves to be conserved and grown, not casually destroyed.

Note: This article was awarded second prize in the *Principes* writing contest. Eds.

Principes, 32(2), 1988, pp. 86–87

LETTERS

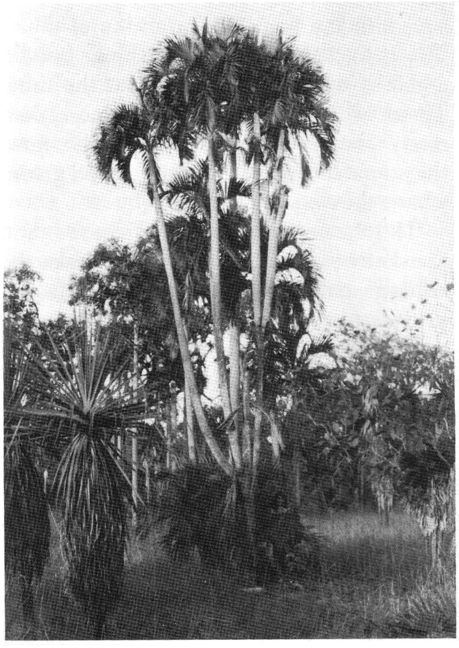
Dear Editors,

Please find enclosed two photos of *Gronophyllum ramsayi* in the Northern Territory, Australia, that may be of interest. These photos were taken at a stand of palms where abnormal branching occurs in as many as 100 individuals. In photo number 2 you can also see *Livistona humilis* near the base.

Photo number 1 shows vividly the trident-shaped trunk. This palm is by far the most beautiful multiple-trunked specimen in the whole stand. My wife Jo-Anne stands 5′7″, at its base. Please note the star steel fence posts in foreground and left of palm. These were used as markers by the Territory Parks & Wildlife Commission. The Commission became aware of these palms when I was in their employ and made it known to them. This resulted in a study started by the Comission. First, we established fire breaks around the area, marked individual palms and photographed them for later reference. Shortly after this survey, I left the Commission and now run a retail garden center. Unfortunately it seems the study has been abandoned.

Photo number 2 shows a palm which has branched many times (11 times), but not all branches survive. A few others in the stand have branched many times more but with little survival of branches. At first I thought this death of branches was caused by fire damage, but this photo shows that the palm branches are well out of the reach of fire.

Here are some more observations on *Gronophyllum ramsayi*: Seeds do not germinate readily, some germinating up to three years after sowing. Seedlings do not



transplant at all readily. In fact, each year many are killed by people trying to transplant them. The scene is sad to behold sometimes where larger seedlings are half-removed from the ground and then left to die with damaged root systems.

The soil at the locality illustrated apparently consists only of sand, and would seem to have little in the way of nutrients, and yet the palm grows only on this small, sandy belt.

Man-introduced, annual fires also take toll of the palms, as inspection shows very few young palms.

Yours faithfully,
PIETER J. CLARKE

Principes, 32(2), 1988, p. 87

PALM LITERATURE

FOR THE NEXT GENERATION: THE COMMITMENT TO RESEARCH AT JOHNSON WAX. Edited by E. D. Kitzke. 272 pp. S. C. Johnson & Son, Inc., Racine, Wisconsin. 1986.

Although they typically contain technical and general information unavailable elsewhere, privately-published corporate histories fall into a gray area of bibliographic resources and are frequently overlooked. I don't want that to be the case with this book.

Palms may not be mentioned in the title, but the carnauba palm and its wax play a part in this comprehensive volume. Ten company scientists contributed chapters detailing the broad contribution of all types of research and development over the first century of Johnson Wax. This brief review can only draw attention to the material concerning the carnauba.

The book recounts the company's beginning as a producer of parquet flooring, along with wax-based polishes with which to care for it. From the very start, carnauba palm leaf wax was a key ingredient of polishes. Early in this century, Johnson Wax gradually got out of the parquet flooring business and diversified into other products, among them car polish. Later, in 1935, increasing demand for carnauba wax prompted a remarkably adventurous company expedition to South America by private aircraft to survey and determine the wax resources of wild stands of carnauba. Shortly thereafter, two company research stations were established in Northeast Brazil. *Copernicia* species from Cuba and elsewhere in South America were brought in and successfully cultivated, and a long-term research program mounted to develop an improved, domesticated waxy palm by cross-breeding. Despite initially promising results, however, the deliberateness of sexual palm breeding, along with the synthesis of replacement raw materials in the late 1950s and 1960s which sharply reduced the company's use of carnauba wax, led to eventual termination of this particular project. Nonetheless, Johnson Wax has continued to use carnauba wax in their polishes.

The thread of American entrepreneurialism is woven throughout this interesting, lavishly-illustrated, well-written book. In many ways, it portrays a style of hands-on management, as well as sustained dedication to applied research, that is often absent within contemporary corporations.

DENNIS JOHNSON

Principes, 32(2), 1988, p. 88

PALM BRIEF

A Distichous Mauritia flexuosa

A trunked palm with leaves arranged in two ranks (Fig. 1) was found in a population of *Mauritia flexuosa* near Iquitos on waterlogged soils. Since March 1984, the date of its discovery, this peculiar palm has not produced inflorescences. The distichous crown arrangement may prevent the development of flowers by the compression of buds between successive sheaths in the same rank.

A few palms are known to have a distichous crown; *Halmoorea trispatha* (Dransfield and Uhl 1984), *Oenocarpus distichus, Orania disticha, Wallichia disticha* (Dransfield 1978), *Catoblastus distichus* and *Aiphanes linearis* (Bernal-Gonzales 1986). In these cases, distichous growth is characteristic of the species.

"The significance of the distichous habit is not understood" concluded Dransfield (1978). *Oenocarpus bacaba*, with several leaf ranks and *O. distichus*, both arborescent, single-stemmed species occur in the same forest of the lower Rio Tocantins valley, Brazil (Kahn 1986). Adults of both species are found in the same stratum (15–25 m) under discontinuities of the forest canopy. The ecological conditions (soil and light) are also identical for the "abnormal" distichous *Mauritia flexuosa* and for its "normal" congeners. These facts suggest that the distichous crown arrangement in palms does not have ecological significance, but much of the biology of these palms remains unknown.

1. A *Mauritia flexuosa* palm with a distichous crown.

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BIENNIAL 1988

See the ballot insert with this issue for revised information on the Biennial.