PRINCIPES

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THE INTERNATIONAL PALM SOCIETY

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PRINCIPES

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Contents for April

Cover Picture

Pejibaye Palms tower above an Indian village of the Sequoya tribe on the Putumayo river, Peru. Photo by Jorge Mora-Urpi.

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Principes, 36(2), 1992, p. 63

Editorial

The contents of this issue reflect the abundance and diversity of work on palms and its international scope. Our papers consider new aspects of palms in Costa Rica, Peninsular Malaysia and Sumatra, Madagascar, the Thakil Mountains in India, and Florida, USA. The first three articles introduce a series of papers on *Bactris gasipaes*, the Pejibaye, considered the economically most promising American palm. Dr. Mora-Urpi who initiated studies on the species in the early 1970's gives us a short introduction to the series. Our second paper points out the high nutritional value of the fruit, a rich energy source supplying vitamins A and C as well as dietary fiber. A third paper by Charles Clement considers the Pejibaye in the context of an interesting discussion on what domesticity means in regard to palms. Future issues will address other features of Pejibaye.

New palms continue to be discovered. *Areca tunku*, named for the first Prime Minister of Malaysia, is striking in its short massive peduncle and purple rachillae. Whether your interest is in unusual specimens for cultivation, in conservation, or in biogeography, the palms in Madagascar are most important, and hence it is timely that we have an article discussing some of the unusual palms of the island and the plans underway to make them available and to conserve them.

Anyone traveling recently in Florida must have noted the large numbers of tall *Sabal palmetto*, which are being transported from the wild and used to landscape all over the state. The loss of many species to lethal yellowing is perhaps partly responsible for the exploitation of a resistant native palm, but the *Sabal* is attractive and its use somehow very satisfying. James Menge and Kyle Brown write of the remarkable ability of *S. palmetto* to survive such moves and explain how the transplanting is being successfully done. Growers and anyone concerned with the spread of LYD will be interested in the comments of coconut grower, Richard Illingworth, on lethal yellowing.

In April 1991 we began a new annual feature—a list of publications on palms, which appeared during the previous year. Numerous palm books and papers were published in 1991. We present the list prepared for this issue by Andrew Henderson and Anders Barfod. Dennis Johnson has added the important references on utilization. Finally Jim Cain brings us up to date on the many and impressive activities of the Chapters.

NATALIE W. UHL
JOHN DRANSFIELD

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On the Pejibaye Palm: A Presentation

JORGE MORA-URPÍ
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A series of papers will be presented on the research developments of the pejibaye palm (*Bactris* (*Guilielma*) *gasipaes* Kunth) in successive numbers of *Principes*. They will be written by the people involved in the effort to develop the basic knowledge and technology necessary to transform this neglected palm into an important agricultural multiuse species for the humid tropics. The primary objectives of this research are to develop this species into two major crops, that of fruit and heart of palm. On the longer term basis, it may also prove to have value as an oil and wood producer as well as an ornamental plant. The topics will range widely in an attempt to relay an integral view of what is being done emphasizing its economic potential and describing some interesting pending problems to be solved. For example, pejibaye has a cespitose growth habit, as contrasted to such domesticated palms as oil, coconut, and date which are all single stem and therefore, provides an increased understanding of palm morphology and of its agronomic handling. The origins and domestication of this palm will emphasize differences with some concepts proposed for other neo-tropical crops. Other topics will cover historical aspects, flower biology, controlled pollination, diversity, phenology, breeding, tissue culture, human and animal nutrition, chemical composition, agronomic aspects, industry, and markets.

This palm seems to be the economically most promising of all American palms. During pre-Columbian times pejibaye was a crop of major importance to most Amerindian tribes that inhabited the humid tropical forests extending from approximately the parallels 16°N to 17°S; that is from the northeastern corner of Honduras to the southern border of the Amazonian regions of Brazil and Bolivia. Archeological sites are starting to show that pejibaye may have been an important cultivated food source from more than 2,000 years ago (Corrales and Mora-Urpí 1991) when primitive corn was still a minor proveyor in the same regions. For many tribes it had become the main agricultural product by the time of European contact, a fact that is still true today for a few of them. Godinez Osorio wrote in 1575 that for the Talamanca Indians of Costa Rica, pejibaye was the most appreciated item after their wives and children (cited by Fernández 1881). And Barandiaran (1967) describes how dependent on pejibaye the Venezuelan tribe of the Sanema-Yanoama is still today, suggesting that they should be called "the pejibaye people," a name that has been proposed before for other tribes as well.

After Columbus, and especially during the present century, its cultivation declined due to a combination of circumstances. Some of the most obvious reasons are the reduction of the Indian population, loss of traditions, introduction of short cycle crops, extensive use of fire to clear land for grass and cattle production, neither of which pejibaye tolerates. These events brought extensive genetic erosion and in general, seriously menaced the rich diversity of its gene pool to the point of producing total extinction of this palm in areas where it once was abundant. This trend, we hope, can still be reversed.

The first scientific study on pejibaye was

published in 1903 by Barbosa-Rodrígues. His work was on pollination and was done in the Botanical Garden of Río de Janeiro. But it was the paper written on general aspects of this palm, published in the Journal of Heredity in 1921 by Popenoe and Jiménez, that has been taken as the presentation of pejibaye to the scientific world. Very few papers were produced between the first publication of Barbosa-Rodrigues and the 1960's. It was not until Johannessen y Camacho started their work during that decade and Patiño's historical review was published that enough interest was produced to continue studies on this palm. At the beginning of the 70's the present author initiated in Costa Rica a research program aimed at the integral development of the scientific, technological, industrial, and commercial aspects of this species aided by a team of researchers who thought that pejibaye deserved to be developed into a major crop. Other similar programs were later initiated in Brazil, Colombia, and Perú and some work was recently started in Ecuador, Bolivia, Panamá, and Nicaragua. By publishing this information in English we hope to extend interest in this palm to a wider public.

(Continued on p. 69)

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Pejibaye Palm Fruit Contribution to Human Nutrition

A. BLANCO METZLER, M. MONTERO CAMPOS, M. FERNÁNDEZ PIEDRA AND J. MORA-URPÍ*

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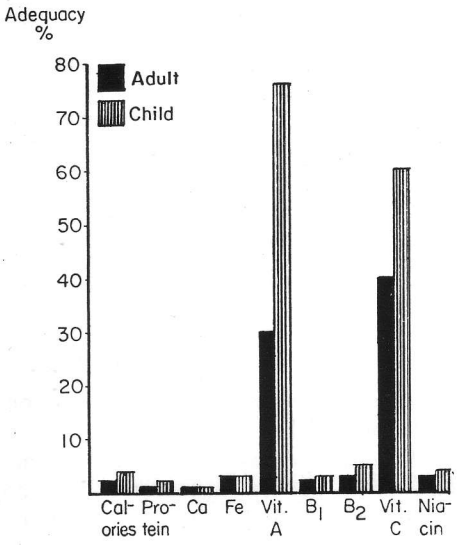
Many tropical fruits and vegetables are not well known in the temperate countries, nor do they receive the attention they deserve in their native countries. Among them—and one with a great potential—is the pejibaye palm (*Bactris gasipaes* Kunth), also known as peach palm. The fruit of this palm can be used as a cereal for human consumption and has high food values for some nutrients.

The pejibaye palm has been cultivated and its fruit prepared for food in different ways since pre-Columbian times in some regions of Bolivia, Brazil, Colombia, Costa Rica, Ecuador, Guayanas, Honduras, Nicaragua, Panamá, Perú, Trinidad, and Venezuela. There is evidence that during some historical periods it was the main dietary staple of a number of indian tribes. At present, the first class fruit is popular and highly acceptable as a between-meal snack and the lower quality—which represents around one third of the production in Costa Rica—is used as animal feed.

Although there is great variability in the chemical composition of the fruits among and within the many landraces known (Vega 1986, Mora-Urpí and Clement 1988) the average result of three native Costa Rican pejibaye populations (Tucurrique, San Carlos and Guápiles) (Fernández 1988) indicates that 58.5 ± 0.5% of the edible portion (mesocarp) is water, 34.2 ± 0.6% is ash. Carbohydrate composition is variable, as starch and "dietary fiber" content ranges between 19.2–30.2% and 5.3–9.7%, respectively. The fat is semisolid at room temperature, since 36% of the fatty acids are saturated and 64% unsaturated (49% monounsaturated and 15% polyunsaturated). A polyunsaturated index (P/S) between 1.0 and 2.2 and a high monounsaturated fatty acid content are factors that reduce the risk of cardiovascular disease (Ernest and Cleeman 1988, Krist-Etherton 1988); even though pejibaye fruit pulp has a low P/S (0.43) half of its fat is monounsaturated.

One third of the pejibaye pulp ash is composed of potassium (229 ± 4 mg%). Other minerals of nutritional value, such as calcium, magnesium, and iron have values of 15.3 ± 3.9 mg%, 16.6 ± 4.1 mg% and 0.8 ± 0.0 mg% respectively in the fresh fruit. Sodium content is very low (3.7 ± 0.2 mg%). Chemical analyses of these nutrients were done on cooked fruit pulp and the methodology used was of the Association of Official Analytical Chemists 1975 for proximal constituents, minerals and fatty acids. "Dietary fiber" analysis was estimated as neutral detergent fiber by the Van Soest method modified by Mongeau (1982). The starch was estimated colorimetrically by the Nielsen method (1943). Details of the preparation and analysis can be found in Fernández (1988).

Vitamin content in pejibaye pulp is less than 1% of its dry weight, but this does not mean that its contribution is unimportant. This fruit is famous because of the amount of vitamin A precursors present,



1. Nutrient adequacy percentage of the nutrients provided by the daily consumption of one medium fruit (approx. 34 g edible) for adults and preschool children.

although values vary considerably according to genotype. Blanco et al. (1990*a*) evaluated four of them, two from Costa Rica and two from Colombia, for biological availability of carotenoids in retinol by the depletion-repletion method. The results demonstrated that the consumption of just one fruit from three of those genotypes satisfies the recommended adult daily allowance of vitamin A. As for the remaining genotype, seven fruits were required.

Another vitamin that is present in significant quantities in pejibaye is ascorbic acid. The average value in raw fruits is 35 mg% (Wu Leung and Flores 1961). But the estimation of vitamin C in cooked and stored fruit still has to be made since cooking of pejibaye is indispensable and this is a water soluble thermolabile compound.

Based on the uncooked pejibaye analysis (later adjustments according to complete results on cooked material have to be done) and the recommended dietary allowances (RDA) (Menchú 1973, Asp 1988) where for adult men and pre-school children, the nutrient adequacy percentage was estimated. Figure 1 indicates that the consumption of just one medium size fruit 50 g total or 34 g edible contributes 30% and 76% of their respective retinol's RDA, 40% and 60% of their vitamin C's RDA.

Table 1. Energy and retinol content per unit of pejibaye fruit, corn tortilla, white wheat bread and raw carrot.

Edible food unit	Energy (Kcal)	Retinol (μg)
Pejibaye, medium (34 g)	66	228
Corn tortilla (18 g)	41	0.9
White wheat bread (32 g)	91	zero
Carrot, medium (74 g)	30	2,368

The consumption of more than one fruit—four, for example, which is common in adults—contributes 8% of their calories, 4% of the protein, 4% of the calcium, 12% iron, 120% of the retinol, 8% of vitamin B1, 24% of the B2, 160% of the vitamin C and 12% of the niacin's RDA.

Because the pejibaye fruit is rich in starch it can be used as a cereal. A well known food practice in Costa Rica is to substitute bread or corn "tortilla" for pejibaye fruit, when in season to accompany meals. A comparison of the caloric content of these three staples (see Table 1) indicates that it is superior to tortillas, and carrots, but lower than wheat white bread. However, varieties of pejibaye rich in oil will have a higher caloric value than bread. The significance of these data is that they stress the value of pejibaye as a common source of energy.

Although in the tropics retinol precursors are abundant, there is a high frequency of diets deficient in vitamin A. The substitution of cereals with pejibaye would benefit the populations that show this problem. For example, in Costa Rica vitamin A is the most deficient nutrient in the average diet (Ministerio de Salud 1986). Table 1 compares the retinol contents in pejibaye and white corn tortilla with that of white

Table 2. Chemical composition of pejibaye flour (fresh basis of 100 g).*

Energy, cal	413.5	Vitamin B2, mg	0.3
Humidity, g	12.0	Vitamin C, mg	62.2
Protein, g	3.8	Niacin, mg	2.5
Fat, g	8.9	Iron, mg	6.1
Ash, g	1.3	Calcium, mg	10.9
Crude fiber, g	2.1	Sodium, mg	2.7
Carbohydrates, g**	72.1	Potassium, mg	162.8
Vitamin A, μg eq	1.2	Magnesium, mg	11.7
Vitamin B1, g	0.1	Zinc, mg	2.1

* Values calculated from fresh pejibaye.
** Carbohydrates by difference.

bread and carrot, the last being a well known source of vitamin A precursors.

Pejibaye fruit mesocarp can be made into a flour for human and animal feeding. Flour has a lower water content than raw material, 10–12% against 58% respectively, consequently nutrient density almost doubles. Estimated flour chemical composition is shown in Table 2.

In order to promote the use of the pejibaye fruit as a regular component of the diet in Costa Rica and other tropical Latin American countries, a booklet (Blanco et al. 1990*b*) was written containing a number of recipes that were developed taking into consideration feeding habits, cost, nutritional value, organoleptic aspects and rural food availability. The nutritional contribution of a portion of a pejibaye recipe is shown in Table 3.

Table 3. Daily nutrient adequacy percentage[1] per portion[2] of tuna-pejibaye "Picadillo."

Nutritional component	Nutrient adequacy (%)
Energy	4.3
Protein	5.2
Calcium	2.9
Iron	3.2
Retinol	18.5
Thiamin	4.5
Riboflavin	6.2
Niacin	8.6
Vitamin C	90.9

[1] % Daily nutrient adequacy = $\frac{\text{amount of nutrient/portion}}{\text{18 year man RDA}} \times 100.$

[2] Portion size = 98 grams.

Obviously pejibaye fruit is not a complete food. Mineral and protein content represent limiting factors at the present time. The protein amount can be improved considerably in future cultivars, since there are genotypes that produce up to 18% protein of the dry weight of the fruit (Vega 1986).

In conclusion the nutritional advantages of the pejibaye fruit could be summarized in the following points:

1. Rich energy source.
2. Rich in vitamin A precursors.
3. A source of "dietary fiber."
4. Rich in vitamin C.
5. Medium monounsaturated fatty acids source.
6. Poor in sodium (when salt not added) and rich in potassium.
7. Rich in complex carbohydrates, therefore low in simple sugars.
8. Forms part of the feeding habits of many areas from Honduras to Bolivia.

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Domesticated Palms

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Johnson (1983) suggested that there are only four domesticated palms: date (*Phoenix dactylifera* L.), coconut (*Cocos nucifera* L.), areca (*Areca catechu* L.) and African oil palm (*Elaeis guineensis* Jacq.). Other authors take a similar position but without a clear definition of domestication in palms. As part of my research with pejibaye (*Bactris gasipaes* Kunth), I reviewed the question of domestication in palms and how many are domesticated or in the process of domestication. This paper discusses domestication in palms and reviews some of the palms identified as domesticated.

What Is Domestication?

This question has yielded different answers at different times, based upon accumulated knowledge of plant genetic-geographic variation, anthropological, archeological and ethnobiological studies of human/plant interactions, and the genetics of selection. In recent decades the discussion has been especially active (Harlan 1975, Hawkes 1983).

Harlan's (1975, p. 63–64) definition of domestication is clear:

> "To *domesticate* means to bring into the household. A domestic is one (servant) who lives in the same house. In the case of domesticated plants and animals, we mean that they have been altered genetically from their wild state and have come to be at home with man. Since domestication is an evolutionary process, there will be found all degrees of plant and animal association with man and a range of morphological differentiations from forms identical to wild races to fully domesticated races. A fully domesticated plant or animal is completely dependent upon man for survival. Therefore, domestication implies a change in ecological adaptation, and this is usually associated with morphological differentiation. There are inevitably many intermediate states."

The key phrase in this definition is "completely dependent upon man for survival" because this is the point of no return in the domestication process. In some annuals this means that the plant itself may not be able to survive without human preparation of a favorable agro-ecosystem and elimination of competition. In perennials and other annuals this means that the plant will not reproduce itself successfully and its genotype therefore fails to survive into the next generation. Botanical varieties and landraces (morphologically distinct races developed by humans in different geographical areas) of the same species may differ in the degree of modification due to selection, i.e., completely domesticated (dependent upon humans for survival) and semi-domesticated landraces, and wild types showing little or no modification. If a species has one or more fully domesticated landraces then it may be considered to be domesticated.

For palms it is also worth defining cultivation, since many palms are cultivated in some way, but are not domesticated. Again Harlan's (1975, pp. 63–64) definition is appropriate:

> "To *cultivate* means to conduct those activities involved in caring for a plant, such as tilling the soil, preparing a seedbed, weeding, pruning, protecting, watering, and manuring. Cultivation is concerned with human activities, while domestication deals with the genetic response of the plants or animals being tended or cultivated. It is therefore quite possible to cultivate wild plants, and cultivated plants are not necessarily domesticated."

Just as there are varying degrees of domestication, there are varying degrees of cultivation, from relatively primitive to highly sophisticated. While Harlan (1975) is correct in saying that cultivated plants are not necessarily domesticated, any plant that has been cultivated for a long period (many generations) will inevitably be modified by natural selection in cultivation and by the farmer's conscious or subconscious selection, i.e., it starts to become domesticated.

"Management" is a less sophisticated form of cultivation. The plant may be protected from human-caused environmental modification (opening of new fields, for example), it may occasionally be liberated from competition from other species and seeds and seedlings may even be planted, although without seedbed preparation *per se*. Anderson and Posey (1987) discuss a case of Amerindian perennial plant management, verging upon cultivation, practiced by the Kayapó indians on the Xingu River in southeastern Amazonia. This is an extremely sophisticated system of human/plant interaction and doubtlessly includes mass selection and thus genetic modification of the species managed. Balée (1988) points out that many Neotropical palms appear to have been managed in this or other ways and morphological modifications are frequently observed.

A continuum from wild and used, to managed, to cultivated, to domesticated (Fig. 1) becomes clear. This continuum refers not only to human interaction with the plant to obtain its economic product, but also to the plant's genetic response to this interaction (progressive changes in gene frequencies), leading finally to full domestication. Because each plant is different, it is not possible to put a numeric scale on either axis of this figure.

Therefore, for a palm to be considered fully domesticated it must have at least one landrace dependent upon human intervention for its continued genetic survival. Ideally it should present a variety of landraces, which can be considered as proof of its importance to early and modern humans. It is worth mentioning that 99+% of all domesticated plants were developed by pre-modern farmers (Harlan 1975, Hawkes 1983). The African oil palm is frequently cited as one of the few modern domesticates (Zeven 1972).

How then can domestication of a palm be proven, since few are abandoned in their native habitat and left to reproduce and even fewer of these are reported? During the domestication process a variety of morphological characters and ratios between diverse components of the reproductive and vegetative biomass or within the reproductive organ are modified, some of which are: increased proportion of usable product in the harvestable product (higher fruit to bunch ratio [Hartley 1977] or higher mesocarp to fruit ratio [Clement 1988]); increased proportion of harvestable product in the year's biological growth (increased Harvest Index, Corley 1983); reduction or elimination of spines; increased ease of propagation; more rapid germination; reduced natural dispersal ability (i.e., fruit do not abscise readily from the rachilla or are damaged by falling from the tree). Harlan (1975) and Hawkes (1983) summarize the modifications expected during domestication, although, obviously, not all modifications will be found in each species. In the following section each major palm is examined and an attempt made to quantify its degree of modification due to domestication.

The Major Palms

Areca. Bavappa et al. (1982) reviewed areca, although they did not specifically discuss its domestication. Areca has been cultivated for 2–3,000 years in India (Rao 1982), where it is a "recent" introduction. Therefore, the history of its interaction with humans is probably at least twice this, possibly as long as the date. Rao (1982) concludes that areca may have originated

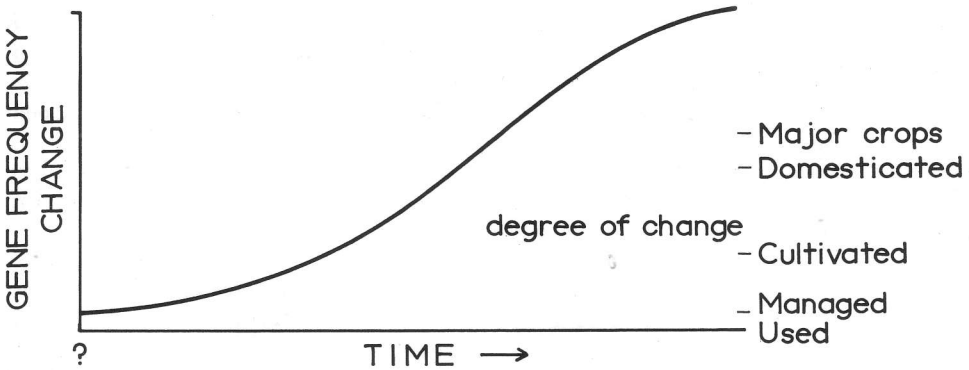

Fig. 1. A schematic representation of the plant genetic continuum from wild to domesticated. The area under the curve represents the degree of genetic modification due to human selection to make the plant conform to agricultural and social requirements.

in the East Indies (perhaps from the Philippines southward to Indonesia) and cites several botanical varieties described by Beccari (1919). The majority of closely related *Areca* occur in the East Indies and adjacent continent (i.e., Malaysia, etc.), which suggests a slightly expanded region as the center of origin. This wider origin is supported by Purseglove (1985).

From Bavappa and Nair's (1982) discussion of current breeding efforts, the characters most likely to have been modified by selection can be identified: larger nut size, better quality nut (meaning both in flavor and in active ingredient), higher fruit/bunch ratio and probably more bunches per tree. Unfortunately these authors do not provide enough information to quantify the modifications in areca over the millenia. They do, however, compare areca with *A. triandra* Roxb. ex Buch.-Ham., a related species occasionally used as a masticatory also. Although this species is not closely related (it has 3 stamens, rather than 6 [N. W. Uhl, pers. comm.]), it provides a rough comparison with areca to estimate modifications due to selection.

A. triandra has a 4 g fruit, while other areca fruit attain 43 g, a difference of about 1,000%; this relatively small difference is probably due to selection of the kernel rather than the mesocarp. *A. triandra* has about 500 fruit/bunch, while areca has about 200 (the negative correlation between fruit number and fruit size is common). If we assume a rachis weight of 300 g for *A. triandra* and 400 g for areca, these values give fruit to bunch ratios of about 87% and 95% respectively.

Bavappa and Nair (1982) analyzed several groups of areca populations with discriminant analysis and their results suggest the existence of landraces (although they do not use this term). A clear discrimination of landraces in areca may prove to be difficult, as landraces have undoubtedly been partially masked by continued and frequent migration of genotypes among areas of intensive selection in south and southeast Asia.

Given the time span of known interaction with humans in India (assuredly much longer in its center of origin), the magnitude of modification due to selection and the probable existence of landraces in south and southeast Asia, the areca is considered a domesticate. One important doubt remains: do the apparent landrace populations depend completely upon human intervention for their genetic survival?

Coconut. Harries' (1978) excellent summary of the coconut palm as a domesticate identifies trends in morpho-genetic modification due to selection and postulates

the most and least domesticated types. The coconut's center of origin is in the East Indies, although it is impossible to define exactly. Harries identifies the long, angular, thick husked coconut as most primitive (*Niu kafa*) and the round, thin husked coconut as most advanced (*Niu vai*). He mentions several criteria of interest in defining Niu vai as domesticated:

1. The proportion of useable product in harvestable product increases from Niu kafa to Niu vai—the Niu vai has up to 50% more solid endosperm (100+% more liquid endosperm when immature) than the Niu kafa, as well as a reduction of about 50% in the proportion of husk in Niu vai.

2. Propagation is facilitated by more rapid germination in the Niu vai, averaging 60–80 days, while the Niu kafa takes as much as 200 days.

3. The Niu vai is not as resistant to damage as the Niu kafa, both in terms of damage to the fruit due to mechanical factors (falling from the tree, being pounded by waves on the shore, etc.) and damage to the germinating seedling. This greater fragility probably reduces natural dispersal ability.

4. The Niu vai has greater resistance to windstorms (because of their smaller stature) and to diseases. Resistance to lethal yellowing is found in Niu vai areas, although the disease has not been reported there!

Harries (1978) cites Sauer (1971) as arguing that the coconut should be considered a semi-domesticate, some populations of which are independent of humans while others are completely dependent. If some are completely dependent, then the species is domesticated by our definition. It is clear that Harries (1978) agrees with this position.

Purseglove (1985), however, cites the reestablishment of coconuts on Krakatau as proof of its natural dispersal ability after floating in ocean currents. Gruezo and Harries (1984) and Buckley and Harries (1984) reported that Niu kafa types are found in wild, self-sown situations in the Philippines and Australia, where Niu vai types would also be expected but are not observed. This suggests that the Niu vai requires human intervention for continued survival.

Date. Chevalier (1952) suggested that the date palm has been cultivated since the Neolithic (at least 10,000 years) and may have been domesticated in any of several areas from India to the Atlantic ocean, although Munier (1981) and Zohary and Spiegel-Roy (1975) support the Fertile Crescent as its center of domestication. Its precise origin is clouded by the ease with which it hybridizes with other species of the genus, so much so that it is impossible to identify an ancestral date (Chevalier 1952). Zohary and Spiegel-Roy (1975) mention the occurrence of wild and weed populations of date in many areas of the Middle East, which may have been involved in the domestication of the species. This means that not only the date but all related sympatric species are subject to introgression that can change their original characteristics. For example, Chevalier (1952) and Munier (1981) mention that *P. atlantica* Chev. (whose taxonomic status is uncertain—it may be a weed date [J. B. Carpenter, pers. comm.]) is cultivated in Morocco and has edible fruit. This may be the result of introgression with the date, however, although these authors do not address this possibility.

Two characters that differentiate the date from other cultivated palms are its dioecious habit (making it extremely heterozygous) and its long history of vegetative propagation. The dioecious habit makes mass selection less efficient than in monoecious species. On the other hand, vegetative propagation can fix good qualities at once and allows the development of clones, some of which have existed continuously for 800 or more years (Goor 1967). Selection within widely planted, popular clones can result in rapid modification of any desired characteristic (Zohary and Spiegel-Roy 1975).

Although much has been written about the date, an estimate of modifications due to domestication is difficult. Oudejans (1976) even suggests that it is impossible to infer these, beyond increased succulence and ease of vegetative propagation. Zohary and Spiegel-Roy (1975) disagree, but do not give quantitative data. I think that fruit size is also a criterion, as in other palms.

From earliest human management and cultivation of date, it is probable that fruit size, succulence and sweetness were selected for. FAO (1982) reports that fruit vary from 2 to 60 g, while seeds vary from 0.5 to 4 g. Therefore, pulp (mesocarp + exocarp) to fruit ratios can be calculated; these vary from 75 to 93% within the species. It is safe to assume that smaller fruit, with lower pulp/fruit ratios are generally more primitive than larger fruit, with higher p/f ratios. J. B. Carpenter (pers. comm.) cautions that this may not always be true, however, as some highly prized clones have small, dry fruit. Nonetheless a 2 gram fruit is probably similar to a primitive date and the difference between it and a 60 g fruit is 3,000%, which is the same order of magnitude as in areca and pejibaye.

In general, vegetative propagation has become easier and fruit size and quality have been improved. Zohary and Spiegel-Roy (1975) point out, however, that vegetative propagation has drastically reduced the number of sexual generations under cultivation/domestication. They suggest that the few changes under domestication noted here probably do not make the date dependent upon humans, as a single generation of open pollination would produce abundant segregation, including wild and weed types of date. While this is doubtlessly true for seedling dates, I consider the date to be completely domesticated because a given clone is completely dependent upon vegetative propagation for its continued survival.

Oil palm. To Harlan (1975, p. 65–66) the oil palm is an "intermediate" species:

> "Wild stands occur near the edges of the forest, but the plant is not sufficiently tolerant of deep shade for it to grow in dense forest. However, as shifting cultivation has reduced the high forest to bush, the oil palm has invaded the forest zone. In the process of shifting cultivation, the farmers slash the bush during the dry season and burn it, reducing the vegetation sufficiently that one or two crops can be grown in the burned area. The oil palm, however, is spared. As a result, the palm is encouraged, and over a period of years, stands become thicker and thicker. In some areas, very extensive stands of oil palm developed without anyone ever purposely planting a seed.
>
> "Here we have a plant that is encouraged, disseminated, harvested, and selected without anyone deliberately planting a seed. Is the oil palm in indigenous agriculture a cultivated plant or not? In this century, it has become a very important plantation crop in the wet tropics, its hectarage is increasing, and the yields of new hybrids are very high. Under plantation conditions, the high-yielding hybrids are domesticated races, but under traditional systems, the status of the plant is very different.

By our definition the oil palm is a managed species in most of its natural distribution. Gene frequencies can be modified by selection during management, however, as shown by the high proportion of "tenera" palms where "dura" palms would be expected (Rajanaidu et al. 1979). Much of the increase in oil palm yields during this century is due to the use of "tenera" palms (Hardon 1976), although the Deli Dura variety's yield potential has been increased by 60% through breeding (Hardon et al. 1987).

Harlan's statement about the modern high-yielding hybrids being domesticated races is similar to the case of the date clones that depend completely on human intervention for their genetic integrity. Improved hybrids would certainly reproduce if returned to the oil palm's native habitat in Africa, although genetic advances would be slowly lost, mostly as a result of change in "tenera" frequency (R. H. V. Corley, pers. comm., estimates that tenera palm frequently would fall from 100% to 20% in 16 generations).

One datum that suggests the semi-

domesticated state of the oil palm is Rajanaidu et al.'s (1979) inability to distinguish landraces using discriminant analysis. Clement (1986) found that discriminant analysis was exceptionally useful in discriminating among landraces of pejibaye, as did Bavappa and Nair (1982) with areca, so that Rajanaidu et al.'s inability to distinguish them can only be due to the lack of landraces.

From the above considerations I conclude that the oil palm was a managed, incipiently domesticated species at the beginning of this century and that it may now be considered a domesticate because of the modern hybrid varieties and the trend towards clonal propagation (Hardon et al. 1987). Zeven (1972), with slightly different reasoning, arrived at the same conclusion.

Pejibaye. Sauer (1959) stated that pejibaye is domesticated, based upon the lack of an identifiable ancestor or wild population of the species and the fact that it only occurs where planted and does not survive long after being abandoned. The latter observation is in agreement with our definition of a domesticated species. My observations on some abandoned plants near Manaus suggest that as the forest canopy shades pejibaye crowns, fruit yield is progressively reduced to zero. Seedling growth in forest shade is extremely slow—only a few etiolated leaves/year. These observations suggest that genetic survival is improbable for pejibaye without human intervention.

The pejibaye is the only domesticated American palm (Clement 1988) and may have originated in southwestern Amazonia where *B. dahlgreniana* Glassman (syn. *Guilielma microcarpa* Huber) is native (Corner 1966, Clement 1988). Huber (1904) and Mora Urpi (1984) suggest that pejibaye is of hybrid origin, although their reasoning could also be explained by introgression with related species (Clement 1988).

Mora Urpi (1984), Clement (1986) and Mora Urpi and Clement (1988) have identified 10 landraces, organized into three racial groups based upon fruit size: "microcarpa" with 15–25 g fruit, two landraces; "mesocarpa" with 25–70 g fruit, 6 landraces; and "macrocarpa" with 70–200+ g fruit, two landraces. They consider the "microcarpa" to be domesticated but least modified by selection, while the "macrocarpa" are most modified.

Clement and Mora Urpi (1988) identified several trends from "microcarpa" to "macrocarpa" in vegetative and reproductive modifications that are those expected during domestication:

1. Trunk diameter and internode length become progressively smaller, which implies reduced vegetative biomass that could be repartitioned to increased reproductive biomass (i.e., higher Harvest Index).

2. Increased bunch weight (3+ kg to 8+ kg averages).

3. Increased fruit to bunch ratio (90% to 95%).

4. Increased fruit weight (15 g to 115 g averages [Clement (1988) mentions a 2,000% increase, but if calculated as done here with date and areca this would be closer to 5,000%: ancestral type fruit from *B. dahlgreniana* average 2 g, advanced fruit from the Vaupés landrace average 113 g]).

5. Increased pulp to fruit ratio (85% in "microcarpa" to 97% in "macrocarpa" landraces).

The least modified landraces have higher oil contents, while the more advanced are exceptionally rich in starch, which helps account for the very large increases in fruit size. Some landraces also have very high frequencies of plants without spines on the trunk and leaves, especially the Pampa Hermosa "mesocarpa" landrace.

Clement et al. (1989) showed that *B. dahlgreniana* fits nicely at the primitive end of this continuum for most of these characteristics, as well as germinating much more slowly (6 months vs. 2 months for

pejibaye). They hypothesize that high oil levels may have been the original attraction of pejibaye, because these are very high in *B. dahlgreniana* (to 60% dry mesocarp). This contrasts with Sauer's (1959) idea of starch being the original attraction.

As noted, I conclude that pejibaye is a completely domesticated palm. Because the modifications mentioned are so extensive and there are no indications of vegetative propagation (Patiño 1965), the time scale for this domestication must be at least as long as that for the date, perhaps longer. I think that it is safe to conclude that pejibaye started being managed, perhaps even cultivated, before the end of the last glacial event (12,000+ years ago).

Which Are "Most" Domesticated?

This question is extremely difficult to answer because there are different criteria for each palm, although I have tried to highlight similarities. One major criterion must be inability to survive without human intervention, as this is the most advanced stage in the domestication process. The whole pejibaye landrace complex clearly meets this criterion, as do the Niu vai coconuts and the date clones. The oil palm hybrids can probably survive but would slowly degenerate. I do not have data about areca.

Another important criterion is the existence of landraces within the species. Pejibaye and coconut surely meet this criterion and areca appears to, although this is an inference from the literature. The date clones can be thought of as extremely uniform landraces. The advanced oil palm hybrids are moving in this direction and the new tissue culture clones will meet this criterion.

Fruit size and quality modifications are also criteria. Pejibaye shows the greatest modifications in size, followed by date, areca and coconut. Coconut and areca are somewhat different, however, as it is the endosperm that is the useful product: this is energetically and physiologically difficult to increase in size beyond the limits that might compromise successful reproduction. Oil palm modifications are due principally to modern selection and the use of the "tenera" type and are still modest compared to the others.

Based upon this review, I am inclined to put these five species in the following order of most to least domesticated: pejibaye, coconut, date, areca, oil palm. Pejibaye first, because it shows the largest increase in fruit size; coconut second, because of smaller increase and the prevalence of Niu kafa types; date third, because only vegetative propagation maintains the fruit modifications noted; areca fourth, because of the doubts about dependence upon humans; oil palm last, because it is just becoming a domesticated species.

Are There Others?

Because of imprecise or varying definitions of domestication, other palms have been called domesticated at one time or another. Solid data about these species are scarce, inaccessible or non-existent, however. The four species mentioned are, or have been widely used or cultivated and perhaps domesticated in the past.

Sago (Metroxylon sagu *Rottboel*). There are two sago morphotypes, differentiated by the presence or absence of spines. Although the lack of spines might suggest domestication, Harlan (1975) considers sago to be an intermediate species, since the spineless populations are maintained by management rather than long term genetic modification. I agree with Harlan more because the spines are apparently the only character modified by management and because the species is not cultivated.

Palmyra (Borassus flabellifer *L.*). Davis and Johnson's (1987) excellent review of the palmyra does not even hint at a possible domestication. Due to its great usefulness,

it is a species that might have been genetically modified during the millenia of its interaction with humans. D. V. Johnson (pers. comm.), however, considers palmyra to be a managed species by our definition.

*Talipot (*Corypha umbraculifera *L.)*. Corner (1966) claims that the talipot is unknown in the wild. If this is true, the talipot may have been domesticated at one time and have fallen into disuse. This species needs further investigation.

*Doum (*Hyphaene thebaica *(L.) Mart.)*. Corner (1966) mentions that the doum palm was sacred in Egypt and appears to have been extremely important both in the ritual and the economy of the pharaohs. Again, I have found no information about its possible domestication.

With this short presentation, I hope to have stimulated some discussion of domestication in palms and hope that Principes might become a forum for continued discussion, with new and old data made available to us all. The history of domestication in the major palms can guide the domestication of new species, especially the many Neotropical palms that are currently being studied (i.e., *Acrocomia* spp., *Astrocaryum* sp., *Euterpe* spp. and *Jessenia bataua* (Mart.) Burret).

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A New Species of Areca from Peninsular Malaysia and Sumatra

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Besides the cultivated and sometimes naturalized betel palm, *Areca catechu* L., two species of the genus *Areca* were until recently known from Peninsular Malaysia. The diminutive *A. ridleyana*, originally identified as *A. furcata* Becc. by Ridley (1907), with its slender stems, irregularly divided leaf-blades and short sparsely branched inflorescences bearing multistaminate flowers is easily distinguished; it occurs sporadically from Terengganu south to Johor. The other species, *A. triandra* Roxb. ex Buch. Ham., is widespread, occurring elsewhere in Burma, Thailand, Indochina, Sumatra, Java and Borneo; it is highly polymorphic but easily separated from other species by the presence of three rather than six stamens in the staminate flowers. In Peninsular Malaysia it is convenient to recognize two main types within the complex; there is a robust clustering taxon, usually referred to as *A. triandra*, and a small single-stemmed taxon conveniently referred to as *A. latiloba* Ridley. *A. latiloba* is also present in Sumatra and Java and possibly in South Thailand. *A. montana* Ridley, based on a collection made by Burn-Murdoch from Semangkok Pass, is a synonym of *A. latiloba*, which deserves further research as broad and narrow leaflet forms have been observed.

In Sumatra, *A. ridleyana* is absent, but *A. triandra* is widespread, both robust clustering and small solitary forms occurring. The presence of another wild species of *Areca* in Sumatra was established when one of us (JD) collected a small solitary species of *Areca* at Bohorok, Langkat in North Sumatra, an area with strong floristic affinities with Peninsular Malaysia. This taxon was remarkable for its litter-trapping habit and tardily abscissing leaves with inflorescences bursting through the rotting leaf sheaths (Fig. 2). The inflorescences were also striking in their thick stiff purple rachillae. In 1977 JD collected what was apparently the same taxon growing in the coastal mountains of north Terengganu in Peninsular Malaysia, an area rich in palm novelties (see Dransfield 1978, 1982; Mogea 1984). A collection made by Cockburn, also in the Terengganu hills, was found among the undetermined palms at Kepong and collections made in Endau Rompin by Wong Khoon Meng, during the Malayan Nature Society's Endau-Rompin Expedition, also appear to fit this same taxon. Independently during 1990 Lim Chong-Keat and his colleagues from the Penang Botanical Gardens under the botanical project called Palm Search Malaysia located fine examples in Upper Perak, and repeatedly monitored a colony under predation by elephants. They collected extensive specimens now lodged at the Forest Research Institute Malaysia (KEP) and Kew (K).

Although there is variation between populations in Peninsular Malaysia and Sumatra, there is also great variation within populations and we thus consider them all to be conspecific. At the time of confirming the joint publication of the new species, the demise on 7 December 1990 of Tunku


A
G
D
F
E
H
C
B

Abdul Rahman Putra al-haj, the first Prime Minister of Malaysia, gave point to our spontaneous intent to honor him and the ideals he promoted; we have named the palm *Areca tunku*.

Areca tunku J. Dransf. & Lim Chong-Keat sp. nov. (Figs. 1–4).

Ad sectionem *Arecellam* H. A. Wendl. & Drude pertinens, a ceteris speciebus Sumatranis vel Malayanis *Arecae* petiolo carenti et rachillis crassis purpureis bene distincta; *A. jugahpunya* J. Dransf. et *A. ahmadii* J. Dransf. speciebus borneensibus affinis sed a *A. jugahpunya* inflorescentia rachillis paucioribus minoribus petalis floris masculi non connatis et a *A. ahmadii* habitu caulescenti et inflorescentia infrafoliacea pedunculo brevi distincta. Typus: Peninsular Malaysia, Terengganu, *J. Dransfield et al.* JD5178 (holotypus K; isotypus KEP).

Solitary, unarmed, monoecious palm to 2.5 m tall. Stem often stilt-rooted at the base, dull green when young, becoming pale brown, 2–6 cm diam., internodes 2–3 cm, nodal scars ca. 0.5 cm wide. Crown composed of ca. 8 leaves, these sometimes tardily abscissing, the whole crown tending to trap leaf litter. Crownshaft to 13–25 cm long, 3–7 cm diam., often partially obscured by the marcescent leaf sheaths. Leaf variably dissected; leaf sheaths 13–20 cm long, dull green to brown, often tinged purple, drying pale brown, striate, bearing thin pale brown scales; petiole absent to very short, not exceeding 5 cm long; rachis to 1 m long, adaxially channelled near the base, abaxially rounded or angled, pale brownish green, sometimes tinged purple; blade irregularly dissected, leaflets adaxially dark shiny green, slightly paler abaxially, usually borne close together, 5–24 on each side of the rachis, varying from narrow to broad, 22–65 × 0.7–10 cm, composed of 1–6 folds, acuminate and somewhat sigmoid except for the terminal shallowly-lobed pair, main veins bearing minute brown punctiform scales. Inflorescence sometimes bursting through marcescent sheaths, erect, 8.5–22 cm, almost always branching to 1 order only, very rarely the basalmost branch bearing a branch of the second order, all axes cream-colored, turning yellowish orange, greenish or deep purple; prophyll 8–22 × 2.5–4 cm, ancipitous, elliptic-lanceolate, winged throughout, creamy brown to pale green, tinged with carmine purple, becoming striate on drying, bearing bands of scattered pale brown scales;

2. *Areca tunku* in flower, Upper Perak. Photo by C.-K. Lim.

←

1. *Areca tunku*. A, leaf tip ×⅔; B, leaf sheath ×⅔; C, basal portion of leaf ×⅔; D, inflorescence ×⅔; E, staminate flower in vertical section ×2; F, pistillate flower in vertical section ×2; G, infructescence ×⅔; H, fruit in vertical section ×⅔. Drawn by M. M. Watt from *Dransfield* JD5178.

3. Inflorescence of *Areca tunku*, Upper Perak.

4. Fruit of *Areca tunku*, Upper Perak. Photos by C.-K. Lim.

peduncle 20–30 × 7–10 × 5 mm glabrous, bearing an inconspicuous, incomplete, low ridge-like peduncular bract ca. 1 mm high, just above the prophyll scar; rachis to 7 cm long; rachillae 6–12, very stiff and stout, borne in two neat rows on either side of the rachis, congested at first, later often widely spreading, 5–12 × 0.2–0.4 cm, sometimes slightly curved, bearing flowers only along one side (the distal side); triads borne only at the very base of the rachillae, 1–6 per rachilla, rarely absent, distally the rachillae bearing paired or solitary staminate flowers, the flowers cream-colored or greenish tinged, often markedly contrasting with the purplish rachillae. Staminate flowers terete, ca. 4–10 × 1.5–2 mm; calyx cup-shaped, sometimes strongly explanate, to 0.75 mm high, three-lobed, the lobes triangular to 1 × 1 mm; petals 3, distinct, 4.5–10 × 1.5–2.5, abaxially slightly striate; stamens 6, filaments 0.75–1.5 mm, anthers 2.5–5.5 × 1 mm, apically and basally sagittate; pollen monosulcate with finely punctate tectate exine; pistillode minute. Pistillate flowers at anthesis cream-colored, borne on enlarged rachillae; buds varying greatly in size depending on stage of development, just before anthesis to 19 × 9 mm; sepals 3, strongly imbricate, irregularly ovate 10 × 9 mm; petals 3, basally strongly imbricate 10 × 9 mm, with triangular valvate tips to 5 × 5 mm; staminodes 3, irregularly dentiform to strap-shaped; ovary ovoid 14 × 4 mm, stigmas 3, strongly adpressed in bud, expanding and becoming reflexed at anthesis, white, fleshy, triangular ca. 5 × 5 mm. Fruit borne on the enlarged, dark brown or blackened rachillae, up to about 12 fruits developing on a single inflorescence; mature fruit 3–4.5 × 1.5–3 cm, dull purplish green to brown, with blackened stigmatic remains borne on a white-

ringed beak to 12 × 6 mm; epicarp smooth, becoming striate on drying; mesocarp thin, pale, inner fibers of mesocarp broad, black, conspicuous, closely adhering to the endocarp; endocarp thin, closely adhering to the seed. Seed to 25 × 15 mm; endosperm deeply ruminate, embryo basal. Seedling leaf bifid (Fig. 1).

Distribution: Sumatra (Sumatera Utara) and Peninsular Malaysia.

Specimens Examined: PENINSULAR MALAYSIA. Terengganu: Besut, Ulu Sungei Kemia, alt. 530 m, *Cockburn* FRI 8212 (KEP); Besut, Ulu Setiu Forest Reserve, alt. 500 m, *Dransfield et al.* JD5178 (holotype K; isotype KEP), alt. 50 m, *Dransfield et al.* JD5169 (K, KEP); Ulu Nerus Forest Reserve, alt. 200 m, *Dransfield et al.* JD6511 (K, KEP). Johor: Labis Forest Reserve, *Wong Khoon Meng* FRI 32485 (KEP). Perak: Upper Perak, Belum Forest Reserve, alt. 800 m, *Lim Chong-Keat et al.* 90/069, 90/524, 90/542 (K, KEP).

SUMATRA. Sumatera Utara: Langkat, Bohorok, Bukit Lawang, alt. 500 m, *Dransfield et al.* JD3144 (BO), JD3145 (BO), JD3170 (BO), JD3263 (BO, K).

In Peninsular Malaysia *Areca tunku* is a palm of hill dipterocarp forest; in Sumatra it occurs in similar habitats. The North Sumatran population seems to consist of plants at the small end of the range of variation. Within populations in Terengganu, the range of variation is considerable, making suspect any separation of the Sumatran plants on the basis of size alone.

The uniseriate staminate flowers (Fig. 1) suggest that *Areca tunku* is a member of Wendland and Drude's section *Arecella* in Furtado's sense (Furtado 1933). The swollen frequently purplish rachillae (Figs. 1,4) seem to suggest a relationship with *Areca jugahpunya* J. Dransf. and *A. ahmadii* J. Dransf. (Dransfield 1984), two Bornean species. However, these two species are immediately distinguishable by their acaulescent habit; furthermore *A. ahmadii* has interfoliar inflorescences with very long peduncles and slender, less strongly beaked fruit, while *A. jugahpunya* is a much more massive palm, with a short peduncle as in *A. tunku*, but with much larger inflorescences with many (20) rachillae and large staminate flowers with petals connate for half their length. The peduncle form and colors of the inflorescence make *A. tunku* especially distinctive and striking.

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Some Aspects of the Palms of Madagascar, and Their Cultivation at the Parc de Tsimbazaza, Antananarivo

BLAISE AND DAVID DU PUY AND VOARA RANDRIANASOLO

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In Madagascar's national botanical garden, the Parc Botanique et Zoologique de Tsimbazaza (PBZT), a horticultural project based on the collection and cultivation of the island's native palms has recently successfully completed its first phase. Principal funding for the project was received from the World Wide Fund for Nature (WWF). Although the focus was on Madagascar's rich endemic palm flora, practical aspects of the project were seen as an opportunity to offer general horticultural training to the Parc staff. The rapid loss of native forest and the alarming rate of erosion and habitat degradation have stimulated a surge of international and local interest in Madagascar, and a concern for the conservation of the wealth of native plants and animals. The Parc is at the forefront of this movement; under strong direction an exciting educational program is emerging and the living collections of native plants and animals are undergoing reassessment and rehabilitation. With the support of international grants and technical advice, the collections will be able to play a major role in the education of the Malagasy people, in the orientation of short-term tourist visitors and possibly in the *ex situ* conservation of some of the more threatened species.

The palms of the island were chosen as the focus for the cultivation project because they are recognized as forming a particularly rich and interesting group, especially when compared with the palm flora of mainland Africa. There are 134 recognized palm species in Madagascar, of which 128 are considered to be endemic. At the generic level, endemism remains high: of the 23 genera 14 are considered endemic. In East Africa, by comparison, there are 11 indigenous palm genera, none of which are endemic. In Madagascar the palms have diversified to fill a range of niches and habitats. Unexpectedly, among the range of growth forms exhibited by Malagasy species, there are no climbing palms. *Calamus*, the most widespread climbing palm genus, is represented by 1 very variable species in East Africa which has not been recorded from Madagascar.

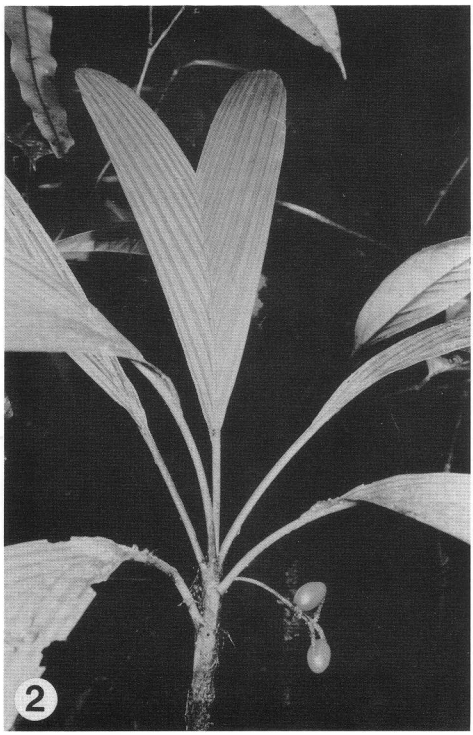
Eastern and Northern Moist Forest Domains

The greatest diversity in the native Malagasy palms is found in the moist forest domains of the east coast and the northerly Sambirano region. Tall solitary stemmed palms are a feature of the canopy in the low to mid altitude (0–1,000 m) forests. One such canopy palm with a robust crown of pinnate leaves is *Neodypsis lastelliana* which may grow to between 15 to 20 m and is distinguished by a thick rusty brown indumentum on the crown shaft. In the forest of Perinet, east of Antananarivo and accessible to visitors, *Ravenea robustior* is conspicuous due to its large clusters of brilliant red fruits. In this same region the

mixed, mid-altitude forest canopy is broken by the few remaining individuals of *Beccariophoenix madagascariensis*, a now rare emergent palm species. With equally limited distribution in an isolated forest region can be found *Marojejya darianii* which produces semi-erect, almost entire leaves forming a 'shuttle-cock', which, until the crown is raised up on a stocky trunk into the canopy, fills to almost a third with litter and debris falling from the canopy above. This trapped litter seems to rot rapidly and the released minerals may supplement the palm's nutritional requirements; *M. darianii* is only known from an area of white sand which is probably nutrient poor and seems to be constantly water-logged. It is from similar isolated moist forest regions along the northern east coast that two new monospecific palm genera have been collected: *Lemurophoenix*, the red lemur palm (Dransfield 1991) and *Voanioala*, the forest coconut (Dransfield 1989*a*); both generic names reflect the local Malagasy names used for these palms. *Lemurophoenix halleuxii* is a very large tree palm; the long pinnate leaves arise from a crown shaft which is up to 1.5 m long and covered in white wax. *Voanioala gerardii* is a spectacular palm in fruit. The fruits are ginger-red, arranged densely on long pendulous infructescences. With increasing altitude in the moist forest domains the forest canopy height falls, and the vegetation becomes more tangled. In these conditions the most common palm is *Neodypsis baronii*, a short, graceful clustering palm, very similar in habit to *Chrysalidocarpus lutescens*, the yellow cane palm of lowland and littoral conditions. The clustering habit is also displayed by members of the genus *Vonitra*, some species of which may also display dichotomously branched stems, such as *V. fibrosa*, the most widespread species of the genus. *Vonitra* palms may be frequent under moist forest conditions near streams or small rivers from sea-level to 900 m altitude and are often the only remaining plants in a recently felled forest patch; the leaves are used for roofing small cabins and dwellings. In the dense shade on the forest floor and in the understory, small single stemmed or clustering palms represent the genera *Dypsis* and *Neophloga*. Of these genera, *Dypsis pinnatifrons* is a frequent palm in the mid-story layer especially in the forests around the Bay of Antongil. It is a graceful, slender palm with a clustering habit and dark pinnate leaves, on which the leaflets are broad and unequal. In the understory of the forest at Perinet *Neophloga concinna* forms attractive small stands; members of the genus *Neophloga* usually have few leaves which are pinnate, divided into narrow or broad segments. *N. concinna* has pinnate leaves with numerous, fine leaflets almost evenly arranged along the midrib and the two terminal leaflets fused at their base.

Western and Southern Dry Forest Domains

On the west coast, in some localities, the palms are a spectacular feature of the landscape. In the savannah-like grasslands the endemic *Bismarckia nobilis*, with blue or green palmate leaves, forms dense stands. Clusters of arching *Hyphaene coriacea* are abundant on the outskirts of these stands and also on the more frequently burnt and impoverished grasslands. Between the western Mangoky and the Tsiribihina Rivers, *Borassus madagascariensis* palms mingle with the *Bismarckia*. These two palmate-leaved species may be distinguished at a glance due to the swollen trunks of the *Borassus* palms. A second endemic *Borassus* species, *B. sambiranensis*, occurs further north on the coastal plain of the Sambirano. *Phoenix reclinata* also occurs on these seasonally wet northern plains. In the western deciduous forests the robust and single-stemmed *Chrysalidocarpus rivularis* and the often clustering, variable *C. madagascariensis* are frequent species. *Chrysalidocarpus onilahensis* is prominent in



1. Malagasy people crowd the Parc on a national holiday. 2. *Dypsis humbertii* var. *angustifolia*, a moist forest understory palm with typically undivided leaves.

the sheltered gullies of the Isalo massif of southern central Madagascar growing with the graceful *Ravenea glauca*. Scattered stands of *Ravenea xerophila*, the most drought tolerant of the Malagasy palms, occur in the xerophytic vegetation of the south. The leaves of this palm are very stiff, the leaflets held in a steep V and covered with a white waxy bloom, and the trunk is obscured beneath the retained fibrous leaf bases. *Neodypsis decaryi*, from the southeast, is a striking palm due to the strong tristichous arrangement of its leaves. This species is endemic to a small patch of forest transitional between the wet and the dry domains.

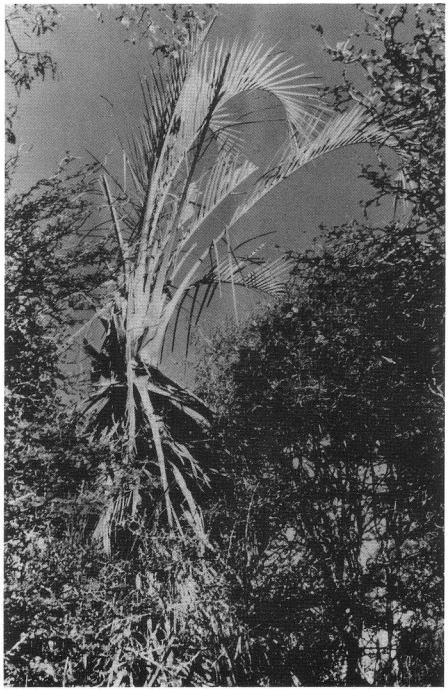
Ethnobotany of the Native Palms

Many of the native palms play an important role in the rural economies of the country; they are known and used by the local people as a source of food or materials. The young leaves of *Bismarckia nobilis* are used for roofing and their trunks for building. *Beccariophoenix madagascariensis* is valued for its leaves which are used to weave hats. The tough leaves of *Hyphaene coriacea* are widely used for weaving mats, and copious sugary sap is collected from its cut inflorescences and rapidly fermented into a heady beer. The sparse, stiff leaves of *Ravenea xerophila* are harvested for basket weaving. *Vonitra fibrosa* and *V. utilis* are important locally for the fiber that is associated with the leaf sheaths. The longer fibers from *Vonitra* may be twisted into ropes and used in the construction of small cabins, the shorter fibers are used in small 'mats' to pad or shield the bare shoulders of porters car-

rying heavy loads slung from horizontally held poles. The narrow stems of some of the *Dypsis* and *Phloga* species are said to have been used to make blow pipes, their narrow straight stems providing a suitable form. Edible fruits are gathered from some palms, such as those of the *Hyphaene*, *Phoenix* and *Borassus*. The trunk of *Ravenea robustior* is rich in carbohydrate and can be used as a source of sago. Palm hearts (the apical bud) of many native species, including *Ravenea madagascariensis* and *Chrysalidocarpus madagascariensis*, make a contribution to the diets of many rural people. Other palms are known to be poisonous or bitter. Malagasy forest people know that *Orania* produces poisonous seeds and bitter, poisonous apical buds; the apical bud of *Ravenea amara* is known to be edible but bitter. *Raphia farinifera*, the Raffia palm, is widespread, but only in secondary vegetation on the island; although it is thought to have been introduced to Madagascar with human settlement (Dransfield 1989*b*), its fiber and fruits are widely used throughout its distribution on the island. Raffia fruits are edible and refreshing, and the trees are further valued for the production of fiber from their young leaflets, which is used locally to weave baskets, and on the east coast a stiff 'cloth' is produced which is used to make simple garments. Fibers are used in the manufacture of fish traps and numerous other utensils; these fibers are produced in sufficient quantities to make a strong contribution to the national exports. The long petioles of this palm are used for roof joists and their rounded smooth structure suits them for use as carrying poles among west coast people.

Habitat Stresses, Endemism and Exploitation

The fragile soils of the island coupled with the traditional agricultural practices encourage a system of shifting cultivation, requiring a steady supply of fresh land, for which the forest is cut. This constant attrition of the forest is a major threat to the diversity of the palm flora. As a group the palms of Madagascar exhibit an extraordinarily high degree of island endemism. Several Malagasy palm species are only known from limited localities; this high level of micro-endemism or local endemism places such species as *Marojejya darianii* and *Borassus sambiranensis*, for example, in a position particularly vulnerable to stress due to habitat loss or habitat degradation. Exploitation by local users also places stress on a declining population of plants; the removal of leaves for weaving or as fodder for cattle reduces fruiting potential. Other endemic species, particularly attractive or rare species such as *Neodypsis decaryi*, *Ravenea xerophila*, and *Beccariophoenix madagascariensis*, are further threatened by the unrestrained collection of seed for palm enthusiasts.



3. The ravaged crown of a rare, mature *Ravenea xerophila*; the stiff grey leaves are cut for basket weaving.

The Parc Botanique et Zoologique de Tsimbazaza

The cultivation of Madagascar's native plant species at the Parc de Tsimbazaza has a long history. The existing botanical and zoological Parc is the modern extension of an ancient Royal garden originally constructed by the Malagasy Merina kings and queens of the 17th to the 19th century. Within the capital city, Antananarivo, and landscaped around a descending series of manmade lakes, the Parc has an air of tranquillity and seclusion created by the surrounding cliffs and steep hillsides and intensified by thick stands of bamboo and woodland areas. Lake Tsimbazaza, the largest of the Parc's lakes, is a place of national legend, the most frequently repeated of which is the story of the young Princes. Many years ago, the twin sons of a Merina king used to bathe in the refreshing waters of the lake. One day an unexpected wind stirred the normally calm waters, and the young men were drowned; their bodies were never recovered. The king, their father, had a gold coffin cast, and to symbolize their burial the coffin was launched into the lake.

Under French colonization, earlier this century, the Parc was developed as a botanical and zoological research center, and opened to the public as an educational resource. Living and dried collections of the fauna and flora of the island were gathered for study and display. The Parc, located towards the eastern slopes of the island's central High Plateaux, at an altitude of 1,250–1,450 m (a.s.l.) falls into a climatic zone where dry cold winters between April and September are followed by heavy summer rains. The average temperature is around 18° C, but winter nights can be cold, with temperatures close to the freezing point. The existing planting indicates that the French collected material from most of the vegetation types on the island. These established plantings set an important precedent in cultivation possibilities for any future redevelopment. Over the past few decades, a serious lack of both horticultural skill and financial support have resulted in the impoverishment of the plantings. Many specimens are over-mature or in need of pruning and others, debilitated by unsuitable cultural conditions, are infested with insect pests.

The Palmetum

On a steep hill, under a stern-faced statue of the French naturalist, Alfred Grandidier, a mixed palmetum has been developed. A structure of paths and open lawns is demarcated by avenues of the exotic Queen Palm *Syagrus romanzoffiana*, probably planted for its rapid growth. The palmetum not only contains palms, but also *Pandanus* plants and specimens of the native Traveller's Tree, *Ravenala madagascariensis*. Native palms include mature clumps of *Chrysalidocarpus lutescens* and the similar *Neodypsis baronii*. A specimen of *Vonitra fibrosa* also forms a dense clump, the stems covered in pale brown fibers. *Chrysalidocarpus decipiens*, native to the High Plateaux, is a valuable and healthy feature of the collection. This species may occur with twin cigar-shaped trunks, an indication of its apparent ability to branch dichotomously as a young plant in the rosette state; more usually one of these stems dies. Several specimens of *Neodypsis decaryi* have been discovered in the palmetum, none of them in good health. However, good cultivation of this species should be possible under the Parc's climatic constraints; a single fruiting specimen has been seen elsewhere in a sheltered garden in the city.

Many of the palms, especially the dense clumps of *Chrysalidocarpus lutescens*, are suffering from heavy infestations of scale insects including the sap sucking soft brown scale (*Coccus hesperidum*) and the coconut scale (*Pinnaspis* sp.) which resembles a sprinkling of shredded coconut on the leaflets. The brown scale is responsible for

further problems: the insects exude a sugary liquid which is colonized by black 'sooty molds' that cover the leaves and reduce photosynthetic efficiency.

The Palm Cultivation Project

The palm collection and cultivation project has four goals:

1. the organized and scientific collection of material to increase the native palm collection at the Parc;
2. to improve germination procedures and nursery cultivation techniques;
3. to assist with the development of general horticultural techniques to improve cultivation of specimens in the palmetum;
4. to assist with educational displays based on the native palm flora.

Seed and plantlet collections were carried out with the assistance of botanical teams from The Royal Botanical Gardens, Kew and from the Missouri Botanical Garden. Particular species considered to be under habitat stress or suitable for cultivation in the Parc were targeted. An expedition to the east coast enabled the recently described endemic *Marojejya darianii* to be accessioned to the Parc. Further expeditions yielded seed of both *Borassus* species, and later the canopy palm *Lemurophoenix halleuxii* was collected. The project resulted in twenty-two new palm accessions to the Parc. Each of these collections of living material was accompanied by an herbarium collection. These dried voucher specimens will facilitate the naming of the living material and will contribute to essential taxonomic studies of the palm flora now underway in Madagascar and at Kew.

Seed Germination

The germination of palm seed was found to be most successful when the seed was fresh and ripe. In these conditions 60–80% germination was achieved. Seed was cleaned immediately on collection and the germination process initiated. The established technique (Jones 1984) of placing cleaned seed, wrapped in moist moss into plastic bags, was followed. Numerous small plastic bags each with 5–10 seeds were used in order to limit the losses of seed to predatory insects hidden within apparently clean seed. Germination of most fresh seed was rapid; ripe seeds of *Marojejya darianii* which had been collected from fallen clusters around the base of the trees gave almost 85% germination after six to eight weeks. Most members of the Dypsidinae (*Dypsis*, *Chrysalidocarpus*, *Neodypsis* and *Vonitra*) produced smaller seed, which germinated within four to six weeks. In these small seeded species, germination is adjacent-ligular. The *Chrysalidocarpus* and *Dypsis* seedlings rapidly lost the radicle and produced several wiry adventitious roots from the base of the seedling. *Neodypsis* seedlings developed a single primary root or radicle which itself produced fine lateral roots. Subsequent development of these seedlings occurred relatively steadily and without undue difficulties. After approximately eleven weeks *Lemurophoenix* seeds also exhibited adjacent germination, but subsequent development of the radicle and plumule was very slow, and the seedlings were prone to rot before this could occur. Seeds of *Orania*, *Hyphaene* and *Bismarckia* provided examples of remote ligular germination. Fleshy, white cotyledonary stalks grew from the seeds, diving into the compost and carrying the seedling away from the large seeds; these cotyledonary stalks proved to be fragile structures, prone to rot and insect attacks. This germination mechanism ensures that the young crown of the seedling is sheltered below the soil surface and that it is well anchored by deep-set roots. The genera *Bismarckia* and *Hyphaene* both form dense stands on the western sedimentary plains of the island, regions that suffer from annual fires. This germination type, coupled with the characteristics of monocot-

yledon trunk morphology, may account for their ability to withstand the effects of the annual burn. *Borassus* species also have the same germination syndrome (Corner 1966). *Orania* occurs on steep, often precipitous slopes in the east coast forests where this plunging seedling development may ensure a secure anchorage which could be an advantage in maintaining position on the slope.

Seedling Cultivation

The palm seedling cultivation was carried out in a secure, shaded greenhouse in the Parc nursery. Seedlings were guarded in their moss wrapping in the bags, often until the first leaf emerged, or until the cotyledonary stalk reached a cumbersome and fragile length. At this point individuals were potted into a carefully developed compost and were weaned under humid conditions in a tent before standing in the open house. Humidity in the house was maintained by the regular spraying of water; the adoption of extra shading in the house and over planting-out beds created a suitably reduced level of light. The compost used was a modification of the basic mix established for the nursery: loam, grit, and humic compost on 1:1:1 ratios. For the palms, this general mix was supplemented with chopped coconut fiber or moss, and pieces of charcoal and brick shards, on the ratio of 2 parts of general mix: 1:1 in order to improve the drainage and structure of the mix. It was considered important that these compost ingredients should be easily available and inexpensive. Pots presented a problem in that containers of sufficient depth combined with a narrow diameter were difficult to locate. This was eventually solved by the use of narrow open weave plastic waste-paper baskets produced by a local factory. These baskets had a suitably low unit price and long life expectancy. The problems of loss of plants to marauding chickens and thieves will necessitate that young palms are cultivated under strict security until they reach a suitable size for planting out safely in the Parc. Seedlings will eventually be moved out of the house, to continue growth in shaded, locked wire cages.

The Project in the Palmetum

In the palmetum, work concentrated on the removal of non-palm specimens and the amelioration of conditions for the remaining plants. Dense, thick clumps of *Chrysalidocarpus lutescens* were thinned. The removal of stems should improve the air circulation, and reduce the shelter offered to insect pests. As a further means of combating the heavy infestations of scale, 'White Oil' was imported. This petroleum oil can be an effective treatment for many insect pests, and is of a sufficiently low level of toxicity for its use to be recommended where safety precautions are difficult. It is used at 1 part of White Oil to 60 or 80 parts of water; if more concentrated it is known to cause scorching, especially under conditions of bright light. Under a school participation program, the turf surrounding specimen plants was removed in a 2 m diameter circle and replaced with an 8 cm layer of organic compost, to improve the nutritional status of the lateritic soil. Most of the *Pandanus* and *Dracaena* plants were cut out, and their roots removed. This had the effect of opening up and accenting the planting, and will help to increase air movement and light levels for the remaining palm specimens. In a future co-operative program with forestry workers, some of the larger exotic palms will be removed. It has also been recommended that irrigation should be installed to supplement the light winter rains.

Leaflets, Labels and Notice Boards

Prior to the cultivation project, a leaflet (available in English, French and Malagasy) was produced as a result of funding

from WWF. This leaflet, distributed through the Parc, formed the pivot for the poster displays developed under the cultivation project.

Labels for the palms have been designed which indicate scientific and vernacular names and region of origin. These will be erected initially for the native palms and eventually for all the plants in the Parc. Notice boards, one of which was constructed in the palmetum, offer the opportunity for seasonal poster displays and information sheets. A series of six colorful cartoon posters was designed and a Malagasy artist commissioned to produce them with text both in French and Malagasy. These posters form part of a larger display highlighting the uses of the native palms.

Recommendations for Future Planting Development

There are many possibilities for the further development of the palmetum using the wide range of native species and their variability in form. It could also be valuable to develop the collection towards a display of palms with different growth habits, such as *Marojejya* with its litter collecting crown and the numerous small forest floor *Dypsis* and *Neophloga* palms. Many of these species could also be incorporated into suitable habitats in the general planting of the Parc. Riparian species such as *Vonitra crinita* could be planted by the lakes and shade-requiring species in the large display shade house. Under the planned redevelopment of the Parc, the palmetum will continue to be a focal area.

Conservation

To ensure the continued survival and diversity of the palms native to Madagascar a co-ordinated conservation policy should be considered and implemented. This policy should be directed into:

—protection of the population in the native habitat to encourage continuation and regeneration *in situ*;
—the *ex situ* cultivation of targeted species by the means of seed produced plants within Madagascar, to explore cultivation requirements and to form the basis of a conservation stock;
—the protection from excessive trade and the monitoring of existing trade as offered by CITES (Convention on International Trade in Endangered Species) listing.

Many of the native palm species are very attractive and would be exciting to see in cultivation. To limit the effects of seed collection from habitat plants a general policy of cultivation for seed harvest could be incorporated into the conservation policy.

Ex Situ Conservation

The restricted distribution of many of the native palm species, and the pressures on wild populations from collectors and enthusiasts, suggests particular species as suitable for the attention of *ex situ* cultivation conservation projects. *Ravenea xerophila*, from the xerophytic vegetation of the central south of the island, would be a suitable candidate for such a project. The remaining individuals are now restricted to small scattered stands all of which fall outside the region's protected areas. This species is thus considered to be in immediate threat of extinction in its native habitat. Most of the *R. xerophila* plants located have been severely debilitated by the removal of leaves or grazing. The populations are further stressed by the uncontrolled and usually unauthorized collection of seed for international collectors. A second threatened palm *Beccariophoenix madagascariensis* from the eastern forests, now probably limited to a single known stand of six adults, would also be a suitable candidate. Habitat loss, at least in principle, is not a threat in this case as

the stand is within a protected area, but the very tall, mature trees are still cut down to facilitate seed collections.

Strict conditions apply to *ex situ* cultivation (BGCS 1989), and if any real contribution to conservation is to be achieved, efforts must be made to adhere to these conditions. Guidelines are set out within the Botanical Garden Conservation Strategy, produced in 1989 by the IUCN Botanical Garden Conservation Secretariat. Among these guidelines is the basic requirement that as wide a range as possible of specimens representing a species should be cultivated, in order to conserve the range of genotypes. Thus seed should be collected and grown from various populations throughout the geographical and ecological range of the species. The limited range of some of the Malagasy endemic palms has already been assessed by preliminary surveys; for the targeted species these surveys could be developed. Following the suggested guidelines for *ex situ* conservation, the Parc could arrange for the designation of a locality within the country for the safe cultivation of these native species and could perhaps eventually facilitate the legal and controlled dispersal of seed from mature plants to overseas collections.

CITES Listing

Only two Malagasy palms are as yet protected by international law: *Neodypsis decaryi* and *Chrysalidocarpus decipiens*. Both these species are named on Appendix 2 of the CITES regulations controlling trade, although seed of both species is exempt. Appendix 2 listing requires that those wishing to export specimens obtain an export permit or certificate which is issued by the country of origin, prior to handling and after determination that "such exports will not be detrimental to the survival of the species" (CITES Secretariat 1982); this system allows the extent of the trade to be monitored. Although exempt from CITES restrictions, the CITES Annual Report for 1989 did indicate the export of 103 kg of *N. decaryi* seed and also reported the exportation of approximately 20 plantlets each of *C. decipiens* and *Ravenea xerophila*. In the case of other endangered groups the listing of a species on the CITES appendices does seem to have had some influence on reducing trade in habitat collected material and on encouraging the controlled cultivation and propagation of the species. Given the extent of the seed collections, and the pressures on existing populations it would seem advisable to remove the exception to CITES control for the seeds of the two listed species and to give CITES monitoring to further, rare Malagasy palm species by CITES listing. Appendix 2 listing would offer some degree of protection to *Marojejya darianii*, *Voanioala gerardii* and *Lemurophoenix halleuxii*, all of which are highly attractive species of very limited known distribution. The listing of species on Appendix 1 of CITES (a level of listing used for species considered to be under threat of extinction in their habitat) would strictly prohibit all commercial trade in wild specimens. This level of protection may be suitable for *Ravenea xerophila*, *Borassus sambiranensis*, and *Beccariophoenix madagascariensis*. The listing of these species on Appendix 1 of the CITES legislation would prohibit international trade and should deter collectors and enthusiasts from taking, buying or accepting specimens of these species.

Acknowledgments

We should like to thank the staff of the Parc Botanique de Tsimbazaza, in particular Jackie Andrianatina and Guy Rafamantanantsoa for their hard work and enthusiasm with the collection and cultivation of the palms. We are grateful to the World Wide Fund for Nature and to the Iris Darnton Foundation for grants awarded to the project; to the Royal Botan-

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Commercial Transplanting of Wild Cabbage Palms, Sabal palmetto, in Florida

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The authors used a residential landscaping project as an opportunity to document the transplanting of cabbage palms from their selection in the wild to planting at the job site.

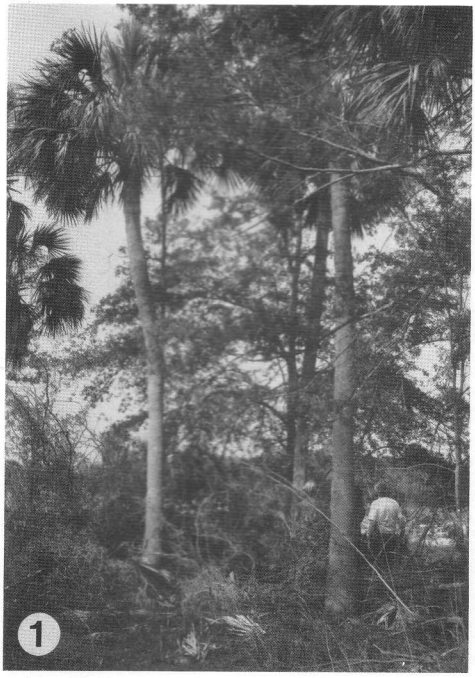
Of all the native palms occurring in the southern United States, none compares in popularity with the cabbage palm, *Sabal palmetto*. Tolerating wide extremes of temperature, soil conditions, and sunlight, the plant is a favorite among landscapers. Mature specimens up to 80 feet in height have been transplanted by the hundreds of thousands during the last century. Their ability to withstand temperatures to near 0° F and tolerate soils ranging from pure beach sand, to sour muck, to clay makes the cabbage palm one of the most adaptable in the world. *Cocos nucifera*, *Phoenix* sp., and *Washingtonia robusta* may claim more total numbers in the world, but none can tolerate as wide a range of conditions as *Sabal palmetto*.

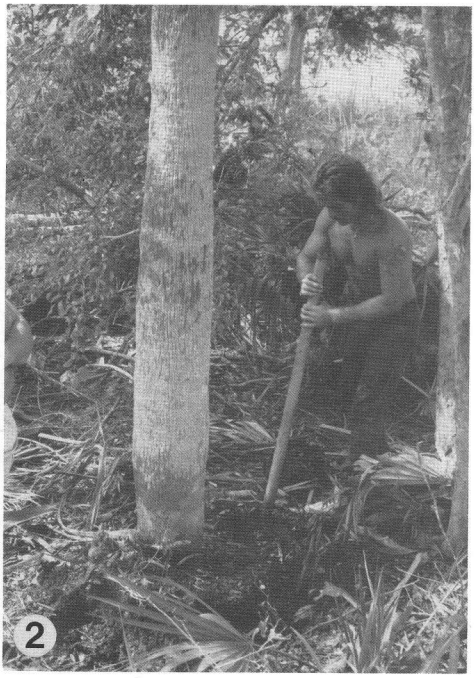
In April 1990 the authors drove to Steinhatchee, Florida, located on the Gulf coast. This remote area of Florida, known as the "Big Bend," is far removed from the fast-paced more populated regions of the state. Much of the area is undeveloped and is used primarily as a source of raw materials for the pulpwood industry.

Upon arrival at this picturesque fishing village we made our way to the comfortable country home of the Hugh Markham family where we were warmly welcomed. The Markhams are one of the few families still in the palm digging business in this part of Florida (Fig. 1). Hugh has been in the business since 1964 and has passed on his skill and knowledge to his sons.

After a short tour of the palm holding and loading area, we sat down for a delicious lunch of "home cooked vittles." Fortified by lunch and accompanied by plenty of cold drinks, we headed for the woods. It was a beautiful, very warm, spring day and we had much to learn about harvesting cabbage palms. We soon came to appreciate the difficulty in finding good mature trees that are accessible. Miles of driving over rough logging roads turned up only one suitable site. Palms are obtained from large property holdings, usually corporate commercial timberlands. Over the years a very small stumpage fee ($2–$5) has been paid to the owner for each tree removed. Recently, things have changed. Stumpage fees have increased dramatically, but more importantly, many of the large companies no longer wish to be bothered by the local palm diggers. Forest management philosophies and liability problems have closed off many previously accessible areas.

Even when permission is granted, the job can still be very difficult. Many different transplanting methods have been tried, but most equipment is limited by whether it can be taken into heavily wooded or steep areas. A large tree spade works very well in accessible areas. Bulldozers with special blades and Ditch-Witch machines are used by some palm diggers. In the Steinhatchee area hand digging is the most common method.





1. A natural setting of *Sabal palmetto* prime for harvest. 2. Hand digging with a special shovel is usually accomplished in about 15 minutes.

Once we had settled on a suitable area, the digging crew went into action. A special shovel with a length of pipe welded to it, in place of the normal handle, is the standard digging tool. This stout, heavy, and very sharp shovel cuts through the ground and roots quickly and easily. A trench is dug around the tree about 12–18 inches away from the trunk and 24–30 inches deep. The best diggers, when rested, can cut out a tree in three or four minutes, but working all day, 15 minutes is closer to average time (Fig. 2). Diggers prefer palms growing in shallow soils on limestone rock, as these palms tend to pull right off from the rock once the lateral roots have been cut. Once the tree is dug or "trenched" it is ready for "snatching." Using an A-frame mounted on a truck or log skidder, a power wench driven cable is wrapped around the trunk and the tree is then slowly pulled (snatched) from the hole. The palm is then dragged or carried out to the nearest road to be cleaned and groomed (Fig. 3).

The fronds, locally called suckers, are removed from the tree to compensate for the large amount of root loss (Fig. 4). Usually five to seven fronds are left while the three or four closest to the emerging spear are cut as they draw the greatest amount of energy from the palm. The remaining fronds are then tied with twine and usually left tied for at least 30 days. Some installers prefer to remove all of the fronds, leaving only the terminal spear. These trees tend to have a higher survival rate, but most landscapers do not engage in this practice as the defoliated palms are not very attractive when set into a finished landscape setting.

Boots (old persistent leaf bases) are removed from the trunk with a modified shovel that has been shortened and sharp-

3. Using a "skidder," the palm is pulled from the wooded area to a road for loading. 4. Trimming excess fronds and cleaning old boots. 5. Hugh Markham separates the palms by size in the loading yard. 6. A truckload of palms arrives at the job site.

ened. Depending on the location, some specimens retain all their boots. Landscape architects often specify palms to be left this way as the boots, when trimmed properly, provide an interesting geometric design on the trunk.

After harvesting two beautiful (25 and 30 foot) specimens, we had to quit for the day as the A-frame broke while removing the second tree. This is a common problem and caused Hugh very little concern. It is a simple matter to "crank up" the arc welder and "patch it up" again. So we returned to the house and selected the remaining trees for the load to be sent to Jacksonville.

A refreshing glass of iced tea and some idle chatter about the dim prospects for the future of palm digging in the Steinhatchee area just about wrapped up this most interesting day with the palm digging Markhams. One more chore remained, to load the truck with needle palms and Florida coonties, *Zamia integrifolia*, which the Markhams also harvest from the local woods. Hugh and his sons are trying to "rescue" as many of these plants as possible before they are destroyed by modern forest management procedures. It is sad to think about how many of these unique little plants are being needlessly destroyed in the conversion of natural woodlands to sterile pine plantations.

Soon we were on our way home from Steinhatchee, but the story continues. In a few days our cabbage palms were on their way to Jacksonville and a new home. Using the repaired A-frame truck, the Markhams had loaded the trees on a dual tandem, two-ton flatbed truck (Fig. 5). This

7. Unloading with a backhoe/front-end loader. 8. Setting the palms in place. 9. A simple temporary irrigation system. 10. The same landscape one year later.

small truck is typically used for short hauls of 300 miles or less and can carry 20 to 22 palms. For longer hauls, for example to Texas or Virginia, a tractor-trailer rig is more economical as 40 to 48 palms can be transported. On the shorter runs, the palms are shipped uncovered as the unique folded shape of the costapalmate fronds and their being tightly tied makes for insignificant windburn in transit.

About mid-morning on the appointed day, the palms arrived at the job site (Fig. 6). Special care must be taken in unloading to prevent bud damage. Weighing from 600 to 1,500 pounds each, the palms are virtually impossible to handle without mechanized equipment (Fig. 7). A combination backhoe/front-end loader is perhaps the most versatile machine, as it can be used to dig the holes, then unload and set the palms. A commercial nylon sling is preferred to a logging chain when cinching the trunk prior to lifting. This prevents ugly trunk scars. Cinching the trunk just above the balance point is best so the tree will remain upright when lifted. It can then be easily set into the prepared hole (Fig. 8). Cabbage palms should be planted as quickly as possible, although it has been observed that the palms become dormant for a time after being dug. There have been numerous instances where unplanted palms have been exposed to the hot summer sun for two weeks or more and have begun growing once planted and properly irrigated. It is common practice for dug trees to be "heeled in" in nursery holding areas with their rootballs covered with sawdust or wood shavings. Trees may be stored in this way for up to several months and often form new roots in the process.

Cabbage palms can be planted deeper

than they originally grew. For taller palms, 20 feet or higher, deep planting may eliminate the need for bracing against the wind. Very tall specimens have been planted as much as three feet deeper than the original depth with no apparent detrimental effect. Once the palm has been lowered into the hole, soil and amendments, such as commercial cow manure, are backfilled slowly while watering liberally. Many palms are lost at this critical stage in the haste to fill the hole. Careless backfilling can create air pockets around the roots that can kill the palm as surely as neglecting regular watering. "Mudding" the hole to the consistency of a thick soup is the best way to assure all air pockets are removed. When the hole is approximately two-thirds filled, the sling and tractor can be backed away and the palm then pushed to its proper upright position manually. If the palm has an interesting curve to the trunk it may need to be turned to achieve maximum visual effect. This can be done by tying a rope loosely around the trunk about four feet above the ground, then placing a shovel handle, board, or other object of similar size and strength between the rope and trunk. After twisting the "handle" until tight, the tree can be rotated by hand (this usually takes several people) using the handle as a lever. After final positioning is achieved, the rest of the soil is mudded in. To help insure proper watering of the palms during recovery, a temporary dike about six inches high is built around the outside of the planting hole to form a shallow basin. On well drained sites this basin should be filled with water at least once a day. On poorly drained sites the watering is reduced to no more than three times a week. A very successful temporary irrigation method has gained popularity of late whereby an inexpensive garden hose is looped around each palm. An ice pick is used to punch three or four holes facing each palm trunk, then water is turned on at very low pressure and allowed to "drool" for two to three weeks (Fig. 9).

Once the palms are in place and final grading is done, the remaining landscape plants and sod can be installed (Fig. 10). Proper landscape planting with cabbage palms can give a tropical look in areas otherwise too cool for tropical plants. Throughout the sunbelt region of the United States, *Sabal palmetto* is unmatched in its versatility. The only drawback is that existing supplies will probably be depleted in less than 30 years. Every effort should be made to avoid transplant losses due to careless handling and neglect after transplanting. The once seemingly unlimited natural supply of cabbage palms has led to a rather cavalier attitude about the plants at times in the past. Now people are becoming more conscious that they are a limited resource and could become threatened in the wild. Since the plant is the state tree of Florida and South Carolina, one would hope that steps are taken to protect the cabbage palm in many areas of both states.

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PALM BRIEF

A Coconut Seed Producer's Perspective on Lethal Yellowing

1. Introduction

The writer of these notes is neither a trained agronomist nor a plant pathologist and, as a seller of hybrid coconut seed, may be regarded as being biased. The thoughts expressed here are based on common sense and his own observation of the effects of Lethal Yellowing disease ("LYD") in Jamaica, Florida and Mexico.

2. Background

LYD is a fatal pandemic disease of the coconut palm which has been present in the Caribbean for well over one hundred years. It was first described as the "unknown disease" and the earliest reported coconut disorder now believed to have been LYD was on Grand Cayman Island in 1834. The disease was named "Lethal Yellowing" in Jamaica in 1955. LYD is known to be present in Cayman Islands, Jamaica, Cuba, Haiti, Dominican Republic, Bahamas, United States and Mexico. Similar diseases exist in Africa. It attacks other palms such as Cluster fishtail, Date, Fiji fan, Princess, Pritchardia, Thurston and Windmill palms, but not the Royal nor African oil palm.

3. Symptoms

The first symptom is premature nutfall of most or all nuts regardless of age; most have a dark water-soaked area under the calyx; since nutfall and natural button shedding can have a number of different causes, this is an unreliable indicator. The next stage is the blackening of emerging inflorescences; when cut open the male flowers inside are necrotic, black or brown; no subsequent female flowers will set fruit. The leaves turn yellow, usually starting with the oldest and working upwards to the crown, then brown and dry, and finally hang down. On occasion one leaf in the crown will turn yellow first, and the leaves of some varieties omit the yellowing, instead turning brown. Death of the palm occurs about half way through the yellowing process and finally the whole crown collapses leaving a bare trunk like a telephone pole. Because a palm's most frequent expression of disease, disorder or even wet feet is the yellowing of leaves, there is always a danger that the presence of LYD will be exaggerated or incorrectly identified.

4. Causal Agent

In the early 1970's laboratories in Germany, the University of the West Indies in Jamaica, and several U.S. universities working in co-operation with the Jamaica Coconut Industry Board and Fairchild Tropical Garden in Miami, identified mycoplasma-like organisms ("MLO") as the pathogenic agents which cause LYD. Early attempts to isolate the cause which started in Cuba in 1880 for many years focused on bacteria, fungi, soil factors and viral aetiology as the likely cause. For the palm to contract LYD the MLO must enter and circulate in the phloem tissues. The action of the MLO can be arrested by regular treatments with antibiotics, but whilst oxytetracycline injections may be feasible in Palm Beach, the cost is too high for their use on a plantation scale.

5. Vector

Scientists concur that the vector is the leaf hopper *Myndus crudus* Van Duzee. Field studies and transmission experiments have provided strong evidence that *M. crudus* is a vector and probably the only

important vector of LYD. Like most insects *M. crudus* is unlikely to travel more than 500 yards in its lifetime, unless removed large distances unnaturally as by hurricane. Twelve other members of Derbidae, Membracidae and Cicadellidae families have been tested as possible vectors without positive results. An idea that has been proposed occasionally that the coconut mite, *Eriophyes guerreronis*, is a vector is highly doubtful. "There is no evidence implicating the coconut mite as a vector of this disease, and in fact, there are several lines of evidence against this motion" (F. W. Howard 1991). *M. crudus* and *Myndus* sp. exist in Central and South America but are not harmful when LYD is not present. Most grasses serve as host plant for *M. crudus*, a further argument in favor of using leguminous cover crops, which do not.

6. Spread

Professor F. W. Howard of University of Florida, one of the leading experts on LYD, describes the movement of LYD as a "jump spread." The spread is most resolute via a land mass continuously planted with susceptible palms. Mexican authorities on the Atlantic coast calculate the annual progress at 15–30 miles aided by frequent high winds; they also fear fishermen carrying coconut materials. Typically the movement of LYD is extremely slow: it took ninety years to move the length of Jamaica, a distance of less than 100 miles, and there are still stands of unaffected Jamaica Talls; it appears to have been present for fifty years in Haiti before crossing the border into Dominican Republic (1969). Transfer between land masses is similarly slow: LYD was present in Cuba at least sixty years before appearing in Key West, Florida (1936) and one hundred years before arrival at Punta Sam, near Cancun in Mexico (1981) a distance of 125 miles; it is thought to have come in grass from Florida.

7. Latin America

In Latin America LYD is present only in the three states Campeche, Yucatan and Quintana Roo in the Yucatan peninsula on the Atlantic coast of Mexico. There have been rumors in recent years that it was in Belize, Honduras and even Costa Rica. Whereas the former may be an obvious future destination, LYD has not been confirmed, and its presence in Honduras and Costa Rica has been reliably investigated and denied. Observers were probably influenced by factors described in 3 above or excited by the gravity of their "discovery." Whereas it may spread in future southwards from Mexico along the Atlantic seaboard there is no certainty that it will ever affect all coconut-growing areas of Latin America, nor in view of the slow transmittals described in 6 above that it will even invade two or more countries in this writer's lifetime (or reader's). Costa Rica has been declared to be free from LYD by its own efficient Plant Protection Service, by OIRSA, Basil O. Been, Owen Drew, among others.

8. Prevention

Plant protection services in coconut countries must restrict the ingress of coconut plant materials which originated or may have originated in an area where LYD is confirmed, unless the materials are to be used for research or breeding programmes in qualified hands. This applies especially to untreated coconuts or plants, as may be transported across borders or in fishing boats, which may be accompanied by an infected vector. Imports of planting material from unaffected countries cannot result in the introduction of LYD but should be regulated, if only for information purposes. In the risk league, embryos pose least, through pollen and seednuts, to actual plants which present most risk. Enlightened plant protection services restrict the entry of other susceptible palms from all origins (list available) thus reducing poten-

tial hosts which might contribute to future spread if LYD were to arrive. In protection of its vast areas of coconuts on the Pacific side, Mexico thoughtfully prohibits movement of planting materials across the country. NAPPO (North American Plant Protection Organization) states in its October 1989 Principles of Plant Quarantine that contracting parties shall institute regulatory or other measures only where such measures are made necessary by phytosanitary considerations, i.e., to prevent the entry and/or spread of quarantine pests, and "plant quarantine measures should represent the least drastic action available that results in the minimum impediment of the international movement of people, products and conveyances." There is no recorded incidence of LYD being transferred via seednut and Jamaican authorities state that it is "quite unlikely that the nuts can carry the disease." In spite of this the Coconut Industry Board routinely pre-fumigates with phosphine.

9. Resistance

Among widely disseminated coconuts that with the highest known resistance to LYD is the Malayan Dwarf ("MD") at 95 to 99%. F1 hybrids of MD have intermediate levels of resistance reflecting that of the other parent but tending towards the greater resistance of MD. Other coconuts with noteworthy tolerance are the King coconut and certain dwarfs from Cuba, India and Sri Lanka. Levels of susceptibility recorded in LYD induced trials are generally higher than the same palms would display under normal field conditions, e.g., MAYPAN hybrid registered 85 per cent resistance in LYD applied trials but 99 per cent in the field in Jamaica. The standard work on the subject is 'Observations on field resistance to Lethal Yellowing in coconut varieties and hybrids in Jamaica' by Basil O. Been, published by I.R.H.O. in January 1981 Oleagineux. The averages of resistance for principal talls and their hybrids with MD in that article were (percentages):

1. Talls: Panama (or Pacific) 56, Rennell 38, Jamaica (or Atlantic = West African) 10.5 percent.
2. Hybrids: MAYPAN 90.2, MAREN 74, MAYJAM 64 percent.* Subsequent estimates place the resistance of MAREN at 80 to 85 percent. Recent reports of reduced MD resistance are largely discounted by circumstances at sample sites. In the selection of hybrid coconut to plant countries which have LYD or with a genuine risk of acquiring it from a neighboring country should opt for highest resistance, and those not so threatened may rely on good resistance while choosing maximum yield potential. MD is not planted commercially because of a range of disadvantages, but is most suitable as mother palm for the production of F1 hybrids.

10. What the Experts say

SACRAC has corresponded with a number of experts in the field of coconuts and LYD. Usually the thrust of our enquiries concerned Costa Rica but the quotes which follow include both local and general observations.

10.01. "Most hybrids have levels of resistance intermediate between those of the parents, but generally closer to that of the more resistant parent. . . . The use of resistant varieties is one of the main forms of disease control." Basil O. Been, 1981, Observations on field resistance to Lethal Yellowing in coconut varieties and hybrids in Jamaica, Oleagineux.

10.02. "Research has shown that for a coconut palm to have Lethal Yellowing disease, mycoplasmas must enter and circulate in the phloem tissues. The palm subsequently sheds all nuts, the inflores-

* SACRAC sells these hybrids as MAPAN, MAREN and MAWAT.

cences become black, the fronds become yellow and the palm begins to die. The Malayan Dwarf coconut which is very highly resistant to Lethal Yellowing disease is being used extensively in Jamaica to replant areas which are affected by the disease and to establish new areas. All nuts used for producing seedlings are from trees which are in full bearing and apparently unaffected by disease. It is quite unlikely that the nuts can carry the disease." Coconut Industry Board of Jamaica, 1982, certificate.

10.03. "Lethal Yellowing disease is a major consideration only in those countries where the disease occurs. . . . Mexico should be testing hybrids now in preparation for a major replanting programme. . . . Efficient plant quarantine is the only way to prevent insect vectors or the pathogen arriving in Costa Rica in, or on, living plant material. This cannot guarantee freedom from Lethal Yellowing disease but could delay arrival indefinitely." Hugh C. Harries, 1988, Notes on coconut planting in Costa Rica.

10.04. "Whilst it has recently been introduced into Mexico this was due to characteristic lack of phytosanitary precautions. It is fairly unlikely that it will spread to Costa Rica and, if it were to spread, that it will cover the country quickly." M. de Nuce de Lamothe, IRHO, 1989, personal communication.

10.05. "In March 1971 seeds were collected from visually healthy Jamaica Tall palms and from Jamaica Talls with clear early symptoms of Lethal Yellowing and set separately in the nursery. Germination was good. In November 1971, 244 seedlings of each group were planted in a disease-free area in Kingston city and 500 of each in a disease-free area near Montego Bay. These plants were maintained and regularly observed. Up to 1981, when I left Jamaica, not one palm had shown any symptom of Lethal Yellowing. This experiment strongly supports the statement of Howard and Barrant that "there is no evidence that MLOs can be transmitted via the seed of plants." D. H. Romney, 1990, Principes.

The composition of these notes has relied much upon the following publications, in addition to those already cited: Personal communications and Lethal Yellowing: how to combat the threat to Costa Rica, Dr. F. W. Howard, University of Florida, 1989 (Article available upon request); Lethal Yellowing of Palms, Drs. R. E. McCoy, editor, F. W. Howard, J. H. Tsai et al., University of Florida, 1983, Dr. Karl Maramorosch of Rutgers University; and Annual Research Reports on the Coconut Industry Board of Jamaica.

11. Conclusion

The best control of LYD is to breed and plant for resistance, minimizing the number of all susceptible palms in its path, especially when new plantings are considered. The best cure is an educated and aware plant protection service preventing the entry of suspect or susceptible materials, well prepared and informed, able to identify the symptoms with certainty. The best hope for unaffected countries is that the spread of LYD will stop or continue to be as lethargic as it has for the past one hundred and fifty years and that its arrival, should it happen, will be greeted not with hysteria or panic, but a logical and well-planned series of sophisticated precautions and phytosanitary measures.

RICHARD ILLINGWORTH

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PALM LITERATURE

THE USEFUL PALMS OF THE WORLD: A SYNOPTIC BIBLIOGRAPHY. Compiled and edited by Michael J. Balick and Hans T. Beck and collaborators. Pp. 724. ISBN 0-231-06676-7. Columbia University Press, New York. Price $50.00.

"Bibliographic studies are crucial to scientific investigation and proper fieldwork," as is stated in the preamble to this new palm bibliography. The palm taxonomist is well served by two essential bibliographic tools (that deal with all seed plants)—*Index Kewensis* and *The Kew Record of Taxonomic Literature*. Finding references to other aspects of palms has always been a rather hit or miss business. *Principes* used to publish a bibliography of recently published palm papers, but the great resurgence of interest in palms, coupled with the need to complete *Genera Palmarum*, defeated the two editors of *Principes* (Uhl and Dransfield) and it was not until 1991 that the bibliographic feature, Palm Research, was begun again in *Principes*, compiled by Henderson and Barfod with the editors' assistance. There is clearly a need for specialized palm bibliographies. In 1986 a truly invaluable bibliography dealing with rattans was published by the Forest Research Institute Malaysia (Kong-Ong and Manokaran 1986), with references to 857 articles on rattans, and then in 1989 the same institute in collaboration with the German aid agency, GTZ, published an annotated bibliography on the utilization of palm stems and leaves with 1,182 references (Killmann et al. 1989). We now have a third bibliography to useful palms, compiled by Balick and Beck and their collaborators. This has been long in the making and a cursory scan of the articles listed will reveal that very few postdate 1985.

The compilers and their collaborators provide references to 1,039 different articles dealing with the uses of palms. These references are ordered alphabetically by author and are each provided with an abstract, a list of the genera referred to in the article, a list of products referred to, highlighted by key words and a list of subjects included in the article, again highlighted by keyword. The articles are indexed by author, by generic name and by keywords. It is thus an easy matter to find in which article there is a reference to the use of palms as shaving cream or fish poison, or similarly to find references to the uses of any particular genus. The bibliography is admirably well laid out, is beautifully printed and is a pleasure to use.

What is astonishing is how little overlap there is between Balick and Beck's bibliography dealing with all useful palms and the two more specialized bibliographies published in Malaysia. Inevitably there are important papers missing from any bibliography. Balick and Beck themselves admit that the bibliography is not complete, so I tested it to see just how incomplete it is. There is a wealth of often very obscure early papers on the uses of palms and the book represents a real treasure trove of such papers. The major absences I can find are of more recent papers. There is much in the world of rattans that has been missed, but, of course, these palms are covered by the separate bibliography referred to above. Balick and Beck's bibliography is weak on the useful palms of southeast Asia, an area, fortunately, where the Killmann et al. bibliography is particularly strong. There are some strange inconsistencies in Balick and Beck. For example, all papers in the Second International Sago Symposium proceedings are included in the bibliography, and individ-

ually referred to. The first International Sago Symposium proceedings are referred to only as one article under the authorship of the editor of those proceedings, K. Tan, not by the individual authors of the papers. It is important that the user of the bibliography should read the disclaimer on completeness and not assume that this bibliography includes most of the important palm use papers—I suggest that many are not included and the serious student of palm utilization would be well advised to purchase the two bibliographies produced in Malaysia as well.

One of the most difficult problems faced by Balick and Beck has been what to do about bringing old nomenclature in the articles sufficiently up to date that information can be retrieved, either from old names or from the names in current usage. Here the compilers have only partially succeeded and it requires some nomenclatural and taxonomic experience of the family to gain access to the references. Sometimes in the abstract the compilers have provided the correct name in brackets; occasionally they have done so in the list of genera referred to, but this is inconsistently done and the user cannot rely on it. Sometimes neighboring articles are treated differently with the first being brought up to date nomenclaturally while the second one remains as it was originally published. At the front of the book is a listing of all palm generic names and their disposition following Uhl and Dransfield (1987). Thus it would seem that one should be able to find one's way around problems of changed names. However, this is not always the case. An extreme example is provided by article 418 by W. J. Hooker, published in 1859 and titled "*Areca sapida*: southern areca or betel-nut." This is provided with the key generic name *Areca* and can only be accessed from the index with this generic name. *Areca sapida* is, of course, the nikau palm of New Zealand, now known as *Rhopalostylis sapida*, yet if one searches through the index using this latter generic name, one will not gain access to this paper. I suppose this unevenness in the abstracting represents the work of different collaborators.

Another aspect I tested was the accuracy of the abstracting. Sometimes the abstracts are excellent pithy summaries of the articles, at other times inaccuracies have crept in. For example, I checked one of my own papers—Dransfield, J. 1980. On the identity of Sika in Paliwan (sic—should be Palawan), Philippines. In the abstract I am cited as recording *Calamus caesius* for Palawan and showing that on this island "sika" refers not to *Calamus spinifolius* as so often uncritically recorded but to *C. caesius*. The abstracters go on to state that *C. caesius* is grown commercially elsewhere in the Philippines. This last statement is completely incorrect. In 1980 *Calamus caesius* was not cultivated anywhere in the Philippines, yet it so easily could have been, occurring naturally in Palawan, with a seed source waiting to be exploited by foresters. The whole point of my article was that the excellent *C. caesius*, cultivated in Malaysia and Indonesia, and for which a well understood cultivation procedure exists already, grew wild in the Philippines unrecorded. This was because of the uncritical reliance on old lists of local names and their scientific equivalents in which "sika," known to be a good cane, was listed as being *C. spinifolius*, a rare species for which no silvicultural data exists. Here the abstractor has missed the point of the paper and has recorded incorrect information. Useful though the abstracts are, the researcher is well advised to go to the original, rather than to rely on the abstract alone—and I am sure the compilers would be the first to agree on this. The abstracts are immensely useful, but they are not always reliable.

This is a beautiful production and the two compilers received the 1991 Oberly Award from the American Library Association for this work, for "bibliographic excellence in agriculture and related sci-

ences." I have one very slight reservation about the production—the production is almost too good for what by its very nature becomes so quickly out of date. The book is some 724 pages long, while Killmann et al.'s bibliography is only 157 pages long and includes references to more articles and the rattan bibliography is 109 pages with references to 857 articles. The rattan and palm stem utilization bibliographies are almost as easy to use and probably just as useful but admittedly not so nice to hold; importantly, however, they are much, much cheaper. Second editions, reprintings or second volumes all become so much easier to contemplate with the cheaper production and dissemination to institutes in the Third World is also easier.

In summary, this is a splendid and immensely useful volume for which the compilers deserve great praise; however, it needs to be used carefully and critically. This will undoubtedly become an extremely useful tool for ethnobotanists and palm scientists. I shall value my copy greatly and I have found it difficult to put down—it's so easy to wander through it, drifting from one obscure reference to the next. My enduring impression from the book is just how much of recent palm ethnobotanical information, published sometimes with fanfare, was already published long ago. Indeed, avoiding this duplication of effort in the future is one of the stated aims of the compilers.

JOHN DRANSFIELD

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UHL, N. W. AND J. DRANSFIELD. 1987. Genera Palmarum: a classification of palms based on the work of H. E. Moore, Jr. L. H. Bailey Hortorium, New York, and the International Palm Society, Kansas.

Principes, 36(2), 1992, pp. 106–110

PALM RESEARCH, 1991

COMPILED BY ANDREW HENDERSON AND ANDERS BARFOD

New York Botanical Garden, Bronx, NY 10458 and Botanical Institute, Aarhus University, Nordlandsvej 68, DK-8240 Risskov, Denmark

The extraordinary abundance and diversity of palm research continues. In general, we are excluding research on the agronomy of important cultivated species (oil palms, date palms, rattans and coconuts). Please bring to our attention any item that should be included here.

Books Published During 1991

Las Palmas de la Region de Araracuara (The Palms in the Araracuara Region). By Gloria Galeano. Estudios en la Amazonia Colombiana. Volumen 1. Tropenbos-Colombia. ISBN 95378-1-2. 1991. 180 pp. Price unknown.

A very fine contribution to our taxonomic knowledge of palms from the Colombian Amazon region. Twenty-six genera and 64 species are treated. Generic descriptions, keys, species descriptions, illustrations and notes on distribution, ecology and uses are given. An excellent work.

Palms of the World. Series 1. By Beppe Spadicini. Studio Tucano, Lungo Lario Trieste 54, 22100 COMO, Italy. 1991. 15 plates. Price unknown.

This is a magnificently produced folio of fifteen color paintings of cultivated palms.

The Subsidy from Nature. By Anthony B. Anderson, Peter H. May, and Michael J. Balick. Columbia University Press, New York. ISBN 0-231-07222-8. 1991. 233 pp. $35.00.

This book covers the natural history, management and economics of the babassu palm (*Orbignya phalerata*) in South America. Or, as the subtitle describes it, "Palm Forests, Peasantry, and Development on an Amazon Frontier." The book is very well written by the three leading experts in the subject. It is also extremely well illustrated. The photograph on the dust jacket perhaps says it all. We strongly recommend this book for anyone interested in the interactions between palms and people. This book will be reviewed more fully in a future part of *Principes*.

Pepabotonë Peliwaisi (Las Palmas). Edited by José Hernando Sánchez. Published for the Comité Guahibo de Educación Bilingüe Integral by Editorial Townsend, Apartado Aéreo 100602, Bogotá, Colombia. ISBN 958-21-0048-6. 1989. 91 pp. Price unknown.

A guide book for school children, in both Spanish and Guahibo, on the palms of Llanos Orientales in Colombia.

Diseases and Disorders of Ornamental Palms. Edited by A. R. Chase and T. K. Broschat. APS Press, 3340 Pilot Knob Road, St. Paul, MN 55121-2097. ISBN 0-89054-119-1. 1991. 64 pp. U.S. orders $27.00, non-U.S. orders $34.00.

A very useful book for growers of palms. Thirty different diseases are described (including symptomology, causal organisms, occurrences, species affected, diagnostic techniques and prevention and treatment), and each is illustrated by a color photograph; similarly with 27 physiological disorders. The illustration of *Syagrus romanzoffiana* on page 37 is actually a coconut.

General Interest Articles Published in 1991

(and a few we missed from 1990)

BALINT, D. 1991. The genus *Pinanga*: the remarkable palms of Sarawak. Palms & Cycads 30: 2–9.

BALSLEV, H. AND U. BLICHER-MATHIESEN. 1991. La Palma Real de la costa ecuatoriana (*Attalea colenda*, Arecaceae)—un recurso poco conocido de aceite vegetal. *In:* M. Ríos and H. Borgtoft Pedersen (eds.). Las plantas y el hombre. Ediciones ABYA-YALA, Quito, Ecuador, pp. 47–62.

BARFOD, A. S. 1991. Usos pasados, presentes y futuros de las palmas Phytelephantoiées (Arecaceae). *In:* M. Rios and H. Borgtoft Pedersen (eds.). Las plantas y el hombre. Ediciones ABYA-YALA, Quito, Ecuador, pp. 23–46.

BLICHER-MATHIESEN, U. AND H. BALSLEV. 1990. *Attalea colenda* (Arecaceae), a potential lauric oil resource. Econ. Bot. 44: 360–368.

BORGTOFT PEDERSON, H. 1991. Management, extractivism and commercial use of wild palms in Ecuador. *In:* M. Ríos and H. Borgtoft Pedersen (eds.). Las plantas y el hombre. Ediciones ABYA-YALA, Quito, Ecuador, pp. 13–22.

BRACHO, R. AND J. JOSE. 1990. Energy fluxes in a Morichal (swamp palm community) at the Orinoco Llanos, Venezuela—microclimate, water vapour and CO_2 exchange. Photosynthetica 24: 468–494.

CEJKA, G. 1990. Palma nikau, endemit Noveho Zelandu. Ziva 38(6): 254.

CHAVEZ, F., H. NODA, AND C. CLEMENT. 1990. Genetic/phenotypic studies on spines in pejibaye (*Bactris gasipaes* HBK, Palmae). Rev. Brasil. Genet. 13: 305–312.

CHAZDON, R. 1991. Plant size and form in the understory palm genus *Geonoma*: are species variations on a theme? Amer. J. Bot. 78: 680–694.

CLEMENT, C. 1990. Pejibaye. *In:* S. Nagy, P. Shaw, and W. Wardowski (eds.). Fruits of tropical and subtropical origin: composition, properties, uses. Florida Science Source, Lake Alfred, Florida, pp. 302–321.

COWAN, P. 1991. Effects of introduced Australian brushtail possums (*Trichosurus vulpecula*) on the fruiting of the endemic New Zealand Nikau palm (*Rhopalostylis sapida*). New Zealand J. Bot. 29: 91–93.

DENSLOW, J., E. NEWELL, AND A. ELLISON. 1991. The effect of understory palms and cyclanths on the growth and survival of *Inga* seedlings. Biotropica 23: 225–234.

GHOSE, M. AND B. JOHRI. 1990. Anatomy of the stems of seedling palms. Proc. Indian Acad. Sci., Plant Sciences 100: 215–223.

KAHN, F. 1991. Palms as key swamp forest resources in Amazonia. Forest Ecology and Management 38: 133–142.

——— AND J.-J. DE GRANVILLE. 1991. Los nombres más comunes de las Palmeras de la Amazonía. Nota inicial. Biota (Revista de Ciencias Biológicas) 15(97): 17–32.

KUBITSKI, K. 1991. Dispersal and distribution in *Leopoldinia* (Palmae). Nordic J. Bot. 11: 429–432.

LOTT, R. AND S. MCINTYRE. 1991. Seed predation and dispersal in a tropical palm *Normanbya normanbyi* (W. Hill) L. H. Bailey. Palms & Cycads 32: 6–16.

MEEROW, A. AND T. BROSCHAT. 1991. Anatomical aspects of K, Mn and Fe deficiencies in Queen palm. Hortscience 26: 581–583.

MIRANDA, I. AND C. CLEMENT. 1990. Germinación y almacenamiento del polen de pejibaye (*Bactris gasipaes* HBK, Palmae). Rev. Biol. Trop. 38: 29–33.

MOGEA, J., B. SEIBERT, AND W. SMITS. 1991. Multipurpose palms—the Sugar Palm (*Arenga pinnata* (Wurmb.) Merr.). Agroforestry Systems 13: 111–129.

MORRIS, D. 1991. The Hunter Region Botanic Garden's palm collection. Palms & Cycads 32: 2–6.

OYAMA, K. 1990. Variation in growth and reproduction in the neotropical dioecious palm *Chamaedorea tepejilote*. J. Ecol. 78: 648–663.

PHILLIPS, R. 1991. Another new palm in Fiji. Palms & Cycads 30: 16–17.

PÜTZ, F. 1990. Growth habits and trellis requirements of climbing palms (*Calamus* spp.) in northeastern Queensland. Australian J. Bot. 38: 603–608.

RAO, P. S. N. AND S. K. SRIVASTAVA. 1990. Wild population of *Calamus* L. in Bay Islands, India. Ethnobotany 2(1–2): 87–90.

SCARIOT, A., E. LLERAS, AND J. HAY. 1991. Reproductive biology of the palm *Acrocomia aculeata* in Central Brazil. Biotropica 23: 12–22.

SORIA, J. 1991. El chontaduro (*Bactris gasipaes* HBK, Arecaceae), especie promisoria de usos múltiples. *In:* M. Ríos and H. Borgtoft Pedersen (eds.). Las plantas y el hombre. Ediciones ABYA-YALA, Quito, Ecuador, pp. 313–321.

SYLVESTRE, L. S., C. O. LEITE, AND L. TRIANI. 1989. Estudo do desenvolvimento do fruto de *Allagoptera arenaria* (Gomes) O. Kuntze. Acta Bot. Brasil. 2(1) (Suppl.): 183–192.

THOMAS, V. AND Y. DAVE. 1990. Branched stem in *Cocos nucifera* L.—a rare occurrence in palms. J. Econ. Tax. Bot. 13(1): 195–197.

TUCKER, R. 1991. Notes on *Bismarckia nobilis*. Palms & Cycads 30: 10–11.

ZIZKA, G. 1991. Die Chonta-Palme (*Juania australis*) der Juan Fernandez Inseln (Chile). Palmengarten 55: 21–24.

A new palm journal, *Mooreana, Journal of the Palmetum*, was launched in 1991. It is published from the Townsville Palmetum in Queensland, Australia, and is dedicated to palm botany, ecology and conservation. The journal is named in honor of the late Harold E. Moore, Jr. Subscriptions are available from *Mooreana*, P.O. Box 1268, Townsville, Queensland 4810, Australia.

Taxonomic Papers Published in 1991

BARFOD, A. 1991. Disposal of *Phytelephas macrocarpa* and *P. microcarpa* (Arecaceae). Taxon 40: 103–110.

BERNAL, G., G. GALEANO, AND A. HENDERSON. 1991. Notes on the genus *Oenocarpus* (Palmae) in the Colombian Amazon. Brittonia 43: 154–164.

BOUDET FERNANDES, H. 1991. Uma nova espécie de *Euterpe* (Palmae-Arecoideae-Areceae) do Brasil. Acta Bot. Bras. 3: 43–49.

DRANSFIELD, J. 1990. *Pinanga yassinii* (Palmae: Arecoideae: Areceae) a beautiful Bornean palm new to science. Brunei Forest Department Occasional Papers. No 2: 1–10.

———. 1991. *Lemurophoenix* (Palmae: Arecoideae), a new genus from Madagascar. Kew Bull. 46: 61–68.

———. 1991. Notes on *Pinanga* (Palmae) in Sarawak. Kew Bull. 46: 691–698.

———. 1991. 123. *Paschalococos disperta* J. Dransf., gen et sp. nov. *In:* G. Zizka (ed.). Flowering plants of Easter Island. Scientific Research Reports no. 3, Palmengarten, Frankfurt, pp. 64–65.

———, I. FERGUSON, AND N. UHL. 1990. The coryphoid palms; patterns of variation and evolution. Ann. Missouri Bot. Gard. 77: 802–815.

HENDERSON, A. AND M. BALICK. 1991. *Attalea crassispatha*, a rare and endemic Haitian palm. Brittonia 43: 189–194.

HENDERSON, A., G. GALEANO, AND E. MEZA. 1991. A new species of *Euterpe* (Palmae) from Peru. Brittonia 43: 178–180.

LAKSHMANA, A. AND C. RENUKA. 1990. New species of *Calamus* (Arecaceae) from India. J. Econ. Taxon. Bot. 14: 705–709.

LAPIS, A. B. 1989. An account of taxa related to *Calamus siphonospathus* complex. Sylvatrop 12(1–2): 61–85.

MUKUNTHAKUMAR, S. AND K. VIJAYAN. 1990. A new record of *Calamus brandisii* Becc. (Arecaceae) from Kerala forest. J. Econ. Taxon Bot. 14: 192–194.

SANDERS, R. In press. Cladistics of *Bactris* (Palmae): refutation of Burret's classification. Selbyana.

WILLIAMS, R. 1991. *Jubaeopsis caffra*; Transkei; Arecaceae (Palmae). Flow. Pl. Afr. 51(20): Pl. 2023 (5p.).

Scientific Meetings in 1991

An international symposium on palms was held in Iquitos, Peru, from 18–24 September 1991. "Palms in Tropical Forests" was organized by Dr. Francis Kahn of ORSTOM, Peru, and was attended by scientists from many countries. More than 25 papers were presented during the meeting, on topics including systematics, floristics, demography and population structure, databases, phenology, pollination, management and economic uses. The meeting was followed by a field trip to Jenaro Herrera, a research station on the Río Ucayali.

Current Research

Dr. Michael Balick (Institute of Economic Botany, New York Botanical Garden, Bronx, NY 10458) is working on a palm flora of Belize, Central America, which will include notes on common names, uses and conservation status. This is an offshoot of a larger project on the flora of Belize, in conjunction with Alfredo Beloz, Rosita Arvigo and Gregory Shropshire. Dr. Balick is also working with Dr. Stephen Dellaporta of Yale University on a molecular biology project concerning the systematics of the Attaleinae.

Dr. Anders S. Barfod (Botanical Institute, Aarhus University, Nordlandsvej 68, DK-8240 Risskov, Denmark) has started morphological studies of palm stigmas. The project is aimed at a better understanding of the interactions occurring between pollen grains, pollinators and the receptive surface of stigmas.

Dr. Charles Clement (Department of Horticulture, University of Hawaii at Manoa, 3190 Maile Way, Honolulu, HI 96822) is carrying out research on *Bactris*

gasipaes in Hawaii. Two projects are examining the potential for palm heart production in Hawaii, and weed control in palm plantations.

Dr. Jean-Jacques de Granville (Centre ORSTOM de Cayenne, B. P. 165, 97323 Cayenne Cedex, France) and Dr. Andrew Henderson (New York Botanical Garden, Bronx, NY 10458) are initiating systematic studies of *Bactris*, with a view to the eventual publication of the genus in *Flora Neotropica*.

Dr. Larry Noblick (Fairchild Tropical Garden Research Center, 11935 Old Cutler Road, Miami, FL 33156) is working on a cladistic analysis of the genus *Syagrus*, to help clarify its evolution and relationships. His study includes some species from other genera of the Butiinae (*Butia*, *Jubaea*, *Jubaeopsis*, *Lytocaryum*, *Parajubaea*, *Allagoptera*, *Polyandrococos*, and *Voanioala*) and a few representatives from the rest of the Coceae (*Beccariophoenix*, *Attalea*, *Scheelea*, *Orbignya*, *Elaeis*, *Gastrococos*, and *Aiphanes*).

A team of researchers led by Dr. Francis Putz and Kimberlyn Williams (Dept. of Botany, University of Florida, Gainesville, FL 32611-2009) is investigating the cause(s) and ecological repercussions of widespread die-off of *Sabal palmetto* along Florida's Gulf Coast. A multi-disciplinary investigation of the cause of mortality, consequences for the plant and animal communities, and long-term population ecology of *S. palmetto* is currently underway.

Additions to the Palm Research List

DENNIS V. JOHNSON

605 Ray Drive, Silver Spring, MD 20910

Coconut as Food. By Julian A. Banzon et al. Philippine Coconut Research and Development Foundation, Inc., Diliman, Quezon City, Philippines. 1990. 239 pp. $30.00.

Excellent discussions on all types of foods and beverages derived from the coconut palm, including prepared foods, are presented in this book. There is a strong focus on the Philippines, where maximum diversity of use occurs. The book is a fine source of technical data.

Coconut Cultivation. By R. Mahindapala and J. L. J. G. Pinto. Coconut Research Institute of Sri Lanka, Lunuwila. ISBN 955-9013-00-9. 1991. 162 pp. $20.00.

This book is a handsomely-illustrated manual for coconut growers, centered on conditions in Sri Lanka. All standard subjects on coconut cultivation are treated as well as intercropping and animal husbandry.

Coconut Production: Present Status and Priorities for Research. Edited by Alan H. Green. Technical Paper No. 136, The World Bank, Washington, D.C. ISSN 0253-7494. 1991. 150 pp. $10.95.

A team of specialists presents concise overviews and identifies research needs in coconut breeding, agronomy, diseases, pests, and coconut timber. The book is written for individuals involved in coconut development to document technical constraints and how they may be overcome.

Growing Oil Palms: An Illustrated Guide. By C. J. Piggott. The Incorporated Society of Planters, Kuala Lumpur, Malaysia. 1990. 152 pp. $65.00.

The author has written a fine introduction to the various aspects of modern African oil palm cultivation, and richly illustrated it with 275 of his own color photographs.

Le Palmier a Huile (*Elaeis guineensis*) Jacq.: Bibliographie Analytique Volume 3. Compiled by A. B.

Ergo. Musée Royal de l'Afrique Centrale, Tervuren, Belgium. 1990. 166 pp. Price unknown.

The third volume of this model bibliography brings to 3,519 the number of references analyzed on the African oil palm. A main entry list by author is followed by geographic and detailed subject indexes covering botany; cultivation; origin, development and history; diseases and insect pests; and oil processing.

Principes, 36(2), 1992, pp. 110–119

CHAPTER NEWS AND EVENTS

News from the Pacific Northwest Chapter

Twenty-five members attended the November 25, 1991, Annual General Meeting. Nick Parker was unanimously named chapter President. Nick has served (and will continue) as Editor of the group's *Hardy Palm—International Newsletter*, which has grown to over 100 circulation with subscribers from England, Northern Ireland, Spain, Germany, Sweden, and Australia, as well as from North America. Contributors in the February 1992 issue were from British Columbia, Tennessee, and Germany.

The Pacific Northwest Chapter has approved the expenditure of $500 CDN for palms to present to the Pacific National Exhibition (PNE) as well as similar funds for a palm planting at Peace Arch Park at the U.S.A./Canada border. The group will again actively participate in the PNE to be held August 22 to September 6, 1992, in Vancouver. Plan to attend if you are in the area.

The first general meeting of 1992 was held at VanDusen Gardens on February 24. Mel Frank presented a slide show on his 1991 trip up along the U.S. west coast, including a visit to the Palmetum in Oakland. The May 19th meeting will feature sales of bananas (including the hardy *Musa basjoo*) as well as other exotics. Agendas for the August 24th and November 23rd meetings will follow later, as will details for the 1992 summer BBQ and a summer palm tour, probably to the Seattle area.

News from Southern California

The 16th Annual Southern California Palm Society Banquet was held on January 18th in the Terrace Room of the Hyatt Newporter in Newport Beach from 11 A.M. to 5 P.M. Members and guests had an opportunity to view the Newporter's palm collection, which includes one of the largest specimens of *Jubaeopsis caffra* in California. Guest speakers were Pauleen Sullivan and Don Tollefson, who recounted their recent palm trip to Colombia. There were special presentations, door prizes, palm raffle and auction.

On March 14th, the chapter met at the Los Angeles State and County Arboretum in Arcadia at 12:30 P.M. After a short business meeting, the group enjoyed the arboretum grounds. A special tour of the nursery area was arranged as well as the purchase of potted palms from the Arboretum's collection.

The Southern California Chapter also announced two new Patrons of the Chapter. Bo-Göran Lundkvist from Poway and Steve Snyder of Seal Beach joined the group's initial two patrons, Phil Keeler and Pauleen Sullivan. This level of support is much appreciated.

Joe Salazar from Whittier, (213)-943-9829, is the new Expansion Committee

Director and is soliciting volunteers from various localities to assist in Chapter membership expansion. Feel free to call if you would like to help.

5331 and 5341 Golden Gate Avenue, Oakland, California, October 20, 1991

On Sunday, October 20, 1991, a catastrophic fire destroyed over 3,000 homes in the Berkeley and Oakland hills overlooking the San Francisco Bay. The fire was the most destructive urban disaster in America since the great San Francisco fire of 1906. Lost in the fire were two of the best known and oldest palm gardens in Northern California. The properties lost belonged to Charles Cornell (the late Warren Dolby's home—the founder of the Palm Society in Northern California) and John Cressey and Greg Haines. The beautiful homes were in the Spanish style, constructed in the 1920's, and surrounded by lovely subtropical gardens. They were completely destroyed in just a few minutes in the early afternoon of that fateful Sunday. The owners escaped with the clothes on their backs and their pets. They lost everything else.

For many of us in The Palm Society the losses were very personal. Although we did not suffer the financial losses of the owners, all of us lost two gardens that had become very special over the years. The gardens on Golden Gate Avenue were the focal point of the Palm Society's activities for many years. There we held local chapter meetings, an IPS biennial meeting and many chapter board meetings. I will always remember the Sunday morning meetings Warren Dolby hosted when he served his last term as president in the mid 1980's. We would meet in the glass-enclosed patio that looked out onto the terraced garden below and discuss chapter business over Warren's excellent coffee and assorted pastries. Or, if the meetings were in the afternoon, we would gather on the lower patio beneath the old California pepper tree, surrounded by palms and subtropical plants, and enjoy Warren's fine cuisine. Just a few feet away were the largest *Caryota*, *Parajubaea* and *Rhopalostylis* in Northern California.

On many other occasions, Greg and John opened their home next door to the Palm Society for board meetings and social gatherings. The last chapter meeting held at 5441 Golden Gate was on June 4, 1989. It was John and Greg's tenth anniversary "Down among the Sheltering Palms" party, complete with mariachi band. The last two Christmas seasons saw large gatherings at John and Greg's home for holiday season kickoff parties and chapter board meetings. We usually held our business meetings in the lower music room, a beautiful Mediterranean style room that looked out onto the lower patio and garden through arched glass doors. The room contained several large potted *Ptychosperma elegans*, assorted *Chamaedorea*, and even a coconut palm. We would gather around the large Spanish coffee table and sample Greg's excellent Bombay gin martinis, always served straight up—never over ice (John and Greg maintain the old standards) and discuss the chapter's future activities.

Now the gardens are gone, the homes are gone, the entire neighborhood is gone. The memories remain, but they are of little consolation to those who lost everything. The homes will be rebuilt eventually; the gardens will be replanted, but it will never be the same. To John, Greg, and Charles: please accept our condolences. We all share in your losses, but unequally. We lost a place to share good times, you lost your homes, gardens, and a lifetime of possessions.

DAN SEKELLA

1991 Activities in Northern California

Northern California has struggled through its fifth year of drought, there was a major earthquake two years ago, a dev-

astating Arctic freeze in the 1990/1991 winter, and a catastrophic fire destroyed much of the Berkeley/Oakland hills last October. Persevering, the Palm Society in Northern California held a full schedule of activities in 1991, despite nature's calamities.

The chapter's first garden meeting of 1991 was held on May 12 at the Marin County garden of Tom Jackson and Kathleen Grant. Their garden had suffered major damage from the previous winter's freeze. Parts of coastal Marin County recorded the lowest temperatures in the Bay Area, with minimums into the low teens Fahrenheit (about −10° C). Tom and Kathy lost 23 *Syagrus romanzoffiana*. After socializing and palm viewing, the palm auction raised over $200 for the chapter treasury.

On Friday, June 28, 20 Northern California Palm Society members journeyed to visit the Virginia Robinson Garden in Beverly Hills. The six acre garden is located just a short walk up (to Elden Way) from the famous Beverly Hills Hotel. The Robinsons moved to Beverly Hills in 1908 and built the original Mediterranean classic revival house in 1911. In 1924 a Roman pavilion-style house was added to accommodate Mrs. Robinson's stream of house guests. Hundreds of *Archontophoenix cunninghamiana* were planted in the informal area of the garden, providing today a 2.5 acre subtropical jungle of naturally reseeding palms reminiscent of the coastal ravines of tropical Queensland.

After Mrs. Robinson's death in 1977, the gardens and houses became part of the Los Angeles Arboretum system, funded through a combination of Mrs. Robinson's original endowment and a Beverly Hills support group. The estate was opened to the public on a very limited basis in 1982, with visitation by reservation only. Parking restrictions are strictly enforced. The hosts and guides for the Northern California group tour were Mr. John Copeland and Mr. Don Hodel. The arrangements were handled from Northern California by Dr. John Cressey. After the Robinson Gardens tour, the members dispersed in various groups to visit Huntington Gardens, the UCLA arboretum, and other botanical locations.

The last meeting of the year was held on November 9 at the Lakeside Garden center in Oakland to view the Lakeside Palmetum. A final palm auction netted $243 for the chapter. There was major damage suffered from the 1990 winter freeze, when temperatures reached the mid-twenties F (−3 to −4° C). All three *Howea* and some *Chamaedorea* did not make it, however most palms are recovering nicely.

South African Announcements

The South African Palm Society (S.A.P.S.) would like to advise a change in administration address. As of January, 1992, please use Ashlyn Fox, P.O. Box 8147, Nahoon 5241, Republic of South Africa (as listed in your IPS Roster) for all inquiries or information concerning S.A.P.S. membership or administrative matters.

On the afternoon of February 29, Pretoria members attended a "Leap Year Brazilian Evening Churrascaria" at Grass Roots Nursery to view slides of the Brazilian S.A.P.S. Seed Bank Expedition. The four week seed collection expedition by five S.A.P.S. members focused on *Syagrus*, obtaining seeds of sixteen species, albeit some in minute quantities. Quite a few other genera were also collected from the states of Minas Gerais, Bahia, and Espiritu Santo, including *Allagoptera*, *Astrocaryum*, *Desmoncus*, *Bactris*, and others.

The South African Palm Society's Annual General Meeting was held on March 28–29, 1992, at the Zinkwazi Holiday Resort, Zinkwazi Beach, Natal Northcoast. The tropical ambiance of Zinkwazi with its collection of palms has been augmented by donations by various S.A.P.S. members attending the 1988 meeting there. They have progressed marvelously.

Louisiana Chapter and Gulf Coast Chapter Meetings

A large group from four states attended the Fall 1991 meeting held on October 20 at Maxwell Stewart's estate in Mobile, Alabama. The Stewart's summer house was partly converted into an auditorium. Dr. Merrill Wilcox gave out a number of seedlings of the hybrid *Jubaea* × *Butia* following his narrated slide show on the subject "Practical Methods for Hybridization in the *Syagrus* Alliance." (An article of the same name has been printed both in the October 1991 issue of the *Central Florida Palm Bulletin* and the January 1992 issue of *Et ceteras*, the Louisiana Chapter newsletter.) The meeting ended with a palm auction and distribution of seedlings.

The first meeting in 1992 of the Louisiana Chapter took place on Sunday, February 9, 1992, at the Executive Conference Room of the Audubon Institute on zoo grounds in Audubon Park, New Orleans. A slide presentation was narrated by Severn Doughty. Thanks to member Stephen Trans Asprodites, Director of Horticulture of the Audubon Institute, for arranging the splendid meeting site.

Fous de Palmiers (France)

The French Chapter of the IPS, Fous de Palmiers, now 250 strong and growing, was quite active in 1991. The group started a successful year with the exhibition "Hyères et ses Palmiers" at l'Hospital San Salvadour at Carqueiranne. The event was a great success with over 3,000 visitors. The exhibition coincided with the society publication of "L'Histoire des Palmiers" by Alain Durnerin.

On March 23, the group visited the Museum of Natural History in Chèvreloup, where the group saw palms of various types, notably various *Chamaedorea* species, *Elaeis guineensis*, *Gaussia maya*, *Hyophorbe verschaffeltii*, a beautiful *Cocos nucifera*, and many others. On this occasion, Alain Moiniè offered four palms to the museum: two *Ptychosperma* sp. "bubuva" from the Solomon Islands and two *Arenga undulatifolia* from Borneo. Afterward, the group visited the gardens of the "Jardins de Gally" society, courtesy of director Xavier Laureau, where magnificent specimens of rare palms were viewed including *Bismarckia nobilis*, *Caryota rumphiana*, *Ravenea rivularis*, *Coccothrinax* sp., *Chamaedorea* sp., *Syagrus schizophylla*, *Neodypsis decaryi* and *Ptychosperma* sp.

On April 13, 1991, 25 members and guests visited the Villa Thuret at Cap d'Antibes. Villa Thuret features more than 30 species of palms, graced by a privileged microclimate and one of the more interesting botanical sites on the Côte d'Azure. Of particular interest were adult *Nannorhops ritchiana*, including one in flower. Afterwards, the group picnicked in sunshine at Cap d'Antibes lighthouse with a magnificent view.

The grand occasion of the year was "Palm Day" at the Royal Botanical Gardens of Kew, England, on July 20, 1991. This was hosted by Dr. John Dransfield, palm taxonomist at Kew (and editor of *Principes*) and Mr. David Cooke, Director of the Palm House. There were about 80 participants from the U.K. and elsewhere in western Europe, including about 20 from Fous de Palmiers. After presentation of the program by Dr. Dransfield, Ms. Sue Minter discussed the history of the Palm House and Mr. David Cooke described the replanting of the palms after the recent renovation. The Palm House now contains more than 167 species, including some 18 species of *Chamaedorea*, a very beautiful collection of *Coccothrinax*, *Cyrtostachys renda*, *Bactris gasipaes*, different *Dypsis* sp., *Johannesteijsmannia altifrons*, 7 species of *Ptychosperma*, *Orbignya phalerata* with immense leaves, *Ravenea moorei*, *Schippia concolor*, *Prestoea montana*, *Verschaffeltia splendida* . . . impossible to list all of the rare and spectacular palms available. After the visit to

Kew, the group enjoyed an excellent lunch organized by the European Palm Society. Afterward, Dr. Dransfield spoke with humor of his favorite palms—for which he often goes deep into the jungles of the world. This presentation was accompanied by excellent photographs. A young plant of the rare *Parajubaea coccoides* was given away. The group then split into two groups, one to view the collection of palms in the Kew "Temperate House" and the other to visit the private "Palm Centre" of Martin Gibbons where members were able to obtain specimens of interesting palms, including *Rhapidophyllum hystrix*.

Kew has assembled more than 400 species of palms in 140 genera. Over 400 gardeners and 100 scientific personnel, coupled with exceptional support, provide the public with the possibility of admiring all sorts of plants in this august 250 year old establishment of great beauty.

Over 30 members of Fous de Palmiers visited the Bambouseraie d'Anduze on September 14, 1991. Members took a simple stroll through the bamboo giants. The naturally occurring *Trachycarpus fortunei* were quite visible within the forests of bamboo. The ambient humidity and the cover of the immense bamboo permitted the *Trachycarpus* to attain great heights and to produce round leaves of a beautiful deep green.

The Annual General Assembly was held on October 5, 1991, at the Mairie de Giens in Presqu'île, where the Administrative Council of 12 members was elected for a two-year term. The financial report indicated a gain of FF15,508.28 during 1990 against total receipts of FF50,955.54. After the serious affairs were concluded, an alfresco lunch was hosted by Mr. and Mrs. Marc Bouisson in the very nice garden of Carqueiranne overlooking the Mediterranean. Afterwards, a palm sale was held with a good collection of rare seed and plants brought by members for sale and exchange as well as all sorts of items, including a selection of *Butia* wines and a delicious fruit pâte and objects of palm design. Ceramic "badges" by the official sculptor, Marie-Christine Meyer, were presented. Small enamel badges (or "pins" pronounced "peanz") are a positive epidemic in France this year. One member has a collection of 138 "palm pins" and they are hotly sought after by palm fanatics of all ages.

The October event also marked release of the new book from Alain Moiniè, *Palmiers pour les Climats Tempérés*, covering descriptions and culture of 57 species with 175 illustrations, published by Editions Champflour. This was the first book on palms in French since 1929 and should do much to provide basic information for the growing number of palm enthusiasts in the French-speaking countries.

Plans for 1992 tentatively include a visit to the botanical garden of Cèdres and a trip to the IPS Biennial in South Florida in November, with visits to Fairchild Gardens and a post biennial trip to Costa Rica. Plans are also underway with Dr. Dransfield for a Palm Day to be held in France in 1993, with volunteers solicited.

Steve Swinscoe, an American living in France, has volunteered for the responsibility of IPS Chapter Correspondent for Fous de Palmiers. His mailing address is given in IPS Roster.

[Any errors in fact above are to be attributed to inadequate translation by Jim Cain while adding to the comments of Digby Neave, Association Secretary, and not to the original accounts in French in *Le Palmier*.]

Central Florida Chapter News

The Central Florida Chapter has announced Alan Fletcher Ingalls of Satellite Beach (see IPS Roster) as the new Editor of the chapter newsletter, taking over from Stacey Peacock, who has served the chapter tirelessly in this capacity over

the last three years. The IPS Chapter Committee extends heartfelt appreciation for Stacey's efforts in enhancing inter-chapter communications over the past several years.

The chapter met on Saturday and Sunday, November 16–17, 1991, in the St. Petersburg/Tampa area, co-hosted by Sunken Gardens and Dr. Gary Litman of St. Petersburg and Roy Works and Dr. and Mrs. U. A. Young of Tampa. The meeting featured several of the Tampa Bay area's best palm and cycad collections. Palms viewed included *Hyophorbe, Bismarckia, Carpentaria, Latania, Wodyetia, Verschaffeltia, Trithrinax, Borassus, Hyphaene, Brahea, Reinhardtia, Chamaedorea, Copernicia, Butia* × *Syagrus, Washingtonia* and many other palms, cycads, and tropical plants. The itinerary spent Saturday in St. Petersburg, opening in the morning with a tour of the Sunken Gardens, followed by a visit to the Litman collection at 12:30 P.M. The Litman home is located on Riviera Bay in northeast St. Petersburg in the Caya Costa development. The shallow bay, mature stand of mangrove, and proximity of adjacent houses creates a unique microclimate for some of the more sensitive species. The Litmans also have a heated greenhouse for sensitive tropicals and seedlings. Approximately 50 species of palm are in the ground with another 100 species or so in containers. Dr. Litman provided a plant sale after the garden tour that afternoon, with 20 percent of proceeds donated to the chapter. Sunday, the group visited the Tampa gardens, viewing Roy Works' collection at 4610 Central in the morning and Dr. and Mrs. U. A. Young's home and gardens at 505 Royal Palm Way starting around noon. A members' plant sale was held following the garden tour.

A spring sale will be held at USF/Tampa, with Ted Langley of Lutz serving as organizer of this event. Contact Ted (per IPS Roster) for more information.

South Florida 1991 Fall Palm Show and Sale Sets the Stage for 1992 Biennial Show and Sale

Biennial visitors to Florida next November are encouraged to plan to attend the excellent Palm Show and Sale which the South Florida Chapter is planning. It should be an unbelievable display, worth enjoying by any and all palm enthusiasts! To get a better idea of what to expect, here's a recap of the Fall 1991 events.

The South Florida Chapter of the IPS held their 13th "modern" Fall Show and Sale on November 2–3, 1991, with excellent results. A record number of over 3,900 plants were grabbed up by palm enthusiasts, with over 400 species offered by 56 growers. All available space was utilized. Long time observers of the annual event agreed that more well-grown species of palms were available than ever before. The average price per plant was $15.84, lower than that of the year before. The theme was "Palms of Australia and Lord Howe Island." Numerous exceptional palms were entered into the education/show display in the Montgomery Auditorium. Containerized specimens of *Wodyetia bifurcata* scraped the high ceiling of the expansive room to create a palmetum atmosphere. Awards were given for categories of Australian/Lord Howe Island Palm, Rare and Difficult-to-Grow Palm, Indoor/Patio Palm, Field Grown Palm, Open Category, and *Chamaedorea.* The award for "Best of Show" went to Bill Shannon for his hybrid *Chamaedorea stolonifera* × *ernesti-augusti.*

Special thanks to Sale Chairman De Hull, Education Chairman Bill Theobald and the host of nongrower volunteers who help make this event a success year after year.

The theme for 1992 is "Palms of Mexico and Central America." The Spring Sale in Broward County will be held May 2–3 at Flamingo Gardens in Davie. The Fall Show and Sale will be held November 7–8, the weekend before the 1992 IPS Bien-

nial Meeting. The Chapter invites IPS members to offer their services for any of the numerous volunteer assignments needed to ensure smooth functioning of these events. Call Leonard Goldstein at (305)-539-7142 (work) or 667-4609 (home) and/or Bill Theobald at (305)-252-4416 (work) or 251-0246 (home).

Proposed categories for judging at the 1992 Palm Show Awards are: Best of Show, Mexico and Central American Palms, Florida Native Palms, Indoor/Patio Palm Display, Field Grown Palms, *Chamaedorea*, and Rare and/or Difficult-to-Grow Palm.

News from South Florida

The South Florida chapter was scheduled to hear Dr. Barry Tomlinson present the "Artistic Architecture of Palms" on December 18, 1991, but his Pan American flight never took place. As a result, his presentation has been rescheduled for June 17 at 7:30 P.M. in the Corbin Building of Fairchild Tropical Garden.

A field trip was held to Castella Hammock, 22301 SW 162 Avenue on January 25. The group met at 10:00 A.M. for a tour of a native hammock and exhibit. Lunch was sponsored by Palm Aire Landscape at the Pavilion, which was followed by a tour of Palm Aire Landscape Nursery and private collection, at 22845 SW 162 Avenue. On February 19, the chapter met to hear "Coconut Palms Around the World" by Dave Romney. On March 28, a field trip was held to De Hull's garden and nursery. This was an excellent opportunity to see many rare and difficult to grow palms. On April 11–12, the chapter put on an exhibit of palm flowers and ripe seeds at the Metropolitan Miami Flower Show at the Deering Estate. This was quite an interesting display!

Additional 1992 meetings are scheduled at Fairchild (7:30 P.M.) on August 19 and October 21. On September 19–20, a field trip is planned to Naples, Ft. Myers, and Tampa. Mark your calendars and contact local chapter officers now if you are interested in attending.

The first 1992 Chapter Board Meeting was held on January 23, electing new officers and focusing on preparation for the upcoming November 1992 IPS Biennial which the South Florida Chapter will host. The new officers are President Bill Theobald, Vice President Ken Johnson, Treasurer Cris Olano, Recording Secretary Lenny Goldstein and Corresponding Secretary Teddie Buhler. Lester Pancoast continues as the Biennial Committee Chair.

The chapter has approved an expenditure of $2,500 for permanent labels to label all of the palms at "The Retreat" for the Bahamas National Trust. Other community service projects include the chapter's continuing major focus at the Dade-Metro Zoo, with two scheduled workdays per month. The palm plantings at the Zoo will be a major activity of the Biennial as will be USDA's Chapman Field palm collection, which is also getting help from scheduled chapter workdays. Community Service activities at local schools are also being expanded in 1992. Donations of suitable native Florida palms are also solicited.

Palm Beach (Florida) Chapter

The Palm Beach Palm and Cycad Society has completed all necessary requirements for affiliation with the International Palm Society. The IPS welcomes this newest active group as an IPS chapter.

At the general meeting on January 8, 1992, David Romney, well-known coconut agronomist spoke on "Coconuts around the World." On February 5th, Libby Besse from Selby Botanical Gardens in Sarasota spoke on "*Encephalartos* in the Florida Garden." The group held a workday at the Norton Sculpture Garden in Palm Beach County on February 29, also inviting volunteers from the nearby South Florida Chapter. On March 4, Bill Theobald from the Division of Forestry spoke on the coconut hybridization program in progress at Chapman Field. On April 1, Carol Lippincot, Curator of Endangered Species at Fairchild Tropical Gardens, spoke on "Protecting Endangered Palms in Florida

and the Caribbean." The group's annual sale was held April 11–12.

Additional events planned for 1992 include: "Palms in Madagascar" by Nancy Edmondson, Sarasota County Extension Agent, on May 6; and "New Palms for Florida Landscapes" by Murray Corman of Garden of Delights on June 6. All meetings, unless otherwise noted, are held at the Mounts Botanical Gardens, 531 Military Trail, West Palm Beach, Florida.

Sunshine Coast (PACSOA)

The Society closed out 1991 with a very successful and enjoyable Christmas party BBQ at Russell and Ginny Lunn's place at Yandina. The meat was tenderly cooked to perfection, the beers icy cold, the wine mellow and the weather divine.

The 1992 Annual General Meeting was held on February 3. Society business was conducted and leadership and direction of the Society for the coming year decided. Meetings slated for 1992 should include presentations by both Stan Walkley and Rolf Kyburz. Also Mike Kvauka visited the Sydney Palm and Cycad Society's President's garden in January and had an interesting account to share with the group. Note that meetings are held on the 1st Monday of every month at the Nambour Band Hall, Daniel Street (off Arundell Avenue), Nambour, Queensland, commencing at 7:30 P.M.

Mackay (PACSOA) Activities

The Mackay Palm and Cycad Society (PACSOM) of PACSOA held an excursion to the Blackdown Tablelands on the weekend of October 12–13, 1991. Thirteen members made the excursion, with most traveling to Dingo on Friday afternoon. The Dingo Hotel/Motel was a good choice for base camp, being not too distant from the National Park. All had a happy and active time at the special sites and admired the *Livistona* sp. "Blackdown" and *Macrozamia platyrachis*. The tour organization was spot on and everyone was pampered with care and nourishment. With no Blackdown souvenirs apart from photographs, the group went to the Publican's garden and the local nursery for something different.

The Society met at 2:00 P.M. on November 24 at the home of Gary Marsh, attended by 17 members and 5 visitors. First time fruiting of *Neodypsis decaryi* in the garden of Percy Simonsen and *Normanbya normanbya* in the garden of Margaret Brown were noted. A triple-header seedling of *Verschaffeltia splendida* and a double-headed seedling of *Wodyetia bifurcata* were displayed by Gary Marsh. November 10 had seen another working party at the Farleigh Plot, with focus on the New Area recently adopted by PACSOM. The watering system is completed with plantings progressing at a fair pace. The 105 palms/trees planted at the site on this visit included 10 *Bismarckia nobilis* (donated by Percy Simonsen), 30 *Chrysalidocarpus lucubensis* (purchased from Glenella) and 19 various local trees purchased from SGAP Mackay Branch. PACSOM also met at the Farleigh Plot on December 1 at 4:00 P.M. with members bringing their own barbecue. Time was made for members to enjoy the fruits of their labors.

Twenty-eight people attended the 1991 year end Christmas barbecue party. The weather was somewhat oppressive, but sheltered in the shade with pleasant company, it was a cheerful group.

Northern Territory [Australia] News

The Northern Territory Palm and Cycad Society held a field trip in November to their garden at Fred's Pass Reserve. The hard work by the society over past years is now maturing into a visual spectacle of the highest order. This garden is now a genuine pleasure to visit!

At the NTPCS meetings in October and November, 1991, raffle prize plants were: (October) *Oncosperma horridum*, *Chamaedorea sartorii*, and *Lepidozamia hopei* and (November) *Pinanga batanensis*,

Hyphaene schatan, and *Licuala lauterbachii*. At the meeting in December, 1991, Max Smith astonished those present with a short dissertation on his technique for planting heavily armored species. The group held their year end Annual Dinner at Jim and Di Mitchell's rural estate.

The Society's January 1992 meeting was held on January 8, with other 1992 meetings scheduled for the first Wednesday of every month.

Western Australia Group Meets

The Western Australia Palm and Cycad Society ran their first Garden Weekend on November 9–10, 1991, which was a great success, due to great efforts put in by quite a few members. The local Horticultural Council is planning to run a similar event near the end of October 1992 in which the Palm and Cycad Society will participate.

The 1991 Christmas Party at Sam and Angie Fagnani's was enjoyed by 75 members and their 20 children. All enjoyed a look around Sam's nursery and great conversation on palms and cycads.

The February 1992 meeting featured a talk on a range of products available from Nurserymen's Supplies by Mark Sinclair. The month's raffle prize was donated by Tim Erceg. The *Rhapis* study group met at John Banasiewicz's place on Saturday, March 7. Afternoon tea and much stimulating discussion was provided. March 16 featured an electronic quiz night on palms and cycads at the Dianella Hotel. It was a fun night with lots of prizes.

News from Townsville, North Queensland

The second issue of *Mooreana, Journal of the Palmetum* was published in December 1991 by the Townsville Botanic Gardens with much hard work in evidence by Robert Tucker. Through the September plant sale and the efforts of *Mooreana*, membership of Friends of the Palmetum had increased to 107 in December. Countries included other than Australia are the U.S.A., Saudi Arabia, Austria, France, England and Japan.

The "Friends Only" moonlight walk on Sunday, October 20 turned out to be quite nice. The gardenias near the bicentennial and near the H. E. Moore, Jr. memorial were quite covered in flowers, the fragrance of which was almost palpable in the warm air. The Friends stayed for three hours, enjoying the quite different night aspect of the gardens.

Hawaii Island Palm Society

The Hawaii Island Palm Society held their Annual Palm Auction and Pot Luck Party on December 8 from noon until 5 P.M. at Onekahakaha Beach Park. Twenty-five percent of the proceeds went to the chapter treasury. Chapter elections were held with the new officers being: David Sylvia as President, Paul Supp as Vice President, Mitzi Christensen as Secretary and Grace Kissell as Treasurer.

Some generous people on the Big Island decided to reorganize their palm inventory and they, through Grace Kissell and Roger Fischer, offered their excess plants to the Hawaii Island Palm Society gratis. Volunteers gathered to move these palms on Sunday, December 15 at the Waikaumalo County Park Pavilion in Ninole, on the Hamakua Coast. Palms varied from flats of seedlings in 2″–4″ pots up to a few 5 gallon bags. Quantities varied from a few to several hundred of the same type. Some of the palms included were: *Areca vestiaria*, *Asterogyne martiana*, *Astrocaryum standleyanum*, *Bactris* sp., *Carpentaria acuminata*, *Chamaedorea* sp., *Geonoma congesta*, *G. densa*, *G.* sp., *Hyophorbe verschaffeltia*, *Iriartea* sp., *Laccospadix australasica*, *Pholidostachys* sp., *Ptychosperma* sp., *Sabal mauritiiformis* and other species, *Socratea* sp. and two other *Wettinia* species. More information will be forthcoming. The donors wish to remain unidentified. The Hawaii

Island Palm Society certainly thanks them for their generosity.

On Friday, December 27 at 7:00 P.M., the Hawaii Island Palm Society met at the Agricultural Complex on 875 Komohana Street. Inge Hoffman, who operates her own seed distribution service, gave a slide presentation on various palm locales in South America. Light refreshments were served at intermission, and an *Euterpe precatoria* var. *variegata* was given as a doorprize. Four other palms were raffled off for $1 per chance: *Mauritia armata*, *Mauritiella peruviana*, *Jessenia bataua*, and *Phytelephas aequatorialis*.

At the end of 1991, the chapter had a financial balance of $2,103. In 1991, 115 members paid $6 each dues for $690. Members' Auctions raised $458 for the Society, which represented 25% of gross auction receipts. The Society also purchased 124 rare palms of 30 species from Lyon Arboretum for $527, selling these for a profit of $359. These three sources of funds together yielded $1,507 for the chapter coffers. These funds do not include any potential yield from the recent palm donations to the Society at Ninole.

Houston (Texas) Chapter News

The Houston Area Chapter of the IPS met on March 14, 1992, at 2:30 P.M. at the Houston Arboretum. The chapter decided to buy copies of the new IPS *Chamaedorea* book by Don Hodel for donation to local libraries, the Chapter Library and the Chapter bookstore. Members and guests expressed thanksgiving for the very mild 1991/1992 winter. Houston did not receive a killing frost although some tender plants such as bananas and begonias suffered some leaf burn during a couple of nights when the temperature dipped slightly below freezing—nothing like 1989 or 1990! A mini-program was provided by Horace Hobbs and Jim Cain featuring slides of "Miscellaneous Palms," not in major gardens or collections, taken by Horace and Jim over the years. As "Seedling of the Month," all attendees received a small *Chamaedorea radicalis* seedling from last year's crop of seed off Jim Cain's trunked female parent, about 4 meters (13 feet) tall. It is not known if the seedlings carry the genes to replicate this behavior.

Gordon Hintz, recently elected to chapter Vice President, gave a lecture to the public at Mercer Arboretum on April 6 from 10:00 to 12:00 A.M. entitled "Palms Suitable for Planting in Houston." The Houston Area Annual Palm Sale was held on Saturday, April 11, 1992, at the Houston Arboretum and Nature Center from 10:00 A.M. to 5:00 P.M. A number of nice specimens were available in a fairly wide number of species. Several IPS members from other areas of Texas were able to attend. The chapter encourages visitors from other parts of Texas and Louisiana (and other nearby states) to make it to Houston for the annual sale.

We Appreciate the News! Keep it Coming!

Jim Cain of the IPS Chapter Committee would like to express appreciation to the many Palm Societies and IPS chapters throughout the world that are regularly contributing their newsletters or journals to him. With limited exceptions, these local chapter publications form the basis for the "Chapter News" section in *Principes*. Although such news is not always timely, it nonetheless lets all IPS members worldwide know the activities of individual active groups and hopefully provides the entire readership with some measure of appreciation for the local involvement of the various societies. In addition, groups may get productive ideas from reading about the activities of others.

If your group isn't participating in this program, you are urgently encouraged to do so. To the large majority who do contribute, "Thanks again" for making my job that much easier!

JIM CAIN
IPS Chapter Committee

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Winners of the BIG LOTTERY

Drawing was at the So. CA. Chapter's Banquet, on January 18, 1992.

1st 6 prizes - **CHAMAEDOREA PALMS**
1. Norman Johnson, CA.
2. Tsuneo Iwami, HI.
3. Frank Ketchum, CA.
4. Don Evans, FL.
5. Chris Hill, CA.
6. Fred Lang, CA.

7th prize - 2 vol. Exotica 4
7. Van Canon, CA.

8th prize - Palms of the World (1960)
8. Frankie Kelchum, CA.

9th prize - Supplement to Palms of the World
9. J. E. Shank, Costa Rica

10th prize - Hand carved Palm Coasters
10. Philip Kealer, CA.

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